Exploration Geophysics (1985) **16**, 1-122

Magnetic Exploration Models incorporating Remanence, Demagnetization and Anisotropy: HP 41C Handheld Computer Algorithms

D. W. Emerson[1], D. A. Clark[2] and S. J. Saul[3]

[1] *Department of Geology & Geophysics, University of Sydney, NSW 2006, Australia*
[2] *CSIRO Division of Mineral Physics, Delhi Road, North Ryde, NSW 2113, Australia*
[3] *Austirex International Ltd, 586 Pacific Highway, Chatswood, NSW 2067, Australia*

Contents

Page

Abstract

Handheld computer (HP 41C) algorithms are presented for basic and advanced magnetic exploration models along principal profiles. The thirteen models are: monopole, 2D line of poles, sheet of poles, dipole, 2D line of dipoles, 2D horizontal sheet of dipoles, 2D dipping thin sheet, 2D dipping thick sheet, 2D sloping step, 2D body with polygonal cross section, prolate and oblate ellipsoids of revolution, 2D elliptic cylinder, vertical rectangular prism. Key diagrams, program useage instructions, worked numerical example, program listing and register contents are given for each model. Induction, remanence, demagnetization and susceptibility anisotropy effects are calculated. The vertical circular and annular cylinders are treated for the cases of induction and remanence.

Preface

This is a presentation of magnetic computational techniques for modelling residual or regional anomalies (but not for separating them). It does not include a detailed theoretical development. Its purpose is as a working compendium of techniques primarily designed to teach and to impart some understanding of the magnetic response of basic models—mostly simple but geologically very important.

Magnetics has a vital place in all exploration, but often data analysis comprises crude eyeballing or overinterpretation with geologically and petrophysically unrealistic sophisticated computer models. There is much to be said for a simple analytic approach with remanence and other factors considered. These programs endeavour to provide such an approach.

The total magnetic intensity (ΔB_T) and vertical magnetic intensity anomaly (ΔB_z) anomalies are computed. A considerable amount of B_z data still exists even though total field data acquisition is now virtually the norm. A diagram depicting the nature of measured (ΔB_m), theoretical total (ΔB_T), and vertical (ΔB_z) anomalies has been included as these concepts appear to be very poorly understood.

For units, the authors have a perverse preference for the cgs emu system as it is based on magnetostatic concepts ideally suited to the problems arising in magnetic interpretation. If SI units are used, factors of 4π crop up in the equations and it is best to avoid this complication. However, all calculations can be done in SI providing the correct conversion factors are used. In the magnetic formulae distances can be in any units provided they are consistent e.g. all in metres. The flux densities (magnetic field strengths) ΔB and F must be in the same units: gammas (10^{-5} gauss, cgs) or nanoteslas (SI). The gamma and nanotesla are numerically equivalent. The magnetic volume susceptibility k is a dimensionless ratio. It is the magnetic moment generated per unit applied field divided by the volume. The emu susceptibility must be inserted into the equations presented herein. Accordingly SI susceptibilities must be divided by 4π. Self demagnetization factors N are also dimensionless, but the emu demagnetizing factor is 4π times the SI value. Then $0 < N_{emu} < 4\pi$ and $0 < N_{SI} < 1$. Pole strengths are calculated in 'pole units' which are hybrid units involving gammas and metres—their SI and emu relationship is not important because they are simply part of an internal computation. The magnitude or intensity of natural remanent magnetization is expressed in 'gammas' (γ), so as to be consistent with the induced magnetization. NRM intensities are usually quoted in the literature in microgauss (emu) or milliamp/metre (SI) which are numerically equivalent. One 'gamma' is equal to 10 microgauss. Southern hemisphere magnetic field inclinations are negative (upward pointing).

As an example of the units consider MAGMOD I with a monopole 20 m radius depth 100 m and resultant magnetization vertically up:

Magnetization $\lvert J_R \rvert$	Pole Strength $P = (J_R.n)\,S$, $S = \pi r^2$	ΔB_T Anomaly calculated from formula at x = 0
5000×10^{-6}	$5000 \times 10^{-6} \times \pi \times 20^2 = 6.28 \times 10^{-6}$ G m²	5.9×10^{-4} G
5000 μG	6,283,185 μG m²	590.4 μG
500×10^{-5} G = 500 γ	628,319 γ m²	59.04 γ = 59.04×10^{-5} G
1 mG (cgs) = 10^{-1} γ (cgs) = 1 mA/m (SI)		1 γ = nT (SI)

The body oriented co-ordinate system used is the Cartesian right-hand convention with the z axis positive downwards. Principal profile x axis analysis is presented. A principal profile is a traverse over the centre of a 3D body or a traverse normal to the strike of a 2D body.

It should be understood quite clearly that for MAGMODS I, II, III the models give correct results only for vertical resultant magnetizations. For inclination (of resultant magnetizations): $90° > |I_R| > 60°$, the results may be acceptable but only approximate owing to the presence of poles on the sides of the bodies.

The exposition for each model includes: formulae, program instruction, key diagram, worked numerical example, and a listing of the program.

The instrument requirements are: HP 41C calculator, card reader, and thermal printer. If there is no printer, users can modify programs up to the LBL E step by inserting SF21 at the beginning of the program and substituting AVIEW everywhere for PRA. When division by zero occurs the program substitutes a very small number, but depth h cannot be set equal to zero metres at any body vertex—instead a small finite number is required. The plotting routine may be useful in some circumstances, but it is more of an ornament with limited application. When using the plotting subroutine $|x|$ cannot exceed 999. This problem can be avoided simply by changing the distance units (e.g. using kilometres instead of metres). The HP 41C is not meant to give detailed plots which may be rigorously interpreted; the plots are simple visual aids. The resolution is limited because the plot field consists of either 119 or 126 'columns', therefore the anomally value is rounded to one of 119 or 126 values (inclusive) between nominated min. and max. values. If B_{MIN}, B_{MAX} are too large an error in the printout arises caused by the finite size of alpha register. If x values are 'too large', then plots appear on two lines causing an apparent origin shift—'too large' varies for different models as different plot fields are used.

Some of the programs will require extra memory (modules) for the basic HP 41C calculator.

For further reading and background theory it may be worthwhile to consult:

(i) the classic paper (the basis for a lot of this work) by D. H. Hall, Directions of polarization determined from magnetic anomalies, *J. Geophys. Res.* **64**, 1945–1959, 1959;

(ii) The ASEG Short Course Notes on 'Pole and Dipole Models in Magnetic Exploration' by D. W. Emerson and D. A. Clark, unpub. 1982, 1983;

(iii) the book: *Magnetic Models in Geophysical Exploration* by D. A. Clark and D. W. Emerson (in prep.);

(iv) The Applied Magnetic Interpretation Symposium Proceedings ed. D. W. Emerson, *Bull. Aust. Soc. Explor. Geophys.* **10**, 1–139, 1979;

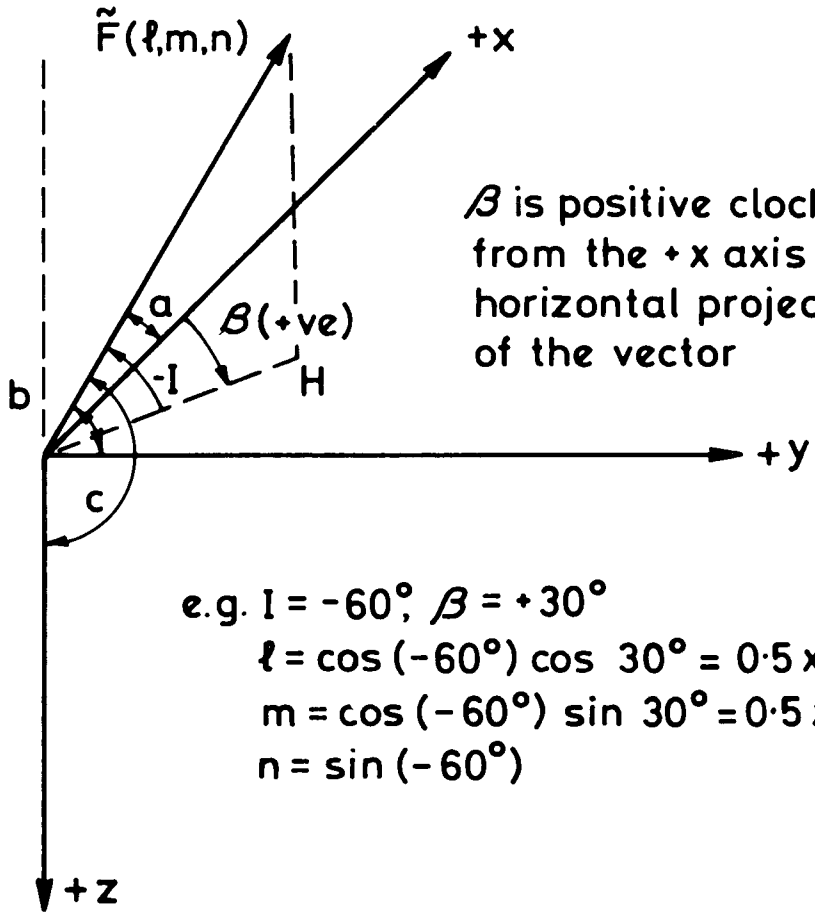
(v) the paper: by D. A. Clark, Comments on magnetic petrophysics, *Bull. Aust. Soc. Explor. Geophys.*, **14**, 49–62, 1983.

It is a pleasure to acknowledge the indispensable assistance of: Mr Len Hay (Sydney University) in drafting the MAGMOD example Figures and for providing the cover design which accurately portrays the feeling of many an interpreter; Mrs D. Garbler (Sydney University) for cheerfully typing many drafts; Mrs Pat Godden (CSIRO), who drafted several Figures; and Miss Diana Bridgewater (CSIRO), who transferred pages of handwritten formulae into camera-ready copy.

Finally, a reminder to users that they are on their own with these programs. Any user accepts and uses any, some, or all of these programs at the user's own risk and responsibility entirely.

RIGHT HAND CO-ORDINATE SYSTEM

$\ell = \cos a = \cos I \cos \beta$
$m = \cos b = \cos I \sin \beta$
$n = \cos c = \sin I$



β is positive clockwise from the +x axis to the horizontal projection of the vector

e.g. $I = -60°$, $\beta = +30°$

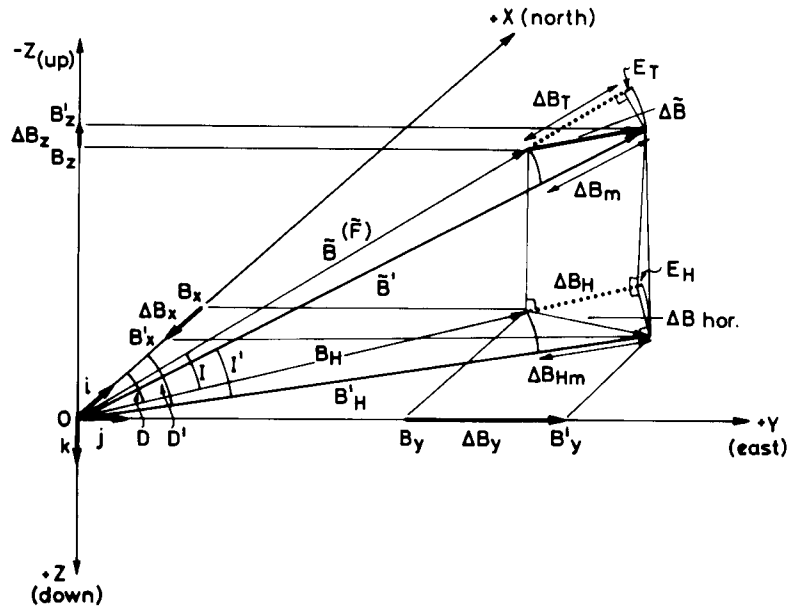
$\ell = \cos(-60°) \cos 30° = 0{\cdot}5 \times 0{\cdot}87 = 0{\cdot}43$

$m = \cos(-60°) \sin 30° = 0{\cdot}5 \times 0{\cdot}5 = 0{\cdot}25$

$n = \sin(-60°) = -0{\cdot}87$

SCHEMATIC RELATIONSHIP BETWEEN MEASURED, TRUE AND CALCULATED TOTAL MAGNETIC INTENSITY ANOMALIES

Southern hemisphere fields depicted with negative inclination



$\Delta B_T = \Delta B_H \cos I + \Delta B_z \sin I$ (computed total field anomaly)

$\Delta B_m = |\tilde{B}'| - |\tilde{B}|$ (measured total field anomaly)

$\Delta E_T = \Delta B_m - \Delta B_T = (|\Delta\tilde{B}|^2 - \Delta B_m^2)/2|\tilde{B}|$, $|\Delta\tilde{B}| \neq \Delta B_T \neq \Delta B_m$

β (= D) is the angle between the +X axis and the horizontal projection of the field vector (ℓ,m,n)

$\tilde{i}$, $\tilde{j}$, $\tilde{k}$ unit vectors parallel to X, Y, Z axes respectively

ℓ, m, n direction cosines. For $\tilde{B}(F)$: $\ell = B_x/|\tilde{B}|$, $m = B_y/|\tilde{B}|$, $n = B_z/|\tilde{B}|$

$\ell\tilde{i} + m\tilde{j} + n\tilde{k}$ unit vector in direction (ℓ,m,n)

$\Delta\tilde{B}$ local magnetic anomaly vector, perturbing $\tilde{B}$

$\tilde{B}(\tilde{F})$ regional or "normal" magnetic field vector of Earth (constant over limited region)

$\tilde{B}'$ resultant (local) field = $\tilde{B} + \Delta\tilde{B}$; with declination D', inclination I'

ΔB_T component of $\Delta\tilde{B}$ along normal field $\tilde{B}$. This is the theoretical computed anomaly. Usually $\Delta B_T \tilde{\sim} \Delta B_m$

ΔB_m measured residual total field anomaly (scalar measurement of variation in magnitude of resultant field)

E_T departure of computed anomaly (ΔB_T) from measured anomaly (ΔB_m). Usually small

ΔB_{hor} horizontal projection of $\Delta\tilde{B}$ = true horizontal component of anomalous field

B_H component of $\tilde{B}(\tilde{F})$ along regional magnetic meridian

B_H' component of $\tilde{B}'$ along local anomalous magnetic meridian

ΔB_H computed horizontal field anomaly = component of $\Delta\tilde{B}$ along regional magnetic meridian

ΔB_{H_m} measured horizontal field anomaly $\Delta B_{H_m} = B_H' - B_H \neq \Delta B_{hor} \neq \Delta B_H$

$E_H = (\Delta B_H^2 - \Delta B_{H_m}^2)/2B_H = B_H'[1-\cos(D'-D)]$. Departure of computed from measured horizontal anomaly

ΔB_x true horizontal anomaly component along X axis = $B_x' - B_x$

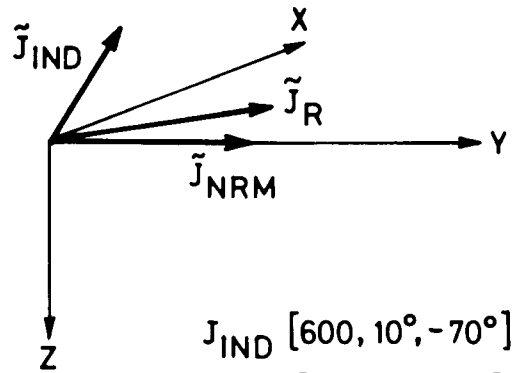
ΔB_y true horizontal anomaly component along Y axis = $B_y' - B_y$

$\Delta B_{hor} = (\Delta B_x^2 + \Delta B_y^2)^{\frac{1}{2}}$

ΔB_z true vertical intensity anomaly, measured anomaly = vertical component.

ADDITION OF MAGNETIZATION VECTORS

$\tilde{J}$: [J,D,I]



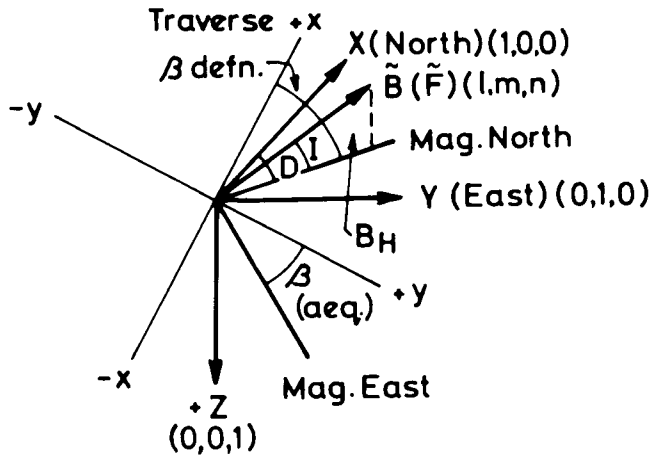
J_{IND} [600, 10°, -70°]

J_{NRM} [1000, 90°, 0°]

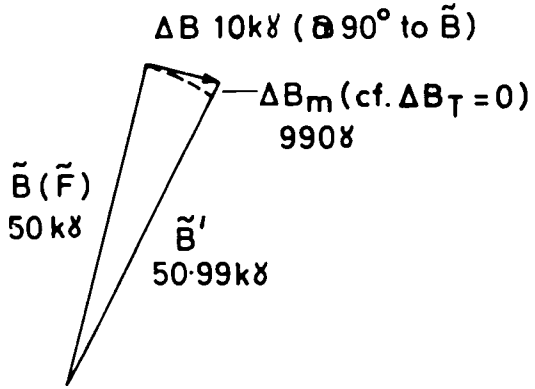
J_R [1196, 79°, -28°]

ANOMALOUS ΔB COMPONENTS IN VARIOUS DIRECTIONS

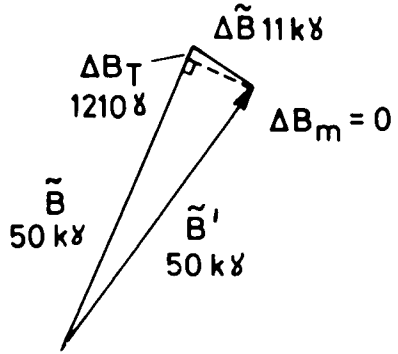
(l,m,n : direction cosines)



ERROR ARISING FROM ΔB_T APPROXIMATING ΔB_m



MAXIMUM DIFFERENCE BETWEEN ΔB_T AND ΔB_m WHEN ΔB_m=0



NOTATION (refer to MAGMOD diagrams and formulae)

O: origin of co-ordinates

x,y,x, Cartesian axes (right-handed)

S: surface area occupied by pole strength p ($=\pi R^2$ for plug radius R)

r: distance from fixed point of subsurface body to observation point, $r = (x^2+y^2+h^2)^{1/2}$.

h: vertical depth to fixed point of subsurface body

Y: half strike length (MAGMOD III)

X: half body width (MAGMOD III)

β: bearing of magnetic north, measured positive clockwise from the + x axis (the positive end of the principal profile).

β_R: bearing of the horizontal projection of the resultant magnetisation, measured positive clockwise from the + x axis.

$\tilde{F}$: Earth's magnetic field vector, with magnitude $|\tilde{F}|=F$, declination D (or bearing β) and inclination I (positive downwards)

$\tilde{J}$: magnetisation (contrast) vector

k: magnetic susceptibility (contrast)

$\tilde{J}_{IND}$: induced magnetisation vector

$J_{IND} = |\tilde{J}_{IND}|$, D, I: induced magnetisation magnitude, declination and inclination (neglecting demagnetisation)

$\tilde{J}_{NRM}$: remanent magnetisation vector, uncorrected for demagnetisation

$J_{NRM} = |\tilde{J}_{NRM}|$, D_{NRM}, I_{NRM}: remanent magnetisation magnitude, declination, inclination.

$\tilde{J}_R$: resultant magnetisation vector, uncorrected for demagnetisation ($\tilde{J}_R = \tilde{J}_{IND} + \tilde{J}_{NRM}$).

$J_R = |\tilde{J}_R|$, D_R, I_R: resultant magnetisation magnitude, declination, inclination

$\tilde{J}_R'$: resultant magnetisation vector, corrected for demagnetisation

$J_R' = |\tilde{J}_R'|$, D_R', I_R': demagnetisation-corrected resultant magnetisation magnitude, declination, inclination

p: magnetic pole strength

λ: line density of magnetic pole strength (pole strength per unit length)

σ: surface magnetic pole density (pole strength per unit area)

$\tilde{\mu} = \mu(L,M,N)$: magnetic dipole moment with magnitude μ and direction cosines L,M,N. $\mu = VJ$, where V is the volume of the causative body ($= 4\pi R^3/3$ if sphere) and J is magnetisation. magnitude.

$\tilde{\mu}_L = \mu_L(L,M,N)$: line density of magnetic dipole moment with magnitude μ_L and direction cosines L, M, N. $\mu_L = AJ$ (A = cross section area of the causative body).

$\Delta\tilde{B} = (\Delta B_x, \Delta B_y, \Delta B_z)$: anomalous magnetic field vector (assumed small compared to F for total field interpretation).

ΔB_i: magnetic anomaly component along measurement direction with direction cosines (ℓ', m', n') i = z,x,y,H or T.

ΔB_H: horizontal magnetic anomaly (component of $\Delta\tilde{B}$ parallel to horizontal component of $\tilde{F}$).

ΔB_T: total field magnetic anomaly (component of $\Delta\tilde{B}$ parallel to $\tilde{F}$)

ℓ,m,n: direction cosines of $\tilde{F}$. $(\ell,m,n) = (\cos\beta\cos I, \sin\beta\cos I, \sin I)$

L,M,N: direction cosines of resultant magnetisation.
$(L,M,N) = (\cos\beta_R \cos I_R, \sin\beta_R \cos I_R, \sin I_R)$

ℓ',m',n': direction cosines of measurement direction

$(\ell',m',n') = (0,0,1)$ (i=z)

$= (1,0,0)$ (i=x)

$= (0,1,0)$ (i=y)

$= (\cos\beta,\sin\beta,0)$ (i=H)

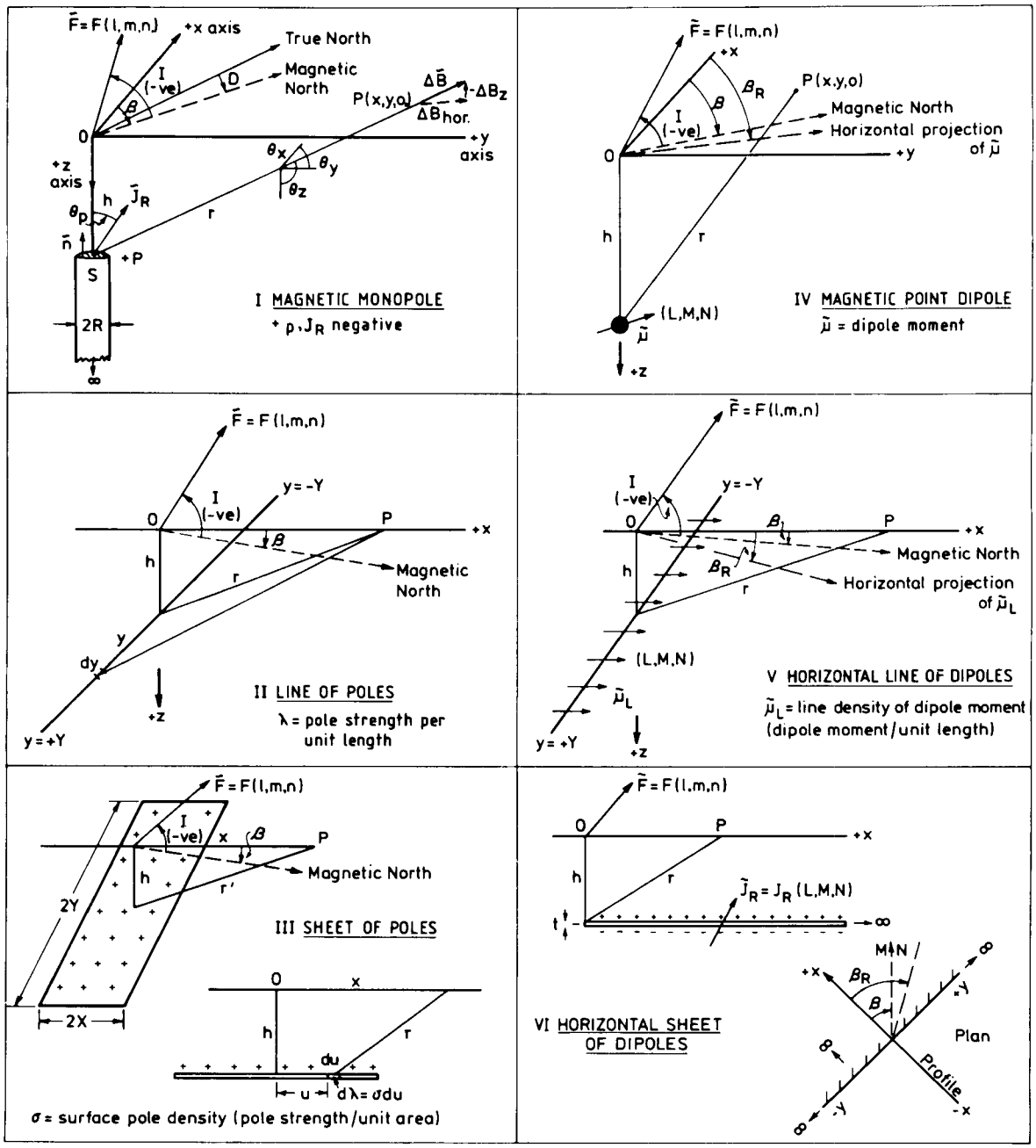
$= (\cos\beta\cos I,\sin\beta\cos I,\sin I)$ (i=T)

d: (a) dip of thin or thick sheet measured downwards from -x axis
(b) dip of sloping step face measured downwards from -x axis

t: thickness of thin sheet

2b: (a) breadth of flat top of thick sheet
(b) vertical thickness of slab, away from sloping step face

MAGNETIC MODELS I to VI



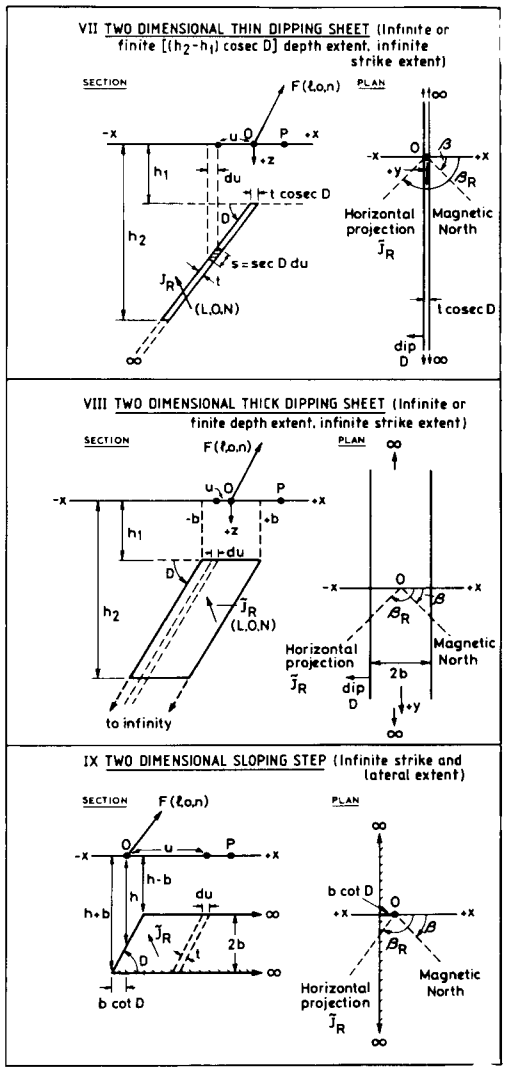
DIAGRAMS & SYMBOLS FOR MATHEMATICAL FORMULAE DEVELOPMENT IN SIX MAGNETIC MODELS WITH PRINCIPAL PROFILES RUNNING DIRECTLY OVER OR NORMAL TO STRIKE OF BODY AS INDICATED

MAGNETIC MODELS

VII, VIII, IX

MAGNETIC MODEL

Note direction cosines ℓ,m,n ($\vec{F}$, Earth's field) and L,M,N (J_R, resultant magnetization) become (ℓ,o,n) and (L,O,N) in plane of section



MAGMOD FORMULAE - PRINCIPAL PROFILES

After Hall, D.H., 1959, J. Geophys. Res., 64: 1945-1949 and Emerson, D.W. and Clark, D.A., unpublished ASEG course notes

General relationship: $\Delta B_T = \Delta B_H \cos I + \Delta B_z \sin I$

MAGMOD I Point pole

$$\Delta B_z = -ph/r^3 = -ph/(x^2+h^2)^{3/2}$$

$$\Delta B_x = px/(x^2+h^2)^{3/2}, \quad \Delta B_y = 0 \text{ (principal profile)}$$

$$\Delta B_H = \Delta B_x \cos\beta$$

$$\Delta B_T = \frac{p\,(x\cos\beta\cos I - h\sin I)}{(x^2+h^2)^{3/2}}$$

MAGMOD II Infinite line of poles

$$\Delta B_z = -2\lambda h/(x^2+h^2)$$

$$\Delta B_x = 2\lambda x/(x^2+h^2)$$

$$\Delta B_y = 0$$

$$\Delta B_H = \Delta B_x \cos\beta$$

$$\Delta B_T = \frac{2\lambda[x\cos\beta\cos I - h\sin I]}{(x^2+h^2)^{3/2}}$$

MAGMOD III Sheet of poles

$$\Delta B_z = -2\sigma\{\tan^{-1}\left(\frac{Y(x+X)/h}{[(x+X)^2+h^2+Y^2]^{1/2}}\right) - \tan^{-1}\left(\frac{Y(x-X)/h}{[(x-X)^2+h^2+Y^2]^{1/2}}\right)\}$$

$$\Delta B_x = \sigma \ln\left\{\frac{([(x-X)^2+h^2+Y^2]^{1/2}+Y)([(x+X)^2+h^2+Y^2]^{1/2}-Y)}{([(x-X)^2+h^2+Y^2]^{1/2}-Y)([(x+X)^2+h^2+Y^2]^{1/2}+Y)}\right\}$$

$$\Delta B_y = 0$$

$$\Delta B_T = \Delta B_x \cos\beta \cos I + \Delta B_z \sin I$$

MAGMODS I - III Amplitude Factors

Pole strength (surface density x area)

$$p = \sigma S = (\tilde{J}_R . \hat{n})S = -J_R S \sin I_R$$

Induced magnetisation only: $p = -kFS \sin I$

Line pole density (surface density x thickness)

$$\lambda = \sigma t = (\tilde{J}_R . \hat{n})t = J_R t \sin I_R$$

Induced magnetisation only: $\lambda = -kFt \sin I$

Surface pole density (magnetisation)

$$\sigma = \tilde{J}_R . \hat{n} = -J_R \sin I_R$$

Induced magnetisation only: $\sigma = -kFS \sin I$

These models, which are assumed to have vertical sides, can only be represented exactly by pole-type sources if the magnetisation is vertical. The formulae are acceptable approximations for bodies with steep resultant magnetisations ($|I_R| > 60°$) and are much better suited to interpretation of latitudinal profiles than meridional profiles, unless J_R is very steep.

MAGMOD IV Point dipole (uniformly magnetised sphere)

General formula: $$\Delta B_i = \frac{\mu}{(x^2+h^2)^{5/2}} [\alpha_{11}x^2+\alpha_{33}h^2-\alpha_{13}xh]$$

$$\Delta B_i = \Delta B_z,\ \Delta B_x,\ \Delta B_y,\ \Delta B_H \text{ or } \Delta B_T$$

$$\alpha_{11} = 2L\ell'-Mm'-Nn'$$
$$\alpha_{33} = 2Nn'-L\ell'-Mm'$$
$$\alpha_{13} = 3\ (N\ell'+Ln')$$

where ℓ',m',n' are the direction cosines of the measurement direction

$(\ell',m',n') = (0,0,1)$ (i=z)

$(\ell',m',n') = (1,0,0)$ (i=x)

$(\ell',m',n') = (0,1,0)$ (i=y)

$(\ell',m',n') = (\cos\beta,\sin\beta,0)$ (i=H)

$(\ell',m',n') = (\cos\beta\cos I,\sin\beta\cos I,\sin I)$ (i=T)

MAGMOD V Infinite line of dipoles

General formula: $$\Delta B_i = 2\mu_L \frac{[C_4x^2+C_5hx-C_4h^2]}{(x^2+h^2)^2}$$

where $\Delta B_i = \Delta B_z, \Delta B_x, \Delta B_y, \Delta B_H$ or ΔB_T

$C_4 = L\ell'-Nn'$; $C_5 = -2(Ln'+N\ell')$

ℓ',m',n' are as for MAGMOD IV

MAGMOD VI, VII Semi-infinite thin sheet

General formula: $\Delta B_i = Jt\ [\frac{C_7 x + C_8 h}{x^2+h^2}]$

$\Delta B_i = \Delta B_z, \Delta B_x, \Delta B_y, \Delta B_H$ or ΔB_T

$C_7 = 2C_4 cosd + C_5 sind$; $C_8 = -2C_4 sind + C_5 cosd$

where C_4, C_5 are as for MAGMOD V

MAGMOD VIII Semi-infinite thick sheet

General formula: $\Delta B_i = Jsind\{(C_7/2)\ell n[\frac{(x+b)^2+h^2}{(x-b)^2+h^2}] + C_8[\tan^{-1}(\frac{x+b}{h}) - \tan^{-1}(\frac{x-b}{h})]\}$

$\Delta B_i = \Delta B_z, \Delta B_x, \Delta B_y, \Delta B_H$ or ΔB_T

C_7, C_8 are as for MAGMOD VII

MAGMOD IX 2D sloping step

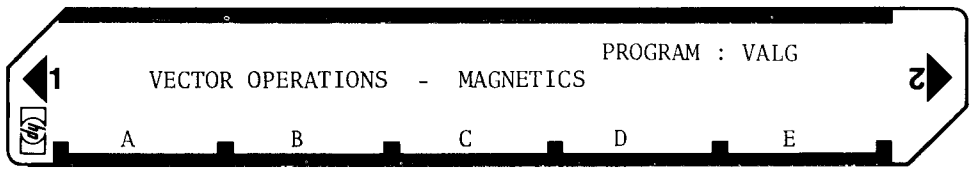
General formula: $\Delta B_i = Jsind\{(C_7/2)\ell n[\frac{(x-bcotD)^2+(h-b)^2}{(x+bcotD)^2+(h+b)^2}] + C_8[\tan^{-1}(\frac{x-bcotD}{h}) - \tan^{-1}(\frac{x+bcotD}{h})]\}$

$\Delta B_i = \Delta B_z, \Delta B_x, \Delta B_y, \Delta B_H$ or ΔB_T

C_7, C_8 are as for MAGMOD VII

The response of finite dip extent or depth extent bodies is simply obtained by subtraction of the response of two bodies with infinite dip or depth extent.

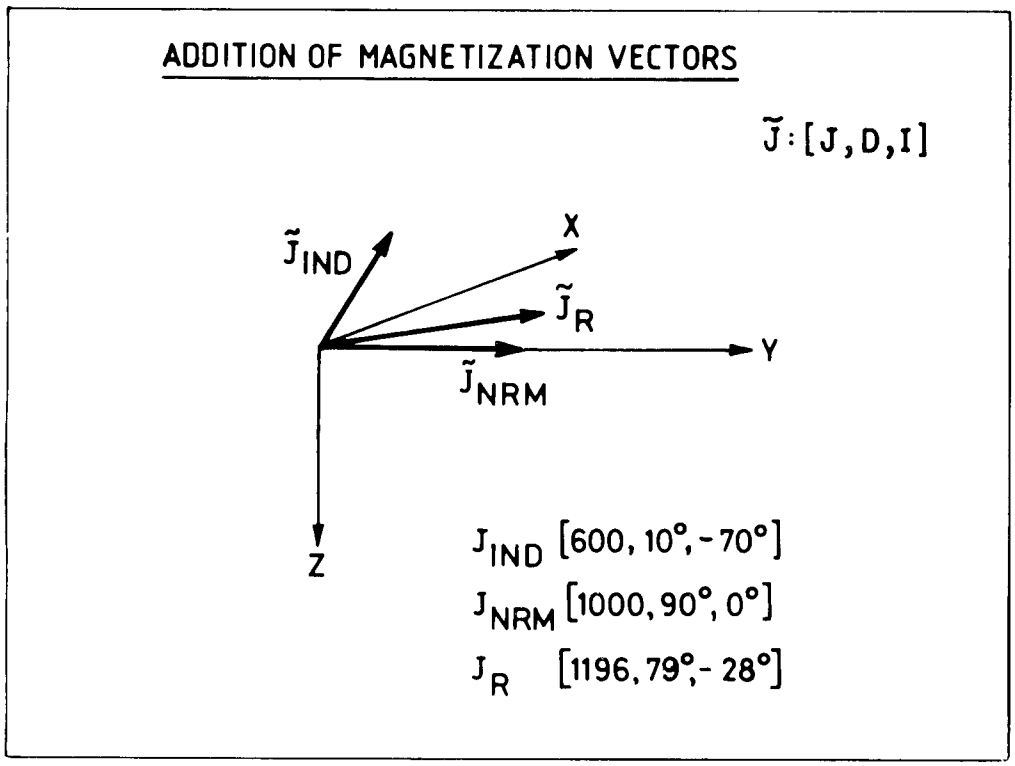
User Instructions



Load cards, run program, USER mode, DEG mode, size : 007

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Cartesian co-ordinates to D, I, F			A	X = ?
2	x value	x		R/S	Y = ?
3	y value	y		R/S	Z = ?
4	z value	z		R/S	D =
	D, I, F printout				I =
					F =
1	Polar D, I, F to Cartesian co-ordinates			B	D =
2	Declination	D		R/S	I =
3	Inclination	I		R/S	F =
4	Magnitude	F		R/S	X =
	Observe x, y, z printout				Y =
					Z =
1	Vector summation; D_i, I_i, F_i; i = 1 to N			C	D = ?
2	Declination of first vector	D_1		R/S	I = ?
3	Inclination of first vector	I_1		R/S	F = ?
4	Magnitude of first vector	F_1		R/S	D = ?
....	Repeat steps 2, 3, 4 for subsequent vectors				
final	Observe resultant vector display			D	RESULTANT
	declination, inclination, magnitude, number of				D, I, F, N, M=
	components (N), M = F/N				
1	Computation of angle between two vectors			E	CARTESIAN?
2	(a) Polar co-ordinates or	0 (zero)		R/S	D1 = ?
	(b) Cartesian co-ordinates (go to 7)	1 (one)		R/S	X1 = ?
3	Declination of first vector (polar)	D_1		R/S	I1 = ?
4	Inclination of first vector (polar)	I_1		R/S	D2 = ?
5	Declination of second vector (polar)	D_2		R/S	I2 = ?
6	Inclination of second vector (polar)	I_2		R/S	∠ =
	Observe angle printout				
7	If Cartesian co-ordinates, x component first	x_1		R/S	Y1 = ?
8	y component of first vector	y_1		R/S	Z1 = ?
9	z component of first vector	z_1		R/S	X2 = ?
10	x component of second vector	x_2		R/S	Y2 = ?
11	y component of second vector	y_2		R/S	Z2 = ?
12	z component of second vector	z_2		R/S	∠ =
	Observe angle printout				

VECTOR OPERATIONS
EXAMPLE
Vector addition and angles between vectors
Calculate the resultant magnetization of a large prismatic body, $k = 10{,}000 \times 10^{-6}$ cgs, in an area where the earth's field (F; D; I) is 0.6 G = 60,000 gammas (nT); 10°E; - 70°. The body has a remanent magnetization with magnitude 10,000 μ gauss = 1,000 gammas and pointing horizontally (I = 0°) in the geographic east direction (D = 90°) $J_{IND} = kF = 6{,}000$ μ gauss = 600 γ ; $J_{NRM} = 1{,}000$ γ = 10,000 μ gauss.
(Answer: D = 79.0°, I = -28.1°, F = (J_{RES}) = 1196.4 γ)
What is the angle between the remanent and induced vectors? (Answer: 86.6°)
What is the angle between the induced and resultant vectors? (Answer: 56.6°)
What is the angle between the remanent and resultant vectors? (Answer: 30.0°).



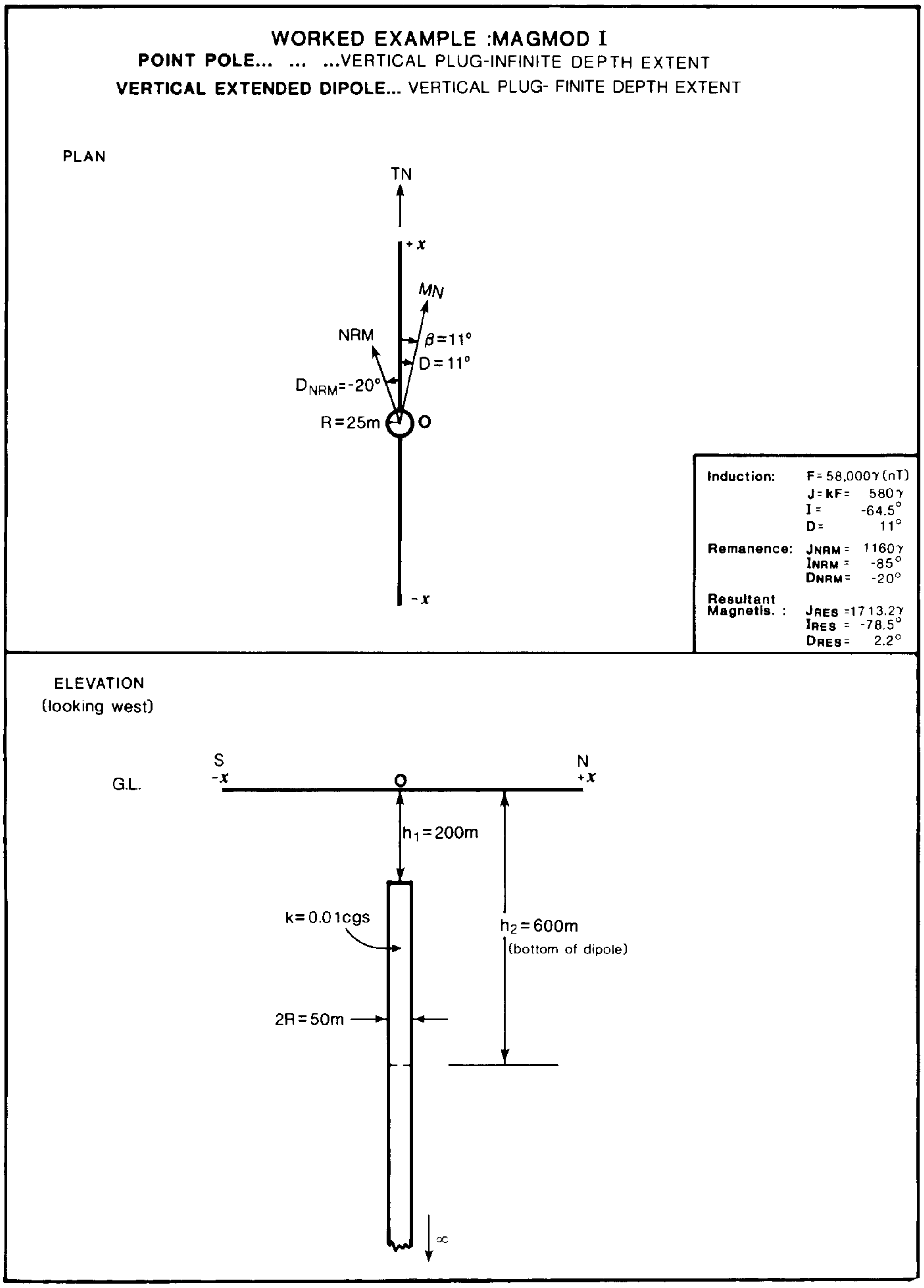

```
D=10.0000
I=-70.0000
F=600.0000

D=90.0000
I=0.0000
F=1,000.0000

RESULTANT
D=78.9580
I=-28.1172
F=1,196.3567

N=2.0000
M=598.1784


D1=10.0000
I1=-70.0000

D2=90.0000
I2=0.0000

∠=86.5951


D1=10.0000
I1=-70.0000

D2=78.9580
I2=-28.1172

∠=56.5530

D1=90.0000
I1=0.0000

D2=78.9580
I2=-28.1172

∠=30.0422
```

User Instructions

MAGMOD I : POINT POLE, VERTICAL PAIR OF POLES (PLUG)
INDUCTION &/OR REMANENCE.

USER mode
DEG mode
SIZE 031

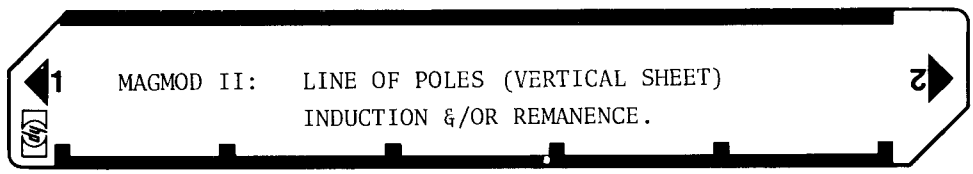
STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG 1	F =
2	Geomagnetic field magnitude	F	R/S	I =
3	Geomagnetic field inclination	I	R/S	D =
4	Geomagnetic field declination	D	R/S	INF? <0,1>
5a	If finite depth extent body	0 (zero)	R/S	H1 =
5b	If infinite depth extent body	1	R/S	H1 =
6	Depth to body top (a) finite body	h_1	R/S	H2 =
	(b) infinite body (go to 8)	h_1	R/S	RADIUS =
7	Depth to body bottom	h_2	R/S	RADIUS =
8	Radius of body	R	R/S	SUSC =
9	Susceptibility contrast	k	R/S	REM? <0,1>
10a	If remanence absent (go to 14)	0	R/S	BEARING =
10b	If remanence present	1	R/S	J_{REM} =
11	Remanent magnetisation magnitude	J_{REM}	R/S	I_{REM} =
12	Remanent magnetisation inclination	I_{REM}	R/S	D_{REM} =
13	Remanent magnetisation declination	D_{REM}	R/S	BEARING =
14	Azimuth of magnetic north w.r.t. +x axis	β	R/S	XMIN = ?
15	Minimum (profile) x value	x_{MIN}	R/S	XMAX = ?
16	Maximum (profile) x value	x_{MAX}	R/S	XINC = ?
17	Profile x increment	x_{INC}	R/S	
18	Observe printout of: station			X =
	vertical component anomaly			BZ =
	total intensity anomaly			BT =
19	Call plotting subroutine if required		F	BZ MIN= ?
	Lower limit for axis	B_Z (MIN)	R/S	BZ MAX = ?
	Upper limit for axis	B_Z (MAX)	R/S	BT MIN = ?
	Lower limit for axis	B_T (MIN)	R/S	BT MAX = ?
	Upper limit for axis	B_T (MAX)	R/S	
	Observe the two profiles plotted			
20	Resultant magnetisation printout		G	J, I, D RES
	Profile recomputation with changed inputs			
	If complete new data		A	F =
	If same geomagnetic data only		B	INF <0, 1>
	If different remanence		C	J_{REM} =
	If different β		D	BEARING =
	If different profile limits		E	XMIN = ?
	If different plot parameters		F	BZMIN = ?




```
F=58,000.0
I=-64.5
D=11.0

H1=200.0
H2=600.0
RADIUS=25.0
SUSC=0.010000

J REM=1,160.0
I REM=-85.0
D REM=-20.0

BEARING=11.0

X=-100.0
BZ=-50.2
BT=33.5

X=-50.0
BZ=-66.2
BT=52.1

X=0.0
BZ=-73.3
BT=66.1

X=50.0
BZ=-66.2
BT=67.4

X=100.0
BZ=-50.2
BT=57.1

X=150.0
BZ=-33.8
BT=43.0

X=200.0
BZ=-21.3
BT=30.5

J RES=1,713.2
I RES=-78.5
D RES=2.2
```

```
                                          BT
MIN=-80.     MAX=-20.                   MIN=30.     MAX=70.
     !                 !                    !                 !
 -100.        x        !                -100.! x
  -50.    x            !                 -50.!         x
    0.  x              !                   0.!                x
   50.    x            !                  50.!                 x
  100.        x        !                 100.!            x
  150.             x   !                 150.!      x
  200.                 x                 200.x
```

User Instructions



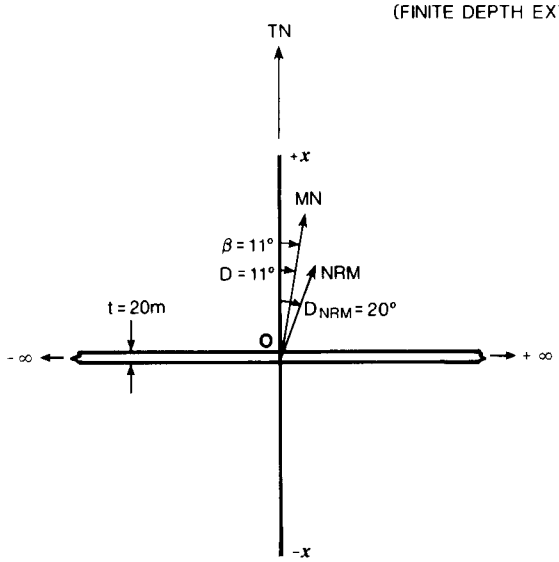
USER mode
DEG mode
SIZE 031

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG 2	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	INF? <0,1>
5a	If finite depth extent vertical sheet	0 (zero)		R/S	H1 =
5b	If finite depth extent vertical sheet	1		R/S	H1 =
6	Depth to sheet top (a) finite body	h_1		R/S	H2
	(b) infinite body (go to 8)	h_1		R/S	THICKNESS =
7	Depth to sheet bottom	h_2		R/S	THICKNESS =
8	Thickness of sheet	t		R/S	SUSC =
9	Susceptibility contrast	k		R/S	REM? <0,1>
10a	If remanence absent (go to 14)	0		R/S	BEARING =
10b	If remanence present	1		R/S	J_{REM} =
11	Remanent magnetisation magnitude	J_{REM}		R/S	I_{REM} =
12	Remanent magnetisation inclination	I_{REM}		R/S	D_{REM} =
13	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
14	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
15	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
16	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
17	Profile x increment	x_{INC}		R/S	
18	Observe printout of: station				X =
	vertical component anomaly				BZ =
	total intensity anomaly				BT =
19	Call plotting subroutine if required			F	BZ MIN = ?
	Lower limit for y axis	B_Z (MIN)		R/S	BZ MAX = ?
	Upper limit for y axis	B_Z (MAX)		R/S	BT MIN = ?
	Lower limit for y axis	B_T (MIN)		R/S	BT MAX = ?
	Upper limit for y axis	B_T (MAX)		R/S	
	Observe the two profiles plotted				
20	Resultant magnetisation printout			G	J, I, D RES
	Profile recomputation with changed inputs				
	If complete new data			A	F =
	If same geomagnetic data only			B	INF <0,1>
	If different remanence			C	J_{REM} =
	If different β			D	BEARING =
	If different profile limits			E	XMIN = ?
	If different plot parameters			F	BZMIN = ?

WORKED EXAMPLE : MAGMOD II

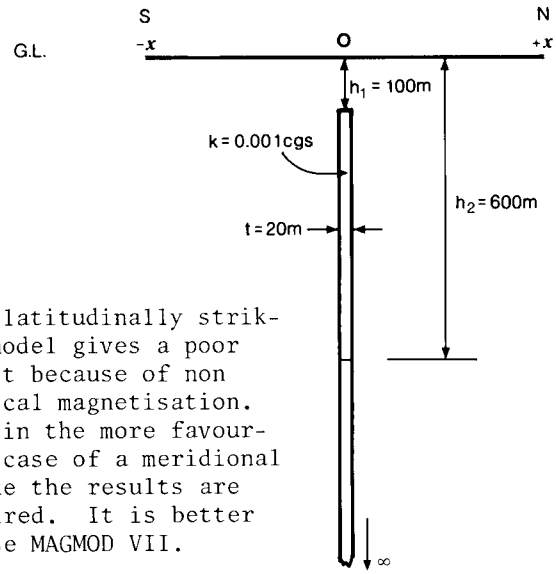
LINE OF POLES...VERTICAL THIN SHEET - INFINITE STRIKE LENGTH
- INFINITE DEPTH EXTENT
(FINITE DEPTH EXTENT BY SUBTRACTION)

PLAN



Induction:	F = 58,000γ (nT)	
	J = kF =	58 γ
	I =	-64.5°
	D =	11°
Remanence:	J_{NRM} =	580 γ
	I_{NRM} =	-70°
	D_{NRM} =	20°
Resultant Magnetis. :	J_{RES} =	637.7 γ
	I_{RES} =	-69.5°
	D_{RES} =	19.0°

ELEVATION
(looking west)



This latitudinally striking model gives a poor result because of non vertical magnetisation. Even in the more favourable case of a meridional strike the results are impaired. It is better to use MAGMOD VII.

```
F=58,000.0
I=-64.5
D=11.0

H1=100.0
H2=600.0
THICKNESS=20.0
SUSC=0.001000

J REM=580.0
I REM=-70.0
D REM=20.0

BEARING=11.0

X=-100.0
BZ=-80.7
BT=25.1

X=-50.0
BZ=-151.6
BT=97.8

X=0.0
BZ=-199.1
BT=179.7

X=50.0
BZ=-151.6
BT=175.8

X=100.0
BZ=-80.7
BT=120.6

X=150.0
BZ=-36.0
BT=75.2

X=200.0
BZ=-11.9
BT=46.1

J RES=637.7
I RES=-69.5
D RES=19.0
```

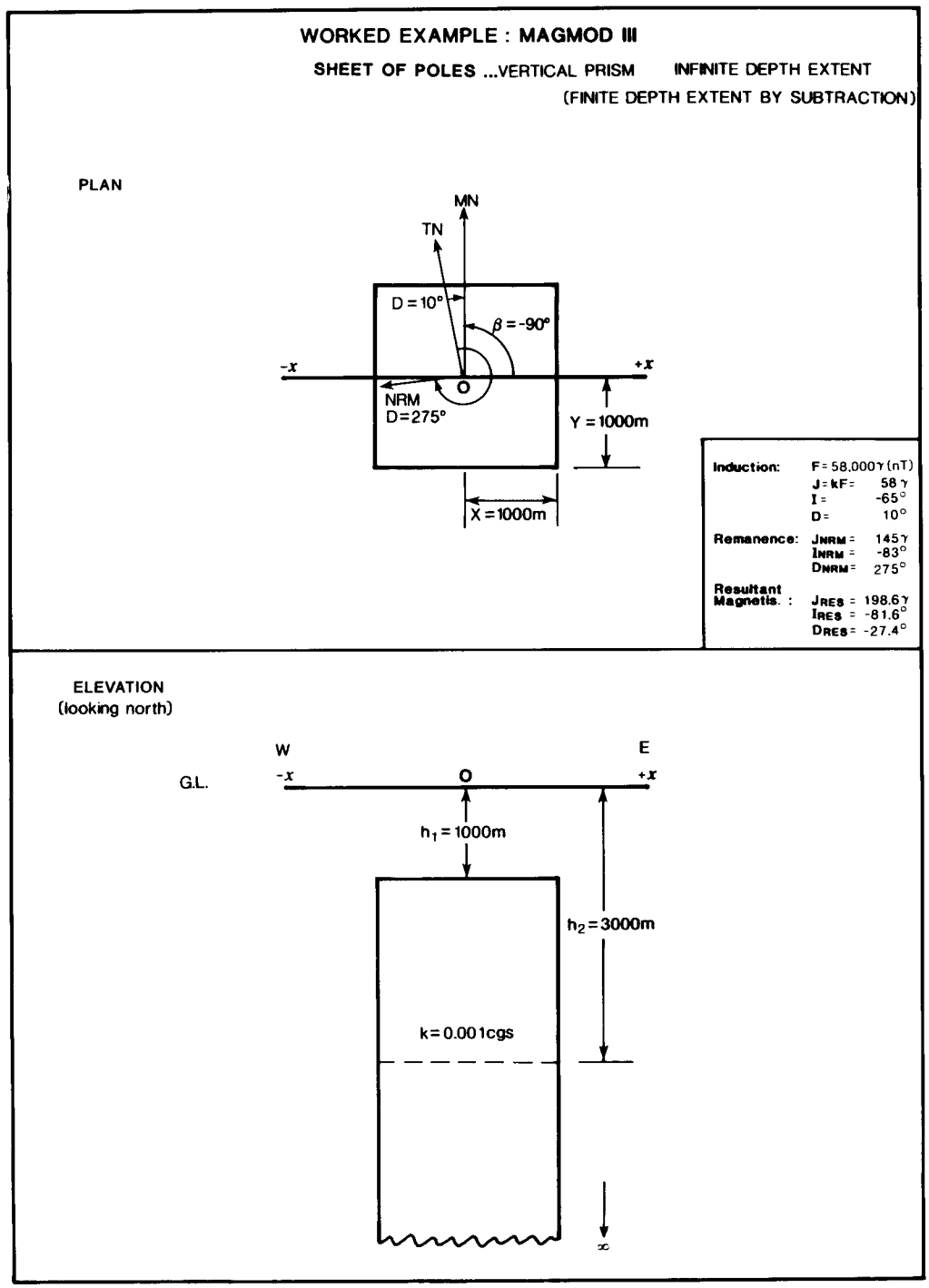
```
BZ
MIN=-200.      MAX=0.
    |                 |
-100.          x      |
 -50.    x            |
   0.x                |
  50.    x            |
 100.          x      |
 150.               x |
 200.                 x|

BT
MIN=20.        MAX=200.
    |                 |
-100.|x
 -50.|       x
   0.|                x
  50.|                x
 100.|          x
 150.|     x
 200.| x
```

User Instructions

MAGMOD III : SHEET OF POLES (VERTICAL PRISM)
INDUCTION &/OR REMANENCE

USER mode
DEG mode
SIZE 040

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG 3	F =
2	Geomagnetic field magnitude	F	R/S	I =
3	Geomagnetic field inclination	I	R/S	D =
4	Geomagnetic field declination	D	R/S	INF? <0,1>
5a	If finite depth extent vertical prism	0 (zero)	R/S	H1 =
5b	If infinite depth extent vertical prism	1	R/S	H1 =
6	Depth to prism top (a) finite body	h_1		H2 =
	(b) infinite body (go to 8)	h_1	R/S	1/2 WIDTH =
7	Depth to prism bottom	h_2	R/S	1/2 WIDTH =
8	Half width of prism	X	R/S	1/2 LENGTH =
9	Half strike length of prism	Y	R/S	SUSC =
10	Susceptibility contrast	k	R/S	REM? <0,1>
11a	If remanence absent (go to 15)	0	R/S	BEARING =
11b	If remanence present	1	R/S	J_{REM} =
12	Remanent magnetisation magnitude	J_{REM}	R/S	I_{REM} =
13	Remanent magnetisation inclination	I_{REM}	R/S	D_{REM} =
14	Remanent magnetisation declination	D_{REM}	R/S	BEARING =
15	Azimuth of magnetic north w.r.t. + x axis	β	R/S	XMIN =?
16	Minimum (profile) x value	x_{MIN}	R/S	XMAX =?
17	Maximum (profile) x value	x_{MAX}	R/S	XINC =?
18	Profile x increment	x_{INC}	R/S	
19	Observe printout of: station			X =
	vertical component anomaly			BZ =
	total intensity anomaly			BT =
20	Call plotting subroutine if required		F	BZ MIN = ?
	Lower limit for y axis	B_Z (MIN)	R/S	BZ MAX = ?
	Upper limit for y axis	B_Z (MAX)	R/S	BT MIN = ?
	Lower limit for y axis	B_T (MIN)	R/S	BT MAX = ?
	Upper limit for y axis	B_T (MAX)	R/A	
	Observe the two profiles plotted			
21	Resultant magnetisation printout		G	J, I, D RES
	Profile recomputation with changed inputs			
	If complete new data		A	F =
	If same geomagnetic data only		B	INF <0,1>
	If different remanence		C	J_{REM} =
	If different β		D	BEARING
	If different profile limits		E	XMIN = ?
	If different plot parameters		F	BZMIN = ?

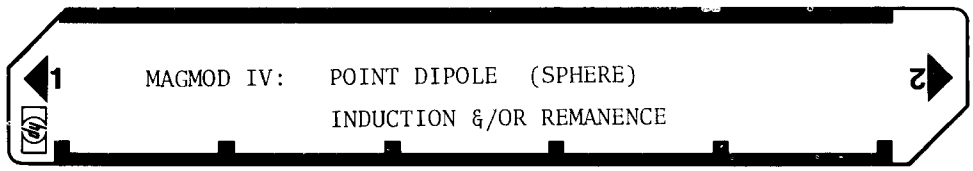



```
F=58,000.0
I=-65.0
D=10.0

H1=1,000.0
H2=3,000.0
1/2 WIDTH=1,000.0
1/2 LENGTH=1,000.0
SUSC=0.001000

J REM=145.0
I REM=-83.0
D REM=275.0

BEARING=-90.0

X=-100.0
BZ=-331.4
BT=300.3

X=-50.0
BZ=-332.4
BT=301.3

X=0.0
BZ=-332.8
BT=301.6

X=50.0
BZ=-332.4
BT=301.3

X=100.0
BZ=-331.4
BT=300.3

X=150.0
BZ=-329.6
BT=298.7

X=200.0
BZ=-327.1
BT=296.5

J RES=198.6
I RES=-81.6
D RES=-27.5
```

```
BZ
MIN=-335.      MAX=-325.
        |                 |
 -100.      x             |
  -50.    x               |
    0.  x                 |
   50.    x               |
  100.      x             |
  150.        x           |
  200.          x         |
```

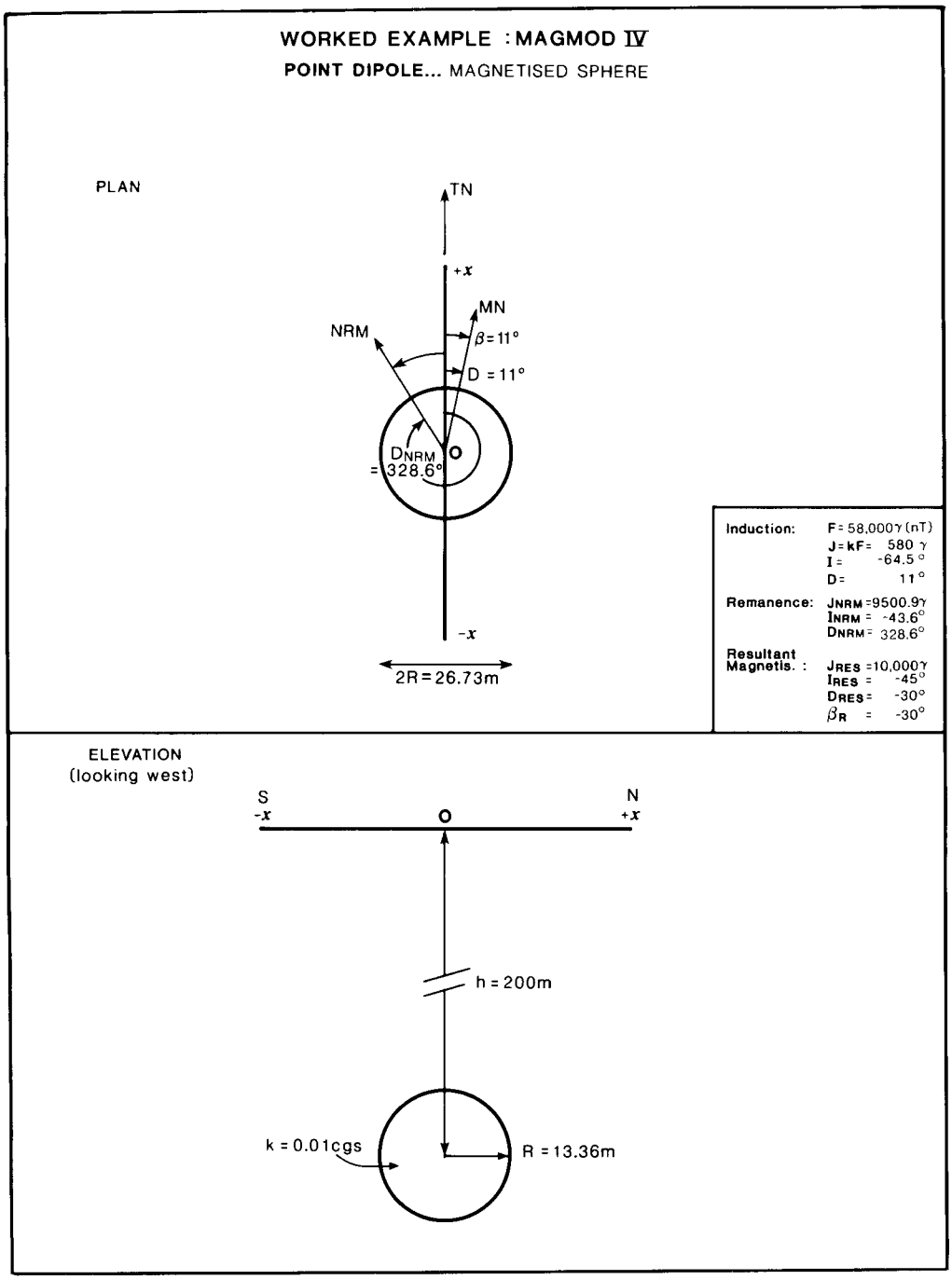
```
BT
MIN=295.       MAX=305.
        |                 |
 -100.|         x         |
  -50.|           x       |
    0.|             x     |
   50.|             x     |
  100.|           x       |
  150.|         x         |
  200.|  x                |
```

User Instructions



USER mode
DEG mode
SIZE 036

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG 4	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	DEPTH =
5	Depth to sphere centre	h		R/S	RADIUS =
6	Radius of sphere; volume displayed	R		R/S	VOL =
7	If volume acceptable, otherwise			R/S	SUSC =
8	If another volume nominated	V		R/S	SUSC =
9	Susceptibility contrast	k		R/S	REM? <0,1>
10a	If remanence absent (go to 14)	0		R/S	BEARING =
10b	If remanence present	1		R/S	J_{REM} =
11	Remanent magnetisation magnitude	J_{REM}		R/S	I_{REM} =
12	Remanent magnetisation inclination	I_{REM}		R/S	D_{REM} =
13	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
14	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
15	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
16	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
17	Profile x increment	x_{INC}		R/S	
18	Observe printout of: station				X =
	vertical component anomaly				B_Z =
	total intensity anomaly				B_T =
19	Call plotting subroutine if required			F	B_Z MIN = ?
	Lower limit for Y axis	B_Z (MIN)		R/S	B_Z MAX = ?
	Upper limit for Y axis	B_Z (MAX)		R/S	B_T MIN = ?
	Lower limit for Y axis	B_T (MIN)		R/S	B_T MAX = ?
	Upper limit for Y axis	B_T (MAX)			
	Observe the two profiles plotted				
20	Resultant magnetisation printout			G	J, I, D RES
21	To obtain β_R azimuth of resultant magnetisation		RCL	18	β_R
	Profile recomputation with changed inputs				
	If complete new data			A	F =
	If same geomagnetic data only			B	DEPTH =
	If different remanence			C	J_{REM} =
	If different β			D	BEARING =
	If different profile limits			E	XMIN = ?
	If different plot parameters			F	BZMIN = ?



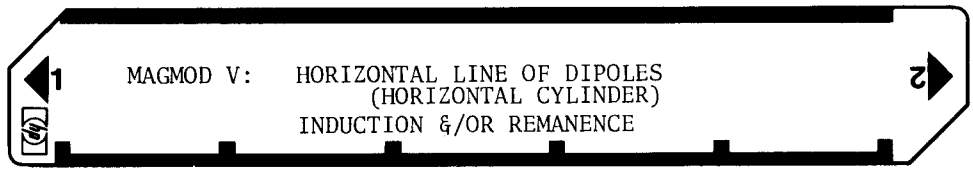

```
F=58,000.0
I=-64.5
D=11.0

DEPTH=200.0
RADIUS=13.4
VOL=10,000.0
SUSC.=0.010000

J REM=9,500.94
I REM=-43.56
D REM=328.64

BEARING=11.0

X=-100.0
BZ=-2.3
BT=-1.8

X=-50.0
BZ=-9.8
BT=4.3

X=0.0
BZ=-17.7
BT=13.1

X=50.0
BZ=-19.7
BT=18.0

X=100.0
BZ=-15.4
BT=16.5

X=150.0
BZ=-9.8
BT=11.9

X=200.0
BZ=-5.6
BT=7.8

J RES=10,000.0
I RES=-45.0
D RES=-30.0

                -30.0    ***
```

(RCL 18) β_R = -30.0

```
BZ
MIN=-20.     MAX=0.
    |                    |
-100.                  x |
 -50.            x       |
   0.   x                |
  50.    x               |
 100.      x             |
 150.            x       |
 200.                 x   |

BT
MIN=-5.      MAX=20.
    |                    |
-100.   x                |
 -50.   |   x             |
   0.   |         x       |
  50.   |              x  |
 100.   |           x     |
 150.   |        x        |
 200.   |     x           |
```

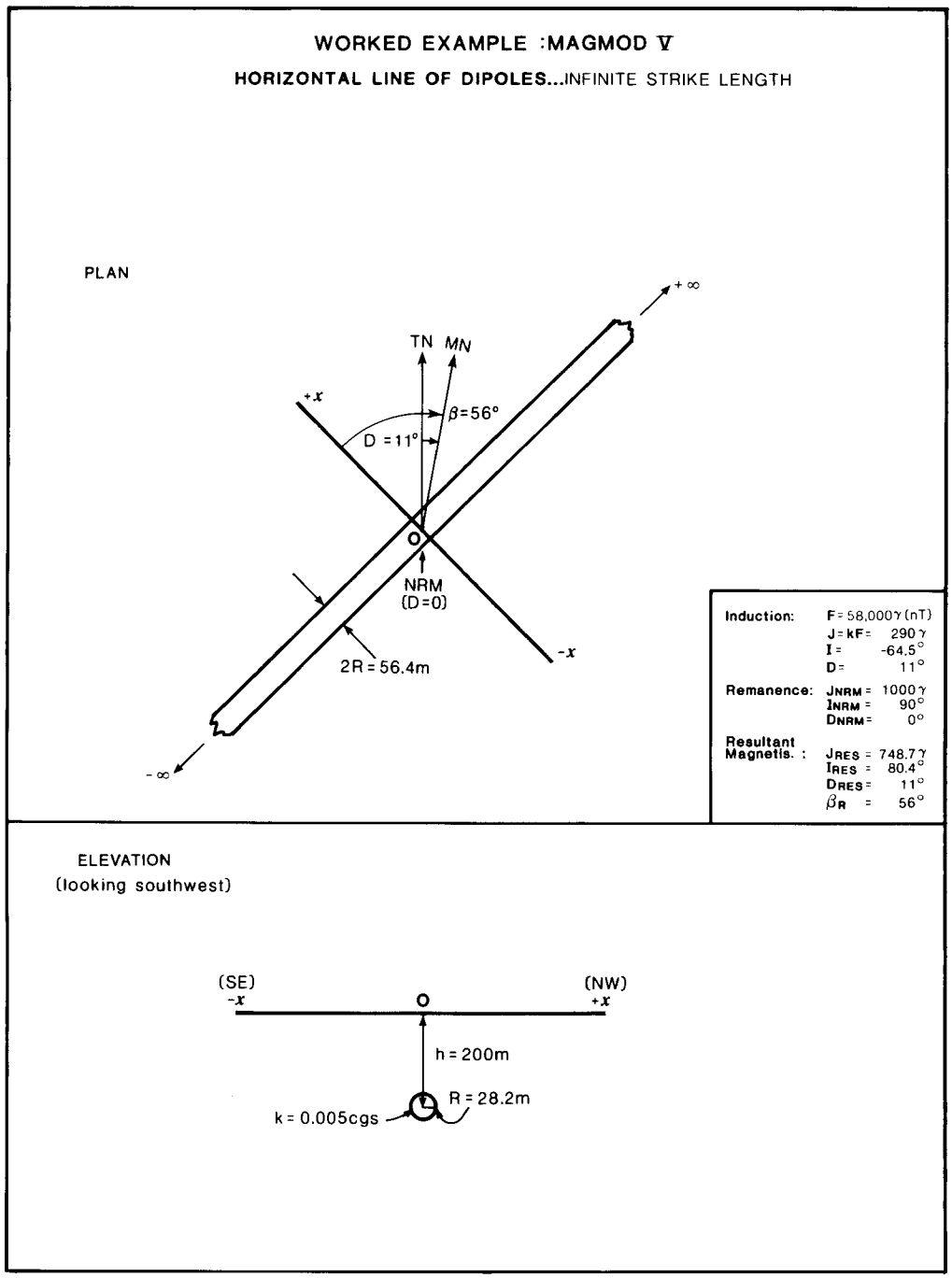
Note on demagnetisation: if spherical body has large k (>0.01 cgs) use $k' = k/(1 + \frac{4}{3}\pi k)$

User Instructions



USER mode
DEG mode
SIZE 035

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG 5	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	DEPTH =
5	Depth to cylinder axis	h		R/S	RADIUS =
6	Radius of cylinder; cross sectional area displ.	R		R/S	A =
7	If area acceptable, otherwise			R/S	SUSC =
8	If another area nominated	A		R/S	SUSC =
9	Susceptibility contrast	k		R/S	REM? <0,1>
10a	If remanence absent (go to 14)	0		R/S	BEARING =
10b	If remanence present	1		R/S	J_{REM} =
11	Remanent magnetisation magnitude	J_{REM}		R/S	I_{REM} =
12	Remanent magnetisation inclination	I_{REM}		R/S	D_{REM} =
13	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
14	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
15	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
16	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
17	Profile x increment	x_{INC}		R/S	
18	Observe printout of: station				X =
	vertical component anomaly				B_Z =
	total intensity anomaly				B_T =
19	Call plotting subroutine if required			F	BZ MIN = ?
	Lower limit for Y axis	B_Z (MIN)		R/S	BZ MAX = ?
	Upper limit for Y axis	B_Z (MAX)		R/S	BT MIN = ?
	Lower limit for Y axis	B_T (MIN)		R/S	BT MAX = ?
	Upper limit for Y axis	B_T (MAX)			
	Observe the two profiles plotted				
20	Resultant magnetisation printout			G	J, I, D RES
21	To obtain β_R azimuth of resultant magnetisation		RCL	19	β_R
	Profile recomputation with changed inputs				
	If complete new data			A	F =
	If same geomagnetic data only			B	DEPTH =
	If different remanence			C	J_{REM} =
	If different β			D	BEARING =
	If different profile limits			E	XMIN = ?
	If different plot parameters			F	BZMIN = ?




```
F=58,000.0
I=-64.5
D=11.0

DEPTH=200.0
RADIUS=28.2
A=2,498.3
SUSC=0.005000

J REM=1,000.0
I REM=90.0
D REM=0.0

BEARING=56.0

X=-100.0
BZ=49.8
BT=-31.8

X=-50.0
BZ=80.4
BT=-64.5

X=0.0
BZ=92.2
BT=-85.3

X=50.0
BZ=72.7
BT=-77.2

X=100.0
BZ=38.7
BT=-50.1

X=150.0
BZ=11.2
BT=-24.1

X=200.0
BZ=-4.4
BT=-7.2

J RES=748.7
I RES=80.4
D RES=11.0

                    56.0    ***
```

(RCL 19) β_R = 56.0

```
BZ                                  BT
MIN=-10.      MAX=100.              MIN=-90.      MAX=0.
    |                 |                 |               |
-100. |       x       |            -100.          x      |
 -50. |           x   |             -50.      x          |
   0. |             x |               0. x               |
  50. |          x    |              50.   x             |
 100. |      x        |             100.        x        |
 150. | x             |             150.             x   |
 200. x|               |             200.                 x|
```

DEMAGNETISATION CORRECTIONS FOR MAGMODS I-V

Point pole/Line of poles/Sheet of poles (MAGMODS I, II, III)

These models realistically apply only to steeply dipping bodies with sub-vertical resultant magnetisation. The effect of the poles on the sides of the bodies is neglected in the formulae, so the self-demagnetisation of the magnetisation component perpendicular to the sides of the body can be ignored. The effective demagnetising factor in the down-dip direction is close to zero, so demagnetisation has negligible effect on the pole strength.

Point dipole (MAGMOD IV)

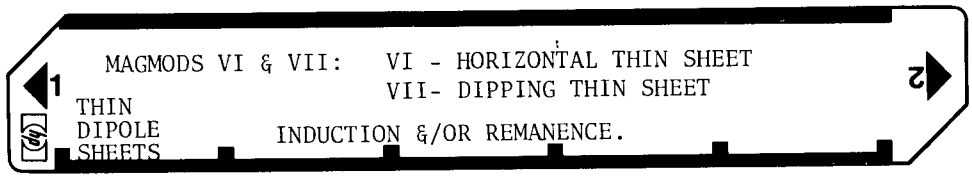
The source is modelled as a sphere and the magnetisation direction is unaffected by demagnetisation. For high susceptibility, roughly spherical sources, such as massive magnetite or pyrrhotite ore bodies, demagnetisation reduces the effective dipole moment. The corrected moment $\mu' = \mu/(1+4\pi k_{emu}/3)$.

However when the high susceptibility body is distinctly elongated or flattened, although compact, a more complicated analysis is required, using demagnetising factors for ellipsoids.

Line of dipoles (MAGMOD V)

In most applications of the line of dipoles mode, e.g. representing a buried anticline, the susceptibility of the source is usually sufficiently low that demagnetisation is unimportant. In the 2D case ($Y \to \infty$) the emu demagnetising factors are: $N_x = N_z = 2\pi$, $N_y = 0$. Only the magnetisation component in the x-z plane contributes to the anomaly - its direction is unaffected by demagnetisation. Therefore the effect of demagnetisation is to lower the linear dipole moment density. $\mu_L' = \mu_L/(1+2\pi k_{emu})$.

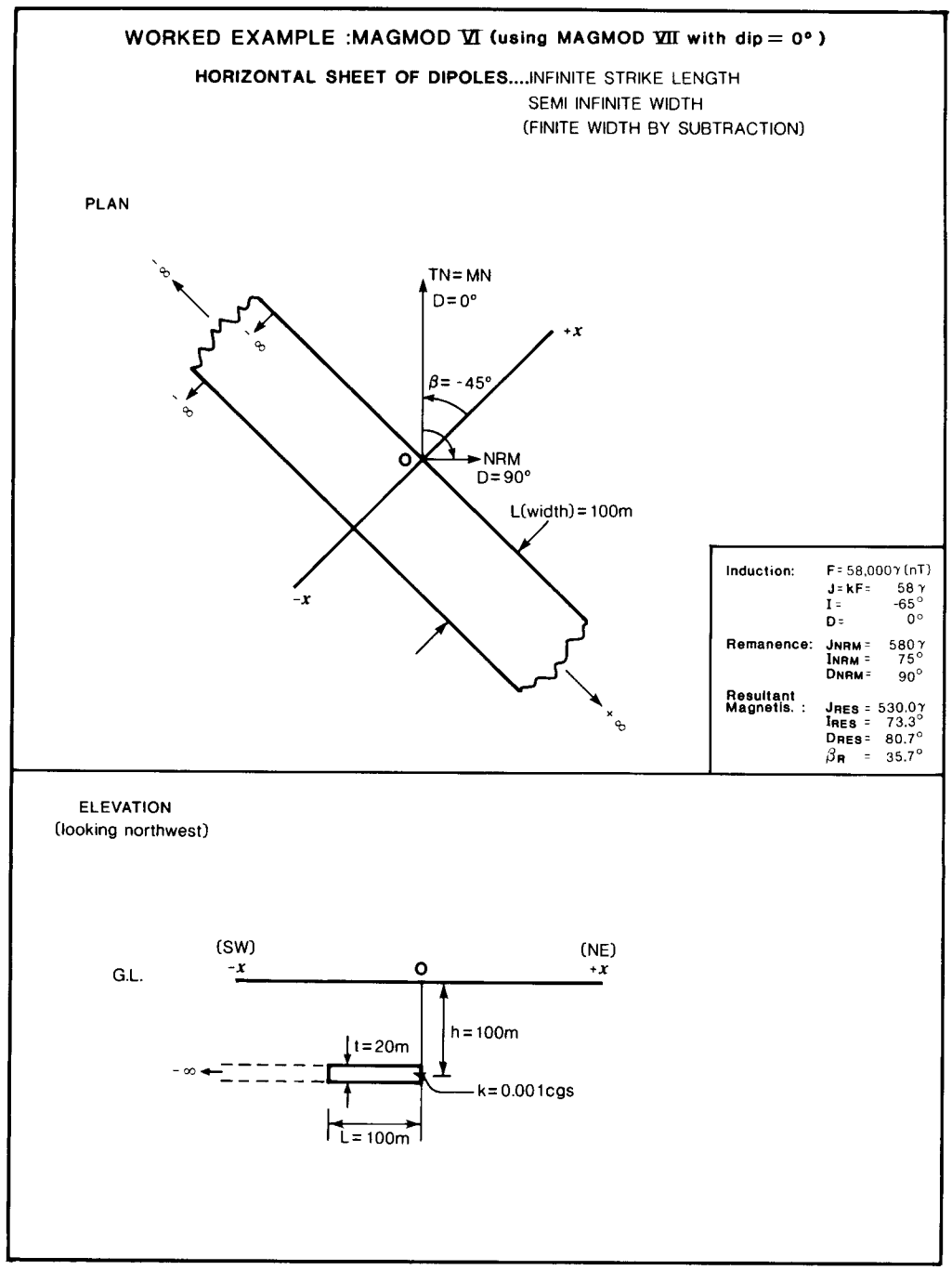
User Instructions



USER mode
DEG mode
SIZE 042

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG 6	F =
2	Geomagnetic field magnitude	F	R/S	I =
3	Geomagnetic field inclination	I	R/S	D =
4	Geomagnetic field declination	D	R/S	DIP =
5	Dip angle of sheet	d	R/S	INF? < 0,1>
6a	If finite dip extent body (L finite)	0 (zero)	R/S	H1 =
6b	If infinite dip extent body (L infinite)	1	R/S	H1 =
7	Depth to sheet top (a) if finite dip o°<d<180°	h_1	R/S	H2 =
	(b) if finite dip d=0 or 180°	h_1	R/S	L =
	(c) if infinite dip extent (go to 9)	h_1	R/S	THICKNESS=
8	(a) Width (=length) for horizontal sheet	L	R/S	THICKNESS=
	(b) Depth to sheet bottom for dipping sheet	h_2	R/S	THICKNESS=
9	Thickness of sheet	t	R/S	SUSC =
10	Susceptibility contrast	k	R/S	REM? <0,1>
11a	If remanence absent (go to 15)	0	R/S	BEARING=
11b	If remanence present	1	R/S	J_{REM} =
12	Remanent magnetisation magnitude	J_{REM}	R/S	I_{REM} =
13	Remanent magnetisation inclination	I_{REM}	R/S	D_{REM} =
14	Remanent magnetisation declination	D_{REM}	R/S	BEARING =
15	Azimuth of magnetic north w.r.t. + x axis	β	R/S	XMIN = ?
16	Minimum (profile) x value	x_{MIN}	R/S	XMAX = ?
17	Maximum (profile) x value	x_{MAX}	R/S	XINC = ?
18	Profile x increment	x_{INC}	R/S	
19	Observe printout of: station			X =
	vertical component anomaly			B_Z =
	total intensity anomaly			B_T =
20	Call plotting subroutine if required		F	BZ MIN= ?
	Lower limit for Y axis	B_Z (MIN)	R/S	BZ MAX= ?
	Upper limit for Y axis	B_Z (MAX)	R/S	BT MIN= ?
	Lower limit for Y axis	B_T (MIN)	R/S	BT MAX= ?
	Upper limit for Y axis	B_T (MAX)	R/S	
	Observe the two profiles plotted			
21	Resultant magnetisation printout		G	J, I, D RES
22	To obtain β_R azimuth of resultant magnetisation		RCL 23	β_R
	Profile recomputation with changed inputs			
	If complete new data		A	F =
	If same geomagnetic data only		B	INF <0,1>
	If different remanence		C	J_{REM} =
	If different β		D	BEARING =
	If different profile limits		E	XMIN = ?
	If different plot parameters		F	BZMIN = ?

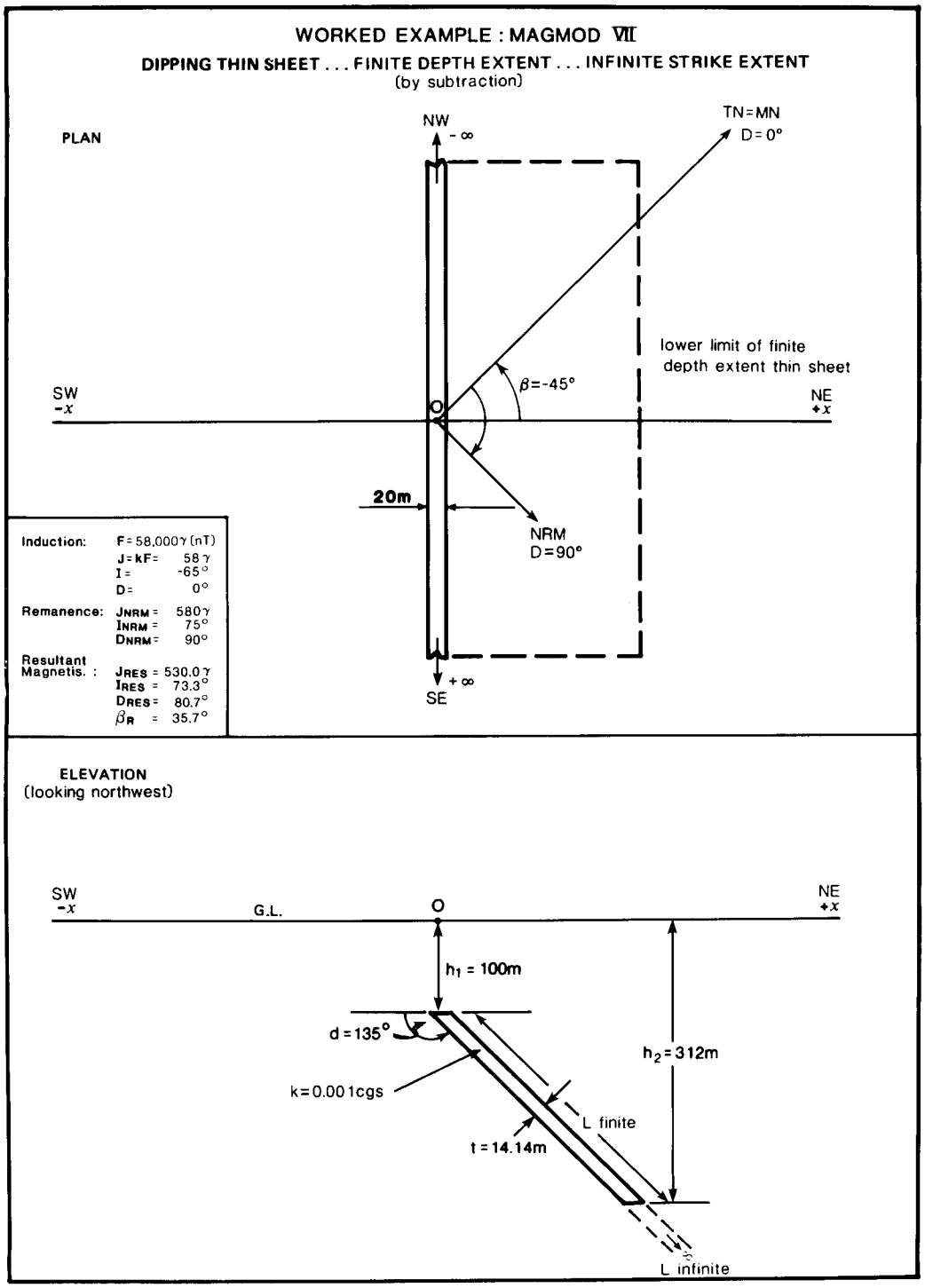
c




```
F=58,000.0
I=-65.0
D=0.0

DIP=0.0
H1=100.0
L=100.0
THICKNESS=20.0
SUSC=0.001000

J REM=580.0
I REM=75.0
D REM=90.0

BEARING=-45.0

X=-100.0
BZ=126.2
BT=-91.4

X=-50.0
BZ=162.5
BT=-159.0

X=0.0
BZ=76.8
BT=-107.4

X=50.0
BZ=-11.8
BT=-20.1

X=100.0
BZ=-35.1
BT=15.1

X=150.0
BZ=-32.1
BT=20.5

X=200.0
BZ=-25.2
BT=18.3

J RES=530.0
I RES=73.3
D RES=80.7

                                35.7     ***
```

(RCL 23) β_R = 35.7

```
BZ
MIN=-40.     MAX=170.
     |                 |
-100.|         x       |
 -50.|             x   |
   0.|     x           |
  50.x|                 |
 100.x|                 |
 150.x|                 |
 200.x|                 |

BT
MIN=-160.    MAX=25.
     |                 |
-100.|      x          |
 -50.x                  |
   0.|  x              |
  50.|           x     |
 100.|                 | x
 150.|                 |  x
 200.|                 |  x
```




```
F=58,000.0
I=-65.0
D=0.0

DIP=135.0
H1=100.0
H2=312.0
THICKNESS=14.14
SUSC=0.001000

J REM=580.0
I REM=75.0
D REM=90.0

BEARING=-45.0

X=-100.0
BZ=16.8
BT=5.4

X=-50.0
BZ=58.6
BT=-30.0

X=0.0
BZ=110.0
BT=-87.4

X=50.0
BZ=109.9
BT=-107.1

X=100.0
BZ=73.5
BT=-84.4

X=150.0
BZ=40.1
BT=-56.1

X=200.0
BZ=16.5
BT=-33.3

J RES=530.0
I RES=73.3
D RES=80.7

                                35.7     ***
```

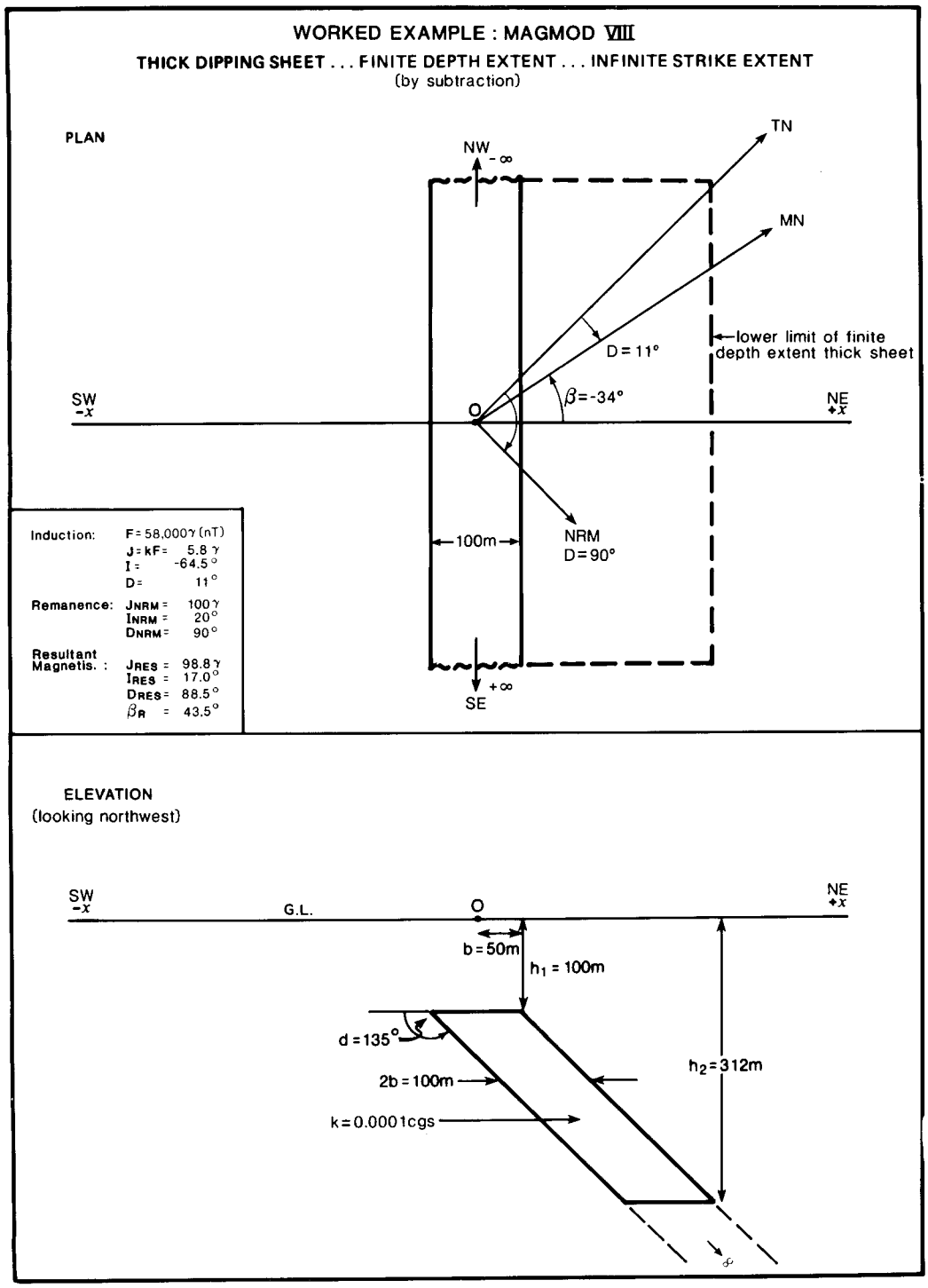
```
(RCL 23) βR = 35.7

BZ
MIN=15.    MAX=110.
    |
-100.*
 -50.!
   0.!
  50.!
 100.!
 150.!
 200.*

BT
MIN=-110.  MAX=10.
    |
-100.
 -50.
   0.
  50.*
 100.
 150.
 200.
```

User Instructions

MAGMOD VIII: DIPPING THICK SHEET OF DIPOLES
INDUCTION &/OR REMANENCE.

USER mode
DEG mode
SIZE 044

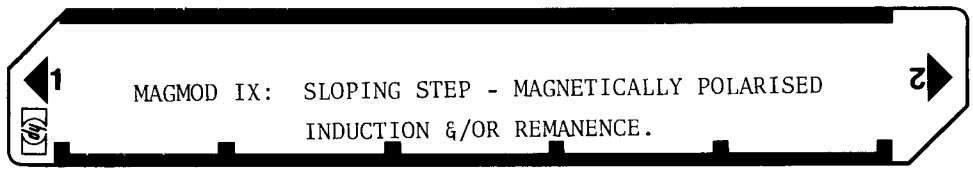
STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG 8	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	INF ? <0,1>
5a	If finite dip extent thick sheet or thin sheet	0 (zero)		R/S	H1 =
5b	If infinite dip extent thick sheet or thin sheet	1		R/S	H1 =
6	Depth to sheet top (a) finite body	h_1		R/S	H2 =
	(b) infinite body (go to 8)	h_1		R/S	THICKNESS=
7	Depth to bottom of sheet	h_2		R/S	THICKNESS=
8	Breadth (horizontal) of sheet (2b = t cosec d)	2b		R/S	DIP =
9	Dip angle of sheet (d ≠ 0° or 180°)	d		R/S	SUSC =
10	Susceptibility contrast	k		R/S	REM? <0,1>
11a	If remanence absent (go to 15)	0		R/S	BEARING =
11b	If remanence present	1		R/S	J_{REM} =
12	Remanent magnetisation magnitude	J_{REM}		R/S	I_{REM} =
13	Remanent magnetisation inclination	I_{REM}		R/S	D_{REM} =
14	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
15	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
16	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
17	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
18	Profile x increment	x_{INC}			
19	Observe printout of: station				X =
	vertical component anomaly				B_Z =
	total intensity anomaly				B_T =
20	Call plotting subroutine if required			F	BZ MIN = ?
	Lower limit for Y axis	B_Z (MIN)		R/S	BZ MAX = ?
	Upper limit for Y axis	B_Z (MAX)		R/S	BT MIN = ?
	Lower limit for Y axis	B_T (MIN)		R/S	BT MAX = ?
	Upper limit for Y axis	B_T (MAX)		R/S	
	Observe the two profiles plotted				
21	Resultant magnetisation printout			G	J, I, D RES
22	To obtain β_R azimuth of resultant magnetisation		RCL	23	β_R
	Profile recomputation with changed inputs				
	If complete new data			A	F =
	If same geomagnetic data only			B	INF <0,1>
	If different remanence			C	J_{REM} =
	If different β			D	BEARING
	If different profile limits			E	XMIN =
	If different plot parameters			F	BZMIN = ?




```
F=58,000.0
I=-64.5
D=11.0

H1=100.0
H2=312.0
THICKNESS=100.0
DIP=135.0
SUSC=0.000100

J REM=100.0
I REM=20.0
D REM=90.0

BEARING=-34.0

X=-100.0
BZ=47.5
BT=-36.9

X=-50.0
BZ=65.7
BT=-61.1

X=0.0
BZ=63.2
BT=-72.1

X=50.0
BZ=33.2
BT=-54.0

X=100.0
BZ=0.2
BT=-23.6

X=150.0
BZ=-19.0
BT=-1.1

X=200.0
BZ=-27.1
BT=11.6

J RES=98.8
I RES=17.0
D RES=88.5

                                    43.5     ***
```

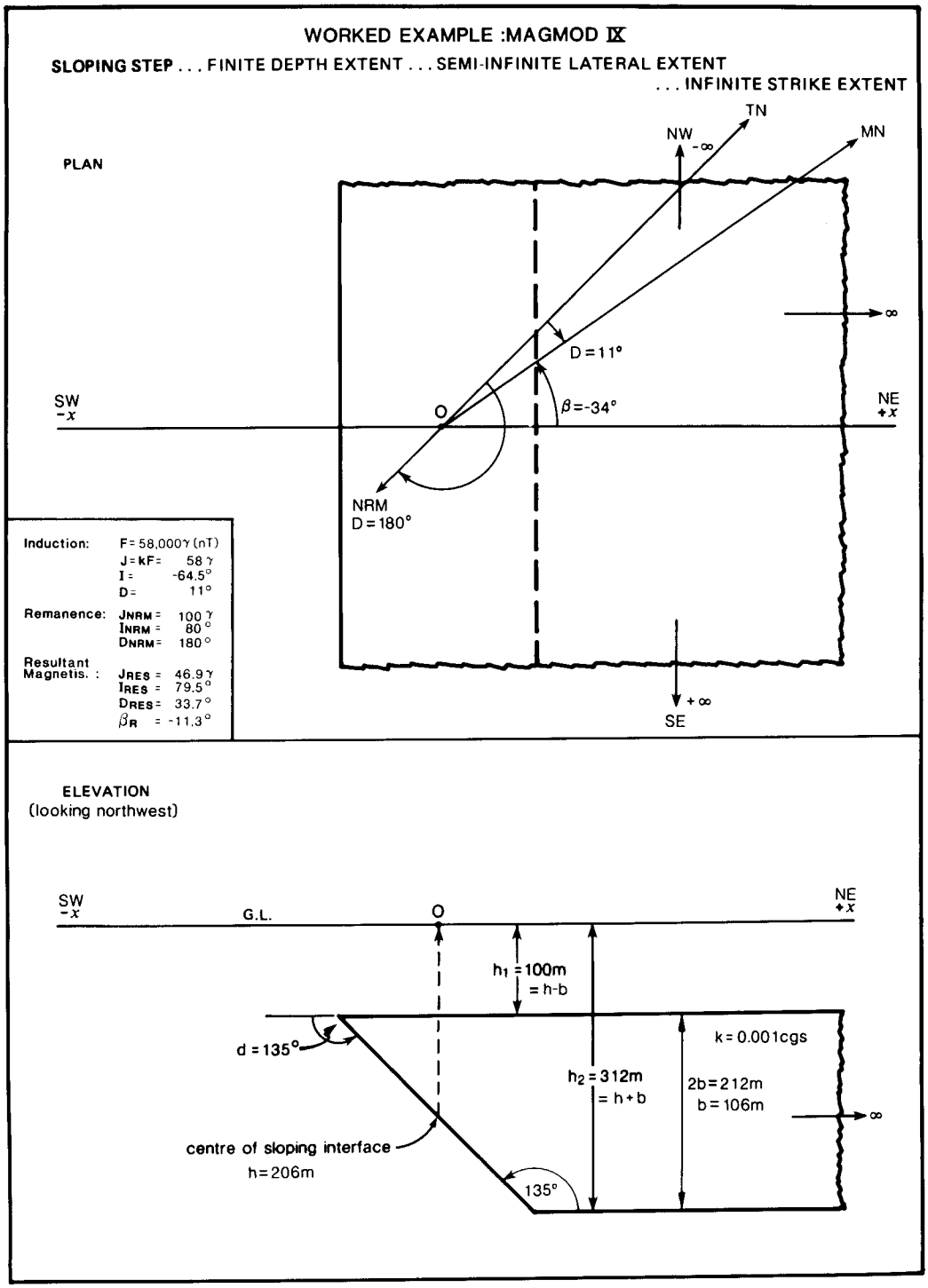
```
(RCL 23) βR = 43.5

BZ
MIN=-30.   MAX=70.
   |
-100.
 -50.
   0.
  50.
 100.
 150.
 200.

BT
MIN=-80.   MAX=20.
   |
-100.
 -50.
   0.
  50.
 100.
 150.
 200.
```

User Instructions

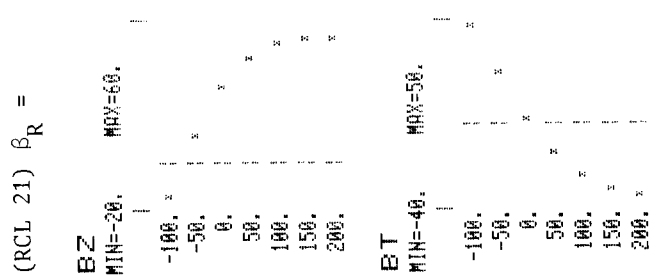


USER mode
DEG mode
SIZE 043

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG9	F =
2	Geomagnetic field mangitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	HI =
5	If finite depth extent body, depth to step top	h_1		R/S	H2 =
6	Depth to step bottom	h_2		R/S	DIP =
7	Dip angle of step face	d		R/S	SUSC =
8	Susceptibility contrast	k		R/S	REM? <0,1>
9a	If remanence absent (go to 13)	0		R/S	BEARING =
9b	If remanence present	1		R/S	J_{REM} =
10	Remanent magnetisation magnitude	J_{REM}		R/S	I_{REM} =
11	Remanent magnetisation inclination	I_{REM}		R/S	D_{REM} =
12	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
13	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
14	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
15	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
16	Profile x increment	x_{INC}		R/S	
17	Observe printout of: station				X =
	vertical component anomaly				B_Z =
	total intensity anomaly				B_T =
18	Call plotting subroutine if required			F	BZMIN = ?
	Lower limit for Y axis	$B_{Z(MIN)}$		R/S	BZMAX = ?
	Upper limit for Y axis	$B_{Z(MAX)}$		R/S	BTMIN = ?
	Lower limit for Y axis	$B_{T(MIN)}$		R/S	BTMAX = ?
	Upper limit for Y axis	$B_{T(MAX)}$		R/S	
	Observe the two profiles plotted				
19	Resultant magnetisation printout			G	J, I, D RES
20	To obtain β_R azimuth of resultant magnetisation		RCL	21	β_R
	Profile recomputation with changed inputs				
	If complete new data			A	F =
	If same geomagnetic data only			B	INF <0,1>
	If different remanence			C	J_{REM}
	If different β			D	BEARING
	If different profile limits			E	XMIN = ?
	If different plot parameters			F	BZMIN = ?

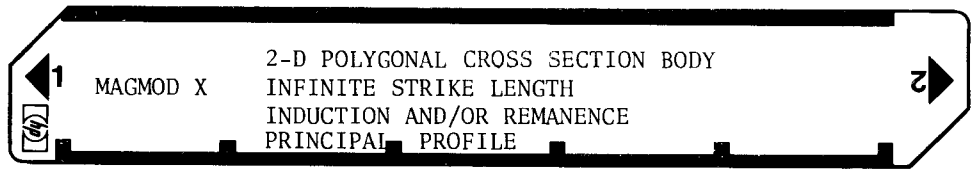



```
F=58,000.0
I=-64.5
D=11.0

H1=100.0
H2=312.0
DIP=135.0
SUSC=0.001000

J REM=100.0
I REM=80.0
D REM=180.0

BEARING=-34.0

X=-100.0
BZ=-14.6
BT=47.4

X=-50.0
BZ=11.2
BT=24.7

X=0.0
BZ=31.5
BT=2.8

X=50.0
BZ=44.0
BT=-13.4

X=100.0
BZ=50.4
BT=-24.2

X=150.0
BZ=52.6
BT=-30.6

X=200.0
BZ=52.0
BT=-33.8

J RES=46.9
I RES=79.5
D RES=33.7

                    -11.3    ***
```



Note: +x part of traverse is over step, -x is away from step.

User Instructions



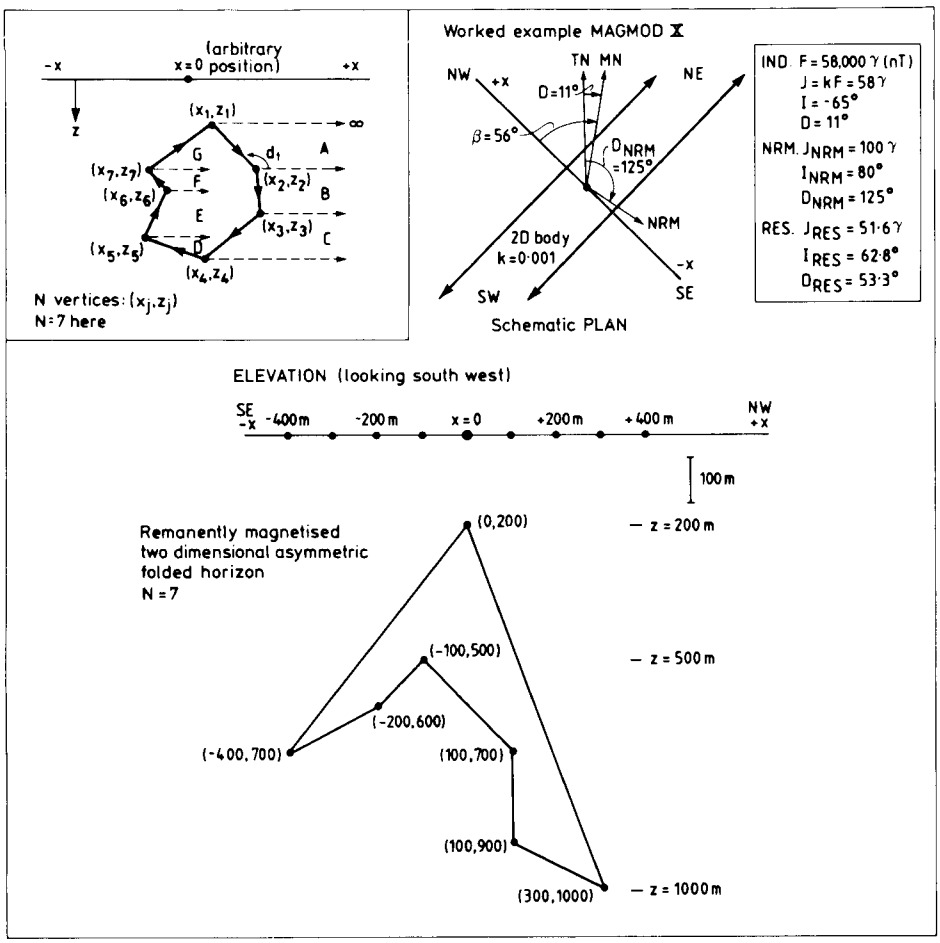
USER mode
DEG mode

SIZE 038 + 2N

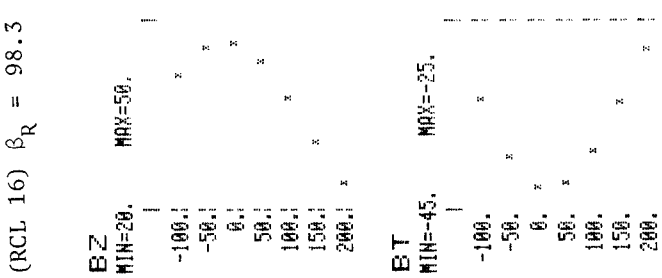
STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG10	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	No. of sides =
5	Number of body vertices (sides)	N		R/S	X1 =
6	x- coordinate of first vertex	x		R/S	Z1 =
7	z- coordinate of first vertex	z		R/S	X2 =
8	Repeat for subsequent vertices (clockwise)				
		x_N, z_N		R/S	SUSC =
9	Susceptibility contrast	k		R/S	REM? <0,1>
10a	If remanence not present (go to 14)	0		R/S	BEARING =
10b	If remanence present	1		R/S	JREM =
11	Remanent magnetisation magnitude	J_{REM}		R/S	IREM =
12	Remanent magnetisation inclination	I_{REM}		R/S	DREM =
13	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
14	Azimuth of magnetic north w.r.t. x-axis	β		R/S	XMIN = ?
15	Minimum (profile) x-value	x_{MIN}		R/S	XMAX = ?
16	Maximum (profile) x-value	x_{MAX}		R/S	XINC = ?
17	Profile x-increment	x_{INC}		R/S	
18	Observe printout of: station				X =
	vertical field anomaly				BZ =
	total field anomaly				BT =
19	Call plotting subroutine if required			F	BZMIN = ?
	Lower limit for Y-axis	B_Z (MIN)		R/S	BZMAX = ?
	Upper limit for Y-axis	B_Z (MAX)		R/S	BTMIN = ?
	Lower limit for Y-axis	B_T (MIN)		R/S	BTMAX = ?
	Upper limit for Y-axis	B_T (MAX)		R/S	
	Observe the two plotted profiles				
20	Resultant magnetisation printout			C	J, I, D RES
21	To obtain β_R, azimuth of resultant magnetization		RCL	16	
	Profile recomputation with changed inputs:				
	If complete new data			A	F =
	If same geomagnetic data only			B	No.of sides =
	If different remanence			C	JREM =
	If different β			D	BEARING =
	If different profile limits			E	XMIN = ?
	If different plot parameters			F	BZMIN = ?

MAGMOD X

TWO DIMENSIONAL BODY WITH POLYGONAL CROSS-SECTION



Magnetic anomalies are calculated by superposition of MAGMOD IX fields for N sloping steps, such as the semi-infinite steps A-G shown above. N vertices (x_j,z_j) are numbered in a clockwise sense from an arbitrary starting point. The steps make a positive contribution for increasing z and negative contribution for decreasing z. N is limited only by storage capacity, but computation is slow for N > 7 and N ≈ 10 is the feasible limit. The position of the principal profile origin, x = 0, is arbitrary.




```
F=58,000.0
I=-65.0
D=11.0

NO. OF SIDES=7.0
X1=0.0
Z1=200.0

X2=300.0
Z2=1000.0

X3=100.0
Z3=900.0

X4=100.0
Z4=700.0

X5=-100.0
Z5=500.0

X6=-200.0
Z6=600.0

X7=-400.0
Z7=700.0

SUSC=1.0E-3

J REM=100.0
I REM=80.0
D REM=125.0

BEARING=56.0

X=-100.0
BZ=41.4
BT=0.0

X=-50.0
BZ=45.7
BT=0.0

X=0.0
BZ=46.5
BT=0.0

X=50.0
BZ=43.5
BT=0.0

X=100.0
BZ=37.7
BT=0.0

X=150.0
BZ=30.9
BT=0.0

X=200.0
BZ=24.2
BT=0.0

J RES=51.6
I RES=62.8
D RES=53.3

98.3  ***
```

MAGMOD X 2D body with polygonal cross-section

Magnetic anomalies are calculated by superposition of MAGMOD IX fields for N sloping steps. N vertices (x_j, z_j) are numbered in a clockwise sense from an arbitrary starting point. The steps make a positive contribution for increasing z and negative contribution for decreasing z. The position of the principal profile origin, x = 0, is arbitrary.

EQUATIONS (refer to MAGMOD IX; d = dip of step face)

$$j = 1 \text{ to } N-1: \Delta B_i = J \sin d_j \{(C_7/2)\ln[\frac{(x-x_{j+1})^2+z_{j+1}^2}{(x-x_j)^2+z_j^2}] + C_8[\tan^{-1}(\frac{x-x_{j+1}}{z_{j+1}}) - \tan^{-1}(\frac{x-x_j}{z_j})]\}$$

$$j = N: \Delta B_i = J\sin d_n \{(C_7/2)\ln[\frac{(x-x_1)^2+z_1^2}{(x-x_N)^2+z_N^2}] + C_8[\tan^{-1}(\frac{x-x_1}{z_1}) - \tan^{-1}(\frac{x-x_N}{z_N})]\}$$

$$d_j = \tan^{-1}(\frac{z_{j+1}-z_j}{x_j-x_{j+1}}) \text{ for } d_j\text{: } 0^0\text{-}90^0\text{; if } d_j \text{negative, add } 180^0 \text{ (j=1 to N-1)}$$

$$d_N = \tan^{-1}(\frac{z_1-Z_N}{x_N-x_1}) \text{for } d_N\text{: } 0^0\text{-}90^0\text{; if } d_N \text{ negative, add } 180^0$$

NOTES ON INCORPORATING ANISOTROPY AND DEMAGNETISATION EFFECTS INTO MODELLING

For a more detailed discussion with worked examples see Emerson and Clark (1982-3) unpub. ASEG course notes

CASE A - Low susceptibility (major susceptibility < 0.01)

Demagnetisation is unimportant

(A1) ISOTROPIC SUSCEPTIBILITY k : $\tilde{J}_R = \tilde{J}_{IND} + \tilde{J}_{NRM} = k\tilde{F} + \tilde{J}_{NRM}$

(A2) ANISOTROPIC SUSCEPTIBILITY (principal susceptibilities $k_1 > k_2 > k_3$)

* $\tilde{J}_{IND}$ is not in general parallel to $\tilde{F}$
* Need to resolve $\tilde{F}$ along principal susceptibility axes, calculate $\tilde{J}_{IND} = (k_1F_1, k_2F_2, k_3F_3)$ and convert to x,y,z components (geographic axes)
* calculate $\tilde{J}_R = \tilde{J}_{IND} + \tilde{J}_{NRM}$

CASE B - High susceptibility ($k_1 > 0.01$)

Demagnetisation may be important. We therefore need to consider magnetisation components resolved along the body axes, in order to make demagnetisation corrections.

(B1) ISOTROPIC SUSCEPTIBILITY k : $\tilde{J}_R = k\tilde{F} + \tilde{J}_{NRM}$

* Resolve $\tilde{J}_R$ along body axes a,b,c
* Apply attenuation factors $1/(1+kN_i)$ to obtain J_i' from J_i (i=a,b,c)
* Convert to x,y,z axes to obtain $\tilde{J}_R'$ (demagnetisation-corrected magnetisation

(B2) ANISOTROPIC SUSCEPTIBILITY - PRINCIPAL SUSCEPTIBILITY AXES PARALLEL TO BODY AXES

* Resolve $\tilde{F}$ and $\tilde{J}_{NRM}$ along body axes a,b,c ($=x_1,x_2,x_3$)
* Calculate $[k_aF_a+(\tilde{J}_{NRM})_a]/(1+k_aN_a)$ etc. to obtain components of demagnetisation-corrected vector with respect to body axes
* Convert to x,y,z axes to obtain J_R'

(B3) ANISOTROPIC SUSCEPTIBILITY - PRINCIPAL SUSCEPTIBILITY AXES NOT PARALLEL TO BODY AXES

* Choose the body axes (a,b,c) as the co-ordinate system
* Calculate the susceptibility tensor elements k_{ij} (i,j=a,b,c)
* Work out the components F_i and $(\tilde{J}_{NRM})_i$ (i=a,b,c)
* The demagnetisation-corrected components are given by the matrix equation $\tilde{J}_R' = A^{-1}\{K\tilde{F} + \tilde{J}_{NRM}\}$, where $A = I + [k_{ij}N_j]$ and $K = [k_{ij}]$ (i,j = a,b,c). $\tilde{J}_R'$, $\tilde{F}$ and $\tilde{J}_{NRM}$ are column vectors.
* Convert to x,y,z axes to obtain $\tilde{J}_R'$

NOTES

(1) The demagnetisation corrections are exact for ellipsoids, but are only approximate for tabular bodies (refer to Emerson and Clark 1982-3).

(2) It is essential to ensure that the susceptibility anisotropy axes ($k_{a,b,c}$) are mutually orthogonal prior to any analysis.

(3) For dipping tabular 2D bodies of the thick and thin sheet type:

(i) MAGMOD VIII can be used for weak isotropic susceptibility and remanence, because it covers MAGMOD VII as a special case. Alternatively, if anisotropy and demagnetisation are important, the resultant magnetisation may be calculated using VECT. MAGMOD VIII can then be used by setting k = 0 and regarding the resultant magnetisation as a pseudo-remanence.

(ii) MAGMOD VIIIA can be used for large isotropic susceptibility (when demagnetisation becomes important) + remanence.

(iii) MAGMOD VIIIB takes anisotropic susceptibility, remanence and demagnetisation into account.

(4) Program VECT calculates the resultant magnetisation vector (approximately corrected for demagnetisation) for a 2D sheet, given anisotropic susceptibility and remanence.

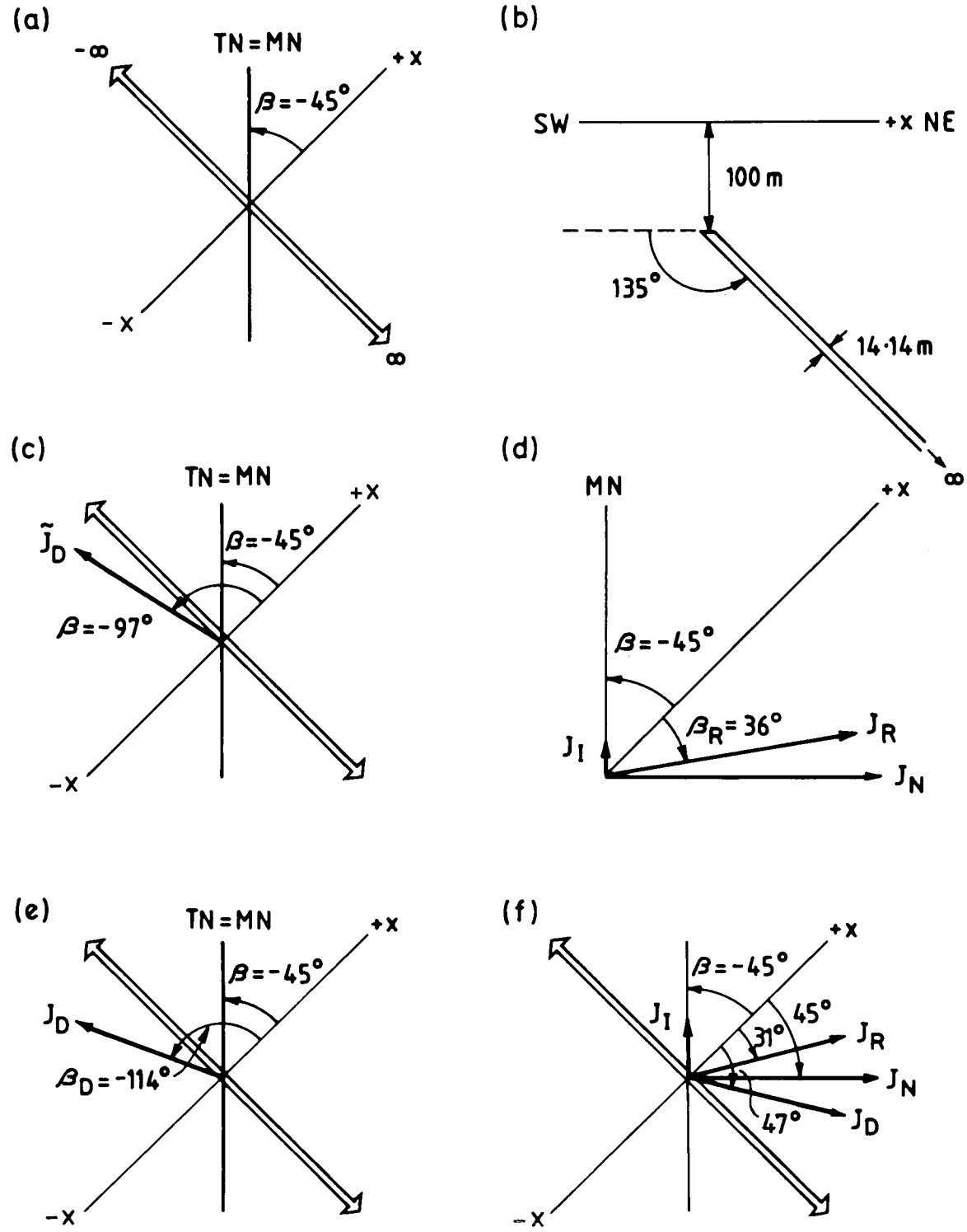
(5) Program VALG (vector operations) calculates the resultant magnetisation for isotropic susceptibility and remanence, when demagnetisation is not important.

Fig 1 2D Tubular Body: The effects of demagnetisation, remanence and susceptibility anisotropy on the resultant magnesitisation vector.

The Figure depicts a thin 2D sheet ($t = 14.14$ m, $2b = 20$ m) model and demonstrates how remanence, demagnetisation and anisotropy affect resultant magnetisation: (a) Plan view of thin sheet striking NW-SE. (b) Cross section $-x$ to $+x$, SW-NE, showing dip of 135°, i.e. 45°NE. (c) F = 58000, k = 0.1 cgs, I = −65°, D = 0°, no remanence; when demagnetisation is neglected the induced magnetisation is J, D, (β), I nominally: 5800γ, 0°, (−45°), −65°; demagnetisation is significant here because of the very high k, when corrections are applied using vector operations program VECT the induced magnetisation is reduced in magnitude and shifted towards the plane of the sheet: J_B, D_B, I_B : 3743γ, −52°, −62° with $\beta_B = -97°$. (d) If k = 0.001 cgs and strong remanence exists, say Q = 10 with $I_{MGL} = 75°$ and $D_{MGL} = 90°$, then J_P D_P I_P : 58γ, 0°, −65° and J_M D_M I_M : 580γ, 90°, 75°; the uncorrected resultant (by program VALG) is J_G D_G I_G : 530γ, 81°, 73° with $\beta_G = 81° - 45° = 36°$; the application of demagnetisation corrections, using VECT, gives J_B, D_B, I_B : 529γ, 80°, 73° with $\beta_B = 80° - 45° = 35°$ (not shown in the Figure), so the demagnetisation shift is negligible, even though NRM is strong, because the demagnetisation is operating through a moderate susceptibility. (e) With a highly anisotropic susceptibility, maximum in the plane of the sheet, say k's along strike (k_a), down dip (k_b) and normal to sheet (k_c) are 0.12, 0.12, 0.06 cgs respectively then bulk k = 0.1 and anisotropy = 2.0, if NRM = 0 and demagnetisation corrections are applied with VECT then J_B, D_B, I_B : 4015γ, −69°, −56° with $\beta_D = 114°$. (f) If the thin sheet has anisotropy as in (e) and an intense NRM horizontal to the east J_N, D_M, I_N : 10,000γ, 90°, 0° ($\beta_N = 45°$) then neglecting the effects of anisotropy, i.e. let $k_a = k_b = k_c = 0.1 = k$, and neglecting demagnetisation gives an uncorrected resultant magnetisation J_R, D_R, I_R : 1158γ, 76°, −27° ($\beta_R = 31°$) using VALG, but taking anisotropy and demagnetisation into account, using VECT, gives J_D, D_D, I_D : 7041γ, 92°, −15° with $\beta_D = 47°$, showing clearly the deflection of the magnetisation, by the shortest route, towards the plane of the sheet. (All magnitudes and angles in this caption have been rounded off.)

2D TABULAR BODY : THE EFFECTS OF DEMAGNETISATION, REMANENCE AND SUSCEPTIBILITY ANISOTROPY ON THE RESULTANT MAGNETISATION VECTOR

(Note demag. corrections approximate)



User Instructions

VECT : RESULTANT MAGNETISATION CALCULATION
taking account of isotropic or anisotropic
susceptibility, demagnetisation (approx.), and
remanence in a 2D sheet

USER mode
DEG mode
SIZE 049

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Initialise program		XEQ VECT	F =
2	Input magnitude of geomagnetic field	F	R/S	D =
3	Input declination of geomagnetic field	D	R/S	I =
4	Input inclination of geomagnetic field	I	R/S	BEARING =
5	Input bearing of magnetic north (w.r.t. + x axis)	β	R/S	ISOTROPIC ?
6	If susceptibility is anisotropic, input 0 and			<0,1>
	proceed to step 10	0	R/S	Ka =
7	If susceptibility is isotropic, input 1	1	R/S	K =
8	Input isotropic susceptibility	k	R/S	REM ? <0,1>
9	Go to step 19			
	Note: check that k axes are orthogonal			
10	Input magnitude of maximum susceptibility	k_a	R/S	D =
11	Input declination of maximum susceptibility	D_a	R/S	I =
12	Input inclination of maximum susceptibility	I_a	R/S	Kb =
13	Input magnitude of intermediate susceptibility	k_b	R/S	D =
14	Input declination of intermediate susceptibility	D_d	R/S	I =
15	Input inclination of intermediate susceptibility	I_b	R/S	Kc =
16	Input magnitude of minimum susceptibility	k_c	R/S	D =
17	Input declination of minimum susceptibility	D_c	R/S	I =
18	Input inclination of minimum susceptibility	I_c	R/S	REM ? <0,1>
19	If remanence is not to be considered,			
	input 0 and proceed to step 24	0	R/S	DEMAG <0,1>
20	If remanence is to be considered, input 1	1	R/S	JREM =
21	Input magnitude of remanence vector	J_{NRM}		IREM =
22	Input inclination of remanence vector	I_{NRM}		DREM =
23	Input declination of remanence vector	D_{NRM}		
24	If demagnetisation is not to be considered,			
	input 0, resultant magnetisation	0	R/S	J RES =
	is then calculated and printed			etc.
25	If demagnetisation is to be considered input 1	1		DIP =
26	Input dip angle of sheet	d	R/S	INF ? <0,1>
27	If sheet is of infinite length down dip input			
	1 and resultant magnetisation is printed	1	R/S	J RES = etc.
28	If sheet is of finite length, down dip, input 0	0	R/S	L =
29	Input sheet length i.e. down dip depth extent	L	R/S	T =
30	Input sheet thickness. Resultant magnetisation	t	R/S	J RES =
	incl. demag. is then calculated and printed			etc.
	To re-run with new data - press A, with new k - press B,			
	with new NRM - press C, with new demag. variable - press D.			

User Instructions

MAGMOD VIIIA : DIPPING 2D TABULAR BODY
THICK OR THIN SHEET
INDUCTION, DEMAGNETISATION (approximate), REMANENCE

USER mode
DEG mode
SIZE 044

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG 8A	F =
2	Subsequent steps as for MAGMOD VIII			

MAGMOD VIII B : DIPPING 2 D TABULAR BODY e.g. Thin Sheet or Thick Sheet.
DEMAGNETISATION (approx.), ANISOTROPIC SUSCEPTIBILITY, REMANENCE

USER mode
DEG mode
SIZE 059

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG 8B	F =
2	Geomagnetic field magnitude	F	R/S	I =
3	Geomagnetic field inclination	I	R/S	D =
4	Geomagnetic field declination	D	R/S	INF ? <0,1>
5a	If finite dip extent thick sheet or thin sheet	0 (zero)	R/S	H1 =
5b	If infinite dip extent thick sheet or thin sheet	1	R/S	H1 =
6	Depth to sheet top (a) finite body	h_1	R/S	H2 =
	(b) infinite body (go to 8)	h_1	R/S	THICKNESS=
7	Depth to bottom of sheet	h_2	R/S	THICKNESS=
8	Breadth (horizontal) of sheet (2b = t cosec d)	2b	R/S	DIP =
9	Dip angle of sheet (d ≠ 0° or 180°)	d	R/S	Ka =
10a	Input magnitude of maximum susceptibility	k_a	R/S	D =
10b	Input declination of maximum susceptibility	D_a	R/S	I =
10c	Input inclination of maximum susceptibility	I_a	R/S	Kb =
10d	Input magnitude of intermediate susceptibility	k_b	R/S	D =
10e	Input declination of intermediate susceptibility	D_b	R/S	I =
10f	Input inclination of intermediate susceptibility	I_b	R/S	Kc =
10g	Input magnitude of minimum susceptibility	k_c	R/S	D =
10h	Input declination of minimum susceptibility	D_c	R/S	I =
10i	Input inclination of minimum susceptibility	I_c	R/S	REM ? <0,1>
	Notes (i) susceptibility axes must be orthogonal			
	(ii) if isotropic susceptibility use MAGMOD VIII A			
	or insert $k_a = k_b = k_c$ with orthogonal			
	axes e.g. 0,0; 0,90; 90,0 can be D, I			
11a	Remainder of instructions same as MAGMOD VIII			
	except RCL 31 to view β_R (step 22)			

Use of MAGMOD VIII A for case (c)

```
F=58,000.0000
I=-65.0000
D=0.0000

H1=100.0000
THICKNESS=20.0000
DIP=135.0000
SUSC=0.1000

BEARING=-45.0000

J RES=5,800.0000
I RES=-65.0000
D RES=0.0000

DEMAGNETISATION
CORRECTION

J RES=3,742.7556
I RES=-62.1877
D RES=-52.0040

X=-100.0000
BZ=-43.6911
BT=-158.2335

X=-50.0000
BZ=-317.0795
BT=55.6113

X=0.0000
BZ=-702.3321
BT=452.0160

X=50.0000
BZ=-809.7755
BT=669.6247

X=100.0000
BZ=-662.1468
BT=612.5058

X=150.0000
BZ=-503.0650
BT=496.0339

X=200.0000
BZ=-388.9697
BT=399.6898

J RES=3,742.7556
I RES=-62.1877
D RES=-52.0040
```

(RCL 23) β_R =

```
          -97.0040    ***
BZ
MIN=-900.     MAX=0.
     |                 |
 -100.                 x|
  -50.           x      |
    0.    x             |
   50.  x               |
  100.     x             |
  150.        x          |
  200.           x       |

BT
MIN=-200.     MAX=700.
     |                  |
 -100. x  |
  -50.    |x
    0.    |        x
   50.    |            x
  100.    |          x
  150.    |         x
  200.    |       x
```

MAGMOD VIII B PLOT

(RCL 31) β_R =

```
          -97.0040    ***
BZ
MIN=-900.     MAX=0.
     |                 |
 -100.                 x|
  -50.           x      |
    0.    x             |
   50.  x               |
  100.     x             |
  150.        x          |
  200.           x       |

BT
MIN=-200.     MAX=700.
     |                  |
 -100. x  |
  -50.    |x
    0.    |        x
   50.    |            x
  100.    |          x
  150.    |         x
  200.    |       x
```

Use of MAGMOD VIII B for case (c)

```
F=58,000.0000
I=-65.0000
D=0.0000

H1=100.0000
THICKNESS=20.0000
DIP=135.0000

Ka=0.1000
D=0.0000
I=0.0000

Kb=0.1000
D=0.0000
I=90.0000

Kc=0.1000
D=90.0000
I=0.0000

BEARING=-45.0000

J RES=5,800.0000
I RES=-65.0000
D RES=0.0000

DEMAGNETISATION
CORRECTION

J RES=3,742.7556
I RES=-62.1877
D RES=-52.0040

X=-100.0000
BZ=-43.6911
BT=-158.2335

X=-50.0000
BZ=-317.0795
BT=55.6113

X=0.0000
BZ=-702.3321
BT=452.0160

X=50.0000
BZ=-809.7755
BT=669.6247

X=100.0000
BZ=-662.1468
BT=612.5058

X=150.0000
BZ=-503.0650
BT=496.0339

X=200.0000
BZ=-388.9697
BT=399.6898

J RES=3,742.7556
I RES=-62.1877
D RES=-52.0040
```

Use of VECT for case (f) to obtain resultant magnetisation corrected for aniso. & demag.

```
F=58,000.0000
D=0.0000
I=-65.0000

BEARING=-45.0000

Ka=0.1200
D=-45.0000
I=0.0000

Kb=0.1200
D=45.0000
I=45.0000

Kc=0.0600
D=45.0000
I=-45.0000

J REM=10,000.0000
I REM=0.0000
D REM=90.0000

DIP=135.0000

J RES=7,041.1352
D RES=92.1326
I RES=-14.7251

BEARING=47.1326
```

Use of MAGMOD VIII B for case (e)

```
F=58,000.0000
I=-65.0000
D=0.0000

H1=100.0000
THICKNESS=20.0000
DIP=135.0000

Ka=0.1200
D=-45.0000
I=0.0000

Kb=0.1200
D=45.0000
I=45.0000

Kc=0.0600
D=45.0000
I=-45.0000

BEARING=-45.0000

J RES=4,696.6359
I RES=-63.7133
D RES=-45.4697

DEMAGNETISATION
CORRECTION

J RES=4,015.2961
I RES=-55.5108
D RES=-68.8258

X=-100.0000
BZ=-184.7951
BT=-30.2283

X=-50.0000
BZ=-485.9453
BT=225.6642

X=0.0000
BZ=-842.7985
BT=621.4005

X=50.0000
BZ=-866.2807
BT=771.3403

X=100.0000
BZ=-662.2104
BT=654.7306

X=150.0000
BZ=-481.3188
BT=508.7726

X=200.0000
BZ=-360.6796
BT=399.3551

J RES=4,015.2961
I RES=-55.5108
D RES=-68.8258

        -113.8258    ***

BZ
MIN=-900.      MAX=-100.
     |                  |
 -100.                x |
  -50.          x       |
    0.  x                |
   50.  x                |
  100.      x            |
  150.          x        |
  200.              x    |

BT
MIN=-30.      MAX=800.
     |                  |
 -100.x
  -50.|    x
    0.|              x
   50.|                  x
  100.|             x
  150.|          x
  200.|       x
```

Use of MAGMOD VIII B for case (f)

```
F=58,000.0000
I=-65.0000
D=0.0000

H1=100.0000
THICKNESS=20.0000
DIP=135.0000

Ka=0.1200
D=-45.0000
I=0.0000

Kb=0.1200
D=45.0000
I=45.0000

Kc=0.0600
D=45.0000
I=-45.0000

J REM=10,000.0000
I REM=0.0000
D REM=90.0000

BEARING=-45.0000

J RES=9,612.6494
I RES=-25.9804
D RES=80.2818

DEMAGNETISATION
CORRECTION

J RES=7,041.1352
I RES=-14.7251
D RES=92.1326

X=-100.0000
BZ=925.9564
BT=-946.6292

X=-50.0000
BZ=965.4409
BT=-1,114.3329

X=0.0000
BZ=566.7291
BT=-896.2148

X=50.0000
BZ=-56.1538
BT=-323.5968

X=100.0000
BZ=-356.3984
BT=45.9408

X=150.0000
BZ=-417.4300
BT=181.5893

X=200.0000
BZ=-399.9794
BT=217.6427

J RES=7,041.1352
I RES=-14.7251
D RES=92.1326

         47.1326    ***

BZ
MIN=-450.      MAX=1,000.
     |                  |
 -100.      |          x
  -50.      |          x
    0.      |      x
   50.     x|
  100. x     |
  150.x      |
  200.x      |

BT
MIN=-1,200.      MAX=250.
     |                  |
 -100.   x          |
  -50. x            |
    0.    x         |
   50.          x   |
  100.              |x
  150.              |  x
  200.              |  x
```

ELLIPSOID NOTATION

(Refer to diagrams and formulae, and to variables defined for previous MAGMODs)

Q: intersection of axis of revolution with xy plane (prolate and oblate)

Q': intersection of down-dip b axis, extended to the surface, with the xy plane (oblate only)

a,b,b: semi-axes of ellipsoid; 2a = diameter of ellipsoid along axis of revolution, 2b = diameter in equatorial plane

$\hat{v}_1, \hat{v}_2, \hat{v}_3$: unit vectors defining body axis co-ordinate system

ℓ_i, m_i, n_i: direction cosines of $\hat{v}_i$ (i=1,2,3) with respect to xyz axes

x_1, x_2, x_3: co-ordinates of observation point P with respect to body axes

$\tilde{r}$: directed distance from ellipsoid centre to observation point P: $|\tilde{r}|^2 = r^2 = x^2+h^2 = x_1^2 + x_2^2 + x_3^2$

λ: an ellipsoidal co-ordinate, the larger root of the equation $x_1^2/(a^2+\lambda) + (x_2^2 + x_3^2)/(b^2+\lambda) = 1$

Δ: positive square root of the discriminant of the above quadratic equation for λ

ℓ_N, m_N, n_N: direction cosines of NRM vector, $\tilde{J}_N$, with respect to xyz axes

k_1, k_2, k_3: principal susceptibilities ($k_1 > k_2 > k_3$)

$\hat{u}_1, \hat{u}_2, \hat{u}_3$: unit vectors parallel to major, intermediate and minor susceptibility axes respectively. Susceptibility measured along $\hat{u}_i$ is k_i (i=1,2,3). If susceptibility is isotropic $k_i = k$ and $\hat{u}_i = \hat{v}_i$, for all i.

k_{ij}: components of susceptibility tensor with respect to body axes.

α_i: azimuth of $\hat{u}_i$, measured positive clockwise from the +x axis

δ_i: plunge of $\hat{u}_i$

L_i, M_i, N_i: direction cosines of $\hat{u}_i$ with respect to xyz axes

$L_i = \cos\alpha_i \cos\delta_i$, $M_i = \sin\alpha_i \cos\delta_i$, $N_i = \sin\delta_i$

N_1': demagnetising factor along axis of revolution

N_2': demagnetising factor in equatorial plane

Prolate ellipsoid of revolution

a: major semi-axis

b,b: minor semi-axes ($b < a$)

α: azimuth of plunge of revolution axis (angle measured positive clockwise from +x axis to horizontal projection of downward-directed revolution axis)

δ: plunge of revolution axis, i.e. the angle between the revolution axis and its horizontal projection.

$\hat{v}_1$: directed in upward sense along revolution axis, i.e. antiparallel to plunge of revolution axis. $\hat{v}_1$ has azimuth $\alpha-180°$, plunge $-\delta$.

$\hat{v}_2$: orthogonal to $\hat{v}_1$ within vertical plane and directed in upward sense, i.e. $\hat{v}_1$ and $\hat{v}_2$ define vertical plane with strike α. $\hat{v}_2$ has azimuth α, plunge $\delta-90°$.

$\hat{v}_3$: orthogonal to $\hat{v}_1$, $\hat{v}_2$ ($\hat{v}_3 = \hat{v}_1 \times \hat{v}_2$). $\hat{v}_3$ has azimuth $\alpha-90°$ and is horizontal (plunge = 0°)

Oblate ellipsoid of revolution

a: minor semi-axis, parallel to revolution axis

b,b: major semi-axes ($b > a$), lying within equatorial plane

δ: dip of equatorial plane

α: down-dip azimuth of equatorial plane, measured positive clockwise from +x axis.

$\hat{v}_1$: parallel to rotation axis, in upward sense; azimuth = α, plunge = $\delta-90°$

$\hat{v}_2$: orthogonal to $\hat{v}_1$, lies in vertical plane containing $\hat{v}_1$ and has upward sense; azimuth = $\alpha + 180°$, plunge = $-\delta$.

$\hat{v}_3$: orthogonal to $\hat{v}_1$, $\hat{v}_2$ ($\hat{v}_3 = \hat{v}_1 \times \hat{v}_2$); azimuth = $\alpha + 90°$, plunge = 0° (horizontal)

FORMULAE - PROLATE ELLIPSOID OF REVOLUTION

Body axes

$$\hat{v}_1 = (-\cos\alpha\cos\delta, -\sin\alpha\cos\delta, -\sin\delta) = (\ell_1, m_1, n_1)$$

$$\hat{v}_2 = (\cos\alpha\sin\delta, \sin\alpha\sin\delta, -\cos\delta) = (\ell_2, m_2, n_2)$$

$$\hat{v}_3 = (\sin\alpha, -\cos\alpha, 0) = (\ell_3, m_3, n_3)$$

Co-ordinates with respect to body axes

$$x_1 = h\sin\delta - x\cos\alpha\cos\delta$$

$$x_2 = x\cos\alpha\sin\delta + h\cos\delta$$

$$x_3 = x\sin\alpha$$

Ellipsoidal co-ordinate λ and its spatial derivatives

$$\Delta = [r^4 + (a^2-b^2)^2 - 2(a^2-b^2)(x_1^2 - x_2^2 - x_3^2)]^{1/2}$$

$$\lambda = (r^2 - a^2 - b^2 + \Delta)/2$$

$$\partial\lambda/\partial x_1 = x_1[1 + (r^2 - a^2+b^2)/\Delta]$$

$$\partial\lambda/\partial x_2 = x_2[1 + (r^2+a^2-b^2)/\Delta]$$

$$\partial\lambda/\partial x_3 = x_3[1 + (r^2+a^2-b^2)/\Delta]$$

Demagnetising factors

$$N_1' = \frac{4\pi ab^2}{(a^2-b^2)^{3/2}}\{\log_e[(\frac{a^2}{b^2}-1)^{1/2} + a/b] - (1-b^2/a^2)^{1/2}\}$$

$$N_2' = 2\pi - N_1'/2$$

Susceptibility tensor

$$k_{ij} = \sum_r k_r (L_r\ell_i + M_r m_i + N_r n_i)(L_r\ell_j + M_r m_j + N_r n_j)$$

$$(r = 1,2,3)$$

Matrix $K = [k_{ij}]$

Field and NRM components with respect to body axes

$$\text{Column vectors } \tilde{F} = \begin{bmatrix} F_1 \\ F_2 \\ F_3 \end{bmatrix}$$

$$\tilde{J}_N = \begin{bmatrix} (J_N)_1 \\ (J_N)_2 \\ (J_N)_3 \end{bmatrix}$$

$$F_i = F\,(\ell\ell_i + mm_i + nn_i)$$

$$(J_N)_i = J_N\,(\ell_N\ell_i + m_Nm_i + n_Nn_i)$$

Resultant magnetisation with respect to body axes

$$\tilde{J}_R = K\tilde{F} + \tilde{J}_N \quad \text{(uncorrected for demagnetisation)}$$

$$A = I + KN = \begin{bmatrix} 1 + k_{11}N_1 & k_{12}N_2 & k_{13}N_2 \\ k_{12}N_1 & 1+k_{22}N_2 & k_{23}N_2 \\ k_{13}N_1 & k_{23}N_2 & 1+k_{33}N_2 \end{bmatrix}$$

$$\tilde{J}_R' = A^{-1}\tilde{J}_R \quad \text{(demagnetisation-corrected)}$$

(all vectors are column vectors; A, I, K, N are 3x3 matrices; I is the identity matrix; N is the matrix of the demagnetising tensor, which is diagonal with respect to body axes)

Anomalous field components with respect to body axes

$$f_1 = 2\pi ab^2 \left[\frac{J_1' x_1}{(a^2+\lambda)^{3/2}(b^2+\lambda)} + \frac{J_2' x_2 + J_3' x_3}{(a^2+\lambda)^{1/2}(b^2+\lambda)^2}\right]$$

$$f_2 = \frac{2\pi ab^2}{(a^2-b^2)^{3/2}} \left\{\log_e\left[\frac{(a^2-b^2)^{1/2} + (a^2+\lambda)^{1/2}}{(b^2+\lambda)^{1/2}}\right] - \frac{[(a^2-b^2)(a^2+\lambda)]^{1/2}}{b^2+\lambda}\right\}$$

$$\Delta B_1 = (\partial\lambda/\partial x_1) f_1 + \frac{4\pi ab^2}{(a^2-b^2)^{3/2}} J_1' \left\{\left[\frac{a^2-b^2}{a^2+\lambda}\right]^{1/2} - \log_e\left[\frac{(a^2-b^2)^{1/2} + (a^2+\lambda)^{1/2}}{(b^2+\lambda)^{1/2}}\right]\right\}$$

$$\Delta B_2 = (\partial\lambda/\partial x_2) f_1 + J_2' f_2$$

$$\Delta B_3 = (\partial\lambda/\partial x_3) f_1 + J_3' f_2$$

Anomalous field components with respect to xyz axes

$$\Delta B_x = \Delta B_1 \ell_1 + \Delta B_2 \ell_2 + \Delta B_3 \ell_3$$

$$\Delta B_y = \Delta B_1 m_1 + \Delta B_2 m_2 + \Delta B_3 m_3$$

$$\Delta B_z = \Delta B_1 n_1 + \Delta B_2 n_2 + \Delta B_3 n_3$$

$$\Delta B_H = \Delta B_x \cos\beta + \Delta B_y \sin\beta$$

$$\Delta B_T = \Delta B_H \cos I + \Delta B_z \sin I$$

FORMULAE - OBLATE ELLIPSOID OF REVOLUTION

Body axes

$$\hat{v}_1 = (\cos\alpha \sin\delta,\ \sin\alpha \sin\delta,\ -\cos\delta) = (\ell_1, m_1, n_1)$$
$$\hat{v}_2 = (-\cos\alpha \cos\delta,\ -\sin\alpha \cos\delta,\ -\sin\delta) = (\ell_2, m_2, n_2)$$
$$\hat{v}_3 = (-\sin\alpha,\ \cos\alpha,\ 0) = (\ell_3, m_3, n_3)$$

Co-ordinates with respect to body axes

$$x_1 = x \cos\alpha \sin\delta + h \cos\delta$$
$$x_2 = h \sin\delta - x \cos\alpha \cos\delta$$
$$x_3 = x \sin\alpha$$

* Formulae for λ and its spatial derivatives are identical to those for prolate ellipsoid.

Demagnetising factors

$$N_1' = \frac{4\pi ab^2}{(b^2-a^2)^{3/2}} \left[\left(\frac{(b^2-a^2)^{1/2}}{a}\right) - \tan^{-1}\frac{(b^2-a^2)^{1/2}}{a}\right)]$$

$$N_2' = 2\pi - N_1'/2$$

* Computation of susceptibility tensor, field and NRM components with respect to body axes and resultant magnetisation with respect to body axes proceed identically to prolate case.

Anomalous field components with respect to body axes

f_1 as for prolate ellipsoid

$$f_2 = \frac{2\pi ab^2}{(b^2-a^2)^{3/2}} \left\{ \frac{[(b^2-a^2)(a^2+\lambda)]^{1/2}}{b^2+\lambda} - \tan^{-1}\left(\frac{b^2-a^2}{a^2+\lambda}\right)^{1/2} \right\}$$

$$\Delta B_1 = (\partial\lambda/\partial x_1) f_1 + \frac{4\pi ab^2}{(b^2-a^2)^{3/2}} J_1' \left[\tan^{-1}\left(\frac{b^2-a^2}{a^2+\lambda}\right)^{1/2} - \left(\frac{b^2-a^2}{a^2+\lambda}\right)^{1/2} \right]$$

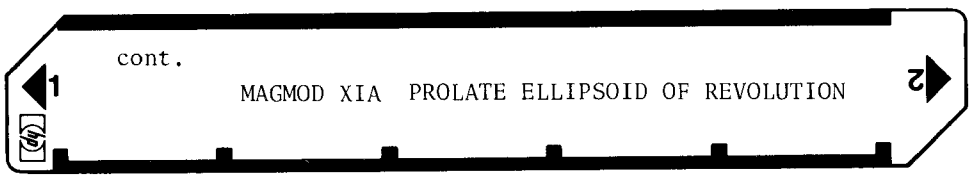
$$\Delta B_2 = (\partial\lambda/\partial x_2) f_1 + J_2' f_2$$

$$\Delta B_3 = (\partial\lambda/\partial x_3) f_1 + J_3' f_2$$

* Anomalous field components with respect to xyz axes as for prolate ellipsoid

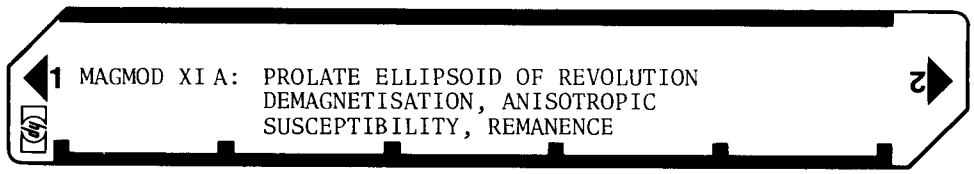
User Instructions

Refer to next page →



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
	Upper limit for Y axis	Bz (MAX)		R/S	BZ MIN = ?
	Lower limit for Y axis	BT (MIN)		R/S	BT MAX = ?
	Upper limit for Y axis	BT (MAX)		R/S	
	Observe the two profiles plotted				
21	Resultant magnetisation calculation			G	J, I, D RES
22	To obtain β_R azimuth of resultant magnetisation		RCL	28	β_R
	Profile recomputation with changed inputs				
	If complete new data			A	F =
	If same geomagnetic data only			B	DEPTH =
	If different remanence			C	J REM =
	If different β			D	BEARING =
	If different profile limits			E	XMIN = ?
	If different plot parameters				BZ MIN = ?

User Instructions



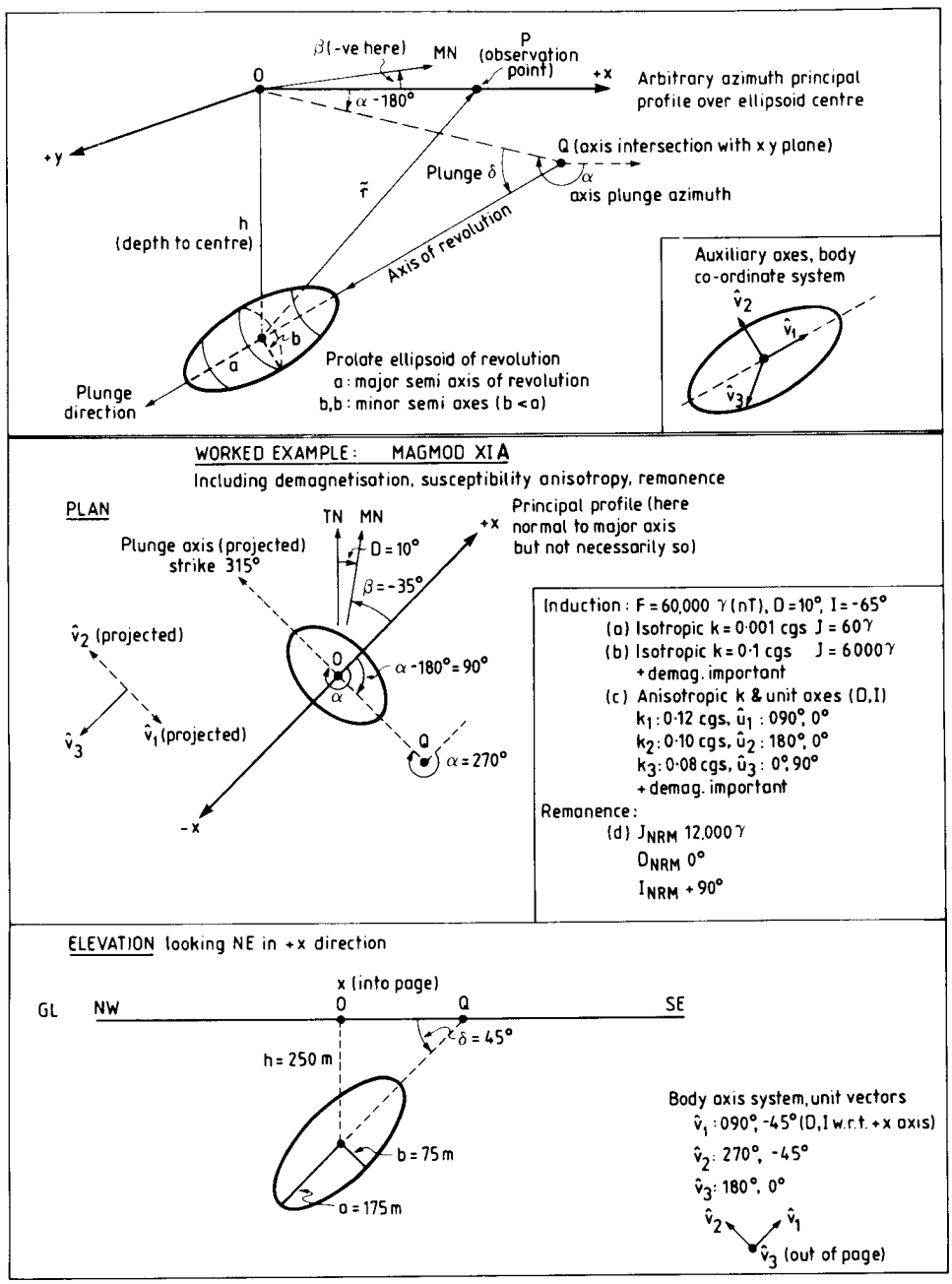
User Mode
Deg Mode
Size 059

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG I IA	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	DEPTH =
5	Depth to ellipsoid centre	h		R/S	PLUNGE =
6	Plunge of major axis	δ		R/S	AZIMUTH =
7	Azimuth of plunge axis	α		R/S	a =
8	Major semi-axis of ellipsoid (axis of revolution)	a		R/S	b =
9	Minor semi-axis of ellipsoid	b		R/S	Ka =
	Observe ellipsoid volume				
10a	Input magnitude of maximum susceptibility	k_a		R/S	D =
10b	Input declination of maximum susceptibility	D_a		R/S	I =
10c	Input inclination of maximum susceptibility	I_a		R/S	Kb =
10d	Input magnitude of intermediate susceptibility	k_b		R/S	D =
10e	Input declination of intermediate susceptibility	D_b		R/S	I =
10f	Input inclination of intermediate susceptibility	I_b		R/S	Kc =
10g	Input magnitude of minimum susceptibility	kc		R/S	D =
10h	Input declination of minimum susceptibility	Dc		R/S	I =
10i	Input inclination of minimum susceptibility	Ic		R/S	REM ? <0,1>
	Notes (i) susceptibility axes must be orthogonal				
	(ii) if isotropic susceptibility, insert				
	$k_a = k_b = k_c$ with orthogonal axes				
	e.g. D, I: 0,90; 0, 0; 90,0				
11a	If remanence absent (go to 15)	0		R/S	BEARING =
11b	If remanence present	1		R/S	JREM =
12	Remanent magnetisation magnitude	J_{REM}		R/S	IREM =
13	Remanent magnetisation inclination	I_{REM}		R/S	DREM =
14	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
15	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
	Observe demagnetisation factors Na				N1 =
	Nb = Nb				N2 =
16	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
17	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
18	Profile x increment	x_{INC}		R/S	
19	Observe printout of: station				X =
	vertical component anomaly				BZ =
	total intensity anomaly				BT =
20	Call plotting subroutine if required			F	BZ MIN = ?
	Lower limit for Y axis	$B_{z(MIN)}$		R/S	BZ MAX = ?

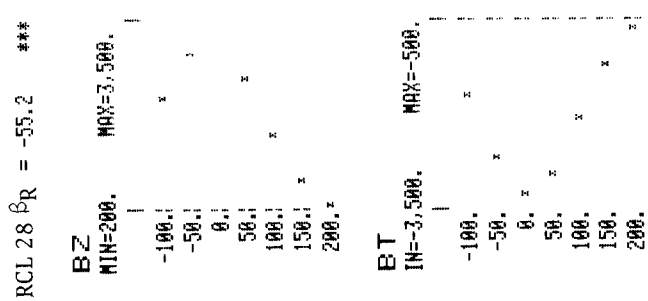
← User instructions continued on previous page

MAGMOD XI A

PROLATE ELLIPSOID OF REVOLUTION



when computing azimuthal traverses with varying β remember that α will change from case to case



Prolate ellipsoid example c + d

```
F=60,000.0
I=-65.0
D=10.0

DEPTH=250.0
PLUNGE=45.0
AZIMUTH=270.0
a=175.0
b=75.0
VOL=4,123,340.4

Ka=0.120000
D=90.0
I=0.0

Kb=0.100000
D=180.0
I=0.0

Kc=0.080000
D=0.0
I=90.0

J REM=12,000.0
I REM=90.0
D REM=0.0

BEARING=-35.0

N1=1.8385
N2=5.3639

X=-100.0
BZ=2,128.8
BT=-1,690.1

X=-50.0
BZ=2,921.4
BT=-2,686.1

X=0.0
BZ=3,117.2
BT=-3,262.6

X=50.0
BZ=2,468.1
BT=-2,943.8

X=100.0
BZ=1,484.0
BT=-2,066.5

X=150.0
BZ=704.3
BT=-1,225.5

X=200.0
BZ=246.7
BT=-652.9

J RES=6,568.5
I RES=69.4
D RES=-10.2
```

User Instructions

MAGMOD XI B : OBLATE ELLIPSOID OF REVOLUTION
DEMAGNETISATION, ANISOTROPIC
SUSCEPTIBILITY, REMANENCE

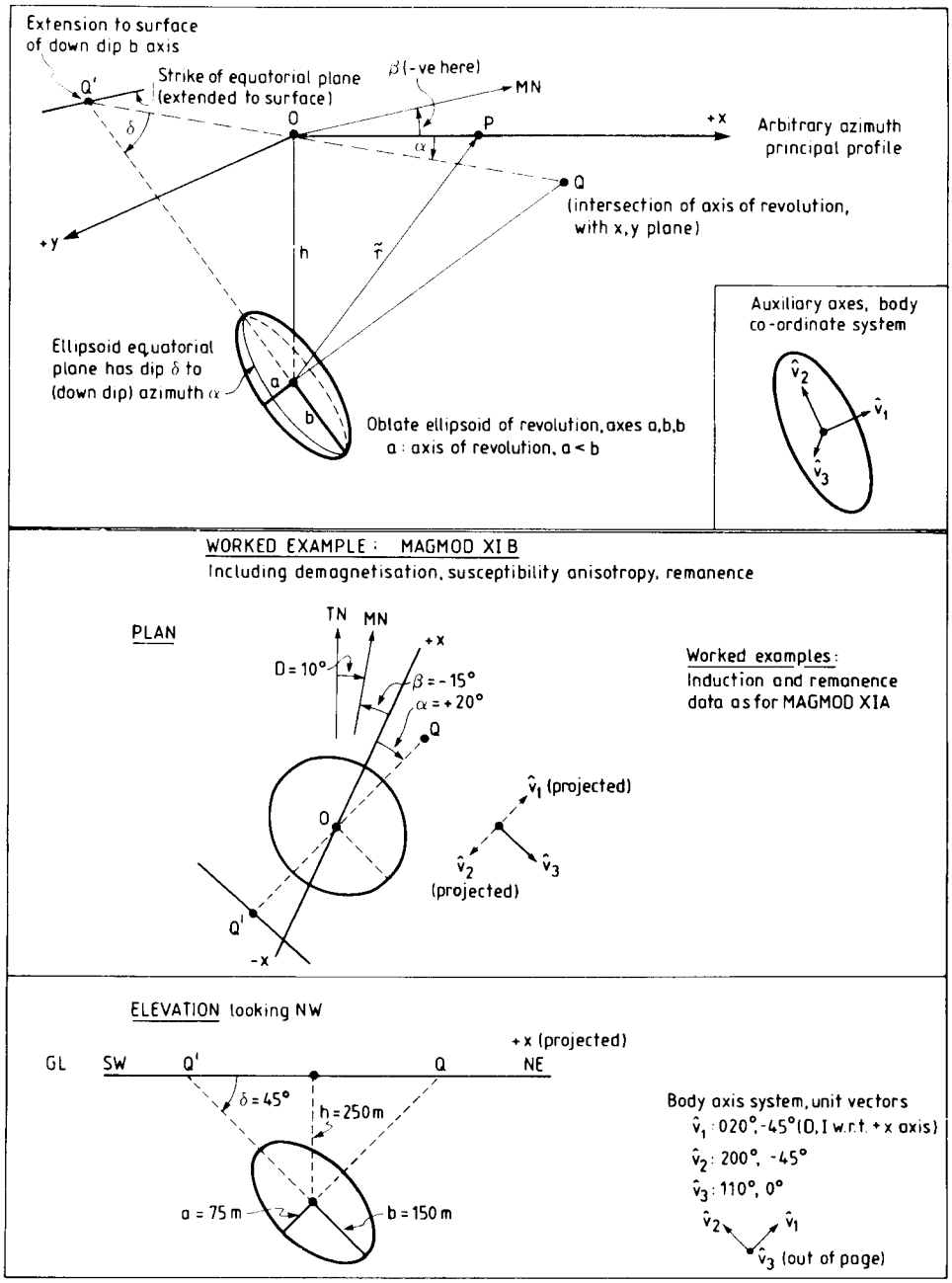
User Mode
Deg Mode
Size 059

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG II B	F =
2	Geomagnetic field magnitude	F	R/S	I =
3	Geomagnetic field inclination	I	R/S	D =
4	Geomagnetic field declination	D	R/S	DEPTH =
5	Depth to ellipsoid centre	h	R/S	PLUNGE =
6	Plunge of major axis	δ	R/S	AZIMUTH =
7	Down dip azimuth of equatorial plane	α	R/S	a =
8	Minor semi-axis of ellipsoid (axis of revolution)	a	R/S	b =
9	Major semi-axis of ellipsoid	b	R/S	Ka =
	Observe ellipsoid volume			VOL =
10a	Input magnitude of maximum susceptibility	k_a	R/S	D =
10b	Input declination of maximum susceptibility	D_a	R/S	I =
10c	Input inclination of maximum susceptibility	I_a	R/S	Kb =
10d	Input magnitude of intermediate susceptibility	k_b	R/S	D =
10e	Input declination of intermediate susceptibility	D_b	R/S	I =
10f	Input inclination of intermediate susceptibility	I_b	R/S	Kc =
10g	Input magnitude of minimum susceptibility	kc	R/S	D =
10h	Input declination of minimum susceptibility	Dc	R/S	I =
10i	Input inclination of minimum susceptibility	Ic	R/S	REM ? <0,1>
	Notes (i) susceptibility axes must be orthogonal			
	(ii) if isotropic susceptibility, insert			
	$k_a = k_b = k_c$ with orthogonal axes			
	e.g. D, I: 0,90; 0, 0: 90,0			
11a	If remanence absent (go to 15)	0	R/S	BEARING =
11b	If remanence present	1	R/S	JREM =
12	Remanent magnetisation mangitude	J_{REM}	R/S	IREM =
13	Remanent magnetisation inclination	I_{REM}	R/S	DREM =
14	Remanent magnetisation declination	D_{REM}	R/S	BEARING =
15	Azimuth of magnetic north w.r.t. + x axis	β	R/S	XMIN = ?
	Observe demagnetisation factors Na			N_1 =
	Nb = Nb			N_2 =
16	Minimum (profile) x value	x_{MIN}	R/S	XMAX = ?
17	Maximum (profile) x value	x_{MAX}	R/S	XINC = ?
18	Profile x increment	x_{INC}	R/S	
19	Observe printout of: station			X =
	vertical component anomaly			BZ =
	total intensity anomaly			BT =
20	Call plotting subroutine if required		F	BZ MIN = ?
	Lower limit for Y axis	$B_{z(MIN)}$	R/S	BZ MAX = ?

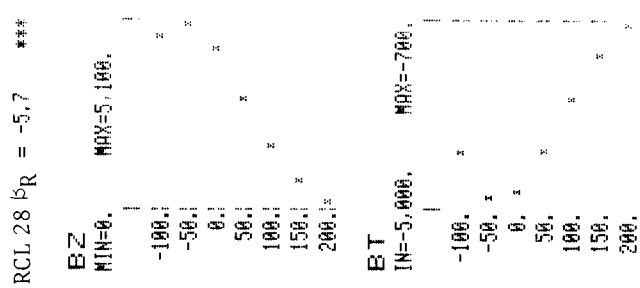
remainder of USER INSTRUCTIONS as for previous model

MAGMOD XI B

OBLATE ELLIPSOID OF REVOLUTION



when computing azimuthal traverses with varying β remember that α will change from case to case



Oblate ellipsoid example c + d

```
F=60,000.0
I=-65.0
D=10.0

DEPTH=250.0
DIP=45.0
AZIMUTH=20.0
a=75.0
b=150.0
VOL=7,068,583.5

Ka=0.120000
D=90.0
I=0.0

Kb=0.100000
D=180.0
I=0.0

Kc=0.080000
D=0.0
I=90.0

J REM=12,000.0
I REM=90.0
D REM=0.0

BEARING=-15.0

N1=6.6250
N2=2.9707

X=-100.0
BZ=4,642.5
BT=-3,705.8

X=-50.0
BZ=5,077.4
BT=-4,708.3

X=0.0
BZ=4,337.6
BT=-4,596.4

X=50.0
BZ=2,994.0
BT=-3,646.8

X=100.0
BZ=1,705.4
BT=-2,475.3

X=150.0
BZ=769.6
BT=-1,477.9

X=200.0
BZ=202.3
BT=-776.2

J RES=6,245.0
I RES=67.2
D RES=19.3
```

2D ELLIPTIC CYLINDER NOTATION

(Refer to diagrams and formulae, and to variables defined for previous MAGMODS.)

Q: intersection of major axis of elliptical cross-section with the principal profile.

b, c: semi-axes of elliptical cross-section of infinite horizontal elliptic cylinder; b = major semi-axis, c = minor semi-axis (b > c).

$\hat{v}_1$, $\hat{v}_2$, $\hat{v}_3$: unit vectors defining body axis co-ordinate system; $\hat{v}_1$ is along strike, parallel to + y axis; $\hat{v}_2$ lies along major axis of elliptical cross-section and is directed upwards; $\hat{v}_3$ lies along minor axis; $\hat{v}_3 = \hat{v}_1 \times \hat{v}_2$.

ℓ_i, n_i, n_i: direction cosines of $\hat{v}_i$ ($i = 1, 2, 3$) with respect to xyz axes.

δ: dip of the principal section containing the major axis (measured from -x axis).

x_2, x_3: co-ordinates of observation point P with respect to body axes $\hat{v}_2$, $\hat{v}_3$.

$\tilde{r}$: directed distance from centre of elliptical cross-section to observation point P: $|\tilde{r}|^2 = r^2 = x^2 + h^2 = x_2^2 + x_3^2$

λ: an ellipsoidal co-ordinate, the larger root of the equation

$$x_2^2/(b^2 + \lambda) + x_3^2/(c^2 + \lambda) = 1 \ .$$

Δ: positive square root of the discriminant of the above quadratic equation for λ.

ℓ_N, m_N, n_N: direction cosines of NRM vector, $\tilde{J}_N$, with respect to xyz axes.

k_1, k_2, k_3: principal susceptibilities ($k_1 > k_2 > k_3$).

$\hat{u}_1$, $\hat{u}_2$, $\hat{u}_3$: unit vectors parallel to major, intermediate and minor susceptibility axes respectively. Susceptibility measured along $\hat{u}_i$ is k_i ($i = 1, 2, 3$). If susceptibility is isotropic $k_i = k$ and $\hat{u}_i = \hat{v}_i$, for all i.

k_{ij}: components of susceptibility tensor with respect to body axes.

α_i: azimuth of $\hat{u}_i$, measured positive clockwise from the + x axis.

δ_i: plunge of $\hat{u}_i$.

L_i, M_i, N_i: direction cosines of $\hat{u}_i$ with respect to xyz axes

$$L_i = \cos \alpha_i \cos \delta_i, \quad M_i = \sin \alpha_i \cos \delta_i, \quad N_i = \sin \delta_i \ .$$

N_2' : demagnetising factor along major axis.

N_3' : demagnetising factor along minor axis.

FORMULAE - 2D ELLIPTIC CYLINDER

Body axes

$$\hat{v}_1 = (\ell_1, m_1, n_1) = (0, 1, 0)$$

$$\hat{v}_2 = (\ell_2, m_2, n_2) = (\cos\delta, 0, -\sin\delta)$$

$$\hat{v}_3 = (\ell_3, m_3, n_3) = (-\sin\delta, 0, -\cos\delta)$$

Co-ordinates with respect to body axes

$$x_2 = x\cos\delta + h\sin\delta$$

$$x_3 = h\cos\delta - x\sin\delta$$

Ellipsoidal co-ordinate λ and its spatial derivatives

$$\Delta = [r^4 + (b^2 - c^2)^2 - 2(b^2 - c^2)(x_2^2 - x_3^2)]^{1/2}$$

$$\lambda = (1/2)(r^2 - b^2 - c^2 + \Delta)$$

$$\partial\lambda/\partial x_2 = x_2[1 + (r^2 - b^2 + c^2)/\Delta]$$

$$\partial\lambda/\partial x_3 = x_3[1 + (r^2 + b^2 - c^2)/\Delta]$$

Demagnetising factors

$$N_2' = 4\pi c/(b + c)$$

$$N_3' = 4\pi b/(b + c)$$

Susceptibility tensor

$$k_{ij} = \sum_r k_r (L_r\ell_i + M_r m_i + N_r n_i)(L_r\ell_j + M_r m_j + N_r n_j) \qquad (r = 1, 2, 3)$$

$$\text{Matrix } K = [k_{ij}]$$

Field and NRM components with respect to body axes

$$\text{Column vectors } \tilde{F} = \begin{bmatrix} F_1 \\ F_2 \\ F_3 \end{bmatrix} \qquad \tilde{J}_N = \begin{bmatrix} (J_N)_1 \\ (J_N)_2 \\ (J_N)_3 \end{bmatrix}$$

$$F_i = F(\ell\ell_i + mm_i + nn_i)$$

$$(J_N)_i = J_N(\ell_N\ell_i + m_Nm_i + n_Nn_i)$$

Resultant magnetisation with respect to body axes

$\tilde{J}_R = K\tilde{F} + \tilde{J}_N$ (uncorrected for demagnetisation)

$$A = I + KN = \begin{bmatrix} 1 & k_{12}N'_2 & k_{13}N'_3 \\ 0 & k_{22}N'_2 & k_{23}N'_3 \\ 0 & k_{23}N'_2 & k_{33}N'_3 \end{bmatrix}$$

$\tilde{J}'_R = A^{-1}\tilde{J}_R$ (demagnetisation-corrected)

(All vectors are column vectors; A, I, K, N are 3 x 3 matrices; I is the identity matrix; N is the matrix of the demagnetising tensor, which is diagonal with respect to body axes.)

Anomalous field components with respect to body axes

$$f_1 = \frac{2\pi bc}{[(b^2 + \lambda)(c^2 + \lambda)]^{1/2}} \left(\frac{J'_2 x_2}{b^2 + \lambda} + \frac{J'_3 x_3}{c^2 + \lambda}\right)$$

$$\Delta B_2 = f_1 \partial\lambda/\partial x_2 - \frac{4\pi bc}{b^2 - c^2} J'_2 \left[1 - \left(\frac{c^2 + \lambda}{b^2 + \lambda}\right)^{1/2}\right]$$

$$\Delta B_3 = f_1 \partial\lambda/\partial x_3 - \frac{4\pi bc}{b^2 - c^2} J'_3 \left[\left(\frac{b^2 + \lambda}{c^2 + \lambda}\right)^{1/2} - 1\right]$$

Anomalous field components with respect to xyz axes

$$\Delta B_x = \Delta B_2 \cos\delta - \Delta B_3 \sin\delta$$

$$\Delta B_z = -\Delta B_2 \sin\delta - \Delta B_3 \cos\delta$$

$$\Delta B_H = \Delta B_x \cos\beta$$

$$\Delta B_T = \Delta B_H \cos I + \Delta B_z \sin I$$

User Instructions

MAGMOD XII : 2D ELLIPTIC CYLINDER (horizontal)
DEMAGNETIZATION, ANISOTROPIC
SUSCEPTIBILITY, REMANENCE

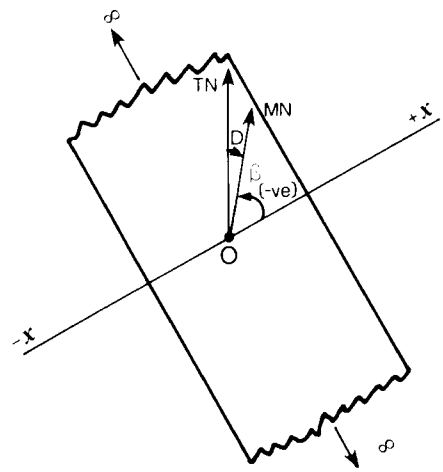
User Mode
Deg Mode
Size 052

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load cards, run program		XEQ MAG 12	F =
2	Geomagnetic field magnitude	F	R/S	I =
3	Geomagnetic field inclination	I	R/S	D =
4	Geomagnetic field declination	D	R/S	DEPTH =
5	Depth to elliptic cylinder centre	h	R/S	DIP =
6	Plunge of major b axis (dip positive anticlock-	δ	R/S	b =
	wise from -x)			
7	Major semi-axis of ellipsoid	b	R/S	c =
8	Minor semi-axis of ellipsoid	c	R/S	Ka =
9a	Input magnitude of maximum susceptibility	k_a	R/S	D =
9b	Input declination of maximum susceptibility	D_a	R/S	I =
9c	Input inclination of maximum susceptibility	I_a	R/S	Kb =
9d	Input magnitude of intermediate susceptibility	k_b	R/S	D =
9e	Input declination of intermediate susceptibility	D_b	R/S	I =
9f	Input inclination of intermediate susceptibility	I_b	R/S	Kc =
9g	Input magnitude of minimum susceptibility	kc	R/S	D =
9h	Input declination of minimum susceptibility	Dc	R/S	I =
9i	Input inclination of minimum susceptibility	Ic	R/S	REM ? <0,1>
	Notes (i) susceptibility axes must be orthogonal			
	(ii) if isotropic susceptibility, insert			
	$k_a = k_b = k_c$ with orthogonal axes			
	e.g. D, I : 0,90; 0, 0 ; 90,0			
10a	If remanence absent (go to 14)	0	R/S	BEARING =
10b	If remanence present	1	R/S	JREM =
11	Remanent magnetisation magnitude	J_{REM}	R/S	IREM =
12	Remanent magnetisation inclination	I_{REM}	R/S	DREM =
13	Remanent magnetisation declination	D_{REM}	R/S	BEARING =
14	Azimuth of magnetic north w.r.t. + x axis	β	R/S	XMIN =
	Observe demagnetisation factors N_2'			N2 =
	N_3'			N3 =
16	Minimum (profile) x value	x_{MIN}	R/S	XMAX = ?
17	Maximum (profile) x value	x_{MAX}	R/S	XINC = ?
18	Profile x increment	x_{INC}	R/S	
19	Observe printout of: station			X =
	vertical component anomaly			BZ =
	total intensity anomaly			BT =
20	Call plotting subroutine if required		F	BZMIN = ?
	Lower limit for Y axis	$B_{Z(MIN)}$	R/S	BZMAX = ?

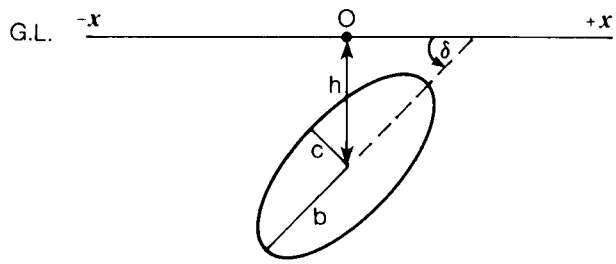
remainder of USER INSTRUCTIONS as for previous model

MAGMOD XII : ELLIPTIC CYLINDER,horizontal,2D,
including demagnetisation,susceptibility anisotropy and remanence

PLAN



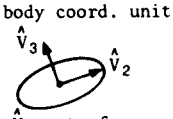
ELEVATION (looking along strike)



Worked Example:

D = 10°
β = -35°
+x : to NE
-x : to SW
semi axis b = 170 m (major)
semi axis c = 75 m (minor)
δ = 45°
h = 200 m

body coord. unit axes D, I



$\hat{V}_1$: 135°, 0°
$\hat{V}_2$: 045°, -45°
$\hat{V}_3$: 225°, -45°

Induction: F = 60,000 γ(nT), D = 10°, I = -65°

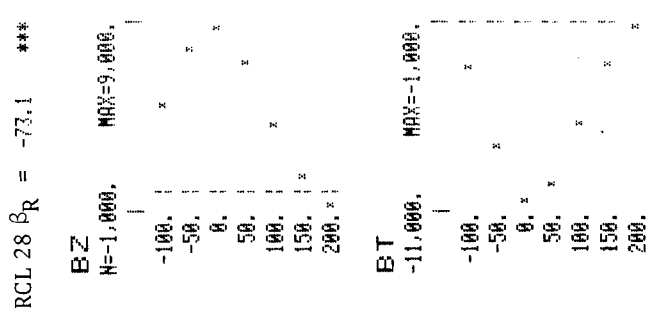
(a) isotropic k = 0.001 cgs J = 60γ

(b) isotropic k = 0.1 cgs J = 6,000γ
+ demag. important

(c) anisotropic k & unit axes (D, I)
k_1 : 0·12 cgs, $\hat{u}_1$: 090°, 0°
k_2 : 0·10 cgs, $\hat{u}_2$: 180°, 0°
k_3 : 0·08 cgs, $\hat{u}_3$: 0°, 90°
+ demag. important

Remanence (d) J_{NRM} 12,000 γ
D_{NRM} 0°
I_{NRM} +90°

note: principal profile only, normal to strike



Elliptic cylinder example c + d

```
F=60,000.0
I=-65.0
D=10.0

DEPTH=200.0
DIP=45.0
b=170.0
c=75.0

Ka=0.120000
D=90.0
I=0.0

Kb=0.100000
D=180.0
I=0.0

Kc=0.080000
D=0.0
I=90.0

J REM=12,000.0
I REM=90.0
D REM=0.0

BEARING=-35.0

N2=3.8
N3=8.7

X=-100.0
BZ=4,598.0
BT=-3,364.6

X=-50.0
BZ=7,547.6
BT=-7,584.1

X=0.0
BZ=8,714.4
BT=-10,403.2

X=50.0
BZ=6,874.4
BT=-9,598.4

X=100.0
BZ=3,569.6
BT=-6,383.2

X=150.0
BZ=859.0
BT=-3,241.7

X=200.0
BZ=-673.3
BT=-1,179.5

J RES=5,282.5
I RES=72.2
D RES=-28.1
```

MAGMOD XIII - VERTICAL RECTANGULAR PRISM

(Principal profile parallel to one pair of sides.)

General formula (bottomless prism)

$$\Delta B_i = J[f(X - x, Y) + f(-X - x, -Y)]$$

where $f(a, b) = (Ln' + N\ell') \log_e \left(\frac{r - b}{r + b}\right) - 2L\ell' \tan^{-1} \left(\frac{ab}{a^2 + rh + h^2}\right)$

$$-2Mm' \tan^{-1} \left(\frac{ab}{b^2 + rh + h^2}\right) + 2Nn' \tan^{-1} (ab/rh)$$

$$r = [a^2 + b^2 + h^2]^{1/2}$$

* For a prism with finite depth extent, from h_1 to h_2, the anomaly is calculated by subtraction

  i.e. $\Delta B_i(h_1, h_2) = \Delta B_i(h_1, \infty) - \Delta B_i(h_2, \infty)$

* If the magnetisation is vertical MAGMOD XIII is equivalent to MAGMOD III.

* MAGMOD XIII may be useful for modelling vertical plugs and vertical dykes of limited strike length (particularly when the magnetisation is not sub-vertical so that MAGMODS I - III are not applicable) as well as large crustal blocks.

DEMAGNETISATION CORRECTION FOR VERTICAL PRISM

Approximate demagnetising factors

$$N_x = \frac{4\pi Y(h_2 - h_1)}{(X + Y)(h_2 - h_1) + 2XY} \rightarrow \frac{4\pi Y}{X + Y} \quad \text{for bottomless prism.}$$

$$N_y = \frac{4\pi X(h_2 - h_1)}{(X + Y)(h_2 - h_1) + 2XY} \rightarrow \frac{4\pi X}{X + Y} \quad \text{for bottomless prism.}$$

$$N_z = \frac{8\pi XY}{(X + Y)(h_2 - h_1) + 2XY} \rightarrow 0 \quad \text{for bottomless prism.}$$

Susceptibility tensor elements in xyz system

Susceptibility axes:

$\hat{u}_i = (\ell_i, m_i, n_i) = (\cos \beta_i \cos I_i, \sin \beta_i \cos I_i, \sin I_i)$

$k_{xx} = k_1 \ell_1^2 + k_2 \ell_2^2 + k_3 \ell_3^2$

$k_{xy} = k_1 \ell_1 m_1 + k_2 \ell_2 m_2 + k_3 \ell_3 m_3$

$k_{xz} = k_1 \ell_1 n_1 + k_2 \ell_2 n_2 + k_3 \ell_3 n_3$

$k_{xy} = k_1 m_1^2 + k_2 m_2^2 + k_3 m_3^2$

$k_{yz} = k_1 m_1 n_1 + k_2 m_2 n_2 + k_3 m_3 n_3$

$k_{zz} = k_1 n_1^2 + k_2 n_2^2 + k_3 n_3^2$

Matrix $K = [k_{ij}]$ $(i, j = x, y, z)$

Field and magnetisation components with respect to xyz axes

$F_x = F \cos \beta \cos I$, $F_y = F \sin \beta \cos I$, $F_z = F \sin I$

$(J_N)_x = J_N \cos \beta_N \cos I_N$, $(J_N)_y = J_N \sin \beta_N \cos I_N$, $(J_N)_z = J_N \sin I_N$

Resultant magnetisation, corrected for demagnetisation

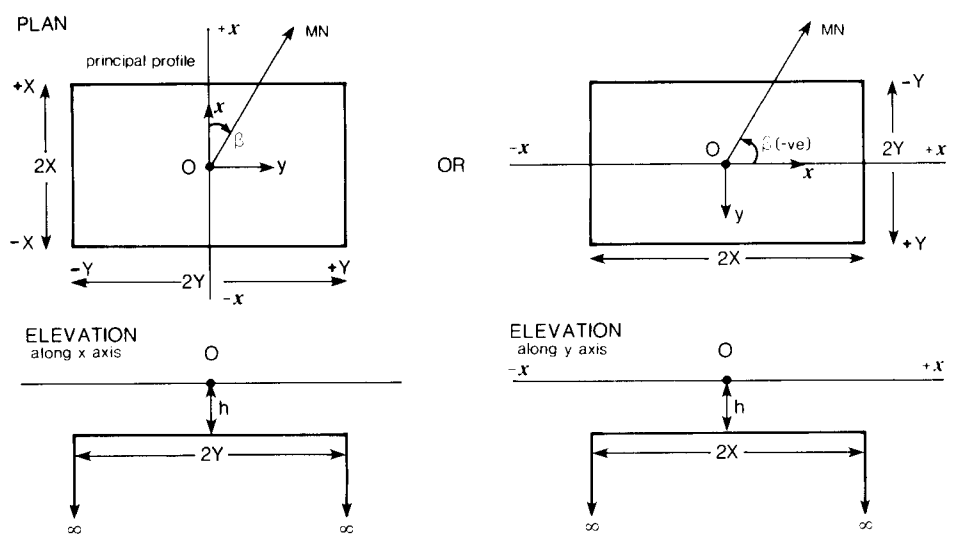
$$A = I + KN = \begin{bmatrix} 1 + k_{xx}N_x & k_{xy}N_y & k_{xz}N_z \\ k_{xy}N_x & 1 + k_{yy}N_y & k_{yz}N_z \\ k_{xz}N_x & k_{yz}N_y & 1 + k_{zz}N_z \end{bmatrix}$$

$$\begin{bmatrix} J'_x \\ J'_y \\ J'_z \end{bmatrix} = A^{-1}\left\{K \begin{bmatrix} F_x \\ F_y \\ F_z \end{bmatrix} + \begin{bmatrix} (J_N)_x \\ (J_N)_y \\ (J_N)_z \end{bmatrix}\right\}$$

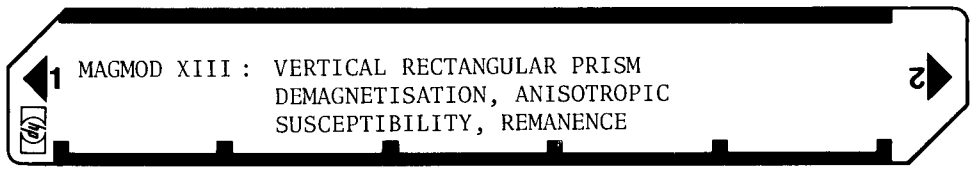
$$J' = [(J'_x)^2 + (J'_y)^2 + (J'_z)^2]^{1/2}$$

$$L' = J'_x/J', \quad M' = J'_y/J', \quad N' = J'_z/J'$$

MAGMOD XIII : VERTICAL RECTANGULAR PRISM infinite depth extent
principal profile over centre and parallel to one pair of sides
finite depth extent by subtraction



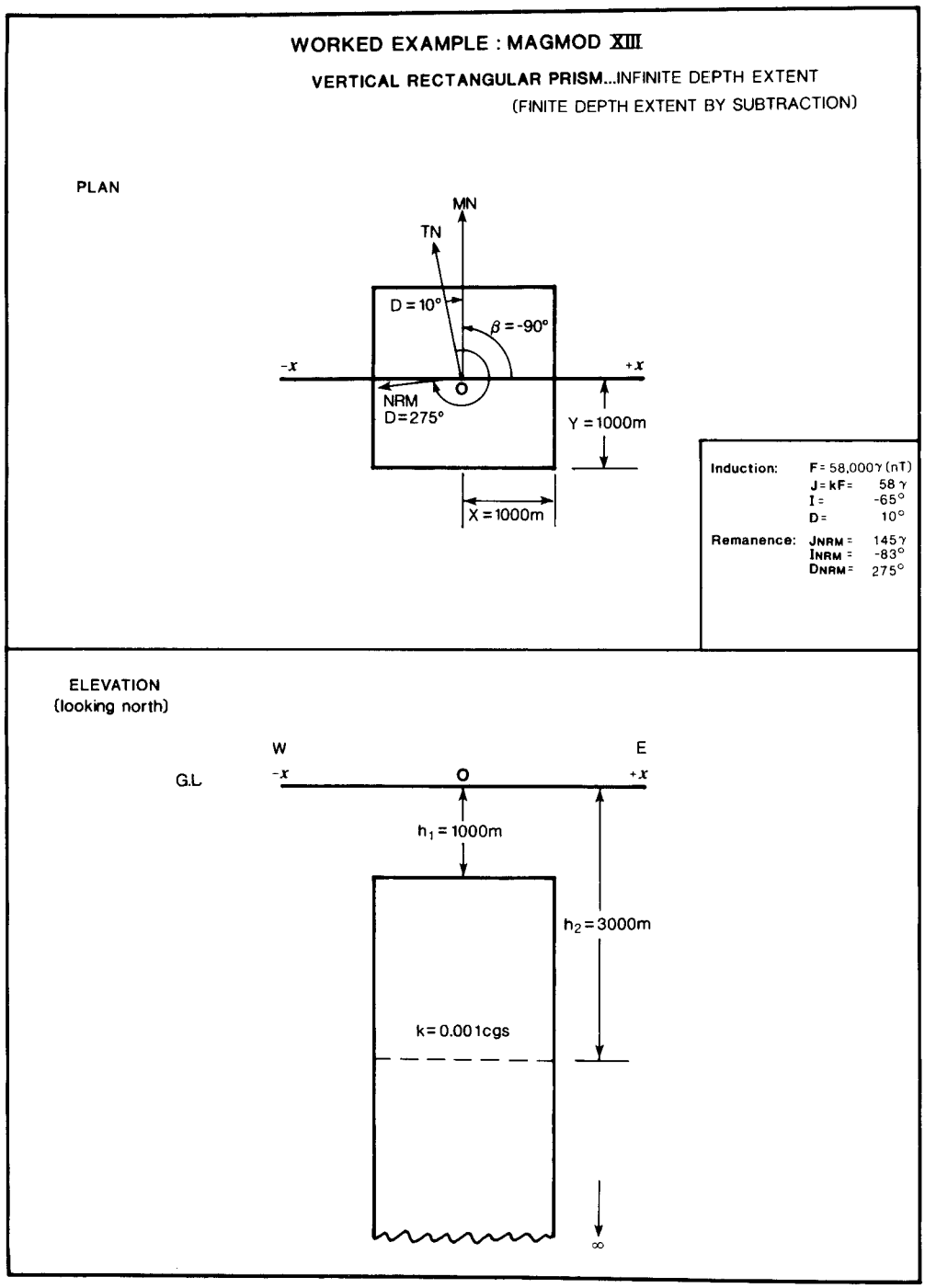
User Instructions



User Mode
Deg Mode
Size 056

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG 13	F =
2	Geomagnetic field magnitude	F		R/S	I =
3	Geomagnetic field inclination	I		R/S	D =
4	Geomagnetic field declination	D		R/S	INF ? <0,1>
5a	If finite depth extent prism	0 (zero)		R/S	H1 =
5b	If infinite depth extent prism	1		R/S	H1 =
6	Depth to prism top				
	(a) finite depth extent	h_1		R/S	H2 =
	(after 6(b) go to 8) (b) infinite depth extent	h_1		R/S	½ WIDTH =
7	Depth to prism bottom	h_2		R/S	½ WIDTH =
8	Half width of prism (side parallel to +x to -x traverse) X			R/S	½ LENGTH =
9	Half length of prism (side normal to traverse)	Y		R/S	K_a =
10a	Input magnitude of maximum susceptibility	k_a		R/S	D =
10b	Input declination of maximum susceptibility	D_a		R/S	I =
10c	Input inclination of maximum suscptibility	I_a		R/S	Kb =
10d	Input magnitude of intermediate susceptibility	k_b		R/S	D =
10e	Input declination of intermediate susceptibility	D_b		R/S	I =
10f	Input inclination of intermediate susceptibility	I_b		R/S	Kc =
10g	Input magnitude of minimum susceptibility	kc		R/S	D =
10h	Input declination of minimum susceptibility	Dc		R/S	I =
10i	Input inclination of minimum susceptibility	Ic		R/S	REM ? <0,1>
	Notes (i) susceptibility axes must be orthogonal				
	(ii) if isotropic susceptibility, insert				
	$k_a = k_b = k_c$ with orthogonal axes				
	e.g. D, I : 0,90; 0, 0; 90,0				
11a	If remanence absent (go to 15)	0		R/S	BEARING =
11b	If remanence present	1		R/S	JREM =
12	Remanent magnetisation magnitude	J_{REM}		R/S	IREM =
13	Remanent magnetisation inclination	I_{REM}		R/S	DREM =
14	Remanent magnetisation declination	D_{REM}		R/S	BEARING =
15	Azimuth of magnetic north w.r.t. + x axis	β		R/S	XMIN = ?
	Observe demagnetisation factors Nz				NZ =
	Ny				NY =
	Nx				NX =
16	Minimum (profile) x value	x_{MIN}		R/S	XMAX = ?
17	Maximum (profile) x value	x_{MAX}		R/S	XINC = ?
18	Profile x increment	x_{INC}		R/S	
19	Observe printout of: station				X =
	vertical component anomaly				BZ =

remainder of USER INSTRUCTIONS as for previous model



F=58,000.0
I=-65.0
D=10.0

H1=1.0
H2=3.0
1/2 WIDTH=1.0
1/2 LENGTH=1.0

Ka=0.001000
D=0.0
I=90.0

Kb=0.001000
D=0.0
I=0.0

Kc=0.001000
D=90.0
I=0.0

J REM=145.0
I REM=-83.0
D REM=275.0

BEARING=-90.0

NZ=4.1888
NY=4.1888
NX=4.1888

X=-2.0
BZ=-43.3
BT=35.9

X=-1.0
BZ=-212.8
BT=186.5

X=0.0
BZ=-331.4
BT=292.2

X=1.0
BZ=-185.1
BT=161.4

X=2.0
BZ=-24.3
BT=18.7

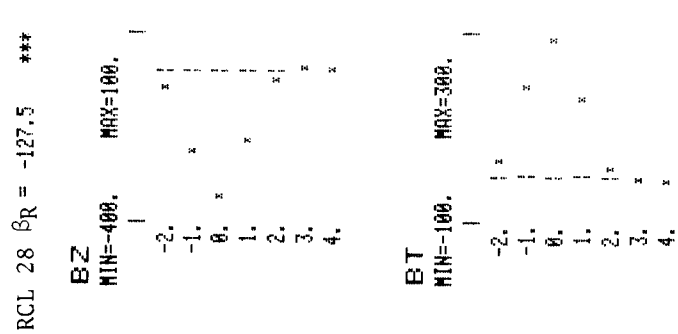
X=3.0
BZ=7.3
BT=-8.3

X=4.0
BZ=9.0
BT=-9.0

J RES=197.8
I RES=-81.6
D RES=-27.5

Use of
MAGMOD XIII
(cf. MAGMOD III
1000 m = 1 km
J_{RES} = 198.6
if no demag.)

note: principal profiles
only, parallel to sides



MAGMODS: HP 41 C REGISTER CONTENTS

	I	II	III	IV	V	VI/VII	VIII	IX
Plot minimum	R00	✓	✓	✓	✓	✓	✓	✓
Plot maximum	R01	✓	✓	✓	✓	✓	✓	✓
Plot width	R02	✓	✓	✓	✓	✓	✓	✓
F	R03	✓	✓	✓	✓	✓	✓	✓
I	R04	✓	✓	✓	✓	✓	✓	✓
D	R05	✓	✓	✓	✓	✓	✓	✓
J_{IND}	R06	✓	✓	✓	✓	✓	✓	✓
I_{REM}	R07	✓	✓	✓	✓	✓	✓	✓
D_{REM}	R08	✓	✓	✓	✓	✓	✓	✓
J_{REM}	R09	✓	✓	✓	✓	✓	✓	✓
I_{RES}	R10	✓	✓	✓	✓	✓	✓	✓
D_{RES}	R11	✓	✓	✓	✓	✓	✓	✓
J_{RES}	R12	✓	✓	✓	✓	✓	✓	✓
Finite/infinite flag	R13	✓	✓			R16	R13	
Depth to top	R14	✓	✓			R17	R14	R13
Depth to bottom	R15	✓	✓			R18	R15	R14
Depth to centre				R13				
Depth to axis					R13			
Radius	R16			R14	✓			
Area cross section					R15			
Volume				R15				
Thickness		R16				R20	R16 (horiz.)	
Half Thickness							R17 "	
Half width			R16					
Half length			R17					
Dip angle						R13	R18	R15
Cosine dip						R14	R19	R16
Sine dip						R15	R20	R17
Dip length						R19		
b cot d								R18
susceptibility	R17	✓	R18	R16	✓	R21	✓	R19
pole strength or moment	R18	✓	R19		R17			
β	R19	✓	R20	R17	R18	R22	✓	R20
β_R				R18	R19	R23	✓	R21
N				R19				
L				R20				
α_{11}				R21				
α_{33}				R22				
α_{13}				R23				
-2L					R20	R24	✓	R22
-N					R21	R25	✓	R23
Lℓ-Nn					R22	R26	✓	R24
-2(Ln+Nℓ)					R23	R27	✓	R25
x min.	R20	✓	R21	R25	R24	R28	✓	R26
x	R21	✓	R22	R26	R25	R29	✓	R27
x max.	R22	✓	R23	R27	R26	R30	✓	R28
x incr.	R23	✓	R24	R28	R27	R31	✓	R29
Inter. result	R24-30	✓	R25-39	R24, 29 -35	R28-34	R32-41	R32-43	R30-38

REGISTER CONTENTS

MAGMOD X

R00= PLOT MINIMUM
R01= PLOT MAXIMUM
R02= PLOT WIDTH
R03= F
R04= I
R05= D
R06= J IND
R07= I REM
R08= D REM
R09= J REM
R10= I RES
R11= D RES
R12= J RES
R13= NUMBER OF SIDES
R14= SUSCEPTIBILITY
R15= PROFILE BEARING
R16= BEARING WRT RES MAG
R17= -2L
R18= -N
R19= L1-Nn
R20= -2(Ln+N1)
R21= X MIN
R22= X
R23= X MAX
R24= X INC
R25-R37= INT RESULTS
R38 UP= VERTEX COORDINATES

MAGMOD VIII A
REGISTER
CONTENTS
SAME AS VIII

REGISTER CONTENTS

VECT

R00= F
R01= I
R02= D
R03= BULK SUSCEPTIBILITY
R04= Fx
R05= Fy
R06= Fz
R07= J REM
R08= I REM
R09= D REM
R10= INT RESULT
R11= Ka
R12= Da
R13= Ia
R14= Kb
R15= Db
R16= Ib
R17= Kc
R18= Dc
R19= Ic
R20= Jx
R21= Jy
R22= Jz
R23-R31= INT RESULTS
R32= D RES
R33= J RES
R34= I RES
R35= PROFILE BEARING
R36= BEARING WRT RES MAG

DEMAGNETISATION
CORRECTION

R37= DIP ANGLE OF SHEET
R38= COSINE OF DIP ANGLE
R39= SINE OF DIP ANGLE
R40= DIP LENGTH OF SHEET
R41= SHEET THICKNESS
R42= FINITE/INF. FLAG
R43-R48= INT RESULTS

REGISTER CONTENTS

MAGMOD VIIIB

R00= PLOT MINIMUM
R01= PLOT MAXIMUM
R02= PLOT WIDTH
R03= F
R04= I
R05= D
R06= J IND
R07= I REM
R08= D REM
R09= J REM
R10= I RES
R11= D RES
R12= J RES
R13= FINITE/INF. FLAG
R14= DEPTH OF TOP
R15= DEPTH OF BOTTOM
R16= SHEET THICKNESS
R17= HALF THICKNESS
R18= DIP ANGLE OF SHEET
R19= COSINE OF DIP ANGLE
R20= SINE OF DIP ANGLE
R21= Ka
R22= Da
R23= Ia
R24= Kb
R25= Db
R26= Ib
R27= Kc
R28= Dc
R29= Ic
R30= PROFILE BEARING
R31= BEARING WRT RES MAG
R32= -2L
R33= -N
R34= L1-Nn
R35= -2(Ln+N1)
R36= X MIN
R37= X
R38= X MAX
R39= X INC
R40-R58= INT RESULTS

REGISTER CONTENTS

MAGMOD XIA

R00= PLOT MINIMUM
R01= PLOT MAXIMUM
R02= PLOT WIDTH
R03= F
R04= I
R05= D
R06= EMPTY
R07= I REM
R08= D REM
R09= J REM
R10= I RES
R11= D RES
R12= J RES
R13= DEPTH TO CENTRE
R14= PLUNGE ANGLE
R15= PLUNGE AZIMUTH
R16= MAJOR SEMI-AXIS
R17= MINOR SEMI-AXIS
R18= Ka
R19= Da
R20= Ia
R21= Kb
R22= Db
R23= Ib
R24= Kc
R25= Dc
R26= Ic
R27= PROFILE BEARING
R28= BEARING WRT RES MAG
R29= a↑2-b↑2
R30-R37= DIRN. COSINES OF BODY AXES
R38= H↑2
R39= X MIN
R40= X
R41= X MAX
R42= X INC
R43-R57= INT RESULTS

REGISTER CONTENTS

MAGMOD XIB

R00= PLOT MINIMUM
R01= PLOT MAXIMUM
R02= PLOT WIDTH
R03= F
R04= I
R05= D
R06= EMPTY
R07= I REM
R08= D REM
R09= J REM
R10= I RES
R11= D RES
R12= J RES
R13= DEPTH TO CENTRE
R14= DIP ANGLE
R15= DIP AZIMUTH
R16= MINOR SEMI-AXIS
R17= MAJOR SEMI-AXIS
R18= Ka
R19= Da
R20= Ia
R21= Kb
R22= Db
R23= Ib
R24= Kc
R25= Dc
R26= Ic
R27= PROFILE BEARING
R28= BEARING WRT RES MAG
R29= b↑2-a↑2
R30-R37= DIRN. COSINES OF AXES
R38= H↑2
R39= X MIN
R40= X
R41= X MAX
R42= X INC
R43-R57= INT RESULTS

REGISTER CONTENTS

MAGMOD XII

R00= PLOT MINIMUM
R01= PLOT MAXIMUM
R02= PLOT WIDTH
R03= F
R04= I
R05= D
R06= EMPTY
R07= I REM
R08= D REM
R09= J REM
R10= I RES
R11= D RES
R12= J RES
R13= DEPTH TO AXIS
R14= DIP ANGLE
R15= MAJOR SEMI-AXIS
R16= MINOR SEMI-AXIS
R17= b↑2-c↑2
R18= Ka
R19= Da
R20= Ia
R21= Kb
R22= Db
R23= Ib
R24= Kc
R25= Dc
R26= Ic
R27= PROFILE BEARING
R28= BEARING WRT RES MAG
R29= COSINE OF DIP ANGLE
R30= SINE OF DIP ANGLE
R31= H↑2
R32= X MIN
R33= X
R34= X MAX
R35= X INC
R36-R47= INT RESULTS

REGISTER CONTENTS

MAGMOD XIII

R00= PLOT MINIMUM
R01= PLOT MAXIMUM
R02= PLOT WIDTH
R03= F
R04= I
R05= D
R06= EMPTY
R07= I REM
R08= D REM
R09= J REM
R10= I RES
R11= D RES
R12= J RES
R13= FINITE/INF. FLAG
R14= DEPTH OF TOP
R15= DEPTH OF BOTTOM
R16= HALF WIDTH
R17= HALF LENGTH
R18= Ka
R19= Da
R20= Ia
R21= Kb
R22= Db
R23= Ib
R24= Kc
R25= Dc
R26= Ic
R27= PROFILE BEARING
R28= BEARING WRT RES MAG
R29= L
R30= M
R31= 2N
R32= X MIN
R33= X
R34= X MAX
R35= X INC
R36= Ln+N1
R37= 2L1
R38= 2Mm
R39= 2Nn
R40-R51= INT RESULTS

MAGMODS
HP 41 C
PROGRAMS

HP 41 C
Vector
Operations
Program VALG

```
01♦LBL "VALG"
02♦LBL A
03 SF 21
04 "X="
05 PROMPT
06 ARCL X
07 FS? 55
08 PRA
09 "Y="
10 PROMPT
11 ARCL X
12 FS? 55
13 PRA
14 "Z="
15 PROMPT
16 ARCL X
17 FS? 55
18 PRA
19 ADV
20 X<> Z
21 XEQ 01
22 STOP
23 GTO A
24♦LBL B
25 SF 21
26 XEQ 02
27 "X="
28 ARCL X
29 AVIEW
30 "Y="
31 ARCL Y
32 AVIEW
33 "Z="
34 ARCL T
35 AVIEW
36 ADV
37 STOP
38 GTO B
39♦LBL C
40 SF 27
41 SF 21
42 0
43 STO 00
44 STO 01
45 STO 02
46 STO 03
47♦LBL 04
```

```
48 1
49 ST+ 00
50 XEQ 02
51 ST+ 01
52 X<>Y
53 ST+ 02
54 R↑
55 ST+ 03
56 GTO 04
57♦LBL D
58 1
59 ST- 00
60 SF 12
61 "RESULTANT"
62 AVIEW
63 CF 12
64 RCL 03
65 RCL 02
66 RCL 01
67 XEQ 01
68 RCL Z
69 RCL 00
70 /
71 "N="
72 ARCL 00
73 AVIEW
74 "M="
75 ARCL X
76 AVIEW
77 ADV
78 STOP
79 GTO C
80♦LBL 01
81 R-P
82 X<>Y
83 RDN
84 R-P
85 R↑
86 0
87 X<=Y?
88 GTO 01
89 CLX
90 360
91 ST+ Y
92♦LBL 01
93 "D="
94 ARCL Y
95 AVIEW
96 "I="
97 ARCL T
98 AVIEW
99 "F="
100 ARCL Z
101 AVIEW
102 ADV
103 RTN
104♦LBL E
105 SF 21
106 "CARTESIAN?<0,1>"
107 PROMPT
108 GTO IND X
109♦LBL 00
110 "D1="
111 PROMPT
112 ARCL X
113 FS? 55
114 PRA
115 "I1="
116 PROMPT
117 ARCL X
118 FS? 55
119 PRA
120 ADV
121 1
122 XEQ 03
123 STO 01
124 X<>Y
125 STO 02
126 R↑
127 STO 03
128 "D2="
129 PROMPT
130 ARCL X
131 FS? 55
132 PRA
133 "I2="
134 PROMPT
135 ARCL X
136 FS? 55
137 PRA
138 1
139 XEQ 03
140 STO 04
141 X<>Y
142 STO 05
143 R↑
144 STO 06
145 GTO 00
146♦LBL 01
147 "X1="
148 PROMPT
149 ARCL X
150 FS? 55
151 PRA
152 STO 01
153 X↑2
154 "Y1="
155 PROMPT
156 ARCL X
157 FS? 55
158 PRA
159 STO 02
160 X↑2
161 +
162 "Z1="
163 PROMPT
164 ARCL X
165 FS? 55
166 PRA
167 ADV
168 STO 03
169 X↑2
170 +
171 SQRT
172 ST/ 01
173 ST/ 02
174 ST/ 03
175 "X2="
176 PROMPT
177 ARCL X
178 FS? 55
179 PRA
180 STO 04
181 X↑2
182 "Y2="
183 PROMPT
184 ARCL X
185 FS? 55
186 PRA
187 STO 05
188 X↑2
189 +
190 "Z2="
191 PROMPT
192 ARCL X
193 FS? 55
194 PRA
195 STO 06
196 X↑2
197 +
198 SQRT
199 ST/ 04
200 ST/ 05
201 ST/ 06
202 RCL 06
203♦LBL 00
204 RCL 03
205 *
206 RCL 01
207 RCL 04
208 *
209 +
210 RCL 02
211 RCL 05
212 *
213 +
214 ACOS
215 ADV
216 "∠="
217 ARCL X
218 AVIEW
219 ADV
220 STOP
221 GTO E
222♦LBL 02
223 "D="
224 PROMPT
225 ARCL X
226 FS? 55
227 PRA
228 "I="
229 PROMPT
230 ARCL X
231 FS? 55
232 PRA
233 "F="
234 PROMPT
235 ARCL X
236 FS? 55
237 PRA
238 ADV
239♦LBL 03
240 P-R
241 X<>Y
242 RDN
243 P-R
244 RTN
245 .END.
```

HP 41 C
Vertical Plug
(monopole)
Program
Magnetics
MAGMOD I

```
01♦LBL "MAG1"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "INF? <0,1>"
26 PROMPT
27 FS?C 22
28 STO 13
29 "H1="
30 PROMPT
31 FS?C 22
32 STO 14
33 ARCL 14
34 PRA
35 GTO IND 13
36♦LBL 00
37 "H2=
38 PROMPT
```

```
 39 FS?C 22
 40 STO 15
 41 ARCL 15
 42 PRA
 43♦LBL 01
 44 "RADIUS="
 45 PROMPT
 46 FS?C 22
 47 STO 16
 48 ARCL 16
 49 PRA
 50 FIX 6
 51 "SUSC="
 52 PROMPT
 53 FS?C 22
 54 STO 17
 55 ARCL 17
 56 PRA
 57 ADV
 58 FIX 1
 59 RCL 17
 60 RCL 03
 61 *
 62 STO 06
 63 STO 12
 64 RCL 04
 65 STO 10
 66 RCL 05
 67 STO 11
 68 "REM?<0,1>"
 69 PROMPT
 70 CF 22
 71 X=0?
 72 GTO D
 73♦LBL C
 74 "J REM="
 75 PROMPT
 76 FS?C 22
 77 STO 09
 78 ARCL 09
 79 PRA
 80 "I REM="
 81 PROMPT
 82 FS?C 22
 83 STO 07
 84 ARCL 07
 85 PRA
 86 "D REM="
 87 PROMPT
 88 FS?C 22
 89 STO 08
 90 ARCL 08
 91 PRA
 92 ADV
 93 RCL 08
 94 RCL 07
 95 RCL 09
 96 P-R
 97 X<>Y
 98 STO 10
 99 RDN
100 P-R
101 STO 11
102 RDN
103 STO 12
104 RCL 05
105 RCL 04
106 RCL 06
107 P-R
108 X<>Y
109 ST+ 10
110 RDN
111 P-R
112 ST+ 11
113 RDN
114 ST+ 12
115 RCL 10
116 RCL 12
117 RCL 11
118 R-P
119 X<>Y
120 STO 11
121 RDN
122 R-P
123 STO 12
124 RDN
125 STO 10
126♦LBL D
127 RCL 16
128 X↑2
129 PI
130 *
131 RCL 10
132 SIN
133 *
134 RCL 12
135 *
136 CHS
137 STO 18
138 "BEARING="
139 PROMPT
140 FS?C 22
141 STO 19
142 ARCL 19
143 PRA
144 ADV
145♦LBL E
146 CF 01
147 "XMIN=?"
148 PROMPT
149 FS?C 22
150 STO 20
151 "XMAX=?"
152 PROMPT
153 FS?C 22
154 STO 22
155 "XINC=?"
156 PROMPT
157 FS?C 22
158 STO 23
159 RCL 20
160 STO 21
161♦LBL 02
162 "Y="
163 ARCL 21
164 PRA
165 RCL 14
166 STO 28
167 XEQ 04
168 "BZ="
169 ARCL Y
170 PRA
171 "BT="
172 ARCL Z
173 PRA
174 ADV
175 RCL 23
176 ST+ 21
177 RCL 22
178 RCL 21
179 X<=Y?
180 GTO 02
181 STOP
182 GTO E
183♦LBL F
184 "BZ MIN=?"
185 PROMPT
186 FS?C 22
187 STO 24
188 "BZ MAX=?"
189 PROMPT
190 FS?C 22
191 STO 25
192 "BT MIN=?"
193 PROMPT
194 FS?C 22
195 STO 26
196 "BT MAX=?"
197 PROMPT
198 FS?C 22
199 STO 27
200 126
201 STO 02
202 RCL 24
203 STO 00
204 RCL 25
205 STO 01
206 FIX 0
207 CF 02
208 "BZ"
209 XEQ 03
210 ADV
211 SF 02
212 RCL 26
213 STO 00
214 RCL 27
215 STO 01
216 "BT"
217 XEQ 03
218 FIX 1
219 CF 02
220 STOP
221 GTO E
222♦LBL 03
223 SF 12
224 PRA
225 FIX 0
226 CF 12
227 "MIN="
228 ARCL 00
229 "├     MAX="
230 ARCL 01
231 PRA
232 127
233 ACCOL
234 124
235 SKPCOL
236 127
237 ACCOL
238 ADV
239 RCL 20
240 STO 21
241♦LBL 05
242 RCL 21
243 ACX
244 RCL 14
245 STO 28
246 XEQ 04
247 RDN
248 FS? 02
249 X<>Y
250 REGPLOT
251 RCL 23
252 ST+ 21
253 RCL 22
254 RCL 21
255 X<=Y?
256 GTO 05
257 RTN
258♦LBL 04
259 RCL 21
260 RCL 19
261 COS
262 *
263 RCL 04
264 COS
265 *
266 RCL 28
267 RCL 04
268 SIN
269 *
270 -
271 RCL 18
272 RCL 21
273 X↑2
274 RCL 28
275 X↑2
276 +
277 1.5
278 Y↑X
279 /
280 *
281 LASTX
282 RCL 28
283 *
284 CHS
285 RCL 13
286 X=0?
```

```
287 FS?C 01
288 RTN
289 RDN
290 STO 29
291 X<>Y
292 STO 30
293 RCL 15
294 STO 28
295 SF 01
296 XEQ 04
297 RDN
298 CHS
299 RCL 29
300 +
301 X<>Y
302 CHS
303 RCL 30
304 +
305 X<>Y
306 R↑
307 RTN
308♦LBL G
309 FIX 1
310 "J RES="
311 ARCL 12
312 PRA
313 "I RES="
314 ARCL 10
315 PRA
316 "D RES="
317 ARCL 11
318 PRA
319 ADV
320 STOP
321 GTO E
322 .END.
```

HP 41 C
Vertical Thin
Sheet
(L.O.P.)
Program
Magnetics
MAGMOD II

```
01♦LBL "MAG2"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "INF? (0,1)"
26 PROMPT
27 FS?C 22
28 STO 13
29 "H1="
30 PROMPT
31 FS?C 22
32 STO 14
33 ARCL 14
34 PRA
35 GTO IND 13
36♦LBL 00
37 "H2="
38 PROMPT
39 FS?C 22
40 STO 15
41 ARCL 15
42 PRA
43♦LBL 01
44 "THICKNESS="
45 PROMPT
46 FS?C 22
47 STO 16
48 ARCL 16
49 PRA
50 FIX 6
51 "SUSC="
52 PROMPT
53 FS?C 22
54 STO 17
55 ARCL 17
56 PRA
57 ADV
58 FIX 1
59 RCL 17
60 RCL 03
61 *
62 STO 06
63 STO 12
64 RCL 04
65 STO 10
66 RCL 05
67 STO 11
68 "REM?(0,1)"
69 PROMPT
70 CF 22
71 X=0?
72 GTO D
73♦LBL C
74 "J REM="
75 PROMPT
76 FS?C 22
77 STO 09
78 ARCL 09
79 PRA
80 "I REM="
81 PROMPT
82 FS?C 22
83 STO 07
84 ARCL 07
85 PRA
86 "D REM="
87 PROMPT
88 FS?C 22
89 STO 08
90 ARCL 08
91 PRA
92 ADV
93 RCL 08
94 RCL 07
95 RCL 09
96 P-R
97 X<>Y
98 STO 10
99 RDN
100 P-R
101 STO 11
102 RDN
103 STO 12
104 RCL 05
105 RCL 04
106 RCL 06
107 P-R
108 X<>Y
109 ST+ 10
110 RDN
111 P-R
112 ST+ 11
113 RDN
114 ST+ 12
115 RCL 10
116 RCL 12
117 RCL 11
118 R-P
119 X<>Y
120 STO 11
121 RDN
122 R-P
123 STO 12
124 RDN
125 STO 10
126♦LBL D
127 RCL 16
128 RCL 10
129 SIN
130 *
131 RCL 12
132 *
133 -2
134 *
135 STO 18
136 "BEARING="
137 PROMPT
138 FS?C 22
139 STO 19
140 ARCL 19
141 PRA
142 ADV
143♦LBL E
144 CF 01
145 "XMIN=?"
146 PROMPT
147 FS?C 22
148 STO 20
149 "XMAX=?"
150 PROMPT
151 FS?C 22
152 STO 22
153 "XINC=?"
154 PROMPT
155 FS?C 22
156 STO 23
157 RCL 20
158 STO 21
159♦LBL 02
160 "X="
161 ARCL 21
162 PRA
163 RCL 14
164 STO 28
165 XEQ 04
166 "BZ="
167 ARCL Y
168 PRA
169 "BT="
170 ARCL Z
171 PRA
172 ADV
173 RCL 23
174 ST+ 21
175 RCL 22
176 RCL 21
177 X<=Y?
178 GTO 02
179 STOP
180 GTO E
181♦LBL F
182 "BZ MIN=?"
183 PROMPT
184 FS?C 22
185 STO 24
186 "BZ MAX=?"
187 PROMPT
188 FS?C 22
189 STO 25
190 "BT MIN=?"
191 PROMPT
192 FS?C 22
193 STO 26
194 "BT MAX=?"
195 PROMPT
196 FS?C 22
197 STO 27
198 126
199 STO 02
```

```
200 RCL 24
201 STO 00
202 RCL 25
203 STO 01
204 FIX 0
205 CF 02
206 "BZ"
207 XEQ 03
208 ADV
209 SF 02
210 RCL 26
211 STO 00
212 RCL 27
213 STO 01
214 "BT"
215 XEQ 03
216 CF 02
217 FIX 1
218 STOP
219 GTO E
220♦LBL 03
221 SF 12
222 PRA
223 FIX 0
224 CF 12
225 "MIN="
226 ARCL 00
227 "⊢     MAX="
228 ARCL 01
229 PRA
230 127
231 ACCOL
232 124
233 SKPCOL
234 127
235 ACCOL
236 ADV
237 RCL 20
238 STO 21
239♦LBL 05
240 RCL 21
241 ACX
242 RCL 14
243 STO 28
244 XEQ 04
245 RDN
246 FS? 02
247 X<>Y
248 REGPLOT
249 RCL 23
250 ST+ 21
251 RCL 22
252 RCL 21
253 X<=Y?
254 GTO 05
255 RTN
256♦LBL 04
257 RCL 21
258 RCL 19
259 COS
260 *
261 RCL 04
262 COS
263 *
264 RCL 28
265 RCL 04
266 SIN
267 *
268 -
269 RCL 18
270 RCL 21
271 X↑2
272 RCL 28
273 X↑2
274 +
275 /
276 *
277 LASTX
278 RCL 28
279 *
280 CHS
281 RCL 13
282 X=0?
283 FS?C 01
284 RTN
285 RDN
286 STO 29
287 X<>Y
288 STO 30
289 RCL 15
290 STO 28
291 SF 01
292 XEQ 04
293 RDN
294 CHS
295 RCL 29
296 +
297 X<>Y
298 CHS
299 RCL 30
300 +
301 X<>Y
302 R↑
303 RTN
304♦LBL G
305 FIX 1
306 "J RES="
307 ARCL 12
308 PRA
309 "I RES="
310 ARCL 10
311 PRA
312 "D RES="
313 ARCL 11
314 PRA
315 ADV
316 STOP
317 GTO E
318 .END.
```

HP 41 C
Vertical Prism
(S.O.P.)
Program
Magnetics
MAGMOD III

```
01♦LBL "MAG3"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "INF H? (0,1)"
26 PROMPT
27 FS?C 22
28 STO 13
29 "H1="
30 PROMPT
31 FS?C 22
32 STO 14
33 ARCL 14
34 PRA
35 GTO IND 13
36♦LBL 00
37 "H2="
38 PROMPT
39 FS?C 22
40 STO 15
41 ARCL 15
42 PRA
43♦LBL 01
44 "1/2 WIDTH="
45 PROMPT
46 FS?C 22
47 STO 16
48 ARCL 16
49 PRA
50 "1/2 LENGTH="
51 PROMPT
52 FS?C 22
53 STO 17
54 ARCL 17
55 PRA
56 FIX 6
57 "SUSC="
58 PROMPT
59 FS?C 22
60 STO 18
61 ARCL 18
62 PRA
63 ADV
64 FIX 1
65 RCL 18
66 RCL 03
67 *
68 STO 06
69 STO 12
70 RCL 04
71 STO 10
72 RCL 05
73 STO 11
74 "REM?(0,1)"
75 PROMPT
76 CF 22
77 X=0?
78 GTO D
79♦LBL C
80 "J REM="
81 PROMPT
82 FS?C 22
83 STO 09
84 ARCL 09
85 PRA
86 "I REM="
87 PROMPT
88 FS?C 22
89 STO 07
90 ARCL 07
91 PRA
92 "D REM="
93 PROMPT
94 FS?C 22
95 STO 08
96 ARCL 08
97 PRA
98 ADV
99 RCL 08
100 RCL 07
101 RCL 09
102 P-R
103 X<>Y
104 STO 10
105 RDN
106 P-R
107 STO 11
108 RDN
109 STO 12
110 RCL 05
111 RCL 04
112 RCL 06
113 P-R
114 X<>Y
115 ST+ 10
116 RDN
```

```
117 P-R
118 ST+ 11
119 RDN
120 ST+ 12
121 RCL 10
122 RCL 12
123 RCL 11
124 R-P
125 X<>Y
126 STO 11
127 RDN
128 R-P
129 STO 12
130 RDN
131 STO 10
132♦LBL D
133 RCL 10
134 SIN
135 RCL 12
136 *
137 CHS
138 STO 19
139 "BEARING="
140 PROMPT
141 FS?C 22
142 STO 20
143 ARCL 20
144 PRA
145 ADV
146♦LBL E
147 CF 01
148 "XMIN=?"
149 PROMPT
150 FS?C 22
151 STO 21
152 "XMAX=?"
153 PROMPT
154 FS?C 22
155 STO 23
156 "XINC=?"
157 PROMPT
158 FS?C 22
159 STO 24
160 RCL 21
161 STO 22
162 RCL 14
163 X↑2
164 RCL 17
165 X↑2
166 +
167 STO 25
168 RCL 15
169 X↑2
170 RCL 17
171 X↑2
172 +
173 STO 26
174♦LBL 02
175 "X="
176 ARCL 22
177 PRA
178 RCL 25
179 STO 27
180 RCL 14
181 STO 28
182 XEQ 04
183 "BZ="
184 ARCL 36
185 PRA
186 "BT="
187 ARCL 37
188 PRA
189 ADV
190 RCL 24
191 ST+ 22
192 RCL 23
193 RCL 22
194 X<=Y?
195 GTO 02
196 STOP
197 GTO E
198♦LBL F
199 "BZ MIN=?"
200 PROMPT
201 FS?C 22
202 STO 30
203 "BZ MAX=?"
204 PROMPT
205 FS?C 22
206 STO 31
207 "BT MIN=?"
208 PROMPT
209 FS?C 22
210 STO 32
211 "BT MAX=?"
212 PROMPT
213 FS?C 22
214 STO 33
215 119
216 STO 02
217 RCL 30
218 STO 00
219 RCL 31
220 STO 01
221 SF 12
222 SF 02
223 "BZ"
224 XEQ 03
225 CF 02
226 RCL 32
227 STO 00
228 RCL 33
229 STO 01
230 ADV
231 SF 12
232 "BT"
233 XEQ 03
234 FIX 1
235 STOP
236 GTO E
237♦LBL 03
238 PRA
239 FIX 0
240 CF 12
241 "MIN="
242 ARCL 00
243 "├     MAX="
244 ARCL 01
245 PRA
246 127
247 ACCOL
248 117
249 SKPCOL
250 127
251 ACCOL
252 ADV
253 RCL 21
254 STO 22
255♦LBL 05
256 RCL 22
257 ACX
258 RCL 25
259 STO 27
260 RCL 14
261 STO 28
262 XEQ 04
263 RCL 37
264 FS? 02
265 RCL 36
266 REGPLOT
267 RCL 24
268 ST+ 22
269 RCL 23
270 RCL 22
271 X<=Y?
272 GTO 05
273 RTN
274 FIX 4
275 STOP
276 GTO E
277♦LBL 04
278 RCL 27
279 RCL 22
280 RCL 16
281 +
282 X↑2
283 +
284 SQRT
285 STO 34
286 RCL 27
287 RCL 22
288 RCL 16
289 -
290 X↑2
291 +
292 SQRT
293 STO 29
294 RCL 17
295 +
296 RCL 34
297 RCL 17
298 -
299 *
300 RCL 29
301 RCL 17
302 -
303 /
304 RCL 34
305 RCL 17
306 +
307 /
308 LN
309 RCL 19
310 *
311 STO 35
312 RCL 17
313 RCL 22
314 RCL 16
315 +
316 *
317 RCL 34
318 RCL 28
319 *
320 /
321 ATAN
322 RCL 17
323 RCL 22
324 RCL 16
325 -
326 *
327 RCL 29
328 RCL 28
329 *
330 /
331 ATAN
332 -
333 D-R
334 RCL 19
335 *
336 -2
337 *
338 STO 36
339 RCL 04
340 SIN
341 *
342 RCL 35
343 RCL 20
344 COS
345 *
346 RCL 04
347 COS
348 *
349 +
350 STO 37
351 RCL 13
352 X=0?
353 FS?C 01
354 RTN
355 RCL 36
356 STO 38
357 RCL 37
358 STO 39
359 RCL 15
360 STO 28
361 RCL 26
362 STO 27
363 SF 01
364 XEQ 04
```

```
365 RCL 38
366 ST- 36
367 RCL 39
368 ST- 37
369 -1
370 ST* 36
371 ST* 37
372 RTN
373♦LBL G
374 FIX 1
375 "J RES="
376 ARCL 12
377 PRA
378 "I RES="
379 ARCL 10
380 PRA
381 "D RES="
382 ARCL 11
383 PRA
384 ADV
385 STOP
386 GTO E
387 .END.
```

HP 41 C
Dipole Program
Magnetics
MAGMOD IV

```
01♦LBL "MAG4"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS? 22
14 STO 04
15 FS?C 22
16 STO 10
17 ARCL 04
18 PRA
19 "D="
20 PROMPT
21 FS? 22
22 STO 05
23 FS?C 22
24 STO 11
25 ARCL 05
26 PRA
27 ADV
28♦LBL B
29 "DEPTH="
30 PROMPT
31 FS?C 22
32 STO 13
33 ARCL 13
34 PRA
35 "RADIUS="
36 PROMPT
37 FS? 22
38 STO 14
39 FC?C 22
40 GTO 01
41 3
42 Y↑X
43 PI
44 *
45 4
46 *
47 3
48 /
49 STO 15
50♦LBL 01
51 ARCL 14
52 PRA
53 "VOL="
54 ARCL 15
55 PROMPT
56 FC? 22
57 GTO 02
58 STO 15
59 "VOL="
60 ARCL 15
61♦LBL 02
62 PRA
63 FIX 6
64 "SUSC.="
65 PROMPT
66 FS?C 22
67 STO 16
68 ARCL 16
69 PRA
70 ADV
71 FIX 1
72 RCL 16
73 RCL 03
74 *
75 STO 06
76 STO 12
77 "REM?(0,1)"
78 PROMPT
79 CF 22
80 X=0?
81 GTO D
82♦LBL C
83 "J REM="
84 PROMPT
85 FS?C 22
86 STO 09
87 ARCL 09
88 PRA
89 "I REM="
90 PROMPT
91 FS?C 22
92 STO 07
93 ARCL 07
94 PRA
95 "D REM="
96 PROMPT
97 FS?C 22
98 STO 08
99 ARCL 08
100 PRA
101 ADV
102 RCL 08
103 RCL 07
104 RCL 09
105 P-R
106 X<>Y
107 STO 10
108 RDN
109 P-R
110 STO 11
111 RDN
112 STO 12
113 RCL 05
114 RCL 04
115 RCL 06
116 P-R
117 X<>Y
118 ST+ 10
119 RDN
120 P-R
121 ST+ 11
122 RDN
123 ST+ 12
124 RCL 10
125 RCL 12
126 RCL 11
127 R-P
128 X<>Y
129 STO 11
130 RDN
131 R-P
132 STO 12
133 RDN
134 STO 10
135♦LBL D
136 "BEARING="
137 PROMPT
138 FS?C 22
139 STO 17
140 ARCL 17
141 PRA
142 ADV
143 RCL 17
144 RCL 05
145 -
146 RCL 11
147 +
148 STO 18
149 RCL 10
150 1
151 P-R
152 X<>Y
153 STO 19
154 RDN
155 P-R
156 STO 20
157 RDN
158 STO 21
159 RCL 17
160 RCL 04
161 1
162 P-R
163 X<>Y
164 STO 24
165 RDN
166 P-R
167 STO 23
168 RDN
169 STO 22
170 RCL 21
171 *
172 RCL 24
173 RCL 19
174 *
175 +
176 CHS
177 RCL 23
178 RCL 20
179 *
180 2
181 *
182 +
183 STO 21
184 LASTX
185 1.5
186 *
187 -
188 RCL 19
189 RCL 24
190 *
191 3
192 *
193 +
194 STO 22
195 RCL 19
196 RCL 23
197 *
198 RCL 20
199 RCL 24
200 *
201 +
202 3
203 *
204 STO 23
205♦LBL E
206 "XMIN=?"
207 PROMPT
208 FS?C 22
209 STO 25
210 "XMAX=?"
211 PROMPT
212 FS?C 22
213 STO 27
214 "XINC=?"
215 PROMPT
216 FS?C 22
```

F

```
217 STO 28
218 RCL 25
219 STO 26
220♦LBL 00
221 "X="
222 ARCL 26
223 PRA
224 XEQ 01
225 XEQ 04
226 "BZ="
227 ARCL X
228 PRA
229 XEQ 02
230 XEQ 04
231 "BT="
232 ARCL X
233 PRA
234 ADV
235 XEQ 03
236 X<=Y?
237 GTO 00
238 STOP
239♦LBL F
240 "BZ MIN=?"
241 PROMPT
242 FS?C 22
243 STO 32
244 "BZ MAX=?"
245 PROMPT
246 FS?C 22
247 STO 33
248 "BT MIN=?"
249 PROMPT
250 FS?C 22
251 STO 34
252 "BT MAX=?"
253 PROMPT
254 FS?C 22
255 STO 35
256 126
257 STO 02
258 RCL 32
259 STO 00
260 RCL 33
261 STO 01
262 XEQ 01
263 SF 12
264 "BZ"
265 XEQ 06
266 RCL 34
267 STO 00
268 RCL 35
269 STO 01
270 ADV
271 XEQ 02
272 SF 12
273 "BT"
274 XEQ 06
275 STOP
276 FIX 1
277 GTO E
278♦LBL 06
279 PRA
280 FIX 0
281 CF 12
282 "MIN="
283 ARCL 00
284 "├     MAX="
285 ARCL 01
286 PRA
287 127
288 ACCOL
289 124
290 SKPCOL
291 127
292 ACCOL
293 ADV
294 RCL 25
295 STO 26
296♦LBL 05
297 RCL 26
298 ACX
299 XEQ 04
300 REGPLOT
301 XEQ 03
302 X<=Y?
303 GTO 05
304 RTN
305♦LBL 01
306 RCL 19
307 CHS
308 STO 29
309 -2
310 *
311 STO 30
312 RCL 20
313 3
314 *
315 STO 31
316 RTN
317♦LBL 02
318 RCL 21
319 STO 29
320 RCL 22
321 STO 30
322 RCL 23
323 STO 31
324 RTN
325♦LBL 03
326 RCL 28
327 ST+ 26
328 RCL 27
329 RCL 26
330 RTN
331♦LBL 04
332 RCL 26
333 X↑2
334 RCL 29
335 *
336 RCL 13
337 X↑2
338 RCL 30
339 *
340 +
341 RCL 26
342 RCL 13
343 *
344 RCL 31
345 *
346 -
347 RCL 13
348 X↑2
349 RCL 26
350 X↑2
351 +
352 -2.5
353 Y↑X
354 *
355 RCL 15
356 *
357 RCL 12
358 *
359 RTN
360♦LBL G
361 FIX 1
362 "J RES="
363 ARCL 12
364 PRA
365 "I RES="
366 ARCL 10
367 PRA
368 "D RES="
369 ARCL 11
370 PRA
371 ADV
372 STOP
373 GTO E
374 ADV
375 .END.
```

HP 41 C
Horizontal
Cylinder
Program
Magnetics
MAGMOD V

```
01♦LBL "MAG5"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "DEPTH="
26 PROMPT
27 FS?C 22
28 STO 13
29 ARCL 13
30 PRA
31 "RADIUS="
32 PROMPT
33 FS? 22
34 STO 14
35 FC?C 22
36 GTO 01
37 X↑2
38 PI
39 *
40 STO 15
41♦LBL 01
42 ARCL 14
43 PRA
44 "A="
45 ARCL 15
46 PROMPT
47 FC?C 22
48 GTO 02
49 STO 15
50 "A="
51 ARCL 15
52♦LBL 02
53 PRA
54 FIX 6
55 "SUSC="
56 PROMPT
57 FS?C 22
58 STO 16
59 ARCL 16
60 PRA
61 ADV
62 FIX 1
63 RCL 16
64 RCL 03
65 *
66 STO 06
67 STO 12
68 RCL 04
69 STO 10
70 RCL 05
71 STO 11
72 "REM?<0,1>"
73 PROMPT
74 CF 22
75 X=0?
76 GTO D
77♦LBL C
78 "J REM="
```

```
 79 PROMPT
 80 FS?C 22
 81 STO 09
 82 ARCL 09
 83 PRA
 84 "I REM="
 85 PROMPT
 86 FS?C 22
 87 STO 07
 88 ARCL 07
 89 PRA
 90 "D REM="
 91 PROMPT
 92 FS?C 22
 93 STO 08
 94 ARCL 08
 95 PRA
 96 ADV
 97 RCL 08
 98 RCL 07
 99 RCL 09
100 P-R
101 X<>Y
102 STO 10
103 RDN
104 P-R
105 STO 11
106 RDN
107 STO 12
108 RCL 05
109 RCL 04
110 RCL 06
111 P-R
112 X<>Y
113 ST+ 10
114 RDN
115 P-R
116 ST+ 11
117 RDN
118 ST+ 12
119 RCL 10
120 RCL 12
121 RCL 11
122 R-P
123 X<>Y
124 STO 11
125 RDN
126 R-P
127 STO 12
128 RDN
129 STO 10
130*LBL D
131 RCL 12
132 RCL 15
133 *
134 2
135 *
136 STO 17
137 "BEARING="
138 PROMPT
139 FS?C 22
140 STO 18
141 ARCL 18
142 PRA
143 ADV
144 RCL 18
145 RCL 05
146 -
147 RCL 11
148 +
149 STO 19
150 RCL 10
151 1
152 P-R
153 X<>Y
154 STO 23
155 CHS
156 STO 21
157 RDN
158 P-R
159 STO 28
160 -2
161 *
162 STO 20
163 RCL 18
164 RCL 04
165 1
166 P-R
167 X<>Y
168 STO 29
169 RDN
170 P-R
171 STO 34
172 RCL 28
173 *
174 RCL 23
175 RCL 29
176 *
177 -
178 STO 22
179 RCL 28
180 RCL 29
181 *
182 RCL 23
183 RCL 34
184 *
185 +
186 -2
187 *
188 STO 23
189*LBL E
190 "XMIN=?"
191 PROMPT
192 FS?C 22
193 STO 24
194 "XMAX=?"
195 PROMPT
196 FS?C 22
197 STO 26
198 "XINC=?"
199 PROMPT
200 FS?C 22
201 STO 27
202 RCL 24
203 STO 25
204*LBL 04
205 "X="
206 ARCL 25
207 PRA
208 RCL 21
209 STO 28
210 RCL 20
211 STO 29
212 XEQ 01
213 "BZ="
214 ARCL X
215 PRA
216 RCL 22
217 STO 28
218 RCL 23
219 STO 29
220 XEQ 01
221 "BT="
222 ARCL X
223 PRA
224 ADV
225 RCL 27
226 ST+ 25
227 RCL 26
228 RCL 25
229 X<=Y?
230 GTO 04
231 STOP
232 GTO E
233*LBL F
234 "BZ MIN=?"
235 PROMPT
236 FS?C 22
237 STO 30
238 "BZ MAX=?"
239 PROMPT
240 FS?C 22
241 STO 31
242 "BT MIN=?"
243 PROMPT
244 FS?C 22
245 STO 32
246 "BT MAX=?"
247 PROMPT
248 FS?C 22
249 STO 33
250 126
251 STO 02
252 RCL 30
253 STO 00
254 RCL 31
255 STO 01
256 RCL 21
257 STO 28
258 RCL 20
259 STO 29
260 SF 12
261 "BZ"
262 XEQ 03
263 RCL 32
264 STO 00
265 RCL 33
266 STO 01
267 RCL 22
268 STO 28
269 RCL 23
270 STO 29
271 ADV
272 SF 12
273 "BT"
274 XEQ 03
275 FIX 1
276 STOP
277 GTO E
278*LBL 03
279 PRA
280 FIX 0
281 CF 12
282 "MIN="
283 ARCL 00
284 "⊢     MAX="
285 ARCL 01
286 PRA
287 127
288 ACCOL
289 124
290 SKPCOL
291 127
292 ACCOL
293 ADV
294 RCL 24
295 STO 25
296*LBL 05
297 RCL 25
298 ACX
299 XEQ 01
300 REGPLOT
301 RCL 27
302 ST+ 25
303 RCL 26
304 RCL 25
305 X<=Y?
306 GTO 05
307 RTN
308*LBL 01
309 RCL 25
310 X↑2
311 RCL 13
312 X↑2
313 -
314 RCL 28
315 *
316 RCL 25
317 RCL 13
318 *
319 RCL 29
320 *
321 +
322 RCL 25
323 X↑2
324 RCL 13
325 X↑2
326 +
```

```
327 X↑2
328 /
329 RCL 17
330 *
331 RTN
332◆LBL G
333 FIX 1
334 "J RES="
335 ARCL 12
336 PRA
337 "I RES="
338 ARCL 10
339 PRA
340 "D RES="
341 ARCL 11
342 PRA
343 ADV
344 STOP
345 GTO E
346 END
```

HP 41 C
Thin Sheet
Program
Magnetics
MAGMODS
VI & VII

Program
MAG 6 handles
both MAGMOD
VI & VII

```
01◆LBL "MAG6"
02◆LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24◆LBL B
25 "DIP="
26 PROMPT
27 FC?C 22
28 GTO 01
29 STO 13
30 COS
31 STO 14
32 LASTX
33 SIN
34 STO 15
35◆LBL 01
36 ARCL 13
37 PRA
38 "INFINITE?(0,1)"
39 PROMPT
40 FS?C 22
41 STO 16
42 "H1="
43 PROMPT
44 FS?C 22
45 STO 17
46 ARCL 17
47 GTO IND 16
48◆LBL 00
49 PRA
50 RCL 15
51 X=0?
52 GTO 00
53 "H2="
54 PROMPT
55 FS?C 22
56 STO 18
57 ARCL 18
58 RCL 18
59 RCL 17
60 -
61 RCL 15
62 /
63 STO 19
64 GTO 01
65◆LBL 00
66 "L="
67 PROMPT
68 FC?C 22
69 GTO 00
70 STO 19
71 RCL 17
72 STO 18
73◆LBL 00
74 ARCL 19
75◆LBL 01
76 PRA
77 "THICKNESS="
78 PROMPT
79 FS?C 22
80 STO 20
81 ARCL 20
82 PRA
83 FIX 6
84 "SUSC="
85 PROMPT
86 FS?C 22
87 STO 21
88 ARCL 21
89 PRA
90 ADV
91 FIX 1
92 RCL 21
93 RCL 03
94 *
95 STO 06
96 STO 12
97 RCL 04
98 STO 10
99 RCL 05
100 STO 11
101 "REM?(0,1)"
102 PROMPT
103 CF 22
104 X=0?
105 GTO D
106◆LBL C
107 "J REM="
108 PROMPT
109 FS?C 22
110 STO 09
111 ARCL 09
112 PRA
113 "I REM="
114 PROMPT
115 FS?C 22
116 STO 07
117 ARCL 07
118 PRA
119 "D REM="
120 PROMPT
121 FS?C 22
122 STO 08
123 ARCL 08
124 PRA
125 ADV
126 RCL 08
127 RCL 07
128 RCL 09
129 P-R
130 X<>Y
131 STO 10
132 RDN
133 P-R
134 STO 11
135 RDN
136 STO 12
137 RCL 05
138 RCL 04
139 RCL 06
140 P-R
141 X<>Y
142 ST+ 10
143 RDN
144 P-R
145 ST+ 11
146 RDN
147 ST+ 12
148 RCL 10
149 RCL 12
150 RCL 11
151 R-P
152 X<>Y
153 STO 11
154 RDN
155 R-P
156 STO 12
157 RDN
158 STO 10
159◆LBL D
160 "BEARING="
161 PROMPT
162 FS?C 22
163 STO 22
164 ARCL 22
165 PRA
166 ADV
167 RCL 22
168 RCL 05
169 -
170 RCL 11
171 +
172 STO 23
173 RCL 10
174 1
175 P-R
176 X<>Y
177 STO 27
178 CHS
179 STO 25
180 RDN
181 P-R
182 STO 32
183 -2
184 *
185 STO 24
186 RCL 22
187 RCL 04
188 1
189 P-R
190 X<>Y
191 STO 33
192 RDN
193 P-R
194 STO 38
195 RCL 32
196 *
197 RCL 27
198 RCL 33
199 *
200 -
201 STO 26
202 RCL 32
203 RCL 33
204 *
205 RCL 27
206 RCL 38
207 *
208 +
209 -2
210 *
211 STO 27
```

```
212♦LBL E
213 "XMIN=?"
214 PROMPT
215 FS?C 22
216 STO 28
217 "XMAX=?"
218 PROMPT
219 FS?C 22
220 STO 30
221 "XINC=?"
222 PROMPT
223 FS?C 22
224 STO 31
225 RCL 28
226 STO 29
227♦LBL 02
228 "X="
229 ARCL 29
230 PRA
231 RCL 25
232 STO 32
233 RCL 24
234 STO 33
235 XEQ 01
236 "BZ="
237 ARCL X
238 PRA
239 RCL 26
240 STO 32
241 RCL 27
242 STO 33
243 XEQ 01
244 "BT="
245 ARCL X
246 PRA
247 ADV
248 RCL 31
249 ST+ 29
250 RCL 30
251 RCL 29
252 X<=Y?
253 GTO 02
254 STOP
255 GTO E
256♦LBL F
257 "BZ MIN=?"
258 PROMPT
259 FS?C 22
260 STO 34
261 "BZ MAX=?"
262 PROMPT
263 FS?C 22
264 STO 35
265 "BT MIN=?"
266 PROMPT
267 FS?C 22
268 STO 36
269 "BT MAX=?"
270 PROMPT
271 FS?C 22
272 STO 37
273 126
274 STO 02
275 RCL 34
276 STO 00
277 RCL 35
278 STO 01
279 RCL 25
280 STO 32
281 RCL 24
282 STO 33
283 SF 12
284 "BZ"
285 XEQ 03
286 RCL 36
287 STO 00
288 RCL 37
289 STO 01
290 RCL 26
291 STO 32
292 RCL 27
293 STO 33
294 ADV
295 SF 12
296 "BT"
297 XEQ 03
298 FIX 1
299 STOP
300 GTO E
301♦LBL 03
302 PRA
303 FIX 0
304 CF 12
305 "MIN="
306 ARCL 00
307 "├     MAX="
308 ARCL 01
309 PRA
310 127
311 ACCOL
312 124
313 SKPCOL
314 127
315 ACCOL
316 ADV
317 RCL 28
318 STO 29
319♦LBL 05
320 RCL 29
321 ACX
322 XEQ 01
323 REGPLOT
324 RCL 31
325 ST+ 29
326 RCL 30
327 RCL 29
328 X<=Y?
329 GTO 05
330 RTN
331♦LBL 01
332 RCL 33
333 RCL 15
334 *
335 RCL 32
336 RCL 14
337 *
338 2
339 *
340 +
341 STO 39
342 RCL 29
343 *
344 RCL 32
345 RCL 15
346 *
347 -2
348 *
349 RCL 33
350 RCL 14
351 *
352 +
353 STO 40
354 RCL 17
355 *
356 +
357 RCL 17
358 X↑2
359 RCL 29
360 X↑2
361 +
362 /
363 GTO IND 16
364♦LBL 00
365 RCL 19
366 RCL 14
367 *
368 RCL 29
369 +
370 STO 41
371 RCL 39
372 *
373 RCL 18
374 RCL 40
375 *
376 +
377 RCL 41
378 X↑2
379 RCL 18
380 X↑2
381 +
382 /
383 -
384♦LBL 01
385 RCL 20
386 *
387 RCL 12
388 *
389 RTN
390♦LBL G
391 FIX 1
392 "J RES="
393 ARCL 12
394 PRA
395 "I RES="
396 ARCL 10
397 PRA
398 "D RES="
399 ARCL 11
400 PRA
401 ADV
402 RTN
403 .END.
```

HP 41 C
Thick Sheet
Program
Magnetics
MAGMOD VIII

```
01♦LBL "MAG8"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS? 22
14 STO 04
15 FS?C 22
16 STO 10
17 ARCL 04
18 PRA
19 "D="
20 PROMPT
21 FS? 22
22 STO 05
23 FS?C 22
24 STO 11
25 ARCL 05
26 PRA
27 ADV
28♦LBL B
29 "INFINITE?(0,1)"
30 PROMPT
31 FS?C 22
32 STO 13
33 "H1="
34 PROMPT
35 FS?C 22
36 STO 14
37 ARCL 14
38 PRA
39 GTO IND 13
40♦LBL 00
41 "H2="
42 PROMPT
43 FS?C 22
44 STO 15
45 ARCL 15
```

```
46 PRA
47♦LBL 01
48 "THICKNESS="
49 PROMPT
50 FC?C 22
51 GTO 01
52 STO 16
53 2
54 /
55 STO 17
56♦LBL 01
57 ARCL 16
58 PRA
59 "DIP="
60 PROMPT
61 FS?C 22
62 STO 18
63 ARCL 18
64 PRA
65 RCL 18
66 COS
67 STO 19
68 LASTX
69 SIN
70 STO 20
71 FIX 6
72 "SUSC="
73 PROMPT
74 FS?C 22
75 STO 21
76 ARCL 21
77 PRA
78 ADV
79 FIX 1
80 RCL 21
81 RCL 03
82 *
83 STO 06
84 STO 12
85 "REM?(0,1)"
86 PROMPT
87 CF 22
88 X=0?
89 GTO D
90♦LBL C
91 "J REM="
92 PROMPT
93 FS?C 22
94 STO 09
95 ARCL 09
96 PRA
97 "I REM="
98 PROMPT
99 FS?C 22
100 STO 07
101 ARCL 07
102 PRA
103 "D REM="
104 PROMPT
105 FS?C 22
106 STO 08
107 ARCL 08
108 PRA
109 ADV
110 RCL 08
111 RCL 07
112 RCL 09
113 P-R
114 X<>Y
115 STO 10
116 RDN
117 P-R
118 STO 11
119 RDN
120 STO 12
121 RCL 05
122 RCL 04
123 RCL 06
124 P-R
125 X<>Y
126 ST+ 10
127 RDN
128 P-R
129 ST+ 11
130 RDN
131 ST+ 12
132 RCL 10
133 RCL 12
134 RCL 11
135 R-P
136 X<>Y
137 STO 11
138 RDN
139 R-P
140 STO 12
141 RDN
142 STO 10
143♦LBL D
144 "BEARING="
145 PROMPT
146 FS?C 22
147 STO 22
148 ARCL 22
149 PRA
150 ADV
151 RCL 22
152 RCL 05
153 -
154 RCL 11
155 +
156 STO 23
157 RCL 10
158 1
159 P-R
160 X<>Y
161 STO 27
162 CHS
163 STO 25
164 RDN
165 P-R
166 STO 32
167 -2
168 *
169 STO 24
170 RCL 22
171 RCL 04
172 1
173 P-R
174 X<>Y
175 STO 33
176 RDN
177 P-R
178 STO 38
179 RCL 32
180 *
181 RCL 27
182 RCL 33
183 *
184 -
185 STO 26
186 RCL 32
187 RCL 33
188 *
189 RCL 27
190 RCL 38
191 *
192 +
193 -2
194 *
195 STO 27
196♦LBL E
197 "XMIN=?"
198 PROMPT
199 FS?C 22
200 STO 28
201 "XMAX=?"
202 PROMPT
203 FS?C 22
204 STO 30
205 "XINC=?"
206 PROMPT
207 FS?C 22
208 STO 31
209 RCL 28
210 STO 29
211♦LBL 02
212 "X="
213 ARCL 29
214 PRA
215 RCL 25
216 STO 32
217 RCL 24
218 STO 33
219 XEQ 01
220 "BZ="
221 ARCL X
222 PRA
223 RCL 26
224 STO 32
225 RCL 27
226 STO 33
227 XEQ 01
228 "BT="
229 ARCL X
230 PRA
231 ADV
232 RCL 31
233 ST+ 29
234 RCL 30
235 RCL 29
236 X<=Y?
237 GTO 02
238 STOP
239 GTO E
240♦LBL F
241 "BZ MIN=?"
242 PROMPT
243 FS?C 22
244 STO 34
245 "BZ MAX=?"
246 PROMPT
247 FS?C 22
248 STO 35
249 "BT MIN=?"
250 PROMPT
251 FS?C 22
252 STO 36
253 "BT MAX=?"
254 PROMPT
255 FS?C 22
256 STO 37
257 126
258 STO 02
259 RCL 34
260 STO 00
261 RCL 35
262 STO 01
263 RCL 25
264 STO 32
265 RCL 24
266 STO 33
267 SF 12
268 "BZ"
269 XEQ 03
270 RCL 36
271 STO 00
272 RCL 37
273 STO 01
274 RCL 26
275 STO 32
276 RCL 27
277 STO 33
278 ADV
279 SF 12
280 "BT"
281 XEQ 03
282 FIX 1
283 STOP
284 GTO E
285♦LBL 03
286 PRA
287 FIX 0
288 CF 12
289 "MIN="
290 ARCL 00
291 "├     MAX="
292 ARCL 01
293 PRA
```

```
294 127
295 ACCOL
296 124
297 SKPCOL
298 127
299 ACCOL
300 ADV
301 RCL 28
302 STO 29
303♦LBL 05
304 RCL 29
305 ACX
306 XEQ 01
307 REGPLOT
308 RCL 31
309 ST+ 29
310 RCL 30
311 RCL 29
312 X<=Y?
313 GTO 05
314 RTN
315♦LBL 01
316 RCL 33
317 RCL 20
318 *
319 RCL 32
320 RCL 19
321 *
322 2
323 *
324 +
325 STO 39
326 RCL 32
327 RCL 20
328 *
329 -2
330 *
331 RCL 33
332 RCL 19
333 *
334 +
335 STO 40
336 RCL 29
337 STO 41
338 RCL 14
339 STO 42
340 XEQ 03
341 GTO IND 13
342♦LBL 00
343 STO 43
344 RCL 15
345 RCL 14
346 -
347 RCL 18
348 TAN
349 X=0?
350 1 E-7
351 /
352 ST+ 41
353 RCL 15
354 STO 42
355 XEQ 03
356 RCL 43
357 X<>Y
358 -
359♦LBL 01
360 RCL 12
361 *
362 RCL 20
363 *
364 RTN
365♦LBL 03
366 RCL 41
367 RCL 17
368 +
369 X↑2
370 RCL 42
371 X↑2
372 +
373 RCL 41
374 RCL 17
375 -
376 X↑2
377 RCL 42
378 X↑2
379 +
380 /
381 LN
382 RCL 39
383 *
384 2
385 /
386 RCL 41
387 RCL 17
388 +
389 RCL 42
390 /
391 ATAN
392 RCL 41
393 RCL 17
394 -
395 RCL 42
396 /
397 ATAN
398 -
399 D-R
400 RCL 40
401 *
402 +
403 RTN
404♦LBL G
405 FIX 1
406 "J RES="
407 ARCL 12
408 PRA
409 "I RES="
410 ARCL 10
411 PRA
412 "D RES="
413 ARCL 11
414 PRA
415 ADV
416 STOP
417 GTO E
418 .END.
```

HP 41 C
Sloping Step
Program
Magnetics
MAGMOD IX

```
01♦LBL "MAG9"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "H1="
26 PROMPT
27 FS?C 22
28 STO 13
29 ARCL 13
30 PRA
31 "H2="
32 PROMPT
33 FS?C 22
34 STO 14
35 ARCL 14
36 PRA
37 "DIP="
38 PROMPT
39 FC?C 22
40 GTO 01
41 STO 15
42 COS
43 STO 16
44 LASTX
45 SIN
46 STO 17
47♦LBL 01
48 RCL 16
49 RCL 17
50 /
51 RCL 14
52 RCL 13
53 -
54 2
55 /
56 *
57 STO 18
58 ARCL 15
59 PRA
60 FIX 6
61 "SUSC="
62 PROMPT
63 FS?C 22
64 STO 19
65 ARCL 19
66 PRA
67 ADV
68 FIX 1
69 RCL 19
70 RCL 03
71 *
72 STO 06
73 STO 12
74 RCL 04
75 STO 10
76 RCL 05
77 STO 11
78 "REM?<0,1>"
79 PROMPT
80 CF 22
81 X=0?
82 GTO D
83♦LBL C
84 "J REM="
85 PROMPT
86 FS?C 22
87 STO 09
88 ARCL 09
89 PRA
90 "I REM="
91 PROMPT
92 FS?C 22
93 STO 07
94 ARCL 07
95 PRA
96 "D REM="
97 PROMPT
98 FS?C 22
99 STO 08
100 ARCL 08
101 PRA
102 ADV
103 RCL 08
104 RCL 07
105 RCL 09
106 P-R
107 X<>Y
108 STO 10
109 RDN
110 P-R
111 STO 11
112 RDN
113 STO 12
114 RCL 05
115 RCL 04
116 RCL 06
117 P-R
```

```
118 X<>Y
119 ST+ 10
120 RDN
121 P-R
122 ST+ 11
123 RDN
124 ST+ 12
125 RCL 10
126 RCL 12
127 RCL 11
128 R-P
129 X<>Y
130 STO 11
131 RDN
132 R-P
133 STO 12
134 RDN
135 STO 10
136♦LBL D
137 "BEARING="
138 PROMPT
139 FS?C 22
140 STO 20
141 ARCL 20
142 PRA
143 ADV
144 RCL 20
145 RCL 05
146 -
147 RCL 11
148 +
149 STO 21
150 RCL 10
151 1
152 P-R
153 X<>Y
154 STO 25
155 CHS
156 STO 23
157 RDN
158 P-R
159 STO 30
160 -2
161 *
162 STO 22
163 RCL 20
164 RCL 04
165 1
166 P-R
167 X<>Y
168 STO 31
169 RDN
170 P-R
171 STO 36
172 RCL 30
173 *
174 RCL 25
175 RCL 31
176 *
177 -
178 STO 24
179 RCL 30
180 RCL 31
181 *
182 RCL 25
183 RCL 36
184 *
185 +
186 -2
187 *
188 STO 25
189♦LBL E
190 "XMIN=?"
191 PROMPT
192 FS?C 22
193 STO 26
194 "XMAX=?"
195 PROMPT
196 FS?C 22
197 STO 28
198 "XINC=?"
199 PROMPT
200 FS?C 22
201 STO 29
202 RCL 26
203 STO 27
204♦LBL 02
205 "X="
206 ARCL 27
207 PRA
208 RCL 23
209 STO 30
210 RCL 22
211 STO 31
212 XEQ 01
213 "BZ="
214 ARCL X
215 PRA
216 RCL 24
217 STO 30
218 RCL 25
219 STO 31
220 XEQ 01
221 "BT="
222 ARCL X
223 PRA
224 ADV
225 RCL 29
226 ST+ 27
227 RCL 28
228 RCL 27
229 X<=Y?
230 GTO 02
231 STOP
232 GTO E
233♦LBL F
234 "BZ MIN=?"
235 PROMPT
236 FS?C 22
237 STO 32
238 "BZ MAX=?"
239 PROMPT
240 FS?C 22
241 STO 33
242 "BT MIN=?"
243 PROMPT
244 FS?C 22
245 STO 34
246 "BT MAX=?"
247 PROMPT
248 FS?C 22
249 STO 35
250 126
251 STO 02
252 RCL 32
253 STO 00
254 RCL 33
255 STO 01
256 RCL 23
257 STO 30
258 RCL 22
259 STO 31
260 SF 12
261 "BZ"
262 XEQ 03
263 RCL 34
264 STO 00
265 RCL 35
266 STO 01
267 RCL 24
268 STO 30
269 RCL 25
270 STO 31
271 ADV
272 SF 12
273 "BT"
274 XEQ 03
275 FIX 1
276 STOP
277 GTO E
278♦LBL 03
279 PRA
280 FIX 0
281 CF 12
282 "MIN="
283 ARCL 00
284 "├     MAX="
285 ARCL 01
286 PRA
287 127
288 ACCOL
289 124
290 SKPCOL
291 127
292 ACCOL
293 ADV
294 RCL 26
295 STO 27
296♦LBL 05
297 RCL 27
298 ACX
299 XEQ 01
300 REGPLOT
301 RCL 29
302 ST+ 27
303 RCL 28
304 RCL 27
305 X<=Y?
306 GTO 05
307 RTN
308♦LBL 01
309 RCL 31
310 RCL 17
311 *
312 RCL 30
313 RCL 16
314 *
315 2
316 *
317 +
318 STO 37
319 RCL 30
320 RCL 17
321 *
322 -2
323 *
324 RCL 31
325 RCL 16
326 *
327 +
328 STO 38
329 RCL 27
330 RCL 18
331 -
332 X↑2
333 RCL 13
334 X↑2
335 +
336 RCL 27
337 RCL 18
338 +
339 X↑2
340 RCL 14
341 X↑2
342 +
343 /
344 LN
345 RCL 37
346 2
347 /
348 *
349 RCL 27
350 RCL 18
351 -
352 RCL 13
353 /
354 ATAN
355 D-R
356 RCL 27
357 RCL 18
358 +
359 RCL 14
360 /
361 ATAN
362 D-R
363 -
364 RCL 38
365 *
```

```
366 +
367 RCL 12
368 *
369 RCL 17
370 *
371 RTN
372♦LBL G
373 FIX 1
374 "J RES="
375 ARCL 12
376 PRA
377 "I RES="
378 ARCL 10
379 PRA
380 "D RES="
381 ARCL 11
382 PRA
383 ADV
384 STOP
385 GTO E
386 .END.
```

HP 41 C
2 D Polygonal
Body Program
Magnetics
MAGMOD X

```
01♦LBL "MAG10"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "NO. OF SIDES="
26 PROMPT
27 FS?C 22
28 STO 13
29 ARCL 13
30 PRA
31 38
32 STO 25
33 1
34 STO 26
35♦LBL 06
36 FIX 0
37 CF 29
38 "X"
39 ARCL 26
40 "⊦="
41 PROMPT
42 FS?C 22
43 STO IND 25
44 FIX 1
45 ARCL IND 25
46 PRA
47 1
48 ST+ 25
49 FIX 0
50 "Z"
51 ARCL 26
52 "⊦="
53 PROMPT
54 FS?C 22
55 STO IND 25
56 FIX 1
57 ARCL IND 25
58 PRA
59 ADV
60 1
61 ST+ 25
62 ST+ 26
63 RCL 13
64 RCL 26
65 X<=Y?
66 GTO 06
67 SF 29
68 "SUSC="
69 PROMPT
70 FS?C 22
71 STO 14
72 ARCL 14
73 PRA
74 ADV
75 RCL 14
76 RCL 03
77 *
78 STO 06
79 STO 12
80 RCL 04
81 STO 10
82 RCL 05
83 STO 11
84 "REM?(0,1)"
85 PROMPT
86 CF 22
87 X=0?
88 GTO D
89♦LBL C
90 "J REM="
91 PROMPT
92 FS?C 22
93 STO 09
94 ARCL 09
95 PRA
96 "I REM="
97 PROMPT
98 FS?C 22
99 STO 07
100 ARCL 07
101 PRA
102 "D REM="
103 PROMPT
104 FS?C 22
105 STO 08
106 ARCL 08
107 PRA
108 ADV
109 RCL 08
110 RCL 07
111 RCL 09
112 P-R
113 X<>Y
114 STO 10
115 RDN
116 P-R
117 STO 11
118 RDN
119 STO 12
120 RCL 05
121 RCL 04
122 RCL 06
123 P-R
124 X<>Y
125 ST+ 10
126 RDN
127 P-R
128 ST+ 11
129 RDN
130 ST+ 12
131 RCL 10
132 RCL 12
133 RCL 11
134 R-P
135 X<>Y
136 STO 11
137 RDN
138 R-P
139 STO 12
140 RDN
141 STO 10
142♦LBL D
143 "BEARING="
144 PROMPT
145 FS?C 22
146 STO 15
147 ARCL 15
148 PRA
149 ADV
150 RCL 15
151 RCL 05
152 -
153 RCL 11
154 +
155 STO 16
156 RCL 10
157 1
158 P-R
159 X<>Y
160 STO 20
161 CHS
162 STO 18
163 RDN
164 P-R
165 STO 25
166 -2
167 *
168 STO 17
169 RCL 15
170 RCL 04
171 1
172 P-R
173 X<>Y
174 STO 26
175 RDN
176 P-R
177 STO 31
178 RCL 25
179 *
180 RCL 20
181 RCL 26
182 *
183 -
184 STO 19
185 RCL 25
186 RCL 26
187 *
188 RCL 20
189 RCL 31
190 *
191 +
192 -2
193 *
194 STO 20
195♦LBL E
196 "XMIN=?"
197 PROMPT
198 FS?C 22
199 STO 21
200 "XMAX=?"
201 PROMPT
202 FS?C 22
203 STO 23
204 "XINC=?"
205 PROMPT
206 FS?C 22
207 STO 24
208 RCL 21
209 STO 22
210♦LBL 02
211 "X="
212 ARCL 22
213 PRA
214 XEQ 01
215 "BZ="
216 ARCL 36
217 PRA
```

```
218 "BT="
219 ARCL 37
220 PRA
221 ADV
222 RCL 24
223 ST+ 22
224 RCL 23
225 RCL 22
226 X<=Y?
227 GTO 02
228 STOP
229 GTO E
230*LBL F
231 "BZ MIN=?"
232 PROMPT
233 FS?C 22
234 STO 27
235 "BZ MAX=?"
236 PROMPT
237 FS?C 22
238 STO 28
239 "BT MIN=?"
240 PROMPT
241 FS?C 22
242 STO 29
243 "BT MAX=?"
244 PROMPT
245 FS?C 22
246 STO 30
247 126
248 STO 02
249 RCL 27
250 STO 00
251 RCL 28
252 STO 01
253 SF 05
254 SF 12
255 "BZ"
256 XEQ 03
257 RCL 29
258 STO 00
259 RCL 30
260 STO 01
261 CF 05
262 SF 06
263 ADV
264 SF 12
265 "BT"
266 XEQ 03
267 CF 06
268 FIX 1
269 STOP
270 GTO E
271*LBL 03
272 PRA
273 FIX 0
274 CF 12
275 "MIN="
276 ARCL 00
277 "⊢     MAX="
278 ARCL 01
279 PRA
280 127
281 ACCOL
282 124
283 SKPCOL
284 127
285 ACCOL
286 ADV
287 RCL 21
288 STO 22
289*LBL 05
290 RCL 22
291 ACX
292 XEQ 01
293 RCL 36
294 FS? 06
295 RCL 37
296 REGPLOT
297 RCL 24
298 ST+ 22
299 RCL 23
300 RCL 22
301 X<=Y?
302 GTO 05
303 RTN
304*LBL 01
305 0
306 STO 36
307 STO 37
308 RCL 13
309 2
310 *
311 37
312 +
313 STO 26
314 1
315 -
316 STO 25
317 RCL 22
318 RCL 38
319 -
320 RCL 39
321 R-P
322 LN
323 STO 31
324 X<>Y
325 D-R
326 STO 32
327 RCL 38
328 RCL 39
329 GTO 01
330*LBL 04
331 SF 07
332 XEQ 03
333 STO 31
334 X<>Y
335 D-R
336 STO 32
337 RCL IND 25
338 RCL IND 26
339 2
340 ST- 26
341 ST- 25
342 RDN
343*LBL 01
344 RCL IND 26
345 -
346 X=0?
347 GTO 07
348 X<>Y
349 RCL IND 25
350 -
351 CHS
352 R-P
353 X<>Y
354 180
355 +
356 STO 33
357*LBL 03
358 RCL 22
359 RCL IND 25
360 -
361 RCL IND 26
362 R-P
363 LN
364 FS?C 07
365 RTN
366 ST- 31
367 X<>Y
368 D-R
369 ST- 32
370 RCL 33
371 SIN
372 STO 34
373 LASTX
374 COS
375 STO 35
376 FS? 06
377 GTO 01
378 RCL 18
379 *
380 2
381 *
382 RCL 34
383 RCL 17
384 *
385 +
386 RCL 31
387 *
388 RCL 18
389 RCL 34
390 *
391 -2
392 *
393 RCL 35
394 RCL 17
395 *
396 +
397 RCL 32
398 *
399 +
400 RCL 34
401 *
402 ST+ 36
403 FS? 05
404 GTO 07
405 RCL 35
406*LBL 01
407 RCL 19
408 *
409 2
410 *
411 RCL 34
412 RCL 20
413 *
414 +
415 RCL 31
416 *
417 RCL 19
418 RCL 34
419 *
420 -2
421 *
422 RCL 35
423 RCL 20
424 *
425 +
426 RCL 32
427 *
428 +
429 RCL 34
430 *
431 ST+ 37
432*LBL 07
433 40
434 RCL 26
435 X>Y?
436 GTO 04
437 RCL 12
438 ST* 36
439 ST* 37
440 RTN
441*LBL G
442 FIX 1
443 "J RES="
444 ARCL 12
445 PRA
446 "I RES="
447 ARCL 10
448 PRA
449 "D RES="
450 ARCL 11
451 PRA
452 ADV
453 STOP
454 GTO E
455 .END.
```

HP 41 C
Vector
Operations
with demag.
& k aniso.
Program VECT.

```
01♦LBL "VECT"
02♦LBL A
03 CF 22
04 "F="
05 PROMPT
06 FS?C 22
07 STO 00
08 ARCL 00
09 PRA
10 "D="
11 PROMPT
12 FS?C 22
13 STO 02
14 ARCL 02
15 PRA
16 "I="
17 PROMPT
18 FS?C 22
19 STO 01
20 ARCL 01
21 PRA
22 ADV
23 "BEARING="
24 PROMPT
25 FS?C 22
26 STO 35
27 ARCL 35
28 PRA
29 ADV
30 RCL 02
31 RCL 01
32 RCL 00
33 XEQ 02
34 STO 04
35 X<>Y
36 STO 05
37 R↑
38 STO 06
39♦LBL B
40 "ISOTROPIC?(0,1)"
41 PROMPT
42 CF 22
43 X=0?
44 GTO 01
45 RCL 35
46 STO 43
47 SF 08
48 "K="
49 PROMPT
50 FS?C 22
51 STO 03
52 ARCL 03
53 PRA
54 ADV
55 RCL 03
56 ST* 04
57 ST* 05
58 ST* 06
59 GTO C
60♦LBL 01
61 CF 08
62 "Ka="
63 PROMPT
64 FS?C 22
65 STO 11
66 ARCL 11
67 PRA
68 "D="
69 PROMPT
70 FS?C 22
71 STO 12
72 ARCL 12
73 PRA
74 "I="
75 PROMPT
76 FS?C 22
77 STO 13
78 ARCL 13
79 PRA
80 ADV
81 "Kb="
82 PROMPT
83 FS?C 22
84 STO 14
85 ARCL 14
86 PRA
87 "D="
88 PROMPT
89 FS?C 22
90 STO 15
91 ARCL 15
92 PRA
93 "I="
94 PROMPT
95 FS?C 22
96 STO 16
97 ARCL 16
98 PRA
99 ADV
100 "Kc="
101 PROMPT
102 FS?C 22
103 STO 17
104 ARCL 17
105 PRA
106 "D="
107 PROMPT
108 FS?C 22
109 STO 18
110 ARCL 18
111 PRA
112 "I="
113 PROMPT
114 FS?C 22
115 STO 19
116 ARCL 19
117 PRA
118 ADV
119 RCL 12
120 RCL 13
121 1
122 XEQ 02
123 STO 20
124 X<>Y
125 STO 21
126 R↑
127 STO 22
128 RCL 15
129 RCL 16
130 1
131 XEQ 02
132 STO 23
133 X<>Y
134 STO 24
135 R↑
136 STO 25
137 RCL 18
138 RCL 19
139 1
140 XEQ 02
141 STO 26
142 X<>Y
143 STO 27
144 R↑
145 STO 28
146 RCL 04
147 RCL 20
148 *
149 RCL 05
150 RCL 21
151 *
152 +
153 RCL 06
154 RCL 22
155 *
156 +
157 RCL 11
158 *
159 STO 29
160 RCL 04
161 RCL 23
162 *
163 RCL 05
164 RCL 24
165 *
166 +
167 RCL 06
168 RCL 25
169 *
170 +
171 RCL 14
172 *
173 STO 30
174 RCL 04
175 RCL 26
176 *
177 RCL 05
178 RCL 27
179 *
180 +
181 RCL 06
182 RCL 28
183 *
184 +
185 RCL 17
186 *
187 STO 31
188 RCL 27
189 *
190 RCL 21
191 RCL 29
192 *
193 +
194 RCL 24
195 RCL 30
196 *
197 +
198 STO 05
199 RCL 31
200 RCL 26
201 *
202 RCL 20
203 RCL 29
204 *
205 +
206 RCL 30
207 RCL 23
208 *
209 +
210 STO 04
211 RCL 22
212 RCL 29
213 *
214 RCL 25
215 RCL 30
216 *
217 +
218 RCL 28
219 RCL 31
220 *
221 +
222 STO 06
223♦LBL C
224 RCL 04
225 STO 20
226 RCL 05
227 STO 21
228 RCL 06
229 STO 22
230 "REM?(0,1)"
231 PROMPT
232 CF 22
233 X=0?
234 GTO D
235 "J REM="
236 PROMPT
237 FS?C 22
238 STO 07
239 ARCL 07
240 PRA
```

```
241 "I REM="
242 PROMPT
243 FS?C 22
244 STO 08
245 ARCL 08
246 PRA
247 "D REM="
248 PROMPT
249 FS?C 22
250 STO 09
251 ARCL 09
252 PRA
253 ADV
254 RCL 09
255 RCL 08
256 RCL 07
257 XEQ 02
258 ST+ 20
259 X<>Y
260 ST+ 21
261 R↑
262 ST+ 22
263♦LBL D
264 RCL 22
265 RCL 21
266 RCL 20
267 R-P
268 X<>Y
269 STO 32
270 RDN
271 R-P
272 STO 33
273 RDN
274 STO 34
275 RCL 35
276 RCL 02
277 -
278 STO 43
279 RCL 32
280 +
281 STO 36
282 "DEMAG?<0,1>"
283 PROMPT
284 CF 22
285 X=0?
286 GTO E
287 "DIP="
288 PROMPT
289 FS?C 22
290 STO 37
291 ARCL 37
292 PRA
293 RCL 37
294 COS
295 STO 38
296 LASTX
297 SIN
298 STO 39
299 "INFINITE?<0,1>"
300 PROMPT
301 FS?C 22
302 STO 42
303 GTO IND 42
304♦LBL 00
305 "L="
306 PROMPT
307 FS?C 22
308 STO 40
309 ARCL 40
310 PRA
311 "T="
312 PROMPT
313 FS?C 22
314 STO 41
315 ARCL 41
316 PRA
317♦LBL 01
318 ADV
319 4
320 PI
321 *
322 STO 10
323 0
324 GTO IND 42
325♦LBL 00
326 RDN
327 RCL 41
328 RCL 40
329 +
330 /
331 STO 10
332 RCL 40
333 ST* 10
334 RDN
335 RCL 41
336 *
337♦LBL 01
338 STO 23
339 RCL 20
340 RCL 43
341 SIN
342 *
343 RCL 21
344 RCL 43
345 COS
346 *
347 +
348 STO 34
349 RCL 20
350 RCL 43
351 COS
352 *
353 RCL 21
354 RCL 43
355 SIN
356 *
357 -
358 STO 25
359 RCL 39
360 *
361 RCL 22
362 RCL 38
363 *
364 +
365 STO 26
366 RCL 22
367 RCL 39
368 *
369 RCL 25
370 RCL 38
371 *
372 -
373 STO 27
374 FC? 08
375 GTO 01
376 RCL 23
377 RCL 03
378 *
379 1
380 +
381 /
382 STO 36
383 RCL 26
384 RCL 10
385 RCL 03
386 *
387 1
388 +
389 /
390 GTO 03
391♦LBL 01
392 1
393 RCL 13
394 RCL 12
395 XEQ 01
396 STO 25
397 X<>Y
398 STO 28
399 R↑
400 STO 29
401 1
402 RCL 16
403 RCL 15
404 XEQ 01
405 STO 30
406 X<>Y
407 STO 31
408 R↑
409 STO 32
410 1
411 RCL 19
412 RCL 18
413 SF 07
414♦LBL 01
415 RCL 43
416 +
417 X<> Z
418♦LBL 02
419 P-R
420 X<>Y
421 RDN
422 P-R
423 FC?C 07
424 RTN
425 STO 33
426 X<>Y
427 STO 24
428 R↑
429 STO 36
430 RCL 39
431 *
432 RCL 33
433 RCL 38
434 *
435 -
436 STO 44
437 RCL 29
438 RCL 39
439 *
440 RCL 25
441 RCL 38
442 *
443 -
444 STO 45
445 RCL 32
446 RCL 39
447 *
448 RCL 30
449 RCL 38
450 *
451 -
452 STO 46
453 RCL 25
454 RCL 39
455 *
456 RCL 29
457 RCL 38
458 *
459 +
460 STO 47
461 RCL 30
462 RCL 39
463 *
464 RCL 32
465 RCL 38
466 *
467 +
468 STO 48
469 RCL 33
470 RCL 39
471 *
472 RCL 36
473 RCL 38
474 *
475 +
476 STO 25
477 RCL 44
478 *
479 RCL 17
480 *
481 RCL 46
482 RCL 48
483 *
484 RCL 14
485 *
486 +
487 RCL 45
488 RCL 47
```

```
489 *
490 RCL 11
491 *
492 +
493 STO 29
494 RCL 11
495 RCL 45
496 X↑2
497 *
498 RCL 14
499 RCL 46
500 X↑2
501 *
502 +
503 RCL 17
504 RCL 44
505 X↑2
506 *
507 +
508 STO 30
509 RCL 11
510 RCL 45
511 *
512 RCL 28
513 *
514 RCL 14
515 RCL 46
516 *
517 RCL 31
518 *
519 +
520 RCL 17
521 RCL 44
522 *
523 RCL 24
524 *
525 +
526 STO 32
527 RCL 11
528 RCL 28
529 *
530 RCL 47
531 *
532 RCL 14
533 RCL 31
534 *
535 RCL 48
536 *
537 +
538 RCL 17
539 RCL 24
540 *
541 RCL 25
542 *
543 +
544 STO 45
545 RCL 11
546 RCL 47
547 X↑2
548 *
549 RCL 14
550 RCL 48
613 RCL 27
614 *
615 RCL 29
616 RCL 26
617 *
618 +
619 STO 36
620 RCL 44
621 RCL 27
622 *
623 RCL 30
624 RCL 26
625 *
626 +
627♦LBL 03
628 STO 32
629 RCL 38
630 *
631 RCL 36
632 RCL 39
633 *
634 +
635 RCL 32
636 RCL 39
637 *
638 RCL 36
639 RCL 38
640 *
641 -
642 RCL 34
643 X<>Y
644 R-P
645 X<>Y
646 STO 36
647 RDN
648 R-P
649 STO 33
650 X<>Y
651 STO 34
652 RCL 28
653 RCL 30
654 *
655 RCL 44
656 RCL 29
657 *
658 -
659 FS? 08
660 1
661 ST/ 33
662 RCL 36
663 RCL 43
664 -
665 STO 32
666♦LBL E
667 "J RES="
668 ARCL 33
669 PRA
670 "D RES="
671 ARCL 32
672 PRA
673 "I RES="
674 ARCL 34
551 X↑2
552 *
553 +
554 RCL 17
555 RCL 25
556 X↑2
557 *
558 +
559 STO 28
560 RCL 23
561 ST* 30
562 ST* 32
563 RCL 29
564 *
565 STO 44
566 RCL 10
567 ST* 29
568 ST* 45
569 ST* 28
570 1
571 ST+ 30
572 ST+ 28
573 CHS
574 ST* 44
575 ST* 29
576 RCL 32
577 RCL 28
578 *
579 RCL 44
580 RCL 45
581 *
582 +
583 CHS
584 STO 31
585 RCL 30
586 RCL 28
587 *
588 RCL 29
589 RCL 44
590 *
591 -
592 STO 25
593 RCL 29
594 RCL 32
595 *
596 RCL 30
597 RCL 45
598 *
599 +
600 CHS
601 RCL 26
602 *
603 RCL 27
604 RCL 31
605 *
606 +
607 RCL 34
608 RCL 25
609 *
610 +
611 STO 34
612 RCL 28
675 PRA
676 ADV
677 "BEARING="
678 ARCL 36
679 PRA
680 ADV
681 .END.
```

HP 41 C
2 D Tabular
Body Program
Thick or Thin
Sheet with
demagnetisation
Magnetics
MAGMOD VIII A

```
01♦LBL "MAG8A"
02♦LBL A
03 CF 22
04 "F="
05 PROMPT
06 FS?C 22
07 STO 03
08 ARCL 03
09 PRA
10 "I="
11 PROMPT
12 FS?C 22
13 STO 04
14 ARCL 04
15 PRA
16 "D="
17 PROMPT
18 FS?C 22
19 STO 05
20 ARCL 05
21 PRA
22 ADV
23♦LBL B
24 "INFINITE?(0,1)"
25 PROMPT
26 FS?C 22
27 STO 13
28 "H1="
29 PROMPT
30 FS?C 22
31 STO 14
32 ARCL 14
33 PRA
34 GTO IND 13
35♦LBL 00
36 "H2="
37 PROMPT
38 FS?C 22
39 STO 15
40 ARCL 15
41 PRA
```

```
42♦LBL 01
43 "THICKNESS="
44 PROMPT
45 FC?C 22
46 GTO 01
47 STO 16
48 2
49 /
50 STO 17
51♦LBL 01
52 ARCL 16
53 PRA
54 "DIP="
55 PROMPT
56 FS?C 22
57 STO 18
58 ARCL 18
59 PRA
60 RCL 18
61 COS
62 STO 19
63 LASTX
64 SIN
65 STO 20
66 "SUSC="
67 PROMPT
68 FS?C 22
69 STO 21
70 ARCL 21
71 PRA
72 ADV
73 RCL 21
74 RCL 03
75 *
76 STO 06
77 STO 12
78 RCL 04
79 STO 10
80 RCL 05
81 STO 11
82 "REM?<0,1>"
83 PROMPT
84 CF 22
85 X=0?
86 GTO D
87♦LBL C
88 "J REM="
89 PROMPT
90 FS?C 22
91 STO 09
92 ARCL 09
93 PRA
94 "I REM="
95 PROMPT
96 FS?C 22
97 STO 07
98 ARCL 07
99 PRA
100 "D REM="
101 PROMPT
102 FS?C 22
103 STO 08
104 ARCL 08
105 PRA
106 ADV
107 RCL 08
108 RCL 07
109 RCL 09
110 P-R
111 X<>Y
112 STO 10
113 RDN
114 P-R
115 STO 11
116 RDN
117 STO 12
118 RCL 05
119 RCL 04
120 RCL 06
121 P-R
122 X<>Y
123 ST+ 10
124 RDN
125 P-R
126 ST+ 11
127 RDN
128 ST+ 12
129 RCL 10
130 RCL 12
131 RCL 11
132 R-P
133 X<>Y
134 STO 11
135 RDN
136 R-P
137 STO 12
138 RDN
139 STO 10
140♦LBL D
141 "BEARING="
142 PROMPT
143 FS?C 22
144 STO 22
145 ARCL 22
146 PRA
147 ADV
148 RCL 22
149 RCL 05
150 -
151 RCL 11
152 +
153 STO 23
154 XEQ G
155 "DEMAGNETISATION"
156 PRA
157 "CORRECTION"
158 PRA
159 ADV
160 RCL 10
161 RCL 12
162 P-R
163 X<>Y
164 STO 10
165 RDN
166 P-R
167 STO 23
168 RDN
169 STO 32
170 RCL 21
171 4
172 *
173 PI
174 *
175 STO 11
176 RCL 10
177 RCL 20
178 *
179 RCL 23
180 RCL 19
181 *
182 -
183 STO 12
184 GTO IND 13
185♦LBL 00
186 RCL 11
187 RCL 16
188 RCL 20
189 *
190 STO 33
191 RCL 15
192 RCL 14
193 -
194 RCL 20
195 /
196 STO 38
197 +
198 /
199 STO 11
200 RCL 38
201 ST* 11
202 RDN
203 RCL 33
204 *
205 1
206 +
207 ST/ 12
208♦LBL 01
209 RCL 23
210 RCL 20
211 *
212 RCL 10
213 RCL 19
214 *
215 +
216 RCL 11
217 1
218 +
219 /
220 STO 10
221 RCL 19
222 *
223 RCL 12
224 RCL 20
225 *
226 +
227 RCL 10
228 RCL 20
229 *
230 RCL 12
231 RCL 19
232 *
233 -
234 RCL 32
235 X<>Y
236 R-P
237 X<>Y
238 STO 23
239 RDN
240 R-P
241 STO 12
242 X<>Y
243 STO 10
244 R↑
245 RCL 22
246 -
247 RCL 05
248 +
249 STO 11
250 XEQ G
251 RCL 23
252 RCL 10
253 1
254 P-R
255 X<>Y
256 STO 27
257 CHS
258 STO 25
259 RDN
260 P-R
261 STO 32
262 -2
263 *
264 STO 24
265 RCL 22
266 RCL 04
267 1
268 P-R
269 X<>Y
270 STO 33
271 RDN
272 P-R
273 STO 38
274 RCL 32
275 *
276 RCL 27
277 RCL 33
278 *
279 -
280 STO 26
281 RCL 32
282 RCL 33
283 *
284 RCL 27
285 RCL 38
286 *
287 +
288 -2
289 *
```

```
290 STO 27
291*LBL E
292 "XMIN=?"
293 PROMPT
294 FS?C 22
295 STO 28
296 "XMAX=?"
297 PROMPT
298 FS?C 22
299 STO 30
300 "XINC=?"
301 PROMPT
302 FS?C 22
303 STO 31
304 RCL 28
305 STO 29
306*LBL 02
307 "X="
308 ARCL 29
309 PRA
310 RCL 25
311 STO 32
312 RCL 24
313 STO 33
314 XEQ 01
315 "BZ="
316 ARCL X
317 PRA
318 RCL 26
319 STO 32
320 RCL 27
321 STO 33
322 XEQ 01
323 "BT="
324 ARCL X
325 PRA
326 ADV
327 RCL 31
328 ST+ 29
329 RCL 30
330 RCL 29
331 X<=Y?
332 GTO 02
333 STOP
334 GTO E
335*LBL F
336 "BZ MIN=?"
337 PROMPT
338 FS?C 22
339 STO 34
340 "BZ MAX=?"
341 PROMPT
342 FS?C 22
343 STO 35
344 "BT MIN=?"
345 PROMPT
346 FS?C 22
347 STO 36
348 "BT MAX=?"
349 PROMPT
350 FS?C 22
351 STO 37
352 126
353 STO 02
354 RCL 34
355 STO 00
356 RCL 35
357 STO 01
358 RCL 25
359 STO 32
360 RCL 24
361 STO 33
362 SF 12
363 "BZ"
364 XEQ 03
365 RCL 36
366 STO 00
367 RCL 37
368 STO 01
369 RCL 26
370 STO 32
371 RCL 27
372 STO 33
373 ADV
374 SF 12
375 "BT"
376 XEQ 03
377 FIX 4
378 STOP
379 GTO E
380*LBL 03
381 PRA
382 FIX 0
383 CF 12
384 "MIN="
385 ARCL 00
386 "+     MAX="
387 ARCL 01
388 PRA
389 127
390 ACCOL
391 124
392 SKPCOL
393 127
394 ACCOL
395 ADV
396 RCL 28
397 STO 29
398*LBL 05
399 RCL 29
400 ACX
401 XEQ 01
402 REGPLOT
403 RCL 31
404 ST+ 29
405 RCL 30
406 RCL 29
407 X<=Y?
408 GTO 05
409 RTN
410*LBL 01
411 RCL 33
412 RCL 20
413 *
414 RCL 32
415 RCL 19
416 *
417 2
418 *
419 +
420 STO 39
421 RCL 32
422 RCL 20
423 *
424 -2
425 *
426 RCL 33
427 RCL 19
428 *
429 +
430 STO 40
431 RCL 29
432 STO 41
433 RCL 14
434 STO 42
435 XEQ 03
436 GTO IND 13
437*LBL 00
438 STO 43
439 RCL 15
440 RCL 14
441 -
442 RCL 18
443 TAN
444 /
445 ST+ 41
446 RCL 15
447 STO 42
448 XEQ 03
449 RCL 43
450 X<>Y
451 -
452*LBL 01
453 RCL 12
454 *
455 RCL 20
456 *
457 RTN
458*LBL 03
459 RCL 41
460 RCL 17
461 +
462 X↑2
463 RCL 42
464 X↑2
465 +
466 RCL 41
467 RCL 17
468 -
469 X↑2
470 RCL 42
471 X↑2
472 +
473 /
474 LN
475 RCL 39
476 *
477 2
478 /
479 RCL 41
480 RCL 17
481 +
482 RCL 42
483 /
484 ATAN
485 RCL 41
486 RCL 17
487 -
488 RCL 42
489 /
490 ATAN
491 -
492 D-R
493 RCL 40
494 *
495 +
496 RTN
497*LBL G
498 FIX 4
499 "J RES="
500 ARCL 12
501 PRA
502 "I RES="
503 ARCL 10
504 PRA
505 "D RES="
506 ARCL 11
507 PRA
508 ADV
509 RTN
510 .END.
```

HP 41 C
2 D Tabular
Body Program
with demag.
& k aniso.
Magnetics
MAGMOD VIII B

```
01*LBL "MAG8B"
02*LBL A
03 CF 22
04 "F="
05 PROMPT
06 FS?C 22
07 STO 03
08 ARCL 03
09 PRA
10 "I="
11 PROMPT
12 FS?C 22
13 STO 04
14 ARCL 04
```

```
15 PRA
16 "D="
17 PROMPT
18 FS?C 22
19 STO 05
20 ARCL 05
21 PRA
22 ADV
23♦LBL B
24 "INFINITE?(0,1)"
25 PROMPT
26 FS?C 22
27 STO 13
28 "H1="
29 PROMPT
30 FS?C 22
31 STO 14
32 ARCL 14
33 PRA
34 GTO IND 13
35♦LBL 00
36 "H2="
37 PROMPT
38 FS?C 22
39 STO 15
40 ARCL 15
41 PRA
42♦LBL 01
43 "THICKNESS="
44 PROMPT
45 FC?C 22
46 GTO 01
47 STO 16
48 2
49 /
50 STO 17
51♦LBL 01
52 ARCL 16
53 PRA
54 "DIP="
55 PROMPT
56 FS?C 22
57 STO 18
58 ARCL 18
59 PRA
60 RCL 18
61 COS
62 STO 19
63 LASTX
64 SIN
65 STO 20
66 ADV
67 "Ka="
68 PROMPT
69 FS?C 22
70 STO 21
71 ARCL 21
72 PRA
73 "D="
74 PROMPT
75 FS?C 22
76 STO 22
77 ARCL 22
78 PRA
79 "I="
80 PROMPT
81 FS?C 22
82 STO 23
83 ARCL 23
84 PRA
85 ADV
86 "Kb="
87 PROMPT
88 FS?C 22
89 STO 24
90 ARCL 24
91 PRA
92 "D="
93 PROMPT
94 FS?C 22
95 STO 25
96 ARCL 25
97 PRA
98 "I="
99 PROMPT
100 FS?C 22
101 STO 26
102 ARCL 26
103 PRA
104 ADV
105 "Kc="
106 PROMPT
107 FS?C 22
108 STO 27
109 ARCL 27
110 PRA
111 "D="
112 PROMPT
113 FS?C 22
114 STO 28
115 ARCL 28
116 PRA
117 "I="
118 PROMPT
119 FS?C 22
120 STO 29
121 ARCL 29
122 PRA
123 ADV
124 RCL 22
125 RCL 23
126 1
127 XEQ 01
128 STO 46
129 X<>Y
130 STO 47
131 R↑
132 STO 48
133 RCL 25
134 RCL 26
135 1
136 XEQ 01
137 STO 49
138 X<>Y
139 STO 50
140 R↑
141 STO 51
142 RCL 28
143 RCL 29
144 1
145 XEQ 01
146 STO 52
147 X<>Y
148 STO 53
149 R↑
150 STO 54
151 RCL 05
152 RCL 04
153 RCL 03
154 XEQ 01
155 STO 55
156 X<>Y
157 STO 56
158 R↑
159 STO 57
160 RCL 48
161 *
162 RCL 55
163 RCL 46
164 *
165 +
166 RCL 56
167 RCL 47
168 *
169 +
170 RCL 21
171 *
172 STO 40
173 RCL 55
174 RCL 49
175 *
176 RCL 56
177 RCL 50
178 *
179 +
180 RCL 57
181 RCL 51
182 *
183 +
184 RCL 24
185 *
186 STO 41
187 RCL 55
188 RCL 52
189 *
190 RCL 56
191 RCL 53
192 *
193 +
194 RCL 57
195 RCL 54
196 *
197 +
198 RCL 27
199 *
200 STO 55
201 RCL 52
202 *
203 RCL 40
204 RCL 46
205 *
206 +
207 RCL 41
208 RCL 49
209 *
210 +
211 STO 46
212 RCL 47
213 RCL 40
214 *
215 RCL 50
216 RCL 41
217 *
218 +
219 RCL 53
220 RCL 55
221 *
222 +
223 STO 47
224 RCL 48
225 RCL 40
226 *
227 RCL 51
228 RCL 41
229 *
230 +
231 RCL 54
232 RCL 55
233 *
234 +
235 STO 48
236♦LBL C
237 RCL 46
238 STO 49
239 RCL 47
240 STO 50
241 RCL 48
242 STO 51
243 "REM?(0,1)"
244 PROMPT
245 CF 22
246 X=0?
247 GTO D
248 "J REM="
249 PROMPT
250 FS?C 22
251 STO 09
252 ARCL 09
253 PRA
254 "I REM="
255 PROMPT
256 FS?C 22
257 STO 07
258 ARCL 07
259 PRA
260 "D REM="
261 PROMPT
262 FS?C 22
```

```
263 STO 08
264 ARCL 08
265 PRA
266 ADV
267 RCL 08
268 RCL 07
269 RCL 09
270 XEQ 01
271 ST+ 49
272 RDN
273 ST+ 50
274 X<> Z
275 ST+ 51
276 GTO D
277♦LBL 01
278 P-R
279 X<>Y
280 RDN
281 P-R
282 RTN
283♦LBL D
284 RCL 51
285 RCL 50
286 RCL 49
287 R-P
288 X<>Y
289 STO 11
290 RDN
291 R-P
292 STO 12
293 RDN
294 STO 10
295 "BEARING="
296 PROMPT
297 FS?C 22
298 STO 30
299 ARCL 30
300 PRA
301 ADV
302 RCL 30
303 RCL 05
304 -
305 STO 56
306 RCL 11
307 +
308 STO 31
309 XEQ G
310 "DEMAGNETISATION"
311 PRA
312 "CORRECTION"
313 PRA
314 ADV
315 1
316 RCL 23
317 RCL 22
318 XEQ 03
319 STO 10
320 X<>Y
321 STO 11
322 R↑
323 STO 12
324 1
325 RCL 26
326 RCL 25
327 XEQ 03
328 STO 31
329 X<>Y
330 STO 40
331 R↑
332 STO 41
333 1
334 RCL 29
335 RCL 28
336 SF 07
337♦LBL 03
338 RCL 56
339 +
340 X<> Z
341 P-R
342 X<>Y
343 RDN
344 P-R
345 FC?C 07
346 RTN
347 STO 52
348 X<>Y
349 STO 53
350 R↑
351 STO 54
352 RCL 20
353 *
354 RCL 52
355 RCL 19
356 *
357 -
358 STO 55
359 RCL 12
360 RCL 20
361 *
362 RCL 10
363 RCL 19
364 *
365 -
366 STO 57
367 RCL 41
368 RCL 20
369 *
370 RCL 31
371 RCL 19
372 *
373 -
374 STO 58
375 RCL 10
376 RCL 20
377 *
378 RCL 12
379 RCL 19
380 *
381 +
382 STO 10
383 RCL 31
384 RCL 20
385 *
386 RCL 41
387 RCL 19
388 *
389 +
390 STO 12
391 RCL 52
392 RCL 20
393 *
394 RCL 54
395 RCL 19
396 *
397 +
398 STO 31
399 RCL 55
400 *
401 RCL 27
402 *
403 RCL 58
404 RCL 12
405 *
406 RCL 24
407 *
408 +
409 RCL 57
410 RCL 10
411 *
412 RCL 21
413 *
414 +
415 STO 52
416 RCL 21
417 RCL 57
418 X↑2
419 *
420 RCL 24
421 RCL 58
422 X↑2
423 *
424 +
425 RCL 27
426 RCL 55
427 X↑2
428 *
429 +
430 STO 54
431 RCL 21
432 RCL 57
433 RCL 11
434 *
435 *
436 RCL 24
437 RCL 58
438 *
439 RCL 40
440 *
441 +
442 RCL 27
443 RCL 55
444 *
445 RCL 53
446 *
447 +
448 STO 58
449 RCL 21
450 RCL 11
451 *
452 RCL 10
453 *
454 RCL 24
455 RCL 40
456 *
457 RCL 12
458 *
459 +
460 RCL 27
461 RCL 53
462 *
463 RCL 31
464 *
465 +
466 STO 57
467 RCL 21
468 RCL 10
469 X↑2
470 *
471 RCL 24
472 RCL 12
473 X↑2
474 *
475 +
476 RCL 27
477 RCL 31
478 X↑2
479 *
480 +
481 STO 11
482 4
483 PI
484 *
485 STO 53
486 0
487 GTO IND 13
488♦LBL 00
489 RDN
490 RCL 16
491 RCL 20
492 *
493 STO 41
494 RCL 15
495 RCL 14
496 -
497 RCL 20
498 /
499 STO 40
500 +
501 /
502 STO 53
503 RCL 40
504 ST* 53
505 RDN
506 RCL 41
507 *
508♦LBL 01
509 STO 41
510 RCL 49
```

G

```
511 RCL 56
512 SIN
513 *
514 RCL 50
515 RCL 56
516 COS
517 *
518 +
519 STO 10
520 RCL 49
521 RCL 56
522 COS
523 *
524 RCL 50
525 RCL 56
526 SIN
527 *
528 -
529 STO 55
530 RCL 20
531 *
532 RCL 51
533 RCL 19
534 *
535 +
536 STO 40
537 RCL 51
538 RCL 20
539 *
540 RCL 55
541 RCL 19
542 *
543 -
544 STO 31
545 RCL 41
546 ST* 54
547 ST* 58
548 RCL 52
549 *
550 STO 55
551 RCL 53
552 ST* 52
553 ST* 57
554 ST* 11
555 1
556 ST+ 54
557 ST+ 11
558 -1
559 ST* 55
560 ST* 52
561 RCL 58
562 RCL 11
563 *
564 RCL 55
565 RCL 57
566 *
567 +
568 CHS
569 STO 41
570 RCL 54
571 RCL 11
572 *
573 RCL 52
574 RCL 55
575 *
576 -
577 STO 53
578 RCL 52
579 RCL 58
580 *
581 RCL 54
582 RCL 57
583 *
584 +
585 CHS
586 STO 12
587 RCL 40
588 *
589 RCL 41
590 RCL 31
591 *
592 +
593 RCL 10
594 RCL 53
595 *
596 +
597 STO 58
598 RCL 11
599 RCL 31
600 *
601 RCL 52
602 RCL 40
603 *
604 +
605 STO 57
606 RCL 55
607 RCL 31
608 *
609 RCL 54
610 RCL 40
611 *
612 +
613 STO 41
614 RCL 19
615 *
616 RCL 57
617 RCL 20
618 *
619 +
620 RCL 41
621 RCL 20
622 *
623 RCL 57
624 RCL 19
625 *
626 -
627 RCL 58
628 X<>Y
629 R-P
630 X<>Y
631 STO 31
632 RDN
633 R-P
634 STO 12
635 X<>Y
636 RCL 11
637 RCL 54
638 *
639 RCL 52
640 RCL 55
641 *
642 -
643 ST/ 12
644 RDN
645 STO 10
646 RCL 31
647 RCL 56
648 -
649 STO 11
650 XEQ G
651 RCL 31
652 RCL 10
653 1
654 P-R
655 X<>Y
656 STO 35
657 CHS
658 STO 33
659 RDN
660 P-R
661 STO 40
662 -2
663 *
664 STO 32
665 RCL 30
666 RCL 04
667 1
668 P-R
669 X<>Y
670 STO 41
671 RDN
672 P-R
673 STO 52
674 RCL 40
675 *
676 RCL 35
677 RCL 41
678 *
679 -
680 STO 34
681 RCL 40
682 RCL 41
683 *
684 RCL 35
685 RCL 52
686 *
687 +
688 -2
689 *
690 STO 35
691*LBL E
692 "XMIN=?"
693 PROMPT
694 FS?C 22
695 STO 36
696 "XMAX=?"
697 PROMPT
698 FS?C 22
699 STO 38
700 "XINC=?"
701 PROMPT
702 FS?C 22
703 STO 39
704 RCL 36
705 STO 37
706*LBL 02
707 "X="
708 ARCL 37
709 PRA
710 RCL 33
711 STO 40
712 RCL 32
713 STO 41
714 XEQ 01
715 "BZ="
716 ARCL X
717 PRA
718 RCL 34
719 STO 40
720 RCL 35
721 STO 41
722 XEQ 01
723 "BT="
724 ARCL X
725 PRA
726 ADV
727 RCL 39
728 ST+ 37
729 RCL 38
730 RCL 37
731 X<=Y?
732 GTO 02
733 STOP
734 GTO E
735*LBL F
736 "BZ MIN=?"
737 PROMPT
738 FS?C 22
739 STO 42
740 "BZ MAX=?"
741 PROMPT
742 FS?C 22
743 STO 43
744 "BT MIN=?"
745 PROMPT
746 FS?C 22
747 STO 44
748 "BT MAX=?"
749 PROMPT
750 FS?C 22
751 STO 45
752 126
753 STO 02
754 RCL 42
755 STO 00
756 RCL 43
757 STO 01
758 RCL 33
```

```
759 STO 40
760 RCL 32
761 STO 41
762 SF 12
763 "BZ"
764 XEQ 03
765 RCL 44
766 STO 00
767 RCL 45
768 STO 01
769 RCL 34
770 STO 40
771 RCL 35
772 STO 41
773 ADV
774 SF 12
775 "BT"
776 XEQ 03
777 FIX 4
778 STOP
779 GTO E
780♦LBL 03
781 PRA
782 FIX 0
783 CF 12
784 "MIN="
785 ARCL 00
786 "┼     MAX="
787 ARCL 01
788 PRA
789 127
790 ACCOL
791 124
792 SKPCOL
793 127
794 ACCOL
795 ADV
796 RCL 36
797 STO 37
798♦LBL 05
799 RCL 37
800 ACX
801 XEQ 01
802 REGPLOT
803 RCL 39
804 ST+ 37
805 RCL 38
806 RCL 37
807 X<=Y?
808 GTO 05
809 RTN
810♦LBL 01
811 RCL 41
812 RCL 20
813 *
814 RCL 40
815 RCL 19
816 *
817 2
818 *
819 +
820 STO 53
821 RCL 40
822 RCL 20
823 *
824 -2
825 *
826 RCL 41
827 RCL 19
828 *
829 +
830 STO 54
831 RCL 37
832 STO 55
833 RCL 14
834 STO 56
835 XEQ 03
836 GTO IND 13
837♦LBL 00
838 STO 57
839 RCL 15
840 RCL 14
841 -
842 RCL 18
843 TAN
844 /
845 ST+ 55
846 RCL 15
847 STO 56
848 XEQ 03
849 RCL 57
850 X<>Y
851 -
852♦LBL 01
853 RCL 12
854 *
855 RCL 20
856 *
857 RTN
858♦LBL 03
859 RCL 55
860 RCL 17
861 +
862 X↑2
863 RCL 56
864 X↑2
865 +
866 RCL 55
867 RCL 17
868 -
869 X↑2
870 RCL 56
871 X↑2
872 +
873 /
874 LN
875 RCL 53
876 *
877 2
878 /
879 RCL 55
880 RCL 17
881 +
882 RCL 56
883 /
884 ATAN
885 RCL 55
886 RCL 17
887 -
888 RCL 56
889 /
890 ATAN
891 -
892 D-R
893 RCL 54
894 *
895 +
896 RTN
897♦LBL G
898 FIX 4
899 "J RES="
900 ARCL 12
901 PRA
902 "I RES="
903 ARCL 10
904 PRA
905 "D RES="
906 ARCL 11
907 PRA
908 ADV
909 .END.
```

HP 41 C
Prolate
Ellipsoid
Program
Magnetics
MAGMOD XIA

```
01♦LBL "MAG11A"
02 GTO B
03♦LBL A
04 CF 22
05 FIX 1
06 "F="
07 PROMPT
08 FS?C 22
09 STO 03
10 ARCL 03
11 PRA
12 "I="
13 PROMPT
14 FS?C 22
15 STO 04
16 ARCL 04
17 PRA
18 "D="
19 PROMPT
20 FS?C 22
21 STO 05
22 ARCL 05
23 PRA
24 ADV
25♦LBL B
26 "DEPTH="
27 PROMPT
28 FS?C 22
29 STO 13
30 ARCL 13
31 PRA
32 "PLUNGE="
33 PROMPT
34 FS?C 22
35 STO 14
36 ARCL 14
37 PRA
38 "AZIMUTH="
39 PROMPT
40 FS?C 22
41 STO 15
42 ARCL 15
43 PRA
44 "a="
45 PROMPT
46 FS?C 22
47 STO 16
48 ARCL 16
49 PRA
50 "b="
51 PROMPT
52 FS?C 22
53 STO 17
54 ARCL 17
55 PRA
56 RCL 16
57 ENTER↑
58 X↑2
59 RCL 17
60 X↑2
61 -
62 STO 29
63 -1.5
64 Y↑X
65 X<>Y
66 4
67 *
68 PI
69 *
70 RCL 17
71 X↑2
72 *
73 *
74 STO 57
75 LASTX
76 3
77 /
78 "VOL="
79 ARCL X
80 PRA
81 ADV
82 RCL 15
83 COS
84 STO 30
85 STO 31
```

```
 86 CHS
 87 STO 32
 88 LASTX
 89 SIN
 90 STO 33
 91 STO 34
 92 STO 35
 93 RCL 14
 94 COS
 95 CHS
 96 ST* 30
 97 ST* 33
 98 STO 36
 99 LASTX
100 SIN
101 ST* 31
102 ST* 34
103 CHS
104 STO 37
105 RCL 13
106 X↑2
107 STO 38
108 FIX 6
109 "Ka="
110 PROMPT
111 FS?C 22
112 STO 18
113 ARCL 18
114 PRA
115 FIX 1
116 "D="
117 PROMPT
118 FS?C 22
119 STO 19
120 ARCL 19
121 PRA
122 "I="
123 PROMPT
124 FS?C 22
125 STO 20
126 ARCL 20
127 PRA
128 ADV
129 FIX 6
130 "Kb="
131 PROMPT
132 FS?C 22
133 STO 21
134 ARCL 21
135 PRA
136 FIX 1
137 "D="
138 PROMPT
139 FS?C 22
140 STO 22
141 ARCL 22
142 PRA
143 "I="
144 PROMPT
145 FS?C 22
146 STO 23
147 ARCL 23
148 PRA
149 ADV
150 FIX 6
151 "Kc="
152 PROMPT
153 FS?C 22
154 STO 24
155 ARCL 24
156 PRA
157 FIX 1
158 "D="
159 PROMPT
160 FS?C 22
161 STO 25
162 ARCL 25
163 PRA
164 "I="
165 PROMPT
166 FS?C 22
167 STO 26
168 ARCL 26
169 PRA
170 ADV
171 "REM?<0,1>"
172 PROMPT
173 CF 22
174 CF 05
175 X=0?
176 GTO D
177*LBL C
178 SF 05
179 "J REM="
180 PROMPT
181 FS?C 22
182 STO 09
183 ARCL 09
184 PRA
185 "I REM="
186 PROMPT
187 FS?C 22
188 STO 07
189 ARCL 07
190 PRA
191 "D REM="
192 PROMPT
193 FS?C 22
194 STO 08
195 ARCL 08
196 PRA
197 ADV
198*LBL D
199 "BEARING="
200 PROMPT
201 FS?C 22
202 STO 27
203 ARCL 27
204 PRA
205 ADV
206 1
207 RCL 20
208 RCL 19
209 XEQ 01
210 STO 43
211 X<>Y
212 STO 44
213 R↑
214 STO 00
215 1
216 RCL 23
217 RCL 22
218 XEQ 01
219 STO 01
220 X<>Y
221 STO 47
222 R↑
223 STO 02
224 1
225 RCL 26
226 RCL 25
227 XEQ 01
228 STO 49
229 X<>Y
230 STO 50
231 R↑
232 STO 51
233 RCL 37
234 *
235 RCL 50
236 RCL 33
237 *
238 +
239 RCL 49
240 RCL 30
241 *
242 +
243 STO 52
244 RCL 36
245 ST* 51
246 RCL 49
247 RCL 31
248 *
249 RCL 50
250 RCL 34
251 *
252 +
253 ST+ 51
254 RCL 35
255 ST* 49
256 RCL 50
257 RCL 32
258 *
259 ST+ 49
260 RCL 43
261 RCL 30
262 *
263 RCL 44
264 RCL 33
265 *
266 +
267 RCL 00
268 RCL 37
269 *
270 +
271 STO 50
272 RCL 36
273 ST* 00
274 RCL 43
275 RCL 31
276 *
277 RCL 44
278 RCL 34
279 *
280 +
281 ST+ 00
282 RCL 35
283 ST* 43
284 RCL 44
285 RCL 32
286 *
287 ST+ 43
288 RCL 01
289 RCL 30
290 *
291 RCL 47
292 RCL 33
293 *
294 +
295 RCL 02
296 RCL 37
297 *
298 +
299 STO 44
300 RCL 36
301 ST* 02
302 RCL 01
303 RCL 31
304 *
305 RCL 47
306 RCL 34
307 *
308 +
309 ST+ 02
310 RCL 35
311 ST* 01
312 RCL 47
313 RCL 32
314 *
315 ST+ 01
316 RCL 18
317 RCL 50
318 X↑2
319 *
320 RCL 21
321 RCL 44
322 X↑2
323 *
324 +
325 RCL 24
326 RCL 52
327 X↑2
328 *
329 +
330 STO 47
331 RCL 18
332 RCL 50
333 *
```

```
334 RCL 00
335 *
336 RCL 21
337 RCL 44
338 *
339 RCL 02
340 *
341 +
342 RCL 24
343 RCL 52
344 *
345 RCL 51
346 *
347 +
348 STO 45
349 RCL 18
350 RCL 43
351 *
352 ST* 50
353 RCL 21
354 RCL 44
355 *
356 RCL 01
357 *
358 RCL 24
359 RCL 52
360 *
361 RCL 49
362 *
363 +
364 ST+ 50
365 RCL 18
366 RCL 00
367 X↑2
368 *
369 RCL 21
370 RCL 02
371 X↑2
372 *
373 +
374 RCL 24
375 RCL 51
376 X↑2
377 *
378 +
379 STO 44
380 RCL 18
381 RCL 43
382 *
383 ST* 00
384 RCL 21
385 RCL 02
386 *
387 RCL 01
388 *
389 RCL 24
390 RCL 51
391 *
392 RCL 49
393 *
394 +
395 ST+ 00
396 RCL 18
397 RCL 43
398 *
399 ST* 43
400 RCL 21
401 RCL 01
402 X↑2
403 *
404 RCL 24
405 RCL 49
406 X↑2
407 *
408 +
409 ST+ 43
410 RCL 27
411 RCL 04
412 RCL 03
413 XEQ 02
414 STO 10
415 X<>Y
416 STO 11
417 R↑
418 STO 12
419 RCL 37
420 *
421 X<>Y
422 RCL 33
423 *
424 +
425 X<>Y
426 RCL 30
427 *
428 +
429 STO 46
430 RCL 36
431 ST* 12
432 RCL 10
433 RCL 31
434 *
435 RCL 11
436 RCL 34
437 *
438 +
439 ST+ 12
440 RCL 32
441 ST* 11
442 RCL 10
443 RCL 35
444 *
445 ST+ 11
446 RCL 46
447 RCL 47
448 *
449 RCL 12
450 RCL 45
451 *
452 +
453 RCL 11
454 RCL 50
455 *
456 +
457 STO 10
458 RCL 46
459 RCL 45
460 *
461 RCL 12
462 RCL 44
463 *
464 +
465 RCL 11
466 RCL 00
467 *
468 +
469 X<> 11
470 RCL 43
471 *
472 RCL 46
473 RCL 50
474 *
475 +
476 RCL 12
477 RCL 00
478 *
479 +
480 STO 12
481 FC? 05
482 GTO 03
483 RCL 09
484 RCL 07
485 RCL 08
486 SF 06
487◆LBL 01
488 RCL 27
489 +
490 RCL 05
491 -
492 X<> Z
493◆LBL 02
494 P-R
495 X<>Y
496 RDN
497 P-R
498 FC?C 06
499 RTN
500 STO 01
501 X<>Y
502 STO 02
503 R↑
504 STO 49
505 RCL 37
506 *
507 X<>Y
508 RCL 33
509 *
510 +
511 X<>Y
512 RCL 30
513 *
514 +
515 ST+ 10
516 RCL 01
517 RCL 31
518 *
519 RCL 02
520 RCL 34
521 *
522 +
523 RCL 49
524 RCL 36
525 *
526 +
527 ST+ 11
528 RCL 01
529 RCL 35
530 *
531 RCL 02
532 RCL 32
533 *
534 +
535 ST+ 12
536◆LBL 03
537 RCL 29
538 RCL 17
539 X↑2
540 /
541 SQRT
542 RCL 16
543 RCL 17
544 /
545 +
546 LN
547 RCL 29
548 RCL 16
549 X↑2
550 /
551 SQRT
552 -
553 RCL 57
554 *
555 STO 01
556 FIX 4
557 "N1="
558 ARCL X
559 PRA
560 ST* 47
561 RCL 45
562 *
563 STO 49
564 2
565 PI
566 *
567 RCL 01
568 2
569 /
570 -
571 STO 02
572 "N2="
573 ARCL X
574 PRA
575 ADV
576 FIX 1
577 ST* 44
578 ST* 45
579 ST* 43
580 ST* 00
581 RCL 50
```

```
582 ST* 01
583 ST* 02
584 1
585 ST+ 43
586 ST+ 44
587 ST+ 47
588 RCL 44
589 RCL 43
590 *
591 RCL 00
592 X↑2
593 -
594 STO 50
595 RCL 47
596 *
597 RCL 00
598 RCL 01
599 *
600 RCL 49
601 RCL 43
602 *
603 -
604 STO 51
605 RCL 45
606 *
607 +
608 RCL 49
609 RCL 00
610 *
611 RCL 44
612 RCL 01
613 *
614 -
615 STO 52
616 RCL 02
617 *
618 +
619 STO 46
620 RCL 45
621 RCL 00
622 *
623 RCL 02
624 RCL 44
625 *
626 -
627 STO 48
628 RCL 47
629 ST* 44
630 RCL 45
631 RCL 49
632 *
633 ST- 44
634 RCL 02
635 ST* 49
636 RCL 47
637 RCL 00
638 *
639 ST- 49
640 RCL 47
641 RCL 43
642 *
643 RCL 02
644 RCL 01
645 *
646 -
647 STO 58
648 RCL 00
649 ST* 02
650 RCL 45
651 RCL 43
652 *
653 ST- 02
654 RCL 45
655 ST* 01
656 RCL 47
657 RCL 00
658 *
659 ST- 01
660 RCL 50
661 RCL 10
662 *
663 RCL 02
664 RCL 11
665 *
666 +
667 RCL 48
668 RCL 12
669 *
670 +
671 RCL 51
672 RCL 10
673 *
674 RCL 58
675 RCL 11
676 *
677 +
678 RCL 49
679 RCL 12
680 *
681 +
682 X<> 11
683 RCL 01
684 *
685 RCL 52
686 RCL 10
687 *
688 +
689 RCL 44
690 RCL 12
691 *
692 +
693 STO 12
694 X<>Y
695 RCL 46
696 ST/ 11
697 ST/ 12
698 /
699 STO 10
700◆LBL E
701 "XMIN=?"
702 PROMPT
703 FS?C 22
704 STO 39
705 "XMAX=?"
706 PROMPT
707 FS?C 22
708 STO 41
709 "XINC=?"
710 PROMPT
711 FS?C 22
712 STO 42
713 RCL 39
714 STO 40
715◆LBL 04
716 "X="
717 ARCL 40
718 PRA
719 XEQ 01
720 "BZ="
721 ARCL 48
722 PRA
723 "BT="
724 ARCL X
725 PRA
726 ADV
727 RCL 42
728 ST+ 40
729 RCL 41
730 RCL 40
731 X<=Y?
732 GTO 04
733 STOP
734 GTO E
735◆LBL F
736 "BZ MIN=?"
737 PROMPT
738 FS?C 22
739 STO 53
740 "BZ MAX=?"
741 PROMPT
742 FS?C 22
743 STO 54
744 "BT MIN=?"
745 PROMPT
746 FS?C 22
747 STO 55
748 "BT MAX=?"
749 PROMPT
750 FS?C 22
751 STO 56
752 126
753 STO 02
754 RCL 53
755 STO 00
756 RCL 54
757 STO 01
758 SF 12
759 "BZ"
760 SF 06
761 FIX 0
762 XEQ 03
763 CF 06
764 RCL 55
765 STO 00
766 RCL 56
767 STO 01
768 SF 12
769 "BT"
770 XEQ 03
771 FIX 1
772 STOP
773 GTO E
774◆LBL 03
775 PRA
776 CF 12
777 "MIN="
778 ARCL 00
779 "├     MAX="
780 ARCL 01
781 PRA
782 127
783 ACCOL
784 124
785 SKPCOL
786 127
787 ACCOL
788 ADV
789 RCL 39
790 STO 40
791◆LBL 05
792 RCL 40
793 ACX
794 XEQ 01
795 FS? 06
796 RCL 48
797 REGPLOT
798 RCL 42
799 ST+ 40
800 RCL 41
801 RCL 40
802 X<=Y?
803 GTO 05
804 ADV
805 RTN
806◆LBL 01
807 RCL 30
808 RCL 40
809 *
810 STO 43
811 LASTX
812 RCL 31
813 *
814 STO 44
815 RCL 37
816 RCL 13
817 *
818 ST- 43
819 LASTX
820 RCL 36
821 *
822 ST- 44
823 RCL 40
824 RCL 35
825 *
826 STO 45
827 X↑2
828 RCL 43
829 X↑2
```

```
830 -
831 RCL 44
832 X↑2
833 +
834 RCL 29
835 *
836 2
837 *
838 RCL 29
839 X↑2
840 +
841 RCL 40
842 X↑2
843 RCL 38
844 +
845 STO 48
846 X↑2
847 +
848 SQRT
849 STO 46
850 RCL 16
851 X↑2
852 STO 49
853 -
854 RCL 17
855 X↑2
856 STO 50
857 -
858 RCL 48
859 +
860 2
861 /
862 ST+ 49
863 ST+ 50
864 RCL 10
865 RCL 43
866 *
867 RCL 49
868 1.5
869 Y↑X
870 /
871 RCL 50
872 /
873 RCL 11
874 RCL 44
875 *
876 RCL 12
877 RCL 45
878 *
879 +
880 RCL 49
881 SQRT
882 /
883 RCL 50
884 X↑2
885 /
886 +
887 STO 51
888 RCL 29
889 SQRT
890 RCL 49
891 SQRT
892 +
893 RCL 50
894 SQRT
895 /
896 LN
897 STO 47
898 RCL 29
899 RCL 49
900 *
901 SQRT
902 RCL 50
903 /
904 -
905 RCL 57
906 2
907 /
908 ST* 51
909 *
910 STO 52
911 RCL 29
912 1.5
913 Y↑X
914 ST* 51
915 X<>Y
916 RCL 11
917 *
918 RCL 48
919 RCL 29
920 +
921 RCL 46
922 /
923 1
924 +
925 RCL 51
926 *
927 ST* 44
928 ST* 45
929 X<>Y
930 ST+ 44
931 RCL 48
932 RCL 29
933 -
934 RCL 46
935 /
936 1
937 +
938 RCL 51
939 *
940 ST* 43
941 RCL 29
942 RCL 49
943 /
944 SQRT
945 RCL 47
946 -
947 RCL 10
948 *
949 RCL 57
950 *
951 ST+ 43
952 RCL 12
953 RCL 52
954 *
955 ST+ 45
956 RCL 43
957 RCL 30
958 *
959 RCL 44
960 RCL 31
961 *
962 +
963 RCL 45
964 RCL 35
965 *
966 +
967 RCL 27
968 COS
969 *
970 RCL 43
971 RCL 33
972 *
973 RCL 44
974 RCL 34
975 *
976 +
977 RCL 45
978 RCL 32
979 *
980 +
981 RCL 27
982 SIN
983 *
984 +
985 RCL 04
986 COS
987 *
988 RCL 43
989 RCL 37
990 *
991 RCL 44
992 RCL 36
993 *
994 +
995 STO 48
996 RCL 04
997 SIN
998 *
999 +
1000 RTN
1001*LBL G
1002 RCL 10
1003 RCL 30
1004 *
1005 RCL 11
1006 RCL 31
1007 *
1008 +
1009 RCL 12
1010 RCL 35
1011 *
1012 +
1013 STO 00
1014 RCL 10
1015 RCL 37
1016 *
1017 RCL 11
1018 RCL 36
1019 *
1020 +
1021 RCL 10
1022 RCL 33
1023 *
1024 RCL 11
1025 RCL 34
1026 *
1027 +
1028 RCL 12
1029 RCL 32
1030 *
1031 +
1032 RCL 00
1033 R-P
1034 X<>Y
1035 RDN
1036 R-P
1037 "J RES="
1038 ARCL X
1039 PRA
1040 "I RES="
1041 ARCL Y
1042 PRA
1043 R↑
1044 STO 28
1045 RCL 27
1046 -
1047 RCL 05
1048 +
1049 "D RES="
1050 ARCL X
1051 PRA
1052 ADV
1053 .END.
```

HP 41 C
Oblate
Ellipsoid
Program
Magnetics
MAGMOD XIB

```
01*LBL "MAG11B"
02*LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
```

```
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "DEPTH="
26 PROMPT
27 FS?C 22
28 STO 13
29 ARCL 13
30 PRA
31 "DIP="
32 PROMPT
33 FS?C 22
34 STO 14
35 ARCL 14
36 PRA
37 "AZIMUTH="
38 PROMPT
39 FS?C 22
40 STO 15
41 ARCL 15
42 PRA
43 "a="
44 PROMPT
45 FS?C 22
46 STO 16
47 ARCL 16
48 PRA
49 "b="
50 PROMPT
51 FS?C 22
52 STO 17
53 ARCL 17
54 PRA
55 RCL 17
56 X↑2
57 ENTER↑
58 ENTER↑
59 RCL 16
60 X↑2
61 -
62 STO 29
63 -1.5
64 Y↑X
65 X<>Y
66 4
67 *
68 PI
69 *
70 RCL 16
71 *
72 *
73 STO 57
74 LASTX
75 3
76 /
77 "VOL="
78 ARCL X
79 PRA
80 ADV
81 RCL 15
82 COS
83 STO 30
84 STO 31
85 STO 32
86 LASTX
87 SIN
88 STO 33
89 STO 34
90 CHS
91 STO 35
92 RCL 14
93 COS
94 CHS
95 ST* 31
96 ST* 34
97 STO 37
98 LASTX
99 SIN
100 ST* 30
101 ST* 33
102 CHS
103 STO 36
104 RCL 13
105 X↑2
106 STO 38
107 FIX 6
108 "Ka="
109 PROMPT
110 FS?C 22
111 STO 18
112 ARCL 18
113 PRA
114 FIX 1
115 "D="
116 PROMPT
117 FS?C 22
118 STO 19
119 ARCL 19
120 PRA
121 "I="
122 PROMPT
123 FS?C 22
124 STO 20
125 ARCL 20
126 PRA
127 ADV
128 FIX 6
129 "Kb="
130 PROMPT
131 FS?C 22
132 STO 21
133 ARCL 21
134 PRA
135 FIX 1
136 "D="
137 PROMPT
138 FS?C 22
139 STO 22
140 ARCL 22
141 PRA
142 "I="
143 PROMPT
144 FS?C 22
145 STO 23
146 ARCL 23
147 PRA
148 ADV
149 FIX 6
150 "Kc="
151 PROMPT
152 FS?C 22
153 STO 24
154 ARCL 24
155 PRA
156 FIX 1
157 "D="
158 PROMPT
159 FS?C 22
160 STO 25
161 ARCL 25
162 PRA
163 "I="
164 PROMPT
165 FS?C 22
166 STO 26
167 ARCL 26
168 PRA
169 ADV
170 "REM?<0,1>"
171 PROMPT
172 CF 22
173 CF 05
174 X=0?
175 GTO D
176♦LBL C
177 SF 05
178 "J REM="
179 PROMPT
180 FS?C 22
181 STO 09
182 ARCL 09
183 PRA
184 "I REM="
185 PROMPT
186 FS?C 22
187 STO 07
188 ARCL 07
189 PRA
190 "D REM="
191 PROMPT
192 FS?C 22
193 STO 08
194 ARCL 08
195 PRA
196 ADV
197♦LBL D
198 "BEARING="
199 PROMPT
200 FS?C 22
201 STO 27
202 ARCL 27
203 PRA
204 ADV
205 1
206 RCL 20
207 RCL 19
208 XEQ 01
209 STO 43
210 X<>Y
211 STO 44
212 R↑
213 STO 00
214 1
215 RCL 23
216 RCL 22
217 XEQ 01
218 STO 01
219 X<>Y
220 STO 47
221 R↑
222 STO 02
223 1
224 RCL 26
225 RCL 25
226 XEQ 01
227 STO 49
228 X<>Y
229 STO 50
230 R↑
231 STO 51
232 RCL 37
233 *
234 RCL 50
235 RCL 33
236 *
237 +
238 RCL 49
239 RCL 30
240 *
241 +
242 STO 52
243 RCL 36
244 ST* 51
245 RCL 49
246 RCL 31
247 *
248 RCL 50
249 RCL 34
250 *
251 +
252 ST+ 51
253 RCL 35
254 ST* 49
255 RCL 50
256 RCL 32
257 *
258 ST+ 49
259 RCL 43
```

```
260 RCL 30
261 *
262 RCL 44
263 RCL 33
264 *
265 +
266 RCL 00
267 RCL 37
268 *
269 +
270 STO 50
271 RCL 36
272 ST* 00
273 RCL 43
274 RCL 31
275 *
276 RCL 44
277 RCL 34
278 *
279 +
280 ST+ 00
281 RCL 35
282 ST* 43
283 RCL 44
284 RCL 32
285 *
286 ST+ 43
287 RCL 01
288 RCL 30
289 *
290 RCL 47
291 RCL 33
292 *
293 +
294 RCL 02
295 RCL 37
296 *
297 +
298 STO 44
299 RCL 36
300 ST* 02
301 RCL 01
302 RCL 31
303 *
304 RCL 47
305 RCL 34
306 *
307 +
308 ST+ 02
309 RCL 35
310 ST* 01
311 RCL 47
312 RCL 32
313 *
314 ST+ 01
315 RCL 18
316 RCL 50
317 X↑2
318 *
319 RCL 21
320 RCL 44
321 X↑2
322 *
323 +
324 RCL 24
325 RCL 52
326 X↑2
327 *
328 +
329 STO 47
330 RCL 18
331 RCL 50
332 *
333 RCL 00
334 *
335 RCL 21
336 RCL 44
337 *
338 RCL 02
339 *
340 +
341 RCL 24
342 RCL 52
343 *
344 RCL 51
345 *
346 +
347 STO 45
348 RCL 18
349 RCL 43
350 *
351 ST* 50
352 RCL 21
353 RCL 44
354 *
355 RCL 01
356 *
357 RCL 24
358 RCL 52
359 *
360 RCL 49
361 *
362 +
363 ST+ 50
364 RCL 18
365 RCL 00
366 X↑2
367 *
368 RCL 21
369 RCL 02
370 X↑2
371 *
372 +
373 RCL 24
374 RCL 51
375 X↑2
376 *
377 +
378 STO 44
379 RCL 18
380 RCL 43
381 *
382 ST* 00
383 RCL 21
384 RCL 02
385 *
386 RCL 01
387 *
388 RCL 24
389 RCL 51
390 *
391 RCL 49
392 *
393 +
394 ST+ 00
395 RCL 18
396 RCL 43
397 *
398 ST* 43
399 RCL 21
400 RCL 01
401 X↑2
402 *
403 RCL 24
404 RCL 49
405 X↑2
406 *
407 +
408 ST+ 43
409 RCL 27
410 RCL 04
411 RCL 03
412 XEQ 02
413 STO 10
414 X<>Y
415 STO 11
416 R↑
417 STO 12
418 RCL 37
419 *
420 X<>Y
421 RCL 33
422 *
423 +
424 X<>Y
425 RCL 30
426 *
427 +
428 STO 46
429 RCL 36
430 ST* 12
431 RCL 10
432 RCL 31
433 *
434 RCL 11
435 RCL 34
436 *
437 +
438 ST+ 12
439 RCL 32
440 ST* 11
441 RCL 10
442 RCL 35
443 *
444 ST+ 11
445 RCL 46
446 RCL 47
447 *
448 RCL 12
449 RCL 45
450 *
451 +
452 RCL 11
453 RCL 50
454 *
455 +
456 STO 10
457 RCL 46
458 RCL 45
459 *
460 RCL 12
461 RCL 44
462 *
463 +
464 RCL 11
465 RCL 00
466 *
467 +
468 X<> 11
469 RCL 43
470 *
471 RCL 46
472 RCL 50
473 *
474 +
475 RCL 12
476 RCL 00
477 *
478 +
479 STO 12
480 FC? 05
481 GTO 03
482 RCL 09
483 RCL 07
484 RCL 08
485 SF 06
486◆LBL 01
487 RCL 27
488 +
489 RCL 05
490 -
491 X<> Z
492◆LBL 02
493 P-R
494 X<>Y
495 RDN
496 P-R
497 FC?C 06
498 RTN
499 STO 01
500 X<>Y
501 STO 02
502 R↑
503 STO 49
504 RCL 37
505 *
506 X<>Y
507 RCL 33
```

```
508 *
509 +
510 X<>Y
511 RCL 30
512 *
513 +
514 ST+ 10
515 RCL 01
516 RCL 31
517 *
518 RCL 02
519 RCL 34
520 *
521 +
522 RCL 49
523 RCL 36
524 *
525 +
526 ST+ 11
527 RCL 01
528 RCL 35
529 *
530 RCL 02
531 RCL 32
532 *
533 +
534 ST+ 12
535♦LBL 03
536 RCL 29
537 SQRT
538 RCL 16
539 /
540 ENTER↑
541 ATAN
542 D-R
543 -
544 RCL 57
545 *
546 STO 01
547 FIX 4
548 "N1="
549 ARCL X
550 PRA
551 ST* 47
552 RCL 45
553 *
554 STO 49
555 2
556 PI
557 *
558 RCL 01
559 2
560 /
561 -
562 STO 02
563 "N2="
564 ARCL X
565 PRA
566 ADV
567 FIX 1
568 ST* 44
569 ST* 45
570 ST* 43
571 ST* 00
572 RCL 50
573 ST* 01
574 ST* 02
575 1
576 ST+ 43
577 ST+ 44
578 ST+ 47
579 RCL 44
580 RCL 43
581 *
582 RCL 00
583 X↑2
584 -
585 STO 50
586 RCL 47
587 *
588 RCL 00
589 RCL 01
590 *
591 RCL 49
592 RCL 43
593 *
594 -
595 STO 51
596 RCL 45
597 *
598 +
599 RCL 49
600 RCL 00
601 *
602 RCL 44
603 RCL 01
604 *
605 -
606 STO 52
607 RCL 02
608 *
609 +
610 STO 46
611 RCL 45
612 RCL 00
613 *
614 RCL 02
615 RCL 44
616 *
617 -
618 STO 48
619 RCL 47
620 ST* 44
621 RCL 45
622 RCL 49
623 *
624 ST- 44
625 RCL 02
626 ST* 49
627 RCL 47
628 RCL 00
629 *
630 ST- 49
631 RCL 47
632 RCL 43
633 *
634 RCL 02
635 RCL 01
636 *
637 -
638 STO 58
639 RCL 00
640 ST* 02
641 RCL 45
642 RCL 43
643 *
644 ST- 02
645 RCL 45
646 ST* 01
647 RCL 47
648 RCL 00
649 *
650 ST- 01
651 RCL 50
652 RCL 10
653 *
654 RCL 02
655 RCL 11
656 *
657 +
658 RCL 48
659 RCL 12
660 *
661 +
662 RCL 51
663 RCL 10
664 *
665 RCL 58
666 RCL 11
667 *
668 +
669 RCL 49
670 RCL 12
671 *
672 +
673 X<> 11
674 RCL 01
675 *
676 RCL 52
677 RCL 10
678 *
679 +
680 RCL 44
681 RCL 12
682 *
683 +
684 STO 12
685 X<>Y
686 RCL 46
687 ST/ 11
688 ST/ 12
689 /
690 STO 10
691♦LBL E
692 "XMIN=?"
693 PROMPT
694 FS?C 22
695 STO 39
696 "XMAX=?"
697 PROMPT
698 FS?C 22
699 STO 41
700 "XINC=?"
701 PROMPT
702 FS?C 22
703 STO 42
704 RCL 39
705 STO 40
706♦LBL 04
707 "X="
708 ARCL 40
709 PRA
710 XEQ 01
711 "BZ="
712 ARCL 48
713 PRA
714 "BT="
715 ARCL X
716 PRA
717 ADV
718 RCL 42
719 ST+ 40
720 RCL 41
721 RCL 40
722 X<=Y?
723 GTO 04
724 STOP
725 GTO E
726♦LBL F
727 "BZ MIN=?"
728 PROMPT
729 FS?C 22
730 STO 53
731 "BZ MAX=?"
732 PROMPT
733 FS?C 22
734 STO 54
735 "BT MIN=?"
736 PROMPT
737 FS?C 22
738 STO 55
739 "BT MAX=?"
740 PROMPT
741 FS?C 22
742 STO 56
743 126
744 STO 02
745 RCL 53
746 STO 00
747 RCL 54
748 STO 01
749 SF 12
750 "BZ"
751 SF 06
752 FIX 0
753 XEQ 03
754 CF 06
755 RCL 55
```

```
756 STO 00
757 RCL 56
758 STO 01
759 ADV
760 SF 12
761 "BT"
762 XEQ 03
763 FIX 1
764 STOP
765 GTO E
766◆LBL 03
767 PRA
768 CF 12
769 "MIN="
770 ARCL 00
771 "├     MAX="
772 ARCL 01
773 PRA
774 127
775 ACCOL
776 124
777 SKPCOL
778 127
779 ACCOL
780 ADV
781 RCL 39
782 STO 40
783◆LBL 05
784 RCL 40
785 ACX
786 XEQ 01
787 FS? 06
788 RCL 48
789 REGPLOT
790 RCL 42
791 ST+ 40
792 RCL 41
793 RCL 40
794 X<=Y?
795 GTO 05
796 ADV
797 RTN
798◆LBL 01
799 RCL 30
800 RCL 40
801 *
802 STO 43
803 LASTX
804 RCL 31
805 *
806 STO 44
807 RCL 37
808 RCL 13
809 *
810 ST- 43
811 LASTX
812 RCL 36
813 *
814 ST- 44
815 RCL 40
816 RCL 35
817 *
818 STO 45
819 X↑2
820 RCL 43
821 X↑2
822 -
823 RCL 44
824 X↑2
825 +
826 RCL 29
827 *
828 -2
829 *
830 RCL 29
831 X↑2
832 +
833 RCL 40
834 X↑2
835 RCL 38
836 +
837 STO 48
838 X↑2
839 +
840 SQRT
841 STO 46
842 RCL 16
843 X↑2
844 STO 49
845 -
846 RCL 17
847 X↑2
848 STO 50
849 -
850 RCL 48
851 +
852 2
853 /
854 ST+ 49
855 ST+ 50
856 RCL 10
857 RCL 43
858 *
859 RCL 49
860 1.5
861 Y↑X
862 /
863 RCL 50
864 /
865 RCL 11
866 RCL 44
867 *
868 RCL 12
869 RCL 45
870 *
871 +
872 RCL 49
873 SQRT
874 /
875 RCL 50
876 X↑2
877 /
878 +
879 STO 51
880 RCL 29
881 RCL 49
882 *
883 SQRT
884 RCL 50
885 /
886 RCL 29
887 RCL 49
888 /
889 SQRT
890 STO 47
891 ATAN
892 D-R
893 -
894 RCL 57
895 2
896 /
897 ST* 51
898 *
899 STO 52
900 RCL 29
901 1.5
902 Y↑X
903 ST* 51
904 X<>Y
905 RCL 11
906 *
907 RCL 48
908 RCL 29
909 -
910 RCL 46
911 /
912 1
913 +
914 RCL 51
915 *
916 ST* 44
917 ST* 45
918 X<>Y
919 ST+ 44
920 RCL 48
921 RCL 29
922 +
923 RCL 46
924 /
925 1
926 +
927 RCL 51
928 *
929 ST* 43
930 RCL 47
931 ENTER↑
932 ATAN
933 D-R
934 -
935 RCL 10
936 *
937 RCL 57
938 *
939 ST- 43
940 RCL 12
941 RCL 52
942 *
943 ST+ 45
944 RCL 43
945 RCL 30
946 *
947 RCL 44
948 RCL 31
949 *
950 +
951 RCL 45
952 RCL 35
953 *
954 +
955 RCL 27
956 COS
957 *
958 RCL 43
959 RCL 33
960 *
961 RCL 44
962 RCL 34
963 *
964 +
965 RCL 45
966 RCL 32
967 *
968 +
969 RCL 27
970 SIN
971 *
972 +
973 RCL 04
974 COS
975 *
976 RCL 43
977 RCL 37
978 *
979 RCL 44
980 RCL 36
981 *
982 +
983 STO 48
984 RCL 04
985 SIN
986 *
987 +
988 RTN
989◆LBL G
990 RCL 10
991 RCL 30
992 *
993 RCL 11
994 RCL 31
995 *
996 +
997 RCL 12
998 RCL 35
999 *
1000 +
1001 STO 00
1002 RCL 10
1003 RCL 37
```

```
1004 *
1005 RCL 11
1006 RCL 36
1007 *
1008 +
1009 RCL 10
1010 RCL 33
1011 *
1012 RCL 11
1013 RCL 34
1014 *
1015 +
1016 RCL 12
1017 RCL 32
1018 *
1019 +
1020 RCL 00
1021 R-P
1022 X<>Y
1023 RDN
1024 R-P
1025 "J RES="
1026 ARCL X
1027 PRA
1028 "I RES="
1029 ARCL Y
1030 PRA
1031 R↑
1032 STO 28
1033 RCL 27
1034 -
1035 RCL 05
1036 +
1037 "D RES="
1038 ARCL X
1039 PRA
1040 ADV
1041 .END.
```

HP 41 C
Elliptic 2D
Cylinder
Program
Magnetics
MAGMOD XII

```
01♦LBL "MAG12"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "DEPTH="
26 PROMPT
27 FS?C 22
28 STO 13
29 ARCL 13
30 PRA
31 "DIP="
32 PROMPT
33 FS?C 22
34 STO 14
35 ARCL 14
36 PRA
37 "b="
38 PROMPT
39 FS?C 22
40 STO 15
41 ARCL 15
42 PRA
43 "c="
44 PROMPT
45 FS?C 22
46 STO 16
47 ARCL 16
48 PRA
49 ADV
50 RCL 15
51 X↑2
52 RCL 16
53 X↑2
54 -
55 STO 17
56 RCL 14
57 COS
58 STO 29
59 LASTX
60 SIN
61 STO 30
62 RCL 13
63 X↑2
64 STO 31
65 FIX 6
66 "Ka="
67 PROMPT
68 FS?C 22
69 STO 18
70 ARCL 18
71 PRA
72 FIX 1
73 "D="
74 PROMPT
75 FS?C 22
76 STO 19
77 ARCL 19
78 PRA
79 "I="
80 PROMPT
81 FS?C 22
82 STO 20
83 ARCL 20
84 PRA
85 ADV
86 FIX 6
87 "Kb="
88 PROMPT
89 FS?C 22
90 STO 21
91 ARCL 21
92 PRA
93 FIX 1
94 "D="
95 PROMPT
96 FS?C 22
97 STO 22
98 ARCL 22
99 PRA
100 "I="
101 PROMPT
102 FS?C 22
103 STO 23
104 ARCL 23
105 PRA
106 ADV
107 FIX 6
108 "Kc="
109 PROMPT
110 FS?C 22
111 STO 24
112 ARCL 24
113 PRA
114 FIX 1
115 "D="
116 PROMPT
117 FS?C 22
118 STO 25
119 ARCL 25
120 PRA
121 "I="
122 PROMPT
123 FS?C 22
124 STO 26
125 ARCL 26
126 PRA
127 ADV
128 "REM?<0,1>"
129 PROMPT
130 CF 22
131 CF 05
132 X=0?
133 GTO D
134♦LBL C
135 SF 05
136 "J REM="
137 PROMPT
138 FS?C 22
139 STO 09
140 ARCL 09
141 PRA
142 "I REM="
143 PROMPT
144 FS?C 22
145 STO 07
146 ARCL 07
147 PRA
148 "D REM="
149 PROMPT
150 FS?C 22
151 STO 08
152 ARCL 08
153 PRA
154 ADV
155♦LBL D
156 "BEARING="
157 PROMPT
158 FS?C 22
159 STO 27
160 ARCL 27
161 PRA
162 ADV
163 1
164 RCL 20
165 RCL 19
166 XEQ 01
167 STO 36
168 X<>Y
169 STO 37
170 R↑
171 STO 38
172 1
173 RCL 23
174 RCL 22
175 XEQ 01
176 STO 39
177 X<>Y
178 STO 40
179 R↑
180 STO 41
181 1
182 RCL 26
183 RCL 25
184 XEQ 01
185 STO 42
186 X<>Y
187 STO 43
188 R↑
189 STO 44
190 CHS
191 RCL 30
192 *
193 RCL 29
194 RCL 42
195 *
196 +
197 STO 45
```

```
198 RCL 30
199 ST* 42
200 RCL 44
201 RCL 29
202 *
203 ST+ 42
204 RCL 36
205 RCL 29
206 *
207 RCL 38
208 RCL 30
209 *
210 -
211 STO 44
212 RCL 30
213 ST* 36
214 RCL 38
215 RCL 29
216 *
217 ST+ 36
218 RCL 39
219 RCL 29
220 *
221 RCL 41
222 RCL 30
223 *
224 -
225 STO 38
226 RCL 30
227 ST* 39
228 RCL 29
229 RCL 41
230 *
231 ST+ 39
232 RCL 37
233 X↑2
234 RCL 18
235 *
236 RCL 40
237 X↑2
238 RCL 21
239 *
240 +
241 RCL 43
242 X↑2
243 RCL 24
244 *
245 +
246 STO 46
247 RCL 18
248 RCL 37
249 *
250 RCL 44
251 *
252 RCL 21
253 RCL 40
254 *
255 RCL 38
256 *
257 +
258 RCL 24
259 RCL 43
260 *
261 RCL 45
262 *
263 +
264 STO 47
265 RCL 24
266 RCL 42
267 *
268 ST* 43
269 RCL 18
270 RCL 37
271 *
272 RCL 36
273 *
274 RCL 21
275 RCL 40
276 *
277 RCL 39
278 *
279 +
280 ST+ 43
281 RCL 18
282 RCL 44
283 X↑2
284 *
285 RCL 21
286 RCL 38
287 X↑2
288 *
289 +
290 RCL 24
291 RCL 45
292 X↑2
293 *
294 +
295 STO 37
296 RCL 18
297 RCL 36
298 *
299 ST* 44
300 RCL 21
301 RCL 38
302 *
303 RCL 39
304 *
305 RCL 24
306 RCL 45
307 *
308 RCL 42
309 *
310 +
311 ST+ 44
312 RCL 18
313 RCL 36
314 *
315 ST* 36
316 RCL 21
317 RCL 39
318 X↑2
319 *
320 RCL 24
321 RCL 42
322 X↑2
323 *
324 +
325 ST+ 36
326 RCL 27
327 RCL 04
328 RCL 03
329 XEQ 02
330 STO 11
331 X<>Y
332 STO 10
333 R↑
334 STO 12
335 RCL 30
336 *
337 CHS
338 RCL 11
339 RCL 29
340 *
341 +
342 X<> 11
343 RCL 30
344 *
345 RCL 12
346 RCL 29
347 *
348 +
349 STO 12
350 RCL 43
351 *
352 RCL 11
353 RCL 47
354 *
355 +
356 RCL 10
357 RCL 46
358 *
359 +
360 RCL 10
361 RCL 47
362 *
363 RCL 11
364 RCL 37
365 *
366 +
367 RCL 12
368 RCL 44
369 *
370 +
371 X<> 11
372 RCL 44
373 *
374 RCL 10
375 RCL 43
376 *
377 +
378 RCL 12
379 RCL 36
380 *
381 +
382 CHS
383 STO 12
384 X<>Y
385 STO 10
386 FC? 05
387 GTO 03
388 RCL 09
389 RCL 07
390 RCL 08
391 SF 06
392*LBL 01
393 RCL 27
394 +
395 RCL 05
396 -
397 X<> Z
398*LBL 02
399 P-R
400 X<>Y
401 RDN
402 P-R
403 FC?C 06
404 RTN
405 STO 38
406 X<>Y
407 ST+ 10
408 R↑
409 STO 39
410 RCL 29
411 *
412 RCL 38
413 RCL 30
414 *
415 +
416 ST- 12
417 RCL 38
418 RCL 29
419 *
420 RCL 39
421 RCL 30
422 *
423 -
424 ST+ 11
425*LBL 03
426 4
427 PI
428 *
429 RCL 15
430 RCL 16
431 +
432 /
433 STO 00
434 STO 01
435 ST* 47
436 ST* 43
437 ST* 37
438 ST* 44
439 ST* 36
440 RCL 16
441 ST* 00
442 ST* 47
443 ST* 37
444 RCL 44
445 *
```

```
446 STO 38
447 RCL 15
448 ST* 01
449 ST* 43
450 ST* 44
451 ST* 36
452 1
453 ST+ 36
454 ST+ 37
455 "N2="
456 ARCL 00
457 PRA
458 "N3="
459 ARCL 01
460 PRA
461 ADV
462 RCL 37
463 RCL 36
464 *
465 RCL 44
466 RCL 38
467 *
468 -
469 STO 39
470 RCL 43
471 RCL 38
472 *
473 RCL 47
474 RCL 36
475 *
476 -
477 STO 40
478 RCL 37
479 ST* 43
480 RCL 47
481 RCL 44
482 *
483 ST- 43
484 RCL 39
485 ST* 10
486 RCL 40
487 RCL 11
488 *
489 RCL 43
490 RCL 12
491 *
492 +
493 ST+ 10
494 RCL 36
495 RCL 11
496 *
497 RCL 44
498 RCL 12
499 *
500 +
501 X<> 11
502 RCL 38
503 *
504 RCL 12
505 RCL 37
506 *
507 +
508 RCL 39
509 ST/ 10
510 ST/ 11
511 /
512 STO 12
513*LBL E
514 "XMIN=?"
515 PROMPT
516 FS?C 22
517 STO 32
518 "XMAX=?"
519 PROMPT
520 FS?C 22
521 STO 34
522 "XINC=?"
523 PROMPT
524 FS?C 22
525 STO 35
526 RCL 32
527 STO 33
528*LBL 04
529 "X="
530 ARCL 33
531 PRA
532 XEQ 01
533 "BZ="
534 ARCL 36
535 PRA
536 "BT="
537 ARCL X
538 PRA
539 ADV
540 RCL 35
541 ST+ 33
542 RCL 34
543 RCL 33
544 X<=Y?
545 GTO 04
546 STOP
547 GTO E
548*LBL F
549 "BZ MIN=?"
550 PROMPT
551 FS?C 22
552 STO 48
553 "BZ MAX=?"
554 PROMPT
555 FS?C 22
556 STO 49
557 "BT MIN=?"
558 PROMPT
559 FS?C 22
560 STO 50
561 "BT MAX=?"
562 PROMPT
563 FS?C 22
564 STO 51
565 126
566 STO 02
567 RCL 48
568 STO 00
569 RCL 49
570 STO 01
571 SF 12
572 "BZ"
573 SF 06
574 FIX 0
575 XEQ 03
576 CF 06
577 RCL 50
578 STO 00
579 RCL 51
580 STO 01
581 SF 12
582 "BT"
583 XEQ 03
584 FIX 1
585 STOP
586 GTO E
587*LBL 03
588 PRA
589 CF 12
590 "MIN="
591 ARCL 00
592 "├     MAX="
593 ARCL 01
594 PRA
595 127
596 ACCOL
597 124
598 SKPCOL
599 127
600 ACCOL
601 ADV
602 RCL 32
603 STO 33
604*LBL 05
605 RCL 33
606 ACX
607 XEQ 01
608 FS? 06
609 RCL 36
610 REGPLOT
611 RCL 35
612 ST+ 33
613 RCL 34
614 RCL 33
615 X<=Y?
616 GTO 05
617 ADV
618 RTN
619*LBL 01
620 RCL 30
621 RCL 13
622 *
623 STO 36
624 LASTX
625 RCL 29
626 *
627 STO 37
628 RCL 29
629 RCL 33
630 *
631 ST+ 36
632 LASTX
633 RCL 30
634 *
635 ST- 37
636 RCL 33
637 X↑2
638 RCL 31
639 +
640 STO 38
641 X↑2
642 RCL 17
643 X↑2
644 +
645 RCL 17
646 2
647 *
648 RCL 36
649 RCL 37
650 -
651 *
652 -
653 SQRT
654 STO 41
655 RCL 38
656 +
657 RCL 15
658 X↑2
659 STO 39
660 -
661 RCL 16
662 X↑2
663 STO 40
664 -
665 2
666 /
667 ST+ 39
668 ST+ 40
669 RCL 11
670 RCL 36
671 *
672 RCL 39
673 /
674 RCL 12
675 RCL 37
676 *
677 RCL 40
678 /
679 +
680 RCL 39
681 RCL 40
682 *
683 SQRT
684 /
685 ST* 36
686 ST* 37
687 RCL 38
688 RCL 17
689 +
690 RCL 41
691 /
692 1
693 +
```

```
694 ST* 36
695 RCL 38
696 RCL 17
697 -
698 RCL 41
699 /
700 1
701 +
702 ST* 37
703 RCL 40
704 ST/ 39
705 RCL 39
706 SQRT
707 1
708 -
709 RCL 12
710 *
711 RCL 17
712 /
713 2
714 *
715 ST- 37
716 1
717 RCL 39
718 1/X
719 SQRT
720 -
721 RCL 11
722 *
723 RCL 17
724 /
725 2
726 *
727 ST- 36
728 2
729 PI
730 *
731 RCL 15
732 *
733 RCL 16
734 *
735 ST* 36
736 ST* 37
737 RCL 36
738 RCL 29
739 *
740 RCL 37
741 RCL 30
742 *
743 -
744 RCL 27
745 COS
746 *
747 RCL 04
748 COS
749 *
750 RCL 36
751 RCL 30
752 *
753 RCL 37
754 RCL 29
755 *
756 +
757 CHS
758 STO 36
759 RCL 04
760 SIN
761 *
762 +
763 RTN
764*LBL G
765 RCL 11
766 RCL 30
767 *
768 RCL 12
769 RCL 29
770 *
771 +
772 CHS
773 RCL 11
774 RCL 29
775 *
776 RCL 12
777 RCL 30
778 *
779 -
780 RCL 10
781 X<>Y
782 R-P
783 X<>Y
784 RDN
785 R-P
786 "J RES="
787 ARCL X
788 PRA
789 "I RES="
790 ARCL Y
791 PRA
792 R↑
793 STO 28
794 RCL 27
795 -
796 RCL 05
797 +
798 "D RES="
799 ARCL X
800 PRA
801 ADV
802 .END.
```

HP 41 C
Vertical Prism
Program
Magnetics
MAGMOD XIII

```
01*LBL "MAG13"
02*LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24*LBL B
25 "INF H? (0,1)"
26 PROMPT
27 FS?C 22
28 STO 13
29 "H1="
30 PROMPT
31 FS?C 22
32 STO 14
33 ARCL 14
34 PRA
35 GTO IND 13
36*LBL 00
37 "H2="
38 PROMPT
39 FS?C 22
40 STO 15
41 ARCL 15
42 PRA
43*LBL 01
44 "1/2 WIDTH="
45 PROMPT
46 FS?C 22
47 STO 16
48 ARCL 16
49 PRA
50 "1/2 LENGTH="
51 PROMPT
52 FS?C 22
53 STO 17
54 ARCL 17
55 PRA
56 ADV
57 FIX 6
58 "Ka="
59 PROMPT
60 FS?C 22
61 STO 18
62 ARCL 18
63 PRA
64 FIX 1
65 "D="
66 PROMPT
67 FS?C 22
68 STO 19
69 ARCL 19
70 PRA
71 "I="
72 PROMPT
73 FS?C 22
74 STO 20
75 ARCL 20
76 PRA
77 ADV
78 FIX 6
79 "Kb="
80 PROMPT
81 FS?C 22
82 STO 21
83 ARCL 21
84 PRA
85 FIX 1
86 "D="
87 PROMPT
88 FS?C 22
89 STO 22
90 ARCL 22
91 PRA
92 "I="
93 PROMPT
94 FS?C 22
95 STO 23
96 ARCL 23
97 PRA
98 ADV
99 FIX 6
100 "Kc="
101 PROMPT
102 FS?C 22
103 STO 24
104 ARCL 24
105 PRA
106 FIX 1
107 "D="
108 PROMPT
109 FS?C 22
110 STO 25
111 ARCL 25
112 PRA
113 "I="
114 PROMPT
115 FS?C 22
116 STO 26
117 ARCL 26
118 PRA
119 ADV
120 "REM?(0,1)"
121 PROMPT
122 CF 22
123 CF 05
124 X=0?
125 GTO D
126*LBL C
127 SF 05
128 "J REM="
129 PROMPT
```

```
130 FS?C 22
131 STO 09
132 ARCL 09
133 PRA
134 "I REM="
135 PROMPT
136 FS?C 22
137 STO 07
138 ARCL 07
139 PRA
140 "D REM="
141 PROMPT
142 FS?C 22
143 STO 08
144 ARCL 08
145 PRA
146 ADV
147*LBL D
148 "BEARING="
149 PROMPT
150 FS?C 22
151 STO 27
152 ARCL 27
153 PRA
154 ADV
155 1
156 RCL 20
157 RCL 19
158 XEQ 01
159 STO 37
160 X<>Y
161 STO 38
162 R↑
163 STO 39
164 1
165 RCL 23
166 RCL 22
167 XEQ 01
168 STO 40
169 X<>Y
170 STO 41
171 R↑
172 STO 42
173 1
174 RCL 26
175 RCL 25
176 XEQ 01
177 STO 43
178 X<>Y
179 STO 44
180 R↑
181 STO 45
182 *
183 RCL 24
184 *
185 RCL 42
186 RCL 41
187 *
188 RCL 21
189 *
190 +
191 RCL 18
192 RCL 38
193 *
194 RCL 39
195 *
196 +
197 STO 46
198 RCL 18
199 RCL 39
200 X↑2
201 *
202 RCL 21
203 RCL 42
204 X↑2
205 *
206 +
207 RCL 24
208 RCL 45
209 X↑2
210 *
211 +
212 STO 36
213 RCL 24
214 RCL 43
215 *
216 ST* 45
217 RCL 18
218 RCL 37
219 *
220 RCL 39
221 *
222 RCL 21
223 RCL 40
224 *
225 RCL 42
226 *
227 +
228 ST+ 45
229 RCL 18
230 RCL 37
231 X↑2
232 *
233 RCL 21
234 RCL 40
235 X↑2
236 *
237 +
238 RCL 24
239 RCL 43
240 X↑2
241 *
242 +
243 STO 39
244 RCL 18
245 RCL 38
246 *
247 ST* 37
248 RCL 21
249 RCL 40
250 *
251 RCL 41
252 *
253 RCL 24
254 RCL 43
255 *
256 RCL 44
257 *
258 +
259 ST+ 37
260 RCL 18
261 RCL 38
262 *
263 ST* 38
264 RCL 21
265 RCL 41
266 X↑2
267 *
268 RCL 24
269 RCL 44
270 X↑2
271 *
272 +
273 ST+ 38
274 RCL 27
275 RCL 04
276 RCL 03
277 XEQ 02
278 STO 00
279 X<>Y
280 STO 01
281 STO 11
282 R↑
283 STO 02
284 RCL 45
285 *
286 X<>Y
287 RCL 37
288 *
289 +
290 X<>Y
291 RCL 39
292 *
293 +
294 RCL 00
295 RCL 37
296 *
297 RCL 01
298 RCL 38
299 *
300 +
301 RCL 02
302 RCL 46
303 *
304 +
305 X<> 11
306 RCL 46
307 *
308 RCL 00
309 RCL 45
310 *
311 +
312 RCL 02
313 RCL 36
314 *
315 +
316 STO 12
317 X<>Y
318 STO 10
319 FC? 05
320 GTO 03
321 RCL 09
322 RCL 07
323 RCL 08
324 SF 06
325*LBL 01
326 RCL 27
327 +
328 RCL 05
329 -
330 X<> Z
331*LBL 02
332 P-R
333 X<>Y
334 RDN
335 P-R
336 FC?C 06
337 RTN
338 ST+ 10
339 X<>Y
340 ST+ 11
341 R↑
342 ST+ 12
343*LBL 03
344 RCL 16
345 STO 41
346 RCL 17
347 STO 42
348 +
349 STO 40
350 4
351 PI
352 *
353 ST* 41
354 ST* 42
355 0
356 GTO IND 13
357*LBL 00
358 RCL 15
359 RCL 14
360 -
361 ST* 40
362 ST* 41
363 ST* 42
364 RCL 16
365 RCL 17
366 *
367 2
368 *
369 ST+ 40
370 4
371 *
372 PI
373 *
374 RCL 40
375 /
376*LBL 01
377 STO 43
```

```
378 FIX 4
379 "NZ="
380 ARCL X
381 PRA
382 ST* 36
383 RCL 46
384 *
385 STO 44
386 RCL 45
387 ST* 43
388 RCL 41
389 RCL 40
390 /
391 "NY="
392 ARCL X
393 PRA
394 ST* 38
395 ST* 46
396 RCL 37
397 *
398 STO 41
399 RCL 42
400 RCL 40
401 /
402 "NX="
403 ARCL X
404 PRA
405 ADV
406 FIX 1
407 ST* 39
408 ST* 37
409 ST* 45
410 1
411 ST+ 39
412 ST+ 38
413 ST+ 36
414 RCL 38
415 RCL 36
416 *
417 RCL 44
418 RCL 46
419 *
420 -
421 STO 40
422 RCL 10
423 *
424 RCL 43
425 RCL 46
426 *
427 RCL 41
428 RCL 36
429 *
430 -
431 RCL 11
432 *
433 +
434 RCL 41
435 RCL 44
436 *
437 RCL 43
438 RCL 38
439 *
440 -
441 RCL 12
442 *
443 +
444 STO 29
445 RCL 44
446 RCL 45
447 *
448 RCL 37
449 RCL 36
450 *
451 -
452 STO 42
453 RCL 10
454 *
455 RCL 39
456 RCL 36
457 *
458 RCL 43
459 RCL 45
460 *
461 -
462 RCL 11
463 *
464 +
465 RCL 43
466 RCL 37
467 *
468 RCL 39
469 RCL 44
470 *
471 -
472 RCL 12
473 *
474 +
475 STO 30
476 RCL 37
477 RCL 46
478 *
479 RCL 38
480 RCL 45
481 *
482 -
483 STO 51
484 RCL 10
485 *
486 RCL 41
487 RCL 45
488 *
489 RCL 39
490 RCL 46
491 *
492 -
493 RCL 11
494 *
495 +
496 RCL 39
497 RCL 38
498 *
499 RCL 41
500 RCL 37
501 *
502 -
503 RCL 12
504 *
505 +
506 RCL 39
507 RCL 40
508 *
509 RCL 41
510 RCL 42
511 *
512 +
513 RCL 43
514 RCL 51
515 *
516 +
517 ST/ 29
518 ST/ 30
519 /
520 STO 31
521 RCL 30
522 RCL 29
523 R-P
524 X<>Y
525 STO 28
526 RDN
527 R-P
528 STO 12
529 ST/ 29
530 ST/ 30
531 ST/ 31
532 X<>Y
533 STO 10
534 RCL 28
535 RCL 27
536 -
537 RCL 05
538 +
539 STO 11
540 RCL 03
541 ST/ 00
542 ST/ 01
543 ST/ 02
544 RCL 29
545 RCL 02
546 STO 39
547 *
548 RCL 31
549 RCL 00
550 STO 37
551 *
552 +
553 STO 36
554 RCL 01
555 STO 38
556 RCL 29
557 ST* 37
558 RCL 30
559 ST* 38
560 2
561 ST* 37
562 ST* 38
563 ST* 31
564 RCL 31
565 ST* 39
566*LBL E
567 "XMIN=?"
568 PROMPT
569 FS?C 22
570 STO 32
571 "XMAX=?"
572 PROMPT
573 FS?C 22
574 STO 34
575 "XINC=?"
576 PROMPT
577 FS?C 22
578 STO 35
579 RCL 32
580 STO 33
581*LBL 04
582 "X="
583 ARCL 33
584 PRA
585 XEQ 01
586 "BZ="
587 ARCL 55
588 PRA
589 "BT="
590 ARCL 54
591 PRA
592 ADV
593 RCL 35
594 ST+ 33
595 RCL 34
596 RCL 33
597 X<=Y?
598 GTO 04
599 STOP
600 GTO E
601*LBL F
602 "BZ MIN=?"
603 PROMPT
604 FS?C 22
605 STO 47
606 "BZ MAX=?"
607 PROMPT
608 FS?C 22
609 STO 48
610 "BT MIN=?"
611 PROMPT
612 FS?C 22
613 STO 49
614 "BT MAX=?"
615 PROMPT
616 FS?C 22
617 STO 50
618 126
619 STO 02
620 RCL 47
621 STO 00
622 RCL 48
623 STO 01
624 SF 12
625 "BZ"
```

```
626 SF 06
627 FIX 0
628 XEQ 03
629 CF 06
630 RCL 49
631 STO 00
632 RCL 50
633 STO 01
634 ADV
635 SF 12
636 "BT"
637 XEQ 03
638 FIX 1
639 STOP
640 GTO E
641*LBL 03
642 PRA
643 CF 12
644 "MIN="
645 ARCL 00
646 "    MAX="
647 ARCL 01
648 PRA
649 127
650 ACCOL
651 124
652 SKPCOL
653 127
654 ACCOL
655 ADV
656 RCL 32
657 STO 33
658*LBL 05
659 RCL 33
660 ACX
661 XEQ 01
662 RCL 54
663 FS? 06
664 RCL 55
665 REGPLOT
666 RCL 35
667 ST+ 33
668 RCL 34
669 RCL 33
670 X<=Y?
671 GTO 05
672 ADV
673 RTN
674*LBL 01
675 RCL 14
676 STO 42
677 XEQ 06
678 RCL 52
679 STO 54
680 RCL 53
681 STO 55
682 GTO IND 13
683*LBL 00
684 RCL 15
685 STO 42
686 XEQ 06
687 RCL 52
688 ST- 54
689 RCL 53
690 ST- 55
691*LBL 01
692 RCL 12
693 ST* 54
694 ST* 55
695 RTN
696*LBL 06
697 RCL 16
698 RCL 33
699 -
700 STO 40
701 RCL 17
702 STO 41
703 XEQ 06
704 STO 52
705 X<>Y
706 STO 53
707 RCL 16
708 RCL 33
709 +
710 CHS
711 STO 40
712 -1
713 ST* 41
714 XEQ 06
715 ST+ 52
716 X<>Y
717 ST+ 53
718 RTN
719*LBL 06
720 RCL 42
721 RCL 41
722 RCL 40
723 R-P
724 RCL Z
725 R-P
726 STO 43
727 RCL 41
728 -
729 RCL 43
730 RCL 41
731 +
732 /
733 LN
734 STO 44
735 RCL 40
736 RCL 41
737 *
738 STO 45
739 STO 46
740 STO 51
741 RCL 40
742 X↑2
743 RCL 43
744 RCL 42
745 *
746 ST/ 51
747 LASTX
748 X↑2
749 +
750 +
751 ST/ 45
752 LASTX
753 RCL 41
754 X↑2
755 +
756 ST/ 46
757 RCL 44
758 RCL 29
759 *
760 RCL 51
761 ATAN
762 D-R
763 STO 51
764 RCL 31
765 *
766 +
767 RCL 36
768 RCL 44
769 *
770 RCL 37
771 RCL 45
772 ATAN
773 D-R
774 *
775 -
776 RCL 38
777 RCL 46
778 ATAN
779 D-R
780 *
781 -
782 RCL 39
783 RCL 51
784 *
785 +
786 RTN
787*LBL G
788 "J RES="
789 ARCL 12
790 PRA
791 "I RES="
792 ARCL 10
793 PRA
794 "D RES="
795 ARCL 11
796 PRA
797 ADV
798 .END.
```

Computation of ΔB_H

$\Delta B_T = \Delta B_H \cos I + \Delta B_z \sin I$
$\Delta B_H = \Delta B_x \cos \beta = \Delta B_x \cos D$, if $+x$ axis is along true north

Although MAGMODS I-XIII have been designed to compute the commonly used total magnetic intensity and less commonly used vertical magnetic intensity anomalies, it is possible to modify each program so that the horizontal magnetic intensity anomaly is computed if ΔB_H is required for some purpose. The following procedures illustrate how this may be done by replacing the ΔB_x computation. It is also possible to modify each program such that all three anomalies (ΔB_T, ΔB_Z, ΔB_H) are computed, but this will not be presented here. The following suggested changes might enable the recovery of ΔB_H from the programs.

MAGMODS I-III

Since ΔB_x is an intermediate result in the calculation of ΔB_T the required changes are made in the final calculation subroutine

MAGMOD I
- Replace line 282 (RCL 28) with RCL 21
- Delete line 284 (CHS)
- Insert: RCL 19
  COS
  * after line 283

MAGMOD II
- Replace line 278 (RCL 28) with RCL 21
- Delete line 280 (CHS)
- Insert: RCL 19
  COS
  * after line 279

MAGMOD III
- Delete line 338 (STO 36)
- Insert: STO 36 after line 345

MAGMOD IV

For this model, the calculation of α_{11}, α_{33} and α_{13} must be altered as follows:

- Replace line 158 (STO 21) with STO 36
- Replace line 170 (RCL 21) with RCL 36
- Replace lines 307-315 (CHS→STO 31) with: 3
  *
  STO 31
  RCL 20
  STO 29
  ST+29
  CHS
  STO 30
  RCL 17
  COS
  ST*29
  ST*30
  ST*31
  LAST X
  SIN
  RCL 36
  *
  ST-29
  ST-30
- Change register allocation (size) to 037

MAGMODS V-X, VIIIA, VIIIB

For these models, the calculation of C_4 and C_5 must be altered as follows:

MAGMOD V
- Delete line 155 (CHS)
- Insert: -2
  * after line 154
- Replace line 156 (STO 21) with STO 20
- Delete lines 159→161 (STO 28→*)
- Replace line 162 (STO 20) with STO 21
- Replace line 172 (RCL 28) with RCL 21
- Replace line 179 (RCL 28) with RCL 21
- Insert: RCL 18
  COS
  ST*20
  ST*21 after line 188

MAGMOD VI/VII
- Delete line 178 (CHS)
- Insert: -2
  * after line 177
- Replace line 179 (STO 25) with STO 24
- Delete lines 182→184 (STO 32→*)
- Replace line 185 (STO 24) with STO 25
- Replace line 195 (RCL 32) with RCL 25
- Replace line 202 (RCL 32) with RCL 25
- Replace line 202 (RCL 32) with RCL 25
- Insert RCL 22
  COS
  ST*24
  ST*25 after line 211

MAGMOD VIII
- Delete line 162 (CHS)
- Insert: -2
  * after line 161
- Replace line 163 (STO 25) with STO 24
- Delete lines 166→168 (STO 32→*)
- Replace line 169 (STO 24) with STO 25
- Replace line 179 (RCL 32) with RCL 25
- Replace line 186 (RCL 32) with RCL 25
- Insert: RCL 22
  COS
  ST*24
  ST*25 after line 195

MAGMOD VIII A
- Delete line 257 (CHS)
- Insert: -2
  * after line 256
- Replace line 258 (STO 25) with STO 24
- Delete lines 261→263 (STO 32→*)
- Replace line 264 (STO 24) with STO 25
- Replace line 274 (RCL 32) with RCL 25
- Replace line 281 (RCL 32) with RCL 25
- Insert: RCL 22
  COS
  ST*24
  ST*25 after line 290

MAGMOD VIII B – Delete line 657 (CHS)
– Insert: – 2
* after line 656
– Replace line 658 (STO 33) with STO 32
– Delete lines 661 → 663 (STO 40 → *)
– Replace line 664 (STO 32) with STO 33
– Replace line 674 (RCL 40) with RCL 33
– Replace line 681 (RCL 40) with RCL 33
– Insert: RCL 30
COS
ST*32
ST*33 after line 690

MAGMOD IX – Delete line 155 (CHS)
– Insert: – 2
* after line 154
– Replace line 156 (STO 23) with STO 22
– Delete lines 159 → 161 (STO 30 → *)
– Replace line 162 (STO 22) with STO 23
– Replace line 172 (RCL 30) with RCL 23
– Replace line 179 (RCL 30) with RCL 23
– Insert: RCL 20
COS
ST*22
ST*23 after line 188

MAGMOD X – Delete line 161 (CHS)
– Insert: – 2
* after line 160
– Replace line 162 (STO 18) with STO 17
– Delete lines 165 → 167 (STO 25 → *)
– Replace line 168 (STO 17) with STO 18
– Replace line 178 (RCL 25) with RCL 18
– Insert: RCL 15
COS
ST*17
ST*18 after line 194

MAGMODS XI A, XI B, XII

For these models, ΔB_H is an intermediate result in the calculation of ΔB_T, so the required changes are again in the final calculation subroutine.

MAGMOD XI A – Insert: (STO 48) after line 984
– Delete line 995 (STO 48)

MAGMOD XI B – Insert: (STO 48) after line 972
– Delete line 983 (STO 48)

MAGMOD XII – Insert: (STO 36) after line 746
– Delete line 758 (STO 36)

MAGMOD XIII

For this model the calculation of Ln + N*l*, L*l*, Mm and Nn must be altered as follows:

– Delete line 563 (ST * 31)
– Insert: ST * 39
ST * 29
ST * 30 after line 562
– Replace lines 758 → 783 (RCL 29 → RCL 51) with:
RCL 31
*
RCL 45
ATAN
D-R
STO 45
RCL 29
*
–
RCL 46
ATAN
D-R
STO 46
RCL 30
*
–
RCL 36
RCL 44
*
RCL 37
RCL 45
*
–
RCL 38
RCL 46
*
–
RCL 39
RCL 51
ATAN
D-R
*
+
RTN

NOTES

The above line numbers are those in the *current* program listings, to complete the changeover from ΔB_Z to ΔB_H in each case, in alpha strings containing "BZ", "BZ" must be replaced with "BH" (e.g. "BZ MIN = " → "BH MIN = ").

MAGMOD XIV - VERTICAL CIRCULAR CYLINDER

Notation

O : origin of co-ordinates, at the intersection of the cylinder axis and the observation plane

h : depth to top of bottomless cylinder

h_1, h_2: depth to top and bottom, respectively, of cylinder with finite depth extent

R : radius of cylinder

R_1,R_2: inner and outer radii, respectively, of annular cylinder

Other symbols as for previous MAGMODs

Formulae:

$$\Delta B_i = 2\pi RJ[(Nn' - L\ell')\, I\,(1,0;0) - \frac{(Mm'-L\ell')}{|x|}\, I\,(1,1;-1) + (N\ell' + Ln')\, I\,(1,1;0)]$$

where

$$I(1,0;0) = \frac{-\kappa h}{4R\sqrt{(R|x|)}}\, F_o(\kappa) - \frac{1}{2R}\, \Lambda_o(\Phi,\kappa) + 1/R \qquad (|x|<R)$$

$$= \frac{-\kappa h}{4R^2}\, F_o(\kappa) + 1/2R \qquad (|x|=R)$$

$$= \frac{-\kappa h}{4R\sqrt{(R|x|)}}\, F_o(\kappa) + \frac{1}{2R}\, \Lambda_o(\Phi,\kappa) \qquad (|x|>R)$$

$$I\,(1,1;-1) = \frac{hE_o(\kappa)}{2\kappa\sqrt{(R|x|)}} - \frac{\kappa h}{4(R|x|)^{3/2}}\,(R^2+x^2+h^2/2)F_o(\kappa)$$

$$+ \frac{(R^2-x^2)}{4R|x|}\, \Lambda_o\,(\Phi,\kappa) + |x|/2R \qquad (|x|<R)$$

$$= \frac{hE_o(\kappa)}{2\kappa R} - \frac{\kappa h}{4R^3}\,(2R^2+h^2/2)F_o(\kappa) + 1/2 \qquad (|x|=R)$$

$$= \frac{hE_o(\kappa)}{2\kappa\sqrt{(R|x|)}} - \frac{\kappa h}{4(R|x|)^{3/2}}\,(R^2 + x^2 + h^2/2)F_o(\kappa)$$

$$+ \frac{(x^2-R^2)}{4R|x|}\, \Lambda_o(\Phi,\kappa) + R/2|x| \qquad (|x|>R)$$

$$I(1,1;0) = \frac{1}{\kappa\sqrt{(R|x|)}}\,[(1-\kappa^2/2)F_o(\kappa) - E_o(\kappa)]$$

$$\kappa = 2\sqrt{(R|x|)}/\sqrt{[(R+|x|)^2+h^2]} \quad , \quad \sin\Phi = h/\sqrt{[(R-|x|)^2 + h^2]}$$

$$F_o(\kappa) = (2/\pi)\,K(\kappa) \quad , \; E_o(\kappa) = (2/\pi)E(k)$$

$K(\kappa)$ and $E(\kappa)$ are the first and second complete elliptic integrals

$\Lambda_o\,(\Phi,\kappa)$ is Heumann's Lamba function

$$* \text{ At } x = 0,\ \Delta B_i = \pi J\,[2(Nn'-L\ell') - (Mm'-L\ell')]\,(1 - \frac{h}{\sqrt{(h^2+R^2)}})$$

* The above formulae pertain to a bottomless solid cylinder. Anomalies due to cylinders of finite depth extent and due to annular cylinders are obtained by subtraction in an obvious fashion.

References

S.K. Singh and F.J. Sabina, Geophysics, 43 (1978), 173-178; 1312 (erratum)

P.F. Byrd and M.D. Friedman, "Handbook of Elliptic Integrals for Engineers and Physicists", 1954, Springer-Verlag, Berlin.

HP41C Registers MAGMOD XIV

00-12	Same as MAGMOD I-X
13	Finite/Inf Flag
14	Depth to Top
15	Depth to Bottom
16	Annulus Flag
17	Inner Radius (R_1: IF Annulus)
18	Outer Radius (R_2: IF Annulus) (R: IF Cylinder)
19	Susceptibility
20	Bearing β
21	Bearing β_R w.r.t. JRES
22	N
23	L
24	Mm-Ll
25	Nn-Ll
26	Nl+Ln
27	XMIN
28	X
29	XMAX
30	XINC
31-54	Inter. Results

DEMAGNETISATION CORRECTION FOR VERTICAL CYLINDER

Approximate demagnetising factors

(i) Solid cylinder

$$N_x = N_y = 2\pi(h_2 - h_1)/[h_2 - h_1 + R] \to 2\pi \text{ for bottomless cylinder}$$

$$N_z = 4\pi R/[h_2 - h_1 + R] \to 0 \quad \text{for bottomless cylinder}$$

(ii) Annular cylinder

$$N_x = N_y = 2\pi\,(h_2 - h_1)/[h_2 - h_1 + \sqrt{(R_2^2 - R_1^2)}]$$

$$N_z = 4\pi\,\sqrt{(R_2^2 - R_1^2)}/[h_2 - h_1 + \sqrt{(R_2^2 - R_1^2)}]$$

Susceptibility tensor elements in xyz system

k_{ij} (i, j = x, y, z) as for vertical prism (MAGMOD XIII).

Matrix $K = [k_{ij}]$.

Resultant magnetisation, corrected for demagnetisation

Field and magnetisation components as for vertical prism.

$$A = I + KN = \begin{bmatrix} 1 + k_{xx}N_x & k_{xy}N_x & k_{xz}N_z \\ k_{xy}N_x & 1 + k_{yy}N_x & k_{yz}N_z \\ k_{xz}N_x & k_{yz}N_x & 1 + k_{zz}N_z \end{bmatrix}$$

$$\tilde{J}' = A^{-1}[K\tilde{F} + \tilde{J}_N] = J'(L', M', N')$$

where J', L', M', N' are calculated as for vertical prism.

User Instructions

MAGMOD XIV: VERTICAL CIRCULAR CYLINDER AND ANNULUS INDUCTION AND REMANENCE (with facility to enter a resultant magnetisation incorporating demagnetisation and anisotropy)

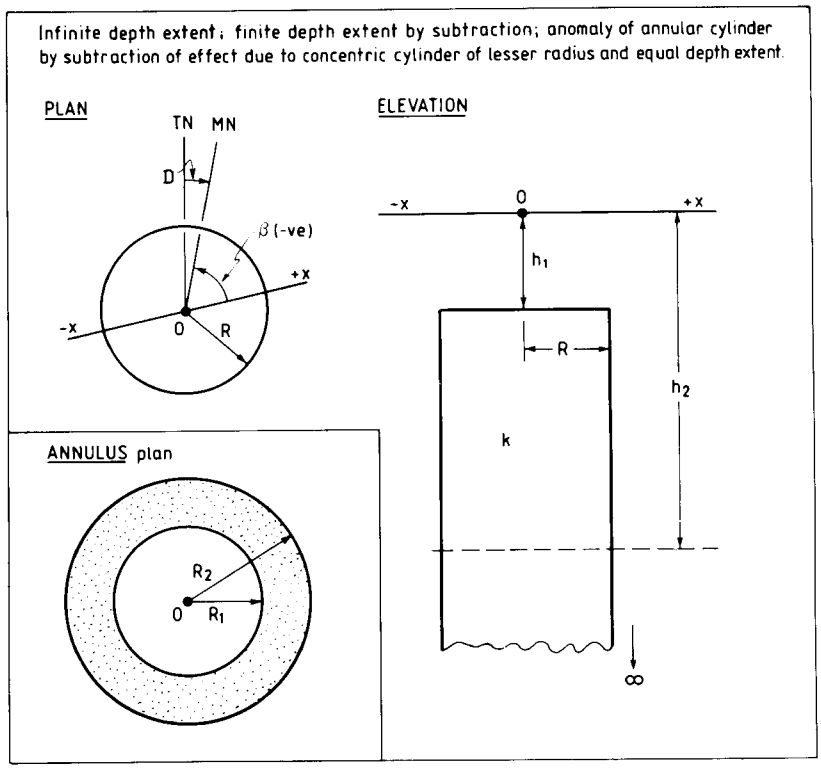
USER mode
DEG mode
SIZE 055

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load cards, run program		XEQ	MAG14	F=
2	Geomagnetic field magnitude	F		R/S	I=
3	Geomagnetic field inclination	I		R/S	D=
4	Geomagnetic field declination	D		R/S	INF?<0,1>
5a	If finite depth extent cylinder	0 (zero)		R/S	H1=
5b	If infinite depth extent cyclinder	1 (one)		R/S	H1=
6	Depth to cylinder top (a) finite depth extent	h_1		R/S	H2=
	(b) infinite depth extent				
	(go to 8)	h_1		R/S	ANNULUS?<0,1>
7	Depth to cylinder base	h_2		R/S	ANNULUS?<0,1>
8a	If cylinder only (go to 10)	0		R/S	R1=
8b	If annulus	1		R/S	R1=
9	Annulus inner radius R_1	R_1		R/S	R2=
10	Annulus outer radius R_2 or cylinder radius				
	R(=R_1)	R_2, or R		R/S	SUSC=
11	Susceptibility contrast	k		R/S	REM?<0,1>
12a	If remanence absent	0		R/S	J,I,D RES
					ACCEPT?<0,1>
12b	Either accept the computed (induced)				
	magnetisation (=J_{RES} print out)	1		R/S	BEARING=
12c	Or reject it and key in indepentently calculated	0		R/S	JRES-
	values which may take account of demag. &/or			R/S	IRES=
	aniso.				DRES=
	(go to 13)				BEARING=
12d	If remanence present	1		R/S	JREM=
12e	Remanent magnetisation magnitude	J_{REM}		R/S	IREM=
12f	Remanent magnetisation inclination	I_{REM}		R/S	DREM=
12g	Remanent magnetisation declination	D_{REM}		R/S	J,I,D RES
					ACCEPT?<0,1>
12h	Either accept the computed resultant	1		R/S	BEARING=
	magnetisation				
12i	Or reject it and key in independently calculated	0		R/S	JRES=
	values which may take account of demag. &/or				IRES=
	aniso.				DRES=
13	Azimuth of magnetic north w.r.t. +x axis	β		R/S	XMIN=?
	(bearing)				
14	Minimum (Principal Profile) x value	x_{MIN}		R/S	XMAX=?
15	Maximum (Principal Profile) x value	x_{MAX}		R/S	XINC=?
16	Profile x increment	x_{INC}		R/S	

Remainder of instructions similar to previous MAGMODS (RCL21 for β_R)

MAGMOD XIV

VERTICAL CIRCULAR CYLINDER



Comments:

1. The MAGMOD XIV program can accept a resultant magnetisation, worked out independently, incorporating the effects of demagnetisation and/or susceptibility anisotropy, using the above formulae for demagnetising factors. Calculation of the resultant magnetisation is facilitated by using the HP 41C MATHPAC Matrix Operations program. The calculated values can be entered into the MAGMOD XIV program at steps 12c or 12i. However, it is thought that induction ± remanence will suffice for most applications of this model.

2. The approximate demagnetising factors for the solid cylinder are equal to those given by the formulae of MAGMOD XIII for a circumscribed square prism and compare well with tabulated demagnetising factors. For the annular cylinder the demagnetising factors are taken to be those of solid cylinder of equivalent cross-section area. The accuracy of this approximation is uncertain.

3. MAGMOD XIV is useful for modelling specific types of body which frequently approximate the assumed geometry (intrusive plugs, ring dykes, contact aureoles). It is a slow program owing to the large number of iterations required to accurately calculate Λ_o, particularly if h/R is large. For h/R >>1 MAGMOD XIII with X = Y is a satisfactory alternative. Some inaccuracy due to round-off errors may be encountered at stations nearly over the edge of the cylinder (i.e. at x ≈ R). The plot (key F) is very slow for MAGMOD XIV; it has been included nevertheless.

```
Worked Example
MAGMOD XIV
Vertical Cylinder
Finite Depth Extent
Induction and
Remanence
S(-x) to N(+x)
Traverse

F=60,000.0
I=-70.0
D=10.0

H1=2.0
H2=10.0
R1=4.0
SUSC=0.001000

J REM=100.0
I REM=0.0
D REM=90.0

J RES=119.6
I RES=-28.1
D RES=79.0

BEARING=10.0

X=-8.0
BZ=12.2
BT=-22.3

X=-7.0
BZ=11.1
BT=-25.9

X=-6.0
BZ=5.6
BT=-27.5

X=-5.0
BZ=-10.6
BT=-21.3

X=-4.0
BZ=-45.5
BT=3.0

X=-3.0
BZ=-91.5
BT=44.3

X=-2.0
BZ=-129.8
BT=85.1

X=-1.0
3Z=-155.4
3T=117.0

X=0.0
BZ=-170.5
BT=140.6

X=1.0
BZ=-176.5
BT=156.7

X=2.0
BZ=-171.6
BT=163.7

X=3.0
BZ=-150.9
BT=156.0

X=4.0
BZ=-111.6
BT=127.1

X=5.0
BZ=-68.3
BT=87.1

X=6.0
BZ=-38.3
BT=55.2

X=7.0
BZ=-21.2
BT=34.8

X=8.0
BZ=-11.5
BT=22.3

            79.0    ***

BZ
MIN=-200.     MAX=20.
     |                |
  -8.                 |x
  -7.                 |x
  -6.                  x
  -5.                 x|
  -4.              x   |
  -3.           x      |
  -2.        x         |
  -1.     x            |
   0.   x              |
   1.  x               |
   2.  x               |
   3.    x             |
   4.       x          |
   5.          x       |
   6.             x    |
   7.                x |
   8.                 x|

BT
MIN=-30.      MAX=200.
     |                |
  -8.x|
  -7.x|
  -6.x|
  -5.x|
  -4.  x
  -3.  |  x
  -2.  |     x
  -1.  |        x
   0.  |           x
   1.  |              x
   2.  |              x
   3.  |              x
   4.  |           x
   5.  |        x
   6.  |     x
   7.  |  x
   8.  | x

Worked Example
MAGMOD XIV
Annular Cylinder
Infinite Depth Extent
Induction and
Remanence
S(-x) to N(+x)
Traverse
F=60,000.0
I=-70.0
D=10.0

H1=2.0
R1=3.0
R2=4.0
SUSC=0.001000

J REM=100.0
I REM=0.0
D REM=90.0

J RES=119.6
I RES=-28.1
D RES=79.0

BEARING=10.0

X=-8.0
BZ=0.4
BT=-7.6

X=-7.0
BZ=-1.6
BT=-8.0

X=-6.0
BZ=-6.6
BT=-6.4

X=-5.0
BZ=-18.4
BT=1.2

X=-4.0
BZ=-39.2
BT=19.8

X=-3.0
BZ=-53.7
BT=38.7

X=-2.0
BZ=-50.0
BT=40.8

X=-1.0
BZ=-41.8
BT=35.2

X=0.0
BZ=-38.1
BT=31.4

X=1.0
BZ=-40.6
BT=32.8

X=2.0
BZ=-50.6
BT=42.1

X=3.0
BZ=-64.2
BT=58.4

X=4.0
BZ=-62.8
BT=64.3

X=5.0
BZ=-45.2
BT=51.5

X=6.0
BZ=-29.3
BT=36.2

X=7.0
BZ=-19.4
BT=25.5

X=8.0
BZ=-13.5
BT=18.7

                                    79.0    ***
```

```
BZ
MIN=-70.      MAX=10.
     |                  |
   -8.                  x
   -7.                 x
   -6.                x |
   -5.              x   |
   -4.           x      |
   -3.       x          |
   -2.      x           |
   -1.     x            |
    0.     x            |
    1.     x            |
    2.    x             |
    3.  x               |
    4.  x               |
    5.     x            |
    6.        x         |
    7.          x       |
    8.           x      |
```

```
BT
MIN=-10.      MAX=70.
     |                  |
   -8. x |
   -7. x |
   -6. x |
   -5.  x
   -4.  |   x
   -3.  |      x
   -2.  |       x
   -1.  |      x
    0.  |     x
    1.  |     x
    2.  |       x
    3.  |           x
    4.  |             x
    5.  |          x
    6.  |      x
    7.  |    x
    8.  |   x
```

HP41C
Vertical
Cylinder
Program
Magnetics
MAGMOD XIV

```
01♦LBL "MAG14"
02♦LBL A
03 CF 22
04 FIX 1
05 "F="
06 PROMPT
07 FS?C 22
08 STO 03
09 ARCL 03
10 PRA
11 "I="
12 PROMPT
13 FS?C 22
14 STO 04
15 ARCL 04
16 PRA
17 "D="
18 PROMPT
19 FS?C 22
20 STO 05
21 ARCL 05
22 PRA
23 ADV
24♦LBL B
25 "INF?(0,1)"
26 PROMPT
27 FS?C 22
28 STO 13
29 "H1="
30 PROMPT
31 FS?C 22
32 STO 14
33 ARCL 14
34 PRA
35 GTO IND 13
36♦LBL 00
37 "H2="
38 PROMPT
39 FS?C 22
40 STO 15
41 ARCL 15
42 PRA
43♦LBL 01
44 "ANNULUS?(0,1)"
45 PROMPT
46 FS?C 22
47 STO 16
48 "R1="
49 PROMPT
50 GTO IND 16
51♦LBL 01
52 FS?C 22
53 STO 17
54 ARCL 17
55 PRA
56 "R2="
57 PROMPT
58♦LBL 00
59 FS?C 22
60 STO 18
61 ARCL 18
62 PRA
63 FIX 6
64 "SUSC="
65 PROMPT
66 FS?C 22
67 STO 19
68 ARCL 19
69 PRA
70 ADV
71 FIX 1
72 RCL 19
73 RCL 03
74 *
75 STO 06
76 STO 12
77 RCL 04
78 STO 10
79 RCL 05
80 STO 11
81 "REM?(0,1)"
82 PROMPT
83 CF 22
84 X=0?
85 GTO 01
86♦LBL C
87 "J REM="
88 PROMPT
89 FS?C 22
90 STO 09
91 ARCL 09
92 PRA
93 "I REM="
94 PROMPT
95 FS?C 22
96 STO 07
97 ARCL 07
98 PRA
99 "D REM="
100 PROMPT
101 FS?C 22
102 STO 08
103 ARCL 08
104 PRA
105 ADV
106 RCL 08
107 RCL 07
108 RCL 09
109 P-R
110 X<>Y
111 STO 10
112 RDN
113 P-R
114 STO 11
115 RDN
116 STO 12
117 RCL 05
118 RCL 04
119 RCL 06
120 P-R
121 X<>Y
122 ST+ 10
123 RDN
124 P-R
125 ST+ 11
126 RDN
127 ST+ 12
128 RCL 10
129 RCL 12
130 RCL 11
131 R-P
132 X<>Y
133 STO 11
134 RDN
135 R-P
136 STO 12
137 RDN
138 STO 10
139♦LBL 01
140 XEQ G
141 "ACCEPT?(0,1)"
142 PROMPT
143 CF 22
144 X≠0?
145 GTO D
146 "J RES="
147 PROMPT
148 FS?C 22
149 STO 12
150 ARCL 12
151 PRA
152 "I RES="
153 PROMPT
154 FS?C 22
155 STO 10
156 ARCL 10
157 PRA
158 "D RES="
159 PROMPT
160 FS?C 22
161 STO 11
162 ARCL 11
163 PRA
164 ADV
165♦LBL D
166 "BEARING="
167 PROMPT
168 FS?C 22
169 STO 20
170 ARCL 20
171 PRA
172 ADV
173 RCL 20
174 RCL 05
175 -
176 RCL 11
177 +
178 STO 21
179 RCL 10
180 1
181 P-R
182 X<>Y
183 STO 22
184 STO 25
185 STO 26
186 RDN
187 P-R
188 STO 23
189 STO 00
190 X<>Y
191 STO 24
192 RCL 20
193 RCL 04
194 1
195 P-R
196 X<>Y
```

```
197 ST* 25
198 ST* 00
199 RDN
200 P-R
201 ST* 26
202 RCL 23
203 *
204 ST- 25
205 X<>Y
206 ST* 24
207 X<>Y
208 ST- 24
209 RCL 00
210 ST+ 26
211♦LBL E
212 "XMIN=?"
213 PROMPT
214 FS?C 22
215 STO 27
216 "XMAX=?"
217 PROMPT
218 FS?C 22
219 STO 29
220 "XINC=?"
221 PROMPT
222 FS?C 22
223 STO 30
224 RCL 27
225 STO 28
226♦LBL 04
227 "X="
228 ARCL 28
229 PRA
230 XEQ 01
231 "BZ="
232 ARCL 54
233 PRA
234 "BT="
235 ARCL 53
236 PRA
237 ADV
238 RCL 30
239 ST+ 28
240 RCL 29
241 RCL 28
242 X<=Y?
243 GTO 04
244 STOP
245 GTO E
246♦LBL F
247 "BZ MIN=?"
248 PROMPT
249 FS?C 22
250 STO 31
251 "BZ MAX=?"
252 PROMPT
253 FS?C 22
254 STO 32
255 "BT MIN=?"
256 PROMPT
257 FS?C 22
258 STO 33
259 "BT MAX=?"
260 PROMPT
261 FS?C 22
262 STO 34
263 126
264 STO 02
265 RCL 31
266 STO 00
267 RCL 32
268 STO 01
269 SF 12
270 FIX 0
271 SF 07
272 "BZ"
273 XEQ 03
274 RCL 33
275 STO 00
276 RCL 34
277 STO 01
278 SF 12
279 CF 07
280 "BT"
281 XEQ 03
282 FIX 1
283 STOP
284 GTO E
285♦LBL 03
286 PRA
287 CF 12
288 "MIN="
289 ARCL 00
290 "┣     MAX="
291 ARCL 01
292 PRA
293 127
294 ACCOL
295 124
296 SKPCOL
297 127
298 ACCOL
299 ADV
300 RCL 27
301 STO 28
302♦LBL 05
303 RCL 28
304 ACX
305 XEQ 01
306 RCL 53
307 FS? 07
308 RCL 54
309 REGPLOT
310 RCL 30
311 ST+ 28
312 RCL 29
313 RCL 28
314 X<=Y?
315 GTO 05
316 ADV
317 RTN
318♦LBL 01
319 RCL 18
320 STO 35
321 XEQ 06
322 RDN
323 STO 53
324 X<>Y
325 STO 54
326 GTO IND 16
327♦LBL 01
328 RCL 17
329 STO 35
330 XEQ 06
331 RDN
332 ST- 53
333 X<>Y
334 ST- 54
335♦LBL 00
336 RCL 12
337 2
338 *
339 PI
340 *
341 ST* 53
342 ST* 54
343 RTN
344♦LBL 06
345 RCL 14
346 X↑2
347 STO 36
348 XEQ 06
349 RCL 37
350 STO 50
351 RCL 38
352 STO 51
353 RCL 39
354 STO 52
355 GTO IND 13
356♦LBL 00
357 RCL 15
358 X↑2
359 STO 36
360 XEQ 06
361 RCL 37
362 ST- 50
363 RCL 38
364 ST- 51
365 RCL 39
366 ST- 52
367♦LBL 01
368 RCL 28
369 ABS
370 SF 25
371 ST/ 51
372 CF 25
373 LASTX
374 SIGN
375 ST* 52
376 RCL 22
377 RCL 50
378 *
379 RCL 23
380 RCL 52
381 *
382 -
383 RCL 25
384 RCL 50
385 *
386 RCL 24
387 RCL 51
388 *
389 -
390 RCL 26
391 RCL 52
392 *
393 -
394 RCL 28
395 X=0?
396 RTN
397 RDN
398 RCL 35
399 ST* Y
400 ST* Z
401 RTN
402♦LBL 06
403 1.386294361
404 STO 37
405 1
406 STO 38
407 .5
408 STO 39
409 RCL 28
410 X=0?
411 GTO 03
412 ABS
413 RCL 35
414 *
415 STO 40
416 LASTX
417 RCL 28
418 ABS
419 +
420 X↑2
421 RCL 36
422 +
423 /
424 4
425 *
426 STO 41
427 9.666344259 E-2
428 1
429 RCL 41
430 -
431 STO 42
432 *
433 ST+ 37
434 LASTX
435 .4432514146
436 *
437 ST+ 38
438 .1249859360
439 RCL 42
440 *
441 ST+ 39
442 LASTX
443 .2499836831
444 *
```

```
445 STO 43
446 3.590092383 E-2
447 RCL 42
448 X↑2
449 *
450 ST+ 37
451 LASTX
452 6.26060122 E-2
453 *
454 ST+ 38
455 6.880248576 E-2
456 RCL 42
457 X↑2
458 *
459 ST+ 39
460 LASTX
461 9.200180037 E-2
462 *
463 ST+ 43
464 3.742563713 E-2
465 RCL 42
466 3
467 Y↑X
468 STO 44
469 *
470 ST+ 37
471 LASTX
472 4.757383546 E-2
473 *
474 ST+ 38
475 3.328355346 E-2
476 RCL 44
477 *
478 ST+ 39
479 LASTX
480 4.069697526 E-2
481 *
482 ST+ 43
483 1.451196212 E-2
484 RCL 42
485 4
486 Y↑X
487 STO 44
488 *
489 ST+ 37
490 LASTX
491 1.736506451 E-2
492 *
493 ST+ 38
494 4.41787012 E-3
495 RCL 44
496 *
497 ST+ 39
498 LASTX
499 5.26449639 E-3
500 *
501 ST+ 43
502 RCL 39
503 RCL 42
504 1/X
505 LN
506 *
507 ST+ 37
508 LASTX
509 RCL 43
510 *
511 ST+ 38
512 2
513 PI
514 /
515 ST* 37
516 ST* 38
517 RCL 36
518 RCL 35
519 RCL 28
520 ABS
521 -
522 X↑2
523 RCL 36
524 +
525 /
526 1
527 STO 43
528 X=Y?
529 GTO 02
530 RDN
531 STO 39
532 SQRT
533 RAD
534 ASIN
535 ST* 43
536 STO 45
537 TAN
538 1/X
539 STO 44
540 DEG
541 RCL 38
542 ST* 43
543 2
544 STO 46
545 /
546 STO 47
547 RCL 37
548 STO 48
549*LBL 07
550 RCL 42
551 ST* 47
552 ST* 48
553 RCL 48
554 RCL 47
555 -
556 STO 49
557 RCL 44
558 RCL 39
559 *
560 STO 44
561 RCL 46
562 CHS
563 /
564 LASTX
565 CHS
566 1/X
567 LASTX
568 1
569 -
570 *
571 RCL 45
572 *
573 +
574 STO 45
575 RCL 49
576 *
577 ST- 43
578 1 E-10
579 X>Y?
580 GTO 02
581 2
582 ST+ 46
583 RCL 46
584 ST/ 47
585 1
586 -
587 ST* 47
588 1
589 -
590 ST/ 48
591 1
592 -
593 ST* 48
594 GTO 07
595*LBL 02
596 RCL 41
597 RCL 40
598 *
599 1/X
600 STO 42
601 SQRT
602 1
603 RCL 41
604 2
605 /
606 -
607 RCL 37
608 *
609 RCL 38
610 -
611 *
612 STO 39
613 RCL 41
614 RCL 36
615 *
616 RCL 40
617 3
618 Y↑X
619 /
620 SQRT
621 -4
622 /
623 ST* 37
624 RCL 42
625 RCL 36
626 *
627 4
628 /
629 SQRT
630 ST* 38
631 RCL 28
632 RCL 35
633 R-P
634 X↑2
635 RCL 36
636 2
637 /
638 +
639 RCL 37
640 *
641 ST+ 38
642 RCL 43
643 RCL 35
644 2
645 *
646 /
647 RCL 28
648 ABS
649 ST* 37
650 RCL 35
651 X<=Y?
652 SF 06
653 -
654 SIGN
655 *
656 ST+ 37
657 RCL 35
658 X↑2
659 RCL 28
660 X↑2
661 -
662 *
663 RCL 28
664 ABS
665 2
666 *
667 /
668 ST- 38
669 RCL 28
670 ABS
671 RCL 35
672 /
673 FS? 06
674 1/X
675 2
676 /
677 ST+ 38
678 FS?C 06
679 GTO 01
680 RCL 35
681 1/X
682 ST+ 37
683*LBL 01
684 RTN
685*LBL 03
686 1
687 RCL 36
688 RCL 35
689 X↑2
690 RCL 36
691 +
692 /
```

```
693 SQRT
694 -
695 STO 37
696 2
697 /
698 STO 38
699 0
700 STO 39
701 RTN
702♦LBL G
703 FIX 1
704 "J RES="
705 ARCL 12
706 PRA
707 "I RES="
708 ARCL 10
709 PRA
710 "D RES="
711 ARCL 11
712 PRA
713 ADV
714 .END.
```