
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session of 2005/2006

*Peperiksaan Semester Pertama
Sidang Akademik 2006/2007*

October/November 2006
Oktober/November 2006

EBS 417E/3 – GEOMECHANICS
GEOMEKANIK

Time : 3 hours
Masa : 3 jam

Instruction to candidates:

Before you begin with the examination, make sure that this paper is made up of 15 (fifteen) printed pages (include 3 (three) pages of Appendices).

The paper consists of 8 (eight) questions. 4 (four) questions in Section A and 4 (four) questions in Section B. Answer FIVE questions with at least 2 (TWO) questions from each section.

Begin your answer for every question on a fresh page.

Answer all questions in English Language. However you are allowed to answer up to TWO questions in Malaysian Language.

Arahan kepada calon:

Sebelum memulakan peperiksaan sila pastikan bahawa kertas peperiksaan ini mengandungi 15 (lima belas) muka surat bercetak (termasuk 3 (tiga) muka surat lampiran).

Kertas soalan ini mengandungi 8 (lapan) soalan. 4 (empat) soalan dalam Bahagian A dan 4 (empat) soalan dalam bahagian B. Jawab 5 (lima) soalan dengan sekurang-kurangnya 2 (dua) soalan bagi setiap bahagian.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Jawap semua soalan dalam Bahasa Inggeris. Namun demikian calon dibenarkan menjawab sehingga DUA soalan dalam Bahasa Malaysia.

SECTION A

BAHAGIAN A

1. (a) The results of a sieve analysis on a soil are:

Seive size (mm)	Mass retained (g)
50.00	0
37.50	15.5
20.00	17.0
14.00	10.0
10.00	11.0
6.30	33.0
3.35	114.5
1.18	63.3
0.60	18.2
0.15	17.0
0.063	10.5

The total mass of the sample was 311 g, plot the particle size distribution curve and, from the inspection of this curve, determine the effective size and uniformity coefficient. Classify the soil based on the chart in Appendix A.

(15 marks)

- [b] Define the following:
- (i) Porosity
 - (ii) Void ratio
 - (iii) Well graded soil
 - (iv) Uniformly graded soil
 - (v) Gap graded soil

(5 marks)

1. (a) Keputusan analisa saringan ke atas suatu tanah ialah:

Saiz saringan (mm)	Jisim yang tertinggal (g)
50.00	0
37.50	15.5
20.00	17.0
14.00	10.0
10.00	11.0
6.30	33.0
3.35	114.5
1.18	63.3
0.60	18.2
0.15	17.0
0.063	10.5

Jumlah jisim sample ialah 311 g, pelotkan lengkung taburan saiz zarah dan, daripada pemeriksaan lengkung ini, tentukan saiz berkesan dan pekali keseragaman. Kelaskan tanah ini berdasarkan carta di Lampiran A.

(15 markah)

(b) Takrifkan perkara berikut:

- (i) keliangan
- (ii) nisbah ruang
- (iii) tanah bergred rapi
- (iv) tanah bergred seragam
- (v) tanah bergred sela

(5 markah)

292

2. (a) A concrete dam, with a base length of 24.4 m, holds back water to a height of 12.2 m above its base. The dam which is 457 m wide, sits on a stratum of soil 18.3 m thick which overlies impermeable rock. The base of the dam is horizontal and, at the downstream end, a sheet pile cut-off has been driven to a depth of 6.1 m.

The coefficient of permeability of the soil is 4×10^{-7} m/s. Determine the seepage loss through the soil, in m^3/day , if there is a head of 1.52 m of water above the base on the downstream side.

(10 marks)

- (b) Undrained shear box tests were carried out on a series of soil samples with the following results:

Test no.	Total normal stress (kN/m^2)	Total shear stress at failure (kN/m^2)
1	100	98
2	200	139
3	300	180
4	400	222

Determine the cohesion and the angle of friction of the soil, with respect to total stress.

(8 marks)

- (c) What is effective stress?

(2 marks)

2. (a) Suatu empangan konkrit, dengan bahagian bawahnya berukuran 24.4 m, menahan air dengan kedalaman 12.2 m di atas dasarnya. Lebar empangan ini ialah 457 m, terletak di atas stratum tanah yang berketebalan 18.3 m melapisi di atas batuan yang tidak boleh telap. Dasar empangan ini ialah mendatar dan di bahagian hilir, cerucuk kepingan penghalang telah dimasukkan sehingga kedalam 6.1 m.

Pekali kebolehtelapan tanah ialah 4×10^{-7} m/s. Tentukan kehilangan air disebabkan resipan melalui tanah dalam m^3 /hari, sekiranya terdapat turus 1.52 m air di atas dari dasar bahagian bawah di hilir empangan

(10 markah)

- (b) Ujian kotak ricihan telah dilakukan ke atas beberapa sampel tanah dengan keputusan seperti berikut:

No. ujian	Jumlah tegasan normal (kN/m^2)	Jumlah tegasan ricih semasa gagal (kN/m^2)
1	100	98
2	200	139
3	300	180
4	400	222

Tentukan kejelekitan dan sudut geseran tanah, dalam keadaan jumlah tegasan.

(8 markah)

- (c) Apakah tegasan berkesan?

(2 markah)

3. (a) A smooth back vertical wall of 7.5 m retains the soil level with the top of the wall. The soil is made up of two layers of non cohesive soil of which the top layer of 3 m thick having the bulk unit weight of 16 kN/m^3 , internal friction of 30° and the underlying layer of 4.5 m thick with the unit weight of 24 kN/m^3 and internal friction of 20° . Draw the diagram of the pressure distribution on the back of the wall and determine the total horizontal active thrust acting on the back of the wall.

(12 marks)

- (b) Define active and passive earth pressures and derive using Rankine's theory of the coefficient of active earth pressure.

(8 marks)

3. (a) *Suatu dinding licin yang menegak mempunyai ketinggian 7.5 m menahan tanah yang separas dengan bahagian atas dinding. Tanah ini terdiri daripada dua lapis tanah yang tidak berjelekit di mana lapisan atas dengan ketebalan 3 m mempunyai berat unit 16 kN/m^3 , geseran dalaman 30° dan lapisan bawah pula setebal 4.5 m dengan berat unit 24 kN/m^3 dan geseran dalaman 20° . Lukiskan rajah taburan tekanan yang dialami di belakan dinding dan tentukan jumlah daya aktif mendatar yang bertindak di belakan dinding.*

(12 markah).

- (b) *Takrifkan tekanan bumi aktif dan pasif dan terbitkan dengan menggunakan teori Rankine bagi pekali tekanan bumi aktif.*

(8 markah)

4. (a) In the pumping out test as shown in Figure 1, water is pumped out from a well at the rate of q and the height of water level at the first observation well at distance r_1 from the centre of the pumping well is h_1 and the water level at the second observation well at r_2 from the pumping well is h_2 . Derive the coefficient of permeability:

$$k = \frac{2.3 q \log_{10} r_2 / r_1}{\pi (h_2^2 - h_1^2)}$$

(10 marks)

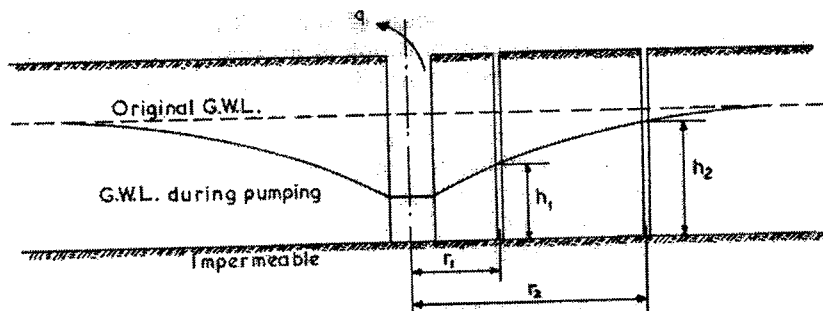


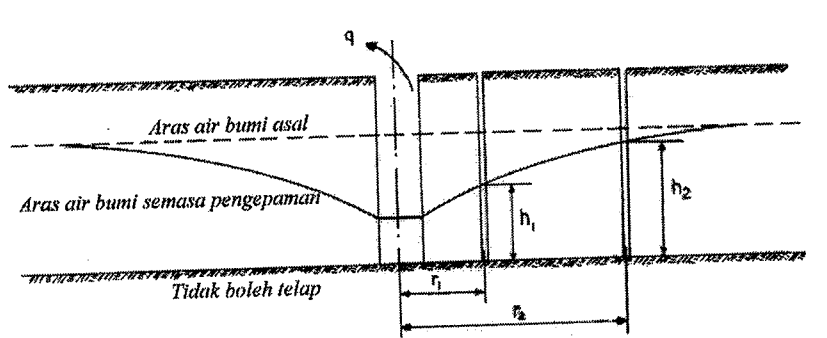
Figure 1

- (b) Discuss briefly how it would be possible to evaluate the permeability of a soil from its particle size distribution.

(10 marks)

4. (a) Dalam ujian pengepaman keluar seperti yang ditunjukkan dalam Rajah 1, air dipam keluar daripada sebuah telaga pada kadar alir q dan ketinggian paras air di telaga pemerhatian pertama dengan jarak r_1 daripada titik tengah telaga yang mengepam ialah h_1 dan paras air di telaga pemerhatian kedua pada r_2 dari telaga pengepaman ialah h_2 . Terbitkan pekali kebolehtelapan:

$$k = \frac{2.3 q \log_{10} r_2 / r_1}{\pi (h_2^2 - h_1^2)}$$



Rajah 1

(10 markah)

- (b) Bincangkan dengan ringkas bagaimanakah untuk menilai kebolehtelapan tanah daripada taburan saiz zarah.

(10 markah)

Section B

Bahagian B

5. (a) Outline the essential requirements considered necessary for a rock mass classification system for mine support design. Discuss the essential differences between the classification system proposed by Bieniawski and that proposed by Barton, Lien and Lunde.

(10 marks)

- (b) Discuss the principle and merits of the application of shotcrete as a method of mine support. Include in the discussion the desirable properties of shotcrete, together with aspects of quality control, testing and safety.

(10 marks)

5. (a) Bincangkan dengan ringkas mengenai keperluan-keperluan yang dianggap perlu untuk sistem pengelasan jisim batuan bagi rekabentuk sokongan lombong. Bincangkan perbezaan yang penting di antara sistem pengelasan yang dicadangkan oleh Bienawskidan yang dicadangkan oleh Barton, Lien dan Lunde..

(10 markah)

- (b) *Bincangkan prinsip dan kebaikan penggunaan syotkret sebagai kaedah sokongan lombong. Masukkan dalam perbincangan mengenai sifat-sifat yang baik untuk syotkret bersama dengan aspek kawalan kualiti, ujian dan keselamatan.*
(10 markah)
6. (a) What are the types of stresses in rock and discuss briefly each one of them?
(10 marks)
- (b) Write short notes about the common rock slope failures illustrating with the help of sketches of the slope and the stereographic projection of each failure.
(10 marks)
6. (a) *Apakah jenis tegasan dalam batuan dan bincangkan dengan ringkas mengenainya setiap satu?*
(10 markah)
- (b) *Tuliskan nota ringkas mengenai kegagalan batuan yang biasa terjadi dan tunjukkan dengan lakaran dan unjuran stereografi bagi setiap kegagalan.*
(10 markah)
7. A circular shaft 10 metres in diameter has been sunk to a depth of 1,500 metres. Stress measurements at that depth indicate virgin maximum and minimum horizontal in-situ stresses of 40 and 20 MPa respectively, with the maximum stress aligned N-S. A crusher station is to be excavated to the East of the shaft and for loading and drainage reasons the bottom of the shaft must be below the bottom of the crusher station.
- (i) What is the tangential stress in the east side of shaft wall?
(6 marks)
- (ii) Use the Kirsh equations to find the nearest point that the crusher station can come to the shaft with the conditions that the stresses at this point induced by the shaft excavation of the station must not differ from the virgin stresses by more than 2 MPa.

In solving the problem you should sketch approximate graphs of radial and tangential stress versus radius. The answer should be correct to the nearest metre.

(14 marks)

Kirsh equations:

$$\sigma_{\theta} = \frac{1}{2}(\sigma_x + \sigma_y) \left(1 + \frac{a^2}{r^2}\right) - \frac{1}{2}(\sigma_x - \sigma_y) \left(1 + 3\frac{a^4}{r^4}\right) \cos 2\theta$$

$$\sigma_r = \frac{1}{2}(\sigma_x + \sigma_y) \left(1 - \frac{a^2}{r^2}\right) + \frac{1}{2}(\sigma_x - \sigma_y) \left(1 + 3\frac{a^4}{r^4} - 4\frac{a^2}{r^2}\right) \cos 2\theta$$

7. Suatu syaf berbentuk bulat bergarispusat 10 meter telah dikorek sehingga kedalaman 1,500 meter. Pengukuran tegasan yang dibuat di kedalaman ini memberikan tegasan dara maksimum dan minimum mendatar bernilai 40 dan 20 MPa masing-masing, dengan tegasan maksimum pada arah U-S. Sebuah stesyen pemecah batuan akan dikorek di timur daripada syaf dan untuk tujuan pemungahan batuan dan saliran, bahagian bawah syaf mestilah lebih bawah daripada lantai stesyen pemecah batuan.

- (i) Apakah tegasan tangen di bahagian barat daripada dinding syaf?

(6 markah)

- (ii) Gunakan persamaan Kirsh untuk mendapatkan tempat yang paling hampir stesyen pemecah batuan boleh ditempatkan berhampiran dengan syaf dengan syarat bahawa tegasan pada titik ini yang diaruhkan oleh pengorekan syaf tidak boleh berbeza daripada tegasan dara lebih daripada 2 MPa.

Dalam menyelesaikan masalah ini anda hendaklah membuat lakaran graf tegasan radial dan tangen melawan jejari. Jawapan hendaklah kepada yang meter yang terhampir.

(14 markah)

Persamaan Kirsh:

$$\sigma_{\theta} = \frac{1}{2}(\sigma_x + \sigma_y) \left(1 + \frac{a^2}{r^2}\right) - \frac{1}{2}(\sigma_x - \sigma_y) \left(1 + 3\frac{a^4}{r^4}\right) \cos 2\theta$$

$$\sigma_r = \frac{1}{2}(\sigma_x + \sigma_y) \left(1 - \frac{a^2}{r^2}\right) + \frac{1}{2}(\sigma_x - \sigma_y) \left(1 + 3\frac{a^4}{r^4} - 4\frac{a^2}{r^2}\right) \cos 2\theta$$

8. (a) What is the difference between the Mohr-Coulomb failure criterion and the Hoek and Brown failure criterion?

(5 marks)

- (b) Plot the poles of the following discontinuities:

- (i) dip 10° towards 030°
- (ii) dip 20° towards 035°
- (iii) dip 21° towards 032°
- (iv) dip 15° towards 031°
- (v) dip 14° towards 032°

What is the general dip and trends of these structures?

(5 marks)

- (c) A conglomerate that contains gold is located at a depth of 208 metres. This information is obtained from a vertical borehole. A second borehole which is also vertical is located 500 metres south west of the previous or first borehole. From this second borehole it is found that the conglomerate appears at the depth of 102 metres. A third vertical borehole that is located 300 metres south of the first borehole found the conglomerate at a depth of 49 metres. The depth of all boreholes are measured from the same datum. Determine the true dip and strike of the conglomerate.

(Use the stereonet in the Appendix B and C)

(10 marks)

8. (a) *Apakah bezanya di antara kriterium kegagalan Mohr-Coulomb dan kriterium kegagalan Hoek dan Brown?*

(5 markah)

(b) *Pelotkan kutub bagi ketakselajaran yang berikut:*

- (i) miring 10° ke arah 030°*
- (ii) miring 20° ke arah 035°*
- (iii) miring 21° ke arah 032°*
- (iv) miring 15° ke arah 031°*
- (v) miring 14° ke arah 032°*

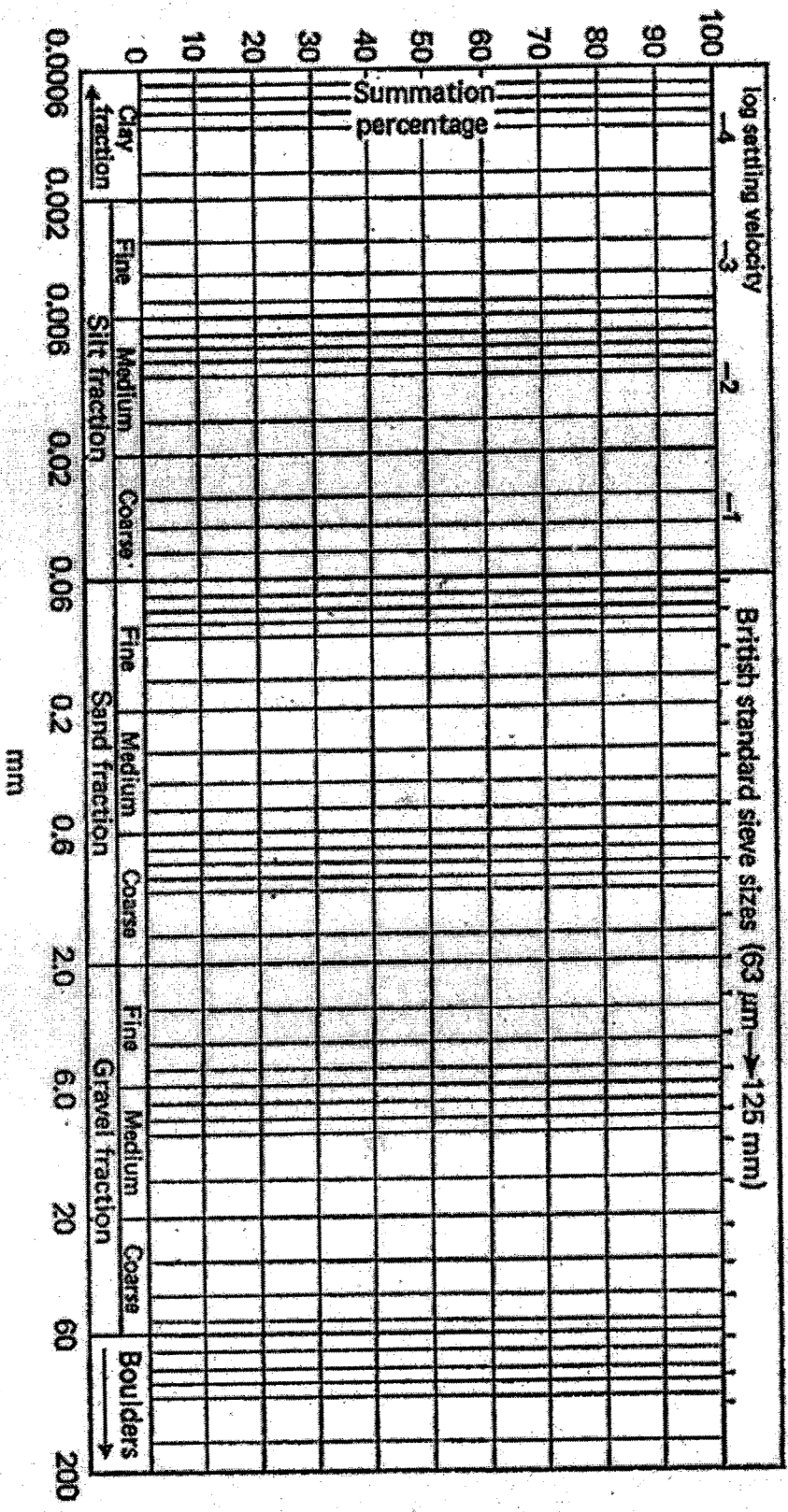
Apakah kemiringan dan tren am bagi struktur-struktur ini?

(5 markah)

(d) *Suatu batuan konglomerat yang mengandungi emas dijumpai terdapat di kedalam 208 meter. Maklumat ini diperolehi daripada lubang gerudi menegak. Lubang gerudi menegak yang kedua ditempatkan 500 meter barat daya daripada lubang pertama. Daripada lubang gerudi yang kedua ini ia didapati konglomerat ini terdapat di kedalaman 102 meter. Lubang gerudi menegak ketiga yang ditempatkan 300 meter selatan daripada lubang gerudi pertama mendapati konglomerat pada kedalaman 49 meter. Kedalaman semua lubang gerudi ini diukur daripada datum yang sama. Tentukan kemiringan dan jurus sebenar konglomerat.*

(Gunakan stereonet di Lampiran B dan C)

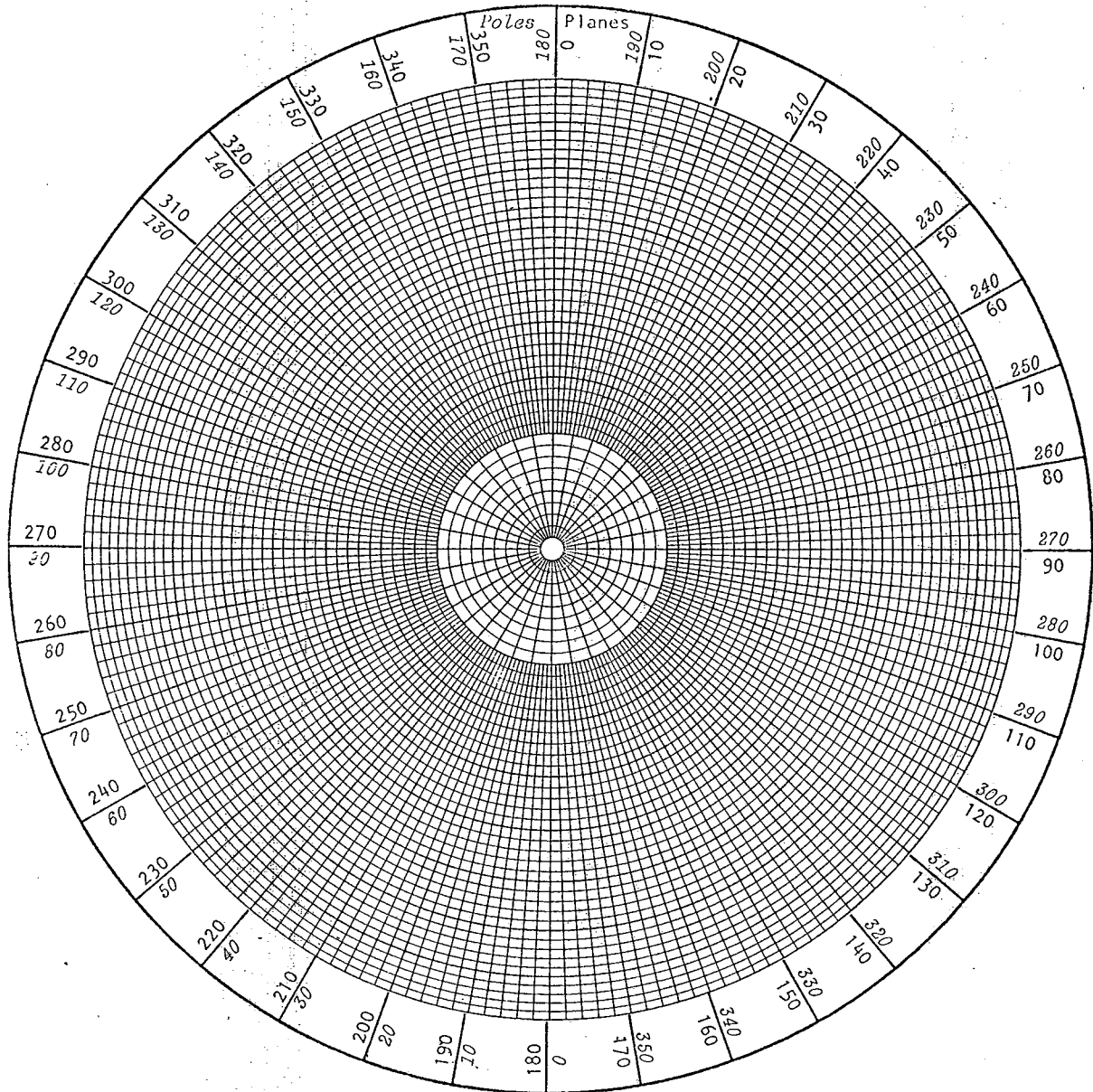
(10 markah)



Particle size distribution chart
Carta taburan saiz zarah

Handwritten marks at the bottom right corner of the page.

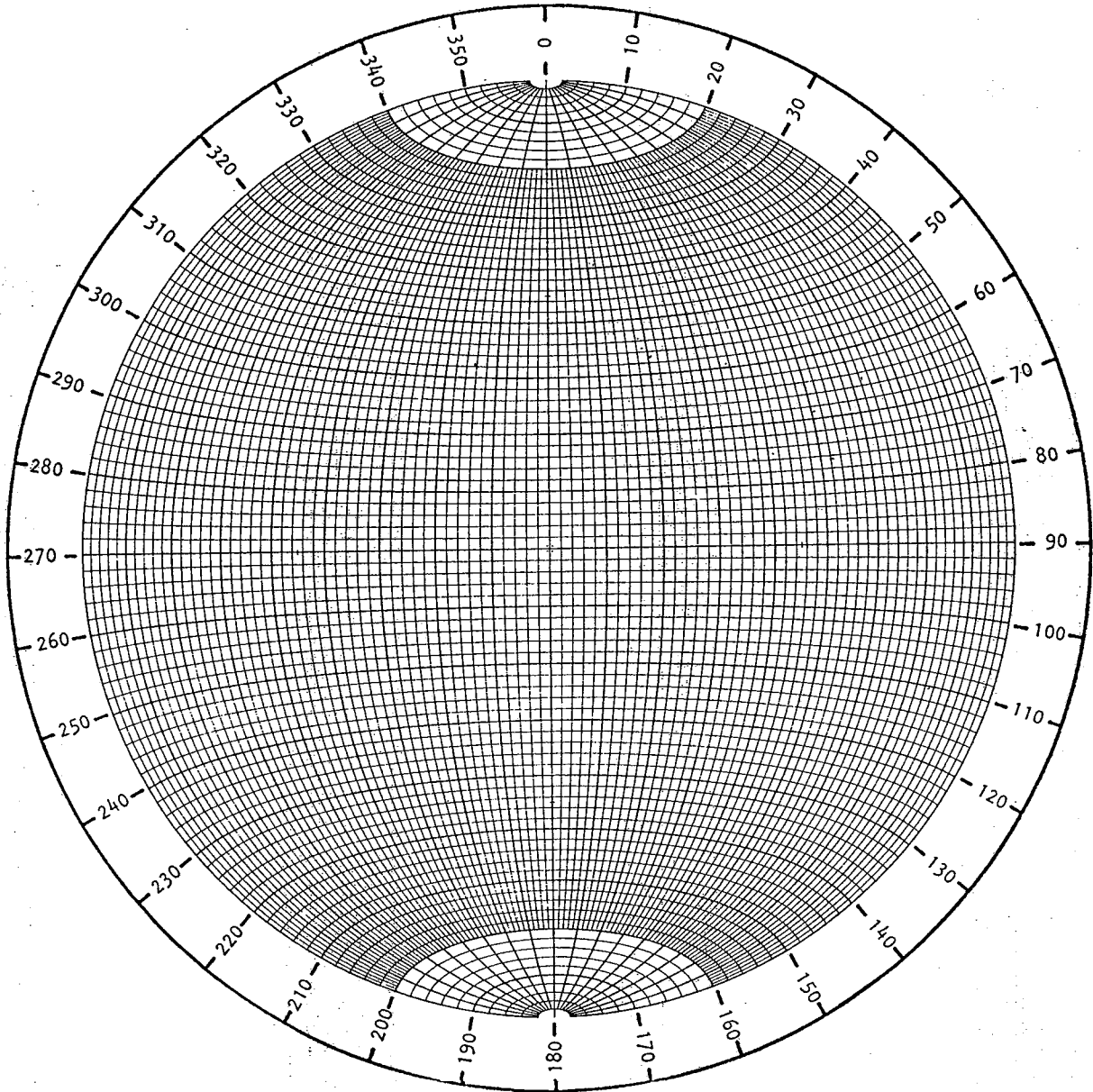
Appendix B
Lampiran B



Polar equal-area stereonet marked in 2° intervals.

Computer drawn by Dr. C.M. St John of the Royal School of Mines,
Imperial College, London.

Appendix C
Lampiran C



Equatorial equal-area stereonet marked in 2° intervals.

*Computer drawn by Dr. C.M. St John of the Royal School of Mines,
Imperial College, London.*

12
7-18