UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2011/2012 Academic Session

June 2012

EAK 263/4 – Geomatic Engineering
[*Kejuruteraan Geomatik*]

Duration : 3 hours
[*Masa : 3 jam*]

Please check that this examination paper consists of **THIRTEEN (13)** pages of printed material before you begin the examination.
[*Sila pastikan bahawa kertas peperiksaan ini mengandungi **TIGA BELAS (13)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*]

Instructions: This paper contains **SIX (6)** questions. Answer **ALL FOUR (4)** questions from **Section A** and **ANY ONE (1)** question from **Section B**.
[***Arahan**: Kertas ini mengandungi **ENAM (6)** soalan. Jawab **SEMUA EMPAT (4)** soalan dari **Bahagian A** dan **MANA-MANA SATU (1)** dari **Bahagian B**].

You may answer the question either in Bahasa Malaysia or English.
[*Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris*].

All questions **MUST BE** answered on a new page.
[*Semua soalan **MESTILAH** dijawab pada muka surat baru*].

In the event of any discrepancies on the questions, the English version shall be used.
[*Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai*].

Section A

Table 1 Project Description

Due to the unprecedented weather conditions and the 2004 tsunami, Kg. Baharu, a small fishing settlement in Ayer Tawar near Lumut, Perak is prone to flooding during monsoon seasons. The site has also been chosen for the Annual Intensive Geomatic Practical (AIGP) for the last 3 years. In December 2011, a group of students were involved in the survey as part of a feasibility study to determine the effect of flooding to the once popular tourist site because of its natural beauty having a river front, chalets and sea food restaurants. An immediate solution to these problems is to improve the concrete retaining walls which were erected along the river front some 10 years ago, to protect from surging or over flooding. Such surveys were carried out to gather up-to-date spatial information for the on-going studies on seasonal flooding problems and the remedial measures, building tourist information database and up-to-date maps of the surrounding areas.

As part of the submission of a conclusive report to the local authority, a comprehensive survey of the area was carried out to establish vertical and horizontal controls.

1. For the proposed upgrading of the existing retaining walls along the river front at the work site as presented in **Table 1** (Project Description) above, a horizontal control surveying was carried out to establish a series of survey controls. The abstract of the survey data is given in the following table **(Table 2).**

Table 2 Horizontal control - Closed-loop traverse survey

Line	Distance (m)	Mean included angle		Notes
AB	103.401	Stn A	94° 10’ 00”	Stn A: Start of retaining wall (RL_A = 3.430m)
BC	157.251	Stn B	178° 10’ 00”	Stn B: Near jetty
CE	143.359	Stn C	118° 21’ 45”	Stn C: End of retaining wall
EG	169.082	Stn E	94° 42’ 25”	Stn E: Manhole
GJ	176.742	Stn G	158° 07’ 30”	Stn G: Entrance of TNB sub-station
JL	110.601	Stn J	89° 03’ 55”	Stn J: In front of Madura Restaurant
LA	140.828	Stn L	167° 15’ 50”	Stn L: At rear of Shell Petrol Station

(a) If the bearing of the baseline AB is 189^{o} 22' 40", calculate the bearings of the other traverse lines.

[5 marks]

(b) If the coordinate of station A is 1500.000mN, 1700.000mE, calculate the coordinates of the other survey stations and determine the accuracy of the traverse using the Bowditch Method of Adjustment. Comment on the accuracy of the survey work carried out.
(You may use the Traverse Computation Sheet provided).

[20 marks]

(c) Calculate the horizontal distance of the retaining wall AC.

[5 marks]

1. Levelling was carried out to determine the reduced levels of all the survey control points B, C, E, G, J and L as presented in **Table 3** below.

Table 3 Levelling of survey control points

BS	IS	FS	RL (m)	Notes
0.393			3.430	TBM at Stn A (start of retaining wall)
1.740		1.817		Stn B: Near jetty
	2.804			Point X: Road shoulder (right)
	1.280			Point Y: Road shoulder (left)
	2.164			Stn C: End of retaining wall
1.935		1.320		Stn E: Manhole
	2.469			Stn G: Entrance of TNB sub-station
	2.835			Stn J: In front of Madura Restaurant
	3.600			Stn L: At rear of Shell Petrol Station
		0.931		TBM at Stn A

(a) Calculate the reduced levels of all survey stations using the Rise and Fall Method.

[6 marks]

(b) Draw a sketch to show the sequence of observation and comment on the results obtained under the second class survey category.
In most vertical control survey jobs, intermediate sights are not taken to important points such as survey controls. Give **ONE (1)** reason why this is practiced.

[5 marks]

(c) Calculate the gradient of the retaining wall AC.

[3 marks]

(d) State **FOUR (4)** necessary precautions that should be taken to ensure that the levelling results are satisfactory even if the level is in good adjustment.

[2 marks]

(e) If the misclosure of the levelling task exceeds the allowable limit under the second class survey category, describe the field procedures that should be carried out to determine the condition of the instrument.

[4 marks]

2. (a) As the level was used continuously at the work site over a long period of time, results of further vertical control surveys may be unsatisfactory. Explain how the task is continued even when the bubble is not in its central position despite numerous temporary adjustments being made to the instrument at every set-up.

[3 marks]

(b) As a results of the outcome from 3(a) above and the misclosure that has exceeded the allowable limit for a second class survey, it was decided that a two-peg test is to be carried out as it was suspected that the line of sight is not truly horizontal even if the bubble is in its central position.

The level, set up at a position C, 40m from a staff held at A, and 40m from a staff held at B, gave readings of 1.914m and 2.237m respectively, and the bubble was brought to the centre of its run before each reading was taken. The level was then set up at position D, 5m away after B, and observed to the staff held at A and at B and the staff readings of 1.874m and 2.141m respectively, were obtained. The positions of the level and the staff are in a straight line.

Draw a sketch to illustrate the different instrument and staff positions. Calculate the collimation error of the level, the corrected difference in level between A and B, and the staff readings obtained from D when the instrument is in good adjustment.

[5 marks]

(c) Using suitable sketches, explain the meaning of a line of collimation and collimation error in levelling.

[3 marks]

(d) Misclosure in a circuit of levels or between bench marks can be due to one or more of a variety of reasons. For every category of errors below, explain **THREE (3)** main causes and their corrective measures taken on site:

(i) Errors due to environmental factors
(ii) Errors due to the observer
(iii) Errors due to the instrument

[9 marks]

3. (a) A 01″ reading theodolite having a 100 multiplying constant and 0 additive constant was used to carry out tacheometric observations to pick up details in the study area as prescribed in **Table 1** (Project Description) above and the following data was recorded **(Table 4).**

Table 4 Tacheometric survey observation

Instrument at Stn A (TBM) Reduced level of Stn A (TBM) = 3.430m Height of instrument above Stn A (TBM) = 1.550m						
Staff point	Horizontal circle reading	Vertical circle reading	Stadia reading			Remarks
			Upper	Middle	Lower	
B	00° 00′					Stn B: Near jetty
P1	24° 17′	92° 48′	2.113	1.829	1.547	Water mark 1
P2	48° 32′	91° 18′	2.438	2.212	1.988	Water mark 2
P3	48° 32′	86° 43′	1.806	1.415	1.027	Top of embankment 1
P4	81° 03′	87° 37′	2.143	1.846	1.552	Top of embankment 2
B	00° 00′					Stn B: Near jetty

(a) Calculate the slope distances from Stn A to P3 and P4.

[5 marks]

(b) Calculate the length of the embankment P3 – P4 and its gradient.

[5marks]

(c) A closed traverse ABCDEFGA as shown in **Figure 1** below was carried out next to the work site as prescribed in **Table 1** (Project Description) above and the coordinates are listed in **Table 5** below. Unfortunately, the coordinate of station B was missing, but the distances between AB and BC are known. The length of AB = 204.184m and BC = 242.334m.

Find the area of the closed traverse ABCDEFGA.

[10 marks]

Table 5 Closed traverse

Stn	Easting (m)	Northing (m)
A	8,667.690	9,888.169
B	-	-
C	8,605.022	9,494.544
D	8,344.949	9,569.819
E	8,200.812	9,781.530
F	8,268.181	9,965.012
G	8,446.785	10,041.856

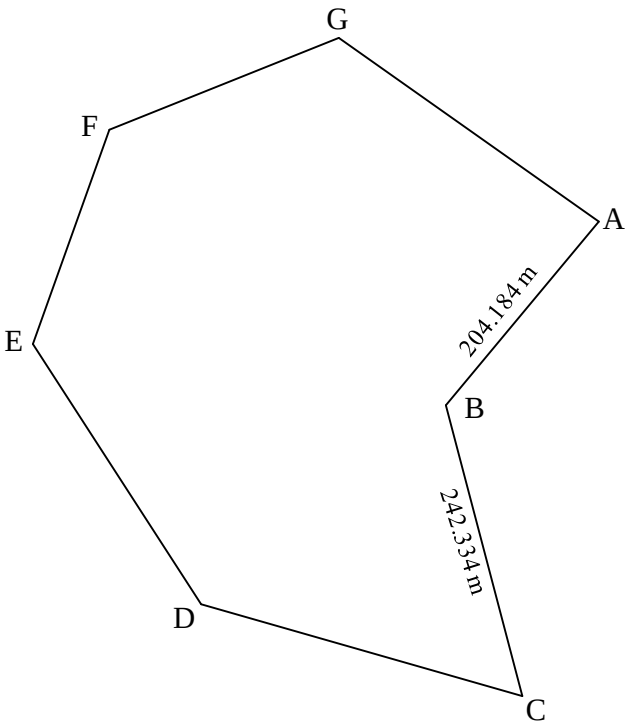


Figure 1 Closed traverse ABCDEFGA

Section B

4. An area of 50m x 50m has to be excavated at the work site for the construction of a hotel. In order to assess the quantity of excavation, levels (in meters) have been taken at the corners of squares of side 25m and the values are shown in **Figure 2** below. The formation level for the excavation is 150m AMSL. The excavation is assumed to be of vertical sides.

Calculate the volume of the excavation.

[10 marks]

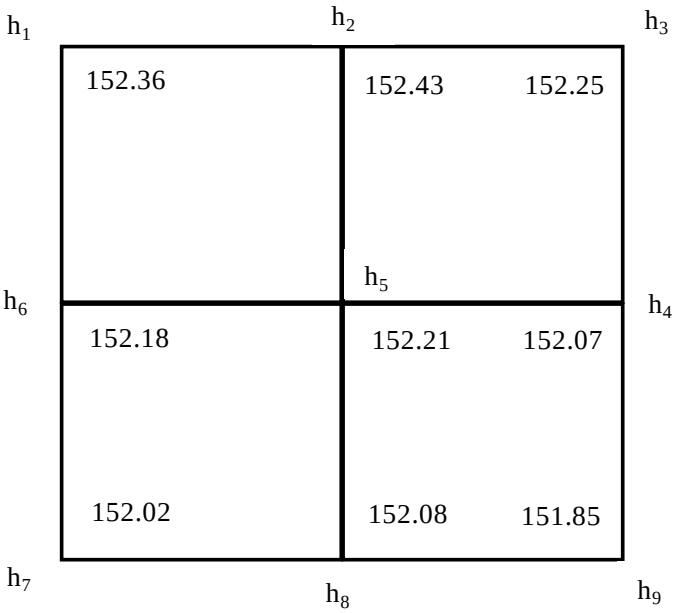


Figure 2 Hotel construction site

6. (a) Mass-haul diagram is commonly used for ascertaining in advance, proper distribution of excavated materials and the amount of waste and borrow required in estimating the cost of earthwork. Explain the following important terms used in the preparation of mass-haul diagram:

(i) Haul distance
(ii) Waste
(iii) Borrow
(iv) Balance line

[4 marks]

(b) The exact intepretation of any mass-haul diagram depends upon the correct positioning of the balance line. Describe **FOUR (4)** applications of a balanced mass-haul diagram in a construction project.

[6 marks]

Bahagian A

Jadual 1 *Huraian Projek*

Disebabkan oleh keadaan cuaca yang tidak menentu kebelakangan ini dan tsunami yang berlaku pada tahun 2004, Kg. Baharu, sebuah penempatan nelayan di Ayer Tawar dekat Lumut, Perak sering terdedah kepada banjir semasa musim tengkujuh. Kampung ini juga telah dipilih untuk diadakan Khemah Kerja Ukur Tahunan (KKUT) sejak 3 tahun yang lepas. Pada bulan Disember 2011, sekumpulan pelajar telah terlibat dengan kerja-kerja pengukuran dalam kajian kebolehlaksanaan untuk menentukan kesan banjir ke atas penempatan ini yang suatu masa dulu dikenali sebagai pusat pelancongan yang popular kerana keindahan semulajadinya seperti sungai, rumah peranginan dan restoran makanan laut. Satu penyelesaian kepada masalah ini ialah dengan membaikpulih tembok penahan yang telah dibina 10 tahun yang lepas bagi melindungi terjahan air atau limpahan banjir. Kerja-kerja pengukuran telah dijalankan untuk mengumpul maklumat reruang terkini yang akan digunakan dalam kajian untuk menangani masalah disebabkan oleh banjir bermusim serta membangunkan pengkalan data pelancongan dan peta terkini bagi kawasan sekitarnya.

Penyerahan laporan konklusif kepada pihak berkuasa tempatan yang merangkumi kewujudan kawalan-kawalan ukur ufuk dan pugak di kawasan tersebut perlu dilaksanakan.

1. *Bagi cadangan menaiktaraf tembok penahan sedia ada di sepanjang sungai di tapak kerja seperti di **Jadual 1** (Huraian Projek) di atas, satu pengukuran kawalan ufuk telah dijalankan bagi mewujudkan satu siri kawalan ukur. Ringkasan data ukur diberi di dalam jadual berikut **(Jadual 2)**.*

Jadual 2 *Kawalan ufuk – Ukur travers tertutup*

Garisan	*Jarak (m)*	*Min sudut dalam*		*Catatan*
AB	*103.401*	*Stn A*	*94° 10' 00"*	*Stn A: Mula tembok penahan (AL_A = 3.430m)*
BC	*157.251*	*Stn B*	*178° 10' 00"*	*Stn B: Dekat jeti*
CE	*143.359*	*Stn C*	*118° 21' 45"*	*Stn C: Hujung tembok penahan*
EG	*169.082*	*Stn E*	*94° 42' 25"*	*Stn E: Lurang*
GJ	*176.742*	*Stn G*	*158° 07' 30"*	*Stn G: Pintu masuk sub-stesen TNB*
JL	*110.601*	*Stn J*	*89° 03' 55"*	*Stn J: Di hadapan Restoran Madura*
LA	*140.828*	*Stn L*	*167° 15' 50"*	*Stn L: Di belakang Stesen Minyak Shell*

(a) *Jika bearing garis dasar AB ialah 189° 22' 40", kira bearing bagi garisan travers yang lain.*

[5 markah]

(b) *Jika koordinat bagi stesen A ialah 1500.000mU, 1700.000mT, kira koordinat bagi stesen-stesen ukur yang lain dan tentukan ketepatan travers menggunakan Kaedah Pelarasan Bowditch. Komen di atas ketepatan kerja ukur yang telah dijalankan.*
(Anda boleh guna Borang Pengiraan Travers yang diberikan).

[20 markah]

(c) *Kira jarak ufuk tembok penahan AC.*

[5 markah]

2. *Ukur aras telah dijalankan bagi menentukan aras laras kesemua titik kawalan ukur B, C, E, G, J dan L seperti di* ***Jadual 2****. Data cerapan berikut telah diperolehi* ***(Jadual 3)****.*

Jadual 3 *Ukur aras titik-titik kawalan ukur*

PB	*PA*	*PH*	*AL (m)*	*Catatan*
0.393			*3.430*	*BAS di Stn A (mula tembok penahan)*
1.740		*1.817*		*Stn B: Dekat jeti*
	2.804			*Titik X: Bahu jalan (kanan)*
	1.280			*Titik Y: Bahu jalan (kiri)*
	2.164			*Stn C: Hujung tembok penahan*
1.935		*1.320*		*Stn E: Lurang*
	2.469			*Stn G: Pintu masuk sub-stesen TNB*
	2.835			*Stn J: Di hadapan Restoran Madura*
	3.600			*Stn L: Di belakang Stesen Minyak Shell*
		0.931		*BAS di Stn A*

(a) *Kira aras laras bagi semua stesen ukur menggunakan Kaedah Naik dan Turun.*

[6 markah]

(b) *Lukis satu lakaran bagi menunjukkan susunan cerapan dan komen keputusan yang diperolehi di bawah kategori ukur kelas kedua.*
Dalam kebanyakan kerja pengukuran kawalan pugak, cerapan pandangan antara tidak diambil kepada titik-titik penting seperti titik kawalan ukur. Beri ***SATU (1)*** *sebab kenapa ianya diamalkan.*

[5 markah]

(c) *Kira kecerunan tembok penahan.*

[3 markah]

(d) *Nyatakan* ***EMPAT (4)*** *langkah pencegahan yang patut diambil bagi memastikan keputusan kerja-kerja ukur aras adalah memuaskan walau pun alat aras berada dalam keadaan pelarasan yang baik.*

[2 markah]

(e) *Jika tikain kerja pengukuran aras melebihi had yang dibenarkan, huraikan kaedah yang perlu dilakukan untuk menentukan keadaan alat di lapangan.*

[4 markah]

3. (a) *Setelah alat aras digunakan secara berterusan di tapak kerja dalam jangka masa yang lama, keputusan pengukuran kawalan pugak boleh menjadi kurang memuaskan. Terangkan bagaimana kerja diteruskan walau pun kedudukan gelembung alat tidak memusat setelah pelarasan sementara di setiap kedudukan dilakukan berulang kali.*

[3 markah]

(b) *Berdasarkan hasil kerja dari 3(a) di atas dan tikaian melebihi had yang dibenarkan bagi pengukuran kelas kedua, ujian dua piket telah diputuskan untuk dilakukan setelah garis pandangan disyaki tidak benar-benar mengufuk walau pun kedudukan gelembung adalah memusat.*

Alat aras yang diset di kedudukan C, 40m dari staf yang ditegakkan di A, dan 40m dari staf yang ditegakkan di B, menghasilkan bacaan masing-masing 1.914m dan 2.237m, dan gelembung telah dipusatkan sebelum tiap-tiap cerapan dibuat. Alat aras seterusnya diset di kedudukan D, 5m melepasi B, dan cerapan ke staf yang ditegakkan di A dan B menghasilkan bacaan masing-masing 1.874m dan 2.141m. Kedudukan alat aras dan staf adalah lelurus.

Lukis satu lakaran untuk menjelaskan kedudukan alat aras dan staf. Kira selisih pengkolimatan bagi alat aras, pembetulan beza aras di antara A dan B, dan bacaan staf yang diperolehi dari D jika pelarasan alat adalah baik.

[5 markah]

(c) *Dengan menggunakan lakaran yang sesuai, terangkan maksud garis kolimatan dan selisih pengkolimatan dalam pengukuran aras.*

[3 markah]

(d) *Tikaian dalam litar pengukuran aras atau di antara batu aras boleh wujud berpunca dari satu atau lebih penyebab. Bagi tiap-tiap kategori selisih di bawah, terangkan* ***TIGA (3)*** *penyebab utama dan langkah-langkah pembetulan yang patut diamalkan di tapak:*

(i) *Selisih disebabkan oleh faktor-faktor persekitaran*
(ii) *Selisih disebabkan oleh pencerap*
(iii) *Selisih disebabkan oleh alat*

[9 markah]

4. *(a)* *Sebuah tiodolit 01" yang mempunyai pemalar daraban 100 dan pemalar campuran 0 telah digunakan untuk menjalankan cerapan tekimetri untuk mengambil butiran di tapak kajian seperti dinyatakan di* ***Jadual 1*** *(Hurain Projek) dan maklumat berikut telah direkod* ***(Jadual 4)***.

Jadual 4 *Cerapan ukur tekimetri*

Alat di Stn. A (BAS)
Aras laras Stn. A (BAS) = 3.430m
Ketinggian alat di Stn. A (BAS) = 1.550m

Staf di	*Bacaan bulatan ufuk*	*Bacaan bulatan pugak*	*Bacaan stadia*			*Catatan*
			Atas	*Tengah*	*Bawah*	
B	*00° 00′*					*Stn B: Dekat jeti*
P1	*24° 17′*	*92° 48′*	*2.113*	*1.829*	*1.547*	*Tanda tera air 1*
P2	*48° 32′*	*91° 18′*	*2.438*	*2.212*	*1.988*	*Tanda tera air 2*
P3	*48° 32′*	*86° 43′*	*1.806*	*1.415*	*1.027*	*Di atas tambak 1*
P4	*81° 03′*	*87° 37′*	*2.143*	*1.846*	*1.552*	*Di atas tambak 2*
B	*00° 00′*					*Stn B: Dekat jeti*

(b) *Kira jarak-jarak cerun dari Stn A ke P3 dan ke P4.*

[5 markah]

(b) *Kira jarak tambak P3 – P4 dan kecerunannya.*

[5 markah]

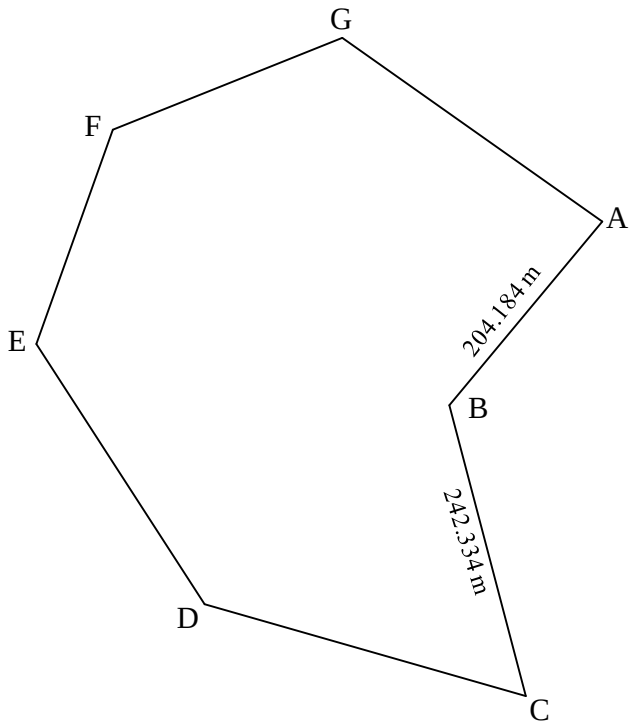
(c) *Sebuah travers tertutup ABCDEFGA berhampiran dengan tapak kerja seperti dalam* ***Rajah 1*** *mempunyai nilai koordinat seperti yang tersenarai di* ***Jadual 5****. Malangnya, koordinat untuk stesen B telah hilang, tetapi jarak di antara AB dan BC diketahui. Jarak AB = 204.184m dan BC = 242.334m.*

Kira keluasan travers tertutup ABCDEFGA.

[10 markah]

Jadual 5 *Travers tertutup*

Stn	*Timur (m)*	*Utara (m)*
A	*8,667.690*	*9,888.169*
B	-	-
C	*8,605.022*	*9,494.544*
D	*8,344.949*	*9,569.819*
E	*8,200.812*	*9,781.530*
F	*8,268.181*	*9,965.012*
G	*8,446.785*	*10,041.856*



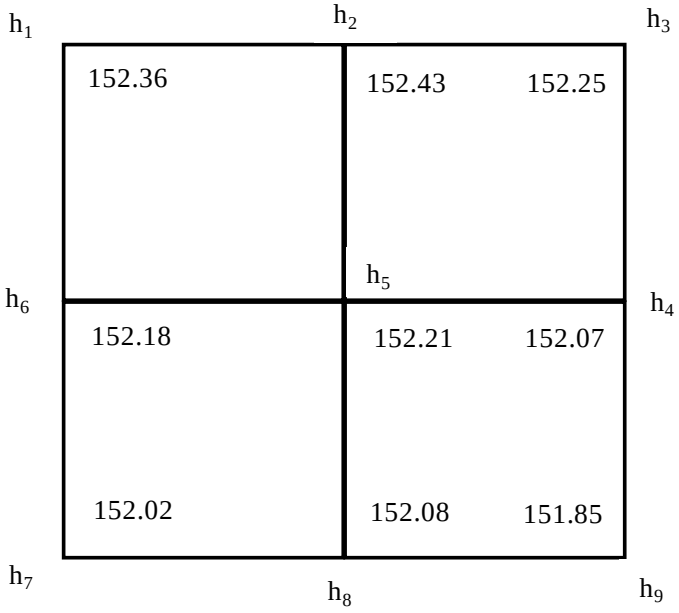
Rajah 1 *Travers tertutup ABCDEFGA*

Bahagian B

5. *Satu kawasan berukuran 50m x 50m di atas tapak pembinaan akan dikorek bagi tujuan pembinaan sebuah hotel. Untuk menilai kuantiti pengorekan, pengukuran aras (dalam meter) telah dibuat di setiap bucu segi empat tepat bersaiz 25m dan nilai aras ditunjukkan dalam* ***Rajah 2*** *di bawah. Nilai aras pembentukan yang dikehendaki ialah 150m di atas APL. Kerja pengorekan tersebut dianggap bersisi pugak.*

Kira jumlah isipadu kerja pengorekan tersebut.

[10 markah]



Rajah 2 *Tapak pembinaan hotel*

6. *(a) Gambar rajah angkut jisim lazimnya digunakan untuk menentukan pengagihan bahan korekan teratur, jumlah buangan dan pinjaman yang diperlukan dalam anggaran kos kerja tanah. Terangkan istilah-istilah penting berikut yang digunakan dalam penghasilan gambar rajah angkut jisim:*

(i) Jarak angkut
(ii) Buangan
(iii) Pinjaman
(iv) Garis seimbang

[4 markah]

(b) Ketepatan intepretasi gambar rajah angkut jisim bergantung kepada kedudukan garis seimbang yang betul. Huraikan ***EMPAT (4)*** *aplikasi perseimbangan gambar rajah angkut jisim dalam sesuatu projek pembinaan.*

[6 markah]

oooOOOooo