
THINKING SKILLS

9694/33

Paper 3 Problem Analysis and Solution

October/November 2014

1 hour 30 minutes

Additional Materials: Electronic Calculator

READ THESE INSTRUCTIONS FIRST

An answer booklet is provided inside this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

Answer **all** the questions.

Calculators should be used where appropriate.

The number of marks is given in brackets [] at the end of each question or part question.

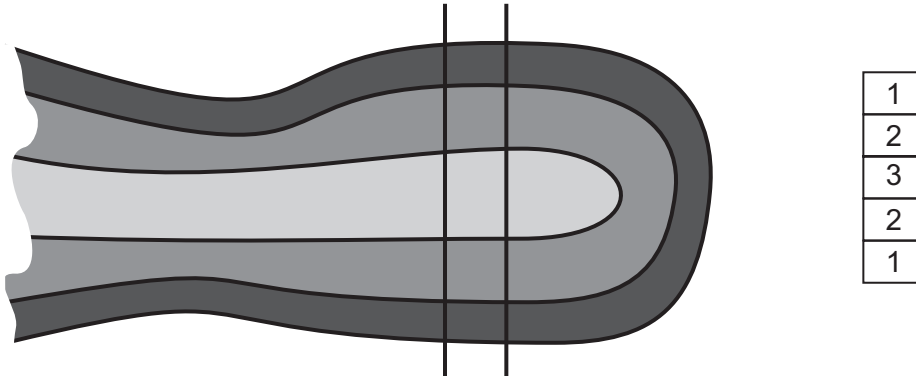
This document consists of **9** printed pages, **3** blank pages and **1** insert.



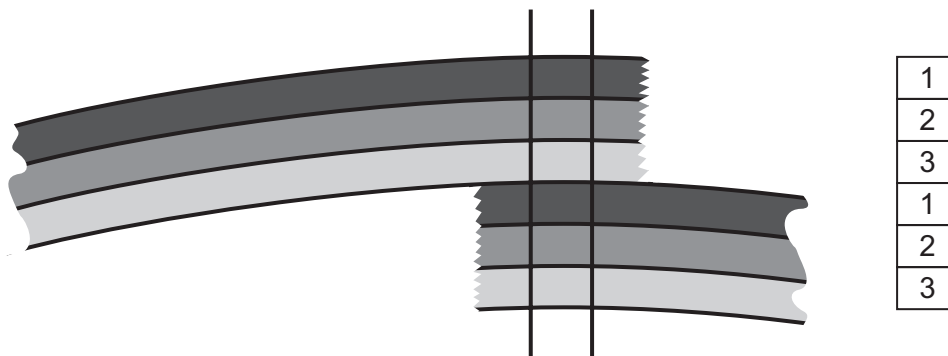
1 Study the information below and answer the questions. Show your working.

Geologists can deduce a lot about how the Earth's surface has been distorted over time by looking at how the layers of different rock are ordered. For the purposes of this question, you can assume that there are only two types of distortion that occur:

A *fold* occurs when a group of layers fold back on themselves as shown below:



A *fault* occurs when a group of layers is broken, and overlapped:



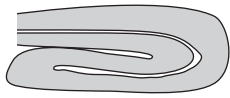
Geologists take vertical samples in order to investigate the patterns and draw conclusions about how the rock has been distorted. These samples can be represented by columns of numbers, as shown to the right, with the different numbers representing different layers of rock. The numbers are assigned according to the order of the layers before any distortion took place, with 1 representing what was on top, then 2 and so on. When representing samples numerically, no two adjacent numbers are the same.

If the sample has not been taken to a sufficient depth, then there may have been more layers that were not included in the sample. Similarly, some of the top layers may have eroded before the sample was taken.

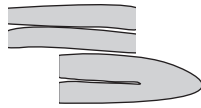
- (a) Give an example of a numbered vertical rock sample involving the numbers 1, 2, 3 and 4 only, without repeating any number, which must have resulted from a fault followed by erosion. [1]
- (b) A sample has been taken for which geologists cannot be sure whether it resulted from a fold or a fault.

Give an example of such a sample, with at least one number appearing more than once. [1]

Although rare, it is possible for there to be combinations of distortions. Some examples are shown below:



fold followed
by fold



fold followed
by fault



fault followed
by fold



fault followed
by fault

- (c) Give the order of the layers which would be found if three layers of rock (1 2 3) were subjected to a fold, followed by a fault, and then the top layer was completely eroded. Assume that the sample goes deep enough to include all relevant layers. [2]
- (d) The sample shown below was the result of two distortions followed by some erosion.

2
3
2
1
3
2

Which one of the four combinations described above could have caused it? You must also identify any layers which were omitted due to the sample being insufficiently deep. [2]

- (e) Give two examples of samples with four layers which could not have been produced by the processes defined in this question. [2]

Different layers may have been of different thickness; but you should assume that each individual layer was originally the same thickness throughout. Erosion may affect the thickness of the top layer.

- (f) What can be concluded about the thicknesses of the three original layers which produced the following rock sample?

	1 m
	9 m
	4 m
	9 m
	8 m

[2]

2 Study the information below and answer the questions. Show your working.

Hannah has not paid the money she owes Richard, so the court has instructed her employer to deduct \$25 per week from her wages and give it to Richard. However, if it would leave her with less than \$100 for that week, then the amount deducted must be reduced so that she will be left with \$100. This minimum is called the protected earnings rate. Hannah is paid at the end of a four-week period, not every week.

She works a basic 30 hours per week at \$4 per hour, and can choose to work up to 10 (whole) hours of overtime in any week at \$5 per hour.

She decided to work a total of 8 hours overtime in the last four-week period, but did it so that it minimised the amount deducted and given to Richard.

(a) (i) How did she distribute the overtime hours over the four weeks? [1]

(ii) How much did her employer deduct at the end of the four weeks? [1]

In an attempt to increase the average weekly amount that he receives, Richard asks the court to amend the order to \$100 per four weeks with a \$400 protected earnings rate.

If this requested change were made, Hannah might change her approach to overtime.

(b) (i) If Hannah were now to work 5 hours overtime per four weeks, how much more would she get on pay day than if she did no overtime? [1]

(ii) What would Richard receive for the four-week period if Hannah did no overtime? [1]

The court instead applies new guidelines, and, in view of the large debt still outstanding, increases the order to \$120 every four weeks, but with a protected earnings rate of \$410 for each four-week period.

(c) (i) What is the minimum number of hours of overtime that Hannah would now have to work in order to get **more** on pay day than if she did no overtime? [1]

She considers this to be too much, so does no overtime.

(ii) What does Richard now receive on average each week? [1]

Richard wants to submit an appeal, asking for a percentage of Hannah's income above the (new) protected earnings rate, instead of a fixed amount every four weeks.

(d) What percentage would be sufficient for him to receive \$90 per four weeks if Hannah worked 4 hours of overtime **each week**? [2]

Unfortunately, paying a percentage is not allowed. However, Hannah's basic rate of pay is increased to \$4.20 per hour, and she continues to do no overtime.

(e) Who benefits from this increase, and by how much? [2]

[Turn over for Question 3]

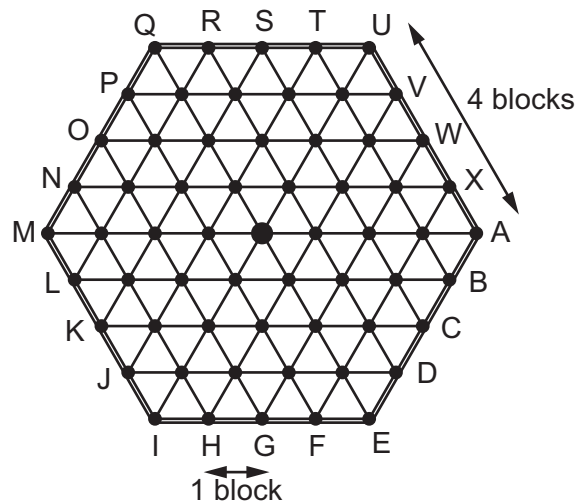
3 Study the information below and answer the questions. Show your working.

The ancient city of Hex is famous for its hexagonal street system. A plan of the city is shown below. The city tax collector wishes to tax those leaving the city, and has a very efficient surveillance system enabling him to see the movements of any citizen who is intending to leave. He then rides to meet them along the city wall which surrounds the city.

The citizens cannot see his movements. Citizens avoid paying tax if they reach the wall before the tax collector gets there.

- The tax collector, on his horse, can move **three times as fast** as the citizens.
- The tax collector aims to reach the point on the wall towards which the citizen is walking by the shorter route. If it is the same distance in either direction, he travels clockwise.
- At the start of each day, the tax collector chooses at random one of the six corners at which to wait.

You can assume that the tax collector is able to reverse his direction of travel instantaneously.



Samantha is the first citizen of the day to attempt to leave the city. She starts at the centre.

- (a) Show that Samantha cannot avoid the tax collector if she travels without changing direction. [1]
- (b) If Samantha decides to change direction **once** on the way out,
- (i) what is the greatest distance she could be from the tax collector when she reaches the wall? [1]
- (ii) what is the probability that Samantha will avoid the tax collector? [2]

Later that morning, Tabitha and Endora are both in the same place, 1 block towards M from the centre. They leave at the same time. Tabitha heads directly to M, while Endora heads directly to point P. The tax collector could be at any of the 24 points on the city wall.

- (c) List the points on the city wall where the tax collector could be if
- (i) he is not able to meet Tabitha, [2]
- (ii) he is able to meet Tabitha but not Endora. [2]

- (d) If the tax collector is waiting at point A, from how many of the 37 starting points within the city wall is it impossible for a citizen to avoid him, if the citizen travels without changing direction? [3]

In the afternoon, the tax collector is at point A. Morgana begins at the centre and moves 1 block towards Q, then one block towards J. After these moves the tax collector will be back at point A.

Morgana is attempting to reach the city wall as far from the tax collector as possible. She only has time to travel a maximum of 10 more blocks.

- (e) What is the greatest distance she could be from the tax collector when she reaches the wall? Describe a possible route for her to take. [4]

4 Study the information below and answer the questions. Show your working.

Matt owns a small plane, and has a contract with Ferreb Delivery Service to transport parcels between its depots. There is one depot on each of the five islands of Dironesia. All five depots have a landing strip, and Matt's plane is based at the depot on Malzay, where he lives.

He charges Ferreb \$7 per parcel, but if a depot has more than 10 parcels to be picked up on any one day for delivery to the same destination, the first 10 are \$7 each and the rest are \$4 each.

He receives emails from the depots first thing every morning, informing him of the number of parcels to be picked up and their destinations. He then constructs a chart to help him plan his route for the day. Under the terms of his contract, he must pick up all the parcels waiting for him, during the day, even if it means two or more visits to the same island. He may, however, delay delivery until, but no later than, the following day.

Because of the size of his plane, he will never fly with more than 100 parcels on board.

This morning Matt has no parcels left over from yesterday, and this is today's chart.

		To be delivered to:				
		Honia	Malzay	Payli	Styha	Tolou
Number of parcels to be picked up from:	Honia	–	12	11	7	10
	Malzay	14	–	12	18	8
	Payli	17	8	–	5	14
	Styha	11	10	17	–	12
	Tolou	12	7	10	14	–

These are the flying distances, in km, between the depots.

Honia				
63	Malzay			
20	48	Payli		
23	54	29	Styha	
88	35	77	71	Tolou

- (a) (i) How much will Matt charge Ferreb for the 44 parcels that he will pick up from Payli today? [2]
- (ii) What is the maximum he could charge for picking up 44 parcels from one depot on any one day? [2]

Matt's route today will allow him to visit each island once only, without carrying more than 100 parcels at any time.

He will fly first from Malzay to Styha with all 52 parcels on board. There he will deliver the 18 parcels from Malzay and pick up the 50 parcels waiting for him, which means that he will take off from Styha with 84 parcels on board.

From Styha he will fly to Payli.

(b) How many parcels will Matt have on board when he leaves Payli? [2]

(c) In what order **must** he visit the remaining islands, and how many parcels will he have on board when he returns to Malzay? Justify your answer. [4]

(d) What is the total distance that Matt will fly today? [2]

Matt's charges used to be based on the flying distances between the depots, as follows:

Deliveries between depots less than 30 km apart	\$5 per parcel
Deliveries between depots from 30 km to 60 km apart	\$7 per parcel
Deliveries between depots more than 60 km apart	\$9 per parcel

Last Tuesday, a quarter of the parcels waiting at Payli were for delivery to Honia, a quarter for Malzay, a quarter for Styha and a quarter for Tolou. Matt calculated that he would have charged exactly the same amount for them under the old system as he did under the present system.

(e) How many parcels in total did Matt pick up from Payli last Tuesday? [3]

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