



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

THINKING SKILLS

9694/31

Paper 3 Problem Analysis and Solution

May/June 2013

1 hour 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic Calculator



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** the questions.

Start each question on a new answer sheet.

Calculators should be used where appropriate.

At the end of the examination, fasten all your work securely together.

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

This document consists of **7** printed pages and **1** blank page.



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

Package holidays to *Costa Natura* are priced per person.

The current brochure only gives departure dates up to December 17th, but holidays continue after that date.

- The **total** price per person is made up from the flight price for the outbound flight, the flight price for the flight back, and their cost for the room.
- The room price does not depend upon the number of people sharing the room, but may change from week to week.
- The flight price changes frequently, but is the same in both directions on any date.
- There are no discounts.

The prices in the brochure (shown below) are **total** prices, **per person**, given in dollars; they refer to holidays starting on the date shown.

Someone has put a coffee mug on my brochure, and I can't read some of the figures.

Departure date	1 person 1 week	1 person 2 weeks	2 sharing 1 week	2 sharing 2 weeks
Nov 5th	550	660	500	560
Nov 12th	570	730	520	630
Nov 19th	640	750	590	645
Nov 26th	710	760	655	65
Dec 3rd	650	760	595	
Dec 10th	590	710	535	
Dec 17th	600	710	545	6

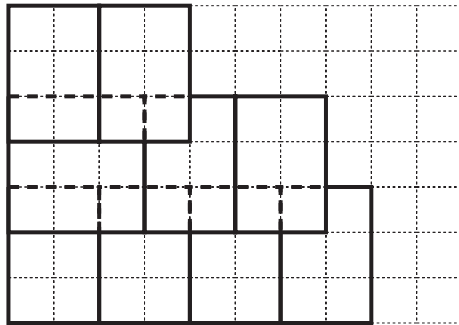
- (a) What is the price of a room for the week beginning Nov 5th? [2]
- (b) Considering only holidays which begin on one of the dates shown in the table, for which week or weeks will it not be possible to be sure of the room price? [1]
- (c) What is the highest weekly room price, for the weeks for which it can be determined? [1]
- (d) What is the cheapest date for an outbound flight, and what is the (one-way) cost per person on that day? [4]
- (e) What is the total price for two people, sharing a room, going for two weeks from December 10th? [2]

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

Rectangular interlocking roof tiles are available as Standard (S) 20 cm x 30 cm for \$1, or Large (L) 30 cm x 30 cm for \$3. The dimensions are given as width x height. Each tile has a top and a bottom, so only fits in one way.

Tiles need to be laid next to each other in rows, touching those either side but with an overlap of 10 cm over the row below. The roof must be two tiles thick for the entire length of such an overlap. The joins in adjacent rows must not line up.

The example below shows a partially-tiled roof of area of 100 cm by 70 cm.



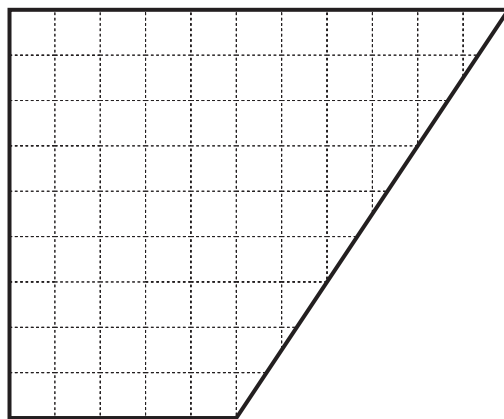
This tiling arrangement is described by writing:

SS
LSS
SSSS

- (a) (i) What is the minimum cost to tile a rectangular area of 120 cm x 110 cm? [2]
 (ii) What is the minimum cost to tile a rectangular area of 130 cm x 110 cm? [1]
 (iii) What is the minimum cost to tile a rectangular area of 700 cm x 390 cm? [2]

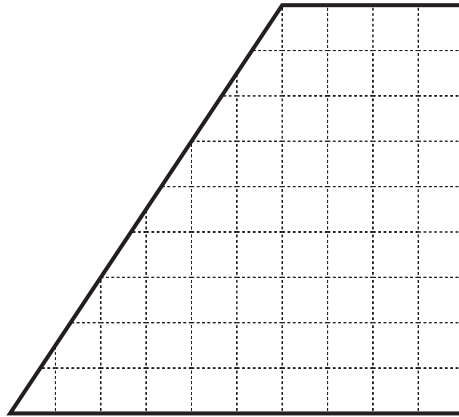
Tiles are never cut vertically to create smaller tiles. However, not all areas to be tiled are rectangular, so some tiles may need to be trimmed at an angle. Where tiles are trimmed, it is important for the top of the tile to be **more than** 10 cm across.

One piece of roof is shown below, with a 10 cm grid superimposed.



- (b) The bottom left tile can be Large or Standard. Which of these enables the cheaper overall cost? Justify your answer, describing the arrangements and calculating the costs. [3]

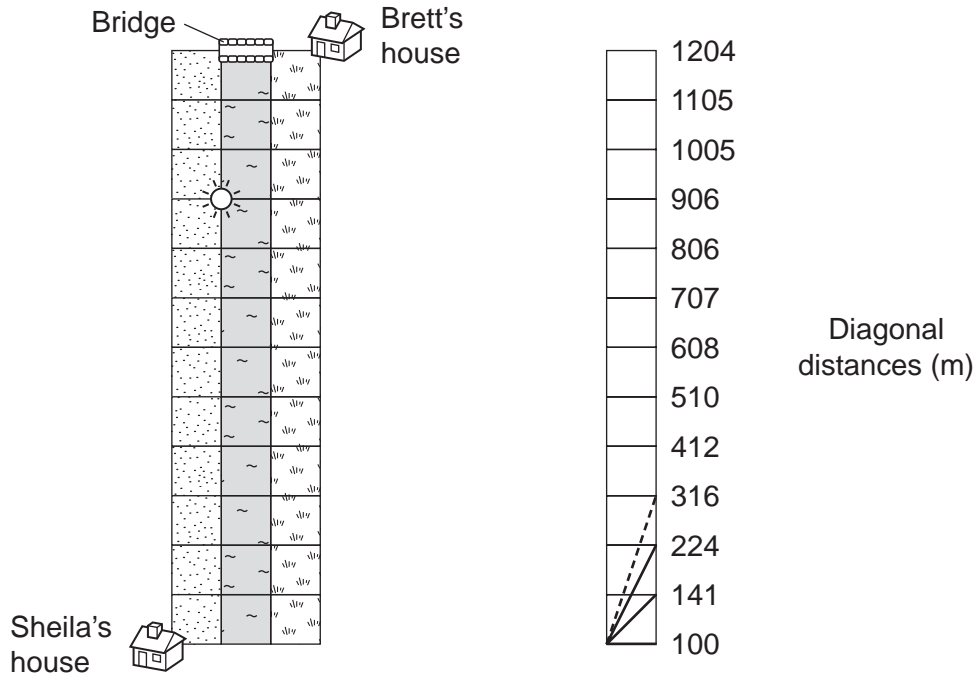
Another piece of roof is



- (c) Identify a part of this roof that cannot be tiled, even if the rules are relaxed to allow the top of the tile to be **at least** 10 cm across. [2]

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

Sheila is considering routes to her friend Brett's house, which is on the other side of a river.



There are three types of terrain that need to be crossed: the sandy beach (on the left), the river (in the middle) and the field (on the right). Each of these is 100 metres across. It is only possible to enter or exit the river at certain points, spaced at 100 m intervals along the banks.

Sheila walks across the beach at a speed of 1 metre per second, swims across the river at 0.5 m/s, and jogs across the field at 2 m/s. There is a bridge across the river, shown at the top of the diagram, which she jogs across at 2 m/s.

In the following questions, use the approximate values given above for the diagonal distances across various rectangles of width 100 m. Assume that there is no current in the river.

- (a) Show that Sheila will take 1442 seconds to get from her house to her friend's, if she travels in a straight line from one to the other. [2]
- (b) How long would it take for her to walk in a straight line to the bridge, and then jog directly to her friend's house? [1]
- (c) What would be the shortest time in which Sheila could make the journey, if she decided she wanted to swim the river, but swim the shortest distance possible? [4]

Brett swims at 0.5 m/s and otherwise walks at 1 m/s. He never jogs.

- (d) What is the shortest time in which Brett could get from his house to Sheila's? Justify your answer. [4]

Mitch has been having a barbecue at ☀. He walks (along the beach) and swims at the same rate as Sheila and Brett. Like Sheila, he jogs when crossing the field or the bridge.

- (e) If his fastest route to Brett's house involves swimming, what does this tell you about his jogging speed? [4]

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

Universal Time (UT) is the standard time at 0° longitude (which is the imaginary line running from pole to pole through Greenwich, UK). Throughout the world, the local time is defined relative to UT.

The table below gives the times of sunrise and sunset (UT) on June 8th each year along the 0° line of longitude at selected latitudes.

<i>Latitude</i>	<i>Sunrise</i>	<i>Sunset</i>
60° North	02:41	21:18
50° North	03:52	20:07
40° North	04:31	19:27
30° North	04:58	19:00
20° North	05:20	18:38
10° North	05:39	18:20
0° (Equator)	05:55	18:03
10° South	06:12	17:46
20° South	06:31	17:28
30° South	06:51	17:07
40° South	07:17	16:41
50° South	07:53	16:05
60° South	08:56	15:02

All locations at the same latitude have the same amount of daylight (the time between sunrise and sunset) on any particular day of the year. The UT sunrise and sunset times are always 4 minutes later for every 1° of longitude further west at the same latitude (and therefore 4 minutes earlier for every 1° of longitude further east).

(a) Piedra del Aguila in Argentina is situated at latitude 40°S, longitude 70°W. The local time here in June is UT−3 (i.e. 3 hours behind UT).

(i) What are the UT sunrise and sunset times in Piedra del Aguila on June 8th? [3]

(ii) What are the local times of sunrise and sunset in Piedra del Aguila on June 8th? [1]

The line of latitude 40°N runs for 4200 km through China: from Jigenxiang in Xinjiang Province at longitude 74°E to Dandong in Liaoning Province at longitude 124°E. The same line (40°N) also runs for 4200 km through the USA: from Mantoloking in New Jersey at 74°W to Shelter Cove in California at longitude 124°W.

The whole of China uses UT+8 all year round, whereas the USA uses a number of local time zones. In June, the local time in New Jersey is UT−4 and the local time in California is UT−7.

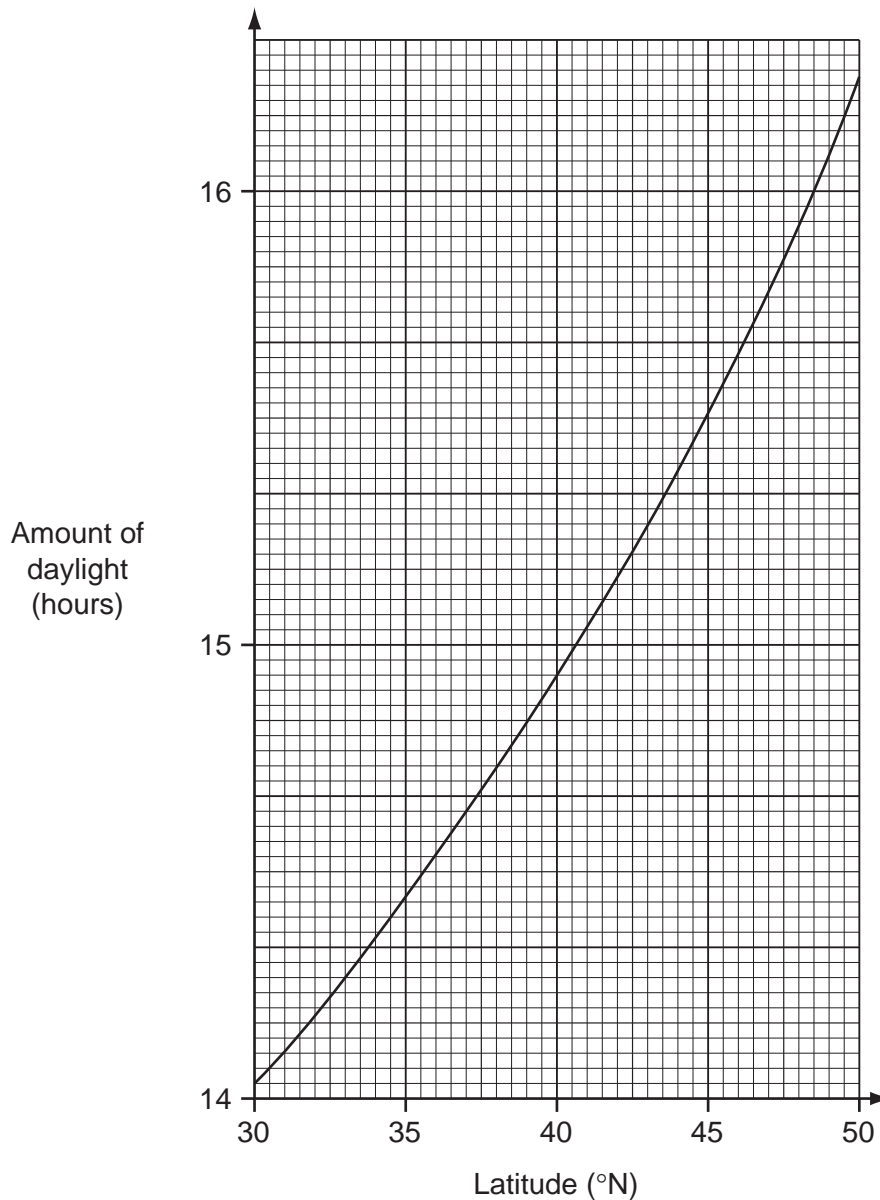
(b) How much later is sunrise in Jigenxiang than it is in Dandong? [1]

(c) What is the local time of sunrise on June 8th in

(i) Mantoloking? [2]

(ii) Shelter Cove? [2]

The graph below shows how the amount of daylight varies between latitudes 30°N and 50°N on June 8th.



(d) Harrison in Michigan, Rochester in Minnesota and Eugene in Oregon all have 15 hours 23 minutes of daylight on June 8th. What is the latitude of these three cities? [1]

The Four Corners Monument marks the point where the states of Arizona, Colorado, New Mexico and Utah meet. It is the only point in the USA where the boundaries of four states meet. The local times of sunrise and sunset at the Four Corners Monument on June 8th are 05:56 and 20:34 respectively. The local time here in June is UT-6.

(e) Use the graph and the previous information you have been given to deduce the latitude and longitude of the Four Corners Monument. [5]

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