UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9694 THINKING SKILLS

9694/32   Paper 3 (Problem Analysis and Solution),
maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

* Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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1 (a) (i) What is the smallest number of pages the map section could cover?

The vertical difference in the pages is 14. There must be at least three rows: so the ~~must~~ must have at least 42 pages dedicated to the map.

Answer: <u>42</u>

(ii) What is the earliest page it could start on? [1]

Answer: <u>38</u>

(iii) What is the latest page it could start on? [1]

Answer: <u>46</u>

(b) If the detective's pages have come from the middle row of the map section, what is the largest possible number of pages in the map section? [2]

If the page was at the left end of the middle row, the rows would begin Pg 60, 46, 32, 18, 4. Another four rows after the middle row would mean there were 9 altogether: 9 × 14 = <u>126</u> pages.

(odd) multiples of 14 (42, 70, 98, 126) – 1 mark for appreciation of what the edge numbers mean.

1 mark for appreciation that doubling the page number yields the largest possible number of pages (e.g. 2 × 62, 62.5, 64, 65).
1 mark for recognition of four rows above the middle row or 9 rows altogether.

(c) Given this assumption, how many pages are there in the map section? [3]

The pages could lie one double page in from the end of the middle row. If so the middle row would be from Pg 60–75: 8 double pages. The pyramid would then reduce by two with each row: 2 × [8 + (2 × 6) + (2 × 4) + (2 × 2)] = <u>64 pages</u>

2 marks for sight of the 8 double pages.
If 2 marks not awarded, award 1 mark for recognition that it must be in the middle row.
Award 1 mark for 36 pages/18 doubles: candidates having dropped the restriction involving the page numbers directly above.

(d) The detective notices that the town hall lies on the right-hand edge of ~~He~~ assumes that this is at the centre of the city.

Given this assumption, on which page does the map section start?

The numbering, combined with the symmetrical regular stepped reduction, means that there must be an even number of double pages in the middle line:

Following this logic through, the middle line must begin with Pg 56, the line above with Pg 44, the line above that with Pg 36 and the top line with <u>Pg 32</u>.
2 marks for this answer without wrong working.
1 mark for evidence that the candidate recognises that the middle line starts on page 56 **and** the line above starts on page 44.

2 (a) How long was it before the bridge became unsafe because some parts had insufficient paint? **[1]**

The first places would become unsound <u>immediately</u> as the sections needing paint from his colleagues would not be getting any.

(b) Instead of getting rid of Albert's colleagues immediately, it had been suggested employing 12 more painters who would be employed for one year (and then making all the painters redundant). If this had been done, with everyone using the new paint, what would the cost have been over a 16-year period? **[2]**

Paint all immediately:
redundancy 16
painters 16
old 0
new 16
Total : <u>$432 000</u>

1 mark for either correct cost for 12 painters ($324 000) **or** missing out redundancy payment ($352 000) **or** calculations in which candidates calculate two of the three parts correctly (320 000 / 32 000 / 80 000).

(c) If the original four painters had switched over to using the new paint, they ~~have~~ been made redundant at the end of four years. How much would that have ~~compared~~ with simply continuing with the old paint, over a 16-year period?

Paint with new paint for 4 years:
redundancy 4 $20 000
painters 4 × 4 = 16 $320 000
old 0
new 16 $32 000
Total: $372 000

Stay with old:
redundancy 0
painters 16 × 4 = 64 $1 280 000
old 16 × 4 = 64 $64 000
new 0
Total $1 344 000

Difference $1 344 000 – $372 000 = <u>$972 000</u>

1 mark if figs. either 372 or 1344 seen or for a single arithmetic error.

(d) A gradual reduction to having just Albert painting full time could have been arranged, without any arch being painted before it needed to be.

(i) Describe the way this could have been done, noting which paint would be used by each painter.   **[2]**

If <u>one painter paints with the new paint</u> and the others carry on with the old (1 mark), a painter is made redundant <u>after 4, 8, and 12 years</u> (1 mark).

(ii) At what stage would Albert have become the only painter?   **[1]**

Only Albert would be left <u>after 12 years</u>.

(iii) How much would this have cost over a 16-year period?   **[2]**

Gradual reduction wastes no paint and requires:
redundancy 3   × 5000
new paint 16   × 2000
old paint 4 × (3 + 2 + 1 + 0) = 24   × 1000
painters 4 × (4 + 3 + 2 + 1) = 40   × 20 000
Total <u>$871 000</u>

Award 1 mark for correct method with not more than 2 arithmetic errors.

3   (a)   **Who took the most money for the journey, and how much did they take in their passengers?**

The following table shows how much each person took.
Therefore the most money was made by <u>Ephron – $350</u>.

	Price	# of passengers	Income ($)
Aaron	10	15	150
Baal	20	10	200
Caelum	25	9	225
Daedalus	4	45	180
Ephron	50	7	350

1 mark for $1 105 (total income from all drivers), or Ephron, or $350

(b)   **According to this model, what price would generate the highest income?**   **[2]**

The solution may be found by trial and improvement: <u>$35</u> will generate the highest income.

Price	# of passengers	Income ($)
30	8	240
35	7	245
40	6	240

Algebraically: takings (t) = $n(25 – 5(n – 9))$ = $n(70 – 5n)$ = $70n – 5n^2$, where n = number of passengers
$dt/dn = 10n – 70$
Maximum where $dt/dn = 0$, i.e. where $n = 7$. So $35 would produce the highest income.
1 mark for any answer which yields more than $225 (8 or 6).

(c) Using only the information offered by Baal and Aaron to form a linear model, been done above with Baal and Caelum, calculate the price which produces highest income, and the number of passengers this price will attract.

$10 increase leads to reduction of 5 people. i.e. $2 increase leads to 1 person reduction. Cursory investigation reveals a maximum.

Price	# of passengers	Income
22	9	$198
<u>20</u>	<u>10</u>	$200
18	11	$198

1 mark for any interpolated pair.
A second mark for any in the table above, or **either** $20 **or** 10 tickets.
Full marks for underlined answers in the table.

(d) **Which two drivers' information does Tadeusz use, and what are the expected takings according to this model?** **[5]**

Answer: <u>Aaron</u> & <u>Daedalus</u>
This would have 35 passengers at $6 per ticket, taking <u>$210</u> in total. (Which is the maximum when only integer prices are allowed; $7 draws just 30 passengers, but also yields $210.)

1 mark for any correct passenger/dollar ratio.
1 mark for correct maximum for any model.
1 mark for a correct maximum involving Daedalus.
1 mark for Aaron & Daedalus.
1 mark for $210.

(e) Show that Jeroboam's claim is correct, and state which other driver's infor*uses for his model.**

Answer: ($27, 26 people) can be linearly interpolated from (<u>$4, 45 people</u>) a
(<u>$50, 7 people</u>). This is the model derived from Daedalus and <u>Ephron</u>.

If 3 marks can not be awarded, credit 1 mark for Ephron; credit 1 mark for an attempt to justify their solution, but with arithmetic errors.

4 (a) How many times each week does the ferry make the crossing from Scutiger to Peladot from Monday to Friday? **[2]**

Answer: <u>32</u>   award 2 marks

If 2 marks cannot be awarded, award 1 mark for evidence of appreciation that there are 19 crossings from Tuesday to Thursday (3 × 6 + 1 extra on Wednesday).

(b) Mr. and Mrs. Newton and their three children, aged 17, 14 and 12, have booked a holiday cottage on Peladot. They are going to take their car across on the ferry.

How much will a one-way ferry crossing cost the Newtons altogether? **[2]**

Answer: <u>$48</u>   award 2 marks

If 2 marks cannot be awarded, award 1 mark for evidence of recognition that $30 for the car includes the driver and/or the children will cost a total of $12 (2 × $3 + 1 × $6).

(c) Mrs. Mander is on holiday on Peladot until Friday. On Tuesday she plans to cross to the mainland, then travel by train to explore the Roman ruins at Craugastor. She intends to buy an off-peak return ticket between Scutiger and Craugastor.

(i) What will be Mrs. Mander's total travel costs on Tuesday? **[2]**

Answer: <u>$20.40</u>   award 2 marks

If 2 marks cannot be awarded, award 1 mark for appreciation that total ferry fare is $12 and/or train fare is $8.40.

(ii) What is the greatest amount of time that Mrs. Mander will be able to spend in Craugastor? **[2]**

Answer: <u>5 hours 19 minutes (allow 5 ¼ hours)</u>   award 2 marks

If 2 marks cannot be awarded, award 1 mark for evidence of appreciation that she should travel on the train that departs from Scutiger at 09:36 / arrives at Craugastor at 10:17 **and** on the train that departs from Craugastor at 15:36 / arrives at Scutiger at 16:17.

(d) (i) What is the earliest time that Jeremy can ever arrive at work?

Answer: <u>09:03</u> (on Thursday)   award 2 ~~~~ks

If 2 marks cannot be awarded, award 1 mark for evidence of appreciation that he should travel on the train that departs from Scutiger at 08:36 / arrives at Bombina at 08:56.

(ii) What is the latest time that Jeremy can leave work in order to catch the 18:00 ferry at Scutiger?   [2]

Answer: <u>16:50</u>   award 2 marks

If 2 marks cannot be awarded, award 1 mark for evidence of appreciation that he should travel on the train that departs from Bombina at 16:57 / arrives at Scutiger at 17:17.

(e) Jeremy always arrives at work as early as possible, and never leaves before 16:15. Travelling as economically as possible, what is the total cost of his travel to and from work each week?   [3]

Answer: <u>$67.00</u> (accept: it alternates between $103.00 and $31.00)   award 3 marks
Or $87 if returns are considered as being just the journey back

If 3 marks cannot be awarded, award 2 marks for evidence of:

either ferry cost for 2 weeks is $72.00 / ferry cost per week is $36.00 / ferry cost alternates between $72.00 and $0 per week;

or train cost per week is $31.00.

If 2 marks cannot be awarded, award 1 mark for evidence of appreciation that each ferry (one-way) trip is effectively $3.60 (12 × $6 ÷ 20) and/or return rail fare each day is $6.20.