MARK SCHEME for the October/November 2012 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

1 (a) Describe the path of the second signal that passes across the network. **[1]**

Answer: (1), 3, 5, 8, 12, 16, 20, 23, (25)

(b) Describe the path of the signal that is the first to travel through node 21. **[2]**

Answer: (1), 3, 6, 9, 14, 18, 21, 23, (25)

Credit 1 mark for the correct path, which is truncated/wrong after 18, or before 6.
Credit 1 mark for an alternative path through 21. (e.g. 6th signal: 1, 3, 5, 8, 12, 17, 21, 24, 25 – choosing one from each row.)

(c) How many signals does it take for the first three rows of switches (nodes 1 to 6) to be returned to their initial positions? **[1]**

Answer: 8

(d) Which will be the last node to receive a signal, and how many signals does it take for it to be reached? **[3]**

Answer: Node 15 **[1]** will be reached on the 16th signal (<u>after</u> the 15th) **[2]**.

1 mark for on the 15th or 17th signal, or evidence of single numerical error.

1	2	4	7	11
1	3	5	8	12
1	2	5	9	13
1	3	6	9	14
1	2	4	8	13
1	3	5	8	12
1	2	5	9	13
1	3	6	10	14
1	2	4	7	12
1	3	5	8	13
1	2	5	9	14
1	3	6	9	13
1	2	4	8	12
1	3	5	8	13
1	2	5	9	14
1	3	6	10	15

Credit solutions which consider a complete run through as 8 signals (8 × 16 + 4).
Credit 1 mark for a systematic listing of nodes, justifying their solution.
SC: a solution which offers node 15, amongst others, and 16 signals gets 2 marks.
SC: award 1 mark for '32' or '8', appealing to the powers of 2, dependent on offering '15' as the final node.

(e) **After the 64th signal, all the switches have returned to their initial positions. Nodes 1 and 25 have received all the signals. Which nodes have received exactly half of the signals?** **[3]**

Answer: 2, 3, 5, 23 and 24

1 mark for 2 **and** 3. 1 mark for 23 **and** 24. 1 mark for 5. Deduct 1 mark for each incorrect symmetric pair (or single value if not in pairs) added.

2 **(a)** **This morning I spent one of the €5 notes. What was the serial number?** **[1]**

P06773001976 is the missing note from the 5 euro sequence. Credit if letter omitted.

(b) **What must it be and why?** **[2]**

1 mark for 0
A 2 mark answer must include a clear explanation, e.g.:
Recognition that 9 and 0 perform the same function, and that 9 already exists.
The examples show all except 0, 3, and 6. 3 and 6 are needed as check-digits to complete the other serial numbers.
SC: 1 mark if solution includes a correct answer and explanation, as well as spurious solutions.

(c) **(i)** **In the case that the last two digits are switched, does the system detect an error always, sometimes or never? Explain your answer.** **[2]**

Answer: sometimes. Is only detected if the switch places 0 as the last digit.
2 marks for a correct answer with a clear explanation.
1 mark if the reasoning is unclear, but does seem to support the decision.
FT from **(b)** = 2 marks
Example/reasons which eliminates one of the possibilities – 1 mark

(ii) In the case that any other pair of adjacent digits is switched, does the system detect an error always, sometimes or never? Explain your answer. **[2]**

Answer: <u>never</u>. No transposition of digits would be detected because the order of adding digits doesn't change the result.
2 marks for a correct answer with a clear explanation – allow examples involving the last two digits.
1 mark if the reasoning is unclear, but does seem to support the decision.
1 mark for concluding that the letter transposed would be noticed.

(d) Does the system detect a single instance of typing the wrong digit always, sometimes, or never? Explain your answer. **[2]**

Answer: <u>sometimes</u>. Replacement of a 9 by a 0 or vice versa would go unnoticed (apart from in the check digit itself).
2 marks for a correct answer with a clear explanation.
1 mark if the reasoning is unclear, but does seem to support their decision.
SC: 1 mark for a solution concluding that the system will always spot a mistyping, because a change of digit will always alter the sum.

(e) When does the system not detect a mistyped letter? **[1]**

<u>Replacement of a letter with one whose code is a multiple of 9 away</u> would not be noticed. (And there must be such because there are at least 10 countries.)
SC: If there is mistyped number, which is of equal and opposite error – some reference to the restriction on the mistyped number necessary to gain the mark.

3 (a) (i) The budget constraints mean that no equipment can be purchased outright. Why is it not possible, even taking advantage of the spread payment offers, for both W and E to replace their equipment in the same year? **[1]**

The minimum cost of buying and operating two links is $140 and HQ's budget is just $125. <u>HQ's budget is not sufficient</u>

(ii) Explain why W can not replace its equipment with Securité Blue in the first year. **[2]**

The cost to HQ for Securité Blue is $80. The cost for maintaining the old system link to E is $50. This comes to $130 which is greater than HQ's budget.

1 mark answer: $80 is a problem for HQ, when combined with its other commitments – exceeds HQ's budget (imprecise explanation).

(iii) **Although the cheapest option in the first year is to not replace any of the equipment, this would mean that it would not be possible to operate both links in the sixth year. Explain why not.** **[2]**

The old equipment will cease to function after five years. Neither equipment can be bought outright, so <u>spread payments would be needed</u>.
During the repayment time, each Blue would require $80, and each Red $70.
The HQ annual limit means that only one of these can be done at a time
and with $50 used up continuing with the other, <u>it must be a Red first</u>.
This means that a Red must be purchased in year 1 or else <u>the other link can not be replaced in time</u>.

Award marks for any two of the underlined explanations.
If none of the above explanations are offered, award 1 mark for a clear explanation of how a particular allocation of equipment would be untenable in the sixth year.

(iv) **In order for it to be possible to operate both links in the sixth year, what must be the total annual cost for each of the first five years?** **[1]**

Answer: <u>$240</u> (see table below)

Both Red	Limit	Years 1-5	Years 6-10	Years 11-20
W	$80	$50	$50+$20	$20
HQ	$125	$50+$50+$20	$50+$20+$20	$20+$20
E	$75	$50+$20	$20	$20
Total	$280	<u>$240</u>	$180	$80

Red/Blue	Limit	Years 1-5	Years 6-8	Years 9-20
W	$80	$50	$70+$10	$10
HQ	$125	$50+$50+$20	$70+$10+$20	$10+$20
E	$75	$50+$20	$20	$20
Total	$280	$240	$200	$60

(b) Consider just the first eight years, assuming no change in the annual budget limits. Which station should purchase what equipment and in which year, in order to keep the total cost over this period to a minimum? **[2]**

E (or W) should purchase <u>one</u> Red immediately. [1 mark]
Then W (or E) should purchase Red in year 6. [1 mark]

(c) (i) Looking instead over the first twenty years, assuming no change in the annual budget limits, what purchasing strategy will keep the total cost to a minimum? **[1]**

<u>E must purchase Red in year 1 and W must purchase Blue in year 6.</u>

(ii) What is this minimum total cost? **[2]**

Red then Blue is better over 20 years. Can't buy both at once.
Years 1 – 5:   5 × 240 = 1200
Years 6 – 8:   3 × 200 = 600
Years 9 – 20:   12 × 60 = 720
<u>Total = $2520</u>

1 mark for $2900 but only if "Red then Red" given in part **(c)(i)**.
1 mark for a correct strategy with one arithmetic error.
1 mark for a clearly defined strategy correctly costed.

(d) (i) If the annual budget limits were amended to be simply a total of $280 for all three stations, what would be the minimum total cost over the first twenty years? **[2]**

Should buy only Blue, if allowed to pool resources:

	Years 1-3	*Years 4-6*	*Years 7-20*
W (or E)	$50	$70+$10	$10
HQ	$50+$70+$10	$10+$70+$10	$10+$10
E (or W)	$70+$10	$10	$10
Total (limit $280)	$260	$180	$40

Total 3 × 260 + 3 × 180 + 14 × 40 = <u>$1880</u>.

1 mark for evidence of Blue then Blue seen in working.
OR 1 mark for a clearly budgeted option (within the $280 limit).

(ii) If the annual budget limits were removed, what would be the minimum total cost over twenty years? **[2]**

With no constraints on in-year costs, the overall cheapest over 20 years would be spend 4 × $200 on Blue equipment in first year and $40 per year to run them: a total of <u>$1600</u>.

1 mark for evidence of purchase of four Blues in first year (e.g. $1640 as total).

4 (a) List all the towns to which Menestor's delivery charges are the same from both stores. **[3]**

Answer: Hertz, Joule, Katal, Newton, Radian and Tesla

3, 4 or 5 correct towns: 2 marks
1 or 2 correct towns: 1 mark
Deduct 1 mark for each incorrect town (minimum 0 marks).

(b) Megan has bought a table and six dining chairs from the Kelvin store. The table cost $450 and the chairs were $80 each.
How much will Menestor charge for delivery to her home in Coulomb? **[3]**

Answer: $152

If 3 marks cannot be awarded, award 1 mark each for evidence of appreciation of the following:
• The total value of goods is $930.
• Delivery to Coulomb is in the 41 km to 80 km range.

(c) (i) How much could Hector save by asking Wheelduit to deliver his furniture to his home in Sievert instead of using Menestor's own delivery service? **[2]**

Answer: $36

If 2 marks cannot be awarded, award 1 mark for evidence that Wheelduit's charge is $59 (3 × $7 + 4% of $950).
1 mark for correct method with one arithmetic error.
SC: comparison of costs from Kelvin: 214 – (98 + 38) = $78

(ii) What is the value of goods for which Menestor and Wheelduit charge exactly the same to deliver to Sievert (from Candela)? **[3]**

Answer: $3400

If 3 marks cannot be awarded, award 1 mark each for evidence of the following (maximum 2 marks):
• $21 is a fixed distance charge by Wheelduit to Sievert.
• Wheelduit's charge for goods worth $1500 is $81 ($21 + 4% of $1500).
• (Menestor's charge for goods worth more than $1500 is fixed at $157 so) the charges will be equal when another $76 (19 × $4) is added to Wheelduit's charge.

Accept an answer of $1900 (without supporting evidence) for 2 marks.
Award 2 marks for a correct solution based upon the wrong distance (e.g. $147 from Menestor: $3150) or for mistaking Wheelduit's distance charge as $14 (yielding $3575 in total).

(d) Which of the four delivery options available is the cheapest for Millie? Support your conclusion with calculations. **[4]**

Answer:
- Menestor   : $198
- 4 hours hire   : $103.80 ($66 + 126 × $0.30)   [1 mark]
- Whole day hire : $89.80 ($82 + 26 × $0.30)   [1 mark]
- Wheelduit   : $95.60 (10 × $7 + 4% of $640)   [1 mark]
- So whole day hire is cheapest (or an alternative that is consistent with (four) incorrectly calculated figures)   [1 mark]

SC: Answer which forgets that it is a return journey
66 + (93 – 60) × 0.30 = $75.90 & $82: 1 mark each