

**MARK SCHEME for the May/June 2015 series**

**9694 THINKING SKILLS**

**9694/33**

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.

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- 1 (a) Explain why the small brick on the left in the second row must be coloured using colour 1. [1]

Box on its own needs a pair (could include reference to '3 would have to be on its own')  
2s already have a pair

SC: *proof by contradiction – if the 1 were in the top right...*

- (b) Copy the diagram of the small wall and complete the design using only colours 1, 2 and 3. [1]

|   |   |   |
|---|---|---|
| 1 | 3 |   |
| 1 | 2 | 3 |
| 2 | 1 |   |
| 3 | 3 | 1 |

- (c) What colour must brick Ckl be painted? Explain your answer. [1]

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|   | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
| A | 1 |   | ? |   | 1 |   | 4 |   | 1 |   | 1 |   | 3 |   |
| B | 4 | 1 |   | ? |   | 1 |   | 4 |   | 2 |   | 4 |   | 3 |
| C | 4 |   | 2 |   | 2 |   | 3 |   | 2 |   | 4 |   | 2 |   |
| D | 3 | 3 |   | 1 |   | 3 |   | 4 |   | 3 |   | 1 |   | 2 |
| E | 4 | 4 |   | 1 |   | 4 |   | 3 |   | 2 |   | 1 |   |   |
| F | ? | ? |   | 2 |   | 3 |   | 1 |   | 2 |   | 4 |   | ? |
| G | ? |   | ? |   | 2 |   | 3 |   | 1 |   | 4 |   |   | ? |

4 AND one of the following reasons:

Amn and Bn must be the same colour.

Blm and Ckl must be the same colour.

Colours 1, 2 and 3 are already adjacent to Blm and Ckl.

Ckl and Dlm cannot be coloured the same because it will leave three bricks uncoloured above it.

|     |     |     |
|-----|-----|-----|
|     | Akl | Amn |
| Bjk | Blm | Bn  |
|     | Ckl | Cmn |
| Djk | Dlm | Dn  |

- (d) Explain why bricks Acd and Bde must be the same colour. [2]

Bde and Bfg cannot be paired [1 mark]

AND contextual explanation why not (e.g. since they have 1234 touching) [1 mark]

SC: *Bfg must be colour 1 [1 mark]*

|               |  |                 |              |
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**(e) Write down the colours of all of the bricks in row D, in order from left to right. [2]**

3, 3, 1, 3, 4, 3, 1, 2

*1 mark for both 1s in correct positions.*

*1 mark for 3s and 4 in the above list correct.*

SC1: 33141

*FT: if answer to (c) is 1, then allow 4 as penultimate number in list: 33134342*

**(f) Draw all the different ways that Kerry can colour the set of bricks Fa, Fbc, Gab, Gcd.[3]**

All 8 options shown below:

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |
| 3 | 3 | 4 | 4 | 1 | 1 | 4 | 4 |
|   |   |   |   |   |   |   |   |
| 1 | 3 | 2 | 1 | 2 | 3 | 3 | 1 |
| 1 | 3 | 2 | 1 | 2 | 3 | 3 | 1 |

*4 correct options OR at least one vertical and one horizontal pairing: 1 mark (ignore incorrect options)*

*6 correct options with no more than 2 extra incorrect: 2 marks*

*8 correct options (with no incorrect options): 3 marks*

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- 2 (a) Charles travels from Babaorum to Laudanum and back 5 times each week. He used to buy day return tickets every time. How much more does he now have to pay each week? [2]

$$(5 \times 48) - (5 \times 37) = \underline{\$55}$$

1 mark for 48 AND 37 seen OR \$240 OR \$11

- (b) What must the probability of needing the return portion have exceeded to have made it worthwhile to risk buying a Day Return ticket? [1]

$$\underline{1/36}$$

- (c) Before the change, what range of prices would have made both a saving for the person selling the half-used ticket, and a saving for the other person? [1]

(Strictly) Between \$1 and \$36 OR \$1.01 and \$35.99. (Condone \$2 to \$35)

- (d) If people's requirements for journeys remained the same, what proportion of tickets would have to have been singles to result in no change in the company's income? [2]

$$\underline{11/23}$$

1 mark for lose \$12 on singles AND gain \$11 on returns

OR 1 mark for an algebraic statement of the problem, e.g.  $36x + 37y = 24x + 48y$

- (e) What was the change in the total income? [2]

$$(\$36 \times 20 + \$37 \times 50) - \$24 \times (30 + 76) = \$(720 + 1850 - 2544) = \underline{\$26}$$

Award 1 mark for sight of \$2570 **oe** OR \$2544 **oe** OR a correct method applied to the problem, with one arithmetic error.

SC1: sight of \$1798 (treating 76 pairs as 76 singles)

- (f) How many journeys were paid for but not used

- (i) on the Wednesday before the change? [1]

$$(20 + 2 \times 50) - (52 + 56) = \underline{12}$$

- (ii) on the Wednesday after the change? [1]

$$(30 + 76) - (51 + 52) = \underline{3}$$

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- 3 (a) Show that Claudel is able to make \$4500 per month if she does the unskilled work herself. [1]

$$(200/40) \times 900 = \$4500 \text{ [answer given]}$$

- (b) If Claudel hires a part-time assistant at the beginning of the first month, what is the maximum profit she can make by the end of that month? [3]

$$200/30 \text{ [1 mark]} = 6\frac{2}{3} \text{ commissions}$$

$$6\frac{2}{3} \times 900 = \$6000 \text{ earnings}$$

$$6\frac{2}{3} \times 10 \times 10 = \$667 \text{ admin costs}$$

[1 mark for method]

$$6000 - 667 = \$5333 \text{ profit (allow } \$5333 - \$5334 \text{ inclusive)}$$

SC1: using 5 commissions per month, yielding  $\$4500 - \$500 = \$4000$

- (c) What is the maximum that Claudel could pay an assistant per hour and ensure that she still makes the same amount of profit in the first year as she would on her own? [3]

Working solo, the amount she can earn is  $12 \times 4500 = \$54\,000$ .

Wages to assistant per year =  $(6\frac{2}{3}) \times 10 \times 12 \times w$

Income per year:  $(6\frac{2}{3}) \times 12 \times 900 = \$72\,000$

1 method mark for correct expression for the assistant's wages **soi**  
OR the two comparable incomes

$$72\,000 - 800w = \$54\,000 \text{ [1 mark]}$$

OR

Wages to assistant per month  $6\frac{2}{3} \times w$

Income per month:  $(6\frac{2}{3}) \times 900 = \$6000$

$$6000 - 6\frac{2}{3}w = \$4500 \text{ [1 mark]}$$

$$w = \$22.50$$

- (d) How much profit could Claudel make per month if she employed one skilled artisan full-time and a part-time unskilled assistant? [3]

Claudel and artisan both working  $4/5$  of  $200 = 160$  hours =  $5\frac{1}{3}$  commissions each. [1 mark]

$$5\frac{1}{3} \times 2 \times 900 = \$9600 \text{ earnings}$$

$$10\frac{2}{3} \times 10 \times 10 = \$1067 \text{ assistant costs}$$

$$15 \times 200 = \$3000 \text{ artisan costs.}$$

[1 mark for two of these **soi**]

$$9600 - 4067 = \$5533 \text{ profit}$$

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- (e) How many artisans working full time would make it necessary to hire a second assistant? [2]

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2 marks with supporting working.

4 artisans: (680) 640 hours; ( $22\frac{2}{3}$ ) 21  $\frac{1}{3}$  commissions; (227) 213 assistant hours

1 mark for the number of commissions or the number of hours for any other number of artisans:

2 artisans: 320 hours;  $10\frac{2}{3}$  commissions; 107 assistant hours

3 artisans: 480 hours; 16 commissions; 160 assistant hours

5 artisans: 800 hours;  $26\frac{2}{3}$  commissions; 267 assistant hours

SC1: working which shows Claudel sculpting as well as the artisans:

4 artisans: 680 hours;  $22\frac{2}{3}$  commissions; 227 assistant hours

- (f) Calculate the maximum profit Claudel could make per year. [3]

Maximum possible number of artisans = 5

1 mark for any two of the following calculated; 2 marks for all four calculated, for whatever number of artisans they have considered.

$5 \times 160 \times 12$  hours of work = 9600 hours = 320 jobs complete = \$288 000 income

Artisan wages =  $(5 \times 200 \times 12) \times 15 = \$180\,000$

Assistant time = 3200 hours = \$32 000 (requiring two since more than 200 hours needed per week)

Annual Employee fee =  $7 \times 1000 = \$7000$

OR

1 mark for any two of the following calculated; 2 marks for all four calculated, for whatever number of artisans they have considered

$5 \times 160$  hours of work = 800 hours =  $26\frac{2}{3}$  jobs complete = \$24 000 income

Artisan wages =  $(5 \times 200) \times 15 = \$15\,000$

Assistant time =  $266\frac{2}{3}$  hours = \$2667

Profit per month \$6333

Total profit =  $288\,000 - (180\,000 + 32\,000 + 7000) = \underline{\underline{\$69\,000}}$

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- 4 (a) Mary has two cards that spell KENTUCKY, and a +\$60 bonus card. How much can she claim? [1]

\$420 (\$240 + \$120 + \$60)

- (b) Which State must be formed in order to be able to claim the top prize of \$500? [1]

MICHIGAN (\$180 + \$220 + \$100)

- (c) What is the largest prize that can be claimed by combining a –O–A wild card with another card, but no bonus card? [1]

\$60 (OKLA + –O–A)

- (d) (i) Which State can only be formed by combining a prize card and a wild card? [1]

NEVADA (NEV + A–A)

- (ii) Which State can be formed by combining two wild cards [1]

MONTANA (M–N– + A–A)

- (e) Give three other examples of a single claim that would win \$330. [3]

*Any three of the following (1 mark each):*

WYO + MING (\$80 + \$250)

MINNE + SOTA (\$50 + \$260 + \$20)

ALA + SKA (\$200 + \$170 + \$60)

OKLA + HOMA (\$60 + \$170 + \$100)

*If more than three examples are given, accept only the first three.*

- (f) (i) How much can Tex claim? [1]

\$310 (VER + MONT + \$100)

- (ii) How much can Carol claim? [1]

\$220 (NEBRA + SKA + \$20)

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**(g) What is the maximum they can claim in total?** [3]

Possible combinations are:

INDIANA = \$170

VERMONT = \$210

NEBRASKA = \$200

ALABAMA = \$240

ALASKA = \$270

MONTANA = \$350

The maximum total is achieved by claiming the first four States and using all three bonus cards, giving a total of \$1020.

*1 mark for any State from the list above other than VERMONT or NEBRASKA.*

*1 mark for selecting the correct four States.*

**(h) What is the maximum number of different prize cards that someone could have and still not be able to claim a prize?** [2]

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*1 mark for 13 or 15 (considering cards that could be used as either first halves or second halves, but forgetting that some can be used for both).*