Cambridge International AS & A Level

THINKING SKILLS **9694/32**

Paper 3 Problem Analysis and Solution **May/June 2022**

MARK SCHEME

Maximum Mark: 50

Published

This document consists of **8** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1: Marks must be awarded in line with: • the specific content of the mark scheme or the generic level descriptors for the question • the specific skills defined in the mark scheme or in the generic level descriptors for the question • the standard of response required by a candidate as exemplified by the standardisation scripts.
GENERIC MARKING PRINCIPLE 2: Marks awarded are always **whole marks** (not half marks, or other fractions).
GENERIC MARKING PRINCIPLE 3: Marks must be awarded **positively**: • marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate • marks are awarded when candidates clearly demonstrate what they know and can do • marks are not deducted for errors • marks are not deducted for omissions • answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.
GENERIC MARKING PRINCIPLE 4: Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.
GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

NOTES FOR MARKERS

Working

Supporting working is **not** needed to gain full marks, unless otherwise stated in the mark scheme.

If working clearly shows, beyond any doubt, that a correct answer derives purely from incorrect reasoning, that answer may be invalidated, unless otherwise stated in the mark scheme.

For partial credit, the evidence needed to award the mark will usually be shown on its own line in the mark scheme, or else will be defined in italic text.

For explanations and verbal justifications, apply the principle of 'words to that effect'.

Incorrectly labelled work

If the candidate has labelled their work with the wrong Question/part number, highlight the label(s) and add a comment to flag it. This will help avoid confusion for anyone checking the script later on.

No response

If there is any attempt at a solution award 0 marks, not NR. '-' or '?' constitute no attempt at a solution.

Abbreviations

The following abbreviations may be used in a mark scheme:
AG   answer given (on question paper)
awrt   answer which rounds to
ft   follow through (from earlier error)
oe   or equivalent
SC   special case
soi   seen or implied

Annotations

Where the answer is underlined in the mark scheme, and a candidate's correct final answer is both clear and clearly identified (encircled, underlined etc.), it is not necessary to annotate that item; nor is it necessary to annotate when there is No Response.

Where there is a response that scores 0, either SEEN should be used, or some other annotation(s) to indicate why no marks can be awarded (Caret, TE, NGE, Cross).

Partial credit should be indicated with a 1 (or, occasionally, a 2) at the point at which that mark has been earned.

The highlighter should be used anywhere it is helpful to clarify the marking.

✔	Correct item
✖	Incorrect item
1	Individual mark of partial credit
2	Double mark of partial credit
^	Essential element of answer/working missing
NGE	Judged to be not good enough to earn the relevant credit
BOD	Benefit of doubt
FT	Correct follow through
TE	Transcription error
SC	Special case
SEEN	Working seen but no credit awarded; blank page checked
Highlight	Use anywhere it is helpful to clarify the marking

There must be at least one annotation on each page of the answer booklet.

Question	Answer	Marks
1(a)	<u>$22.50, $24.00, $24.50, $25.50, $27.00</u> *1 mark for any three correct*	**2**
1(b)	4 same-day returns and 1 Weekend special **[1]** $4 \times \$7.50 + \$5.00 =$ $35.00 **[1]**	**2**
1(c)(i)	<u>$64</u> *SC: Allow $80*	**1**
1(c)(ii)	One week of travel costs $35 In the current scheme, her minimum claim = $32 **[1]** (The minimum satisfies the 10 or more occasions requirement) So costs could be lower by at most $35 – $32 = $3 **AG** *SC:* *2 marks for their (b) compared with half of their (c)(i)* *OR* *2 marks for $35 or $45 compared with any of $32, $40 or half of their (c)(i)* *OR* *1 mark for $45 or $40 or $32 or half of their 1(c)(i) seen*	**2**
1(d)(i)	Use the $50 weekly ticket for 7 return journeys in 7 days **soi [1]** 3 weekly + 3 day return: $150 + $27 = <u>$177</u>	**2**
1(d)(ii)	<u>12th</u>	**1**

Question	Answer	Marks
2(a)(i)	3 paintings would require a height of $2 \times 30 + 3 \times 30 + 2 \times 10 = 170$ cm, which is possible. **[1]** 4 paintings would require a height of $2 \times 30 + 4 \times 30 + 3 \times 10 = 210$ cm, which is not possible. **[1]** *Alternative:* Consider the paintings as having a height of 40 cm and borders of 25 cm at the top and bottom (or 30 at one and 20 at other). **[1]** The number of paintings that can be fitted is $(200 – 2 \times 25) / 40 \ (= 3.75)$, so 3 is the maximum. **[1]**	**2**
2(a)(ii)	$200 – 2 \times 30 – 3 \times 30 = 50$. 2 gaps so $50 \div 2 = \underline{25}$ cm	**1**
2(b)	A maximum of 4 columns can be placed on one 3.0 m board. **[1]** $20 \times 2 \div 12 = 3.33$, so <u>4</u> display boards are needed.	**2**

Question	Answer	Marks
2(c)	On one board: 2 columns requires a width of at least 170 cm, so \$50 3 columns requires a width of at least 230 cm, so \$55 4 columns requires a width of at least 290 cm, so \$60 5 columns requires a width of at least 350 cm, so \$65 (6 columns requires a width of at least 410 cm, which is too much for any board.) *1 mark for any 2 numbers of columns/pictures or 2 widths of board evaluated correctly.* *1 mark for all of 2–5 columns or all widths of board evaluated correctly.* The cheapest price is therefore $2 \times 65 + 60 = $ $\underline{\$190}$. *SC: If 0 scored,* *1 mark for seeing that 40 paintings will require a total of 14 columns.* *OR 1 mark for selecting 3.5 m (for having no waste)*	3
2(d)(i)	$\underline{\$115}$	1
2(d)(ii)	If the shorter side is horizontal, then only 2 paintings can be in each column, so 10 columns are required. 3 columns requires a width of at least 170 cm, so \$50 4 columns requires a width of at least 210 cm, so \$55 5 columns requires a width of at least 250 cm, so \$55 6 columns requires a width of at least 290 cm, so \$60 7 columns requires a width of at least 330 cm, so \$65 8 columns requires a width of at least 370 cm, so \$70 *1 mark for any 2 numbers of columns/pictures or 2 widths of board evaluated correctly.* 2 boards at \$55 is best, so $\underline{\$110}$.	2
2(e)	*1 mark for any two arrangements correctly established.* *2 marks for any set of boards (including at least one with mixed orientations) that caters for 40 paintings.* *3 marks for a correct price \$190 together with boards that cater for 20 paintings of each orientation.* ***Plus** 1 mark for number of columns of each orientation correctly shown for each board used in a correct solution.* *Alternatively* 7 columns with longer side horizontal and 10 columns with shorter side horizontal. Taking widths of paintings as 40cm and 60cm, the total width required is $7 \times 60 + 10 \times 40 = 820$. **[1]** Widths of boards that can be used are 150, 200, 250, 300 and 350. 820 fits into e.g. $2 \times 300 + 250$ **[1]** 3.5 m boards could have 3 columns of each orientation. 3 m board with 1 column with long side horizontal and 4 with short side horizontal. **[1]** So cost of boards will be $2 \times \$65 + \$60 = \$190$. **[1]**	4

Question	Answer	Marks
3(a)	A = Q, B = S, D = P A = S, B = P, D = Q	1
3(b)	<table><tr><td>*Pozzle*</td><td>B</td><td>B</td><td>B</td><td>**C**</td><td>**C**</td><td>**D**</td><td>**D**</td><td>**D**</td><td>**E**</td><td>**E**</td><td>**E**</td></tr><tr><td>*Quiggie*</td><td>C</td><td>D</td><td>E</td><td>**E**</td><td>**D**</td><td>**E**</td><td>**C**</td><td>**E**</td><td>**C**</td><td>**D**</td><td>**D**</td></tr><tr><td>*Rusty*</td><td>A</td><td>A</td><td>A</td><td>**A**</td><td>**A**</td><td>**A**</td><td>**A**</td><td>**A**</td><td>**A**</td><td>**A**</td><td>**A**</td></tr><tr><td>*Soppet*</td><td>E</td><td>E</td><td>C</td><td>**B**</td><td>**E**</td><td>**B**</td><td>**E**</td><td>**C**</td><td>**B**</td><td>**B**</td><td>**C**</td></tr><tr><td>*Tupper*</td><td>D</td><td>C</td><td>D</td><td>**D**</td><td>**B**</td><td>**C**</td><td>**B**</td><td>**B**</td><td>**D**</td><td>**C**</td><td>**B**</td></tr></table> *If 3 not scored, then award 1 mark for each set of P=C, P=D and P=E all correct* *OR* *1 mark for all columns where S=B correct or all where T=B correct* *OR* *1 mark for observation Q≠B, S≠D, and T≠E.*	3
3(c)(i)	The row for Quiggie does not repeat any sibling in the relevant columns (those where P=B), **[1]** so identifying which sibling is Quiggie must identify which column of the table is correct. **[1]** *OR* If Moses looked at the letter to Soppet or Tupper, there could still be two possibilities for the other two nicknames, **[1]** but identifying Quiggie determines all three names because whoever Quiggie turns out to be there is only one possibility left for Soppet and Tupper. **[1]** The letter written by Bede (to Quiggie) *1 mark for the letter written by Bede without (correct) explanation.*	2
3(c)(ii)	None of the rows for Q, S and T contains a repetition in the columns where P=C. OR There are only two possibilities left, both of which match all the names differently, so finding out the identity of any of the remaining three will determine all the pairs.	1
3(d)	Rusty = Alfred (given) so Pozzle = Ethel (to avoid a pair) **[1]** Soppet = Bede (given) so the remaining pairs are Q=D and T=C or Q=C and T=D Quiggie cannot be Dorian (to avoid a pair) **[1]** so Quiggie = Celeste and Tupper = Dorian. **[1]**	3

Question	Answer	Marks
4(a)(i)	(30 × $36) + (30 × $3 × 3) + (10 × $20) = $1550 **AG**	1
4(a)(ii)	(30 × 40) + (30 × 4 × 3) + (10 × 25) = <u>1810 mins</u>	1
4(b)(i)	Houses give greatest income per minute **[1]** In 7 hours (= 420 mins), George can clean 10 houses + 1 apartment, giving an income of <u>$372</u>	2
4(b)(ii)	Apartments give least income per minute, but only 15 **[1]** 15 apartments leave 90 minutes. Arrangement of houses and bungalows between 90 and 120 minutes **[1]** Least income from 1 house + 2 bungalows = $180 + $76 = <u>$256</u>	3
4(c)	10 houses + 1 apartment take 7 hours to clean, 240 houses + 24 apartments take 168 hours. Remaining 96 apartments take 32 hours, so total time needed is 168 + 32 = 200 hours **[1]** 35 hours per week, so 200/35 **oe [1]** = 5.7... Number of employees needed is 6. **[1]** *3 marks for final answer 6 if 200 hours **oe** seen*	3
4(d)(i)	1500/30 = 50 houses per week. Time taken = 50 × 40 = <u>2000 mins</u> (33 hours 20 mins)	1
4(d)(ii)	Profit = $1500 – $1000 – $250 = $250 per employee, so for 10 employees, <u>$2500</u>	1
4(e)	In 6 hours, one employee can clean 360/30 (6/0.5) = 12 houses with a daily income of 12 × $30 × 1.10 = $396 Total annual income = $396 × 5 = $1980 per week for 45 weeks **[1]** Outgoings = $1000 + $500 = $1500 per employee for 52 weeks **[1]** Profit = $1980 × 45 – $1500 × 52 = $11 100 per year per employee Number of employees for this to be $80 000 in 52 weeks = ($80 000/11 100) > 7 < 8. so least number of employees required is 8. **[1]** *3 marks for final answer 8 if 11 100 seen*	3