



## **Cambridge International AS & A Level**

---

**THINKING SKILLS**

**9694/31**

Paper 3 Problem Analysis and Solution

**October/November 2022**

**MARK SCHEME**

Maximum Mark: 50

---

**Published**

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

---

This document consists of **9** 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’.

**Units**

Unless required by the question or mark scheme, units such as \$ do not need to be seen to award the marks.

**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:

<b>AG</b>	answer given (on question paper)
<b>awrt</b>	answer which rounds to
<b>ft</b>	follow through (from earlier error)
<b>oe</b>	or equivalent
<b>SC</b>	special case
<b>soi</b>	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
	Individual mark of partial credit
	Double mark of partial credit
	Essential element of answer/working missing
	Judged to be not good enough to earn the relevant credit
	Benefit of doubt
	Correct follow through
	Transcription error
	Special case
	Working seen but no credit awarded; blank page checked
<b>Highlight</b>	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)	Rooms booked would be 1 small, 1 medium and 1 large for a half day and 1 medium for a whole day, so the cost is $\$400 + \$800 + \$1500 + \$1500 = \$4200$ The income from the delegates will be 50 at \$100 each and 20 at \$200 each, which is a total of \$9000. The profit will be $\$9000 - \$4200 = \underline{\$4800}$  <i>1 mark for either \$4200 or \$9000 seen</i> <i>OR</i> <i>1 mark for profits for individual rooms (<math>700 + 500 + 2500 + 1100</math>) seen</i>	2
1(b)(i)	Only one extra delegate could be given a place, so the additional profit would be <u>\$100</u> .	1
1(b)(ii)	The Medium room will cost \$400 more; <b>[1]</b> so he would need $1 + 4 + 1 = \underline{6}$ additional delegates.  <i>SC: 1 mark for answer of 13 from considering Large room rather than Medium.</i> <i>SC: 2 marks for final answer of 5 from comparing profit from 9 delegates in Small room with 14 delegates in Medium room.</i>	2
1(c)(i)	Profit from a fully used Medium room is $25 \times 200 - 1500 = 3500$ For a Large room this would require $\$2400 + \$3500$ from delegates. $5900 / 200 = 29.5$ , so 30 delegates <b>[1]</b> To be certain that it is better to book a large room this must be at least an increase of $\frac{1}{4}$ on the number already enrolled. <b>[1]</b> A minimum of <u>24</u> delegates would need to be registered.	3
1(c)(ii)	An increase by $\frac{1}{2}$ must not reach a total of 30 delegates. <b>[1]</b> 20 would increase to 30 A maximum of 19 <b>[1]</b> delegates could be registered.	2

Question	Answer	Marks
2(a)	As claimant a player may claim 25 points with (e.g.) 9, 8 and 8, which would be doubled to 50 if challenged, and as judge a correct challenge involving 9, 9 and 9 would score $27 + 10 = 37$ , so the greatest possible score is $50 + 37 = \underline{87}$ .  <i>1 mark for 50 OR 37 seen.</i>  <i>SC: 1 mark for final answer 89</i>	2
2(b)(i)	Olivia's claim for 20 points was accepted and Gavin scored 10 points for judging correctly. Gavin's claim for 25 points with cards numbered 6, 4 and 2 was successfully challenged, so Gavin scored 0 and Olivia scored $6 + 4 + 2 + 10 = 22$ .  <u>Olivia: 42 [1]</u> <u>Gavin: 10 [1]</u> <i>SC: 1 mark for 10, 42 with no indication of which score belongs to each person.</i>	2
2(b)(ii)	A sum of 25 requires at least one 9. [1] Olivia has already taken all/four 9s. [1]	2
2(c)	6 and 6 [1] Reasoning that rules out 7 [1] e.g. With 7 he could have made 15 ( $7 + 6 + 2$ ). Reasoning that rules out 8 [1] e.g. With 8 and 6 he could have made 20 ( $8 + 6 + 6$ ) and with 8 and 8 he could (also) have made 20 ( $8 + 8 + 4$ ).  Must be at least 6.	3
2(d)	<u>3</u> (Olivia – unsuccessfully challenged) <u>6</u> (Gavin – unsuccessfully challenged) <u>7</u> (Olivia – successfully challenged)  Accept any unambiguously clear description of the relevant claims.  <i>2 marks for all three correct with no extra incorrect answers</i> <i>1 mark for all three correct with no more than one extra incorrect answer</i> <i>OR for two correct and no more than one incorrect answer</i>	2
2(e)	<i>1 mark for recognition of each of the following:</i> <ul style="list-style-type: none"> <li>If Gavin accepts her claim she will be 20 points behind/the score will be Olivia 100; Gavin 120.</li> <li>The cards that she has not seen (of which Gavin has five) are: 8, 8, 6, 5, 5, 3 and 3.</li> <li>Gavin could not make a multiple of 5 from any three of these cards.</li> <li>(So) she is guaranteed a successful challenge, which will score (at least) (<math>5 + 3 + 3 + 10 =</math>) 21 points.</li> </ul>	4

Question	Answer	Marks
3(a)	9 executives are necessary [1] If there are 2 empty seats between every pair of executives, then with 8 executives this would only account for $8 + 2 \times 8 = 24$ seats. [1]	2
3(b)	She is correct, because 18 executives could sit in 6 separate groups of 3 (or 5 groups of 3, a pair and a single), but, no matter where they sit, the nineteenth executive will have to create a group of at least 4. <i>Award 1 mark for recognising that 18 executives could sit down without 4 executives sitting consecutively.</i>  <i>Alternatively:</i> 6 separate groups of three people plus a gap would use up $6 \times 4 = 24$ seats, but there are 25 seats, so there must be another person in a seat somewhere, making a group of 4. <i>Award 1 mark for evidence of <math>6 \times 4</math>.</i>	2
3(c)	7 people sitting together with one empty seat can happen 3 times [1] so with <u>22</u> executives (only 3 empty seats) a group of (at least) 8 must occur.	2
3(d)	10 managers could sit consecutively on each table, which would mean that Hugh must invite at least $10 \times (12 - 2) = \underline{100}$ managers.	1
3(e)	4 managers are necessary in order to prevent more than two groups of 3 consecutive empty seats. [1]  In fact, only 4 managers, suitably deployed, are needed to prevent 3 consecutive empty seats. [1]  So the total number of managers needed is $4 \times 10 = \underline{40}$ .	3

Question	Answer	Marks
4(a)(i)	2 points for empty squares. <b>[1]</b> It is not possible to score for both stars as the Quadrominoes would have to be placed with three dots in the sections that touch. So a maximum of 3 points for stars. <u>5</u>	<b>2</b>
4(a)(ii)	The maximum must come from scoring all three stars touching a square (gaining 9 points). <b>[1]</b> <b>Only</b> one adjacent square could be empty, scoring 1 additional point. <b>[1]</b>	<b>2</b>
4(b)(i)	<u>E</u>	<b>1</b>
4(b)(ii)	Scott will have scored 2 points for empty squares adjacent to his first tile, 1 point for an empty square adjacent to his second tile and 3 points for the star touching just B and C. His total score is 6. Miles will have scored 2 points for empty squares adjacent to his tile. Scott 6 <b>[1]</b> Miles 2 <b>[1]</b>  <i>SC: 1 mark for 6–2 without a name.</i>	<b>2</b>
4(c)	To score 6 points the tile needs to be placed with three dots in the bottom right. Tile 2 <b>[1]</b> cannot be placed like this as there would be one dot in the top left. Tile 5 <b>[1]</b> cannot be placed like this as there would either be three dots on the bottom left or one dot in the top left.  <i>Only award second mark if no extras.</i>  <i>SC: 1 mark for the three tiles that can be placed.</i>	<b>2</b>
4(d)(i)	There must be three dots in the bottom left <b>[1]</b> (as he places the tile) if Miles is to have a chance to score 9 points on his final move. To ensure that the star on the left of square D is scored even if Scott places only one dot next to it, Miles needs to have 2 dots in the top right of the tile (as he places it) that he plays. So the tile must have three dots and two dots in opposite corners. <b>[1]</b> Tiles 2 and 3 do not satisfy this requirement. Since the tile on square G will need to have three dots in the bottom right, the tile that Miles plays cannot have three dots in the top left. This means that tile 5 will not be playable either. <b>[1]</b>	<b>3</b>

Question	Answer	Marks
4(d)(ii)	<p>If Miles plays tile 1, then Scott might be able to play tile 4 on his turn which would prevent Miles from being able to score 9 points on his final turn. Therefore Miles must not play tile 1.</p> <p>Since either of the tiles that Miles could play on square F will only add one dot to the star touching the top edge of square F, Miles needs to have 2 dots in the top right of the tile that he plays on square G.</p> <p>Tile 3 must therefore be played rotated 90 degrees anticlockwise from the orientation displayed on the diagram.</p> <p>Tile 3 identified with correct orientation <b>[1]</b> <i>1 mark for each of the following (max 2)</i></p> <p>Tile 1 cannot be played as tile 4 might not be available. Top left of tile on square F will be one dot when placed. Two dots needed in top right.</p>	<b>3</b>