



# Cambridge International AS & A Level

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**THINKING SKILLS**

**9694/03**

Paper 3 Problem Analysis and Solution

**For examination from 2020**

MARK SCHEME

Maximum Mark: 50

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**Specimen**

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This document has **8** pages. Blank pages are indicated.

**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.

**MARK SCHEME NOTES**

Where a final answer is underlined in the mark scheme, full marks are awarded for a correct answer, regardless of whether there is any supporting working.

If the final answer is not correct, marks may be awarded for correct working as indicated in the mark scheme.

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

Question	Answer	Marks																
1(a)	<p>Warehouse &gt; Model Solutions &gt; Model Market &gt; Warehouse  <math>5 + 6 + 8 = \underline{19}</math> km            Warehouse &gt; Model Emporium &gt; Model Market &gt; Warehouse  <math>7 + 10 + 8 = \underline{25}</math> km</p> <p><i>Award 1 mark for each of the two calculations.</i></p>	<b>2</b>																
1(b)	<p>Model Emporium cannot be the first destination, because the boxes for the other two stores will not all fit on the van.            All the routes are:</p> <table border="1"> <thead> <tr> <th>Store</th> <th>First trip</th> <th>Second trip</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Model Solutions</td> <td>10 km</td> <td>25 km</td> <td>35 km</td> </tr> <tr> <td>Model Emporium</td> <td>14 km</td> <td>19 km</td> <td>33 km</td> </tr> <tr> <td>Model Market</td> <td>16 km</td> <td>20 km</td> <td>36 km</td> </tr> </tbody> </table> <p>Bill should deliver to <u>Model Solutions</u> first.            The shortest distance is <u>35</u> km.</p> <p><i>Award 1 mark for calculation of total distance of any one set of deliveries.            Award 1 mark for identifying Model Solutions as the store to be delivered to first.            Award 1 mark for correct shortest distance of 35 km for Model Solutions OR 33 km for Model Emporium.            SC: award 2 marks for all distances calculated, but wrong judgement made.</i></p>	Store	First trip	Second trip	Total	Model Solutions	10 km	25 km	35 km	Model Emporium	14 km	19 km	33 km	Model Market	16 km	20 km	36 km	<b>3</b>
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Question	Answer	Marks
1(c)(i)	<p>If there are no boxes to be delivered to Model Emporium then the total distance would be 19km and the large van could be used to make just one trip. The cost for hiring the van would be <math>19 \times \\$7 = \\$133</math>.</p> <p>With the smaller van, two trips would be needed, so it would be most efficient to do one delivery to each of the stores. The distances for these two trips would be 10km and 16 km. The cost for hiring the van would be <math>26 \times \\$6 = \\$156</math>.</p> <p>Bill will save <b>\$23</b> by hiring the larger van.</p> <p><i>Award 1 mark for one of the two calculations of the cost for the deliveries.</i></p>	<b>2</b>
1(c)(ii)	<p>With the larger van the deliveries can be made with a total distance of 33 km since there is enough space for the boxes for Model Market (MM) and Model Solutions (MS) to go on one trip. Therefore the cost of delivering with the large van will be \$231 for anything up to 25 boxes needed at Model Emporium (ME).</p> <p>The smaller van can be used for trips as in part (b), provided that the boxes for ME can fit with the boxes for one of the other stores. So with 8 boxes Bill can deliver to both MM and ME in one trip, making a total distance of 35 km, giving a total cost of \$210.</p> <p>But if there are 9 boxes, the shortest route (MS&amp;MM, MS&amp;ME) has a total distance of 39km with the smaller van (<math>39 \times \\$6 = \\$234</math>) which makes it cheaper to use the larger one on its shortest route (ME, MS&amp;MM, \$231).</p> <p><i>3 marks for 9 boxes AND comparative costs (\$231 v \$234)</i>  <i>2 marks for 9 boxes and either \$231 or \$234 seen</i>  <i>0 marks for 9 boxes with no supporting working</i></p> <p><i>If 9 boxes is not identified, award marks as follows (max 2):</i>  <i>1 mark for a correct minimum cost for 7 or 8 boxes and van size (e.g. small van, 8 boxes = \$210); 1 mark for a correct cost for the other van size.</i>  <i>1 mark for a comparison of small and large van (non-minimal) costs for 7, 8, or 9 boxes.</i>  <i>1 mark for minimal costs calculated for both vans for a number of boxes greater than 9.</i>  <i>1 mark for comparison of costs for large and small vans for 8 or 9 boxes, with one arithmetic error.</i></p>	<b>3</b>

Question	Answer	Marks
2(a)(i)	<u>140</u> (5 × 10 as deliverer; 9 × 10 as recipient)	<b>1</b>
2(a)(ii)	The greatest score from 9 strands is 81 points (9 lenks as recipient). In this situation, the loser will have won 1 strand as deliverer (minimum 1 point) and 10 strands as recipient (minimum 20 points).  <u>60</u> points (accept 81 – 21)  <i>1 mark for appreciation that the winner's greatest possible score is 81 points OR a correct answer for the player who won 11 and lost 9: 95 – 18 = 77.</i>	<b>2</b>
2(b)	Brown will not play on Court 2. Lyne will not play on Court 3.  <u>Brown and Lyne</u>	<b>1</b>
2(c)	<u>Knuttall and Sharif</u>	<b>1</b>
2(d)	Brown scored 5 lenks (9 points each) and 2 grods (2 points each) as recipient and 2 torfs (3 points each) and 2 grods (1 point each) as deliverer.  This means that Knuttall won 3 strands as deliverer and 6 as recipient.  Knuttall scored 4 lenks (9 points each, or 36 points in total) and 1 grod (2 points) as recipient. So the 5-pointer must have been a torf (as recipient).  <i>1 mark for correct identification of at least three of the point scores (rows of the table) as lenks, torfs or grods.</i> <i>1 mark for correctly calculating the number of strands won by EITHER Brown as deliverer (4), OR Brown as recipient (7), OR Knuttall as deliverer (3), OR Knuttall as recipient (5 or 6). This may be implied by a supported statement that 9 strands involve Brown as deliverer OR 10 strands involve Knuttall as deliverer.</i> <i>1 mark for correct division of the strands into recipients and deliverers AND the conclusion that the 5-point score was a torf.</i>  <i>No marks for 'torf' without explanation.</i>	<b>3</b>
2(e)	<u>1 grod, 1 torf, 4 lenks</u> (2 lenks and a grod as recipient; 2 lenks and 1 torf as deliverer)  <i>Award 1 mark for each of the following:</i> <ul style="list-style-type: none"> <li>• 6 numbers that sum to 33 (using 1, 2, 3, 5 &amp; 9)</li> <li>• 999222 or 999321 or 995532 Identifying 9 + 9 + 5 + 5 + 3 + 2 as the solution</li> <li>• Converting their 6 numbers into grods, torfs and lenks (dependent on 1 mark already given)</li> </ul>	<b>4</b>
2(f)	<u>Serrano is second; Fiander is third</u>  <i>If 3 marks cannot be awarded, award 1 mark each for evidence of appreciation of the following (maximum 2):</i> <ul style="list-style-type: none"> <li>• <b>Only</b> Fiander and Serrano have 3 wins – stated or implied by a complete list</li> <li>• Fiander has 137 points</li> <li>• Serrano has 144 points</li> </ul>	<b>3</b>

Question	Answer	Marks
3(a)	Any three numbers, all between 12.5 and 50 that add up to not more than 100, with the largest less than the sum of the other two.	1
3(b)(i)	Assumption requires different numbers, so cannot all have exactly 12.5%, hence only <u>7</u> .	1
3(b)(ii)	<u>9</u>	1
3(c)(i)	10502 is more than 50% of votes cast ( $4273 + 53 + 5370 + 651 = 10347$ ), so failure must be because it <u>doesn't include a quarter (25%) of the electorate</u> .	1
3(c)(ii)	Electorate must be at least $10502 \times 4 + 1 = 42009$ , of whom 20849 voted. So at least <u>21160</u> did not.  <i>Award 1 mark if 42009 or 42008 or 21159 seen.</i>	2
3(c)(iii)	<u>42730 or fewer</u>  <i>Award 1 mark for sight of 42730 or 42371 or 34184 (derived from the new threshold).</i>	2
3(d)	David would have won on the first round by having $10524 > 42070/4$ (as well as more than 50% of the votes cast).  <i>Award 2 marks if a correct judgement and a precise comparison of votes is given. Award 1 mark if appropriate working is shown, but an incorrect judgement is given OR a correct judgement is given with a correct qualitative justification (e.g. 'David would have won because he had more than a quarter of the electorate's vote'). Award 0 marks for a judgement with no correct justification.</i>	2

Question	Answer	Marks
4(a)	$(200/40) \times 900 = \$4500$ [answer given]	1
4(b)	$200/30$ [1 mark] = $6\frac{2}{3}$ commissions  $6\frac{2}{3} \times 900 = \$6000$ earnings $6\frac{2}{3} \times 10 \times 10 = \$667$ admin costs [1 mark for method]  $6000 - 667 = \$5333$ profit (allow \$5333 – \$5334 inclusive)  SC: Award 1 mark for using 5 commissions per month, yielding $\$4500 - \$500 = \$4000$ .	3

Question	Answer	Marks
4(c)	<p>Working solo, the amount she can earn is <math>12 \times 4500 = \\$54\,000</math>.  Wages to assistant per year = <math>(6\frac{2}{3}) \times 10 \times 12 \times w</math>  Income per year: <math>(6\frac{2}{3}) \times 12 \times 900 = \\$72\,000</math>  <i>1 method mark for correct expression for the assistant's wages soi</i>  OR <i>the two comparable incomes</i></p> <p><math>72\,000 - 800w = \\$54\,000</math> [1 mark]  OR  Wages to assistant per month <math>66\frac{2}{3} \times w</math>  Income per month: <math>(6\frac{2}{3}) \times 900 = \\$6\,000</math>  <math>6\,000 - 66\frac{2}{3}w = \\$4\,500</math> [1 mark]  <math>w = \underline{\\$22.50}</math></p>	<b>3</b>
4(d)	<p>Claudiel and artisan both working <math>\frac{4}{5}</math> of 200 = 160 hours = <math>5\frac{1}{3}</math> commissions each. [1 mark]</p> <p><math>5\frac{1}{3} \times 2 \times 900 = \\$9\,600</math> earnings  <math>10\frac{2}{3} \times 10 \times 10 = \\$1\,067</math> assistant costs  <math>15 \times 200 = \\$3\,000</math> artisan costs  [1 mark for two of these soi]  <math>9\,600 - 4\,067 = \underline{\\$5\,533}</math> profit</p>	<b>3</b>
4(e)	<p><u>4</u></p> <p><i>2 marks with supporting working:</i>  4 artisans: 640 hours; <math>21\frac{1}{3}</math> commissions; 213 assistant hours</p> <p><i>1 mark for the number of commissions or the number of hours for any other number of artisans:</i>  2 artisans: 320 hours; <math>10\frac{2}{3}</math> commissions; 107 assistant hours  3 artisans: 480 hours; 16 commissions; 160 assistant hours  5 artisans: 800 hours; <math>26\frac{2}{3}</math> commissions; 267 assistant hours</p> <p><i>SC: Award 1 mark for working which shows Claudiel sculpting as well as the artisans:</i>  4 artisans: 680 hours; <math>22\frac{2}{3}</math> commissions; 227 assistant hours.</p>	<b>2</b>

Question	Answer	Marks
4(f)	<p>Maximum possible number of artisans = 5</p> <p><i>1 mark for any two of the following calculated; 2 marks for all four calculated, for whatever number of artisans they have considered.</i></p> <p><math>5 \times 160 \times 12</math> hours of work = 9600 hours = 320 jobs complete = \$288 000 income            Artisan wages = <math>(5 \times 200 \times 12) \times 15 = \\$180\,000</math>            Assistant time = 3200 hours = \$32 000 (requiring two since more than 200 hours needed per week)            Annual employee fee = <math>7 \times 1000 = \\$7000</math></p> <p>OR</p> <p><i>1 mark for any two of the following calculated; 2 marks for all four calculated, for whatever number of artisans they have considered.</i></p> <p><math>5 \times 160</math> hours of work = 800 hours = <math>26\frac{2}{3}</math> jobs complete = \$24 000 income            Artisan wages = <math>(5 \times 200) \times 15 = \\$15\,000</math>            Assistant time = <math>266\frac{2}{3}</math> hours = \$2667            Profit per month \$6333</p> <p>Total profit = <math>288\,000 - (180\,000 + 32\,000 + 7000) = \underline{\\$69\,000}</math></p>	<b>3</b>