
THINKING SKILLS

9694/31

Paper 3 Problem Analysis and Solution

May/June 2017

MARK SCHEME

Maximum Mark: 50

Published

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This document consists of **7** printed pages.

| Question | Answer | Marks |
|----------|--|----------|
| 1(a) | <p><u>1 round and 5 squares; 5 rounds and 2 squares</u></p> <p><i>Award 1 mark for each one of these. If no reference to the shapes, award 1 mark for complete correct numerical working ($1 \cdot 6 + 5 \cdot 8$) and ($5 \cdot 6 + 2 \cdot 8$).</i></p> | 2 |
| 1(b) | <p>The best he can do is <u>4 rounds and 3 squares</u>, which provides 48 seats at a cost of \$380.</p> <p><i>Award 1 mark for either of the other two, more expensive, combinations which provide at least 46 seats, with a correct cost: 4 rounds and 4 squares = \$440 OR 3 rounds and 4 squares = \$390</i></p> | 2 |
| 1(c) | <p>Reducing the total number of people to 44 would enable him to use 2 rounds and 4 squares at a cost of <u>\$340</u>.</p> | 1 |
| 1(d) | <p>For 46 people, the cheapest way is to pay for the drinks at the whole room rate but the decorations per person, giving a total of $130 + 46 \cdot 1 = \\$176$. For 44 people, the cheapest way is to pay for both items per table, giving a total of $6 \cdot 20 + 6 \cdot 7 = \\162. So the difference is <u>\$14</u>.</p> <p><i>Award 1 mark for at least two of the bracketed values: ($1 \cdot 130$) + ($46 \cdot 1$) = 176 ($6 \cdot 20$) + ($6 \cdot 7$) = 162 Alternative construal: ($1 \cdot 130$) – ($6 \cdot 20$) = 10; ($46 \cdot 1$) – ($6 \cdot 7$) = 4</i></p> <p><i>Award 2 marks for three of the bracketed values appropriately combined, including one pair in which different rates are used.</i></p> | 3 |
| 1(e) | <p>The cheapest method overall for 46 people is at the whole room rate: $130 + 50 = \\$180$ The cheapest method overall for 44 people is per table: $120 + 42 = \\$162$. So the difference is <u>\$18</u>.</p> <p><i>If \$18 not seen, award 1 mark for \$180</i></p> | 2 |

| Question | Answer | Marks | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|--|--|----------------------------------|----------------------------------|----------|----------|---|---|------------------------------|----------------------|---------------------|---|---|--|--|--|---|---|---|----------------|----------------|---|---|--|---------------|----------------|---|---|------------------------------------|----------------------------------|----------------------------------|---|
| 2(a) | \$ <u>60</u> if three \$60 books are bought. | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(b) | Voucher L applied to \$33, \$40, \$50 = \$ <u>33</u> discount <i>1 mark for (S: \$160 total; 20% discount = \$)32</i> | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(c)(i) | <p><i>1 mark for vouchers correctly applied to any collection of Brodie's books. 1 mark for vouchers correctly applied in the other order.</i></p> <p><i>If vouchers and prices do not lead to a change of price after the order of discounts is altered, then no marks should be awarded.</i></p> <p><i>Allow prices instead of discounts (given in square brackets in the table) SC1: if prices used are not from Brodie's list of five, award 1 mark for correct selection and application of discounts (in both orders).</i></p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Voucher 1</th> <th>Voucher 2</th> <th>Price</th> <th>1 then 2</th> <th>2 then 1</th> </tr> </thead> <tbody> <tr> <td>S</td> <td>A</td> <td>20 + 33 [50 < price ≤ 55]</td> <td>[\$38.16] \$14.84</td> <td>[\$47.70] \$5.30</td> </tr> <tr> <td>S</td> <td>L</td> <td>3+ books price > 50 more expensive < 50 not possible with Brodie's books</td> <td></td> <td></td> </tr> <tr> <td>S</td> <td>E</td> <td>Any books with price > 50 e.g. 40 + 50</td> <td>[\$52] \$38</td> <td>[\$56] \$34</td> </tr> <tr> <td>A</td> <td>E</td> <td>Any books incl. one > 30 e.g. 17 + 33</td> <td>[\$45] \$5</td> <td>[\$27] \$23</td> </tr> <tr> <td>L</td> <td>E</td> <td>17 + 20 + 33 OR 33 + 40 + 50</td> <td>[\$33] \$37 OR [\$70] \$53</td> <td>[\$37] \$33 OR [\$73] \$50</td> </tr> </tbody> </table> | Voucher 1 | Voucher 2 | Price | 1 then 2 | 2 then 1 | S | A | 20 + 33 [50 < price ≤ 55] | [\$38.16] \$14.84 | [\$47.70] \$5.30 | S | L | 3+ books price > 50 more expensive < 50 not possible with Brodie's books | | | S | E | Any books with price > 50 e.g. 40 + 50 | [\$52] \$38 | [\$56] \$34 | A | E | Any books incl. one > 30 e.g. 17 + 33 | [\$45] \$5 | [\$27] \$23 | L | E | 17 + 20 + 33 OR 33 + 40 + 50 | [\$33] \$37 OR [\$70] \$53 | [\$37] \$33 OR [\$73] \$50 | 2 |
| Voucher 1 | Voucher 2 | Price | 1 then 2 | 2 then 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S | A | 20 + 33 [50 < price ≤ 55] | [\$38.16] \$14.84 | [\$47.70] \$5.30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| L | E | 17 + 20 + 33 OR 33 + 40 + 50 | [\$33] \$37 OR [\$70] \$53 | [\$37] \$33 OR [\$73] \$50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(c)(ii) | <p><u>A & L</u> is the only pair.</p> <p><i>No mark if any other pairs included.</i></p> | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Question | Answer | Marks |
|----------|--|----------|
| 2(d) | <p>If \$50, \$40 and \$33 are bought first \$123: cheapest book free = \$90 20% off = \$72 10% off = \$64.80 \$20 off = \$44.80 remaining books = \$37 TOTAL = \$81.80 (discount of \$78.20)</p> <p><i>Award 4 marks for a correct solution (division of books, and order of application) yielding a total of \$81.80 or discount of \$78.20.</i></p> <p>If all bought together \$160: cheapest book free = \$143 (can be applied later) 20% off = \$114.40 10% off = \$102.96 \$20 off = \$82.96 TOTAL = \$82.96 (discount of \$77.04)</p> <p><i>Award 3 marks for correct application of 4 vouchers if all bought together (total of \$82.96 or discount of \$77.04).</i> <i>Award 2 marks for a clear and correct application of 4 vouchers to the 5 books, with S & A not after E (allow one processing error).</i> <i>Award 1 mark for a clear and correct application of 4 vouchers to the 5 books in any order (allow one processing error).</i></p> <p><i>SC3: \$81.80 without any clear direction as to how the vouchers are applied.</i> <i>SC2: \$82.96 without any clear direction as to how the vouchers are applied.</i></p> <p><i>If no total prices or discounts calculated: award 1 mark for clear order of application of all vouchers that avoids putting E before A and/or S and avoids applying L to fewer than 3 books.</i></p> | 4 |

| Question | Answer | Marks |
|----------|---|-------|
| 3(a)(i) | <u>6</u> | 1 |
| 3(a)(ii) | $15 + (10 \cdot 5) + 15 = \underline{80}$ cm 1 mark for 65 cm (forgets piece at end) OR 1 mark for FT from (a)(i) | 2 |
| 3(b) | <u>124</u> Award 1 mark for 123 or 125 OR Award 1 mark for an algebraic representation: $0.4x + 0.25$ or $40x + 25$ | 2 |
| 3(c) | <u>8</u> flags | 1 |
| 3(d) | Any design that has 5 stripes, with ratio of lengths of blue: white as 2 : 1 and a total length of 30 cm For example: Lengths 5, 5, 10, 5, 5  If 2 marks not awarded, award 1 mark for evidence that the blue and white stripes have lengths in the ratio 2 : 1 OR for a correct design shown on lined paper but with no lengths indicated OR a flag with 5 labelled lengths, with 3 blue and 2 white stripes of total length 15 cm each (misreading 'equal numbers of (his and) Andy's flags') | 2 |
| 3(e) | <u>With two joins, cheaper by \$2.50</u> No joins: 185 cm needed, 4 flags Cost = $1.85 \cdot \$10 + \$2 \cdot 4 = \$26.50$ Two joins: 80 cm white (+ 60 cm blue) needed, so 140 cm Cost = $1.4 \cdot \$10 + 4 \cdot 2 \cdot \$1.25 = \$24.00$ If 3 marks cannot be awarded Award 1 mark for \$26.50 oe Award 1 mark for \$24.00 oe Award 0 marks for \$2.50 on its own | 3 |

| Question | Answer | Marks |
|----------|--|-------|
| 3(f) | <p><u>83 flags</u> (with supporting working)</p> <p>If the maximum number of flags are made without any joins, then $\\$((40n + 25)/10 + n \cdot 2) = \\$(6n + 2.5) = 500$, giving $n = 82.92$. This enables 82 flags to be made, but the initial white section of the roll has not been used; with 1 join a further flag can be stitched ($\\$494.50 + \\2).</p> <p><i>If 4 marks cannot be awarded:</i></p> <p style="padding-left: 40px;"><i>award 3 marks for 82.92 (seen), or 82 flags with supporting working</i> <i>award 2 marks for 82 or 83 flags (without clear working)</i> <i>award 1 mark for 80 or 81 flags (with some demonstration that these are possible)</i></p> <p><i>If no marks earned, then award 1 mark for either expression:</i> n flags: with joins, cost = $\\$10(0.4n - 2) + 2n \cdot 1.25 = \\$(6.5n - 2)$ with no joins, cost = $\\$10(0.4n + 2.5) + 2n = \\$(6n + 2.5)$</p> | 4 |

| Question | Answer | Marks |
|----------|---|-------|
| 4(a) | <p><u>249</u> (points) ($1^2 + 7^2 + 6^2 + 2^2$ and $7^2 + 6^2 + 7^2 + 5^2$)</p> <p><i>If 3 marks cannot be awarded, award 1 mark for each of the following:</i></p> <p style="padding-left: 40px;">Identification of all three lines (and no others) that add up to square number totals: (4,6,3,3) (1,7,6,2) and (7,6,7,5). Correct calculation of the value of at least one of the three lines: 70, 90 and 159 points respectively.</p> | 3 |
| 4(b) | <p><u>2 and 4 with justification</u></p> <p><i>Award 1 mark the correct pair chosen</i></p> <p><i>Award 1 mark each for recognition of the following:</i></p> <p style="padding-left: 40px;">0 would have allowed him to make a Square Deal. 7 would have produced a column value of 90 points (or “greater than 84”)</p> | 3 |
| 4(c)(i) | <p><u>352</u> ($8^2 + 8^2 + 7^2 + 2^2$ and $8^2 + 7^2 + 7^2 + 3^2$)</p> <p><i>Award 2 marks for an answer of 340 or more.</i> <i>(340 fails to appreciate that one of the 8s can be used in a row and a column, and is made up of $8^2 + 8^2 + 7^2 + 2^2$ and $7^2 + 7^2 + 6^2 + 5^2$.)</i></p> <p><i>Award 1 mark for sight of 181 or identification of (8,8,7,2) as the best possible line</i> <i>OR</i> <i>for a row and a column that each add up to 25.</i></p> | 3 |

| Question | Answer | Marks |
|----------|--|----------|
| 4(c)(ii) | <p><i>Award 1 mark for any complete grid that does not contain any numbers that would not be allowed (e.g. three 0s, four 1s, one or more 9s etc.).</i></p> <p><i>Award 1 mark for any grid (even if incomplete) that would produce 352 or the candidate's answer to (c)(i) – provided it is more than 158.</i></p> | 2 |
| 4(d) | <p>1 placed in third row of Russell's grid and 5 placed in bottom row of Gordon's grid + explanation</p> <p><i>Award 1 mark for stating (or indicating clearly in some other way) that the 1 should be placed in the third row down (or other suitable description) of Russell's grid and the 5 should be placed in the bottom row of Gordon's grid.</i></p> <p><i>Award 1 mark each (up to a maximum of 3) for any of the following observations:</i></p> <p style="padding-left: 40px;">The four tiles left in the bag are 3, 4, 4 and 6. OR There is still a 3 in the bag, but no 2 or 8. (So) placing 5 in Gordon's bottom row guarantees that his score for the round will be 0. 1 on Russell's grid (in third row/second column) guarantees a score for the round ($0^2 + 6^2 + 1^2 + 2^2 = 41$). Unless Gordon takes the 3 from the bag, he will have to place a number in Russell's last square (4 or 6) that will create a row that scores points ($8^2 + 6^2 + 7^2 + 4^2 = 165$) OR a column that is better than the one already in place ($5^2 + 6^2 + 1^2 + 4^2 = 78$).</p> <p><i>SC1: if no other marks can be awarded, award 1 mark for stating that tile 1 should be placed in the third row of Russell's grid, AND tile 5 can go in either of Gordon's empty spaces.</i></p> | 4 |