Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

THINKING SKILLS **9694/33**

Paper 3 Problem Analysis and Solution **May/June 2017**

MARK SCHEME

Maximum Mark: 50

Published

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Question	Answer	Marks
1(a)	With (8; 7, 0, 0, 0) we would need (3; 3, 0, 0, 0) staff and could accommodate 15 children. *Award 1 mark for 14.*	**2**
1(b)	With numbers of children in each room as (10; 4, 4, 0, 0) we would need (4; 2, 2, 0, 0) adults, or 8 adults altogether. Other possibilities would be (8; 4, 6, 0, 0) and (3; 2, 3, 0, 0). (Seven adults can supervise a maximum of 17.) *1 mark for any arrangement requiring 9 (e.g., (10; 7, 1, 0, 0)).*	**2**
1(c)	The smallest number of adults is 10 (e.g., (9; 7, 7, 0, 0)). (Nine adults can supervise a maximum of 22.)	**1**
1(d)	**Option 1** [capacity (17; 7, 7, 7)] (16; 7, 0, 0) needs 5 + 3 = 8 adults **Option 2** [capacity (14; 10; 7, 7)] (14; 9; 0, 0) needs 5 + 4 = 9 adults (13; 10; 0, 0) needs 5 + 4 = 9 adults (12; 8; 3, 0) needs 4 + 3 + 2 = 9 adults (12; 7; 4, 0) needs 4 + 3 + 2 = 9 adults (11; 8; 4, 0) needs 4 + 3 + 2 = 9 adults (8; 8; 7, 0) needs 3 + 3 + 3 = 9 adults **Option 3** [capacity (21; 10; 7)] (20; 3; 0) needs 6 + 2 = 8 adults (19; 4; 0) needs 6 + 2 = 8 adults (16; 7; 0) needs 5 + 3 = 8 adults *1 mark each for any correct arrangement for each of the three options.* *SC2: 8, 9, 8* *SC1: one off from 8, 9, 8*	**3**
1(e)	As soon as 24 children attend, option 3 becomes the best, allowing just 8 adults to supervise all 24 children in the arrangement (20; 4; 0), whilst the other two options would require 9. *2 marks for clear explanation that option 1 and 2 are 'sometimes worse' or example where option 3 is better for some number between 23 and 38* *OR* *consideration of general principle that larger rooms are more efficient* *OR* *consideration of maximum case (38 children) with comparison of at least two options* *1 mark for single arithmetic error or FT from their 1(d).*	**2**

Question	Answer	Marks
2(a)	99 people owning \$1 each = \$99: 1000 – 99 = \$<u>901</u>	**1**
2(b)(i)	\$<u>5</u> (since the remaining 9 must all own at least \$5, and 10 · \$5 = \$50)	**1**
2(b)(ii)	This would entail the other, wealthier 90 people all owning at least \$50 *[1 mark]*, which would make a total in the community in excess of \$1000 *[1 mark]*.	**2**
2(b)(iii)	\$50 for each of the other 9 deciles: \$450 in total So the top 10% could own at most 1000 – 450 = \$<u>550</u>	**1**
2(c)	\$400 to be split over 9 deciles. If all equal, 400/9 = \$44.4 per decile. However, integer units mean that there would have to be at least one \$5 or more, meaning the second decile would have a minimum of 5 · 10 = \$50. So the most possible, under the student's model, for the bottom decile is \$<u>40</u> (or <u>4%</u>). *3 marks for \$40 (or 4% or \$4 each) with justification.* *2 marks for \$44 (or 4.4%) or \$40 without working.* *1 mark for \$44.4… (or 4.44%) seen.*	**3**
2(d)	<u>5 with justification</u> With the population split 10% : 80% : 10%, wealth distributed 55 : 40 : 5 represents the maximum, where the middle 80% have the same wealth as the bottom 10% (40/8 = 5). Algebraically, if the middle 80% are minimised, $x + 8x + (x + 50) = 100$. A value of B of 6 entails 56 : 38 : 6, where 38/8 < 6 (or 46 : 48 : 6, where inequality measure is less than 50). *2 marks for 5 with a justification.* *1 mark for 5 unjustified or for any value of B with implications for the middle 80% explained.*	**2**

Question	Answer	Marks
3(a)	3 minutes for each of the boxes, plus a total of 28 minutes for the 56 chocolates. 34 minutes in total. *Allow 15 minutes and 19 minutes both given (the times for each box).* *1 mark for either 28 minutes for the 56 chocolates or the total time for either box calculated (15 or 19 minutes).*	**2**
3(b)	The total is $4 \cdot 48 + 18 = 210$ chocolates. The largest boxes (48 chocolates) take 27 minutes to pack. *[1 mark]* There are two hours available, so 4 boxes can be packed, (with an extra 12 minutes left). *[1 mark]* *Award 1 mark for an attempt to find a set of at most 5 boxes that can be packed in the 2 hours available.* *SC1: 234 chocolates in one box.*	**3**
3(c)	To reach the correct proportions requires packing 10 additional medium boxes and 4 additional large boxes, (which will take a total of 120 minutes). *[1 mark]* Packing 1 small, 2 medium and 1 large box will take a total of 30 = (4 +8 + 8 + 10) minutes. *[1 mark]* There will be enough time to pack 12 additional sets of 1 small, 2 medium and 1 large, so in total Richard should pack 12 small, 34 medium and 16 large boxes. *[1 mark]*	**3**
3(d)	84 boxes The assistant is considerably slower packing small and large boxes compared to Richard, but only slightly slower packing medium boxes, so the assistant should be assigned to pack medium boxes. (In 3 hours, 20 boxes can be packed.) *[1 mark]* It will take Richard 140 minutes to pack 10 boxes each of small and large, leaving 340 minutes more packing time. *[1 mark]* In 340 minutes, 11 sets in the ratio 1 : 2 : 1 can be packed, so in total $20 + 20 + 11 \cdot 4 = 84$ boxes. *[1 mark]* *SC1: Has both pack in the ratio 1 : 2 : 1, obtains total of 80 boxes.* *OR* *SC1: Assistant only takes 40 minutes, so can only complete 4 sets/16 boxes.*	**3**

Question	Answer	Marks
3(e)	With Richard working on his own the number of boxes in stock has reduced by 11 small, 18 medium and 10 large boxes over the week. *[1 mark]* It would be most efficient for Richard to package the small and large boxes and the assistant to package the medium boxes, plus some of the medium boxes that Richard had been packaging. Richard needs 11 · 4 + 10 · 10 = 144 minutes to package the additional small and large boxes. *[1 mark]* This means that Richard will be able to package 144 ÷ 8 = 18 fewer medium boxes, which will need to be packaged by the assistant (in addition to the 18 other medium boxes that are required). *[1 mark]* OR (SC1) If assistant only for 11S 18M 10L, 77 + 162 + 150 = 389 minutes, (rounding up to 7 hours). A total of 36 medium boxes will require 36 · 9 = 324 minutes, so the assistant should be employed for 6 hours each week since it must be a whole number of hours. *[1 mark for rounding up their answer]*	**4**

Question	Answer	Marks
4(a)	2820 (47 · 60) *If 2 marks cannot be awarded, award 1 mark for any of:* *recognition that there are 47 runs per day (every 10 minutes from 10:25 to 18:05)* *correct calculation of an incorrect number of runs · 60* *2760*	**2**
4(b)	3000 (15 · 200) *If 2 marks cannot be awarded, award 1 mark for either of the following:* *recognition that there are 15 runs per day of each of the Swashbuckler Rides for which Black Spot tokens are offered for sale (every 30 minutes from 10:45 to 17:45)* *recognition that for any specific time there are 200 Black Spot tokens offered for sale (half of the total number of seats on the Swashbuckler Rides)*	**2**
4(c)	$585 (3 · $75 + 12 · $30) *For 2 marks to be awarded, there must be evidence of comparison with (2 · $120 + 11 · $30 + 1 · $25 =) $595.* *If 2 marks cannot be awarded, award 1 mark for sight of $585 or $595 or $600.* *($600 is 1 · $120 + 2 · $75 +11 · $30.)*	**2**

Question	Answer	Marks
4(d)	286 72 people from the queue rode at 11:05, 11:25 and 11:35, 36 rode at 11:15 and 34 + Will and Elizabeth rode at 11:45. *If 2 marks cannot be awarded, award 1 mark for one of the following answers:* *288 (which includes Will and Elizabeth)* *322 (which takes account of the Black Spot tokens on one of the runs but not the other)* *358 (which fails to take account of any Black Spot tokens)* *178 (which allows Black Spot tokens for all runs)*	**2**
4(e)	$116 They "spent" a total of 200 doubloons altogether: Broadside 12 doubloons the other Swashbuckler Rides 100 doubloons the other rides, including three of them twice 88 doubloons They bought 200 – (2 · 30) = 140 doubloons at Blackbeard's Booth at a cost of 2 · $40 + 2 · $18 = $116. *1 mark for evidence of appreciation that they "spent" 200 doubloons altogether OR needed 140 more.*	**2**
4(f)	*Award marks as follows:* Evidence of ruling out 15:15 and 15:45 (because of the Treasure Hunt). This may be implied by a set of five timings that do not include 15:15 or 15:45. *[1 mark]* Mutiny at 13:15 *[1 mark]* Evidence of appreciation that they must watch the 14:15 show (because of Mutiny at 13:15, the Treasure Hunt and Plunder at 17:15). This may be implied by a set of five timings that do not include 14:15 or 14:45. *[1 mark]* Broadside at 16:15 *[1 mark]* Scuppered at 13:45, Keelhaul at 17:45 **and** Avast at 16:45 *[1 mark]* *If no more than 1 mark can be awarded as detailed above:* *award 2 marks in total for any five timings for which sufficient tokens are available which do not include 15:15 or 15:45 (when the Treasure Hunt is on), otherwise award 1 mark in total for **any** five distinct timings for which sufficient tokens are available.*	**5**