Cambridge Assessment International Education

Cambridge International AS & A Level

THINKING SKILLS **9694/32**

Paper 3 Problem Analysis and Solution **May/June 2023**

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 May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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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.

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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
Highlight	Use anywhere it is helpful to clarify the marking

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

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Question	Answer	Marks
1(a)	160 – (5 × 14) = 90 cm for 6 black stripes so each black stripe is 15 cm **AG**	**1**
1(b)	For each narrow stripe, 40 cm of wool is needed, so for 5 rainbow stripes 200 cm (= 2 m) is needed *OR* for 24 rainbow stripes 960 cm is needed *1 mark for either* For 24 scarves with 5 stripes on each, 48 m of wool is needed, so 3 balls **[1]** *Condone 2.4*	**2**
1(c)(i)	8 balls of wool = 8 × 20 = 160 m Number of scarves = 160/2 = 80 **AG**	**1**
1(c)(ii)	There are 6 black stripes each 15 cm long, so 90 cm in total Length of black wool required = 45 × 0.4 = 18 m per scarf **[1]** 80 scarves requires 80 × 18/20 = 72 balls, so 75 balls is sufficient *OR* (75 × 20) / 18 = 83.33 scarves, so Yes **[1]**	**2**
1(d)	Cost of 75 black = 18 × \$20 + 3 × \$6 = \$378 Cost of 8 balls of each colour = 2 × \$20 × 7 = \$280 *1 mark for either* Total cost = \$378 + \$280 = \$658 **[1]** Cost per scarf = \$658/80 **[1]** = \$8.225 So price of scarves = \$9 **[1]**	**4**

Question	Answer	Marks
2(a)	Price per 10 g is \$0.70. **[1]** Total weight is 482 + 507 + 442 = 1431 g \$1.00 + 14 × \$0.70 = \$10.80 **[1] AG**	**2**
2(b)	Prices for bags would be: Red: \$1.00 + 4 × \$0.30 = \$2.20 Yellow: \$1.00 + 5 × \$0.50 = \$3.50 Green: \$1.00 + 4 × \$0.70 = \$3.80 *1 mark for any one calculated correctly* Total cost is \$2.20 + \$3.50 + \$3.80 = \$9.50 *SC 1 mark for answer \$6.50*	**2**
2(c)	The cheapest with 2 bags is: R+Y: 989 g, so \$1.00 + 9 × \$0.50 = \$5.50 Total cost \$3.80 + \$5.50 = \$9.30 With 3 bags: Add between 8 g and 57 g (inclusive) of yellow to the green bag reduces cost of yellow bag by \$0.50 without increasing price of green bag Cheapest possible = \$9.00 *1 mark for correct calculation for any 2-bag case* *OR 2 marks for identifying \$9.30 as cheapest with 2 bags*	**3**
2(d)(i)	2 bags should be used, leaving \$12.00 to spend on the sweets. The amount paid for the bag containing purple sweets will be at least twice the amount paid for the bag containing only yellow sweets, so \$4.00 will be paid for yellow sweets and \$8.00 for purple sweets. **[1]** The maximum weight possible is 899 g for each colour. 1798 g	**2**
2(d)(ii)	The amount paid for the bag containing purple sweets will be at least four times the amount paid for the bag containing only yellow sweets. \$2.40 and \$9.60 is not possible, so values would be \$2.00 and \$10.00. **[1] soi** Weight in \$2.00 bag would be up to 499 g Weight in \$10.00 bag would be up to 1099 g Total weight would be 1598 g **[1]**, but must be a multiple of 3 g, so 1596 g (one bag containing 499 g of yellow and one bag containing 33 g of yellow and 1064 g of purple) *SC 1 mark for 1497 g (Maximum if only one colour in each bag)*	**3**
2(e)	Every complete 100 g will now cost \$0.15 more. **[1]** This will exceed \$1.00 once 700 g has been bought.	**2**
2(f)	\$1.21	**1**

Question	Answer	Marks
3(a)	$1 \rightarrow 11$ and $1 \rightarrow 7$	**1**
3(b)	$1 \rightarrow 3 \rightarrow 9$ $3 \rightarrow 1 \rightarrow 9$ $1 \rightarrow 10 \rightarrow 5$ $10 \rightarrow 1 \rightarrow 5$ *1 mark for any one of the above* $* \rightarrow 1 \rightarrow 11$: where * could be any of the 10 other numbers $* \rightarrow 1 \rightarrow 7$: where * could be any of the 10 other numbers *1 mark for any one of the above* *1 mark for final answer 24 or complete list with no additions*	**3**
3(c)	For example, $5 \rightarrow 10 \rightarrow 2 \rightarrow 6 \rightarrow 3 \rightarrow 12 \rightarrow 4 \rightarrow 8 \rightarrow 1 \rightarrow 11$ *2 marks for a valid string of exactly ten numbers* *1 mark for a valid string or substring of eight or nine numbers* *OR* *1 mark for a string of ten numbers which could continue*	**2**
3(d)(i)	Both 7 and 11 may only be linked to 1, (so one of them or all the other numbers must be left out).	**1**
3(d)(ii)	*Any of:* $5 \rightarrow 1 \rightarrow 3 \rightarrow 6 \rightarrow 2 \rightarrow 4$ $4 \rightarrow 2 \rightarrow 6 \rightarrow 3 \rightarrow 1 \rightarrow 5$ $5 \rightarrow 1 \rightarrow 4 \rightarrow 2 \rightarrow 6 \rightarrow 3$ $3 \rightarrow 6 \rightarrow 2 \rightarrow 4 \rightarrow 1 \rightarrow 5$	**1**
3(e)	For example, $18 \rightarrow 6 \rightarrow 2 \rightarrow 8 \rightarrow 16 \rightarrow 4 \rightarrow 12$ leaves 11, 13, 17 and 19, which must be taken alternately with Jenny taking the last one. *1 mark for a correct string of four, five or seven numbers* *1 mark for a clear description of how the game progresses to her inevitable victory*	**2**

Question	Answer	Marks
4(a)	$25 - 2 \times 2.5 = 20$, so 20/2 = 10 gaps, so number of trees = 11 **AG**	**1**
4(b)	121 pine trees: cost = \$1800 + 4 × \$95 + \$20 = \$2200 **[1]** Number of beech = $4 \times 25 \times 2 = 200$ **[1]** cost \$1400 Total cost = \$2200 + \$1400 = <u>\$3600</u>	**3**
4(c)(i)	40 – 5 = 35, so 18 trees; 35 – 5 = 30, so 16 trees, total number of pine trees = $18 \times 16 = 288$ **[1]** Cost of pine trees = 2 × \$1800 + 3 × \$460 + 2 × \$95 + 3 × \$20 = \$5230 *OR* cost of beech trees = 3 × \$700 = \$2100 *1 mark for either* Total cost = \$5230 + \$2100 = <u>\$7330</u>	**3**
4(c)(ii)	Cost of beech trees is unchanged. Number of pine trees = 121 + 288 = 409, cost = \$7375 **[1]** Saving = \$2200 + \$5230 – \$7375 = <u>\$55</u>	**2**
4(d)	$5000 = 2 \times 1800 + 3 \times 460 + 20$ so number of trees = 200 + 75 + 1 = 276 **[1]** Wilfred will have up to 92 trees; the most he can plant is <u>90</u> (9×10) *Condone 81 (Thinks 'same in each row' means 'must be square')*	**2**
4(e)	Common boundary of 25 m: so 100 fewer beech trees needed. **[1]** Saving on beech trees = \$700 Condone \$400 for 50 fewer. Number of pine trees per row along the 65 m is 31 instead of (11 + 18 =) 29, so 2 extra for each of 11 rows, so 22 **[1]** So number of pine trees required is 409 + 22 = 431 Extra cost = \$7775- \$7375 = \$400 **[1]** Saving is \$700 – \$400 = <u>\$300</u> *Alternative:* Beech perimeter price **[1]** Pine area price **[1]** (both **ft**) Total **[1]** Difference **[1]** (**ft** if saving)	**4**