



MARKSCHEME

May 2013

MATHEMATICAL STUDIES

Standard Level

Paper 2

22 pages

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**Paper 2 Markscheme
Instructions to Examiners**

Notes: If in doubt about these instructions or any other marking issues, contact your team leader for clarification.

1 Abbreviations

M Marks awarded for **Method**

A Marks awarded for an **Answer** or for **Accuracy**

R Marks awarded for clear **Reasoning**

G Marks awarded for correct solutions obtained from a **Graphic Display Calculator**, when no working shown.

AG **Answer Given** in the question and consequently, marks not awarded.

ft Marks that can be awarded as **follow through** from previous results in the question.

2 Method of Marking

- (a) All marking must be done in scoris using the mathematical studies annotations and in accordance with the current document for guidance in e-marking Mathematical Studies SL. It is essential that you read this document before you start marking.
- (b) If a question part is completely correct use the number tick annotations to award full marks. If a part is completely wrong use the **A0** annotation, otherwise full annotations must be shown.
- (c) Working crossed out by the candidate should not be awarded any marks.
- (d) Where candidates have written two solutions to a question, only the first solution should be marked.
- (e) If correct working results in a correct answer but then further working is developed, full marks may **not** always be awarded. Full marks **will** be awarded if the candidate shows correct working leading to the correct answer. See also section 4(c).

Example: Calculate the gradient of the line passing through the points (5, 3) and (0, 9).

Markscheme	Candidates' Scripts	Marking
$\frac{9-3}{0-5} \quad (M1)$ <p><i>Award (M1) for correct substitution in gradient formula</i></p> $= -\frac{6}{5} \quad (A1)$	<p>(i) $\frac{9-3}{0-5} = -\frac{6}{5}$</p> <p>Gradient is $= -\frac{6}{5}$</p> <p style="text-align: right;"><i>(There is clear understanding of the gradient.)</i></p> $y = -\frac{6}{5}x + 9$	<p style="text-align: right;">(M1)</p> <p style="text-align: right;">(A1)</p>
	<p>(ii) $\frac{9-3}{0-5} = -\frac{6}{5}$</p> $y = -\frac{6}{5}x + 9$ <p style="text-align: right;"><i>(There is confusion about what is required.)</i></p>	<p style="text-align: right;">(M1)</p> <p style="text-align: right;">(A0)</p>

3 Follow-through (ft) Marks

Errors made at any step of a solution affect all working that follows. To limit the severity of the penalty, **follow through (ft)** marks can be awarded. Mark schemes will indicate where it is appropriate to apply follow through in a question with **'(ft)'**.

- (a) Follow through applies only from one part of a question to a subsequent part of the question. Follow through does not apply within the same part.
- (b) If an answer resulting from follow through is extremely unrealistic (*e.g.* negative distances or incorrect by large order of magnitude) then the final **A** mark should not be awarded.
- (c) If a question is transformed by an error into a **different, much simpler question** then follow through may not apply.
- (d) To award follow through marks for a question part, **there must be working present for that part**. An isolated follow through answer, without working is regarded as incorrect and receives no marks **even if it is approximately correct**.
- (e) The exception to the above would be in a question which is testing the candidate's use of the GDC, where working will not be expected. **The markscheme will clearly indicate where this applies**.
- (f) Inadvertent use of radians will be penalised the first time it occurs. The markscheme will give clear instructions to ensure that only one mark per paper can be lost for the use of radians.

Example: Finding angles and lengths using trigonometry

Markscheme	Candidates' Scripts	Marking
<p>(a) $\frac{\sin A}{3} = \frac{\sin 30}{4}$ (MI)(AI)</p> <p><i>Award (MI) for substitution in sine rule formula, (AI) for correct substitutions.</i></p> <p>$A = 22.0^\circ$ (22.0243...) (AI)(G2)</p>	<p>(a) $\frac{\sin A}{4} = \frac{\sin 30}{3}$</p> <p>$A = 41.8^\circ$</p> <p><i>(Note: the 2nd (AI) here was not marked (ft) and cannot be awarded because there was an earlier error in the same question part.)</i></p>	<p>(MI)(A0)</p> <p><i>(use of sine rule but with wrong values)</i></p> <p>(A0)</p>
<p>(b) $x = 7 \tan (22.0243\dots)$ (MI)</p> <p>$= 2.83$ (2.83163...) (AI)(ft)</p>	<p>(b) case (i) $x = 7 \tan 41.8^\circ$</p> <p>$= 6.26$</p> <p>but case (ii) 6.26</p>	<p>(MI)</p> <p>(AI)(ft)</p> <p>(G0)</p> <p><i>since no working shown</i></p>

4 Using the Markscheme

- (a) **A** marks are **dependent** on the preceding **M** mark being awarded, it is **not** possible to award **(M0)(A1)**. Once an **(M0)** has been awarded, all subsequent **A** marks are lost in that part of the question, even if calculations are performed correctly, until the next **M** mark.
The only exception to this will be for an answer where the accuracy is specified in the question – see section 5.
- (b) **A** marks are **dependent** on the **R** mark being awarded, it is **not** possible to award **(A1)(R0)**. Hence the **(A1)** cannot be awarded for an answer which is correct when no reason or the wrong reason is given.
- (c) In paper 2 candidates are expected to demonstrate their ability to communicate mathematics using appropriate working. Answers which are correct but not supported by adequate working will **not always receive full marks**, these unsupported answers are designated **G** in the mark scheme as an alternative to the full marks. Example **(M1)(A1)(A1)(G2)**.

Example: Using trigonometry to calculate an angle in a triangle.

Markscheme	Candidates' Scripts	Marking
<p>(a) $\frac{\sin A}{3} = \frac{\sin 30}{4}$ (M1)(A1) Award (M1) for substitution in sine rule formula, (A1) for correct substitutions. $A = 22.0^\circ$ (22.0243...) (A1)(G2)</p>	<p>(i) $\frac{\sin A}{3} = \frac{\sin 30}{4}$ $A = 22.0^\circ$</p> <p>(ii) $A = 22.0^\circ$ Note: G marks are used only if no working has been shown and the answer is correct.</p>	<p>(M1)(A1) (A1) (G2)</p>

- (d) **Alternative methods** may not always be included. Thus, if an answer is wrong then the working must be carefully analysed in order that marks are awarded for a different method consistent with the markscheme.
Where alternative methods for complete questions are included in the markscheme, they are indicated by '**OR**' etc.
- (e) Unless the question specifies otherwise, accept **equivalent forms**. For example: $\frac{\sin \theta}{\cos \theta}$ for $\tan \theta$.
On the markscheme, these equivalent numerical or algebraic forms will sometimes be written in brackets after the required answer.
Where numerical answers are required as the final answer to a part of a question in the markscheme, the scheme will show, in order:
the 3 significant figure answer worked through from full calculator display;
the exact value (for example $\sqrt{3}$ if applicable);
the full calculator display in the form 2.83163... as in the example above.
Where answers are given to 3 significant figures and are then used in subsequent parts of the question leading to a **different** 3 significant figure answer, these solutions will also be given.

- (f) As this is an international examination, all valid **alternative forms of notation** should be accepted. Some examples of these are:

Decimal points: 1.7; 1'7; 1·7; 1,7 .

Different descriptions of an interval: $3 < x < 5$; $(3, 5)$; $] 3, 5 [$.

Different forms of notation for set properties (*e.g.* complement): A' ; \bar{A} ; A^c ; $U - A$; $(A; U \setminus A$.

Different forms of logic notation: $\neg p$; p' ; \tilde{p} ; \bar{p} ; $\sim p$.

$p \Rightarrow q$; $p \rightarrow q$; $q \Leftarrow p$.

- (g) Discretionary marks: There will be very rare occasions where the markscheme does not cover the work seen. In such cases the annotation DM should be used to indicate where an examiner has used discretion. Discretion should be used sparingly and if there is doubt and exception should be raised through scoris to the team leader.

There will be no whole paper penalty marks for accuracy AP, financial accuracy FP and units UP. Instead these skills will be assessed in particular questions and the marks applied according to the rules given in sections 5, 6 and 7 below.

5 Accuracy of Answers

Incorrect accuracy should be penalized once only in each question according to the rules below.

Unless otherwise stated in the question, all numerical answers should be given exactly or correct to 3 significant figures.

1. If the candidate’s unrounded answer is seen and would round to the required 3 sf answer, then award **(AI)** and ignore subsequent rounding.
2. If the candidate’s unrounded answer is **not** seen then award **(AI)** if the answer given is **correctly** rounded to 2 or more significant figures, otherwise **(A0)**.
Note: If the candidate’s unrounded answer is **not** seen and the answer is given correct to 1 sf (correct or not), the answer will be considered wrong and will not count as incorrect accuracy. If this answer is used in subsequent parts, then working must be shown for further marks to be awarded.
3. If a correct 2 sf answer is used in subsequent parts, then working **must** be shown for further marks to be awarded. (This treatment is the same as for following through from an incorrect answer.)

These 3 points (see numbers in superscript) have been summarized in the table below and illustrated in the examples following.

	If candidates final answer is given ...				
	Exact or correct to 3 or more sf	Incorrect to 3 sf	Correct to 2 sf ³	Incorrect to 2 sf	Correct or incorrect to 1 sf
Unrounded answer seen ¹	Award the final (AI) irrespective of correct or incorrect rounding				
Unrounded answer not seen ²	(AI)	(A0)	(AI)	(A0)	(A0)
Treatment of subsequent parts	As per MS	Treat as follow through, only if working is seen ³			

Examples:

Markscheme	Candidates' Scripts	Marking
9.43 (9.43398...) (AI)	(i) 9.43398... is seen followed by 9; 9.4; 9.43; 9.434 <i>etc.</i> (correctly rounded)	(AI)
	(ii) 9.43398... is seen followed by 9.433; 9.44 <i>etc.</i> (incorrectly rounded)	(AI)
	(iii) 9.4	(AI)
	(iv) 9	(A0) (correct to 1 sf)
	(v) 9.3	(A0) (incorrectly rounded to 2 sf)
	(vi) 9.44	(A0) (incorrectly rounded to 3 sf)

Markscheme	Candidates' Scripts	Marking
7.44 (7.43798...) (AI)	(i) 7.43798... is seen followed by 7; 7.4; 7.44; 7.438 <i>etc.</i> (correctly rounded)	(AI)
	(ii) 7.43798... is seen followed by 7.437; 7.43 <i>etc.</i> (incorrectly rounded)	(AI)
	(iii) 7.4	(AI)
	(iv) 7	(A0) (correct to 1 sf)
	(v) 7.5	(A0) (incorrectly rounded to 2 sf)
	(vi) 7.43	(A0) (incorrectly rounded to 3 sf)

Example: ABC is a right angled triangle with angle $ABC = 90^\circ$, $AC = 32$ cm and $AB = 30$ cm. Find (a) the length of BC, (b) The area of triangle ABC.

Markscheme	Candidates' Scripts	Marking
(a) $BC = \sqrt{32^2 - 30^2}$ (MI) Award (MI) for correct substitution in Pythagoras' formula $= 11.1 (\sqrt{124}, 11.1355...)$ (AI)	(a) $BC = \sqrt{32^2 - 30^2}$ 11 (cm) (2 sf answer only seen, but correct)	(MI) (AI)
(b) $\text{Area} = \frac{1}{2} \times 30 \times 11.1355...$ (MI) Award (MI) for correct substitution in area of triangle formula $= 167(167.032...)$ (AI)(ft)	(b) case (i) $\text{Area} = \frac{1}{2} \times 30 \times 11$ $= 165 \text{ (cm}^2\text{)}$ case (ii) $= 165 \text{ (cm}^2\text{)}$	(MI) (AI)(ft) (M0)(A0)(ft) (No working shown, the answer 11 is treated as a ft, so no marks awarded here)

Certain answers obtained from the GDC are worth 2 marks and working will not be seen. In these cases only one mark should be lost for accuracy.

e.g. Chi-squared, correlation coefficient, mean

Markscheme	Candidates' Scripts	Marking
Chi-squared	(a) 7.7	(G2)
7.68 (7.67543...) (A2)	(b) 7.67	(G1)
	(c) 7.6	(G1)
	(d) 8	(G0)
	(e) 7	(G0)
	(e) 7.66	(G0)

Regression line

Markscheme	Candidates' Scripts	Marking
$y = 0.888x + 13.5$ (A2) ($y = 0.887686\dots x + 13.4895\dots$) If an answer is not in the form of an equation award at most (A1)(A0).	(a) $y = 0.89x + 13$	(G2) (both accepted)
	(b) $y = 0.88x + 13$	(G1) (one rounding error)
	(c) $y = 0.88x + 14$	(G1) (rounding error repeated)
	(d) (i) $y = 0.9x + 13$	(G1) (1 sf not accepted)
	(ii) $y = 0.8x + 13$	
(e) $0.88x + 13$	(G0) (one rounding error and not an equation)	

Maximum/minimum/points of intersection

Markscheme	Candidates' Scripts	Marking
(2.06, 4.49) (A1)(A1) (2.06020..., 4.49253...)	(a) (2.1, 4.5)	(A1)(A1) (both accepted)
	(b) (2.0, 4.4)	(A1) (same rounding error twice)
	(c) (2.06, 4.4)	(A1) (one rounding error)
	(d) (2, 4.4)	(A0) (1sf not accepted, one rounding error)

Rounding of an exact answer to 3 significant figures **should be accepted if performed correctly**.

Exact answers such as $\frac{1}{4}$ can be written as decimals to fewer than three significant figures if the result is still exact. Reduction of a fraction to its lowest terms is **not** essential, however where an answer simplifies to an integer this is expected.

Ratios of π and answers taking the form of square roots of integers or any rational power of an integer (e.g. $\sqrt{13}, 2^{\frac{3}{4}}, \sqrt[4]{5}$,) may be accepted as exact answers. All other powers (e.g. of non-integers) and values of transcendental functions such as sine and cosine must be evaluated.

If the level of accuracy is specified in the question, a mark will be allocated for giving the answer to the required accuracy. In all such cases the final mark is not awarded if the rounding does not follow the instructions given in the question. A mark for specified accuracy can be regarded as a (ft) mark regardless of an immediately preceding (M0).

6 Level of accuracy in finance questions

The accuracy level required for answers will be specified in all questions involving money. This will usually be either whole units or two decimal places. The first answer not given to the specified level of accuracy will not be awarded the final **A** mark. The markscheme will give clear instructions to ensure that only one mark per paper can be lost for incorrect accuracy in a financial question.

Example: A financial question demands accuracy correct to 2 dp.

Markscheme	Candidates' Scripts	Marking
\$231.62 (231.6189) (AI)	(i) 231.6	(A0)
	(ii) 232	(A0) <i>(Correct rounding to incorrect level)</i>
	(iii) 231.61	(A0)
	(iv) 232.00	(A0) <i>(Parts (iii) and (iv) are both incorrect rounding to correct level)</i>

7 Units in answers

There will be specific questions for which the units are required and this will be indicated clearly in the markscheme. The first correct answer with no units or incorrect units will not be awarded the final **A** mark. The markscheme will give clear instructions to ensure that only one mark per paper can be lost for lack of units or incorrect units.

The units are considered only when the numerical answer is awarded **(AI)** under the accuracy rules given in Section 5.

Example:

Markscheme	Candidates' Scripts	Marking
(a) 37000 m ² (AI)	(a) 36000 m ²	(A0) <i>(Incorrect answer so units not considered)</i>
(b) 3200 m ³ (AI)	(b) 3200 m ²	(A0) <i>(Incorrect units)</i>

If no method is shown and the answer is correct but with incorrect or missing units award G marks with a one mark penalty.

8 Graphic Display Calculators

Candidates will often be obtaining solutions directly from their calculators. They must use mathematical notation, not calculator notation. No method marks can be awarded for incorrect answers supported only by calculator notation. The comment 'I used my GDC' cannot receive a method mark.

QUESTION 1

- (a) The (crop) yield is **independent** of the (type of) fertilizer used. (AI)(AI) [2 marks]

Note: Award (AI) for (crop) yield and (type of) fertilizer, (AI) for “independent” or “not dependent” or “not associated”. Do not accept “not correlated” or “not related” or “not connected” or “does not depend on”.

- (b) 4 (AI) [1 mark]

- (c) 13.277 (AI)(ft) [1 mark]

Note: Accept 13.3. Follow through from part (b).

- (d) $\frac{50}{120} \times \frac{40}{120} \times 120$ or $\frac{50 \times 40}{120}$ (MI)

Note: Award (MI) for correct substitution in the expected value formula.

$= 16.6666\dots$ (AI)
 $= 17$ (AG) [2 marks]

Note: Both unrounded and rounded answers must be seen to award (AI).

- (e) (i) $\chi^2_{calc} = 3.86$ (3.86133...) (G2)

- (ii) $p\text{-value} = 0.425$ (0.425097...) (G1) [3 marks]

- (f) Since $\chi^2_{calc} < \text{Critical Value}$ (RI)

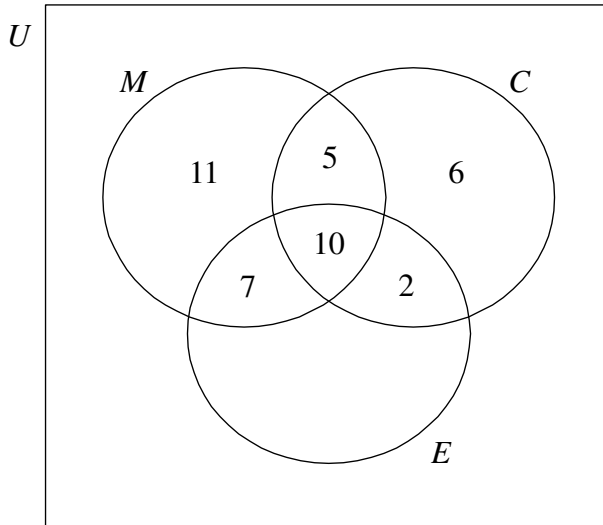
Accept (do not reject) the Null Hypothesis. (AI)(ft) [2 marks]

Note: Accept decision based on $p\text{-value}$ with comparison to 1 % (0.425097... > 0.01). Do not award (R0)(AI). Follow through from parts (c) and (e). Numerical answers must be present in the question for a valid comparison to be made.

Total [11 marks]

QUESTION 2

(a)



(AI) for rectangle and three labelled circles (*U* need not be seen)

(AI) for 10 in the correct region

(AI) for 2, 7 and 5 in the correct regions

(AI) for 6 and 11 in the correct regions

(A4) [4 marks]

(b) 16

(AI)(ft) [1 mark]

Note: Follow through from their Venn diagram.

(c) (i) $10 + 7 + 2$

(MI)

Note: Award (MI) for summing their 10, 7 and 2.

$$22 - 19$$

$$= 3$$

(AI)(ft)(G2)

Note: Follow through from their diagram. Award (MI)(AI)(ft) for answers consistent with their diagram irrespective of whether working seen. Award a maximum of (MI)(A0) for a negative answer.

(ii) $22 + 11 + 5 + 6$

(MI)

Note: Award (MI) for summing 22, and their 11, 5 and 6.

$$100 - 44$$

$$= 56$$

(AI)(ft)(G2) [4 marks]

Note: Follow through from their diagram. Award (MI)(AI)(ft) for answers consistent with their diagram **and** the use of 22 irrespective of whether working seen. If negative values are used or implied award (M0)(A0).

continued...

Question 2 continued

(d) (i) $\frac{22}{100} \left(\frac{11}{50}, 0.22, 22\% \right)$ (AI)(G1)

(ii) $\frac{5}{100} \left(\frac{1}{20}, 0.05, 5\% \right)$ (AI)(ft)(AI)(G2)

Note: Award (AI)(ft) for their 5 in numerator, (AI) for denominator.
Follow through from their diagram.

(iii) $\frac{62}{100} \left(\frac{31}{50}, 0.62, 62\% \right)$ (AI)(ft)(AI)(G2)

Note: Award (AI)(ft) for $100 - (22 + 11 + \text{their } 5)$, (AI) for denominator.
Follow through from their diagram.

(iv) $\frac{62}{78} \left(\frac{31}{39}, 0.795, 79.5\% \right) (0.794871\dots)$ (AI)(ft)(AI)(G2) [7 marks]

Note: Award (AI)(ft) for numerator, (AI) for denominator. Follow through from part (d)(iii) for numerator.

Total [16 marks]

QUESTION 3

- (a) (i) 40
- (ii) 20
- (iii) 10

(A3) [3 marks]

Notes: Award **(A0)(AI)(ft)(AI)(ft)** for $-40, -20, -10$.
Award **(AI)(A0)(AI)(ft)** for 40, 60, 70 seen.
Award **(A0)(A0)(AI)(ft)** for $-40, -60, -70$ seen.

- (b) $24 - k = 5$ or equivalent

(AI)(MI)

Note: Award **(AI)** for 5 seen, **(MI)** for difference from 24 indicated.

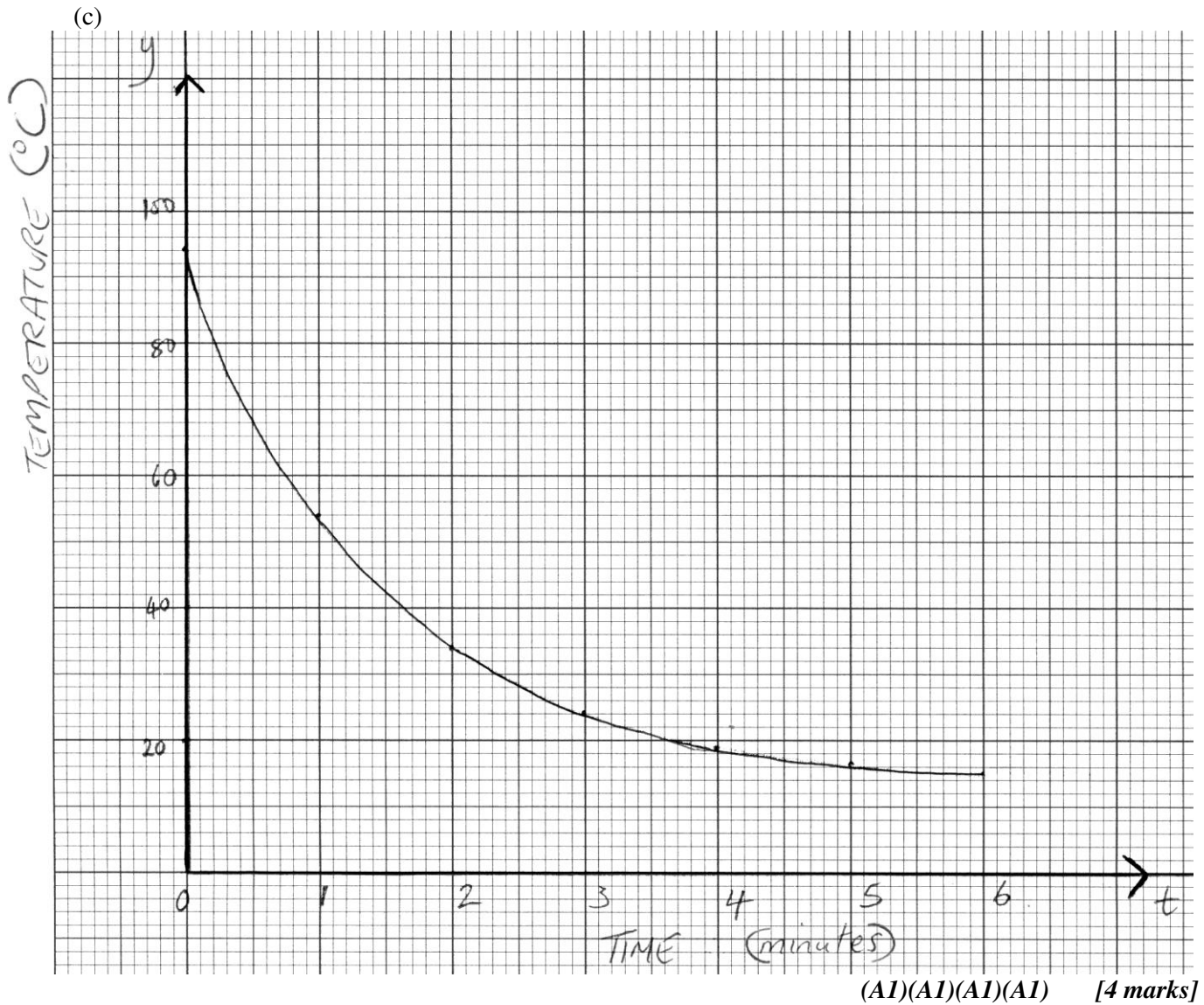
$k = 19$

(AG) [2 marks]

Note: If 19 is not seen award at most **(AI)(M0)**.

continued...

Question 3 continued



Note: Award (A1) for scales and labelled axes (t or “time” and y or “temperature”).
 Accept the use of x on the horizontal axis only if “time” is also seen as the label.
 Award (A2) for all seven points accurately plotted, award (A1) for 5 or 6 points accurately plotted, award (A0) for 4 points or fewer accurately plotted.
 Award (A1) for smooth curve that passes through all points on domain $[0, 6]$.
 If graph paper is not used or one or more scales is missing, award a maximum of (A0)(A0)(A0)(A1).

- (d) (i) $94 = p + q$ (A1)
- (ii) $54 = 0.5p + q$ (A1) [2 marks]

Note: The equations need not be simplified; accept, for example $94 = p(2^{-0}) + q$.

continued...

Question 3 continued

(e) $p = 80, q = 14$

(GI)(GI)(ft) [2 marks]

Note: If the equations have been incorrectly simplified, follow through even if no working is shown.

(f) $y = 14$

(AI)(AI)(ft) [2 marks]

Note: Award (AI) for $y =$ a constant, (AI) for their 14. Follow through from part (e) only if their q lies between 0 and 15.25 inclusive.

(g) (i) $-0.878 (-0.87787\dots)$

(G2)

Note: Award (GI) if -0.877 seen only. If negative sign omitted award a maximum of (AI)(A0).

(ii) $y = -11.7t + 71.6 (y = -11.6517\dots t + 71.6336\dots)$

(GI)(GI) [4 marks]

Note: Award (GI) for $-11.7t$, (GI) for 71.6.
If $y =$ is omitted award at most (G0)(GI).
If the use of x in part (c) has **not** been penalized (the axis has been labelled "time") then award at most (G0)(GI).

(h) $-11.6517\dots(3) + 71.6339\dots$

(MI)

Note: Award (MI) for correct substitution in their part (g)(ii).

$= 36.7 (36.6785\dots)$

(AI)(ft)(G2) [2 marks]

Note: Follow through from part (g). Accept 36.5 for use of the 3sf answers from part (g).

(i) $\frac{36.6785\dots - 24}{24} \times 100$

(MI)

Note: Award (MI) for their correct substitution in percentage error formula.

$= 52.8 \% (52.82738\dots)$

(AI)(ft)(G2) [2 marks]

Note: Follow through from part (h). Accept 52.1% for use of 36.5.
Accept 52.9 % for use of 36.7. If partial working ($\times 100$ omitted) is followed by their correct answer award (MI)(AI). If partial working is followed by an incorrect answer award (M0)(A0). The percentage sign is not required.

Total [23 marks]

QUESTION 4

(a) $\frac{14}{(1)} + (1) - 6$ (MI)

Note: Award (MI) for substituting $x = 1$ into f .

$= 9$ (A1)(G2) [2 marks]

(b) $-\frac{14}{x^2} + 1$ (A3) [3 marks]

Note: Award (AI) for -14 , (AI) for $\frac{1}{x^2}$ or for x^{-2} , (AI) for 1 .
Award at most (A2) if any extra terms are present.

(c) $-\frac{14}{x^2} + 1 = 0$ or $f'(x) = 0$ (MI)

Note: Award (MI) for equating **their** derivative in part (b) to 0.

$\frac{14}{x^2} = 1$ or $x^2 = 14$ or equivalent (MI)

Note: Award (MI) for correct rearrangement of **their** equation.

$x = 3.74165... (\sqrt{14})$ (AI)

$x = 3.7$ (AG) [3 marks]

Notes: Both the unrounded and rounded answers must be seen to award the (AI). This is a “show that” question; appeals to their GDC are not accepted –award a maximum of (MI)(M0)(A0).
Specifically, $-\frac{14}{x^2} + 1 = 0$ followed by $x = 3.74165...$, $x = 3.7$ is awarded (MI)(M0)(A0).

(d) $1.48 \leq y \leq 9$ (A1)(A1)(ft)(A1) [3 marks]

Note: Accept alternative notations, for example $[1.48, 9]$.
($x = \sqrt{14}$ leads to answer 1.48331...)

Note: Award (AI) for 1.48331...seen, accept 1.48378... from using the given answer $x = 3.7$, (A1)(ft) for their 9 from part (a) seen, (AI) for the correct notation for their interval (accept $\leq y \leq$ or $\leq f \leq$).

continued...

Question 4 continued

(e) 3 (A1) [1 mark]

Note: Do not accept a coordinate pair.

(f) $\frac{3-9}{7-1}$ (M1)

Note: Award (M1) for their correct substitution into the gradient formula.

= -1 (A1)(ft)(G2) [2 marks]

Note: Follow through from their answers to parts (a) and (e).

(g) (4, 6) (A1)(ft)(A1) [2 marks]

Note: Accept $x = 4, y = 6$. Award at most (A1)(A0) if parentheses not seen.
If coordinates reversed award (A0)(A1)(ft).
Follow through from their answers to parts (a) and (e).

(h) $-\frac{14}{4^2} + 1$ (M1)

Note: Award (M1) for substitution into their gradient function.
Follow through from their answers to parts (b) and (g).

$= \frac{1}{8} (0.125)$ (A1)(ft)(G2) [2 marks]

(i) $y - 1.5 = \frac{1}{8} (x - 4)$ (M1)(ft)(M1)

Note: Award (M1) for substituting their (4, 1.5) in any straight line formula,
(M1) for substituting their gradient in any straight line formula.

$y = \frac{x}{8} + 1$ ($y = 0.125x + 1$) (A1)(ft)(G2) [3 marks]

Note: The form of the line has been specified in the question.

Total [21 marks]

QUESTION 5

(a) 110° (A1) [1 mark]

(b) $\frac{AQ}{\sin 35^\circ} = \frac{10}{\sin 110^\circ}$ (M1)(A1)

Note: Award (M1) for substituted sine rule formula, (A1) for their correct substitutions.

OR

$AQ = \frac{5}{\cos 35^\circ}$ (A1)(M1)

Note: Award (A1) for 5 seen, (M1) for correctly substituted trigonometric ratio.

$AQ = 6.10 (6.10387\dots)$ (A1)(ft)(G2) [3 marks]

Notes: Follow through from their answer to part (a).

(c) $AC^2 = 10^2 + 50^2$ (M1)

Note: Award (M1) for correctly substituted Pythagoras formula.

$AC = 51.0 (\sqrt{2600}, 50.9901\dots)$ (A1)(G2) [2 marks]

(d) $QC^2 = (6.10387\dots)^2 + (50)^2$ (M1)

Note: Award (M1) for correctly substituted Pythagoras formula.

$QC = 50.3711\dots$ (A1)
 $= 50.37$ (AG) [2 marks]

Note: Both the unrounded and rounded answers must be seen to award (A1).
 If 6.10 is used then 50.3707... is the unrounded answer.
 For an incorrect follow through from part (b) award a maximum of (M1)(A0) – the given answer must be reached to award the final (A1)(AG).

continued...

Question 5 continued

(e) $\cos AQC = \frac{(6.10387\dots)^2 + (50.3711\dots)^2 - (50.9901\dots)^2}{2(6.10387\dots)(50.3711\dots)}$ (MI)(AI)(ft)

Note: Award (MI) for substituted cosine rule formula, (AI)(ft) for their correct substitutions.

$= 92.4^\circ$ (92.3753...°) (AI)(ft)(G2) [3 marks]

Notes: Follow through from their answers to parts (b), (c) and (d). Accept 92.2° if the 3 sf answers to parts (b), (c) and (d) are used.
Accept 92.5° (92.4858...) if the 3 sf answers to parts (b), (c) and 4 sf answers to part (d) used.

(f) (i) $2(50 \times 6.10387\dots)$ (MI)

Note: Award (MI) for their correctly substituted rectangular area formula, the area of one rectangle is not sufficient.

$= 610 \text{ m}^2$ (610.387...) (AI)(ft)(G2)

Notes: Follow through from their answer to part (b).
The answer is 610 m². The units are required.

(ii) Area of triangular face $= \frac{1}{2} \times 10 \times 6.10387\dots \times \sin 35^\circ$ (MI)(AI)(ft)

OR

Area of triangular face $= \frac{1}{2} \times 6.10387\dots \times 6.10387\dots \times \sin 110^\circ$ (MI)(AI)(ft)
 $= 17.5051\dots$

Note: Award (MI) for substituted triangle area formula, (AI)(ft) for correct substitutions.

OR

(Height of triangle)² $= (6.10387\dots)^2 - 5^2$
 $= 3.50103\dots$
Area of triangular face $= \frac{1}{2} \times 10 \times \text{their height}$ (MI)(AI)(ft)
 $= 17.5051\dots$

Note: Award (MI) for substituted triangle area formula, (AI)(ft) for correctly substituted area formula. If 6.1 is used, the height is 3.49428... and the area of both triangular faces 34.9 m²

Area of both triangular faces $= 35.0 \text{ m}^2$ (35.0103...) (AI)(ft)(G2) [5 marks]

Notes: The answer is 35.0 m². The units are required. Do not penalize if already penalized in part (f)(i). Follow through from their part (b).

continued...

Question 5 continued

(g) $(610.387\dots + 35.0103\dots) \times 4.80$

(M1)

$= 3097.90\dots$

(A1)(ft)

Notes: Follow through from their answers to parts (f)(i) and (f)(ii).
Accept 3096 if the 3 sf answers to part (f) are used.

$= 3100$

(A1)(ft)(G2) [3 marks]

Notes: Follow through from their unrounded answer, irrespective of whether it is correct. Award (M1)(A2) if working is shown and 3100 seen without the unrounded answer being given.

Total [19 marks]