N12/5/MATSD/SP1/ENG/TZ0/XX/M

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MARKSCHEME

November 2012

MATHEMATICAL STUDIES

Standard Level

Paper 1

26 pages

Paper 1 Markscheme
Instructions to Examiners

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

The number of marks for each question is 6.

1 Abbreviations

The markscheme may make use of the following abbreviations:

M Marks awarded for **Method**

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

C Marks awarded for **Correct** answers (irrespective of working shown)

R Marks awarded for clear **Reasoning**

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 the candidate has full marks on a question use the ***C6*** annotation, if the candidate has made an attempt but scores zero marks use ***C0***. If there is no attempt use the No response button. If a candidate does not score full or zero marks then full annotations **MUST** be shown.

(c) In this paper, if the **correct answer is seen on the answer line the** maximum mark is awarded. **There is no need to check the working!** Award ***C*** marks and move on.

(d) If the answer does not appear on the answer line, but the correct answer is seen in the working box with no subsequent working, award the maximum mark.

(e) If the **answer is wrong**, marks should be awarded for the working according to the markscheme.

(f) Working crossed out by the candidate should not be awarded any marks. Where candidates have written two solutions to a question, only the first solution should be marked.

(g) A correct answer in the working box transcribed inaccurately to the answer line can receive full marks.

(h) If correct working results in a correct answer **in the working box** but then further working is developed, full marks should **not** be awarded. In most such cases it will be a single final answer mark that is lost, however, a statement on the answer line should always be taken as the candidate's final decision on the answer **as long as it is unambiguous**.
Accuracy of numerical answers is an exception to this rule – see Section 5.

Example: Factorise $x^2 - 5x - 6$

Markscheme	Candidates' Scripts		Marking
$(x-6)(x+1)$ ***(A1)(A1)***	(i)	Answer line: $(x+6)(x+1)$	***(A0)(A1)***
	(ii)	Working box: $(x-6)(x+1)$ followed by $x=6$ and -1, or just $6, -1$ in either working box or on answer line.	***(A1)*** ***(A0)***

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. Markschemes 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 (for example, 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
(a) $\frac{\sin A}{3} = \frac{\sin 30}{4}$ ***(M1)(A1)***	(a)	$\frac{\sin A}{4} = \frac{\sin 30}{3}$		***(M1)(A0)*** *(use of sine rule but with wrong values)*
$A = 22.0^\circ$ (22.0243…) ***(A1)***		$A = 41.8^\circ$		***(A0)*** *(**Note:** the 2nd **(A1)** here was not marked* **(ft)** *and cannot be awarded because there was an earlier error in the **same** question part.)*
(b) $x = 7\tan(22.0243…^\circ)$ ***(M1)*** $= 2.83$ (2.83163…) ***(A1)*****(ft)**	(b)	case (i) $x = 7\tan 41.8^\circ$ $= 6.26$		***(M1)*** ***(A1)*****(ft)**
	but	case (ii) 6.26		***(C0)*** *since no working shown*

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 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)*** is not awarded for a correct answer if no reason or the wrong reason is given.

(c) **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*.

(d) 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.

(e) 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; $1\cdot7$; 1,7 .

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

Different forms of notation for set properties (for example, complement): A'; $\overline{A}$; A^c; $U - A$;(A;U \ A.
Different forms of logic notation: $\neg p$; p'; $\tilde{p}$; $\overline{p}$; ~ p.
$p \Rightarrow q$; $p \rightarrow q$; $q \Leftarrow p$.

(f) 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 an exception should be raised through scoris to the team leader.

As from Nov 11 the AP, FP and UP penalties will no longer apply. Accuracy and units 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 ***(A1)*** and ignore subsequent rounding.
Note: The unrounded answer may appear in either the working box or on the final answer line.

2. If the candidate's unrounded answer is **not** seen then award ***(A1)*** 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 summarised in the table below and illustrated in the examples which follow.

	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 ***(A1)*** irrespective of correct or incorrect rounding				
Unrounded answer not seen[2]	***(A1)***	***(A0)***	***(A1)***	***(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…) ***(A1)***	(i) 9.43398… is seen in the working box followed by 9; 9.4; 9.43; 9.434 *etc.* (correctly rounded)	***(A1)***
	(ii) 9.43398… is seen in the working box followed by 9.433; 9.44 *etc*. (incorrectly rounded)	***(A1)***
	(iii) 9.4	***(A1)***
	(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…) ***(A1)***	(i) 7.43798… is seen in the working box followed by 7; 7.4; 7.44; 7.438 *etc.* (correctly rounded)	***(A1)***
	(ii) 7.43798… is seen in the working box followed by 7.437; 7.43 *etc.* (incorrectly rounded)	***(A1)***
	(iii) 7.4	***(A1)***
	(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 $ABC = 90^\circ$, $AC = 32\,\text{cm}$ and $AB = 30\,\text{cm}$. Find (a) the length of BC, (b) The area of triangle ABC.

Markscheme	Candidates' Scripts	Marking
(a) $BC = \sqrt{32^2 - 30^2}$ ***(M1)***	(a) $BC = \sqrt{32^2 - 30^2}$	***(M1)***
*Award **(M1)** for correct substitution in Pythagoras' formula*	$11\,(\text{cm})$	***(A1)***
$= 11.1\ \left(\sqrt{124}, 11.1355...\right)(\text{cm})$ ***(A1)***	*(2 sf answer only seen, but correct)*	
(b) $\text{Area} = \frac{1}{2} \times 30 \times 11.1355...$ ***(M1)***	(b) case (i) $\text{Area} = \frac{1}{2} \times 30 \times 11$	***(M1)***
*Award **(M1)** for correct substitution in area of triangle formula*		*(working shown)*
$= 167 (167.032...)\,(\text{cm}^2)$ ***(A1)*(ft)***	$= 165\,(\text{cm}^2)$	***(A1)*(ft)***
	case (ii) $= 165\,(\text{cm}^2)$	***(M0)(A0)*(ft)***
	(No working shown, the answer 11 is treated as a ft, so no marks awarded here)	

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 (for example, $\sqrt{13}, 2^{\frac{2}{3}}, \sqrt[4]{5}$,) may be accepted as exact answers. All other powers (for example, 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)***.

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.

For example, Chi-squared, correlation coefficient, mean

Markscheme	Candidates' Scripts	Marking
Chi-squared	(a) 7.7	***(A2)***
7.68 (7.67543…) ***(A2)***	(b) 7.67	***(A1)***
	(c) 7.6	***(A1)***
	(d) 8	***(A0)***
	(e) 7	***(A0)***
	(e) 7.66	***(A0)***

Regression line

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

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) ***(A1)***	(i) 231.6	***(A0)***
	(ii) 232	***(A0)*** *(Correct rounding to incorrect level)*
	(iii) 231.61	***(A0)***
	(iv) 232.00	***(A0)*** *(Parts (iii) and (iv) are both incorrect rounding to correct level)*

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 ***(A1)*** under the accuracy rules given in Section 5.

Markscheme	Candidates' Scripts	Marking
(a) 37 000 m^2 ***(A1)***	(a) 36 000 m^2	***(A0)*** *(Incorrect answer so units not considered)*
(b) 3200 m^3 ***(A1)***	(b) 3200 m^2	***(A0)*** *(Incorrect units)*

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

8 Graphic Display Calculators

Candidates will often obtain 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) $15 \mid 7, 8$
$16 \mid 0, 3, 4$
$17 \mid 4, 7, 7$
$18 \mid 0, 3, 4$ ***(A1)(A1)***

Key $15 \mid 7 = 157$ (cm) ***(A1)*** ***(C3)***

Note: Award ***(A1)*** for stem and leaf diagram, ***(A1)*** for correct ordering and correct and complete values, ***(A1)*** for key.
The first ***(A1)*** is awarded for a stem and leaf diagram, even if the order and key are incorrect.
Commas separating the data are not required.

(b) (i) 174 (cm) ***(A1)*****(ft)**

Note: Follow through from their part (a).

(ii) 180 – 160 ***(M1)*****(ft)**

Notes: Award ***(M1)*****(ft)** for their correct quartiles seen.
Follow through from part (a).

IQR = 20 (cm) ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their quartiles only if working is seen.

[6 marks]

QUESTION 2

(a) $33 = 3 + d(6)$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted formula or a correct numerical expression to find the common difference.

$(d =) 5$ ***(A1)*** ***(C2)***

(b) $u_{95} = 3 + 94(5)$ ***(M1)***

Note: Award ***(M1)*** for their correctly substituted formula.

$= 473$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their part (a).

(c) $S_{250} = 125[2(3) + 249(5)]$ ***(M1)***

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

$S_{250} = 156375$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their part (a).

[6 marks]

QUESTION 3

(a) $\left(\frac{104.5+105.1+\ldots}{6}\right)$ ***(M1)***

Note: Award ***(M1)*** for use of mean formula.

$=104.9$ (cm) ***(A1)*** ***(C2)***

(b) 1.049×10^{2} ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Award ***(A1)*****(ft)** for 1.049, ***(A1)*****(ft)** for 10^{2}.
Follow through from their part (a).

(c) $\frac{105-104.9}{104.9}\times100$ (%) ***(M1)***

Notes: Award ***(M1)*** for their correctly substituted % error formula.

% error $=0.0953$ (%) $(0.0953288\ldots)$ ***(A1)*****(ft)** ***(C2)***

Notes: A 2sf answer of 0.095 following $\frac{105-104.9}{105}\times100$ working is awarded no marks.
Follow through from their part (a), provided it is not 105.
Do not accept a negative answer.
% sign not required.

[6 marks]

QUESTION 4

(a) $\pi r^2 = 8$ ***(M1)***

Note: Award ***(M1)*** for correct area formula.

$r = 1.60$ (cm) (1.59576…) ***(A1)*** ***(C2)***

(b) $200\ \text{cm}^3$ ***(A1)*****(ft)** ***(C1)***

Notes: Units are required. Follow through from their part (a). Accept $201\ \text{cm}^3$ (201.061…) for use of $r = 1.60$.

(c) Surface area $= 16 + 2\pi(1.59576\ldots)25$ ***(M1)******(M1)***

Note: Award ***(M1)*** for correct substitution of their *r* into curved surface area formula, ***(M1)*** for adding 16 or $2 \times \pi \times$ (their answer to part (a))^2

$267\ \text{cm}^2$ ($266.662\ldots\text{cm}^2$) ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their part (a).

[6 marks]

QUESTION 5

(a) 200 (students) ***(M1)(A1)*** ***(C2)***

Note: Award ***(M1)*** for line drawn on the graph connecting 50 % with 200 or any indication (cross or dash) at the required point on the graph, ***(A1)*** for correct answer.

(b) $500 - 350$ ***(M1)***

Notes: Award ***(M1)*** for 350 seen or for a line on the graph from 57 % up to the curve showing number of students.
An indication (cross or dash) at the required point on the graph is sufficient for method.

$= 150$ ***(A1)*** ***(C2)***

(c) 60 (%) ***(M1)(A1)*** ***(C2)***

Notes: Award ***(M1)*** for 400 or a line on the graph at 400 seen, ***(A1)*** for correct answer. % sign not required.
An indication (cross or dash) at the required point on the graph is sufficient for method.

[6 marks]

QUESTION 6

(a) $2r^2 = 2.205$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in geometric sequence formula.

$r = 1.05$ ***(A1)*** ***(C2)***

(b) $2(1.05)^{10}$ ***(M1)***

Note: Award ***(M1)*** for the correct substitution, using their answer to part (a), in geometric sequence formula.

$= 3.26$ (3.25778…) ***(A1)*(ft)** ***(C2)***

Note: Follow through from their part (a).

(c) $\dfrac{2\left(1.05^{23} - 1\right)}{(1.05 - 1)}$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution in geometric sum formula.

$= 82.9$ (82.8609…) ***(A1)*(ft)** ***(C2)***

Notes: Accept an answer of 3.97221...if $r = -1.05$ is found in part (a) and used again in part (c).
Follow through from their part (a).

[6 marks]

QUESTION 7 ***The first time the answer is not given to two decimal places the final (A1) in that part is not awarded.***

(a) 1240×0.7681 ***(M1)***

Note: Award ***(M1)*** for multiplying by 0.7681

$= 952.44$ ***(A1)*** ***(C2)***

(b) $\frac{750}{0.7470} \times (1 - 0.0312)$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for dividing by 0.7470, ***(M1)*** for subtracting 0.0312 from 1, ***(M1)*** for multiplying by the (1–0.0312).

OR

$\frac{750}{0.7470} (= 1004.016\ldots)$ ***(M1)***

$1004.016\ldots \times 0.0312 (= 31.325\ldots)$ ***(M1)***

$1004.016\ldots - 31.325\ldots$ ***(M1)***

Note: Award ***(M1)*** for dividing by 0.7470, ***(M1)*** for multiplication by 0.0312, ***(M1)*** for subtraction of their 31.325 from their 1004.016.

OR

$750 \times 3.12\,\% = 23.4$ ***(M1)***

$750 - 23.4 = 726.60$ ***(M1)***

$\frac{726.60}{0.7470}$ ***(M1)***

Note: Award ***(M1)*** for multiplication by 3.12 %, ***(M1)*** for subtraction of their 23.4 from 750, ***(M1)*** for division by 0.7470.

$= 972.69$ ***(A1)*** ***(C4)***

Note: If division by 0.7681 is used in part (a) then award ***(M1)*** for multiplying by 0.7470 in part (b).

[6 marks]

QUESTION 8

(a) -2 ***(A1)*** ***(C1)***

Note: Do not accept $\frac{-2}{1}$

(b) (i) $\frac{1}{2}(0.5)$ ***(A1)*****(ft)**

Note: Follow through from their part (a).

(ii) $5=\frac{1}{2}(4)+c$ ***(M1)***

Note: Award ***(M1)*** for their gradient substituted correctly.

$y=\frac{1}{2}x+3$ ***(A1)*****(ft)**

Note: Follow through from their part (b)(i).

OR

$y-5=\frac{1}{2}(x-4)$ ***(M1)(A1)*****(ft)** ***(C3)***

Notes: Award ***(M1)*** for their gradient substituted correctly, ***(A1)*****(ft)** for 5 and 4 seen in the correct places.
Follow through from their part (b)(i).

(c) $(0.8, 3.4)$ or $\left(\frac{4}{5}, \frac{17}{5}\right)$ ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Notes: Accept $x=0.8$ and $y=3.4$.
Award ***(A1)*****(ft)** for an attempt to solve the equations analytically, (attempt to eliminate either x or y), or graphically with a sketch (two reasonably accurate straight line graphs (from their answer to part (b)) and an indication of scale).
Follow through from their L_2 if it intersects L_1, **OR** follow through from their equation, or expression in x, from their part (b)(ii).
Award at most ***(A1)*****(ft)*****(A0)*****(ft)** if brackets missing.
Award ***(A0)*****(ft)*****(A1)*****(ft)** for an answer of $(0, 5)$ following an equation (or expression in x) of the form $y=mx+5$ $(m \neq -2)$ found in part (b).

[6 marks]

QUESTION 9

(a) Carlos is not playing the guitar and he is studying for his IB exams. ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for "and", ***(A1)*** for correct statements.

(b) $p \veebar q$ ***(A1)*** ***(C1)***

(c) $\neg q \Rightarrow p$ ***(A1)(A1)(A1)*** ***(C3)***

Notes: Award ***(A1)*** for implication, ***(A1)*** for the $\neg q$, ***(A1)*** for both $\neg q$ and p in the correct order.
If correct converse seen in words only award ***(A1)(A1)(A0)***.
Accept $p \Leftarrow \neg q$.
Accept $-q$ for $\neg q$.

[6 marks]

QUESTION 10

(a) $-5 = 5 - (2) + a(2)^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in equation.

$(a =) -2$ ***(A1)*** ***(C2)***

(b) $x = -\frac{1}{4}$ (-0.25) ***(A1)(A1)*****(ft)** ***(C2)***

Notes: Follow through from their part (a).
Award ***(A1)(A0)*****(ft)** for "$x =$ constant"
Award ***(A0)(A1)*****(ft)** for $y = -\frac{1}{4}$.

(c) $f(x) \leq 5.125$ ***(A1)(A1)*****(ft)** ***(C2)***

Notes: Award ***(A1)*** for $f(x) \leq$ (accept y). Do not accept strict inequality.
Award ***(A1)*****(ft)** for 5.125 (accept 5.13).
Accept other correct notation, for example, $(-\infty, 5.125]$
Follow through from their answer to part (b).

[6 marks]

QUESTION 11

(a) $14 \leq x < 18$ ***(A1)*** ***(C1)***

(b) 8 ***(A1)*** ***(C1)***

(c) $\dfrac{4\times 30+8\times 26+12\times 29+16\times 32+20\times 18+24\times 27+28\times 14}{176}$ ***(M1)***

Notes: Award ***(M1)*** for an attempt to substitute their mid-interval values (consistent with their answer to part (b)) into the formula for the mean.
Award ***(M1)*** where a table is constructed with their (consistent) mid-interval values listed along with the frequencies.

$= 14.7$ (cm) (14.7045…) ***(A1)*****(ft)** ***(C2)***

Notes: Follow through from their answer to part (b).
If a final incorrect answer that is consistent with their (b) is given award ***(M1)(A1)*****(ft)** even if no working is seen.

(d) $18 + 27 + 14$ ***(M1)***

Note: Award ***(M1)*** for adding 18, 27 and 14.

$= 59$ ***(A1)*** ***(C2)***

[6 marks]

QUESTION 12

(a) $9.5^2 = 8^2 + AB^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into Pythagoras' theorem.

$AB = 5.12\,(\text{cm})$ $(5.12347\ldots)$ ***(A1)*** ***(C2)***

(b) $BM = \sqrt{9.5^2 + \left(\frac{5.12347\ldots}{2}\right)^2}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into Pythagoras' theorem.

$= 9.84\,(\text{cm})$ $(9.83933\ldots)$ ***(A1)*****(ft)** ***(C2)***

Notes: Accept alternative methods.
Follow through from their answer to part

(c) $\sin A\hat{M}B = \frac{5.12347\ldots}{9.83933\ldots}$ ***(M1)***

Note: Award ***(M1)*** for a correctly substituted trigonometrical equation using $A\hat{M}B$.

$= 31.4$ $(31.3801\ldots)$ ***(A1)*****(ft)** ***(C2)***

Notes: If radians used, the answer will be 0.5476… award ***(M1)(A0)*****(ft)**.
Degree symbol ° not required.
Follow through from their answers to part (a) and to part (b).

[6 marks]

QUESTION 13

(a) (i) 2 ***(A1)***

(ii) $\frac{360}{120}$ ***(M1)***

$= 3$ ***(A1)***

(iii) 4 ***(A1)*** ***(C4)***

(b) $70, 110$ ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Follow through from their part (a) even if no working seen and answers are in the required range.
If extra answers are seen award a maximum of ***(A1)*(ft)*(A0)*(ft)**.
Degree symbol ° not required.
Do not accept 68.9, 69, 111 or 113 because it implies the use of the trace function in the GDC.
Do not accept radian answers.
If coordinates given, award, at most ***(A0)*(ft)*(A1)*(ft)**.

[6 marks]

QUESTION 14

(a) $12\,000 = \dfrac{12\,000 \times r \times 20}{100}$ ***(A1)(M1)***

Note: Award ***(A1)*** for 12 000 used as interest on one side, ***(M1)*** for correct substitution in simple interest formula on the other side.

$r = 5$ ***(A1)*** ***(C3)***

Notes: Award ***(A0)(M1)(A1)*** for $r = 10$ if $24\,000$ used as interest.
Do not accept $r = 0.05$

(b) $45\,000 = 15\,000\left(1 + \dfrac{4.44}{400}\right)^{4n}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for a correctly substituted formula and correctly equated to 45 000.

OR

$3 = \left(1 + \dfrac{4.44}{400}\right)^{4n}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for a correctly substituted formula and correctly equated to 3.

$n = 25$ years ***(A1)*** ***(C3)***

Notes: Award ***(A1)(M0)(A0)*** if 24.9 or 24.88 seen as a final answer, with no working seen.
Award, at most, ***(A1)(M1)(A0)*** if working is seen and a final answer of 24.9 or 24.88 is given.

[6 marks]

QUESTION 15

(a) $15x^2 - 8x + 1$ ***(A1)(A1)(A1)*** ***(C3)***

Note: Award ***(A1)*** for each correct term.

(b) $15x^2 - 8x + 1 = 0$ ***(A1)*****(ft)**

Note: Award ***(A1)*****(ft)** for setting their derivative to zero.

(i) $(x =)\frac{1}{5}(0.2)$ ***(A1)*****(ft)**

(ii) $(x =)\frac{1}{3}(0.333)$ ***(A1)*****(ft)** ***(C3)***

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

[6 marks]