Topic 6 Part 2 *[235 marks]*

1a. *[2 marks]*

Markscheme

$x = 0, x = 4$ ***(A1)(A1)*** ***(C2)***

Notes: Accept 0 and 4.

[2 marks]

Examiners report

A number of candidates left out this question which indicated that this topic was either entirely unfamiliar, that this topic of the syllabus had perhaps not been taught, or was barely familiar. A few candidates wrote down coordinate pairs when asked for a solution to the equation. A number of candidates wrote down the formula for the equation of the axis of symmetry without being able to substitute values for a and b. When given the minimum value of the graph a small number of candidates could identify the range of the function correctly. Overall this question proved to be difficult with its demands for reading and interpreting the graph, and dealing with additional information about the quadratic function given in the different parts.

1b. *[2 marks]*

Markscheme

$x = 2$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for x = constant, ***(A1)*** for 2.

[2 marks]

Examiners report

A number of candidates left out this question which indicated that this topic was either entirely unfamiliar, that this topic of the syllabus had perhaps not been taught, or was barely familiar. A few candidates wrote down coordinate pairs when asked for a solution to the equation. A number of candidates wrote down the formula for the equation of the axis of symmetry without being able to substitute values for a and b. When given the minimum value of the graph a small number of candidates could identify the range of the function correctly. Overall this question proved to be difficult with its demands for reading and interpreting the graph, and dealing with additional information about the quadratic function given in the different parts.

1c. *[1 mark]*

Markscheme

$x = -2$ ***(A1)*** ***(C1)***

Note: Accept –2.

[1 mark]

Examiners report

A number of candidates left out this question which indicated that this topic was either entirely unfamiliar, that this topic of the syllabus had perhaps not been taught, or was barely familiar. A few candidates wrote down coordinate pairs when asked for a solution to the equation. A number of candidates wrote down the formula for the equation of the axis of symmetry without being able to substitute values for a and b. When given the minimum value of the graph a small number of candidates could identify the range of the function correctly. Overall this question proved to be difficult with its demands for reading and interpreting the graph, and dealing with additional information about the quadratic function given in the different parts.

1d. *[1 mark]*

Markscheme

$y \geqslant -4 \ (f(x) \geqslant -4)$ ***(A1)*** ***(C1)***

Notes: Accept alternative notations.

Award ***(A0)*** for use of strict inequality.

[1 mark]

Examiners report

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2a. *[4 marks]*

Markscheme

(i)

$1.25 = -\frac{k}{2(2)}$ ***(M1)***

OR

$f'(x) = 4x + k = 0$ ***(M1)***

Note: Award ***(M1)*** for setting the gradient function to zero.

$k = -5$ ***(A1)*** ***(C2)***

(ii)

$2(1.25)^2 - 5(1.25) + 4$ ***(M1)***

$= 0.875$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their k.

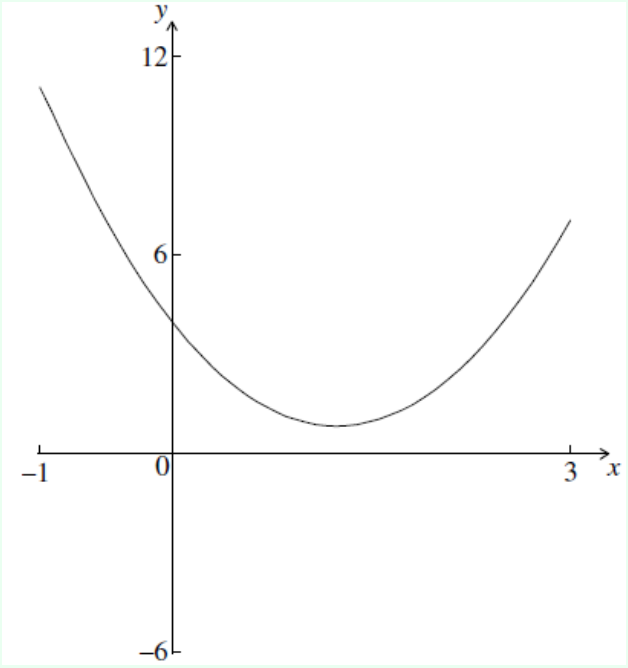
[4 marks]

Examiners report

This question was not answered well at all except by the more able. Indeed, of the lower quartile of candidates, the maximum mark achieved was only 1. Of those that did make a successful attempt at the question, very few used the fact that $1.25 = -\frac{k}{2(2)}$ preferring instead to differentiate and equate to zero. But such candidates were in the minority as substituting $x = 1.25$ into the given quadratic and equating to zero produced the popular, but erroneous, answer of -5.7. Recovery was possible for the next two marks if this incorrect value had been seen to be substituted into the correct quadratic, along with $x = 1.25$ to arrive at an answer of 0. This would have given (M1)(A1)(ft). However, candidates who had an answer of $k = -5.7$ in part (a)(i), invariably showed no working in part (ii) and consequently earned no marks here. Irrespective of incorrect working in part (a), the quadratic function clearly passes through (0, 4) and has a minimum at $x = 1.25$. Using this information, a minority of candidates picked up at least one of the two marks in part (b).

2b. *[2 marks]*

Markscheme



(A1)*(ft)*(A1)*(ft)** ***(C2)

Notes: Award ***(A1)*(ft)** for a curve with correct concavity consistent with their k passing through (0, 4).

***(A1)*(ft)** for minimum in approximately the correct place. Follow through from their part (a).

[2 marks]

Examiners report

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3a. *[2 marks]*

Markscheme

$80 = 16 + k(c^0)$ ***(M1)***

$k = 64$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

This was perhaps the most difficult question on the paper. Being the last question some candidates may have felt that they were under pressure to complete and many scripts showed no attempt at an answer to this question. The response by the upper quartile of candidates was quite encouraging with many achieving at least 4 of the 6 marks available. For the rest, many fell at the first hurdle and were unable to obtain a value of k. This, in turn, led to problems in finding c. For a large number of candidates the only mark that they achieved was identifying that the asymptote was a linear equation in y.

3b. *[2 marks]*

Markscheme

$48 = 16 + 64(c^{-2})$ ***(M1)***

Note: Award ***(M1)*** for substitution of their k and $(2, 48)$ into the equation for $g(x)$.

$c = \sqrt{2}$ (1.41) ($1.41421\ldots$) ***(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)(A1)*****(ft)** for $c = \pm\sqrt{2}$. Follow through from their answer to part (a).

[2 marks]

Examiners report

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3c. *[2 marks]*

Markscheme

$y = 16$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $y =$ a constant, ***(A1)*** for 16.

[2 marks]

Examiners report

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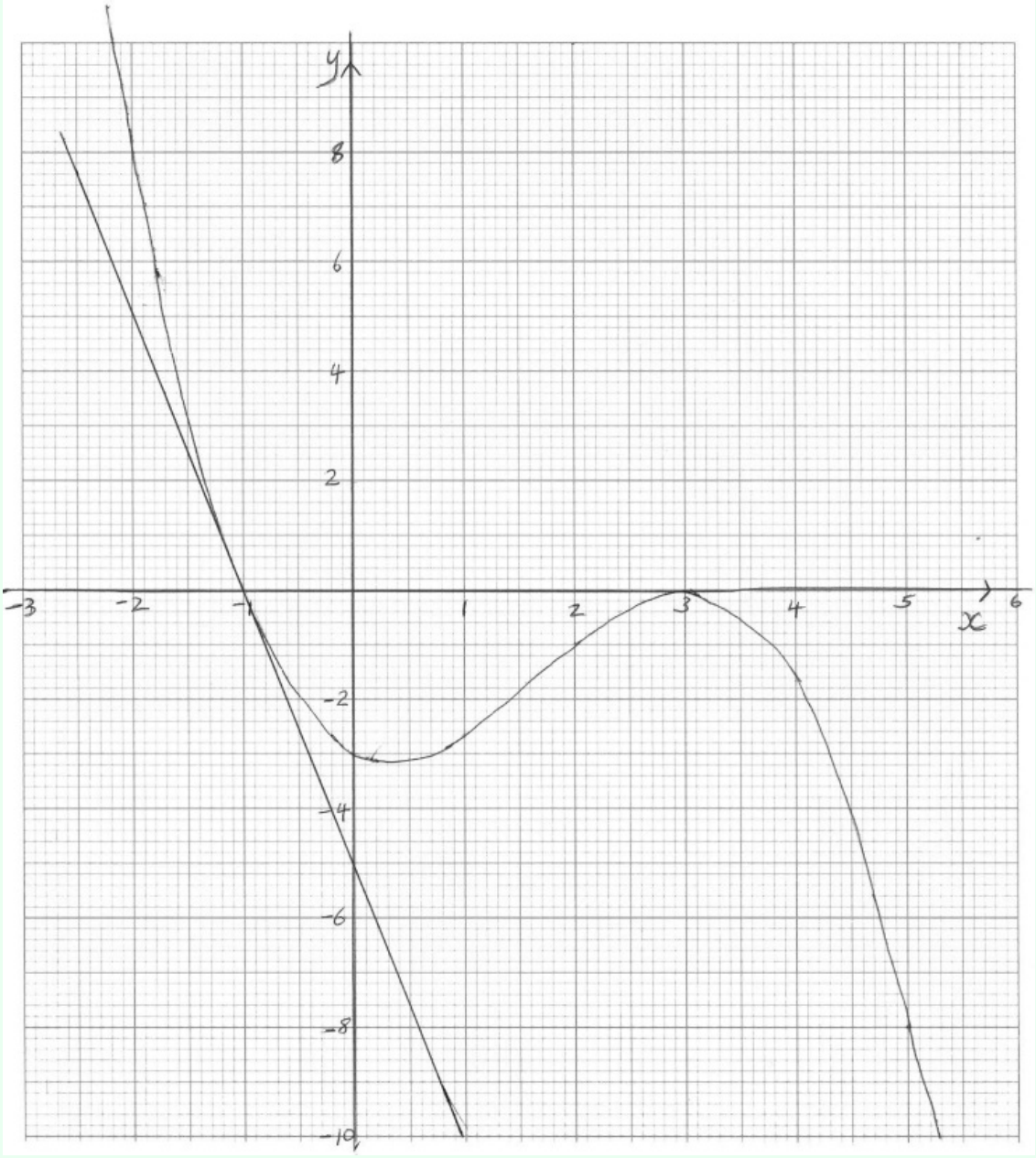
y.

4a. *[4 marks]*

Markscheme



(A1) for indication of window and labels. ***(A1)*** for smooth curve that does not enter the first quadrant, the curve must consist of one line only.

(A1) for x and y intercepts in approximately correct positions (allow ±0.5).

(A1) for local maximum and minimum in approximately correct position. (minimum should be $0 \le x \le 1$ and $-2 \le y \le -4$), the y-coordinate of the maximum should be 0 ± 0.5. ***(A4)***

[4 marks]

Examiners report

This question caused the most difficulty to candidates for two reasons; its content and perhaps lack of time.

Drawing/sketching graphs is perhaps the area of the course that results in the poorest responses. It is also the area of the course that results in the best. It is therefore the area of the course that good teaching can influence the most.

Candidates should:

- Use the correct scale and window. Label the axes.
- Enter the formula into the GDC and use the table function to determine the points to be plotted.
- Refer to the graph on the GDC when drawing the curve.
- Draw a curve rather than line segments; ensure that the curve is smooth.
- Use a pencil rather than a pen so that required changes once further information has been gathered (the turning points, for example) can be made.

4b. *[2 marks]*

Markscheme

$-\frac{1}{3}(-1)^3+\frac{5}{3}(-1)^2-(-1)-3$ ***(M1)***

Note: Award ***(M1)*** for substitution of –1 into $f(x)$

$= 0$ ***(A1)(G2)***

[2 marks]

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- Use a pencil rather than a pen so that required changes once further information has been gathered (the turning points, for example) can be made.

In part (b) the answer could have been checked using the table on the GDC.

4c. *[1 mark]*

Markscheme

(0, –3) ***(A1)***

OR

$x = 0, y = -3$ ***(A1)***

Note: Award ***(A0)*** if brackets are omitted.

[1 mark]

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In part (c) **coordinates** were required.

4d. *[3 marks]*

Markscheme

$f'(x) = -x^2 + \frac{10}{3}x - 1$ ***(A1)(A1)(A1)***

Note: Award ***(A1)*** for each correct term. Award ***(A1)(A1)(A0)*** at most if there are extra terms.

[3 marks]

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- Use a pencil rather than a pen so that required changes once further information has been gathered (the turning points, for example) can be made.

The responses to part (d) were generally correct.

4e. *[1 mark]*

Markscheme

$f'(-1) = -(-1)^2 + \frac{10}{3}(-1) - 1$ ***(M1)***

$= -\frac{16}{3}$ ***(AG)***

Note: Award ***(M1)*** for substitution of $x = -1$ into correct derivative only. The final answer must be seen.

[1 mark]

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The "show that" nature of part (e) meant that the final answer had to be stated.

4f. *[2 marks]*

Markscheme

$f'(-1)$ gives the gradient of the tangent to the curve at the point with $x = -1$. ***(A1)(A1)***

Note: Award ***(A1)*** for "gradient (of curve)", ***(A1)*** for "at the point with $x = -1$". Accept "the instantaneous rate of change of y" or "the (first) derivative".

[2 marks]

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The interpretive nature of part (f) was not understood by the majority.

4g. *[2 marks]*

Markscheme

$y = -\frac{16}{3}x + c$ ***(M1)***

Note: Award ***(M1)*** for $-\frac{16}{3}$ substituted in equation.

$0 = -\frac{16}{3} \times (-1) + c$

$c = -\frac{16}{3}$

$y = -\frac{16}{3}x - \frac{16}{3}$ ***(A1)(G2)***

Note: Accept $y = -5.33x - 5.33$.

OR

$(y - 0) = \frac{-16}{3}(x + 1)$ ***(M1)(A1)(G2)***

Note: Award ***(M1)*** for $-\frac{16}{3}$ substituted in equation, ***(A1)*** for correct equation. Follow through from their answer to part (b). Accept $y = -5.33\ (x + 1)$. Accept equivalent equations.

[2 marks]

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4h. *[2 marks]*

Markscheme

(A1)**(ft)** for a tangent to their curve drawn.

(A1)**(ft)** for their tangent drawn at the point $x = -1$. ***(A1)*****(ft)*****(A1)*****(ft)**

Note: Follow through from their graph. The tangent must be a straight line otherwise award at most ***(A0)(A1)***.

[2 marks]

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4i. *[2 marks]*

Markscheme

(i)

$a = \frac{1}{3}$ ***(G1)***

(ii)

$b = 3$ ***(G1)***

Note: If a and b are reversed award ***(A0)(A1)***.

[2 marks]

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Parts (i) and (j) had many candidates floundering; there were few good responses to these parts.

4j. *[1 mark]*

Markscheme

$f(x)$ is increasing ***(A1)***

[1 mark]

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5a. *[4 marks]*

Markscheme

(i) $2^0 + 3$ ***(M1)***

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

$= 4$ ***(A1)*** ***(C2)***

(ii) $3.5 = 2^{-b} + 3$ ***(M1)***

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

$b = 1$ ***(A1)*** ***(C2)***

[4 marks]

Examiners report

Most candidates answered parts (a) i and ii correctly, however a large number of candidates could not find the correct equation for part (b).

5b. *[2 marks]*

Markscheme

$y = 3$ ***(A1)(A1)*** ***(C2)***

Notes: y = constant (other than 3) award ***(A1)(A0)***.

[2 marks]

Examiners report

Most candidates answered parts (a) i and ii correctly, however a large number of candidates could not find the correct equation for part (b).

6a. *[5 marks]*

Markscheme

(i)

$x = 0$ ***(A1)(A1)***

Note: Award ***(A1)*** for $x =$ a constant, ***(A1)*** for the constant in their equation being 0.

(ii)

-1.58 ($-1.58454\ldots$) ***(G1)***

Note: Accept -1.6, do not accept -2 or -1.59.

(iii)

$(2.06, 4.49)$

$(2.06020\ldots, 4.49253\ldots)$ ***(G1)(G1)***

Note: Award at most ***(G1)(G0)*** if brackets not used. Award ***(G0)(G1)*****(ft)** if coordinates are reversed.

Note: Accept $x = 2.06$, $y = 4.49$.

Note: Accept 2.1, do not accept 2.0 or 2. Accept 4.5, do not accept 5 or 4.50.

[5 marks]

Examiners report

As usual, the content in this question caused difficulty for many candidates. However, for those with a sound grasp of the topic, there were many very successful attempts. The curve was given so that a comparison could be made to a GDC version and the correct form of the derivative was also given to permit weaker candidates to progress to the latter stages. Unfortunately, some decided to proceed with their own incorrect versions, in which case **very limited follow through accrued**. It should be emphasized to candidates that when an answer is given in this way it should be used in subsequent parts of the question.

As in previous years, much of the question could have been answered successfully by using the GDC. However, it was also clear that a large number of candidates did not attempt either to verify their work with their GDC or to use it in place of an algebraic approach.

Differentiation of terms with negative indices remains a testing process for the majority; it will continue to be tested. Some centres still do not teach the differential calculus.

6b. *[4 marks]*

Markscheme

$f'(x) = 2x - 2 - \frac{9}{x^2}$ ***(A1)(A1)(A1)(A1)***

Notes: Award ***(A1)*** for $2x$, ***(A1)*** for -2, ***(A1)*** for -9, ***(A1)*** for x^{-2} . Award a maximum of ***(A1)(A1)(A1)(A0)*** if there are extra terms present.

[4 marks]

Examiners report

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6c. *[2 marks]*

Markscheme

$f'(x) = \frac{x^2(2x-2)}{x^2} - \frac{9}{x^2}$ ***(M1)***

Note: Award ***(M1)*** for taking the correct common denominator.

$= \frac{(2x^3-2x^2)}{x^2} - \frac{9}{x^2}$ ***(M1)***

Note: Award ***(M1)*** for multiplying brackets or equivalent.

$= \frac{2x^3-2x^2-9}{x^2}$ ***(AG)***

Note: The final ***(M1)*** is not awarded if the given answer is not seen.

[2 marks]

Examiners report

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6d. *[2 marks]*

Markscheme

$f'(1) = \frac{2(1)^3-2(1)-9}{(1)^2}$ ***(M1)***

$= -9$ ***(A1)(G2)***

Note: Award ***(M1)*** for substitution into **given** (or their correct) $f'(x)$. There is no follow through for use of their incorrect derivative.

[2 marks]

Examiners report

As usual, the content in this question caused difficulty for many candidates. However, for those with a sound grasp of the topic, there were many very successful attempts. The curve was given so that a comparison could be made to a GDC version and the correct form of the derivative was also given to permit weaker candidates to progress to the latter stages. Unfortunately, some decided to proceed with their own incorrect versions, in which case **very limited follow through accrued**. It should be emphasized to candidates that when an answer is given in this way it should be used in subsequent parts of the question.

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6e. *[1 mark]*

Markscheme

$\frac{1}{9}$ ***(A1)*****(ft)**

Note: Follow through from part (d).

[1 mark]

Examiners report

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6f. *[3 marks]*

Markscheme

$y - 8 = \frac{1}{9}(x - 1)$ ***(M1)(M1)***

Notes: Award ***(M1)*** for substitution of their gradient from (e), ***(M1)*** for substitution of given point. Accept all forms of straight line.

$y = \frac{1}{9}x + \frac{71}{9}$ (
$y = 0.111111\ldots x + 7.88888\ldots$) ***(A1)*****(ft)*****(G3)***

Note: Award the final ***(A1)*****(ft)** for a correctly rearranged formula of **their** straight line in (f). Accept
$0.11x$, do not accept
$0.1x$. Accept
7.9, do not accept
7.88, do not accept
7.8.

[3 marks]

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As usual, the content in this question caused difficulty for many candidates. However, for those with a sound grasp of the topic, there were many very successful attempts. The curve was given so that a comparison could be made to a GDC version and the correct form of the derivative was also given to permit weaker candidates to progress to the latter stages. Unfortunately, some decided to proceed with their own incorrect versions, in which case **very limited follow through accrued**. It should be emphasized to candidates that when an answer is given in this way it should be used in subsequent parts of the question.

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Differentiation of terms with negative indices remains a testing process for the majority; it will continue to be tested. Some centres still do not teach the differential calculus.

6g. *[2 marks]*

Markscheme

-2.50,
3.61 (
$-2.49545\ldots$,
$3.60656\ldots$) ***(A1)*(ft)*(A1)*(ft)**

Notes: Follow through from their line
L from part (f) even if no working shown. Award at most ***(A0)(A1)*(ft)** if their correct coordinate pairs given.

Note: Accept
-2.5, do not accept
-2.49. Accept
3.6, do not accept
3.60.

[2 marks]

Examiners report

As usual, the content in this question caused difficulty for many candidates. However, for those with a sound grasp of the topic, there were many very successful attempts. The curve was given so that a comparison could be made to a GDC version and the correct form of the derivative was also given to permit weaker candidates to progress to the latter stages. Unfortunately, some decided to proceed with their own incorrect versions, in which case **very limited follow through accrued**. It should be emphasized to candidates that when an answer is given in this way it should be used in subsequent parts of the question.

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7a. *[2 marks]*

Markscheme

(i)
14 m ***(A1)***

(ii)
26 m ***(A1)***

[2 marks]

Examiners report

Most candidates were able to start this question. Those of an average ability completed it to the end of part (c) and the best gained good success in the latter parts. Its purpose was to discriminate at the highest level and this it did.

Some concerns were raised on the G2 forms as to the appropriateness of this question. However, the MSSL course tries in part to link areas of the syllabus to "real-life" situations and address these. A look back to past years' examination papers, and to the syllabus documentation, should yield similar examples.

7b. *[2 marks]*

Markscheme

A:
10, B:
30 ***(A1)(A1)***

[2 marks]

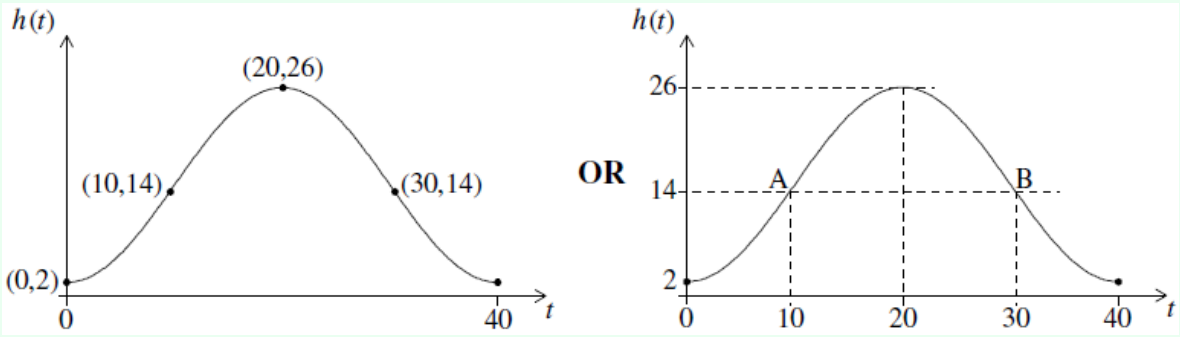
Examiners report

Most candidates were able to start this question. Those of an average ability completed it to the end of part (c) and the best gained good success in the latter parts. Its purpose was to discriminate at the highest level and this it did.

Some concerns were raised on the G2 forms as to the appropriateness of this question. However, the MSSL course tries in part to link areas of the syllabus to "real-life" situations and address these. A look back to past years' examination papers, and to the syllabus documentation, should yield similar examples.

7c. *[4 marks]*

Markscheme



***(A1)*(ft)*(A1)*(ft)*(A1)*(ft)*(A1)*(ft)**

Note: Award ***(A1)*(ft)** for coordinates of each point clearly indicated either by scale or by coordinate pairs. Points need not be labelled A and B in the second diagram. Award a maximum of ***(A1)(A0)(A1)*(ft)*(A1)*(ft)** if coordinates are reversed. Do not penalise reversed coordinates if this has already been penalised in Q4(a)(iii).

[4 marks]

Examiners report

Most candidates were able to start this question. Those of an average ability completed it to the end of part (c) and the best gained good success in the latter parts. Its purpose was to discriminate at the highest level and this it did.

Some concerns were raised on the G2 forms as to the appropriateness of this question. However, the MSSL course tries in part to link areas of the syllabus to "real-life" situations and address these. A look back to past years' examination papers, and to the syllabus documentation, should yield similar examples.

8a. *[3 marks]*

Markscheme

$x = -\frac{4}{-2}$ ***(M1)***
$x = 2$ ***(A1)***

OR

$\frac{dy}{dx} = 4 - 2x$ ***(M1)***
$x = 2$ ***(A1)***
$(2, 7)$ or
$x = 2,$
$y = 7$ ***(A1)*** ***(C3)***

Notes: Award ***(M1)(A1)(A0)*** for 2, 7 without parentheses.

[3 marks]

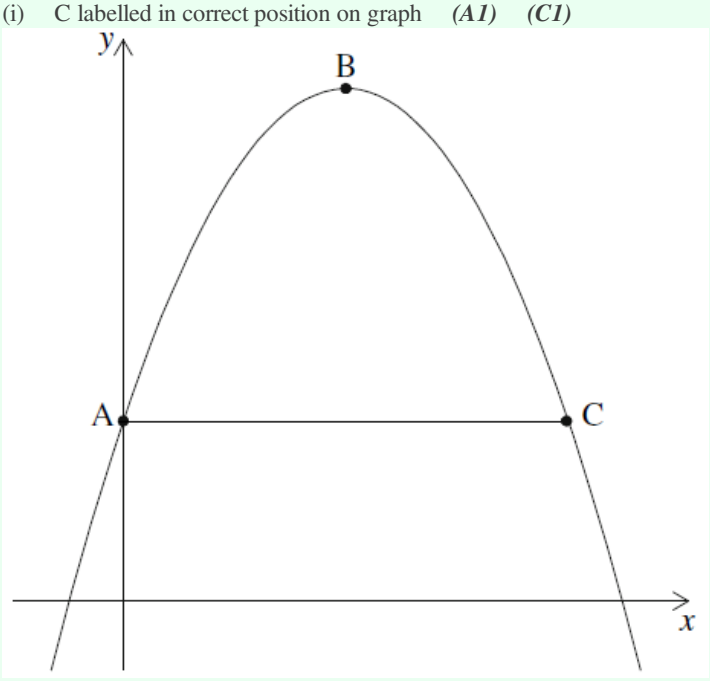
Examiners report

In part b, the point C was sometimes not labelled or not shown on the graph provided. Candidates using their GDC to find the coordinates of the vertex needed to translate their calculator answer to the exact mathematical answer. Answers of
$(1.9, 7)$ or
$(2.1, 7)$ did not achieve the maximum number of marks. A common response in part c was to give
$(4, 3)$, with no working shown. This incurred a penalty of one mark. The correct answer to this question was
$x = 4$.

8b. *[3 marks]*

Markscheme

(i) C labelled in correct position on graph ***(A1)*** ***(C1)***



(ii)

$3 = 3 + 4x - x^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of $y = 3$ into quadratic.

$(x =)4$ ***(A1)*** ***(C2)***

OR

Using symmetry of graph

$x = 2 + 2$. ***(M1)***

Note: Follow through from their x-coordinate of the vertex.

$(x =)4$ ***(A1)*****(ft)** ***(C2)***

[3 marks]

Examiners report

In part b, the point C was sometimes not labelled or not shown on the graph provided. Candidates using their GDC to find the coordinates of the vertex needed to translate their calculator answer to the exact mathematical answer. Answers of $(1.9, 7)$ or $(2.1, 7)$ did not achieve the maximum number of marks.

9a. *[2 marks]*

Markscheme

$y = 1.25 - a^0$
$1.25 - 1$ ***(M1)***

$= 0.25$ ***(A1)*** ***(C2)***

Note: Award ***(M1)(A1)*** for $(0, 0.25)$.

[2 marks]

Examiners report

Very few candidates showed working and subsequently lost marks due to this. Many candidates seemed to forget that $a^0 = 1$ and not 0.

9b. *[2 marks]*

Markscheme

$1 = 1.25 - a^{-2}$ ***(M1)***
$a = 2$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

Very few candidates showed working and subsequently lost marks due to this. Many candidates seemed to forget that $a^0 = 1$ and not 0.

9c. *[2 marks]*

Markscheme

$y = 1.25$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for $y =$ "a constant", ***(A1)*** for 1.25.

[2 marks]

Examiners report

Very few candidates showed working and subsequently lost marks due to this. Many candidates seemed to forget that $a^0 = 1$ and not 0.

10a. *[2 marks]*

Markscheme

$f(2) = 2^3 + \frac{48}{2}$ ***(M1)***

$= 32$ ***(A1)(G2)***

[2 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

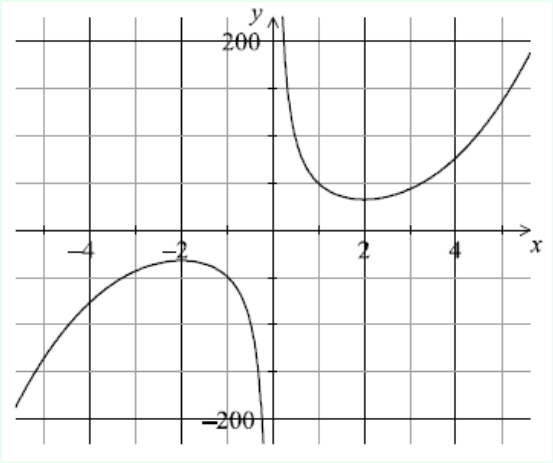
The majority of sketches were drawn sloppily and with little attention to detail. Teachers must impress on their students that a mathematical sketch is designed to illustrate the main points of a curve – the smooth nature by which it changes, any symmetries (reflectional or rotational), positions of turning points, intercepts with axes and the behaviour of a curve as it approaches an asymptote. There must also be some indication of the dimensions used for the "window".

Differentiation of terms with negative indices remains a testing process for the majority; it will continue to be tested.

It was also evident that some centres do not teach the differential calculus.

10b. *[4 marks]*

Markscheme



(A1) for labels and some indication of scale in an appropriate window
(A1) for correct shape of the two unconnected and smooth branches
(A1) for maximum and minimum in approximately correct positions
(A1) for asymptotic behaviour at
y-axis ***(A4)***

Notes: Please be rigorous.
The axes need not be drawn with a ruler.
The branches must be smooth: a single continuous line that does not deviate from its proper direction.
The position of the maximum and minimum points must be symmetrical about the origin.
The
y-axis must be an asymptote for both branches. Neither branch should touch the axis nor must the curve approach the asymptote then deviate away later.

[4 marks]

Examiners report

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10c. *[3 marks]*

Markscheme

$f'(x) = 3x^2 - \frac{48}{x^2}$ ***(A1)(A1)(A1)***

Notes: Award ***(A1)*** for $3x^2$, ***(A1)*** for -48, ***(A1)*** for x^{-2}. Award a maximum of ***(A1)(A1)(A0)*** if extra terms seen.

[3 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

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10d. *[2 marks]*

Markscheme

$f'(2) = 3(2)^2 - \frac{48}{(2)^2}$ ***(M1)***

Note: Award ***(M1)*** for substitution of $x = 2$ into their derivative.

$= 0$ ***(A1)*****(ft)*****(G1)***

[2 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

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10e. *[2 marks]*

Markscheme

$(-2,\ -32)$ or
$x = -2$,
$y = -32$ ***(G1)(G1)***

Notes: Award ***(G0)(G0)*** for
$x = -32$,
$y = -2$. Award at most ***(G0)(G1)*** if parentheses are omitted.

[2 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

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10f. *[3 marks]*

Markscheme

$\{y \geqslant 32\} \cup \{y \leqslant -32\}$ ***(A1)(A1)*****(ft)*****(A1)*****(ft)**

Notes: Award ***(A1)*****(ft)**
$y \geqslant 32$ or
$y > 32$ seen, ***(A1)*****(ft)** for
$y \leqslant -32$ or
$y < -32$, ***(A1)*** for weak (non-strict) inequalities used in both of the above.
Accept use of
f in place of
y. Accept alternative interval notation.
Follow through from their (a) and (e).
If domain is given award ***(A0)(A0)(A0)***.
Award ***(A0)(A1)*****(ft)*****(A1)*****(ft)** for
$[-200,\ -32]$,
$[32, 200]$.
Award ***(A0)(A1)*****(ft)*****(A1)*****(ft)** for
$]-200,\ -32]$,
$[32, 200[$.

[3 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

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10g. *[2 marks]*

Markscheme

$f'(1) = -45$ ***(M1)(A1)*****(ft)*****(G2)***

Notes: Award ***(M1)*** for
$f'(1)$ seen or substitution of
$x = 1$ into their derivative. Follow through from their derivative if working is seen.

[2 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

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10h. *[2 marks]*

Markscheme

$x = -1$ ***(M1)(A1)*****(ft)*****(G2)***

Notes: Award ***(M1)*** for equating their derivative to their
-45 or for seeing parallel lines on their graph in the approximately correct position.

[2 marks]

Examiners report

As usual and by intention, this question caused the most difficulty in terms of its content; however, for those with a sound grasp of the topic, there were many very successful attempts. Much of the question could have been answered successfully by using the GDC, however, it was also clear that a number of candidates did not connect the question they were attempting with the curve that they had either sketched or were viewing on their GDC. Where there was no alternative to using the calculus, many candidates struggled.

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11a. *[1 mark]*

25000 USD

Examiners report

A substituted value of
$t = 1$ in part (a) saw many incorrect answers of
23052.70 for this part of the question. Part (b) was better attempted with many correct answers seen. Many candidates picked up the first two marks of part (c) equating a correct expression to half their answer found in part (a). Many though did not seem to know the correct process of using their GDC to find the required answer. Much *trial and improvement* was seen here with varying degrees of success.

11b. *[2 marks]*

Markscheme

$25000 \times 1.5^{-0.6}$ ***(M1)***
19601.32 USD ***(A1)*** ***(C2)***

[2 marks]

Examiners report

A substituted value of
$t = 1$ in part (a) saw many incorrect answers of
23052.70 for this part of the question. Part (b) was better attempted with many correct answers seen. Many candidates picked up the first two marks of part (c) equating a correct expression to half their answer found in part (a). Many though did not seem to know the correct process of using their GDC to find the required answer. Much *trial and improvement* was seen here with varying degrees of success.

11c. *[3 marks]*

Markscheme

$12500 = 25000 \times 1.5^{-0.2t}$ ***(A1)*****(ft)*****(M1)***

Notes: Award ***(A1)*****(ft)** for
12500 seen. Follow through from their answer to part (a). Award ***(M1)*** for equating their half value to
$25000 \times 1.5^{-0.2t}$. Allow the use of an inequality.

OR

Graphical method (sketch):

(A1)**(ft)** for
$y = 12500$ seen on the sketch. Follow through from their answer to part (a). ***(A1)*****(ft)**

(M1) for the exponent model and an indication of their intersection with their horizontal line. ***(M1)***

8.55 ***(A1)*****(ft)** ***(C3)***

[3 marks]

Examiners report

A substituted value of
$t = 1$ in part (a) saw many incorrect answers of
23052.70 for this part of the question. Part (b) was better attempted with many correct answers seen. Many candidates picked up the first two marks of part (c) equating a correct expression to half their answer found in part (a). Many though did not seem to know the correct process of using their GDC to find the required answer. Much *trial and improvement* was seen here with varying degrees of success.

12a. *[2 marks]*

Markscheme

$x = 0$ ***(A1)(A1)***

Note: Award ***(A1)*** for $x =$ constant, ***(A1)*** for 0.

[2 marks]

Examiners report

Part a) was either answered well or poorly.

12b. *[3 marks]*

Markscheme

$f'(x) = 1.5 - \frac{6}{x^2}$ ***(A1)(A1)(A1)***

Notes: Award ***(A1)*** for 1.5, ***(A1)*** for -6, ***(A1)*** for x^{-2} . Award ***(A1)(A1)(A0)*** at most if any other term present.

[3 marks]

Examiners report

Most candidates found the first term of the derivative in part b) correctly, but the rest of the terms were incorrect.

12c. *[2 marks]*

Markscheme

$1.5 - \frac{6}{(-1)}$ ***(M1)***

$= -4.5$ ***(A1)*****(ft)*****(G2)***

Note: Follow through from their derivative function.

[2 marks]

Examiners report

The gradient in c) was for the most part correctly calculated, although some candidates substituted incorrectly in $f(x)$ instead of in $f'(x)$.

12d. *[2 marks]*

Markscheme

Decreasing, the derivative (gradient or slope) is negative (at $x = -1$) ***(A1)(R1)*****(ft)**

Notes: Do not award ***(A1)(R0)***. Follow through from their answer to part (c).

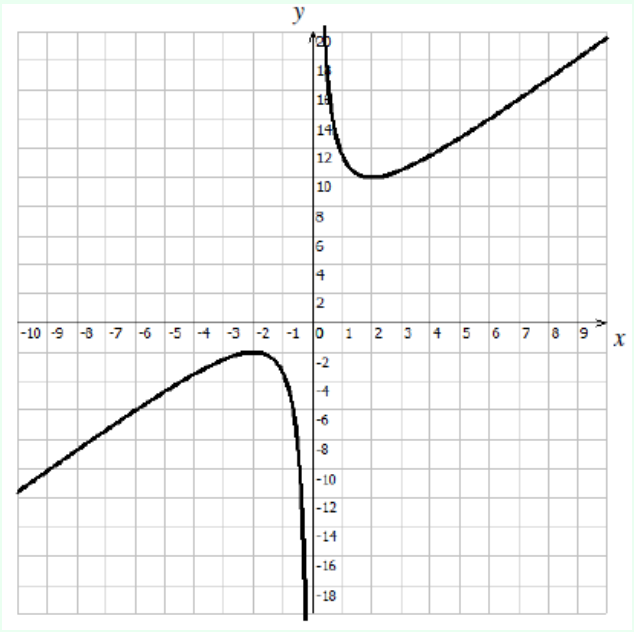
[2 marks]

Examiners report

Part d) had mixed responses.

12e. *[4 marks]*

Markscheme



(A4)

Notes: Award ***(A1)*** for labels and some indication of scales and an appropriate window.

Award ***(A1)*** for correct shape of the two unconnected, and smooth branches.

Award ***(A1)*** for the maximum and minimum points in the approximately correct positions.

Award ***(A1)*** for correct asymptotic behaviour at
$x = 0$.

Notes: Please be rigorous.

The axes need not be drawn with a ruler.

The branches must be smooth and single continuous lines that do not deviate from their proper direction.

The max and min points must be symmetrical about point
$(0, 4)$.

The
y-axis must be an asymptote for **both** branches.

[4 marks]

Examiners report

Lack of labels of the axes, appropriate scale, window, incorrect maximum and minimum and incorrect asymptotic behaviour were the main problems with the sketches in e).

12f. *[4 marks]*

Markscheme

(i)
$(-2,\ -2)$ or
$x = -2$,
$y = -2$ ***(G1)(G1)***

(ii)
$(2, 10)$ or
$x = 2$,
$y = 10$ ***(G1)(G1)***

[4 marks]

Examiners report

Part f) was also either answered correctly or entirely incorrectly. Some candidates used the trace function on the GDC instead of the min and max functions, and thus acquired coordinates with unacceptable accuracy. Some were unclear that a point of local maximum may be positioned on the coordinate system "below" the point of local minimum, and exchanged the pairs of coordinates of those points in f(i) and f(ii).

12g. *[3 marks]*

Markscheme

$\{-2 \geqslant y\}$ or
$\{y \geqslant 10\}$ ***(A1)(A1)*****(ft)*****(A1)***

Notes: ***(A1)*****(ft)** for
$y > 10$ or
$y \geqslant 10$. ***(A1)*****(ft)** for
$y < -2$ or
$y \leqslant -2$. ***(A1)*** for weak (non-strict) inequalities used in **both** of the above. Follow through from their (e) and (f).

[3 marks]

Examiners report

Very few candidates were able to identify the range of the function in (g) irrespective of whether or not they had the sketches drawn correctly.

13. *[6 marks]*

Markscheme

(i) B ***(A1)***

(ii) D ***(A1)***

(iii) A ***(A1)***

(iv) E ***(A1)***

(v) C ***(A1)***

(vi) F ***(A1)*** ***(C6)***

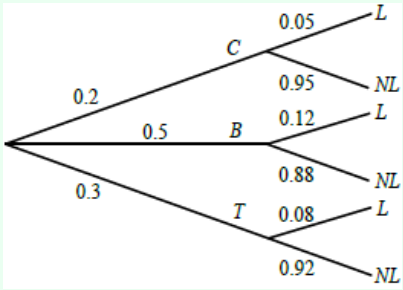
[6 marks]

Examiners report

Nearly all the candidates scored 6 marks for this question.Without any working shown it was difficult to say where the errors might have arisen from the few candidates who did not score full marks. However, it was obvious that the candidates were using their GDC's to graph the functions.

14a. *[5 marks]*

Markscheme



Award ***(A1)*** *for 0.5 at B,* ***(A1)*** *for 0.3 at T, then* ***(A1)*** *for each correct pair. Accept fractions or percentages.* ***(A5)***

[5 marks]

Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

14b. *[1 mark]*

Markscheme

0.06 (*accept*
0.5×0.12 *or* 6%) ***(A1)*****(ft)**

[1 mark]

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This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

14c. *[3 marks]*

Markscheme

for a relevant two-factor product, either
$C \times L$ *or*
$T \times L$ ***(M1)***

for summing three two-factor products ***(M1)***

$(0.2 \times 0.05 + 0.06 + 0.3 \times 0.08)$

0.094 ***(A1)*****(ft)*****(G2)***

[3 marks]

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This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

14d. *[3 marks]*

Markscheme

$\frac{0.3 \times 0.08}{0.094}$ ***(M1)******(A1)*****(ft)**

award ***(M1)*** *for substituted conditional probability formula seen,* ***(A1)*****(ft)** *for correct substitution*

$= 0.255$ ***(A1)*****(ft)*****(G2)***

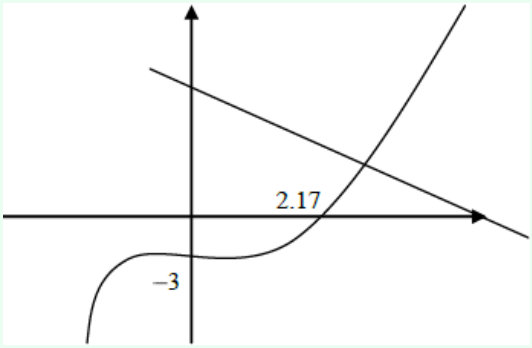
[3 marks]

Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

14e. *[3 marks]*

Markscheme



(G3)

[3 marks]

Examiners report

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The curve sketching and straight line were well drawn but not all candidates indicated the intersection points with the axes. In finding the line / curve intersection some candidates did not use the intersection function on the GDC. Few candidates managed the last part. Many just chose two sets of coordinates and used the gradient formula.

14f. *[3 marks]*

Markscheme

line drawn with ***–ve*** *gradient and* ***+ve*** *y-intercept* ***(G1)***

(2.45, 2.11) ***(G1)(G1)***

[3 marks]

Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

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14g. *[2 marks]*

Markscheme

$f'(1.7) = 3(1.7)^2 - 4(1.7) + 1$ ***(M1)***

award ***(M1)*** *for substituting in their* \(f' (x)\)

2.87 ***(A1)(G2)***

[2 marks]

Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

The curve sketching and straight line were well drawn but not all candidates indicated the intersection points with the axes. In finding the line / curve intersection some candidates did not use the intersection function on the GDC. Few candidates managed the last part. Many just chose two sets of coordinates and used the gradient formula.

15a. *[1 mark]*

Markscheme

*Unit penalty **(UP)** is applicable in part (i)(a)(c)(d)(e) and (f)*

(UP) 90°C ***(A1)***

[1 mark]

Examiners report

Many candidates who had not lost a UP in question 2 lost one here. Parts (a), (c) and (d) were reasonably well tackled. Almost everybody had difficulty with the equation of the horizontal asymptote, a common answer being $y = 20$. Most of the candidates realised that 30 seconds was 0.5 minutes and calculated part (e) correctly. Part (f), solving an exponential equation, was a good discriminator. Trial and error was expected but many students did not think of doing this.

15b. *[1 mark]*

Markscheme

$y = 16$ ***(A1)***

[1 mark]

Examiners report

Many candidates who had not lost a UP in question 2 lost one here. Parts (a), (c) and (d) were reasonably well tackled. Almost everybody had difficulty with the equation of the horizontal asymptote, a common answer being $y = 20$. Most of the candidates realised that 30 seconds was 0.5 minutes and calculated part (e) correctly. Part (f), solving an exponential equation, was a good discriminator. Trial and error was expected but many students did not think of doing this.

15c. *[1 mark]*

Markscheme

*Unit penalty **(UP)** is applicable in part (i)(a)(c)(d)(e) and (f)*

(UP) 16°C **(ft)** *from answer to part (b)* ***(A1)*****(ft)**

[1 mark]

Examiners report

Many candidates who had not lost a UP in question 2 lost one here. Parts (a), (c) and (d) were reasonably well tackled. Almost everybody had difficulty with the equation of the horizontal asymptote, a common answer being $y = 20$. Most of the candidates realised that 30 seconds was 0.5 minutes and calculated part (e) correctly. Part (f), solving an exponential equation, was a good discriminator. Trial and error was expected but many students did not think of doing this.

15d. *[1 mark]*

Markscheme

*Unit penalty **(UP)** is applicable in part (i)(a)(c)(d)(e) and (f)*

(UP) 25.4°C ***(A1)***

[1 mark]

Examiners report

Many candidates who had not lost a UP in question 2 lost one here. Parts (a), (c) and (d) were reasonably well tackled. Almost everybody had difficulty with the equation of the horizontal asymptote, a common answer being $y = 20$. Most of the candidates realised that 30 seconds was 0.5 minutes and calculated part (e) correctly. Part (f), solving an exponential equation, was a good discriminator. Trial and error was expected but many students did not think of doing this.

15e. *[3 marks]*

Markscheme

*Unit penalty **(UP)** is applicable in part (i)(a)(c)(d)(e) and (f)*

for seeing $2^{0.75}$ *or equivalent* ***(A1)***

for multiplying their (d) by their $2^{0.75}$ ***(M1)***

(UP) 42.8°C ***(A1)*****(ft)*****(G2)***

[3 marks]

Examiners report

Many candidates who had not lost a UP in question 2 lost one here. Parts (a), (c) and (d) were reasonably well tackled. Almost everybody had difficulty with the equation of the horizontal asymptote, a common answer being $y = 20$. Most of the candidates realised that 30 seconds was 0.5 minutes and calculated part (e) correctly. Part (f), solving an exponential equation, was a good discriminator. Trial and error was expected but many students did not think of doing this.

15f. *[4 marks]*

Markscheme

*Unit penalty **(UP)** is applicable in part (i)(a)(c)(d)(e) and (f)*

for seeing
$20 \times 2^{1.5t} = 100$ ***(A1)***

for seeing a value of t *between* 1.54 *and* 1.56 *inclusive* ***(M1)(A1)***

(UP) 1.55 minutes or 92.9 seconds ***(A1)(G3)***

[4 marks]

Examiners report

Many candidates who had not lost a UP in question 2 lost one here. Parts (a), (c) and (d) were reasonably well tackled. Almost everybody had difficulty with the equation of the horizontal asymptote, a common answer being $y = 20$. Most of the candidates realised that 30 seconds was 0.5 minutes and calculated part (e) correctly. Part (f), solving an exponential equation, was a good discriminator. Trial and error was expected but many students did not think of doing this.

15g. *[3 marks]*

Markscheme

*Financial accuracy penalty **(FP)** is applicable in part (ii) **only**.*

$120 - 3 = 117$

(FP)

117×1.37 ***(A1)***

= 160.29 euros *(correct answer only)* ***(M1)***

*first **(A1)** for 117 seen, **(M1)** for multiplying by 1.37* ***(A1)(G2)***

[3 marks]

Examiners report

The financial part was the best done question in the paper and a large majority of candidates gained full marks here.

15h. *[3 marks]*

Markscheme

*Financial accuracy penalty **(FP)** is applicable in part (ii) **only**.*

(FP)

$\frac{13.5}{1.37}$ ***(A1)(M1)***

9.85 GBP *(answer correct to 2dp only)*

*first **(A1)** is for 13.5 seen, **(M1)** for dividing by 1.37* ***(A1)(ft)(G3)***

[3 marks]

Examiners report

The financial part was the best done question in the paper and a large majority of candidates gained full marks here.

16a. *[1 mark]*

Markscheme

$50b + 20c = 260$ ***(A1)***

[1 mark]

Examiners report

Most candidates managed to write down the equation.

16b. *[1 mark]*

Markscheme

$12b + 6c = 66$ ***(A1)***

[1 mark]

Examiners report

Most candidates managed to write down the equation.

16c. *[2 marks]*

Markscheme

Solve to get
$b = 4$ ***(M1)(A1)*****(ft)*****(G2)***

Note: ***(M1)*** for attempting to solve the equations simultaneously.

[2 marks]

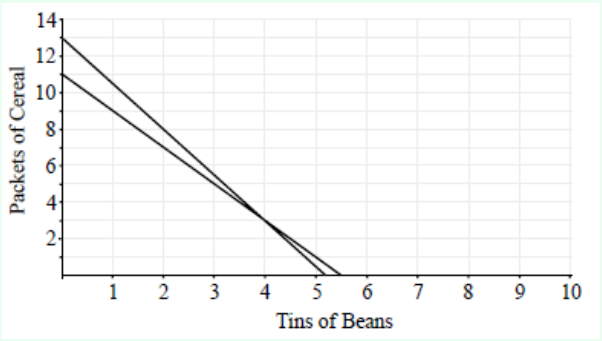
Examiners report

Many managed to find the correct answer and the others tried their best but made some mistake in the process.

16d. *[4 marks]*

Markscheme

(i)



(A1)(A1)(A1)

Notes: Award ***(A1)*** for labels and some idea of scale, ***(A1)*****(ft)*****(A1)*****(ft)** for each line.
The axis can be reversed.

(ii)
$(4, 3)$ or
$(3, 4)$ ***(A1)*****(ft)**

Note: Accept
$b = 4$,
$c = 3$

[4 marks]

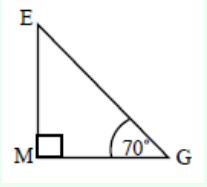
Examiners report

(i) Few candidates sketched the graphs well. Few used a ruler.

(ii) Many candidates could not be awarded ft from their graph because the answer they gave was not possible.

16e. *[1 mark]*

Markscheme



(A1)

[1 mark]

Examiners report

Very few correct drawings.

16f. *[2 marks]*

Markscheme

$\tan 70 = \frac{h}{5}$ ***(M1)***

$h = 5\tan 70 = 13.74$ ***(A1)***

$h = 13.7$ cm ***(AG)***

[2 marks]

Examiners report

Some managed to show this more by good fortune and ignoring their original triangle than by good reasoning.

16g. *[4 marks]*

Markscheme

*Unit penalty **(UP)** is applicable in this part of the question where indicated in the left hand column.*

(i)

$\text{EG}^2 = 5^2 + 13.7^2$ OR

$5^2 + (5\tan 70)^2$ ***(M1)***

(UP)

$\text{EG} = 14.6$ cm ***(A1)(G2)***

(ii)

$\text{DEC} = 2 \times \tan^{-1}\left(\frac{5}{14.6}\right)$ ***(M1)***

$= 37.8°$ ***(A1)*****(ft)*****(G2)***

[4 marks]

Examiners report

(i) Many found this as ft from the previous part. Some lost a UP here.

(ii) This was not well done. The most common answer was $40°$.

16h. *[2 marks]*

Markscheme

*Unit penalty **(UP)** is applicable in this part of the question where indicated in the left hand column.*

$\text{Area} = 10 \times 10 + 4 \times 0.5 \times 10 \times 14.619$ ***(M1)***

(UP)

$= 392$ cm^2 ***(A1)*****(ft)*****(G2)***

[2 marks]

Examiners report

Many managed this or were awarded ft points.

16i. *[2 marks]*

Markscheme

*Unit penalty **(UP)** is applicable in this part of the question where indicated in the left hand column.*

Volume $= \frac{1}{3} \times 10 \times 10 \times 13.7$ ***(M1)***

(UP)
$= 457 \text{ cm}^3$ (
458 cm^3) ***(A1)(G2)***

[2 marks]

Examiners report

This was well done and most candidates also remembered their units on this part.

17a. *[2 marks]*

Markscheme

$(3x-2)(x+5)$ ***(A1)(A1)***

[2 marks]

Examiners report

Most candidates made a good attempt to factorise the expression.

17b. *[2 marks]*

Markscheme

$(3x-2)(x+5)=0$

$x = \frac{2}{3}$ or
$x = -5$ ***(A1)*****(ft)*****(A1)*****(ft)*****(G2)***

[2 marks]

Examiners report

Many gained both marks here from a correct answer or ft from the previous part.

17c. *[2 marks]*

Markscheme

$x = \frac{-13}{6}$ (-2.17) ***(A1)(A1)*****(ft)*****(G2)***

Note: ***(A1)*** is for
$x =$, ***(A1)*** for value. **(ft)** if value is half way between roots in (b).

[2 marks]

Examiners report

Many used the formula correctly. Some forgot to put
$x =$.

17d. *[2 marks]*

Markscheme

Minimum

$y = 3\left(\frac{-13}{6}\right)^2 + 13\left(\frac{-13}{6}\right) - 10$ ***(M1)***

Note: ***(M1)*** for substituting their value of x from (c) into $f(x)$.

$= -24.1$ ***(A1)*****(ft)*****(G2)***

[2 marks]

Examiners report

Most candidates found this value from their GDC.

17e. *[2 marks]*

Markscheme

$\text{Area} = 2(2x)x + 2xy + 2(2x)y$ ***(M1)(A1)***

Note: ***(M1)*** for using the correct surface area formula (which can be implied if numbers in the correct place). ***(A1)*** for using correct numbers.

$300 = 4x^2 + 6xy$ ***(AG)***

Note: Final line must be seen or previous ***(A1)*** mark is lost.

[2 marks]

Examiners report

A good attempt was made to show the correct surface area.

17f. *[2 marks]*

Markscheme

$6xy = 300 - 4x^2$ ***(M1)***

$y = \frac{300-4x^2}{6x}$ *or* $\frac{150-2x^2}{3x}$ ***(A1)***

[2 marks]

Examiners report

Many could rearrange the equation correctly.

17g. *[2 marks]*

Markscheme

Volume $= x(2x)y$ ***(M1)***

$V = 2x^2\left(\frac{300-4x^2}{6x}\right)$ ***(A1)*****(ft)**

$= 100x - \frac{4}{3}x^3$ **(AG)**

Note: Final line must be seen or previous ***(A1)*** mark is lost.

[2 marks]

Examiners report

Although this was not a difficult question it probably looked complicated for the candidates and it was often left out.

17h. *[2 marks]*

Markscheme

$\frac{dV}{dx} = 100 - \frac{12x^2}{3}$ or
$100 - 4x^2$ ***(A1)(A1)***

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

[2 marks]

Examiners report

Those who reached this length could usually manage the differentiation.

17i. *[5 marks]*

Markscheme

Unit penalty ***(UP)*** *is applicable where indicated in the left hand column*

(i) For maximum
$\frac{dV}{dx} = 0$ or
$100 - 4x^2 = 0$ ***(M1)***

$x = 5$ ***(A1)*****(ft)**

$y = \frac{300-4(5)^2}{6(5)}$ or
$\left(\frac{150-2(5)^2}{3(5)}\right)$ ***(M1)***

$= \frac{20}{3}$ ***(A1)*****(ft)**

(UP) (ii)
$333\frac{1}{3}$ cm^3 (333 cm^3)

Note: **(ft)** from their (e)(i) if working for volume is seen.

[5 marks]

Examiners report

(i) Many found the correct value of
x but not of
y.

(ii) This was well done and again the units were included in most scripts.

18a. *[2 marks]*

Markscheme

$f(1) = \frac{k}{2^1}$ ***(M1)***

Note: ***(M1)*** for substituting $x = 1$ into the formula.

$\frac{k}{2} = 2$ ***(M1)***

Note: ***(M1)*** for equating to 2.

$k = 4$ ***(AG)***

[2 marks]

Examiners report

There were many well drawn graphs using correctly scaled and labelled axes with a good curve drawn. A number of students did not label the maximum point. Although many students showed in their graph the asymptotic behaviour of the curve, they did not know how to describe the asymptote. It was noticed that some students were tracing the curve to find the coordinates of the maximum instead of finding the maximum directly. The intersection between the line $y = 1$ and the curve was not always read from their graph but from their GDC's graph.

18b. *[2 marks]*

Markscheme

$q = 2$,
$r = 0.125$ ***(A1)(A1)***

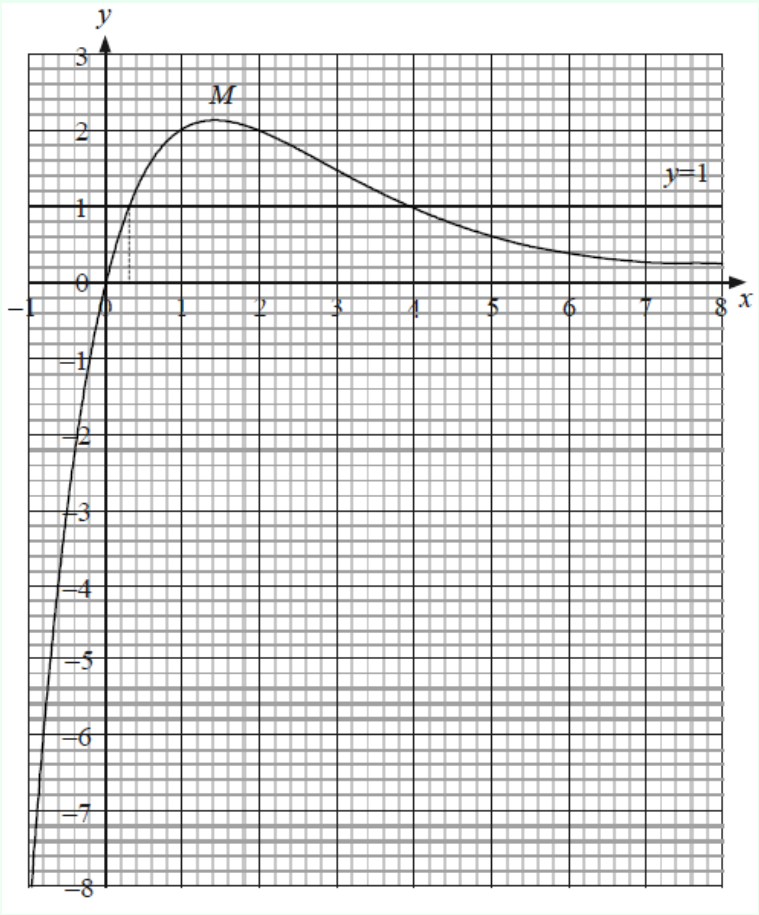
[2 marks]

Examiners report

There were many well drawn graphs using correctly scaled and labelled axes with a good curve drawn. A number of students did not label the maximum point. Although many students showed in their graph the asymptotic behaviour of the curve, they did not know how to describe the asymptote. It was noticed that some students were tracing the curve to find the coordinates of the maximum instead of finding the maximum directly. The intersection between the line $y = 1$ and the curve was not always read from their graph but from their GDC's graph.

18c. *[4 marks]*

Markscheme



(A4)

Notes: ***(A1)*** for scales and labels.
(A1) for accurate smooth curve passing through $(0, 0)$ drawn at least in the given domain.
(A1) for asymptotic behaviour (curve must not go up or cross the x-axis).
(A1) for indicating the position of the maximum point.

[4 marks]

Examiners report

There were many well drawn graphs using correctly scaled and labelled axes with a good curve drawn. A number of students did not label the maximum point. Although many students showed in their graph the asymptotic behaviour of the curve, they did not know how to describe the asymptote. It was noticed that some students were tracing the curve to find the coordinates of the maximum instead of finding the maximum directly. The intersection between the line $y = 1$ and the curve was not always read from their graph but from their GDC's graph.

18d. *[2 marks]*

Markscheme

M (
1.44,
2.12) ***(G1)(G1)***

Note: Brackets required, if missing award ***(G1)(G0)***. Accept $x = 1.44$ and $y = 2.12$.

[2 marks]

Examiners report

There were many well drawn graphs using correctly scaled and labelled axes with a good curve drawn. A number of students did not label the maximum point. Although many students showed in their graph the asymptotic behaviour of the curve, they did not know how to describe the asymptote. It was noticed that some students were tracing the curve to find the coordinates of the maximum instead of finding the maximum directly. The intersection between the line $y = 1$ and the curve was not always read from their graph but from their GDC's graph.

18e. *[2 marks]*

Markscheme

$y = 0$ ***(A1)(A1)***

Note: ***(A1)*** for '$y =$' provided the right hand side is a constant. ***(A1)*** for 0.

[2 marks]

Examiners report

There were many well drawn graphs using correctly scaled and labelled axes with a good curve drawn. A number of students did not label the maximum point. Although many students showed in their graph the asymptotic behaviour of the curve, they did not know how to describe the asymptote. It was noticed that some students were tracing the curve to find the coordinates of the maximum instead of finding the maximum directly. The intersection between the line $y = 1$ and the curve was not always read from their graph but from their GDC's graph.

18f. *[4 marks]*

Markscheme

(i) See graph ***(A1)(A1)***

Note: ***(A1)*** for correct line, ***(A1)*** for label.

(ii)

$x = 0.3$ **(ft)** from candidate's graph. ***(A2)*****(ft)**

Notes: Accept ± 0.1 from their x. For 0.310 award ***(G1)(G0)***. For other answers taken from the GDC and not given correct to 3 significant figures award ***(G0)(AP)(G0)*** or ***(G1)(G0)*** if ***(AP)*** already applied.

[4 marks]

Examiners report

There were many well drawn graphs using correctly scaled and labelled axes with a good curve drawn. A number of students did not label the maximum point. Although many students showed in their graph the asymptotic behaviour of the curve, they did not know how to describe the asymptote. It was noticed that some students were tracing the curve to find the coordinates of the maximum instead of finding the maximum directly. The intersection between the line $y = 1$ and the curve was not always read from their graph but from their GDC's graph.

18g. *[3 marks]*

Markscheme

$C'(x) = 1 - \frac{100}{x^2}$ ***(A1)(A1)(A1)***

Note: ***(A1)*** for 1, ***(A1)*** for
-100 , ***(A1)*** for
x^2 as denominator or
x^{-2} as numerator. Award a maximum of ***(A2)*** if an extra term is seen.

[3 marks]

Examiners report

Finding the derivative was done at least partially correctly by most of the candidates. However, using it to find the minimum and to justify why it is a minimum was troublesome for the majority of the candidates. Even those who used a graph in their reasoning neglected to mention the change from decreasing to increasing or to supply a sign diagram. Many candidates recovered in the last part of the question when finding the minimum cost.

18h. *[2 marks]*

Markscheme

For studying signs of the derivative at either side of
$x = 10$ ***(M1)***

For saying there is a change of sign of the derivative ***(M1)(AG)***

OR

For putting
$x = 10$ into
C' and getting zero ***(M1)***

For clear sketch of the function or for mentioning that the function changes from decreasing to increasing at
$x = 10$ ***(M1)(AG)***

OR

For solving
$C'(x) = 0$ and getting
10 ***(M1)***

For clear sketch of the function or for mentioning that the function changes from decreasing to increasing at
$x = 10$ ***(M1)(AG)***

Note: For a sketch with a clear indication of the minimum or for a table with values of
x at either side of
$x = 10$ award ***(M1)(M0)***.

[2 marks]

Examiners report

Finding the derivative was done at least partially correctly by most of the candidates. However, using it to find the minimum and to justify why it is a minimum was troublesome for the majority of the candidates. Even those who used a graph in their reasoning neglected to mention the change from decreasing to increasing or to supply a sign diagram. Many candidates recovered in the last part of the question when finding the minimum cost.

18i. *[2 marks]*

Markscheme

$C(10) = 10 + \frac{100}{10}$ ***(M1)***

$C(10) = 20$ ***(A1)(G2)***

[2 marks]

Examiners report

Finding the derivative was done at least partially correctly by most of the candidates. However, using it to find the minimum and to justify why it is a minimum was troublesome for the majority of the candidates. Even those who used a graph in their reasoning neglected to mention the change from decreasing to increasing or to supply a sign diagram. Many candidates recovered in the last part of the question when finding the minimum cost.