Topic 7 Part 1 *[230 marks]*

1a. *[2 marks]*

Markscheme

greater than *(A1)*

Gradient between $x = -2$ and $x = 0$ is positive. *(R1)*

OR

The function is increased between these points or equivalent. *(R1)* *(C2)*

Note: Accept a sketch. Do not award *(A1)(R0)*.

[2 marks]

Examiners report

Very few candidates received full marks for this question and many omitted the question completely. A sketch showing the information provided in the table would have been very useful but few candidates chose this approach.

1b. *[2 marks]*

Markscheme

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

Note: Award *(A1)* for $y =$ a constant, *(A1)* for 3.

[2 marks]

Examiners report

Very few candidates received full marks for this question and many omitted the question completely. A sketch showing the information provided in the table would have been very useful but few candidates chose this approach.

1c. *[2 marks]*

Markscheme

minimum *(A1)*

Gradient is negative to the left and positive to the right or equivalent. *(R1)* *(C2)*

Note: Accept a sketch. Do not award *(A1)(R0)*.

[2 marks]

Examiners report

Very few candidates received full marks for this question and many omitted the question completely. A sketch showing the information provided in the table would have been very useful but few candidates chose this approach.

2a. *[3 marks]*

Markscheme

–1.10, 0.218, 3.13 ***(A1)(A1)(A1)***

[3 marks]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

It was however disappointing to note the number of candidates who do not use the GDC to good effect; in part (a) for example, the zeros were not found accurately due to "trace" being used; this is not a suitable approach – there is a built-in zero finder which should be used. Much of the question was accessible via a GDC approach, a sketch was given that could have been verified on the GDC; this was lost on many.

2b. *[3 marks]*

Markscheme

$f'(x) = 12x^2 - 18x - 12$ ***(A1)(A1)(A1)***

Note: Award ***(A1)*** for each correct term and award maximum of ***(A1)(A1)*** if other terms seen.

[3 marks]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

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2c. *[4 marks]*

3 2

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

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2d. *[1 mark]*

Markscheme

(0, 3) ***(A1)***

Note: Accept $x = 0$, $y = 3$.

[1 mark]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

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2e. *[2 marks]*

Markscheme

$f'(0) = -12$ ***(M1)(A1)*****(ft)*****(G2)***

Note: Award ***(M1)*** for substituting $x = 0$ into their derivative.

[2 marks]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

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2f. *[2 marks]*

Markscheme

Tangent: $y = -12x + 3$ ***(A1)*****(ft)*****(A1)(G2)***

Note: Award ***(A1)*****(ft)** for their gradient, ***(A1)*** for intercept = 3.

Award ***(A1)(A0)*** if y = not seen.

[2 marks]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

It was however disappointing to note the number of candidates who do not use the GDC to good effect; in part (a) for example, the zeros were not found accurately due to "trace" being used; this is not a suitable approach – there is a built-in zero finder which should be used. Much of the question was accessible via a GDC approach, a sketch was given that could have been verified on the GDC; this was lost on many.

2g. *[1 mark]*

Markscheme

-12 ***(A1)*****(ft)**

Note: Follow through from their part (e).

[1 mark]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

It was however disappointing to note the number of candidates who do not use the GDC to good effect; in part (a) for example, the zeros were not found accurately due to "trace" being used; this is not a suitable approach – there is a built-in zero finder which should be used. Much of the question was accessible via a GDC approach, a sketch was given that could have been verified on the GDC; this was lost on many.

2h. *[3 marks]*

Markscheme

$12x^2 - 18x - 12 = -12$ ***(M1)***

$12x^2 - 18x = 0$ ***(M1)***

$x = 1.5, 0$

At Q $x = 1.5$ ***(A1)*****(ft)*****(G2)***

Note: Award ***(M1)(G2)*** for $12x^2 - 18x - 12 = -12$ followed by $x = 1.5$.

Follow through from their part (g).

[3 marks]

Examiners report

This question was either very well done – by the majority – or very poor and incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, though it is recognised that the differential calculus is one of the more problematic topics for the candidature.

It was however disappointing to note the number of candidates who do not use the GDC to good effect; in part (a) for example, the zeros were not found accurately due to "trace" being used; this is not a suitable approach – there is a built-in zero finder which should be used. Much of the question was accessible via a GDC approach, a sketch was given that could have been verified on the GDC; this was lost on many.

3a. *[1 mark]*

Markscheme

30 ***(A1)***

[1 mark]

Examiners report

The value of $f(0)$ and the derivative function, $f'(x)$ were well done in parts (a) and (b). In part (c) many candidates found $f(1)$ instead of $f'(1)$. In part (d) many students did not use their $f(x)$ to find the x-coordinates of M and N and instead used their GDC. The sketch was generally well done although some students forgot to label M and N or did not use the specified window. The last part of the question was a clear discriminator. Examiners were pleased to see how this challenging question was solved using alternative methods.

3b. *[3 marks]*

Markscheme

$f'(x) = 3x^2 - 6x - 24$ ***(A1)(A1)(A1)***

Note: Award ***(A1)*** for each term. Award at most ***(A1)(A1)*** if extra terms present.

[3 marks]

Examiners report

The value of $f(0)$ and the derivative function, $f'(x)$ were well done in parts (a) and (b). In part (c) many candidates found $f(1)$ instead of $f'(1)$. In part (d) many students did not use their $f(x)$ to find the x-coordinates of M and N and instead used their GDC. The sketch was generally well done although some students forgot to label M and N or did not use the specified window. The last part of the question was a clear discriminator. Examiners were pleased to see how this challenging question was solved using alternative methods.

3c. *[2 marks]*

Markscheme

$f'(1) = -27$ ***(M1)(A1)*****(ft)*****(G2)***

Note: Award ***(M1)*** for substituting $x = 1$ into their derivative.

[2 marks]

Examiners report

The value of $f(0)$ and the derivative function, $f'(x)$ were well done in parts (a) and (b). In part (c) many candidates found $f(1)$ instead of $f'(1)$. In part (d) many students did not use their $f(x)$ to find the x-coordinates of M and N and instead used their GDC. The sketch was generally well done although some students forgot to label M and N or did not use the specified window. The last part of the question was a clear discriminator. Examiners were pleased to see how this challenging question was solved using alternative methods.

3d. *[5 marks]*

Markscheme

(i) $f'(x) = 0$

$3x^2 - 6x - 24 = 0$ ***(M1)***

$x = 4; x = -2$ ***(A1)*****(ft)*****(A1)*****(ft)**

Notes: Award ***(M1)*** for either $f'(x) = 0$ or $3x^2 - 6x - 24 = 0$ seen. Follow through from their derivative. Do not award the two answer marks if derivative not used.

(ii) M(–2, 58) accept $x = -2$, $y = 58$ ***(A1)*****(ft)**

N(4, – 50) accept $x = 4$, $y = -50$ ***(A1)*****(ft)**

Note: Follow through from their answer to part (d) (i).

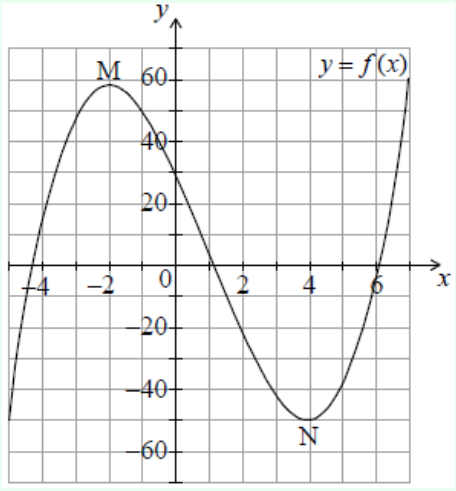
[5 marks]

Examiners report

The value of $f(0)$ and the derivative function, $f'(x)$ were well done in parts (a) and (b). In part (c) many candidates found $f(1)$ instead of $f'(1)$. In part (d) many students did not use their $f(x)$ to find the x-coordinates of M and N and instead used their GDC. The sketch was generally well done although some students forgot to label M and N or did not use the specified window. The last part of the question was a clear discriminator. Examiners were pleased to see how this challenging question was solved using alternative methods.

3e. *[4 marks]*

Markscheme



(A1) for window

(A1) for a smooth curve with the correct shape

(A1) for axes intercepts in approximately the correct positions

(A1) for M and N marked on diagram and in approximately correct position ***(A4)***

Note: If window is not indicated award at most ***(A0)(A1)(A0)(A1)*****(ft)**.

[4 marks]

Examiners report

The value of $f(0)$ and the derivative function, $f'(x)$ were well done in parts (a) and (b). In part (c) many candidates found $f(1)$ instead of $f'(1)$. In part (d) many students did not use their $f(x)$ to find the x-coordinates of M and N and instead used their GDC. The sketch was generally well done although some students forgot to label M and N or did not use the specified window. The last part of the question was a clear discriminator. Examiners were pleased to see how this challenging question was solved using alternative methods.

3f. *[6 marks]*

Markscheme

(i) $3x^2 - 6x - 24 = 21$ ***(M1)***

$3x^2 - 6x - 45 = 0$ ***(M1)***

$x = 5; x = -3$ ***(A1)*****(ft)*****(A1)*****(ft)*****(G3)***

Note: Follow through from their derivative.

OR

Award ***(A1)*** for L_1 drawn tangent to the graph of f on their sketch in approximately the correct position ($x = -3$), ***(A1)*** for a second tangent parallel to their L_1, ***(A1)*** for $x = -3$, ***(A1)*** for $x = 5$. ***(A1)*****(ft)*****(A1)*****(ft)*****(A1)*****(A1)***

Note: If only $x = -3$ is shown without working award ***(G2)*****.** If both answers are shown irrespective of workingaward ***(G3)***.

(ii) $f(5) = -40$ ***(M1)*****(A1)*****(ft)*****(G2)***

Notes: Award ***(M1)*** for attempting to find the image of their $x = 5$. Award ***(A1)*** only for (5, –40). Follow through from their x-coordinate of B only if it has **been clearly identified** in (f) (i).

[6 marks]

Examiners report

The value of $f(0)$ and the derivative function, $f'(x)$ were well done in parts (a) and (b). In part (c) many candidates found $f(1)$ instead of $f'(1)$. In part (d) many students did not use their $f(x)$ to find the x-coordinates of M and N and instead used their GDC. The sketch was generally well done although some students forgot to label M and N or did not use the specified window. The last part of the question was a clear discriminator. Examiners were pleased to see how this challenging question was solved using alternative methods.

4a. *[2 marks]*

Markscheme

$600 = \pi x^2 h$ ***(M1)(A1)***

$\frac{600}{\pi x^2} = h$ ***(AG)***

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*** for correct substitution. If answer given not shown award at most ***(M1)(A0)***.

[2 marks]

Examiners report

This was the most difficult question for the candidates. It was clear that the vast majority of them had not had exposure to this style of question. Part (a) was well answered by most of the students. In part (b) the correct expression "in terms of x " for the curve surface area was not frequently seen. In many cases the impression was that they did not know what "in terms of x " meant as correct equivalent expressions were seen but where the h was also involved. Those candidates that made progress in the question, even with the wrong expression for the total area of the can, A were able to earn follow through marks.

4b. *[2 marks]*

Markscheme

$C = 2\pi x \frac{600}{\pi x^2}$ ***(M1)***

$C = \frac{1200}{x}$ (or $1200x^{-1}$) ***(A1)***

Note: Award ***(M1)*** for correct substitution in formula, ***(A1)*** for correct simplification.

[??? marks]

Examiners report

This was the most difficult question for the candidates. It was clear that the vast majority of them had not had exposure to this style of question. Part (a) was well answered by most of the students. In part (b) the correct expression "in terms of x " for the curve surface area was not frequently seen. In many cases the impression was that they did not know what "in terms of x " meant as correct equivalent expressions were seen but where the h was also involved. Those candidates that made progress in the question, even with the wrong expression for the total area of the can, A were able to earn follow through marks.

4c. *[2 marks]*

Markscheme

$A = 2\pi x^2 + 1200x^{-1}$ ***(A1)(A1)*(ft)**

Note: Award ***(A1)*** for multiplying the area of the base by two, ***(A1)*** for adding on their answer to part (b) (i).

For both marks to be awarded answer must be in terms of x.

[??? marks]

Examiners report

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4d. *[3 marks]*

Markscheme

$\frac{dA}{dx} = 4\pi x - \frac{1200}{x^2}$ ***(A1)*(ft)*(A1)*(ft)*(A1)*(ft)**

Notes: Award ***(A1)*** for
$4\pi x$, ***(A1)*** for
-1200, ***(A1)*** for
x^{-2}. Award at most ***(A2)*** if any extra term is written. Follow through from their part (b) (ii).

[??? marks]

Examiners report

This was the most difficult question for the candidates. It was clear that the vast majority of them had not had exposure to this style of question. Part (a) was well answered by most of the students. In part (b) the correct expression "in terms of x " for the curve surface area was not frequently seen. In many cases the impression was that they did not know what "in terms of x " meant as correct equivalent expressions were seen but where the h was also involved. Those candidates that made progress in the question, even with the wrong expression for the total area of the can, A were able to earn follow through marks.

4e. *[3 marks]*

Markscheme

$4\pi x - \frac{1200}{x^2} = 0$ ***(M1)(M1)***

$x^3 = \frac{1200}{4\pi}$ (or equivalent)

$x = 4.57$ ***(A1)*(ft)*(G2)***

Note: Award ***(M1)*** for using their derivative, ***(M1)*** for setting the derivative to zero, ***(A1)*(ft)** for answer.

Follow through from their derivative.

Last mark is lost if value of x is zero or negative.

[3 marks]

Examiners report

This was the most difficult question for the candidates. It was clear that the vast majority of them had not had exposure to this style of question. Part (a) was well answered by most of the students. In part (b) the correct expression "in terms of x " for the curve surface area was not frequently seen. In many cases the impression was that they did not know what "in terms of x " meant as correct equivalent expressions were seen but where the h was also involved. Those candidates that made progress in the question, even with the wrong expression for the total area of the can, A were able to earn follow through marks.

4f. *[2 marks]*

Markscheme

$A = 2\pi(4.57)^2 + 1200(4.57)^{-1}$ ***(M1)***

$A = 394$ ***(A1)*****(ft)*****(G2)***

Note: Follow through from their answers to parts (b) (ii) and (d).

[2 marks]

Examiners report

This was the most difficult question for the candidates. It was clear that the vast majority of them had not had exposure to this style of question. Part (a) was well answered by most of the students. In part (b) the correct expression "in terms of x " for the curve surface area was not frequently seen. In many cases the impression was that they did not know what "in terms of x " meant as correct equivalent expressions were seen but where the h was also involved. Those candidates that made progress in the question, even with the wrong expression for the total area of the can, A were able to earn follow through marks.

5a. *[3 marks]*

Markscheme

$f'(x) = 4x + 1$ ***(A1)(A1)(A1)*** ***(C3)***

Note: Award ***(A1)*** for each term differentiated correctly.

Award at most ***(A1)(A1)(A0)*** if any extra terms seen.

[3 marks]

Examiners report

This was a fairly standard question. However, some candidates found $f(-3)$ instead of $f'(-3)$. Quite a few candidates were unable to answer part (c) as they tried to find $f'(0)$ instead of finding x when $f'(x) = 0$.

5b. *[1 mark]*

Markscheme

$f'(-3) = -11$ ***(A1)*****(ft)** ***(C1)***

[1 mark]

Examiners report

This was a fairly standard question. However, some candidates found $f(-3)$ instead of $f'(-3)$. Quite a few candidates were unable to answer part (c) as they tried to find $f'(0)$ instead of finding x when $f'(x) = 0$.

5c. *[2 marks]*

Markscheme

$4x + 1 = 0$ ***(M1)***

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

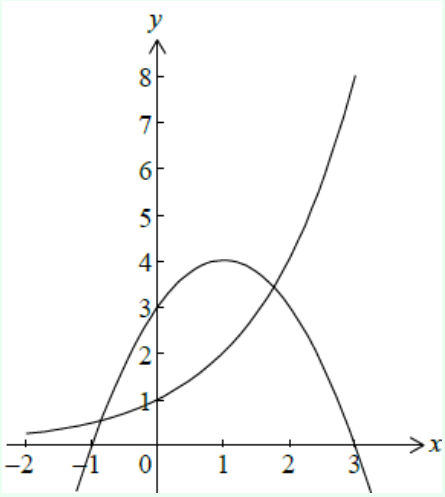
[2 marks]

Examiners report

This was a fairly standard question. However, some candidates found $f(-3)$ instead of $f'(-3)$. Quite a few candidates were unable to answer part (c) as they tried to find $f'(0)$ instead of finding x when $f'(x) = 0$.

6a. *[3 marks]*

Markscheme



(A1)(A1)(A1)

Note: Award ***(A1)*** for correct domain, ***(A1)*** for smooth curve, ***(A1)*** for y-intercept clearly indicated.

[3 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

The most common error was using the incorrect domain.

6b. *[2 marks]*

Markscheme

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

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

[2 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

Many had little idea of asymptotes. Others did not write their answer as an equation.

6c. *[3 marks]*

Markscheme

Note: Award ***(A1)*** for smooth parabola,

(A1) for vertex (maximum) in correct quadrant.

(A1) for all clearly indicated intercepts $x = -1$, $x = 3$ and $y = 3$.

The final mark is to be applied very strictly. ***(A1)(A1)(A1)***

[3 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

The intercepts being inexact or unlabelled was the most frequent cause of loss of marks.

6d. *[2 marks]*

Markscheme

$x = -0.857$ $x = 1.77$ ***(G1)(G1)***

Note: Award a maximum of ***(G1)*** if x and y coordinates are both given.

[2 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

Often, only one solution to the equation was given. Elsewhere, a lack of appreciation that the solutions were the x coordinates was a common mistake.

6e. *[1 mark]*

Markscheme

4 ***(G1)***

Note: Award ***(G0)*** for (1, 4).

[1 mark]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

The maximum is the *y* coordinate only; again a common misapprehension was the answer "(1, 4)".

6f. *[5 marks]*

Markscheme

$f'(x) = 2 - 2x$ ***(A1)(A1)***

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

Award at most ***(A1)(A0)*** if any extra terms seen.

$2 - 2x = 0$ ***(M1)***

Note: Award ***(M1)*** for equating their gradient function to zero.

$x = 1$ ***(A1)*****(ft)**

$f(1) = 3 + 2(1) - (1)^2 = 4$ ***(A1)***

Note: The final ***(A1)*** is for substitution of $x = 1$ into
$f(x)$ and subsequent correct answer. Working must be seen for final ***(A1)*** to be awarded.

[5 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

This was a major discriminator in the paper. Many candidates were unable to follow the analytic approach to finding a maximum point.

6g. *[2 marks]*

Markscheme

$2^2 \times p + 2q - 4 = -10$ ***(M1)***

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

$4p + 2q = -6$ or $2p + q = -3$ ***(A1)***

Note: Accept equivalent simplified forms.

[2 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

This part was challenging to the majority, with a large number not attempting the question at all. However, there were a pleasing number of correct attempts that showed a fine understanding of the calculus.

6h. *[2 marks]*

Markscheme

$\frac{dy}{dx} = 2px + q$ ***(A1)(A1)***

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

Award at most ***(A1)(A0)*** if any extra terms seen.

[2 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

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6i. *[1 mark]*

Markscheme

$4p + q = 1$ ***(A1)*****(ft)**

[1 mark]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

This part was challenging to the majority, with a large number not attempting the question at all. However, there were a pleasing number of correct attempts that showed a fine understanding of the calculus.

6j. *[3 marks]*

Markscheme

$4p + 2q = -6$

$4p + q = 1$ ***(M1)***

Note: Award ***(M1)*** for sensible attempt to solve the equations.

$p = 2, q = -7$ ***(A1)(A1)*****(ft)*****(G3)***

[3 marks]

Examiners report

Undoubtedly, this question caused the most difficulty in terms of its content. Where there was no alternative to using the calculus, the majority of candidates struggled. However, for those with a sound grasp of the topic, there were many very successful attempts.

This part was challenging to the majority, with a large number not attempting the question at all. However, there were a pleasing number of correct attempts that showed a fine understanding of the calculus.

7a. *[2 marks]*

Markscheme

$y = 13.5x + 4.5$ ***(M1)***

Note: Award ***(M1)*** for $13.5x$ seen.

gradient = 13.5 ***(A1)*** ***(C2)***

[2 marks]

Examiners report

The structure of this question was not well understood by the majority; the links between parts not being made. Again, this question was included to discriminate at the grade 6/7 level.

Most were successful in this part.

7b. *[1 mark]*

Markscheme

$4x^3$ ***(A1)*** ***(C1)***

[1 mark]

Examiners report

The structure of this question was not well understood by the majority; the links between parts not being made. Again, this question was included to discriminate at the grade 6/7 level.

This part was usually well attempted.

7c. *[2 marks]*

Markscheme

$4x^3 = 13.5$ ***(M1)***

Note: Award ***(M1)*** for equating their answers to (a) and (b).

$x = 1.5$ ***(A1)*****(ft)**

[2 marks]

Examiners report

The structure of this question was not well understood by the majority; the links between parts not being made. Again, this question was included to discriminate at the grade 6/7 level.

Only the best candidates succeeded in this part.

7d. *[1 mark]*

Markscheme

$\frac{81}{16}$ (5.0625, 5.06) ***(A1)*****(ft)** ***(C3)***

Note: Award ***(A1)*****(ft)** for substitution of their (c)(i) into $x4$ with working seen.

[1 mark]

Examiners report

The structure of this question was not well understood by the majority; the links between parts not being made. Again, this question was included to discriminate at the grade 6/7 level.

Only the best candidates succeeded in this part.

8a. *[3 marks]*

Markscheme

$f'(x) = 3 - \frac{24}{x^3}$ ***(A1)(A1)(A1)***

Note: Award ***(A1)*** for 3, ***(A1)*** for –24, ***(A1)*** for x^3 (or x^{-3}). If extra terms present award at most ***(A1)(A1)(A0)***.

[3 marks]

Examiners report

Many students did not know the term “differentiate” and did not answer part (a).

8b. *[2 marks]*

Markscheme

$f'(1) = -21$ ***(M1)(A1)*****(ft)*****(G2)***

Note: **(ft)** from their derivative only if working seen.

[2 marks]

Examiners report

However, the derivative was seen in (b) when finding the gradient at $x = 1$. The negative index of the formula did cause problems for many when finding the derivative. The meaning of the derivative was not clear for a number of students.

8c. *[2 marks]*

Markscheme

Derivative (gradient, slope) is negative. Decreasing. ***(R1)(A1)*****(ft)**

Note: Do not award ***(R0)(A1)***.

[2 marks]

Examiners report

[N/A]

8d. *[3 marks]*

Markscheme

$3 - \frac{24}{x^3} = 0$ ***(M1)***

$x^3 = 8$ ***(A1)***

$x = 2$ ***(A1)*****(ft)*****(G2)***

[3 marks]

Examiners report

Part (d) was handled well by some but many substituted $x = 0$ into $f'(x)$.

8e. *[2 marks]*

Markscheme

(2, 9) (Accept $x = 2$, $y = 9$) ***(A1)(A1)(G2)***

Notes: **(ft)** from their answer in (d).

Award ***(A1)(A0)*** if brackets not included and not previously penalized.

[2 marks]

Examiners report

It was clear that most candidates neither knew that the tangent at a minimum is horizontal nor that its gradient is zero.

8f. *[1 mark]*

Markscheme

0 ***(A1)***

[1 mark]

Examiners report

It was clear that most candidates neither knew that the tangent at a minimum is horizontal nor that its gradient is zero.

8g. *[2 marks]*

Markscheme

$y = 9$ ***(A1)(A1)*****(ft)*****(G2)***

Notes: Award ***(A1)*** for y = constant, ***(A1)*** for 9.

Award ***(A1)*****(ft)** for their value of y in (e)(i).

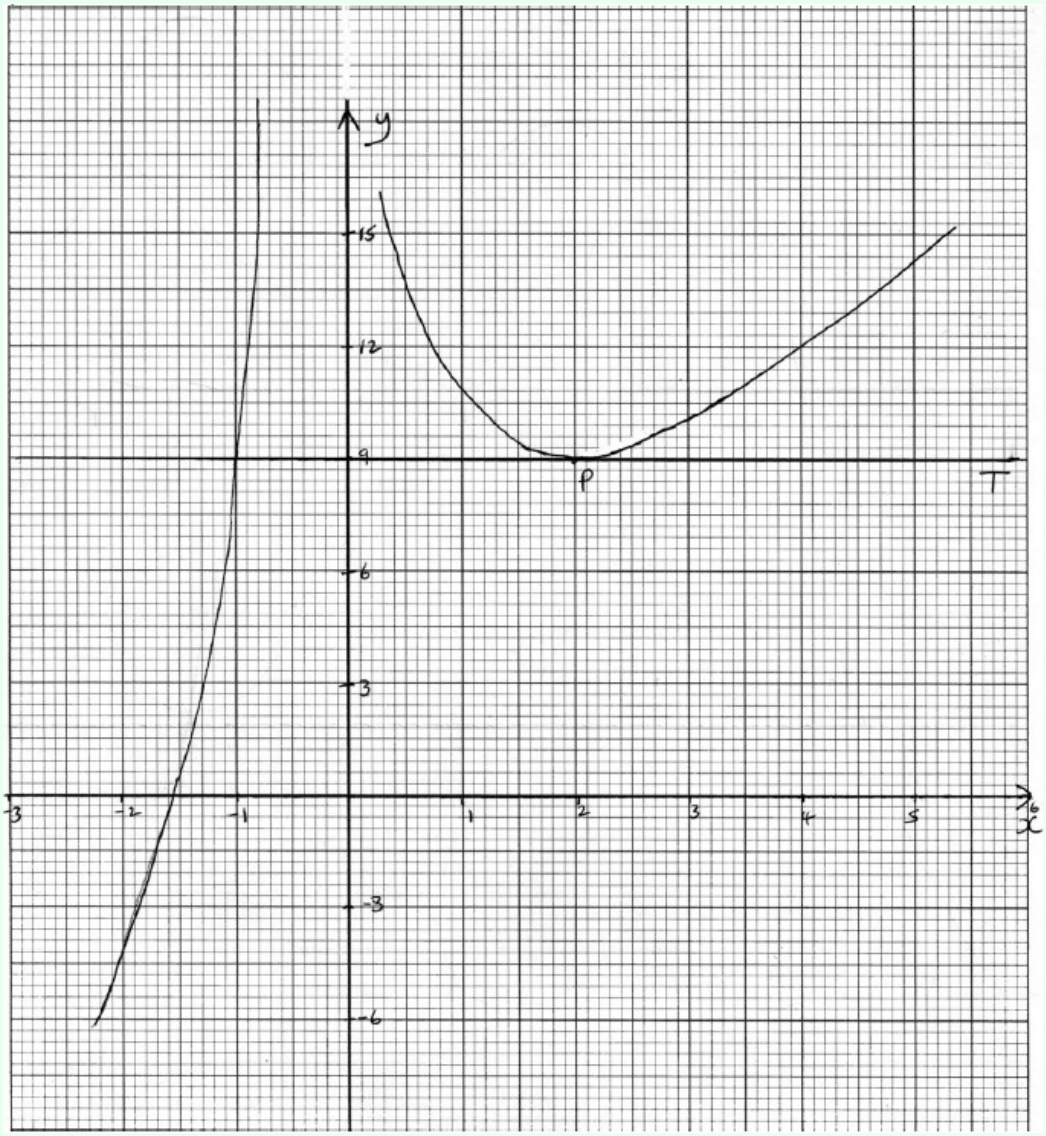
[2 marks]

Examiners report

It was clear that most candidates neither knew that the tangent at a minimum is horizontal nor that its gradient is zero.

8h. *[4 marks]*

Markscheme



(A4)

Notes: Award ***(A1)*** for labels and some indication of scale in the stated window.

Award ***(A1)*** for correct general shape (curve must be smooth and must not cross the *y*-axis).

Award ***(A1)*** for *x*-intercept seen in roughly the correct position.

Award ***(A1)*** for minimum (P).

[4 marks]

Examiners report

There were good answers to the sketch though setting out axes and a scale seemed not to have had enough practise.

8i. *[2 marks]*

Markscheme

Tangent drawn at P (line must be a tangent and horizontal). ***(A1)***

Tangent labeled *T*. ***(A1)***

Note: (ft) from their tangent equation only if tangent is drawn and answer is consistent with graph.

[2 marks]

Examiners report

Those who were able to sketch the function were often able to correctly place and label the tangent and also to find the second intersection point with the graph of the function.

8j. *[1 mark]*

Markscheme

$x = -1$ ***(G1)*****(ft)**

[1 mark]

Examiners report

Those who were able to sketch the function were often able to correctly place and label the tangent and also to find the second intersection point with the graph of the function.

9a. *[1 mark]*

Markscheme

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

[1 mark]

Examiners report

This question was generally answered well in parts (a) and (b).

9b. *[1 mark]*

Markscheme

3 ***(A1)*** ***(C1)***

[1 mark]

Examiners report

This question was generally answered well in parts (a) and (b).

9c. *[4 marks]*

Markscheme

$2x = 3$ ***(M1)***

Note: ***(M1)*** for equating their (a) to their (b).

$x = 1.5$ ***(A1)*****(ft)**

$y = (1.5)^2 - 4$ ***(M1)***

Note: ***(M1)*** for substituting their x in $f(x)$.

(1.5, −1.75) (accept $x = 1.5$, $y = -1.75$) ***(A1)*****(ft)** ***(C4)***

Note: Missing coordinate brackets receive ***(A0)*** if this is the first time it occurs.

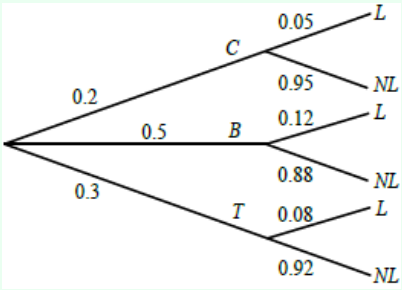
[4 marks]

Examiners report

This part proved to be difficult as candidates did not realise that to find the value of the x coordinate they needed to equate their answers to the first two parts. They did not understand that the first derivative is the gradient of the function. Some found the value of x, but did not substitute it back into the function to find the value of y.

10a. *[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.

10b. *[1 mark]*

Markscheme

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

[1 mark]

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.

10c. *[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]

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.

10d. *[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)***

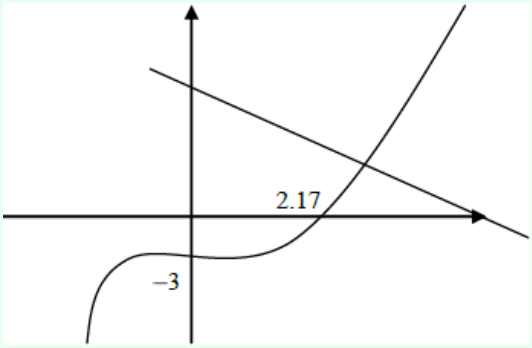
[3 marks]

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.

10e. *[3 marks]*

Markscheme



(G3)

[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.

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.

10f. *[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.

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.

10g. *[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.

11a. *[3 marks]*

Markscheme

$f(x) = ax^2 + 4x^{-1} - 3$

$f'(x) = 2ax - 4x^{-2}$ ***(A3)***

(A1) *for* $2ax$, ***(A1)*** *for* $-4x^{-2}$ *and* ***(A1)*** *for derivative of* -3 *being zero.* ***(C3)***

[3 marks]

Examiners report

(a) Many candidates gave up at this point. Those who attempted the derivative did so with varying success. Many could not differentiate a term with a negative index.

11b. *[3 marks]*

Markscheme

$2ax - 4x^{-2} = 0$ ***(M1)***

$2a(-1) - 4(-1)^{-2} = 0$ ***(M1)***

$-2a - 4 = 0$

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

(M1) *for setting derivative function equal to 0.* ***(M1)*** *for inserting* $x = -1$ *but do not award* ***(M0)(M1)*** ***(C3)***

[3 marks]

Examiners report

(b) In part (b) most substituted the -1 into the original function rather than the differentiated one. They did not realize they had to put the differentiated function equal to zero.

12a. *[2 marks]*

Markscheme

for attempt at substituted $\frac{ydistance}{xdistance}$ ***(M1)***

gradient = 2 ***(A1)(G2)***

[2 marks]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

12b. *[2 marks]*

Markscheme

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

(A1) *for*
$2x$, ***(A1)*** *for*
-3

[2 marks]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

12c. *[3 marks]*

Markscheme

for their
$2x - 3 =$ *their gradient and attempt to solve* ***(M1)***

$x = 2.5$ ***(A1)*****(ft)**

$y = -5.25$ *(***(ft)** *from their x value)* ***(A1)*****(ft)*****(G2)***

[3 marks]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

12d. *[4 marks]*

Markscheme

for seeing
$\frac{-1}{their(a)}$ ***(M1)***

solving
$2x-3 = -\frac{1}{2}$ *(or their value)* ***(M1)***

$x = 1.25$ ***(A1)*****(ft)*****(G1)***

$y = -6.1875$ ***(A1)*****(ft)*****(G1)***

[4 marks]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

12e. *[3 marks]*

Markscheme

(i)

$2 \times 2 - 3 = 1$ *(***(ft)** *from (b))* ***(A1)*****(ft)*****(G1)***

(ii)

$y = mx + c$ *or equivalent method to find*

$c \Rightarrow -6 = 2 + c$ ***(M1)***

$y = x - 8$ ***(A1)*****(ft)*****(G2)***

[3 marks]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

12f. *[1 mark]*

Markscheme

$x = 1.5$ ***(A1)***

[1 mark]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

12g. *[3 marks]*

Markscheme

for substituting their answer to part (f) into the equation of the parabola (1.5, −6.25) *accept* $x = 1.5$, $y = -6.25$ ***(M1)*****(A1)****(ft)*****(G2)***

gradient is zero *(accept*

$\frac{dy}{dx} = 0$*)* ***(A1)***

[3 marks]

Examiners report

Parts (a) and (b) were very well done. After that, only the stronger candidates were able to cope. The equation of the tangent at the point with coordinates (2, 6) was badly done but some candidates managed to find the equation of the tangent line from their GDC. The equation of the axis of symmetry was reasonably well done although many just wrote down 1.5 instead of $x = 1.5$.

Some forgot to write down that the gradient at the vertex was 0.

13a. *[3 marks]*

Markscheme

$f'(x) = 6x^2 - 10x + 3$ ***(A1)(A1)(A1)*** ***(C3)***

Notes: Award ***(A1)*** for each correct term and no extra terms.
Award ***(A1)(A1)(A0)*** if each term correct and extra term seen.
Award***(A1)(A0)(A0)*** if two terms correct and extra term seen.
Award ***(A0)*** otherwise.

[3 marks]

Examiners report

Most candidates were able to score full marks for parts (a) and (b). When mistakes were made in part (a) follow-through marks could be awarded for part (b) provided working was shown. Part (c) was disappointing with many candidates not realizing that the answer in (b) was the gradient of the tangent line.

13b. *[1 mark]*

Markscheme

$f'(2) = 7$ ***(A1)*****(ft)** ***(C1)***

[1 mark]

Examiners report

Most candidates were able to score full marks for parts (a) and (b). When mistakes were made in part (a) follow-through marks could be awarded for part (b) provided working was shown. Part (c) was disappointing with many candidates not realizing that the answer in (b) was the gradient of the tangent line.

13c. *[2 marks]*

Markscheme

$y = 7x - 11$ or equivalent ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*****(ft)** on their (b) for
$7x$ (must have
x), ***(A1)*****(ft)** for
-11. Accept
$y - 3 = 7(x - 2)$.

[2 marks]

Examiners report

Most candidates were able to score full marks for parts (a) and (b). When mistakes were made in part (a) follow-through marks could be awarded for part (b) provided working was shown. Part (c) was disappointing with many candidates not realizing that the answer in (b) was the gradient of the tangent line.

14a. *[2 marks]*

Markscheme

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

[2 marks]

Examiners report

Most candidates made a good attempt to factorise the expression.

14b. *[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.

14c. *[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
$x=$.

14d. *[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.

14e. *[2 marks]*

Markscheme

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.

14f. *[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.

14g. *[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.

14h. *[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.

14i. *[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.

15a. *[2 marks]*

Markscheme

$\frac{3x^2}{2} - 4x$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for each correct term and no extra terms; award ***(A1)(A0)*** for both terms correct and extra terms; ***(A0)*** otherwise.

[2 marks]

Examiners report

The final part of this question was not well answered. Most candidates could gain 4 marks in this question as most knew how to differentiate and they were required to do it twice. However, few realized that they could find the gradient of the tangent from their answer to part (a). This part was badly answered by most candidates.

15b. *[2 marks]*

Markscheme

$3x - 4$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Note: accept
$3x^1 - 4^0$

[2 marks]

Examiners report

The final part of this question was not well answered. Most candidates could gain 4 marks in this question as most knew how to differentiate and they were required to do it twice. However, few realized that they could find the gradient of the tangent from their answer to part (a). This part was badly answered by most candidates.

15c. *[2 marks]*

Markscheme

$y = -2.5x + 4$ or equivalent ***(A1)*****(ft)*****(A1)*** ***(C2)***

Note: Award ***(A1)*****(ft)** on their (a) for
$-2.5x$ (must have
x), ***(A1)*** for
4 or equivalent correct answer only.
Accept
$y - 1.5 = -2.5(x - 1)$

[2 marks]

Examiners report

The final part of this question was not well answered. Most candidates could gain 4 marks in this question as most knew how to differentiate and they were required to do it twice. However, few realized that they could find the gradient of the tangent from their answer to part (a). This part was badly answered by most candidates.

16a. *[2 marks]*

Markscheme

$y = 2$. ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for
$y = \ldots$, ***(A1)*** for
2.
Accept
$f(x) = 2$ and
$y = 0x + 2$

Examiners report

This question was poorly answered by many of the candidates. They could not write down the equation of the tangent, they could not say whether one value was greater or less than another and they could not answer that
P was a minimum point. Most attempted the question so it was not a case that the paper was too long. This was a very good discriminator for the paper.

16b. *[2 marks]*

Markscheme

Less (than). ***(A2)*** ***(C2)***

[2 marks]

Examiners report

This question was poorly answered by many of the candidates. They could not write down the equation of the tangent, they could not say whether one value was greater or less than another and they could not answer that
P was a minimum point. Most attempted the question so it was not a case that the paper was too long. This was a very good discriminator for the paper.

16c. *[2 marks]*

Markscheme

Local minimum (*accept minimum, smallest or equivalent*) ***(A2)*** ***(C2)***

Note: Award ***(A1)*** for stationary or turning point mentioned.
No mark is awarded for
gradient $= 0$ as this is given in the question.

Examiners report

This question was poorly answered by many of the candidates. They could not write down the equation of the tangent, they could not say whether one value was greater or less than another and they could not answer that
P was a minimum point. Most attempted the question so it was not a case that the paper was too long. This was a very good discriminator for the paper.

17a. *[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.

17b. *[2 marks]*

Markscheme

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

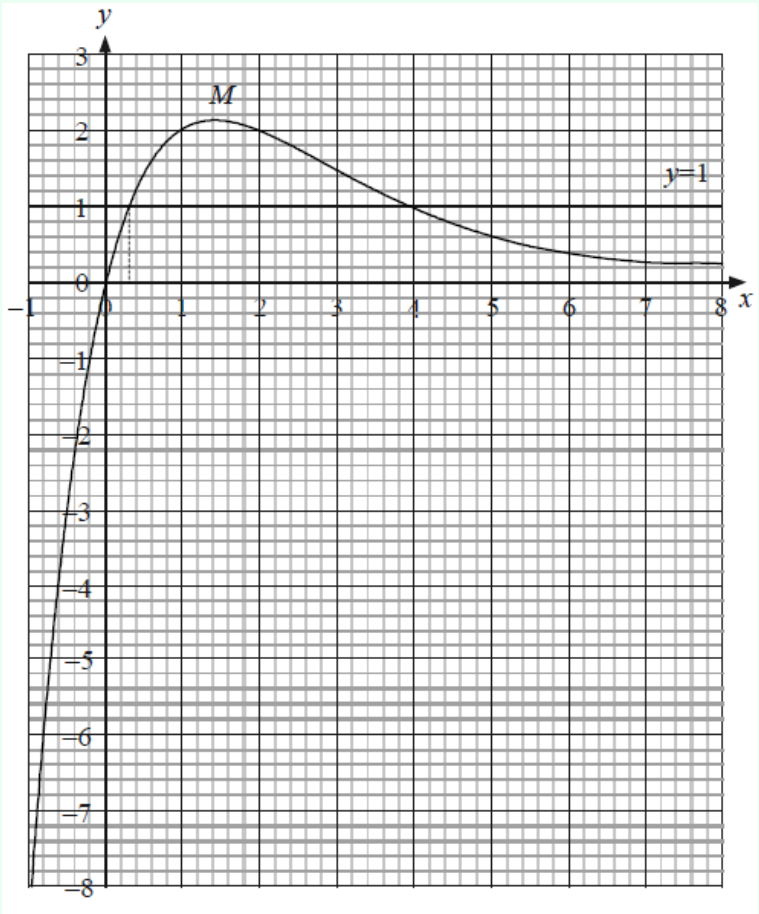
[2 marks]

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.

17c. *[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.

17d. *[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.

17e. *[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.

17f. *[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.

17g. *[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.

17h. *[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.

17i. *[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.