Topic 5 Part 5 *[219 marks]*

1a. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

There were two common errors identified on a number of scripts in this question. In part (a), the majority of candidates correctly wrote down $\pi r^2 = 8$ for method but a significant number of candidates then went on to write down $r = 2.55$ (forgetting to square root). Such candidates were able to recover in subsequent parts of the question with the allowable follow through marks, but a method mark and final accuracy mark was lost on many scripts in part (c) with incomplete methods shown for the total surface area of the cylinder. Leaving off the addition of either one or both end surfaces of the cylinder resulted in the final two marks being lost.

1b. *[1 mark]*

Markscheme

200 cm^3 ***(A1)*(ft)** ***(C1)***

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

[1 mark]

Examiners report

There were two common errors identified on a number of scripts in this question. In part (a), the majority of candidates correctly wrote down $\pi r^2 = 8$ for method but a significant number of candidates then went on to write down $r = 2.55$ (forgetting to square root). Such candidates were able to recover in subsequent parts of the question with the allowable follow through marks, but a method mark and final accuracy mark was lost on many scripts in part (c) with incomplete methods shown for the total surface area of the cylinder. Leaving off the addition of either one or both end surfaces of the cylinder resulted in the final two marks being lost.

1c. *[3 marks]*

Markscheme

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

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

267 cm^2 (266.662...cm^2) ***(A1)*(ft)** ***(C3)***

Note: Follow through from their part (a).

[3 marks]

Examiners report

There were two common errors identified on a number of scripts in this question. In part (a), the majority of candidates correctly wrote down $\pi r^2 = 8$ for method but a significant number of candidates then went on to write down $r = 2.55$ (forgetting to square root). Such candidates were able to recover in subsequent parts of the question with the allowable follow through marks, but a method mark and final accuracy mark was lost on many scripts in part (c) with incomplete methods shown for the total surface area of the cylinder. Leaving off the addition of either one or both end surfaces of the cylinder resulted in the final two marks being lost.

2a.

[1 mark]

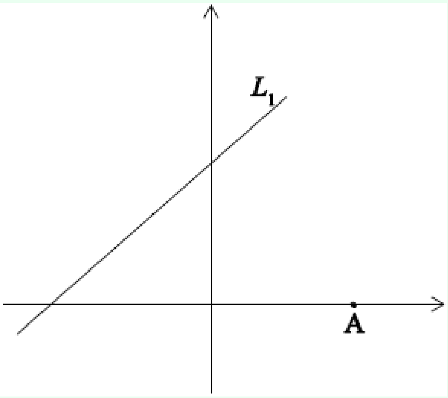
Markscheme

$2 \times 0 - 3 \times 6 \neq 11$ ***(R1)***

Note: Stating
$2 \times 0 - 3 \times 6 = -18$ without a conclusion is not sufficient.

OR

Clear sketch of L_1 and A.



(R1)

OR

Point **A** is (6, 0) and
$2y - 3x = 11$ has x-intercept at
$-\frac{11}{3}$ or the line has only one x-intercept which occurs when x is negative. ***(R1)*** ***(C1)***

Examiners report

There were multiple acceptable reasons why the line did not pass through a given point (including numerically substituting values in the equation; drawing a graph or algebraically finding the x-intercept of the line). This was one of two reasoning marks in the paper.

2b.

[2 marks]

Markscheme

$2y = 3x + 11$ **or**
$y - \frac{3}{2}x = \frac{11}{2}$ ***(M1)***

Note: Award ***(M1)*** for a correct first step in making y the subject of the equation.

$(\text{gradient equals}) = \frac{3}{2}(1.5)$ ***(A1)*** ***(C2)***

Note: Do not accept $1.5x$.

Examiners report

There were multiple acceptable reasons why the line did not pass through a given point (including numerically substituting values in the equation; drawing a graph or algebraically finding the x-intercept of the line). This was one of two reasoning marks in the paper.

2c.

[1 mark]

Markscheme

$(m =) -\frac{2}{3}$ ***(A1)*(ft)** ***(C1)***

Notes: Follow through from their part (b).

Examiners report

There were multiple acceptable reasons why the line did not pass through a given point (including numerically substituting values in the equation; drawing a graph or algebraically finding the x-intercept of the line). This was one of two reasoning marks in the paper.

2d.

[2 marks]

Markscheme

$0 = -\frac{2}{3}(6) + c$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of their gradient and (6, 0) into any form of the equation.

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

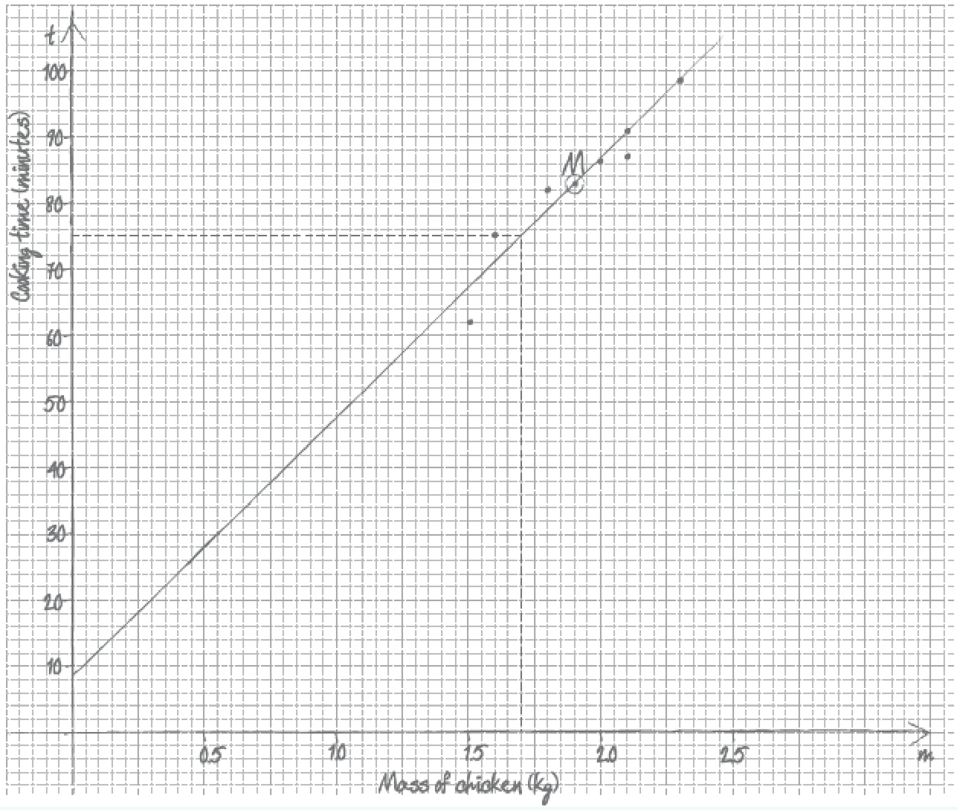
Note: Follow through from part (c).

Examiners report

There were multiple acceptable reasons why the line did not pass through a given point (including numerically substituting values in the equation; drawing a graph or algebraically finding the x-intercept of the line). This was one of two reasoning marks in the paper.

3a. *[4 marks]*

Markscheme



(A1) *for correct scales and labels (mass or m on the horizontals axis, time or t on the vertical axis)*

(A3) *for 7 or 8 correctly placed data points*

(A2) *for 5 or 6 correctly placed data points*

(A1) *for 3 or 4 correctly placed data points,* ***(A0)*** *otherwise.* ***(A4)***

Note: If axes reversed award at most ***(A0)(A3)*****(ft)**. If graph paper not used, award at most ***(A1)(A0)***.

Examiners report

[N/A]

3b. *[2 marks]*

Markscheme

(i) 1.91 (kg) (1.9125 kg) ***(G1)***

(ii) 83 (minutes) ***(G1)***

Examiners report

[N/A]

3c. *[1 mark]*

Markscheme

Their mean point labelled. ***(A1)*****(ft)**

Note: Follow through from part (b). Accept any clear indication of the mean point. For example: circle around point, (m, t), M , etc.

Examiners report

[N/A]

3d.

[2 marks]

Markscheme

Line of best fit drawn on scatter diagram. ***(A1)*(ft)*(A1)*(ft)**

Notes:Award ***(A1)*(ft)** for straight line through their mean point, ***(A1)*(ft)** for line of best fit with intercept 9(±2) . The second ***(A1)*(ft)** can be awarded even if the line does not reach the t-axis but, if extended, the t-intercept is correct.

Examiners report

[N/A]

3e.

[2 marks]

Markscheme

75 ***(M1)(A1)*(ft)*(G2)***

Notes: Accept 74.77 from the regression line equation. Award ***(M1)*** for indication of the use of their graph to get an estimate **OR** for correct substitution of 1.7 in the correct regression line equation $t = 38.5m + 9.32$.

Examiners report

[N/A]

3f.

[2 marks]

Markscheme

0.960 (0.959614...) ***(G2)***

Note: Award ***(G0)(G1)*(ft)** for 0.95, 0.959

Examiners report

[N/A]

3g.

[2 marks]

Markscheme

Strong and positive ***(A1)*(ft)*(A1)*(ft)**

Note: Follow through from their correlation coefficient in part (f).

Examiners report

[N/A]

3h.

[2 marks]

Markscheme

(i) Cooking time is much larger (or smaller) than the other eight ***(A1)***

(ii) The gradient of the new line of best fit will be larger (or smaller) ***(A1)***

Note: Some acceptable explanations may include but are not limited to:

The line of best fit may be further away from the plotted points
It may be steeper than the previous line (as the mean would change)
The t-intercept of the new line is smaller (larger)

Do not accept vague explanations, like:

The new line would vary
It would not go through all points
It would not fit the patterns
The line may be slightly tilted

Examiners report

[N/A]

4a.

[2 marks]

Markscheme

$\frac{14}{(1)} + (1) - 6$ ***(M1)***

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

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

Examiners report

Most candidates were able to evaluate the function and find the derivative for
$x + 6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4b.

[3 marks]

Markscheme

$-\frac{14}{x^2} + 1$ ***(A3)***

Note: Award ***(A1)*** for
-14, ***(A1)*** for
$\frac{14}{x^2}$ or for
x^{-2}, ***(A1)*** for
1.

Award at most ***(A2)*** if any extra terms are present.

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x + 6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the y-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4c. *[3 marks]*

Markscheme

$-\frac{14}{x^2} + 1 = 0$ or
$f'(x) = 0$ ***(M1)***

Note: Award ***(M1)*** for equating **their** derivative in part (b) to 0.

$\frac{14}{x^2} = 1$ or
$x^2 = 14$ or equivalent ***(M1)***

Note: Award ***(M1)*** for correct rearrangement of their equation.

$x = 3.74165...(\sqrt{14})$ ***(A1)***

$x = 3.7$ ***(AG)***

Notes: Both the unrounded and rounded answers must be seen to award the ***(A1)***. This is a “show that” question; appeals to their GDC are not accepted –award a maximum of ***(M1)(M0)(A0)***.

Specifically,
$-\frac{14}{x^2} + 1 = 0$ followed by
$x = 3.74165..., x = 3.7$ is awarded ***(M1)(M0)(A0)***.

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x + 6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the y-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4d. *[3 marks]*

Markscheme

$1.48 \leqslant y \leqslant 9$ ***(A1)(A1)*(ft)*(A1)***

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

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

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x + 6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4e. *[1 mark]*

Markscheme

3 ***(A1)***

Note: Do not accept a coordinate pair.

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x + 6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4f. *[2 marks]*

Markscheme

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

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

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

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

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x+6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4g. *[2 marks]*

Markscheme

(4, 6)   ***(A1)*(ft)*(A1)***

Note: Accept $x=4$, $y=6$. Award at most ***(A1)(A0)*** if parentheses not seen.

If coordinates reversed award ***(A0)(A1)*(ft)**.

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

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x+6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4h. *[2 marks]*

Markscheme

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

Note: Award ***(M1)*** for substitution into their gradient function.

Follow through from their answers to parts (b) and (g).

$=\frac{1}{8}(0.125)$ ***(A1)*(ft)*(G2)***

Examiners report

Most candidates were able to evaluate the function and find the derivative for $x+6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

4i. *[3 marks]*

Markscheme

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

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

(M1) for substituting their gradient in any straight line formula.

$y = \frac{x}{8} + 4$ ***(A1)*(ft)*(G2)***

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

Examiners report

Most candidates were able to evaluate the function and find the derivative for
$x + 6$ but the term with the negative index was problematic. The few candidates who equated their derivative to zero at the local minimum point progressed well and showed a thorough understanding of the differential calculus. Many did not attain full marks for the range of the function, either confusing this with the statistical concept of range or using the *y*-coordinate at B. Most were able to find the gradient and midpoint of the straight line passing through A and B. The final parts were also challenging for the majority: many had difficulty finding the gradient of the tangent L, instead using the slope formula for a straight line; the most common error in part (i) was to substitute in the coordinates of midpoint M rather than the point on the curve. Greater insight into the problem would have come from using the given sketch of the curve and annotating it; it seems that many candidates do not link the algebraic nature of the differential calculus with the curve in question.

5a. *[1 mark]*

Markscheme

110° ***(A1)***

Examiners report

Most candidates used the appropriate area formula – however, some did not read the question with the attention it required and found the area of three rectangles – one of which being the stated “concrete base”.

5b. *[3 marks]*

$\frac{AQ}{\sin 35^\circ} = \frac{10}{\sin 110^\circ}$

$AQ = \frac{5}{\cos 35^\circ}$

$AQ = 6.10$

Examiners report

Most candidates used the appropriate area formula – however, some did not read the question with the attention it required and found the area of three rectangles – one of which being the stated “concrete base”.

5c. *[2 marks]*

Markscheme

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

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

$AC = 51.0(\sqrt{2600}, 50.9901...)$ ***(A1)(G2)***

Examiners report

Most candidates were able to recognize sine rule, substitute correctly and reach the required result.

5d. *[2 marks]*

Markscheme

$QC^2 = (6.10387...)^2 + (50)^2$ ***(M1)***

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

$QC = 50.3711...$ ***(A1)***

$= 50.37$ ***(AG)***

Note: Both the unrounded and rounded answers must be seen to award ***(A1)***.

If 6.10 is used then 50.3707... is the unrounded answer.

For an incorrect follow through from part (b) award a maximum of ***(M1)(A0)*** – the given answer must be reached to award the final ***(A1)(AG)***.

Examiners report

Most candidates were able to recognize sine rule, substitute correctly and reach the required result. The use of Pythagoras’ theorem was also successful, the major source of error being the lack of unrounded and rounded answers in part (d).

Again, most candidates used the appropriate area formula – however, some did not read the question with the attention it required and found the area of three rectangles – one of which being the stated “concrete base”.

5e. *[3 marks]*

Markscheme

$\cos AQC = \frac{(6.10387...)^2 + (50.3711...)^2 - (50.9901...)^2}{2(6.10387...)(50.3711...)}$ ***(M1)(A1)*(ft)**

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

$= 92.4°$ ($92.3753...°$) ***(A1)*(ft)*(G2)***

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

Accept 92.5° ($92.4858...°$) if the 3 sf answers to parts (b), (c) and 4 sf answers to part (d) used.

Examiners report

Most candidates were able to recognize sine rule, substitute correctly and reach the required result. Part (e) was less well answered, due in part to the triangle being in three dimensions. However, all three sides had either been asked for in previous parts or given and all that was required was a sketch of a triangle with the vertices labelled; such a diagram was never on any script and this technique should be encouraged.

Again, most candidates used the appropriate area formula – however, some did not read the question with the attention it required and found the area of three rectangles – one of which being the stated “concrete base”.

5f. [5 marks]

Markscheme

(i)

$2(50 \times 6.10387...)$ ***(M1)***

Note: Award ***(M1)*** for their correctly substituted rectangular area formula, the area of one rectangle is not sufficient.

= 610 m^2 (610.387...) ***(A1)*(ft)*(G2)***

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

The answer is 610 m^2. The units are required.

(ii) Area of triangular face

$= \frac{1}{2} \times 10 \times 6.10387... \times \sin 35°$ ***(M1)(A1)*(ft)**

OR

Area of triangular face

$= \frac{1}{2} \times 6.10387... \times 6.10387... \times \sin 110°$ ***(M1)(A1)*(ft)**

$= 17.5051...$

Note: Award ***(M1)*** for substituted triangle area formula, ***(A1)*(ft)** for correct substitutions.

OR

(Height of triangle)

$= (6.10387...)^2 - 5^2$

$= 3.50103...$

Area of triangular face

$= \frac{1}{2} \times 10 \times their\ height$

$= 17.5051...$

Note: Award ***(M1)*** for substituted triangle area formula, ***(A1)*(ft)** for correctly substituted area formula. If 6.1 is used, the height is 3.49428... and the area of both triangular faces 34.9 m^2

Area of both triangular faces = 35.0 m^2 (35.0103...) ***(A1)(ft)(G2)***

Notes: The answer is 35.0 m^2. The units are required. Do not penalize if already penalized in part (f)(i). Follow through from their part (b).

Examiners report

Most candidates used the appropriate area formula – however, some did not read the question with the attention it required and found the area of three rectangles – one of which being the stated “concrete base”.

5g.

[3 marks]

Markscheme

$(610.387... + 35.0103...) \times 4.80$ ***(M1)***

$= 3097.90...$ ***(A1)*(ft)**

Notes: Follow through from their answers to parts (f)(i) and (f)(ii).

Accept 3096 if the 3 sf answers to part (f) are used.

$= 3100$ ***(A1)*(ft)*(G2)***

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

Examiners report

Most candidates used the appropriate area formula – however, some did not read the question with the attention it required and found the area of three rectangles – one of which being the stated “concrete base”.

6a.

[2 marks]

Markscheme

$\mathrm{V} = 8.7 \times 5.6 \times 3.4$ ***(M1)***

Note: Award ***(M1)*** for multiplication of the 3 given values.

$= 165.648$ ***(A1)*** ***(C2)***

Examiners report

[N/A]

6b.

[2 marks]

Markscheme

(i) 165.6 ***(A1)*(ft)**

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

(ii) 166 ***(A1)*(ft)** ***(C2)***

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

Examiners report

[N/A]

6c. *[2 marks]*

Markscheme

1.66×10^2 ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)** for 1.66, ***(A1)*(ft)** for 10^2. Follow through from their answer to part (b)(ii) only. The follow through for the index should be dependent on the value of the mantissa in part (c) and their answer to part (b)(ii).

Examiners report

[N/A]

7a. *[3 marks]*

Markscheme

$\frac{\text{AC}}{\sin 100^\circ} = \frac{10}{\sin 50^\circ}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution in the sine rule formula, ***(A1)*** for correct substitutions.

$= 12.9(12.8557\ldots)$ ***(A1)*** ***(C3)***

Note: Radian answer is 19.3, award ***(M1)(A1)(A0)***.

Examiners report

[N/A]

7b. *[3 marks]*

Markscheme

$\frac{12^2+7^2-12.8557\ldots^2}{2\times 12\times 7}$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for substitution in the cosine rule formula, ***(A1)*(ft)** for correct substitutions.

= 80.5° (80.4994...°) ***(A1)*(ft)** ***(C3)***

Notes: Follow through from their answer to part (a). Accept 80.9° for using 12.9. Using the radian answer from part (a) leads to an impossible triangle, award ***(M1)(A1)*(ft)*(A0)***.

Examiners report

[N/A]

8a. *[1 mark]*

Markscheme

$\frac{-2}{5}$ ***(A1)*** ***(C1)***

Examiners report

[N/A]

8b. *[1 mark]*

Markscheme

$\frac{5}{2}$ ***(A1)*(ft)** ***(C1)***

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

Examiners report

[N/A]

8c. *[2 marks]*

Markscheme

$3 = \frac{5}{2} \times 5 + c$ ***(M1)***

Notes: Award ***(M1)*** for correct substitution of their gradient into equation of line. Follow through from their answer to part (b).

$y = \frac{5}{2}x - \frac{19}{2}$ ***(A1)(ft)***

OR

$y - 3 = \frac{5}{2}(x - 5)$ ***(M1)(A1)*(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct substitution of their gradient into equation of line. Follow through from their answer to part (b).

Examiners report

[N/A]

8d. *[2 marks]*

Markscheme

(3, −2) ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Notes: If parentheses not seen award at most ***(A0)(A1)*(ft)**. Accept $x = 3$, $y = -2$. Follow through from their answer to part (c), even if no working is seen. Award ***(M1)(A1)*(ft)** for a sensible attempt to solve
$2x + 5y = -4$ and their
$y = \frac{5}{2}x - \frac{19}{2}$ or equivalent, simultaneously.

Examiners report

[N/A]

9a. *[1 mark]*

Markscheme

Units are required in this question for full marks to be awarded.

13800 cm^2 ***(A1)*** ***(C1)***

Examiners report

[N/A]

9b. *[1 mark]*

Markscheme

75 ***(A1)*** ***(C1)***

Examiners report

[N/A]

9c. *[1 mark]*

Markscheme

Units are required in this question for full marks to be awarded.

4600 cm^2 ***(A1)*(ft)*** ***(C1)***

Notes: Units are required unless already penalized in part (a). Follow through from their part (a).

Examiners report

[N/A]

9d. *[3 marks]*

Markscheme

$0.5(x+92)\times 75 = 4600$ ***(M1)(A1)*(ft)**

OR

$0.5\times 150\times (92-x) = 4600$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for substitution into area formula, ***(A1)*(ft)** for their correct substitution.

(= 30.7 (cm)(30.6666...(cm)) ***(A1)*(ft)** ***(C3)***

Note: Follow through from their parts (b) and (c).

Examiners report

[N/A]

10a. *[3 marks]*

Markscheme

$\text{ST} = \frac{1.6}{\cos 35°}$ ***(M1)(A1)***

Note: Award ***(M1)*** for correctly substituted trig equation, ***(A1)*** for 1.6 seen.

OR

$\frac{\text{ST}}{\sin 35°} = \frac{3.2}{\sin 110°}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted sine rule equation, ***(A1)*** for correct substitutions.

ST = 1.95323... ***(A1)***

= 1.95 (m) ***(AG)***

Notes: Both unrounded and rounded answer must be seen for final ***(A1)*** to be awarded.

Examiners report

[N/A]

10b. *[3 marks]*

Markscheme

$\frac{1}{2} \times 3.2 \times 1.95323... \times \sin 35°$ **or**
$\frac{1}{2} \times 1.95323... \times 1.95323... \times \sin 110°$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted area formula, ***(A1)*** for correct substitutions. Do not award follow through marks.

= 1.79 m^2 (1.79253...m^2) ***(A1)(G2)***

Notes: The answer is 1.79 m^2, **units are required**. Accept 1.78955... from using 1.95.

OR

$\frac{1}{2} \times 3.2 \times 1.12033...$ ***(A1) (M1)***

Note: Award ***(A1)*** for the correct value for TM (1.12033...) **OR** correct expression for TM (i.e. 1.6tan35°, $\sqrt{(1.95323...)^2 - 1.6^2}$), ***(M1)*** for correctly substituted formula for triangle area.

= 1.79 m^2 (1.79253...m^2) ***(A1)(G2)***

Notes: The answer is 1.79 m^2, **units are required**. Accept 1.78 m^2 from using 1.95.

Examiners report

[N/A]

10c. *[1 mark]*

Markscheme

9.18 m^2 (9.18022 m^2) ***(A1)(G1)***

Notes: The answer is 9.18 m^2, **units are required**. Do not penalize if lack of units was already penalized in (b). Do not award follow through marks here. Accept 9.17 m^2 (9.165 m^2) from using 1.95.

Examiners report

[N/A]

10d. *[3 marks]*

Markscheme

$2 \times 1.79253... + 2 \times 9.18022... + 4.7 \times 3.2$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for addition of three products, ***(A1)*(ft)** for three correct products.

= 37.0 m^2 (36.9855...m^2) ***(A1)*(ft)*(G2)***

Notes: The answer is 37.0 m^2, **units are required**. Accept 36.98 m^2 from using 3sf answers. Follow through from their answers to (b) and (c). Do not penalize if lack of units was penalized earlier in the question.

Examiners report

[N/A]

10e. *[2 marks]*

Markscheme

$1.79253... \times 4.7$ ***(M1)***

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

= 8.42 m^3 (8.42489...m^3) ***(A1)*(ft)*(G2)***

Notes: The answer is 8.42 m^3, **units are required**. Accept 8.41 m^3 from use of 1.79. An answer of 8.35, from use of TM = 1.11, will receive follow-through marks if working is shown. Follow through from their answer to part (b). Do not penalize if lack of units was penalized earlier in the question.

Examiners report

[N/A]

10f. *[4 marks]*

Markscheme

(i)

$\text{TM} = 1.6 \tan 35°$ ***(M1)***

Notes: Award ***(M1)*** for their correct substitution in trig ratio.

OR

$\text{TM} = \sqrt{(1.95323...)^2 - 1.6^2}$ ***(M1)***

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

OR

$\frac{3.2 \times \text{TM}}{2} = 1.79253...$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution in area of triangle formula.

= 1.12 (m) (1.12033...) ***(A1)(ft)(G2)***

Notes: Follow through from their answer to (b) if area of triangle is used. Accept 1.11 (1.11467) from use of ST = 1.95.

(ii)

$\text{VM} = \sqrt{1.12033...^2 + 4.7^2}$ ***(M1)***

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

= 4.83 (m) (4.83168) ***(A1)*(ft)*(G2)***

Notes: Follow through from (f)(i).

Examiners report

[N/A]

10g. *[2 marks]*

Markscheme

$\sin^{-1}\left(\frac{1.12033...}{4.83168...}\right)$ ***(M1)***

OR

$\cos^{-1}\left(\frac{4.7}{4.83168...}\right)$ ***(M1)***

OR

$\tan^{-1}\left(\frac{1.12033...}{4.7}\right)$ ***(M1)***

Note: Award ***(M1)*** for correctly substituted trig equation.

OR

$\cos^{-1}\left(\frac{4.7^2+(4.83168...)^2-(1.12033...)^2}{2\times4.7\times4.83168...}\right)$ ***(M1)***

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

= 13.4° (13.4073...) ***(A1)*(ft)*(G2)***

Notes: Accept 13.3°. Follow through from part (f).

Examiners report

[N/A]

11a. *[3 marks]*

Markscheme

$y=-\frac{75^2}{10}+\frac{27}{2}\times75$ ***(M1)***

Note: Award ***(M1)*** for substitution of 75 in the formula of the function.

= 450 ***(A1)***

Yes, point A is on the bike track. ***(A1)***

Note: Do not award the final ***(A1)*** if correct working is not seen.

Examiners report

[N/A]

11b. *[2 marks]*

Markscheme

$\frac{\mathrm{d}y}{\mathrm{d}x}=-\frac{2x}{10}+\frac{27}{2}\left(\frac{\mathrm{d}y}{\mathrm{d}x}=-0.2x+13.5\right)$ ***(A1)(A1)***

Notes: Award ***(A1)*** for each correct term. If extra terms are seen award at most ***(A1)(A0)***. Accept equivalent forms.

Examiners report

[N/A]

11c. *[4 marks]*

Markscheme

$-\frac{2x}{10}+\frac{27}{2}=0$ ***(M1)***

Note: Award ***(M1)*** for equating their derivative from part (b) to zero.

$x=67.5$ ***(A1)*****(ft)**

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

$(\text{Their})\ 67.5\neq 75$ ***(R1)***

Note: Award ***(R1)*** for a comparison of their 67.5 with 75. Comparison may be implied (*eg* 67.5 is the *x*-coordinate of the furthest north point).

OR

$\frac{\mathrm{d}y}{\mathrm{d}x}=-\frac{2\times(75)}{10}+\frac{27}{2}$ ***(M1)***

Note: Award ***(M1)*** for substitution of 75 into their derivative from part (b).

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

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

$(\text{Their})-1.5\neq 0$ ***(R1)***

Note: Award ***(R1)*** for a comparison of their –1.5 with 0. Comparison may be implied (*eg* The gradient of the parabola at the furthest north point (vertex) is 0).

Hence A is not the furthest north point. ***(A1)*****(ft)**

Note: Do not award ***(R0)(A1)*****(ft)**. Follow through from their derivative from part (b).

Examiners report

[N/A]

11d.

[3 marks]

Markscheme

(i) M(50,175)   ***(A1)***

Note: If parentheses are omitted award ***(A0)***. Accept $x = 50$, $y = 175$.

(ii)

$\frac{350-0}{100-0}$ ***(M1)***

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

$= 3.5\left(\frac{350}{100}, \frac{7}{2}\right)$ ***(A1)*****(ft)*****(G2)***

Note: Follow through from (d)(i) if midpoint is used to calculate gradient. Award ***(G1)(G0)*** for answer $3.5x$ without working.

Examiners report

[N/A]

11e.

[3 marks]

Markscheme

$y = 3.5x + 150$ ***(A1)*****(ft)*****(A1)*****(ft)**

Note: Award ***(A1)*****(ft)** for using their gradient from part (d), ***(A1)*****(ft)** for correct equation of line.

$3.5x - y = -150$ **or**

$7x - 2y = -300$ (or equivalent)   ***(A1)*****(ft)**

Note: Award ***(A1)*****(ft)** for expressing their equation in the form

$ax + by = c$.

Examiners report

[N/A]

11f.

[2 marks]

Markscheme

(18.4, 214) (18.3772..., 214.320...)   ***(A1)*****(ft)*****(A1)*****(ft)*****(G2)*****(ft)**

Notes: Follow through from their equation in (e). Coordinates must be positive for follow through marks to be awarded. If parentheses are omitted and not already penalized in (d)(i) award at most ***(A0)(A1)*****(ft)**. If coordinates of the two intersection points are given award ***(A0)(A1)*****(ft)**. Accept $x = 18.4$, $y = 214$.

Examiners report

[N/A]

12a. *[1 mark]*

Markscheme

–2 ***(A1)*** ***(C1)***

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

[1 mark]

Examiners report

The majority of candidates were able to write down the gradient of the straight line in part (a) but a correct answer for the gradient of the perpendicular proved to be more elusive in part (b)(i). Many however recovered in the remainder of the question as they were able to find the equation of a line using their gradient and the coordinates of a point on the line but, in some case, did not always show clear working. A significant minority of candidates, who attempted to substitute (4, 5) into the equation $y = mx + c$, incorrectly identified the value of c as 5.

12b. *[3 marks]*

Markscheme

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

Note: Follow through from their part (a).

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

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

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

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

OR

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

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

[3 marks]

Examiners report

The majority of candidates were able to write down the gradient of the straight line in part (a) but a correct answer for the gradient of the perpendicular proved to be more elusive in part (b)(i). Many however recovered in the remainder of the question as they were able to find the equation of a line using their gradient and the coordinates of a point on the line but, in some case, did not always show clear working. A significant minority of candidates, who attempted to substitute (4, 5) into the equation $y = mx + c$, incorrectly identified the value of c as 5.

12c. *[2 marks]*

Markscheme

(0.8, 3.4) or

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

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

[2 marks]

Examiners report

The majority of candidates were able to write down the gradient of the straight line in part (a) but a correct answer for the gradient of the perpendicular proved to be more elusive in part (b)(i). Many however recovered in the remainder of the question as they were able to find the equation of a line using their gradient and the coordinates of a point on the line but, in some case, did not always show clear working. A significant minority of candidates, who attempted to substitute (4, 5) into the equation $y = mx + c$, incorrectly identified the value of c as 5.

13a. *[2 marks]*

Markscheme

$9.5^2 = 8^2 + \text{AB}^2$ ***(M1)***

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

AB = 5.12 (cm) (5.12347…) ***(A1)*** ***(C2)***

[2 marks]

Examiners report

This seemed to be a good discriminatory question enabling the majority of candidates to at least score well on part (a). Challenges arose for candidates who were then required to see the problem in three dimensions for the remainder of the question. Indeed, a significant number of candidates correctly identified the required lengths for part (b) and, provided they used Pythagoras correctly, were able to pick up the marks in this part of the question. However, in part (c), invariably the wrong triangle was chosen with triangles BFM and BAF proving to be the most popular, but incorrect triangles, chosen.

13b. *[2 marks]*

Markscheme

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

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

= 9.84 (cm) (9.83933…) ***(A1)*(ft)** ***(C2)***

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

[2 marks]

13c.

[2 marks]

Markscheme

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

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

= 31.4 (31.3801...) ***(A1)*(ft)** ***(C2)***

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

[2 marks]

Examiners report

This seemed to be a good discriminatory question enabling the majority of candidates to at least score well on part (a). Challenges arose for candidates who were then required to see the problem in three dimensions for the remainder of the question. Indeed, a significant number of candidates correctly identified the required lengths for part (b) and, provided they used Pythagoras correctly, were able to pick up the marks in this part of the question. However, in part (c), invariably the wrong triangle was chosen with triangles BFM and BAF proving to be the most popular, but incorrect triangles, chosen.

14a.

[3 marks]

Markscheme

Units are required in part (c) only.

$BC^2 = 5^2 + 7^2 - 2(5)(7)\cos 112°$ ***(M1)(A1)***

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

BC = 10.0 (m) (10.0111...) ***(A1)(G2)***

Note: If radians are used, award at most ***(M1)(A1)(A0)***.

[3 marks]

Examiners report

The responses to this question showed appropriate use of sine and cosine formulae for the most part. A few students still used the Pythagorean formula incorrectly, although the given triangles were not right ones. There was an occasional use of GDC set to radians, and very few students lost marks for giving their answers in radians. In part (d), converting from cm^3 to m^3 was largely problematic for the great majority of students. Part (e) also was difficult for some students, as it requires some interpretation before the volume formula is used.

14b. *[4 marks]*

Markscheme

Units are required in part (c) only.

$\frac{\sin 40^\circ}{10.0111...} = \frac{\sin \mathrm{D\hat{C}B}}{6}$ ***(M1)(A1)*(ft)**

Notes: Award ***(M1)*** for substitution in sine formula, ***(A1)*(ft)** for their correct substitutions. Follow through from their part (a).

$\mathrm{D\hat{C}B} = 22.7^\circ$ (22.6589...) ***(A1)*(ft)**

Notes: Award ***(A2)*** for 22.7° seen without working. Use of radians results in unrealistic answer. Award a maximum of ***(M1)(A1)*(ft)*(A0)*(ft)**. Follow through from their part (a).

$\mathrm{D\hat{C}B} = 117^\circ$ (117.341...) ***(A1)*(ft)*(G3)***

Notes: Do not penalize if use of radians was already penalized in part (a). Follow through from their answer to part (a).

OR

From use of cosine formula

DC = 13.8(m) (13.8346…) ***(A1)*(ft)**

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

$\frac{\sin \alpha}{13.8346...} = \frac{\sin 40^\circ}{10.0111...}$ ***(M1)***

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

$\alpha = 62.7^\circ$ (62.6589) ***(A1)*(ft)**

Note: Accept 62.5° from use of 3sf.

$\mathrm{D\hat{B}C} = 117$(117.341...) ***(A1)*(ft)**

Note: Follow through from their part (a). Use of radians results in unrealistic answer, award a maximum of ***(A1)(M1)(A0)(A0)***.

[4 marks]

Examiners report

The responses to this question showed appropriate use of sine and cosine formulae for the most part. A few students still used the Pythagorean formula incorrectly, although the given triangles were not right ones. There was an occasional use of GDC set to radians, and very few students lost marks for giving their answers in radians. In part (d), converting from cm^3 to m^3 was largely problematic for the great majority of students. Part (e) also was difficult for some students, as it requires some interpretation before the volume formula is used.

14c. *[4 marks]*

Markscheme

Units are required in part (c) only.

$\text{ABDC} = \frac{1}{2}(5)(7)\sin 112^\circ + \frac{1}{2}(6)(10.0111\ldots)\sin 117.341\ldots^\circ$ ***(M1)(A1)*(ft)*(M1)*N**

Note: Award ***(M1)*** for substitution in both **triangle** area formulae, ***(A1)*(ft)** for their correct substitutions, ***(M1)*** for seen or implied addition of their two **triangle** areas. Follow through from their answer to part (a) and (b).

= 42.9 m^2 (42.9039...) ***(A1)*(ft)*(G3)***

Notes: Answer is 42.9 m^2 *i.e.* **the units are required** for the final ***(A1)*(ft)** to be awarded. Accept 43.0 m^2 from using 3sf answers to parts (a) and (b). Do not penalize if use of radians was previously penalized.

[4 marks]

Examiners report

The responses to this question showed appropriate use of sine and cosine formulae for the most part. A few students still used the Pythagorean formula incorrectly, although the given triangles were not right ones. There was an occasional use of GDC set to radians, and very few students lost marks for giving their answers in radians. In part (d), converting from cm^3 to m^3 was largely problematic for the great majority of students. Part (e) also was difficult for some students, as it requires some interpretation before the volume formula is used.

14d. *[3 marks]*

Markscheme

Units are required in part (c) only.

42.9039... × 0.5 ***(M1)(M1)***

Note: Award ***(M1)*** for 0.5 seen (or equivalent), ***(M1)*** for multiplication of their answer in part (c) with their value for depth.

= 21.5 (m^3) (21.4519...) ***(A1)*(ft)*(G3)***

Note: Follow through from their part (c) only if working is seen. Do not penalize if use of radians was previously penalized. Award at most ***(A0)(M1)(A0)*(ft)** for multiplying by 50.

[3 marks]

Examiners report

The responses to this question showed appropriate use of sine and cosine formulae for the most part. A few students still used the Pythagorean formula incorrectly, although the given triangles were not right ones. There was an occasional use of GDC set to radians, and very few students lost marks for giving their answers in radians. In part (d), converting from cm^3 to m^3 was largely problematic for the great majority of students. Part (e) also was difficult for some students, as it requires some interpretation before the volume formula is used.

14e.

[5 marks]

Markscheme

Units are required in part (c) only.

(i) $\pi(0.15)^2(0.4)$ ***(M1)(A1)***

OR

$\pi \times 15^2 \times 40$ (28274.3...) ***(M1)(A1)***

Notes: Award ***(M1)*** for substitution in the correct volume formula. ***(A1)*** for correct substitutions.

= 0.0283 (m^3) (0.0282743..., 0.09π)

(ii)
$\frac{21.4519...}{0.0282743...}$ ***(M1)***

Note: Award ***(M1)*** for correct division of their volumes.

= 759 ***(A1)*(ft)*(G2)***

Notes: Follow through from their parts (d) and (e)(i). Accept 760 from use of 3sf answers. Answer must be a positive integer for the final ***(A1)*(ft)** mark to be awarded.

[5 marks]

Examiners report

The responses to this question showed appropriate use of sine and cosine formulae for the most part. A few students still used the Pythagorean formula incorrectly, although the given triangles were not right ones. There was an occasional use of GDC set to radians, and very few students lost marks for giving their answers in radians. In part (d), converting from cm^3 to m^3 was largely problematic for the great majority of students. Part (e) also was difficult for some students, as it requires some interpretation before the volume formula is used.

15a.

[4 marks]

Markscheme

(i)
$\frac{-4+2}{2} = q$ ***(M1)***

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

$q = -1$ ***(A1)***

(ii)
$\frac{p+(-3)}{2} = 1$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the correct formula or consistent with their equation in (i).

$p = 5$ ***(A1)*** ***(C4)***

Notes: Award A marks for integer values. Penalise if answers left as a fraction the first time a fraction is seen.

[4 marks]

Examiners report

(a) Despite some good answers in this part of the question, sign errors in setting up one or both of the equations meant that marks were lost by some candidates. This error was particularly prevalent in finding the value of p and the equation $\frac{(p+3)}{2} = 1$ was seen quite often. In part (b), there was a requirement for a correct substitution of their coordinates for A and B into the correct formula for Pythagoras and, while $(2 + 4)^2$ was often seen, sign errors in the second component of $(–3 – 5)^2$ proved to be the downfall of a significant number of candidates. As a consequence, the final two marks were lost. Given these errors, there were still a significant number of full mark responses to this question.

15b. *[2 marks]*

Markscheme

AB $= \sqrt{(2+4)^2 + (-3-5)^2}$ ***(M1)***

Note: Award ***(M1)*** for the correct substitution of their coordinates for A and B in the correct formula.

AB = 10 ***(A1)*(ft)** ***(C2)***

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

[2 marks]

Examiners report

(a) Despite some good answers in this part of the question, sign errors in setting up one or both of the equations meant that marks were lost by some candidates. This error was particularly prevalent in finding the value of p and the equation $\frac{(p+3)}{2} = 1$ was seen quite often. In part (b), there was a requirement for a correct substitution of their coordinates for A and B into the correct formula for Pythagoras and, while $(2 + 4)^2$ was often seen, sign errors in the second component of $(–3 – 5)^2$ proved to be the downfall of a significant number of candidates. As a consequence, the final two marks were lost. Given these errors, there were still a significant number of full mark responses to this question.

16a. *[1 mark]*

Markscheme

$3 \times (–5) + 2 \times 6 \neq 9$ ***(A1)*** ***(C1)***

Note: Also accept $3 \times (–5) + 2x = 9$ gives $x = 12 \neq 6$ or $3y + 2 \times (6) = 9$ gives $y = –1 \neq –5$.

[1 mark]

Examiners report

In part (a), the word *'explain'* required more than simply stating that '*I put the coordinates into my GDC and it did not work*'. A written statement, showing the substitution of one or both of the coordinates leading to an inequality was required for this first mark. It was pleasing to see that many scripts showed correct methodology for calculating the gradient of L and the gradient of a line perpendicular to L. The correct equation of the line perpendicular to L passing through P proved to be more elusive as poor arithmetic spoilt what could have been excellent work. In particular

$-5 = \frac{3}{2} \times 6 + c$ leading to

$c = (\pm)4$ proved to be a popular but erroneous calculation.

16b. *[2 marks]*

Markscheme

$3y = -2x + 9$ ***(M1)***

Note: Award ***(M1)*** for $3y = -2x + 9$ or
$y = \frac{-2}{3}x + 3$ or
$y = \frac{(-2x+9)}{3}$.

gradient $= -\frac{2}{3}(-0.667)(-0.666666...)$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

In part (a), the word *'explain'* required more than simply stating that '*I put the coordinates into my GDC and it did not work*'. A written statement, showing the substitution of one or both of the coordinates leading to an inequality was required for this first mark. It was pleasing to see that many scripts showed correct methodology for calculating the gradient of L and the gradient of a line perpendicular to L. The correct equation of the line perpendicular to L passing through P proved to be more elusive as poor arithmetic spoilt what could have been excellent work. In particular
$-5 = \frac{3}{2} \times 6 + c$ leading to
$c = (\pm)4$ proved to be a popular but erroneous calculation.

16c. *[3 marks]*

Markscheme

(i) gradient of perpendicular line
$= \frac{3}{2}(1.5)$ ***(A1)*(ft)**

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

(ii)
$y = \frac{3}{2}x + c$

$-5 = \frac{3}{2} \times 6 + c$ ***(M1)***

Note: Award ***(M1)*** for substitution of their perpendicular gradient and the point (6, –5) into the equation of their line.

$y = \frac{3}{2}x - 14$ ***(A1)*(ft)**

Note: Follow through from their perpendicular gradient. Accept equivalent forms.

OR

$y + 5 = \frac{3}{2}(x - 6)$ ***(M1)(A1)*(ft)** ***(C3)***

Notes: Award ***(M1)*** for substitution of their perpendicular gradient and the point (6, –5) into the equation of their line. Follow through from their perpendicular gradient.

[3 marks]

Examiners report

In part (a), the word *'explain'* required more than simply stating that '*I put the coordinates into my GDC and it did not work*'. A written statement, showing the substitution of one or both of the coordinates leading to an inequality was required for this first mark. It was pleasing to see that many scripts showed correct methodology for calculating the gradient of L and the gradient of a line perpendicular to L. The correct equation of the line perpendicular to L passing through P proved to be more elusive as poor arithmetic spoilt what could have been excellent work. In particular
$-5 = \frac{3}{2} \times 6 + c$ leading to
$c = (\pm)4$ proved to be a popular but erroneous calculation.

17a. *[3 marks]*

Markscheme

$AC^2 = 6^2 + 10^2 – 2×10×6×\cos120°$ ***(M1)(A1)***

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

AC = 14 (m) ***(A1)*** ***(C3)***

[3 marks]

Examiners report

In part (a), candidates seemed to be well drilled in the use of the cosine rule and AC = 14 m proved to be a popular, and correct, answer seen. The most popular incorrect answer seemed to be 11.7 m. This seems to have been arrived at by simple Pythagoras on triangle DCA – clearly, a totally incorrect method. Not as many candidates then went on to find the required angle in part (b). Some simply continued with using triangle DCA and found angle DCA. Indeed, some candidates even found angle DCB rather than the required angle ACB. In most cases, correct or otherwise, the sine rule was used and credit was awarded for this process.

17b. *[3 marks]*

Markscheme

$\frac{14}{\sin 40} = \frac{13}{\sin \mathrm{ACB}}$ ***(M1)(A1)*****(ft)**

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

Angle ACB = 36.6° (36.6463...) ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their (a).

[3 marks]

Examiners report

In part (a), candidates seemed to be well drilled in the use of the cosine rule and AC = 14 m proved to be a popular, and correct, answer seen. The most popular incorrect answer seemed to be 11.7 m. This seems to have been arrived at by simple Pythagoras on triangle DCA – clearly, a totally incorrect method. Not as many candidates then went on to find the required angle in part (b). Some simply continued with using triangle DCA and found angle DCA. Indeed, some candidates even found angle DCB rather than the required angle ACB. In most cases, correct or otherwise, the sine rule was used and credit was awarded for this process.

18a. *[3 marks]*

$\frac{\mathrm{AC}}{\sin 30°} = \frac{8}{\sin 40°}$

Examiners report

Whilst using the sine rule to find an angle was tested in question 10, here the sine rule was required to be used to find a length. Many scripts showed the correct value of 6.22 m, but a significant number of candidates calculated AB instead of AC and the answer of 11.7 m proved to be a popular, but erroneous, answer. Some candidates turned the problem into two right angled triangles by dropping the perpendicular from C to the line AB. Much working was then required to find AC and again, some of these candidates simply determined the length of AB. Despite a significant number of candidates identifying the incorrect length in part (a), many of these recovered in part (b) to use their value correctly in the formula for the area of a triangle and many correct calculations were seen. Unfortunately, this good work was spoilt as some candidates either missed the units or gave the incorrect units in their final answer and, as a consequence, lost the last mark.

18b. *[3 marks]*

Markscheme

Area of triangle
$\text{ABC} = \frac{1}{2} \times 8 \times 6.22289... \times \sin 110^\circ$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for substitution in the correct formula, ***(A1)*(ft)** for their correct substitutions. Follow through from their part (a).

Area triangle ABC = 23.4 m^2 (23.3904...m^2) ***(A1)*(ft)** ***(C3)***

Note: Follow through from a positive answer to their part (a). The answer is 23.4 m^2, units are required.

[3 marks]

Examiners report

Whilst using the sine rule to find an angle was tested in question 10, here the sine rule was required to be used to find a length. Many scripts showed the correct value of 6.22 m, but a significant number of candidates calculated AB instead of AC and the answer of 11.7 m proved to be a popular, but erroneous, answer. Some candidates turned the problem into two right angled triangles by dropping the perpendicular from C to the line AB. Much working was then required to find AC and again, some of these candidates simply determined the length of AB. Despite a significant number of candidates identifying the incorrect length in part (a), many of these recovered in part (b) to use their value correctly in the formula for the area of a triangle and many correct calculations were seen. Unfortunately, this good work was spoilt as some candidates either missed the units or gave the incorrect units in their final answer and, as a consequence, lost the last mark.

19a. *[2 marks]*

Markscheme

$\pi \times 4^2$ ***(M1)***

= 50.3 (16
π) cm^2 (50.2654...) ***(A1)(G2)***

Note: Award ***(M1)*** for correct substitution in area formula. The answer is 50.3 cm^2, the units are required.

[2 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of “total surface area” was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

19b. *[2 marks]*

Markscheme

50.265...× 8 ***(M1)***

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

= 402.123... ***(A1)***
= 402 (cm^3) ***(AG)***

Note: Both the unrounded and the rounded answer must be seen for the ***(A1)*** to be awarded. The units are **not** required

[2 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of "total surface area" was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

19c. *[3 marks]*

Markscheme

$2 \times \pi \times 4 \times 8 + 2 \times \pi \times 4^2$ ***(M1)(M1)***

Note: Award ***(M1)*** for correct substitution in the curved surface area formula, ***(M1)*** for adding the area of their two bases.

= 302 cm^2 (96π cm^2) (301.592...) ***(A1)*(ft)*(G2)***

Notes: The answer is 302 cm^2, the units are required. Do not penalise for missing or incorrect units if penalised in part (a). Follow through from their answer to part (a).

[3 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of "total surface area" was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

19d. *[3 marks]*

Markscheme

$\frac{1}{3}\pi \times 6^2 \times \mathrm{OC} = 402$ ***(M1)(M1)***

Note: Award ***(M1)*** for correctly substituted volume formula, ***(M1)*** for equating to 402 (402.123…).

$\mathrm{OC} = 10.7\ (\mathrm{cm})\ \left(10\frac{2}{3},\ 10.6666...\right)$ ***(A1)(G2)***

[3 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of “total surface area” was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

19e. *[2 marks]*

Markscheme

$\tan \mathrm{BCO} = \frac{6}{10.66...}$ ***(M1)***

Note: Award ***(M1)*** for use of correct tangent ratio.

$\mathrm{B\hat{C}O} = 29.4°\ (29.3577...)$ ***(A1)*(ft)*(G2)***

Notes: Accept 29.3° (29.2814...) if 10.7 is used. An acceptable alternative method is to calculate CB first and then angle BCO. Allow follow through from parts (d) and (f). Answers range from 29.2° to 29.5°.

[2 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of “total surface area” was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

19f. *[2 marks]*

Markscheme

$\mathrm{CB} = \sqrt{6^2 + (10.66...)^2}$ ***(M1)***

OR

$\sin 29.35...° = \frac{6}{\mathrm{CB}}$ ***(M1)***

OR

$\cos 29.35...° = \frac{10.66...}{\mathrm{CB}}$ ***(M1)***

CB = 12.2 (cm) (12.2383...) ***(A1)*(ft)*(G2)***

Note: Accept 12.3 (12.2674...) if 10.7 (and/or 29.3) used. Follow through from part (d) or part (e) as appropriate.

[2 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of “total surface area” was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

19g. *[4 marks]*

Markscheme

$\pi \times 6 \times 12.2383... + \pi \times 6^2$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correct substitution in curved surface area formula, ***(M1)*** for correct substitution in area of circle formula, ***(M1)*** for addition of the two areas.

= 344 cm^2 (343.785...) ***(A1)*****(ft)*****(G3)***

Note: The answer is 344 cm^2, the units are required. Do not penalise for missing or incorrect units if already penalised in either part (a) or (c). Accept 345 cm^2 if 12.3 is used and 343 cm^2 if 12.2 is used. Follow through from their part (f).

[4 marks]

Examiners report

This question was either very well done – by the majority – or very poorly (but not both). Many incomplete attempts were seen. This would perhaps indicate a lack of preparation in this area of the syllabus from some centres, since it was that the formulas for cones were not well understood. Further, the idea of "total surface area" was a mystery to many – a slavish reliance of formulas, irrespective of context, led to many errors and a consequent loss of marks.

The invariance of volume for solids and liquids that provided the link in this question was not understood by many, but was felt to be an appropriate subject for an examination.

20a. *[1 mark]*

Markscheme

32° ***(A1)*** ***(C1)***

[1 mark]

Examiners report

Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

20b. *[1 mark]*

Markscheme

116° ***(A1)*** ***(C1)***

[1 mark]

Examiners report

Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

20c. *[4 marks]*

Markscheme

$360 = \frac{1}{2} \times x^2 \times \sin 116^\circ$ ***(M1)(A1)*(ft)**

Notes: Award ***(M1)*** for substitution into correct formula with 360 seen, ***(A1)*(ft)** for correct substitution, follow through from their answer to part (b).

$x = 28.3$ (cm) ***(A1)*(ft)**

$x = 283$ (mm) ***(A1)*(ft)** ***(C4)***

Notes: The final ***(A1)*(ft)** is for their cm answer converted to mm. If their incorrect cm answer is seen the final ***(A1)*(ft)** can be awarded for correct conversion to mm.

[4 marks]

Examiners report

Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

21a. *[2 marks]*

Markscheme

$\frac{\mathrm{d}y}{\mathrm{d}x} = 4x - 5$ ***(A1)(A1)*** ***(C2)***

Notes: Award ***(A1)*** for each correct term. Award ***(A1)(A0)*** if any other terms are given.

[2 marks]

Examiners report

The derivative of the function was correctly found by most candidates. Rearranging the equation of the line to find the gradient was also successfully performed. Most candidates could not find the x-coordinate of the point on the curve whose tangent was parallel to a given line. To most candidates, part (b) appeared to be disconnected to part (a).

21b. *[4 marks]*

Markscheme

$y = -3x - \frac{1}{2}$ ***(M1)***

Note: Award ***(M1)*** for rearrangement of equation

gradient of line is –3 ***(A1)***

$4x - 5 = -3$ ***(M1)***

Notes: Award ***(M1)*** for equating their gradient to their derivative from part (a). If $4x - 5 = -3$ is seen with no working award ***(M1)(A1)(M1)***.

$x = \frac{1}{2}$ ***(A1)*(ft)** ***(C4)***

Note: Follow through from their part (a). If answer is given as (0.5, 2) with no working award the final ***(A1)*** only.

[4 marks]

Examiners report

The derivative of the function was correctly found by most candidates. Rearranging the equation of the line to find the gradient was also successfully performed. Most candidates could not find the x-coordinate of the point on the curve whose tangent was parallel to a given line. To most candidates, part (b) appeared to be disconnected to part (a).

22a. *[2 marks]*

Markscheme

$150\tan 50$ ***(M1)***

OR

$\frac{150}{\tan 40}$ ***(M1)***

$= 179\ (\mathrm{m})$ (
$178.763\ldots$) ***(A1)*** ***(C2)***

Examiners report

[N/A]

22b. *[4 marks]*

Markscheme

$150\tan 50 - 150\tan 35$ ***(M1)(M1)***

Note: Award ***(M1)*** for
$150\tan 35$, ***(M1)*** for subtraction from their part (a).

$= 73.7\ (\mathrm{m})$ (
$73.7319\ldots$) ***(A1)*****(ft)**
$= 74\ (\mathrm{m})$ ***(A1)*****(ft)** ***(C4)***

Note: The final ***(A1)*** is awarded for the correct rounding of their answer to (b).
Note: There will always be one answer with a specified degree of accuracy on each paper.

Examiners report

[N/A]