Topic 5 Part 2 *[251 marks]*

1a. *[2 marks]*

Markscheme

$\left(\frac{2+4}{2}, \frac{8+2}{2}\right)$ ***(M1)***

Note: Award ***(M1)*** for a correct substitution into the midpoint formula.

$= (3, 5)$ ***(A1)*** ***(C2)***

Note: Brackets must be present for final ***(A1)*** to be awarded.

Note: Accept
$x = 3$,
$y = 5$.

[2 marks]

Examiners report

Overall, there was a very good response to parts (a) and (b) with only a few candidates giving an incorrect expression for the gradient in part (b).

1b. *[2 marks]*

Markscheme

$\frac{8-4}{2-14}$ ***(M1)***

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

$= -\frac{1}{3}$
$\left(\frac{-4}{12}, -0.333\right)$
$(-0.333333\ldots)$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

Overall, there was a very good response to parts (a) and (b) with only a few candidates giving an incorrect expression for the gradient in part (b). Occasionally, the final mark in part (b) was lost because the negative sign was dropped by some candidates.

1c. *[2 marks]*

Markscheme

$(y-5) = -\frac{1}{3}(x-3)$ ***(M1)(A1)*****(ft)**

OR

$5 = -\frac{1}{3}(3) + c$ ***(M1)***

$y = -\frac{1}{3}x + 6$ ***(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)*** for substitution of their gradient into equation of line with their values from (a) correctly substituted.

Accept correct equivalent forms of the equation of the line. Follow through from their parts (a) and (b).

[2 marks]

Examiners report

Many able candidates recognized they needed to do something with the equation $y = mx + c$ in part (c). Weaker candidates clearly showed a lack of understanding of an equation of a line and either simply gave a numerical answer for this part of the question or tried to use the coordinates of M into what they believed was the required equation of the straight line. A popular incorrect answer seen was $y = 3x + 5$.

2a.

[4 marks]

Markscheme

$V = \pi(15)^2(12) + 0.5 \times \frac{4\pi(15)^3}{3}$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correctly substituted cylinder formula, ***(M1)*** for correctly substituted sphere formula, ***(M1)*** for dividing the sphere formula by 2.

$= 15550.8\ldots$

$= 15600 \text{ m}^3 \ (4950\pi \text{ m}^3)$ ***(A1) (C4)***

Notes: The final answer is 15600 m^3; the units are required. The use of $\pi = 3.14$ which gives a final answer of 15500 (15543) is premature rounding; the final ***(A1)*** is not awarded.

[4 marks]

Examiners report

This question was only done well by the more able candidates. For the lower quartile of candidates, about a half of these scored no more than one mark in total for this question. In many cases, formulae were either misquoted or misused. Indeed, in part (a) many ignored the hemisphere, choosing to use the formula for the volume of a sphere instead. Some candidates who correctly used a hemisphere in part (a) then treated the surface area as a sphere in part (b). A minority of candidates thought the area to be painted in the last part of the question was a circle rather than a hemisphere.

2b.

[2 marks]

Markscheme

$SA = 0.5 \times 4\pi(15)^2$ ***(M1)***

$= 1413.71\ldots$

$= 1410 \text{ m}^2 \ (450\pi \text{ m}^2)$ ***(A1) (C2)***

Notes: The final answer is 1410 m^2 ; do not penalize lack of units if this has been penalized in part (a).

[2 marks]

Examiners report

This question was only done well by the more able candidates. For the lower quartile of candidates, about a half of these scored no more than one mark in total for this question. In many cases, formulae were either misquoted or misused. Indeed, in part (a) many ignored the hemisphere, choosing to use the formula for the volume of a sphere instead. Some candidates who correctly used a hemisphere in part (a) then treated the surface area as a sphere in part (b). A minority of candidates thought the area to be painted in the last part of the question was a circle rather than a hemisphere.

3a. *[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.

3b. *[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.

3c. *[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.

3d. *[3 marks]*

Markscheme

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

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

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

3e. *[2 marks]*

Markscheme

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

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

$\text{B}\hat{\text{C}}\text{O} = 29.4^\circ\ (29.3577...)$ ***(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.

3f. *[2 marks]*

Markscheme

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

OR

$\sin 29.35\ldots^\circ = \frac{6}{\text{CB}}$ ***(M1)***

OR

$\cos 29.35\ldots^\circ = \frac{10.66\ldots}{\text{CB}}$ ***(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.

3g. *[4 marks]*

Markscheme

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

4a. *[3 marks]*

Markscheme

(i) 115.2 (m) ***(A1)***

Note: Accept 115 (m)

(ii)

$\sqrt{(146.5^2 + 115.2^2)}$ ***(M1)***

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

186 (m) (186.368…) ***(A1)*(ft)*(G2)***

Note: Follow through from part (a)(i).

[3 marks]

Examiners report

(a) This part was very well done on the whole.

4b. *[2 marks]*

Markscheme

$\frac{1}{2} \times 230.4 \times 186.368...$ ***(M1)***

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

21500 m^2 (21469.6…m^2) ***(A1)*(ft)*(G2)***

Notes: The final answer is 21500 m^2; **units are required**. Accept 21400 m^2 for use of 186 m and/or 115 m.

[2 marks]

Examiners report

(b) Amazingly badly done. Many candidates used 146.4 for the height and others tried unsuccessfully to find slant heights and angles to that they could use the area of a triangle formula

$\frac{1}{2}ab\sin C$.

4c. *[2 marks]*

Markscheme

$\frac{1}{3} \times 230.4^2 \times 146.5$ ***(M1)***

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

2590000 m^3 (2592276.48 m^3) ***(A1)(G2)***

Note: The final answer is 2590000 m^3; **units are required** but do not penalise missing or incorrect units if this has already been penalised in part (b).

[2 marks]

Examiners report

(c) This was fairly well done.

4d. *[2 marks]*

Markscheme

$\tan^{-1}\left(\frac{146.5}{115.2}\right)$ ***(M1)***

Notes: Award ***(M1)*** for correct substituted trig ratio. Accept alternate correct trig ratios.

= 51.8203...= 52°   ***(A1)(AG)***

Notes: Both the unrounded answer and the final answer must be seen for the ***(A1)*** to be awarded. Accept 51.96° = 52°, 51.9° = 52° or 51.7° = 52°

Examiners report

(d) Quite a few candidates managed to show this although they did not always put down the unrounded answer and so lost the last mark. Some even tried to use 52° to verify its value.

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4e. *[1 mark]*

Markscheme

128°   ***(A1)***

[1 mark]

Examiners report

(e) Very well done on the whole – even if part (d) was wrong.

4f. *[4 marks]*

Markscheme

$\frac{186.368}{\sin 27} = \frac{x}{\sin 25}$ ***(A1)(M1)(A1)*****(ft)**

Notes: Award ***(A1)*****(ft)** for their angle MVP seen, follow through from their part (e). Award ***(M1)*** for substitution into sine formula, ***(A1)*** for correct substitutions. Follow through from their VM and their angle VMP.

x = 173 (m) (173.490...)   ***(A1)*****(ft)*****(G3)***

Note: Accept 174 from use of 186.4.

[4 marks]

Examiners report

(f) This was well done by those who attempted it. Not all candidates used VM to find x and so lost one mark. There were quite a few different methods of finding the answer.

4g. *[4 marks]*

Markscheme

$VQ^2 = (186.368...)^2 + (123.490...)^2 - 2 \times (186.368...) \times (123.490...) \times \cos 128$ ***(A1)*(ft)*(M1)(A1)*(ft)**

Notes: Award ***(A1)*(ft)** for 123.490...(123) seen, follow through from their x (PM) in part (f), ***(M1)*** for substitution into cosine formula, ***(A1)*(ft)** for correct substitutions. Follow through from their VM and their angle VMP.

OR

173.490... − 50 = 123.490... (123) ***(A1)*(ft)**

115.2 + 123.490... = 238.690... ***(A1)*(ft)**

$VQ = \sqrt{(146.5^2 + 238.690...^2)}$ ***(M1)***

VQ = 280 (m) (280.062...) ***(A1)*(ft)*(G3)***

Note: Accept 279 (m) from use of 3 significant figure answers.

[4 marks]

Examiners report

(g) Again this was well done by those who attempted it. Again there were many different ways to reach the correct answer.

5a. *[3 marks]*

Markscheme

$4(2x) + 4y + 4x = 48$ ***(M1)***

Note: Award ***(M1)*** for setting up the equation.

$12x + 4y = 48$ ***(M1)***

Note: Award ***(M1)*** for simplifying (can be implied).

$y = \frac{48-12x}{4}$ **OR**
$3x + y = 12$ ***(A1)***

$y = 12 - 3x$ ***(AG)***

Note: The last line must be seen for the ***(A1)*** to be awarded.

[3 marks]

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(a) This was very poorly done. Most candidates had no idea what they were supposed to do here. Many tried to find values for x.

5b.

[2 marks]

Markscheme

$V = 2x \times x \times (12 - 3x)$ ***(M1)(A1)***

Note: Award ***(M1)*** for substitution into volume equation, ***(A1)*** for correct substitution.

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

Note: The last line must be seen for the ***(A1)*** to be awarded.

[2 marks]

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(a) This was very poorly done. Most candidates had no idea what they were supposed to do here. Many tried to find values for *x*.

(b) Similar comment as for part (a) although more candidates made an attempt at finding the Volume.

5c.

[2 marks]

Markscheme

$\frac{\mathrm{d}V}{\mathrm{d}x} = 48x - 18x^2$ ***(A1)(A1)***

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

[2 marks]

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(c) This part was very well done.

5d.

[3 marks]

Markscheme

$48x - 18x^2 = 0$ ***(M1)(M1)***

Note: Award ***(M1)*** for using their derivative, ***(M1)*** for equating their answer to part (c) to 0.

OR

(M1) for sketch of
$V = 24x^2 - 6x^3$, ***(M1)*** for the maximum point indicated ***(M1)(M1)***

OR

(M1) for sketch of
$\frac{\mathrm{d}V}{\mathrm{d}x} = 48x - 18x^2$, ***(M1)*** for the positive root indicated ***(M1)(M1)***

$2.67 \left(\frac{24}{9}, \frac{8}{3}, 2.66666\ldots\right)$ ***(A1)*****(ft)*****(G2)***

Note: Follow through from their part (c).

[3 marks]

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(d) Not many correct answers seen. Many candidates graphed the wrong equation and found 1.333 as their answer.

5e. *[2 marks]*

Markscheme

$V = 24 \times \left(\frac{8}{3}\right)^2 - 6 \times \left(\frac{8}{3}\right)^3$ ***(M1)***

Note: Award ***(M1)*** for substitution of their value from part (d) into volume equation.

$56.9(\mathrm{m}^3) \left(\frac{512}{9}, 56.8888...\right)$ ***(A1)*****(ft)*****(G2)***

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

[2 marks]

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(e) Some managed to gain follow through marks for this part.

5f. *[3 marks]*

Markscheme

$\text{length} = \frac{16}{3}$ ***(A1)*****(ft)*****(G1)***

Note: Follow through from their answer to part (d). Accept 5.34 from use of 2.67

$\text{height} = 12 - 3 \times \left(\frac{8}{3}\right) = 4$ ***(M1)(A1)*****(ft)*****(G2)***

Notes: Award ***(M1)*** for substitution of their answer to part (d), ***(A1)*****(ft)** for answer. Accept 3.99 from use of 2.67.

[3 marks]

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(f) Again here follow through marks were gained by those who attempted it.

5g. *[4 marks]*

Markscheme

$\text{SA} = 2 \times \frac{16}{3} \times 4 + 2 \times \frac{8}{3} \times 4 + 2 \times \frac{16}{3} \times \frac{8}{3}$ ***(M1)***

OR

$\text{SA} = 4\left(\frac{8}{3}\right)^2 + 6 \times \frac{8}{3} \times 4$ ***(M1)***

Note: Award ***(M1)*** for substitution of their values from parts (d) and (f) into formula for surface area.

92.4 (m^2) (92.4444...(m^2)) ***(A1)***

Note: Accept 92.5 (92.4622...) from use of 3 sf answers.

$\text{Number of tins} = \frac{92.4444...}{15 \times 4} (= 1.54)$ ***(M1)***

[4 marks]

Note: Award ***(M1)*** for division of their surface area by 60.

2 tins required ***(A1)*(ft)**

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

Examiners report

Many candidates did not answer this question at all and others did not get past part (c). It was unclear if this was because they could not do the question or they ran out of time.

(g) Very few correct answers for the surface area were seen. Most candidates thought that there were 4 equal faces 2 xy and 2 faces xy. Some managed to get follow through marks for the last part if they divided by 60.

6a. *[3 marks]*

Markscheme

$\cos \text{ADB} = \frac{12^2 + 20^2 - 28^2}{2(12)(20)}$ ***(M1)(A1)***

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

\(\angle {\text{ADB}} = 120\) ***(A1)(G2)***

[3 marks]

Examiners report

The vast majority of candidates scored very well on this question. Those who did not attempted it using the trigonometry associated with right angled triangles. There were few problems with the use of radians and part (d), which was expected to prove challenging, was successfully overcome by more than half of the candidature. Problems arose mainly because of a lack of clarity in identifying the correct triangle.

6b. *[3 marks]*

Markscheme

Area $= \frac{(12)(20)\sin 120°}{2}$ ***(M1)(A1)*(ft)**

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

$= 104 \text{ cm}^2$ (
$103.923\ldots \text{ cm}^2$) ***(A1)*(ft)*(G2)***

Note: The final answer is
104 cm^2 , **the units are required**. Accept
100 cm^2 .

[3 marks]

Examiners report

The vast majority of candidates scored very well on this question. Those who did not attempted it using the trigonometry associated with right angled triangles. There were few problems with the use of radians and part (d), which was expected to prove challenging, was successfully overcome by more than half of the candidature. Problems arose mainly because of a lack of clarity in identifying the correct triangle.

6c. *[4 marks]*

Markscheme

$\frac{\sin \text{BCD}}{12} = \frac{\sin 60°}{13}$ ***(A1)*(ft)*(M1)(A1)***

Note: Award ***(A1)*(ft)** for their 60 seen, ***(M1)*** for substituted sine rule formula, ***(A1)*** for correct substitutions.

$\text{BCD} = 53.1°$ (
$53.0736\ldots$) ***(A1)(G3)***

Note: Accept
53, do not accept
50 or
53.0.

[4 marks]

Examiners report

The vast majority of candidates scored very well on this question. Those who did not attempted it using the trigonometry associated with right angled triangles. There were few problems with the use of radians and part (d), which was expected to prove challenging, was successfully overcome by more than half of the candidature. Problems arose mainly because of a lack of clarity in identifying the correct triangle.

6d. *[4 marks]*

Markscheme

Using triangle ABC

$\frac{\sin \mathrm{BAC}}{13} = \frac{\sin 53.1^\circ}{28}$ ***(M1)(A1)*(ft)**

OR

Using triangle ABD

$\frac{\sin \mathrm{BAD}}{12} = \frac{\sin 120^\circ}{28}$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for substituted sine rule formula (one of the above), ***(A1)*(ft)** for their correct substitutions. Follow through from (a) or (c) as appropriate.

$\mathrm{BAC} = \mathrm{BAD} = 21.8^\circ$ (
$21.7867\ldots$) ***(A1)*(ft)*(G2)***

Notes: Accept
22, do not accept
20 or
21.7. Accept equivalent methods, for example cosine rule.

$180^\circ - (53.1^\circ + 21.8^\circ) \neq 90^\circ$, hence triangle ABC is not right angled ***(R1)(AG)***

OR

$\frac{\mathrm{CD}}{\sin 66.9^\circ} = \frac{13}{\sin 60^\circ}$ ***(M1)(A1)*(ft)**

Note: Award ***(M1)*** for substituted sine rule formula, ***(A1)*(ft)** for their correct substitutions. Follow through from (a) and (c).

$\mathrm{CD} = 13.8\ (13.8075\ldots)$ ***(A1)*(ft)**

$13^3 + 28^2 \neq 33.8^2$, hence triangle ABC is not right angled. ***(R1)*(ft)*(AG)***

Note: The complete statement is required for the final ***(R1)*** to be awarded.

[4 marks]

Examiners report

The vast majority of candidates scored very well on this question. Those who did not attempted it using the trigonometry associated with right angled triangles. There were few problems with the use of radians and part (d), which was expected to prove challenging, was successfully overcome by more than half of the candidature. Problems arose mainly because of a lack of clarity in identifying the correct triangle.

7a. *[5 marks]*

Markscheme

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

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

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

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

(iii)
$(2.06, 4.49)$
$(2.06020\ldots, 4.49253\ldots)$ *(G1)(G1)*

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

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

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

[5 marks]

Examiners report

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

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

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

7b. *[4 marks]*

Markscheme

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

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

[4 marks]

Examiners report

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

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

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

7c. *[2 marks]*

Markscheme

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

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

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

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

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

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

[2 marks]

Examiners report

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

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7d. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

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7e. *[1 mark]*

Markscheme

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

Note: Follow through from part (d).

[1 mark]

Examiners report

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

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7f. *[3 marks]*

Markscheme

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

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

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

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

[3 marks]

Examiners report

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

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7g. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

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8a. *[2 marks]*

Markscheme

(i)

14 m ***(A1)***

(ii)

26 m ***(A1)***

[2 marks]

Examiners report

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

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

8b. *[2 marks]*

Markscheme

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

[2 marks]

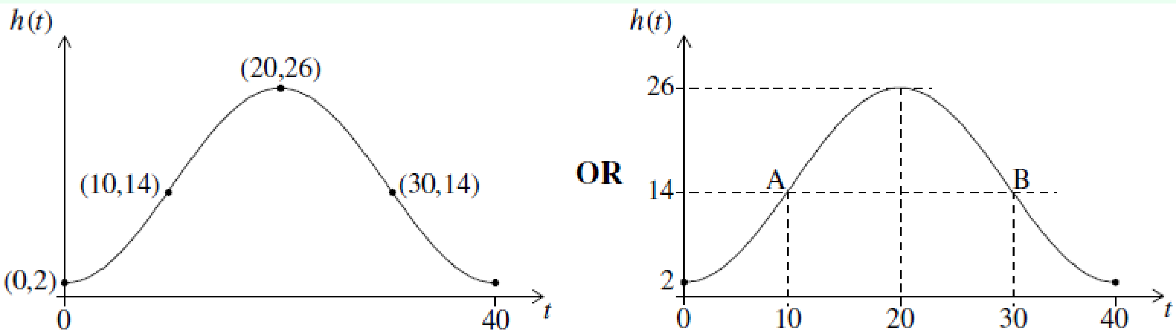
Examiners report

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

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

8c. *[4 marks]*

Markscheme



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

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

[4 marks]

Examiners report

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

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

9a. *[1 mark]*

Markscheme

6900 km *(A1)* *(C1)*

[1 mark]

Examiners report

Candidates appeared to be confused by the context in this question. They had difficulty identifying the radius and many used the formula for the area of a circle, rather than the circumference.

9b. *[3 marks]*

Markscheme

$2\pi(6900)$ *(M1)(A1)*(**ft**)

Notes: Award *(M1)* for substitution into circumference formula, *(A1)*(**ft**) for correct substitution. Follow through from part (a).

$= 43354$ *(A1)*(**ft**) *(C3)*

Notes: Follow through from part (a). The final *(A1)* is awarded for rounding their answer correct to the nearest km. Award *(A2)* for 43400 shown with no working.

[3 marks]

Examiners report

Candidates appeared to be confused by the context in this question. They had difficulty identifying the radius and many used the formula for the area of a circle, rather than the circumference. A large number of candidates misread the final sentence in part b and did not write their answer to the nearest kilometre.

9c. *[2 marks]*

Markscheme

4.3354×10^4 *(A1)*(**ft**)*(A1)*(**ft**) *(C2)*

Notes: Award *(A1)*(**ft**) for
4.3354, *(A1)*(**ft**) for
$\times 10^4$. Follow through from part (b). Accept
4.34×10^4 .

[2 marks]

Examiners report

Candidates appeared to be confused by the context in this question. They had difficulty identifying the radius and many used the formula for the area of a circle, rather than the circumference.

10a. *[2 marks]*

Markscheme

$\text{AC}^2 = 7.2^2 + 9.6^2$ *(M1)*

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

$\text{AC} = 12\text{ m}$ *(A1)* *(C2)*

[2 marks]

Examiners report

Question 7 was surprisingly difficult for many candidates, especially part b. Many candidates did not recognize that **ACG** was a right angled triangle and tried to use the law of cosines to find angle A. Although correct substitution and manipulation provided the correct answer, many candidates attempting this method made arithmetical errors.

10b. *[2 marks]*

Markscheme

$\mathrm{AG}^2 = 12^2 + 3.5^2$ ***(M1)***

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

$\mathrm{AG} = 12.5\ \mathrm{m}$ ***(A1)*(ft)** ***(C2)***

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

[2 marks]

Examiners report

Question 7 was surprisingly difficult for many candidates, especially part b. Many candidates did not recognize that **ACG** was a right angled triangle and tried to use the law of cosines to find angle A. Although correct substitution and manipulation provided the correct answer, many candidates attempting this method made arithmetical errors.

10c. *[2 marks]*

Markscheme

$\tan\theta = \frac{3.5}{12}$ or
$\sin\theta = \frac{3.5}{12.5}$ or
$\cos\theta = \frac{12}{12.5}$ ***(M1)***

Note: Award ***(M1)*** for correct substitutions in trig ratio.

$\theta = 16.3^\circ$ ***(A1)*(ft)** ***(C2)***

Notes: Follow through from parts (a) and/or part (b) where appropriate. Award ***(M1)(A0)*** for use of radians (0.284).

[2 marks]

Examiners report

Question 7 was surprisingly difficult for many candidates, especially part b. Many candidates did not recognize that **ACG** was a right angled triangle and tried to use the law of cosines to find angle A. Although correct substitution and manipulation provided the correct answer, many candidates attempting this method made arithmetical errors.

11a. *[3 marks]*

Markscheme

(i)

$\frac{0-2}{6-0}$ ***(M1)***

$= -\frac{1}{3}$ $\left(-\frac{2}{6}, -0.333\right)$ ***(A1)*** ***(C2)***

(ii)

$y = -\frac{1}{3}x + 2$ ***(A1)*(ft)** ***(C1)***

Notes: Follow through from their gradient in part (a)(i). Accept equivalent forms for the equation of a line.

[3 marks]

Examiners report

In this question, many candidates did not use the
x and
y intercepts to find the slope and attempted to read ordered pairs from the graph.

11b. *[2 marks]*

Markscheme

area $= \frac{6 \times 1.5}{2}$ ***(A1)(M1)***

Note: Award ***(A1)*** for
1.5 seen, ***(M1)*** for use of triangle formula with
6 seen.

$= 4.5$ ***(A1)*** ***(C3)***

[2 marks]

Examiners report

Part b proved difficult for many candidates, often using trigonometry rather than the more straight forward area of the triangle.

12a. *[2 marks]*

Markscheme

$50 \times 100 \times 40 = 200\,000\text{ cm}^3$ ***(M1)(A1)*** ***(C2)***

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

[2 marks]

Examiners report

This question proved to be the one that most candidates answered correctly. Many received full marks and the only error seen was incorrect substitution in the percentage error formula.

12b.

[2 marks]

Markscheme

$\frac{200\,000}{500} = 400$ ***(M1)(A1)*(ft)** ***(C2)***

Note: Award ***(M1)*** for dividing their answer to part (a) by 500.

[2 marks]

Examiners report

This question proved to be the one that most candidates answered correctly. Many received full marks and the only error seen was incorrect substitution in the percentage error formula.

12c.

[2 marks]

Markscheme

$\frac{400-350}{350} \times 100 = 14.3\,\%$ ***(M1)(A1)*(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct substitution in the percentage error formula.

Award ***(A1)*** for answer, follow through from part (b).

Accept –14.3 %.

$\%$ sign not necessary.

[2 marks]

Examiners report

This question proved to be the one that most candidates answered correctly. Many received full marks and the only error seen was incorrect substitution in the percentage error formula.

13.

[6 marks]

Markscheme

Condition	Line
$m > 0$ and $c > 0$	L_5
$m < 0$ and $c > 0$	L_4
$m < 0$ and $c < 0$	L_1
$m > 0$ and $c < 0$	L_3

(A6) ***(C6)***

Notes: Award ***(A6)*** for all correct, ***(A5)*** for 3 correct, ***(A3)*** for 2 correct, ***(A1)*** for 1 correct.

Deduct ***(A1)*** for any repetition.

[6 marks]

Examiners report

Many candidates received full marks and a number received 3 marks for giving two correct answers. Very few candidates were awarded zero marks. As most candidates did not show working for this question it is difficult to comment on the errors that might have been made.

14a. *[1 mark]*

Markscheme

$60°$ ***(A1)*** ***(C1)***

[1 mark]

Examiners report

This question proved to be difficult for a number of candidates. Most were able find the size of the angle in part a), but many had problems finding the area of the triangle in part b). A significant number of candidates were unable to use the Pythagoras Theorem correctly to find the height of the triangle AOB. Those who used the formula for the area of a triangle $\mathrm{A} = \frac{1}{2}\mathrm{ab}\sin\mathrm{C}$ were more successful in this part of the question. It was surprising that a great number of candidates were unable to find the volume of the prism – many incorrectly used the formula for calculating volume of a pyramid rather than a hexagonal prism.

14b. *[3 marks]*

Markscheme

$\frac{15\times\sqrt{15^2-7.5^2}}{2} = 97.4\ \mathrm{cm}^2$ $(97.5\ \mathrm{cm}^2)$ ***(A1)(M1)(A1)***

Notes: Award ***(A1)*** for correct height, ***(M1)*** for substitution in the area formula, ***(A1)*** for correct answer.

Accept $97.5\ \mathrm{cm}^2$ from taking the height to be 13 cm.

OR

$\frac{1}{2}\times 15^2\times\sin 60° = 97.4\ \mathrm{cm}^2$ ***(M1)(A1)(A1)*****(ft)** ***(C3)***

Notes: Award ***(M1)*** for substituted formula of the area of a triangle, ***(A1)*** for correct substitution, ***(A1)*****(ft)** for answer.

Follow through from their answer to part (a).

If radians used award at most ***(M1)(A1)(A0)***.

[3 marks]

Examiners report

This question proved to be difficult for a number of candidates. Most were able find the size of the angle in part a), but many had problems finding the area of the triangle in part b). A significant number of candidates were unable to use the Pythagoras Theorem correctly to find the height of the triangle AOB. Those who used the formula for the area of a triangle $\mathrm{A} = \frac{1}{2}\mathrm{ab}\sin\mathrm{C}$ were more successful in this part of the question. It was surprising that a great number of candidates were unable to find the volume of the prism – many incorrectly used the formula for calculating volume of a pyramid rather than a hexagonal prism.

14c. *[2 marks]*

Markscheme

$97.4 \times 120 = 11700\ \text{cm}^3$ ***(M1)(A1)*(ft)** ***(C2)***

Notes: Award ***(M1)*** for multiplying their part (b) by 120.

[2 marks]

Examiners report

This question proved to be difficult for a number of candidates. Most were able find the size of the angle in part a), but many had problems finding the area of the triangle in part b). A significant number of candidates were unable to use the Pythagoras Theorem correctly to find the height of the triangle AOB. Those who used the formula for the area of a triangle $\mathrm{A} = \frac{1}{2}\mathrm{ab}\sin\mathrm{C}$ were more successful in this part of the question. It was surprising that a great number of candidates were unable to find the volume of the prism – many incorrectly used the formula for calculating volume of a pyramid rather than a hexagonal prism.

15a. *[1 mark]*

Markscheme

$(x+1)^2 - 1$ ***or*** $x^2 + 2x$ ***(A1)*** ***(C1)***

[1 mark]

Examiners report

Some candidates were able to answer this question correctly, but the majority experienced difficulty in finding the correct expression for the area of the shaded region. Those who showed working could then be awarded follow through marks for correctly equating their expressions to the given area and for their found value of x. Many candidates also could not find the perimeter of the shaded region in part c) even though they had found the value of x correctly.

15b. *[3 marks]*

Markscheme

$(x + 1)^2 - 1 = 109.25$ ***(M1)***

$x^2 + 2x - 109.25 = 0$ ***(M1)***

Notes: Award ***(M1)*** for writing an equation consistent with their expression in (a) (accept equivalent forms), ***(M1)*** for correctly removing the brackets.

OR

$(x + 1)^2 - 1 = 109.25$ ***(M1)***

$x + 1 = \sqrt{110.25}$ ***(M1)***

Note: Award ***(M1)*** for writing an equation consistent with their expression in (a) (accept equivalent forms), ***(M1)*** for taking the square root of both sides.

OR

$(x + 1)^2 - 10.5^2 = 0$ ***(M1)***

$(x - 9.5)(x + 11.5) = 0$ ***(M1)***

Note: Award ***(M1)*** for writing an equation consistent with their expression in (a) (accept equivalent forms), ***(M1)*** for factorised left side of the equation.

$x = 9.5$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from their expression in part (a).

The last mark is lost if x is non positive.

If the follow through equation is not quadratic award at most ***(M1)(M0)(A1)*****(ft)**.

[3 marks]

Examiners report

Some candidates were able to answer this question correctly, but the majority experienced difficulty in finding the correct expression for the area of the shaded region. Those who showed working could then be awarded follow through marks for correctly equating their expressions to the given area and for their found value of x. Many candidates also could not find the perimeter of the shaded region in part c) even though they had found the value of x correctly.

15c. *[2 marks]*

Markscheme

$4 \times (9.5 + 1) = 42$ m ***(M1)(A1)*****(ft)** ***(C2)***

Notes: Award ***(M1)*** for correct method for finding the length of the fence. Accept equivalent methods.

[2 marks]

Examiners report

Some candidates were able to answer this question correctly, but the majority experienced difficulty in finding the correct expression for the area of the shaded region. Those who showed working could then be awarded follow through marks for correctly equating their expressions to the given area and for their found value of x. Many candidates also could not find the perimeter of the shaded region in part c) even though they had found the value of x correctly.

16a. *[2 marks]*

Markscheme

$\frac{9-1}{0-(-4)}$ ***(M1)***

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

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

[2 marks]

Examiners report

This question was in general well answered. In part (a) the gradient of the line AB was correctly found although some candidates did not substitute well in the gradient formula and found answers as $\frac{1}{2}$ or –2. Also some students read B as (0, 8) instead of (0, 9). In part (b) many students again did not make good use of time as they found the equation of the line instead of just extending it to find the y - intercept. The equation of L_2 in (c) was correctly found in the form $y = mx + c$ but very few students were able to rearrange the equation in the form $ax + by + d = 0$ where $a, b, d \in \mathbb{Z}$. In (d) many candidates found the coordinates of point D by solving simultaneous equations which led again to a waste of time. The last two parts of this question were well done by those students that attempted them.

16b. *[1 mark]*

Markscheme

–6 ***(A1)***

Note: Accept (0, –6) .

[1 mark]

Examiners report

This question was in general well answered. In part (a) the gradient of the line AB was correctly found although some candidates did not substitute well in the gradient formula and found answers as $\frac{1}{2}$ or –2. Also some students read B as (0, 8) instead of (0, 9). In part (b) many students again did not make good use of time as they found the equation of the line instead of just extending it to find the y - intercept. The equation of L_2 in (c) was correctly found in the form $y = mx + c$ but very few students were able to rearrange the equation in the form $ax + by + d = 0$ where $a, b, d \in \mathbb{Z}$. In (d) many candidates found the coordinates of point D by solving simultaneous equations which led again to a waste of time. The last two parts of this question were well done by those students that attempted them.

16c. *[3 marks]*

Markscheme

$y = -\frac{1}{2}x - 1$ (or equivalent) ***(A1)*(ft)*(A1)***

Notes: Award ***(A1)*(ft)** for gradient, ***(A1)*** for correct y-intercept. Follow through from their gradient in (a).

$x + 2y + 2 = 0$ ***(A1)*(ft)**

Notes: Award ***(A1)*(ft)** from their gradient and their y-intercept. Accept any multiple of this equation with integer coefficients.

OR

$y - 1 = -\frac{1}{2}(x + 4)$ (or equivalent) ***(A1)*(ft)*(A1)***

Note: Award ***(A1)*(ft)** for gradient, ***(A1)*** for any point on the line correctly substituted in equation.

$x + 2y + 2 = 0$ ***(A1)*(ft)**

Notes: Award ***(A1)*(ft)** from their equation. Accept any multiple of this equation with integer coefficients.

[3 marks]

Examiners report

This question was in general well answered. In part (a) the gradient of the line AB was correctly found although some candidates did not substitute well in the gradient formula and found answers as $\frac{1}{2}$ or –2. Also some students read B as (0, 8) instead of (0, 9). In part (b) many students again did not make good use of time as they found the equation of the line instead of just extending it to find the y - intercept. The equation of L_2 in (c) was correctly found in the form $y = mx + c$ but very few students were able to rearrange the equation in the form $ax + by + d = 0$ where $a, b, d \in \mathbb{Z}$. In (d) many candidates found the coordinates of point D by solving simultaneous equations which led again to a waste of time. The last two parts of this question were well done by those students that attempted them.

16d. *[1 mark]*

Markscheme

D(2, –2) or $x = 2$, $y = -2$ ***(A1)***

Note: Award ***(A0)*** if brackets not present.

[1 mark]

Examiners report

This question was in general well answered. In part (a) the gradient of the line AB was correctly found although some candidates did not substitute well in the gradient formula and found answers as $\frac{1}{2}$ or –2. Also some students read B as (0, 8) instead of (0, 9). In part (b) many students again did not make good use of time as they found the equation of the line instead of just extending it to find the y - intercept. The equation of L_2 in (c) was correctly found in the form $y = mx + c$ but very few students were able to rearrange the equation in the form $ax + by + d = 0$ where $a, b, d \in \mathbb{Z}$. In (d) many candidates found the coordinates of point D by solving simultaneous equations which led again to a waste of time. The last two parts of this question were well done by those students that attempted them.

16e.

[2 marks]

Markscheme

R(6, 6) **or** $x = 6$, $y = 6$ ***(A1)(A1)***

Note: Award at most ***(A0)(A1)*(ft)** if brackets not present and absence of brackets has not already been penalised in part (d).

[2 marks]

Examiners report

This question was in general well answered. In part (a) the gradient of the line AB was correctly found although some candidates did not substitute well in the gradient formula and found answers as $\frac{1}{2}$ or –2. Also some students read B as (0, 8) instead of (0, 9). In part (b) many students again did not make good use of time as they found the equation of the line instead of just extending it to find the y - intercept. The equation of L_2 in (c) was correctly found in the form $y = mx + c$ but very few students were able to rearrange the equation in the form $ax + by + d = 0$ where $a, b, d \in \mathbb{Z}$. In (d) many candidates found the coordinates of point D by solving simultaneous equations which led again to a waste of time. The last two parts of this question were well done by those students that attempted them.

16f.

[4 marks]

Markscheme

(i)

$\mathrm{DR} = \sqrt{8^2 + 4^2}$ ***(M1)***

$\mathrm{DR} = \sqrt{80}$ (8.94) ***(A1)*(ft)*(G2)***

Note: Award ***(M1)*** for correct substitution into the distance formula. Follow through from their D and R.

(ii)

$\text{Area} = \frac{\sqrt{80} \times \sqrt{45}}{2}$ ***(M1)***

= 30 (30.0) ***(A1)*(ft)*(G2)***

Note: Award ***(M1)*** for correct substitution in the area of triangle formula. Follow through from their answer to part (f) (i).

[4 marks]

Examiners report

This question was in general well answered. In part (a) the gradient of the line AB was correctly found although some candidates did not substitute well in the gradient formula and found answers as $\frac{1}{2}$ or –2. Also some students read B as (0, 8) instead of (0, 9). In part (b) many students again did not make good use of time as they found the equation of the line instead of just extending it to find the y - intercept. The equation of L_2 in (c) was correctly found in the form $y = mx + c$ but very few students were able to rearrange the equation in the form $ax + by + d = 0$ where $a, b, d \in \mathbb{Z}$. In (d) many candidates found the coordinates of point D by solving simultaneous equations which led again to a waste of time. The last two parts of this question were well done by those students that attempted them.

17a.

[2 marks]

Markscheme

$y = -2x + 8$ ***(M1)***

Note: Award ***(M1)*** for rearrangement of equation or for -2 seen.

$m(\text{perp}) = \frac{1}{2}$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

Parts a and bi of Question 13 appeared to be accessible to most candidates, but part bii was not well attempted. Many candidates did not show their working and lost method marks due to their incorrect answers.

17b. *[4 marks]*

Markscheme

(i)

$2(4) + k - 8 = 0$ ***(M1)***

Note: Award ***(M1)*** for evidence of substituting $x = 4$ into R_1 .

$k = 0$ ***(A1) (C2)***

(ii)

$y = \frac{1}{2}x + c$ *(can be implied)* ***(M1)***

Note: Award ***(M1)*** for substitution of $\frac{1}{2}$ into equation of the line.

$0 = \frac{1}{2}(4) + c$

$y = \frac{1}{2}x - 2$ ***(A1)*(ft)** ***(C2)***

Notes: Follow through from parts (a) and (b)(i). Accept equivalent forms for the equation of a line.

OR

$y - y_1 = \frac{1}{2}(x - x_1)$ ***(M1)***

Note: Award ***(M1)*** for substitution of $\frac{1}{2}$ into equation of the line.

$y = \frac{1}{2}(x - 4)$ ***(A1)*(ft)** ***(C2)***

Notes: Follow through from parts (a) and (b)(i). Accept equivalent forms for the equation of a line.

[4 marks]

Examiners report

Parts a and bi of Question 13 appeared to be accessible to most candidates, but part bii was not well attempted. Many candidates did not show their working and lost method marks due to their incorrect answers.

18a. *[2 marks]*

Markscheme

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

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

[2 marks]

Examiners report

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

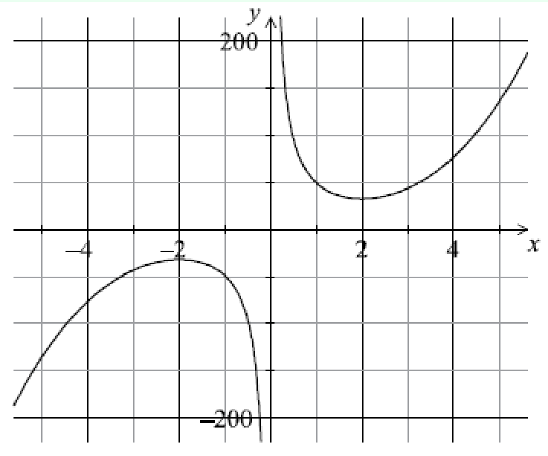
The majority of sketches were drawn sloppily and with little attention to detail. Teachers must impress on their students that a mathematical sketch is designed to illustrate the main points of a curve – the smooth nature by which it changes, any symmetries (reflectional or rotational), positions of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

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

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

18b. *[4 marks]*

Markscheme



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

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

[4 marks]

Examiners report

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

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18c. *[3 marks]*

Markscheme

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

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

[3 marks]

Examiners report

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

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

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

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

18d. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

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18e. *[2 marks]*

Markscheme

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

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

[2 marks]

Examiners report

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

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

18f. *[3 marks]*

Markscheme

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

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

[3 marks]

Examiners report

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

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18g. *[2 marks]*

Markscheme

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

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

[2 marks]

Examiners report

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

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

18h. *[2 marks]*

Markscheme

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

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

[2 marks]

Examiners report

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

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19a. *[3 marks]*

Markscheme

$\mathrm{BD}^2 = 190^2 + 120^2 - 2(190)(120)\cos 75°$ ***(M1)(A1)***

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

$= 197$ m ***(A1)(G2)***

Note: If radians are used award a maximum of ***(M1)(A1)(A0)***.

[3 marks]

Examiners report

Most candidates were able to recognise cosine rule, and substitute correctly. Where the final answer was not attained, this was mainly due to further unnecessary manipulation; the GDC should be used efficiently in such a case. Some students used the answer given and sine rule – this gained no credit.

19b. *[2 marks]*

Markscheme

cost $= 196.717\ldots \times 17$ ***(M1)***

$= 3344$ USD ***(A1)*(ft)*(G2)***

Note: Accept
3349 from
197.

[2 marks]

Examiners report

Most candidates were able to recognise cosine rule, and substitute correctly. Where the final answer was not attained, this was mainly due to further unnecessary manipulation; the GDC should be used efficiently in such a case. Some students used the answer given and sine rule – this gained no credit.

19c. *[3 marks]*

Markscheme

$\frac{\sin(\mathrm{ABD})}{70} = \frac{\sin(115°)}{196.7}$ ***(M1)(A1)***

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

$= 18.81°\ldots$ ***(A1)*(ft)**
$= 18.8°$ ***(AG)***

Notes: Both the unrounded and rounded answers must be seen for the final ***(A1)*** to be awarded. Follow through from their (a). If 197 is used the unrounded answer is
$= 18.78°\ldots$

[3 marks]

Examiners report

Most candidates were able to recognise cosine rule, and substitute correctly. Where the final answer was not attained, this was mainly due to further unnecessary manipulation; the GDC should be used efficiently in such a case. Some students used the answer given and sine rule – this gained no credit.

19d. *[4 marks]*

Markscheme

angle BDA $= 46.2^\circ$ ***(A1)***

Area $= \frac{70 \times (196.717\ldots) \times \sin(46.2^\circ)}{2}$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituted area formula, ***(A1)*** for correct substitution.

Area ABD $= 4970\ \text{m}^2$ ***(A1)*(ft)*(G2)***

Notes: If
197 used answer is
4980.

Notes: Follow through from (a) only. Award ***(G2)*** if there is no working shown and
46.2° not seen. If
46.2° seen without subsequent working, award ***(A1)(G2)***.

[4 marks]

Examiners report

Again, most candidates used the appropriate area formula – however, some did not appreciate the purpose of the given answer and were unable to complete the question accurately.

19e. *[2 marks]*

Markscheme

$4969.38\ldots \times 120$ ***(M1)***

$= 596327$ USD   ***(A1)*(ft)*(G2)***

Notes: Follow through from their (d).

[2 marks]

Examiners report

Again, most candidates used the appropriate area formula – however, some did not appreciate the purpose of the given answer and were unable to complete the question accurately.

19f.

[4 marks]

Markscheme

$300000\left(1+\frac{r}{100}\right)^{15}=600000$ or equivalent ***(A1)(M1)(A1)***

Notes: Award ***(A1)*** for
600000 seen or implied by alternative formula, ***(M1)*** for substituted CI formula, ***(A1)*** for correct substitutions.

$r=4.73$ ***(A1)*****(ft)*****(G3)***

Notes: Award ***(G3)*** for
4.73 with no working. Award ***(G2)*** for
4.7 with no working.

[4 marks]

Examiners report

The final part, in which compound interest was again asked for, tested most candidates but there were many successful attempts using either the GDC's finance package or correct use of the formula. Care must be taken with the former to show some indication of the values to be used in the context of the question. With the latter approach marks were again lost due to a lack of appreciation of the difference between interest and value.

20a.

[4 marks]

Markscheme

$2\pi\frac{150000000}{365}$ ***(M1)(A1)(M1)***

Notes: Award ***(M1)*** for substitution in correct formula for circumference of circle.

Award ***(A1)*** for correct substitution.

Award ***(M1)*** for dividing their perimeter by
365.

Award ***(M0)(A0)(M1)*** for
$\frac{150000000}{365}$.

2580000 km ***(A1)*** ***(C4)***

[4 marks]

Examiners report

A significant number of candidates simply divided
150000000 by
365 and consequently lost all but one method mark in part (a). Presumably these candidates assumed that the given value was the circumference rather than the radius.

20b.

[2 marks]

Markscheme

2.58×10^{6} ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Award ***(A1)*****(ft)** for
2.58, ***(A1)*****(ft)** for
10^{6} . Follow through from their answer to part (a). The follow through for the index should be dependent not only on the answer to part (a), but also on the value of their mantissa. No ***(AP)*** penalty for first ***(A1)*** provided their value is to 3 sf or is all their digits from part (a).

[2 marks]

Examiners report

A significant number of candidates simply divided 150000000 by 365 and consequently lost all but one method mark in part (a). Presumably these candidates assumed that the given value was the circumference rather than the radius. Recovery in part (b) did, however, result in many getting both marks here. It was noted on some answers to part (b) that the index power was negative rather than positive suggesting a misunderstanding by candidates of standard form.

21a. *[2 marks]*

Markscheme

$\frac{8-4}{5-(-1)}$ ***(M1)***

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

$\frac{2}{3}$ $\left(\frac{4}{6}, 0.667\right)$ ***(A1)*** ***(C2)***

[2 marks]

Examiners report

Generally, a well answered question with many candidates achieving full marks. Indeed, marks which tended to be lost were as a result of premature rounding rather than method. On a number of scripts, part (a) produced a rather curious wrong answer of 8.2 following a correct gradient expression. It would seem that this was as a result of typing into the calculator $8-4 \div 5+1$.

21b. *[2 marks]*

Markscheme

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

Note: Award ***(A1)*(ft)** for their gradient substituted in their equation.

$y = \frac{2}{3}x + \frac{14}{3}$ ***(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)** for their correct equation. Accept any equivalent form. Accept decimal equivalents for coefficients to 3 sf.

OR

$y - y_1 = \frac{2}{3}(x - x_1)$ ***(A1)*(ft)**

Note: Award ***(A1)*(ft)** for their gradient substituted in the equation.

$y - 4 = \frac{2}{3}(x + 1)$ **OR**
$y - 8 = \frac{2}{3}(x - 5)$ ***(A1)*(ft)** ***(C2)***

Note: Award ***(A1)*(ft)** for correct equation.

[2 marks]

Examiners report

Generally, a well answered question with many candidates achieving full marks. Indeed, marks which tended to be lost were as a result of premature rounding rather than method.

21c. *[2 marks]*

Markscheme

$y = \frac{2}{3} \times 8 + \frac{14}{3}$ **OR**
$y - 4 = \frac{2}{3}(8 + 1)$ **OR**
$y - 8 = \frac{2}{3}(8 - 5)$ ***(M1)***

Note: Award ***(M1)*** for substitution of $x = 8$ into their equation.

$y = 10$ (10.0) ***(A1)*****(ft)*** ***(C2)***

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

[2 marks]

Examiners report

Generally, a well answered question with many candidates achieving full marks. Indeed, marks which tended to be lost were as a result of premature rounding rather than method.

22a. *[3 marks]*

Markscheme

$75 \times \frac{4}{3}\pi \times 5^3$ ***(M1)(M1)***

Notes: Award ***(M1)*** for correctly substituted formula of a sphere. Award ***(M1)*** for multiplying their volume by 75. If $r = 10$ is used, award ***(M0)(M1)(A1)*****(ft)** for the answer 314000 cm^3 .

39300 cm^3 . ***(A1)*** ***(C3)***

Examiners report

As well as some candidates reading the diameter given as the radius, there was much confusion between the area and volume of a sphere and, although there was some recovery when multiplying by 75, two of the three marks were invariably lost. Recovery was possible in part (b) and many successful attempts were seen to calculate the height of the cone.

22b. *[3 marks]*

Markscheme

$\frac{1}{3}\pi \times 20^2 \times h = 39300$ ***(M1)(M1)***

Notes: Award ***(M1)*** for correctly substituted formula of a cone. Award ***(M1)*** for equating their volume to their answer to part (a).

$h = 93.8$ cm ***(A1)*****(ft)** ***(C3)***

Notes: Accept the exact value of 93.75 . Follow through from their part (a).

[3 marks]

23a. *[3 marks]*

Markscheme

$\sin \mathrm{A\hat{B}D} = \frac{4}{9}$ ***(M1)***

$100 + \text{their } (\mathrm{A\hat{B}D})$ ***(M1)***

126% ***(A1)*** ***(C3)***

Notes: Accept an equivalent trigonometrical equation involving angle ABD for the first ***(M1)***.

Radians used gives
100% . Award at most ***(M1)(M1)(A0)*** if working shown.

$\mathrm{BD} = 8$ m leading to
127% . Award at most ***(M1)(M1)(A0)*** (premature rounding).

[3 marks]

Examiners report

Although many candidates were able to calculate the size of angle ABD correctly, a significant number then simply stopped, failing to add on
100% and consequently losing the last two marks in part (a). Recovery was seen on many scripts in part (b) as candidates seemed to be well drilled in the use of the cosine rule and much correct working was seen. Indeed, despite many incorrect final answers of
26.4% seen in part (a), many used the correct angle of
126% in part (b).

23b. *[3 marks]*

Markscheme

$\mathrm{AC}^2 = 10^2 + 9^2 - 2 \times 10 \times 9 \times \cos(126.38\ldots)$ ***(M1)(A1)***

Notes: Award ***(M1)*** for substituted cosine formula. Award ***(A1)*** for correct substitution using their answer to part (a).

$\mathrm{AC} = 17.0$ m ***(A1)*****(ft)** ***(C3)***

Notes: Accept
16.9 m for using
126. Follow through from their answer to part (a). Radians used gives
5.08. Award at most ***(M1)(A1)(A0)*****(ft)** if working shown.

[3 marks]

Examiners report

Although many candidates were able to calculate the size of angle ABD correctly, a significant number then simply stopped, failing to add on
100% and consequently losing the last two marks in part (a). Recovery was seen on many scripts in part (b) as candidates seemed to be well drilled in the use of the cosine rule and much correct working was seen. Indeed, despite many incorrect final answers of
26.4% seen in part (a), many used the correct angle of
126% in part (b).

24a. *[3 marks]*

Markscheme

$(x+8)^2 = (x+7)^2 + x^2$ *(A1)*

Note: Award *(A1)* for a correct equation.

$x^2 + 16x + 64 = x^2 + 14x + 49 + x^2$ *(A1)*

Note: Award *(A1)* for correctly removed parentheses.

$x^2 - 2x - 15 = 0$ *(A1)* *(C3)*

Note: Accept any equivalent form.

[3 marks]

Examiners report

This question proved to be difficult for the majority of candidates. Many simply were unable to see that, to relate the three given lengths, a Pythagorean equation needed to be produced. Indeed, many did not seem to appreciate the concept of a quadratic equation and, as a consequence, either wrote down a linear equation linking one length to the sum of the other two lengths or multiplied all three lengths together. For the minority who stated a correct Pythagorean equation, many could not remove brackets successfully and arrived at
$x^2 = 15$. Consequently, very few candidates earned more than one mark for part (a). Where the correct quadratic equation was seen in part (a), many were able to solve this quadratic correctly in part (b) and arrive at the required value of
$x = 5$ for the answer for part (c).

24b. *[2 marks]*

Markscheme

$x = 5$,
$x = -3$ *(A1)***(ft)***(A1)***(ft)** *(C2)*

Notes: Accept *(A1)***(ft)** only from the candidate's **quadratic** equation.

[2 marks]

Examiners report

This question proved to be difficult for the majority of candidates. Many simply were unable to see that, to relate the three given lengths, a Pythagorean equation needed to be produced. Indeed, many did not seem to appreciate the concept of a quadratic equation and, as a consequence, either wrote down a linear equation linking one length to the sum of the other two lengths or multiplied all three lengths together. For the minority who stated a correct Pythagorean equation, many could not remove brackets successfully and arrived at
$x^2 = 15$. Consequently, very few candidates earned more than one mark for part (a). Where the correct quadratic equation was seen in part (a), many were able to solve this quadratic correctly in part (b) and arrive at the required value of
$x = 5$ for the answer for part (c).

24c. *[1 mark]*

Markscheme

30 cm *(A1)***(ft)** *(C1)*

Note: Follow through from a positive answer found in part (b).

[1 mark]

Examiners report

This question proved to be difficult for the majority of candidates. Many simply were unable to see that, to relate the three given lengths, a Pythagorean equation needed to be produced. Indeed, many did not seem to appreciate the concept of a quadratic equation and, as a consequence, either wrote down a linear equation linking one length to the sum of the other two lengths or multiplied all three lengths together. For the minority who stated a correct Pythagorean equation, many could not remove brackets successfully and arrived at
$x^2 = 15$. Consequently, very few candidates earned more than one mark for part (a). Where the correct quadratic equation was seen in part (a), many were able to solve this quadratic correctly in part (b) and arrive at the required value of
$x = 5$ for the answer for part (c).

25a.

[1 mark]

Markscheme

Angle $\text{ABC} = 50^\circ$ ***(A1)***

[1 mark]

Examiners report

Many candidates assumed incorrectly that the triangle ABC is isosceles or/and that CN is an angle bisector, and those assumptions led them to use incorrect methods. Wherever those assumptions were made first, all or most of the marks were lost in that specific part of Question 4. There were provisions in the mark scheme to follow through in subsequent parts. Most candidates at least attempted parts a), b) and c). Some candidates incorrectly used an area formula for a right triangle in c) and lost all marks. Many candidates lost a mark for premature rounding in d). Part e) proved to be especially difficult for the candidates. Here many candidates offered guesses instead of sound mathematical reasoning.

25b.

[3 marks]

Markscheme

$\frac{\text{AC}}{\sin 50^\circ} = \frac{25}{\sin 55^\circ}$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution into the correct formula, ***(A1)*****(ft)** for correct substitution. Follow through from their angle ABC.

$\text{AC} = 23.4\text{ m}$ ***(A1)*****(ft)*****(G2)***

[3 marks]

Examiners report

Many candidates assumed incorrectly that the triangle ABC is isosceles or/and that CN is an angle bisector, and those assumptions led them to use incorrect methods. Wherever those assumptions were made first, all or most of the marks were lost in that specific part of Question 4. There were provisions in the mark scheme to follow through in subsequent parts. Most candidates at least attempted parts a), b) and c). Some candidates incorrectly used an area formula for a right triangle in c) and lost all marks. Many candidates lost a mark for premature rounding in d). Part e) proved to be especially difficult for the candidates. Here many candidates offered guesses instead of sound mathematical reasoning.

25c. *[3 marks]*

Markscheme

Area of Δ ABC $= \frac{1}{2} \times 23.379\ldots \times 25 \times \sin 75^\circ$ ***(M1)(A1)*(ft)**

Notes: Award ***(M1)*** for substitution into the correct formula, ***(A1)*(ft)** for correct substitution. Follow through from their AC.

OR

Area of triangle ABC $= \frac{29.479\ldots \times 19.151\ldots}{2}$ ***(A1)*(ft)*(M1)***

Note: ***(A1)*(ft)** for correct values of AB (29.479…) and CN (19.151…). Follow through from their (a) and /or (b). Award ***(M1)*** for substitution of their values of AB and CN into the correct formula.

Area of Δ ABC $= 282\ \mathrm{m}^2$ ***(A1)*(ft)*(G2)***

Note: Accept
$283\ \mathrm{m}^2$ if
23.4 is used.

[3 marks]

Examiners report

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25d. *[3 marks]*

Markscheme

NM $= \frac{25 \times \sin 50^\circ}{2}$ ***(M1)(M1)***

Note: Award ***(M1)*** for
$25 \times \sin 50^\circ$ or equivalent for the length of CN. ***(M1)*** for dividing their CN by
2.

NM $= 9.58\ \mathrm{m}$ ***(A1)*(ft)*(G2)***

Note: Follow through from their angle ABC.

Notes: Premature rounding of CN leads to the answers
9.60 or
9.6. Award at most ***(M1)(M1)(A0)*** if working seen. Do not penalize with ***(AP)***. CN may be found in (c).

Note: The working for this part of the question may be in part (b).

[3 marks]

Examiners report

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25e. *[5 marks]*

Markscheme

Angle NCB $= 40°$ seen ***(A1)*(ft)**

Note: Follow through from their (a).

From triangle MCP:

$\text{MP}^2 = (9.5756\ldots)^2 + 12.5^2 - 2 \times 9.5756\ldots \times 12.5 \times \cos(40°)$ ***(M1)(A1)*(ft)**

$\text{MP} = 8.034\ldots\ \text{m}$ ***(A1)*(ft)*(G3)***

Notes: Award ***(M1)*** for substitution into the correct formula, ***(A1)*(ft)** for their correct substitution. Follow through from their d). Award ***(G3)*** for correct value of MP seen without working.

OR

From right triangle MCP

CP $= 12.5$ m seen ***(A1)***

$\text{MP}^2 = (12.5)^2 - (9.575\ldots)^2$ ***(M1)(A1)*(ft)**

$\text{MP} = 8.034\ldots\ \text{m}$ ***(A1)(G3)*(ft)**

Notes: Award ***(M1)*** for substitution into the correct formula, ***(A1)*(ft)** for their correct substitution. Follow through from their (d). Award ***(G3)*** for correct value of MP seen without working.

OR

From right triangle MCP

Angle MCP $= 40°$ seen ***(A1)*(ft)**

$\frac{\text{MP}}{12.5} = \sin(40°)$ or equivalent ***(M1)(A1)*(ft)**

$\text{MP} = 8.034\ldots\ \text{m}$ ***(A1)(G3)*(ft)**

Notes: Award ***(M1)*** for substitution into the correct formula, ***(A1)*(ft)** for their correct substitution. Follow through from their (a). Award ***(G3)*** for correct value of MP seen without working.

The goat cannot reach point P as
$\text{MP} > 7\ \text{m}$. ***(A1)*(ft)**

Note: Award ***(A1)*(ft)** only if their value of MP is compared to 7 m, and conclusion is stated.

[5 marks]

Examiners report

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