Topic 5 Part 1 *[240 marks]*

1a. *[1 mark]*

Markscheme

22.5 (m) ***(A1)***

[1 mark]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

1b. *[1 mark]*

Markscheme

(A1)

[1 mark]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

1c. *[2 marks]*

Markscheme

$h = 22.5 \quad \sin 53.1° \quad$ ***(M1)***

$= 17.99 \quad$ ***(A1)***

$= 18.0 \quad$ ***(AG)***

Note: Unrounded answer must be seen for ***(A1)*** to be awarded.

Accept 18 as ***(AG)***.

[2 marks]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

1d. *[3 marks]*

Markscheme

$AC = 2\sqrt{22.5^2 - 17.99...^2}$ ***(M1)(M1)***

Note: Award ***(M1)*** for multiplying by 2, ***(M1)*** for correct substitution into formula.

OR

$AC = 2(22.5)\cos 53.1°$ ***(M1)(M1)***

Notes: Award ***(M1)*** for correct use of cosine trig ratio, ***(M1)*** for multiplying by 2.

OR

$AC^2 = 22.5^2 + 22.5^2 - 2(22.5)(22.5)\cos 73.8°$ ***(M1)(A1)***

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

OR

$\frac{AC}{\sin(73.8°)} = \frac{22.5}{\sin(53.1°)}$ ***(M1)(A1)***

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

$AC = 27.0$ ***(A1)(G2)***

[3 marks]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

1e. *[2 marks]*

Markscheme

$BC = \sqrt{13.5^2 + 13.5^2}$ ***(M1)***

$= 19.09$ ***(A1)***

$= 19.1$ ***(AG)***

OR

$x^2 + x^2 = 27^2$ ***(M1)***

$2x^2 = 27^2$ ***(A1)***

$BC = 19.09\ldots$ ***(A1)***

$= 19.1$ ***(AG)***

Notes: Unrounded answer must be seen for ***(A1)*** to be awarded.

[2 marks]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

1f. *[4 marks]*

Markscheme

Volume = Pyramid + Cuboid

$= \frac{1}{3}(18)(19.1^2) + (108)(19.1^2)$ ***(A1)(M1)(M1)***

Note: Award ***(A1)*** for 108, the height of the cuboid seen. Award ***(M1)*** for correctly substituted volume of cuboid and ***(M1)*** for correctly substituted volume of pyramid.

=
41 588 *(41 553 if* $2(13.5^2)$ *is used)*

=
41 600 m^3 ***(A1)*****(ft)*****(G3)***

[4 marks]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

1g. *[3 marks]*

Markscheme

Weight of air =
$41\,600 \times 1.2 \times 0.9$ ***(M1)(M1)***

=
44 900 kg ***(A1)*****(ft)*****(G2)***

Note: Award ***(M1)*** for their part (e) × 1.2, ***(M1)*** for × 0.9.

Award at most ***(M1)(M1)(A0)*** if the volume of the cuboid is used.

[3 marks]

Examiners report

This question also caused many problems for the candidature. There seems to be a lack of ability in visualising a problem in three dimensions – clearly, further exposure to such problems is needed by the students. Further, as in question 2, the final two parts of the question were independent of those preceding them; many candidates did not reach these parts, though for some, these were the only parts of the question attempted. There is also a lack of awareness of the appropriate volume formula on the formula sheet to use.

2a. *[3 marks]*

Markscheme

15.4×5.5 ***(M1)***

$84.7\ m^2$ ***(A1)***

$= 847000\ cm^2$ ***(A1)(G3)***

Note: Award ***(G2)*** if $84.7\ m^2$ seen with no working.

OR

1540×550 ***(A1)(M1)***

$= 847000\ cm^2$ ***(A1)*****(ft)*****(G3)***

Note: Award ***(A1)*** for both dimensions converted correctly to cm, ***(M1)*** for multiplication of both dimensions. ***(A1)*****(ft)** for correct product of their sides in cm.

[3 marks]

Examiners report

Part (a) was well done except for the fact that very few students were able to convert correctly from m^2 to cm^2 and this was very disappointing.

2b. *[1 mark]*

Markscheme

$242\ cm^2$ $(0.0242\ m^2)$ ***(A1)***

[1 marks}

Examiners report

Part (a) was well done except for the fact that very few students were able to convert correctly from m^2 to cm^2 and this was very disappointing.

2c. *[2 marks]*

Markscheme

$\frac{15.4}{0.22} = 70$ ***(M1)***

$\frac{5.5}{0.11} = 50$

$70 \times 50 = 3500$ ***(A1)(G2)***

OR

$\frac{847000}{242} = 3500$ ***(M1)(A1)*****(ft)*****(G2)***

Note: Follow through from parts (a) (i) and (ii).

[2 marks]

Examiners report

Part (a) was well done except for the fact that very few students were able to convert correctly from m^2 to m^2 and this was very disappointing.

2d. *[3 marks]*

Markscheme

$BC^2 = 4^2 + 6^2 - 2 \times 4 \times 6 \times \cos 40°$ ***(M1)(A1)***

$BC = 3.90\ m$ ***(A1)(G2)***

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*** for correct substitutions, ***(A1)*** for correct answer.

[3 marks]

Examiners report

In part (b) the cosine rule and the area of a triangle were well done. In some cases units were missing and therefore a unit penalty was applied.

2e. *[1 mark]*

Markscheme

perimeter = 13.9 m ***(A1)*****(ft)*****(G1)***

Notes: Follow through from part (b) (i).

[1 mark]

Examiners report

In part (b) the cosine rule and the area of a triangle were well done. In some cases units were missing and therefore a unit penalty was applied.

2f. *[2 marks]*

Markscheme

$\text{Area} = \frac{1}{2} \times 4 \times 6 \times \sin 40°$ ***(M1)***

$= 7.71\ m^2$ ***(A1)*****(ft)*****(G2)***

Notes: Award ***(M1)*** for correct formula and correct substitution, ***(A1)*****(ft)** for correct answer.

[2 marks]

Examiners report

In part (b) the cosine rule and the area of a triangle were well done. In some cases units were missing and therefore a unit penalty was applied.

2g. *[3 marks]*

Markscheme

$\frac{7.713}{84.7} \times 100\ \% = 9.11\ \%$ ***(A1)(M1)(A1)*****(ft)*****(G2)***

Notes: Accept $9.10\ \%$.

Award ***(A1)*** for both measurements correctly written in the same unit, ***(M1)*** for correct method, ***(A1)*****(ft)** for correct answer.

Follow through from (b) (iii) and from consistent error in conversion of units throughout the question.

[3 marks]

Examiners report

In part (b) the cosine rule and the area of a triangle were well done. In some cases units were missing and therefore a unit penalty was applied.

2h. *[2 marks]*

Markscheme

$\frac{360^\circ}{12}$ ***(M1)***

$= 30^\circ$ ***(A1)(G2)***

[2 marks]

Examiners report

Part (c) was clearly the most difficult one for the students. The general impression was that they did not read the diagram in detail. A number of candidates could not distinguish the circle from the triangle and hence used an incorrect method to find the radius.

2i. *[3 marks]*

Markscheme

$\text{MN} = 2 \times \frac{11}{\tan 15}$ ***(A1)*****(ft)*****(M1)***

OR

$\text{MN} = 2 \times 11 \tan 75^\circ$

$\text{MN} = 82.1\ \text{cm}$ ***(A1)*****(ft)*****(G2)***

Notes: Award ***(A1)*** for 11 and 2 seen (implied by 22 seen), ***(M1)*** for dividing by tan15 (or multiplying by tan 75).

Follow through from their angle in part (c) (i).

[3 marks]

Examiners report

Part (c) was clearly the most difficult one for the students. The general impression was that they did not read the diagram in detail. A number of candidates could not distinguish the circle from the triangle and hence used an incorrect method to find the radius.

2j. *[2 marks]*

Markscheme

volume = 5419×2.5 ***(M1)***

$= 13500\ \text{cm}^3$ ***(A1)(G2)***

[2 marks]

Examiners report

It was pleasing to see candidates recovering well to get full marks for the last two parts.

2k. *[2 marks]*

Markscheme

$\frac{13547.34\ldots}{514} = 26.4$ ***(M1)(A1)*****(ft)*****(G2)***

Note: Award ***(M1)*** for dividing their part (d) by 514.

Accept 26.3.

[2 marks]

Examiners report

It was pleasing to see candidates recovering well to get full marks for the last two parts.

3a. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

3b. *[2 marks]*

Markscheme

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

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

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

[??? marks]

Examiners report

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

3c. *[2 marks]*

Markscheme

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

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

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

[??? marks]

Examiners report

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

3d. *[3 marks]*

Markscheme

$\frac{\mathrm{d}A}{\mathrm{d}x} = 4\pi x - \frac{1200}{x^2}$ ***(A1)*****(ft)*****(A1)*****(ft)*****(A1)*****(ft)**

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

[??? marks]

Examiners report

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

3e. *[3 marks]*

Markscheme

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

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

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

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

Follow through from their derivative.

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

[3 marks]

Examiners report

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

3f. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

4a. *[2 marks]*

Markscheme

If a quadrilateral is not a square (then) the four sides of the quadrilateral are not equal. ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for "if…(then)", ***(A1)*** for the correct phrases in the correct order.

[2 marks]

Examiners report

There was confusion among some students about which was the inverse and converse of the given statement.

4b. *[2 marks]*

Markscheme

If the four sides of the quadrilateral are equal (then) the quadrilateral is a square. ***(A1)(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*** for "if…(then)", ***(A1)*****(ft)** for the correct phrases in the correct order.

Note: Follow through in (b) if the inverse and converse in (a) and (b) are correct and reversed.

[2 marks]

Examiners report

There was confusion among some students about which was the inverse and converse of the given statement.

4c. *[2 marks]*

Markscheme

The converse is not always true, for example a rhombus (diamond) is a quadrilateral with four equal sides, but it is not a square. ***(A1)(R1)*** ***(C2)***

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

[2 marks]

Examiners report

There was confusion among some students about which was the inverse and converse of the given statement. Part (c) was poorly done with very few students able to provide an example that shows that the converse is not always true.

5a. *[2 marks]*

Markscheme

Gradient $= \frac{(5-1)}{(4-2)}$ ***(M1)***

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

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

[2 marks]

Examiners report

While parts (a) and (b) were answered or at least attempted with various success, few candidates made progress in part (c). Some candidates used the coordinates of point A or B rather than M and others could not find the gradient of the perpendicular line.

5b. *[1 mark]*

Markscheme

Midpoint = (3, 3) (accept $x = 3$, $y = 3$) ***(A1)*** ***(C1)***

[1 mark]

Examiners report

While parts (a) and (b) were answered or at least attempted with various success, few candidates made progress in part (c). Some candidates used the coordinates of point A or B rather than M and others could not find the gradient of the perpendicular line.

5c. *[3 marks]*

Markscheme

Gradient of perpendicular $= -\frac{1}{2}$ ***(A1)*****(ft)**

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

$3 = -\frac{1}{2} \times 3 + c$

$c = 4.5$

$y = -0.5x + 4.5$ ***(A1)*****(ft)**

OR

$y - 3 = -0.5(x - 3)$ ***(A1)(A1)*****(ft)**

Note: Award ***(A1)*** for –0.5, ***(A1)*** for both threes.

OR

$2y + x = 9$ ***(A1)(A1)*****(ft)** ***(C3)***

Note: Award ***(A1)*** for 2, ***(A1)*** for 9.

[3 marks]

Examiners report

While parts (a) and (b) were answered or at least attempted with various success, few candidates made progress in part (c). Some candidates used the coordinates of point A or B rather than M and others could not find the gradient of the perpendicular line.

6a. *[1 mark]*

Markscheme

UP applies in this question

(UP) XM = 5 cm ***(A1)***

[1 mark]

Examiners report

This part proved accessible to the great majority of candidates. The common errors were (1) the inversion of the tangent ratio (2) the omission of the units and (3) the incorrect rounding of the answer; with 58° being all too commonly seen.

6b. *[1 mark]*

Markscheme

16.8 ***(G1)***

[1 mark]

Examiners report

A straightforward question that saw many fine attempts. Given its nature – where much of the work was done on the GDC – it must be emphasised to candidates that incorrect entry of data into the calculator will result in considerable penalties; they must check their data entry most carefully.

The use of the inappropriate standard deviation was seen, but infrequently.

6c. *[2 marks]*

Markscheme

UP applies in this question

$VM^2 = 5^2 + 8^2$ ***(M1)***

Note: Award ***(M1)*** for correct use of Pythagoras Theorem.

(UP) VM = $\sqrt{89}$ = 9.43 cm ***(A1)*****(ft)*****(G2)***

[2 marks]

Examiners report

This part proved accessible to the great majority of candidates. The common errors were (1) the inversion of the tangent ratio (2) the omission of the units and (3) the incorrect rounding of the answer; with 58° being all too commonly seen.

6d. *[2 marks]*

Markscheme

$\tan \text{VMX} = \frac{8}{5}$ ***(M1)***

Note: Other trigonometric ratios may be used.

$\hat{\text{VMX}} = 58.0°$ ***(A1)*****(ft)*****(G2)***

[2 marks]

Examiners report

This part proved accessible to the great majority of candidates. The common errors were (1) the inversion of the tangent ratio (2) the omission of the units and (3) the incorrect rounding of the answer; with 58° being all too commonly seen.

6e. *[4 marks]*

Markscheme

UP applies in this question

$l^2 = 290^2 + 550^2 - 2 \times 290 \times 550 \times \cos 115°$ ***(M1)(A1)***

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

$l = 722$ ***(A1)(G2)***

(UP) $= 720$ m ***(A1)***

Note: If 720 m seen without working award ***(G3)***.

The final ***(A1)*** is awarded for the correct rounding of their answer.

[4 marks]

Examiners report

Again, this part proved accessible to the majority with a large number of candidates attaining full marks. However, there were also a number of candidates who seemed not to have been prepared in the use of trigonometry in non right-angled triangles. Also, failing to round the answer in (a) to the nearest 10m was a common omission.

6f. *[3 marks]*

Markscheme

UP applies in this question

$\text{Area} = \frac{1}{2} \times 290 \times 550 \times \sin 115$ ***(M1)(A1)***

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

(UP) $= 72\,300 \text{ m}^2$ ***(A1)(G2)***

[3 marks]

Examiners report

Again, this part proved accessible to the majority with a large number of candidates attaining full marks. However, there were also a number of candidates who seemed not to have been prepared in the use of trigonometry in non right-angled triangles. Also, failing to round the answer in (a) to the nearest 10 m was a common omission.

6g. *[4 marks]*

Markscheme

$\frac{180}{\sin B} = \frac{230}{\sin 53}$ ***(M1)(A1)***

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

$B = 38.7°$ ***(A1)(G2)***

$A\hat{C}B = 180 - (53° + 38.7°)$

$= 88.3°$ ***(A1)*****(ft)**

[4 marks]

Examiners report

Again, this part proved accessible to the majority with a large number of candidates attaining full marks. However, there were also a number of candidates who seemed not to have been prepared in the use of trigonometry in non right-angled triangles. Also, failing to round the answer in (a) to the nearest 10 m was a common omission.

7a. *[1 mark]*

Markscheme

6

OR

(0, 6) ***(A1)*** ***(C1)***

[1 mark]

Examiners report

This was generally well answered.

7b. *[2 marks]*

Markscheme

$\frac{(2-5)}{(8-2)}$ ***(M1)***

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

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

[2 marks]

Examiners report

This was generally well answered, the errors coming from incorrect substitution into the gradient formula rather than using the two intercepts.

7c. *[1 mark]*

Markscheme

Angle clearly identified. ***(A1)*** ***(C1)***

[1 mark]

Examiners report

There was often a lack of accuracy in the answers. Also, the use of the sine rule overly complicated matters for many.

7d. *[2 marks]*

Markscheme

$\tan\theta = \frac{1}{2}$ (or equivalent fraction) ***(M1)***

$\theta = 26.6°$ ***(A1)*****(ft)** ***(C2)***

Note: (ft) from (b).

Accept alternative correct trigonometrical methods.

[2 marks]

Examiners report

[N/A]

8a. *[4 marks]*

Markscheme

$\frac{\sin \hat{ABC}}{13.4} = \frac{\sin 30°}{6.7}$ ***(M1)(A1)***

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

$\hat{ABC} = 90°$ ***(A1)***

$\hat{ACB} = 60°$ ***(A1)*****(ft)** ***(C4)***

Note: Radians give no solution, award maximum ***(M1)(A1)(A0)***.

[4 marks]

Examiners report

Use of cosine rule was common. The assumption of a right angle in the given diagram was minimal.

8b. *[2 marks]*

Markscheme

$\frac{29-30}{30} \times 100$ ***(M1)***

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

% error = −33.3 % ***(A1)*** ***(C2)***

Notes: Percentage symbol not required. Accept positive answer.

[2 marks]

Examiners report

The incorrect denominator was often seen in the error formula.

9a. *[2 marks]*

Markscheme

Unit penalty (UP) applies

Volume of tennis ball $= \frac{4}{3}\pi 3.15^3$ ***(M1)***

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

(UP) Volume of tennis ball = 131 cm^3 ***(A1)*** ***(C2)***

[2 marks]

Examiners report

This question was poorly answered by many but perfectly well by many others, there being little in between. Volume seemed to be little understood and this part of the course is perhaps overlooked. A (candidate drawn) diagram helped visualise the situation and this, in general, is to be encouraged.

9b. *[4 marks]*

Markscheme

Unit penalty (UP) applies

Volume of empty space $= \pi 3.2^2 \times 26 - 4 \times 130.9$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correct substitution into cylinder formula, ***(M1)*** 4 × their (a), ***(M1)*** for subtracting appropriate volumes.

(UP) Volume of empty space = 313 cm^3 ***(A1)*****(ft)** ***(C4)***

Note: Accept 312 cm^3 with use of 131.

[4 marks]

Examiners report

This question was poorly answered by many but perfectly well by many others, there being little in between. Volume seemed to be little understood and this part of the course is perhaps overlooked. A (candidate drawn) diagram helped visualise the situation and this, in general, is to be encouraged. Many found (b) difficult due to it not being broken up into "one stage" parts in the question. Practice in multi-stage questions is recommended.

10a. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

Most were successful in this part.

10b. *[1 mark]*

Markscheme

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

[1 mark]

Examiners report

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

This part was usually well attempted.

10c. *[2 marks]*

Markscheme

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

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

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

[2 marks]

Examiners report

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

Only the best candidates succeeded in this part.

10d. *[1 mark]*

Markscheme

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

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

[1 mark]

Examiners report

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

Only the best candidates succeeded in this part.

11a. *[2 marks]*

Markscheme

Gradient of CD $= \frac{1-(-1)}{-2-(-1)}$ ***(M1)***

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

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

[2 marks]

Examiners report

This was well done overall. Almost all students could calculate the gradient of the straight line. Gradient of perpendicular line was found, but some candidates failed to communicate the requirement, in terms of gradients for two lines to be perpendicular (Example: They are perpendicular because their gradients are opposite and reciprocal or they are perpendicular because the product of their gradients is –1)

Distance between points and area of triangle was answered well by most candidates. Both formulae for the area of the triangle were correctly used.

11b. *[2 marks]*

Markscheme

Gradient of AD $= \frac{1}{2}$ ***(A1)***

$-2 \times \frac{1}{2} = -1$ or
$\frac{1}{2}$ is negative reciprocal of –2 ***(M1)***

Hence AD is perpendicular for CD. ***(AG)***

Note: Last line must be seen for the ***(M1)*** to be awarded.

[2 marks]

Examiners report

This was well done overall. Almost all students could calculate the gradient of the straight line. Gradient of perpendicular line was found, but some candidates failed to communicate the requirement, in terms of gradients for two lines to be perpendicular (Example: They are perpendicular because their gradients are opposite and reciprocal or they are perpendicular because the product of their gradients is -1)

Distance between points and area of triangle was answered well by most candidates. Both formulae for the area of the triangle were correctly used.

11c. *[3 marks]*

Markscheme

$y = -2x - 3$ ***(A1)*****(ft)*****(A1)*****(ft)**

Note: Award ***(A1)*****(ft)** for their (a), ***(A1)*****(ft)** for -3.

If part (a) incorrect award ***(A1)*****(ft)** for their y-intercept only if working is seen.

OR

$y - 1 = -2(x + 2)$ ***(A1)*****(ft)*****(A1)***

OR

$y + 1 = -2(x + 1)$ ***(A1)*****(ft)*****(A1)***

Note: Award ***(A1)*****(ft)** for their (a), ***(A1)*** for correct substitution of point.

$2x + y = -3$ ***(A1)*****(ft)**

Note: The final ***(A1)*****(ft)** is for their equation in the stated form.

[3 marks]

Examiners report

This was well done overall. Almost all students could calculate the gradient of the straight line. Gradient of perpendicular line was found, but some candidates failed to communicate the requirement, in terms of gradients for two lines to be perpendicular (Example: They are perpendicular because their gradients are opposite and reciprocal or they are perpendicular because the product of their gradients is -1)

Distance between points and area of triangle was answered well by most candidates. Both formulae for the area of the triangle were correctly used.

11d. *[2 marks]*

Markscheme

E (−3, 3) (Accept $x = -3$, $y = 3$) ***(G2)***

OR

Award ***(M1)*** for solving the pair of simultaneous equations by hand. ***(A1)*****(ft)** for correct answer, **(ft)** from their (c). ***(M1)(A1)*****(ft)**

OR

Award ***(M1)*** for having extended the lines in their own graph seen drawn on answer paper. ***(A1)*** for correct answer. ***(M1)(A1)***

Note: Missing coordinate brackets receive ***(G1)(G0)*** or ***(M1)(A0)***.

[2 marks]

Examiners report

This was well done overall. Almost all students could calculate the gradient of the straight line. Gradient of perpendicular line was found, but some candidates failed to communicate the requirement, in terms of gradients for two lines to be perpendicular (Example: They are perpendicular because their gradients are opposite and reciprocal or they are perpendicular because the product of their gradients is −1)

Distance between points and area of triangle was answered well by most candidates. Both formulae for the area of the triangle were correctly used.

11e. *[2 marks]*

Markscheme

Distance between A and D =
$\sqrt{4^2 + 2^2}$ ***(M1)***

$= \sqrt{20}$ **OR**
$2\sqrt{5}$ **OR** 4.47 (3 *s.f.*) ***(A1)(G2)***

Note: Award ***(M1)*** for correct substitution into the distance formula, ***(A1)*** for correct answer.

[2 marks]

Examiners report

This was well done overall. Almost all students could calculate the gradient of the straight line. Gradient of perpendicular line was found, but some candidates failed to communicate the requirement, in terms of gradients for two lines to be perpendicular (Example: They are perpendicular because their gradients are opposite and reciprocal or they are perpendicular because the product of their gradients is −1)

Distance between points and area of triangle was answered well by most candidates. Both formulae for the area of the triangle were correctly used.

11f. *[2 marks]*

Markscheme

Area of ADE =
$\frac{1}{2}\sqrt{20} \times \sqrt{20}$ ***(M1)***

= 10 ***(A1)*****(ft)*****(G2)***

Follow through from (e).

[2 marks]

Examiners report

This was well done overall. Almost all students could calculate the gradient of the straight line. Gradient of perpendicular line was found, but some candidates failed to communicate the requirement, in terms of gradients for two lines to be perpendicular (Example: They are perpendicular because their gradients are opposite and reciprocal or they are perpendicular because the product of their gradients is -1)

Distance between points and area of triangle was answered well by most candidates. Both formulae for the area of the triangle were correctly used.

12a. *[1 mark]*

Markscheme

$60°$ ***(A1)***

[1 mark]

Examiners report

It was pleasing to show candidate working throughout this question. Follow through marks could be awarded when incorrect answers were given. Many candidates incorrectly calculated the weight of the chocolate bar by multiplying the surface area by $1.5g$. Also a large number of students incorrectly used the formula for the volume of a pyramid rather than for a prism. Most candidates were successful in their use of the cosine rule but did not give the answer before it was rounded to 86.4, resulting in the loss of the final A mark. The last part acted as a clear discriminator, very few students were able to find the correct length of the new chocolate bar. Most students used units correctly.

12b. *[3 marks]*

Markscheme

Unit penalty (UP) applies in this part

$\text{Area} = \frac{6\times 6\times \sin 60°}{2}$ ***(M1)(A1)***

(UP) $= 15.6 \text{ cm}^2$

$(9\sqrt{3})$ ***(A1)*****(ft)*****(G2)***

Note: Award ***(M1)*** for substitution into correct formula, ***(A1)*** for correct values. Accept alternative correct methods.

[3 marks]

Examiners report

It was pleasing to show candidate working throughout this question. Follow through marks could be awarded when incorrect answers were given. Many candidates incorrectly calculated the weight of the chocolate bar by multiplying the surface area by $1.5g$. Also a large number of students incorrectly used the formula for the volume of a pyramid rather than for a prism.Most candidates were successful in their use of the cosine rule but did not give the answer before it was rounded to 86.4, resulting in the loss of the final A mark. The last part acted as a clear discriminator, very few students were able to find the correct length of the new chocolate bar. Most students used units correctly.

12c. *[3 marks]*

Markscheme

Unit penalty (UP) applies in this part

Surface Area $= 15.58 \times 2 + 23 \times 6 \times 3$ ***(M1)(M1)***

Note: Award ***(M1)*** for two terms with 2 and 3 respectively, ***(M1)*** for 23×6 (138).

(UP) Surface Area = 445 cm^2 ***(A1)*****(ft)*****(G2)***

[3 marks]

Examiners report

It was pleasing to show candidate working throughout this question. Follow through marks could be awarded when incorrect answers were given. Many candidates incorrectly calculated the weight of the chocolate bar by multiplying the surface area by 1.5g. Also a large number of students incorrectly used the formula for the volume of a pyramid rather than for a prism. Most candidates were successful in their use of the cosine rule but did not give the answer before it was rounded to 86.4, resulting in the loss of the final A mark. The last part acted as a clear discriminator, very few students were able to find the correct length of the new chocolate bar. Most students used units correctly.

12d. *[3 marks]*

Markscheme

Unit penalty (UP) applies in this part

weight $= 1.5 \times 15.59 \times 23$ ***(M1)(M1)***

Note: Award ***(M1)*** for finding the volume, ***(M1)*** for multiplying their volume by 1.5.

(UP) weight = 538 g ***(A1)*****(ft)*****(G3)***

[3 marks]

Examiners report

It was pleasing to show candidate working throughout this question. Follow through marks could be awarded when incorrect answers were given. Many candidates incorrectly calculated the weight of the chocolate bar by multiplying the surface area by 1.5g. Also a large number of students incorrectly used the formula for the volume of a pyramid rather than for a prism. Most candidates were successful in their use of the cosine rule but did not give the answer before it was rounded to 86.4, resulting in the loss of the final A mark. The last part acted as a clear discriminator, very few students were able to find the correct length of the new chocolate bar. Most students used units correctly.

12e. *[3 marks]*

Markscheme

$\cos\alpha = \frac{4^2+6^2-7^2}{2\times4\times6}$ ***(M1)(A1)***

Note: Award ***(M1)*** for using cosine rule with values from the problem, ***(A1)*** for correct substitution.

$\alpha = 86.41\ldots$ ***(A1)***

$\alpha = 86.4^\circ$ ***(AG)***

Note: 86.41… must be seen for final ***(A1)*** to be awarded.

[3 marks]

Examiners report

It was pleasing to show candidate working throughout this question. Follow through marks could be awarded when incorrect answers were given. Many candidates incorrectly calculated the weight of the chocolate bar by multiplying the surface area by $1.5g$. Also a large number of students incorrectly used the formula for the volume of a pyramid rather than for a prism. Most candidates were successful in their use of the cosine rule but did not give the answer before it was rounded to 86.4, resulting in the loss of the final A mark. The last part acted as a clear discriminator, very few students were able to find the correct length of the new chocolate bar. Most students used units correctly.

12f. *[4 marks]*

Markscheme

Unit penalty (UP) applies in this part

$l \times \frac{4\times6\times\sin 86.4^\circ}{2} \times 1.5 = 500$ ***(M1)(A1)(M1)***

Notes: Award ***(M1)*** for finding an expression for the volume, ***(A1)*** for correct substitution, ***(M1)*** for multiplying the volume by 1.5 and equating to 500, or for equating the volume to $\frac{500}{1.5}$.

If formula for volume is not correct but consistent with that in (c) award at most ***(M1)(A0)*****(ft)*****(M1)(A0)**.

(UP) $l = 27.8$ cm ***(A1)(G3)***

[4 marks]

Examiners report

It was pleasing to show candidate working throughout this question. Follow through marks could be awarded when incorrect answers were given. Many candidates incorrectly calculated the weight of the chocolate bar by multiplying the surface area by $1.5g$. Also a large number of students incorrectly used the formula for the volume of a pyramid rather than for a prism. Most candidates were successful in their use of the cosine rule but did not give the answer before it was rounded to 86.4, resulting in the loss of the final A mark. The last part acted as a clear discriminator, very few students were able to find the correct length of the new chocolate bar. Most students used units correctly.

13a. *[3 marks]*

Markscheme

$\frac{\sin \text{BCA}}{35} = \frac{\sin 105^\circ}{80}$ ***(M1)(A1)***

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

$\hat{\text{BCA}} = 25.0^\circ$ ***(A1)(G2)***

[3 marks]

Examiners report

This was a simple application of non-right angled trigonometry and most candidates answered it well. Some candidates lost marks in both parts due to the incorrect setting of the calculators. Those that did not score well overall primarily used Pythagoras.

13b. *[5 marks]*

Markscheme

Note: Unit penalty (UP) applies in parts (b)(c) and (e)

Length BD = 40 m ***(A1)***

Angle ABC = 180° − 105° − 25° = 50° ***(A1)*****(ft)**

Note: **(ft)** from their answer to (a).

$\text{AD}^2 = 35^2 + 40^2 - (2 \times 35 \times 40 \times \cos 50^\circ)$ ***(M1)(A1)*****(ft)**

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

(UP) AD = 32.0 m ***(A1)*****(ft)*****(G3)***

Notes: If 80 is used for BD award at most ***(A0)(A1)*****(ft)*****(M1)(A1)*****(ft)*****(A1)*****(ft)** for an answer of 63.4 m.

If the angle ABC is incorrectly calculated **in this part** award at most ***(A1)(A0)(M1)(A1)*****(ft)*****(A1)*****(ft)**.

If angle BCA is used award at most ***(A1)(A0)(M1)(A0)(A0)***.

[5 marks]

Examiners report

This was a simple application of non-right angled trigonometry and most candidates answered it well. Some candidates lost marks in both parts due to the incorrect setting of the calculators. Those that did not score well overall primarily used Pythagoras.

13c. *[2 marks]*

Markscheme

Note: Unit penalty (UP) applies in parts (b)(c) and (e)

length of fence = 35 + 40 + 32 ***(M1)***

(UP) = 107 m ***(A1)*(ft)*(G2)***

Note: ***(M1)*** for adding 35 + 40 + their (b).

[2 marks]

Examiners report

Most candidates scored full marks, many by follow through from an incorrect part (b). The main error was using the value for BC and not BD.

13d. *[2 marks]*

Markscheme

cost per metre
$= \frac{802.50}{107}$ ***(M1)***

Note: Award ***(M1)*** for dividing 802.50 by their (c).

cost per metre = 7.50 USD (7.5 USD) (USD not required) ***(A1)*(ft)*(G2)***

[2 marks]

Examiners report

Most candidates scored full marks, many by follow through from an incorrect part (b). The main error was using the value for BC and not BD.

13e. *[3 marks]*

Markscheme

Note: Unit penalty (UP) applies in parts (b)(c) and (e)

Area of ABD
$= \frac{1}{2} \times 35 \times 40 \times \sin 50°$ ***(M1)***

= 536.2311102 ***(A1)*(ft)**

(UP) = 536 m^2 ***(A1)*(ft)*(G2)***

Note: Award ***(M1)*** for correct substituted formula, ***(A1)*(ft)** for correct substitution, **(ft)** from their value of BD and their angle ABC in (b).

[3 marks]

Examiners report

Done well; again some candidates used the right-angled formula.

13f. *[3 marks]*

Markscheme

Volume = 0.03×536 ***(A1)(M1)***

$= 16.08$

$= 16.1$ ***(A1)*****(ft)*****(G2)***

Note: Award ***(A1)*** for 0.03, ***(M1)*** for correct formula. **(ft)** from their (e).

If 3 is used award at most ***(A0)(M1)(A0)***.

[3 marks]

Examiners report

This part was poorly done; many candidates unable to convert 3 cm to 0.03 m. A significant number used the wrong formula, multiplying their answer by 1/3.

14a. *[3 marks]*

Markscheme

Note: Unit penalty (UP) applies in this part

$(2680 + 1970) \times 2$ ***(M1)***

(UP) $= 9.30 \times 10^3$ cm ***(A1)(A1)*** ***(C3)***

Notes: Award ***(M1)*** for correct formula.

(A1) for 9.30 (Accept 9.3).

(A1) for 10^3.

[3 marks]

Examiners report

This question was well answered by many candidates although the majority lost a mark as a unit penalty in part (a). Some candidates used the wrong formula for the perimeter. Most could give their answer in standard form.

14b. *[3 marks]*

Markscheme

2680×1970 ***(M1)***

$= 5279600$ ***(A1)***

= 5,280,000 (5280 thousand) ***(A1)*****(ft)** ***(C3)***

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

Accept 5.280×10^6.

Note: The last ***(A1)*** is for specified accuracy, **(ft)** from their answer.

The ***(AP)*** for the paper is not applied here.

[3 marks]

Examiners report

This question was well answered by many candidates although the majority lost a mark as a unit penalty in part (a). Some candidates used the wrong formula for the perimeter. Most could give their answer in standard form.

15a. *[3 marks]*

Markscheme

$0 + 2y = 12$ or
$x + 2(0) = 12$ ***(M1)***

P(0, 6) (accept
$x = 0$,
$y = 6$) ***(A1)***

Q(12, 0) (accept
$x = 12$,
$y = 0$) ***(A1)*** ***(C3)***

Notes: Award ***(M1)*** for setting either value to zero.

Missing coordinate brackets receive ***(A0)*** the first time this occurs.

Award ***(A0)(A1)*****(ft)** for P(0, 12) and Q(6, 0).

[3 marks]

Examiners report

Most candidates could find the x and y intercepts but many wrote the coordinates the wrong way around. A number of candidates did not label their coordinates as P and Q or did not include parentheses.

15b. *[3 marks]*

Markscheme

$x + 2(x - 3) = 12$ ***(M1)***

$(6, 3)$ (accept $x = 6$, $y = 3$) ***(A1)(A1)*** ***(C3)***

Note: ***(A1)*** for each correct coordinate.

Missing coordinate brackets receive ***(A0)(A1)*** if this is the first time it occurs.

[3 marks]

Examiners report

In this part many had trouble recognising the need to solve the two simultaneous equations.

16a. *[2 marks]*

Markscheme

$m(\text{AB}) = \frac{-3-3}{7-4} = -2$ ***(M1)(A1)*** ***(C2)***

Note: Award ***(M1)*** for attempt to substitute into correct gradient formula.

[2 marks]

Examiners report

While parts (a) and (b)(i) were attempted with some success, few candidates made progress in (b)(ii). Some candidates used the coordinates of point *B* rather than *C* and others could not find the unknown value p as they did not realise they had to equate their substituted formula for the gradient to the answer to part (b)(i). A large number of candidates did not attempt this part of the question.

16b. *[1 mark]*

Markscheme

$m(\text{AC}) = \frac{1}{2}$ ***(A1)*****(ft)**

[1 mark]

Examiners report

While parts (a) and (b)(i) were attempted with some success, few candidates made progress in (b)(ii). Some candidates used the coordinates of point *B* rather than *C* and others could not find the unknown value p as they did not realise they had to equate their substituted formula for the gradient to the answer to part (b)(i). A large number of candidates did not attempt this part of the question.

16c. *[3 marks]*

Markscheme

$\frac{p-3}{0.5-4} = \frac{1}{2}$ *(or equivalent method)* ***(M1)(A1)*****(ft)**

Note: Award ***(M1)*** for equating gradient to $\frac{1}{2}$. ***(A1)*** for correct substitution.

$p = 1.25$ ***(A1)*****(ft)** ***(C4)***

[3 marks]

Examiners report

While parts (a) and (b)(i) were attempted with some success, few candidates made progressin (b)(ii). Some candidates used the coordinates of point *B* rather than *C* and others could not find the unknown value p as they did not realise they had to equate their substituted formula for the gradient to the answer to part (b)(i). A large number of candidates did notattempt this part of the question.

17a. *[1 mark]*

Markscheme

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

[1 mark]

Examiners report

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

17b. *[1 mark]*

Markscheme

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

[1 mark]

Examiners report

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

17c. *[4 marks]*

Markscheme

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

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

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

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

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

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

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

[4 marks]

Examiners report

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

18a. *[4 marks]*

Markscheme

Note: Unit penalty (UP) applies in this part

$\text{PB} = \frac{1}{2}\sqrt{40^2 + 40^2} = \sqrt{800} = 28.28 (28.3)$ ***(M1)(A1)***

Note: Award ***(M1)*** for correct substitutions, ***(A1)*** for correct answer.

(UP)
$\text{OB} = \sqrt{40^2 + 28.28^2} = 49.0 \text{ cm } \left(\sqrt{2400} \text{ cm}\right)$ ***(M1)(A1)*****(ft)** ***(C4)***

Note: Award ***(M1)*** for correct substitution, can **(ft)** from any answer to PB.

[4 marks]

Examiners report

This question was well answered by many candidates although a number lost an accuracy penalty or a unit penalty in this question. A very common error was assuming *PB* to be 20 cm. The mark-scheme allowed for follow through marks to be awarded in this case. Most candidates could find the angle and very few did not use right angled trigonometry.

18b. *[2 marks]*

Markscheme

$\sin^{-1}\left(\frac{40}{49}\right)$

OR

$\cos^{-1}\left(\frac{28.28}{49}\right)$

OR

$\tan^{-1}\left(\frac{40}{28.28}\right)$ ***(M1)***

= 54.7 (54.8) ***(A1)*****(ft)** ***(C2)***

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

In radians = 0.616, award ***(M1)(A0)***.

Note: Common error: (a)
$OB = \sqrt{40^2 + 20^2} = 44.7$ cm. Award ***(M0)(A0)(M1)***, ***(A1)*****(ft)**, and (b) angle OBP = 63.4° (63.5°) ***(M1)(A1)*****(ft)**.

[2 marks]

Examiners report

This question was well answered by many candidates although a number lost an accuracy penalty or a unit penalty in this question. A very common error was assuming *PB* to be 20 cm. The mark-scheme allowed for follow through marks to be awarded in this case. Most candidates could find the angle and very few did not use right angled trigonometry.

19a. *[2 marks]*

Markscheme

$4y = -x - 34$ or similar rearrangement ***(M1)***

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

Examiners report

The omission of the negative sign was a common fault.

19b. *[2 marks]*

Markscheme

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

Note: ***(A1)*** Change of sign
(A1) Use of reciprocal

[2 marks]

Examiners report

Most candidates managed to answer this correctly from their (a).

19c. *[2 marks]*

Markscheme

Reasonable attempt to solve equations simultaneously ***(M1)***

$(-2,\ -8)$ ***(A1)*****(ft)** ***(C2)***

Note: Accept
$x = -2$
$y = -8$. Award ***(A0)*** if brackets not included.

[2 marks]

Examiners report

This part proved challenging for the majority. Once again, the use of the GDC was expected.

20a. *[4 marks]*

Markscheme

(i)
$\sqrt{15^2 + 20^2}$ ***(M1)***

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

$\text{AC} = 25\ (\text{cm})$ ***(A1)*** ***(C2)***

(ii)
$\sqrt{12.5^2 + 30^2}$ ***(M1)***

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

$\text{VC} = 32.5\ (\text{cm})$ ***(A1)*****(ft)** ***(C2)***

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

Examiners report

[N/A]

20b. *[2 marks]*

Markscheme

$\sin \text{VCN} = \frac{30}{32.5}$ **OR**
$\tan \text{VCN} = \frac{30}{12.5}$ **OR**
$\cos \text{VCN} = \frac{12.5}{32.5}$ ***(M1)***
$= 67.4^\circ$ (
$67.3801\ldots$) ***(A1)*****(ft)** ***(C2)***

Note: Accept alternative methods. Follow through from part (a) and/or part (b).

Examiners report

[N/A]

21a. *[2 marks]*

Markscheme

$\sqrt{5^2+12^2}$ ***(M1)***

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

=
$13\ (\text{cm})$ ***(A1)*** ***(C2)***

Examiners report

[N/A]

21b. *[4 marks]*

Markscheme

$\text{Area} = 2\pi(5)^2 + \pi(5)(13)$ ***(M1)(M1)(M1)***

Notes: Award ***(M1)*** for surface area of hemisphere, ***(M1)*** for surface of cone, ***(M1)*** for addition of two surface areas. Follow through from their answer to part (a).

$= 361\ \text{cm}^2$ (
$361.283\ldots$) ***(A1)*****(ft)** ***(C4)***

Note: The answer is
$361\ \text{cm}^2$, the units are required.

Examiners report

[N/A]

22a. *[3 marks]*

Markscheme

$\cos \text{ACB} = \frac{30^2+50^2-70^2}{2\times30\times50}$ ***(M1)(A1)***

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

$\text{ACB} = 120^\circ$ ***(A1)(G2)***

Examiners report

[N/A]

22b. *[3 marks]*

Markscheme

Area of triangle ABC $= \frac{30(50)\sin 120^\circ}{2}$ ***(M1)(A1)*****(ft)**

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

$= 650\ \text{m}^2$
$(649.519\ldots\ \text{m}^2)$ ***(A1)*****(ft)*****(G2)***

Notes: The answer is
$650\ \text{m}^2$; the units are required. Follow through from their answer in part (a).

Examiners report

[N/A]

22c. *[2 marks]*

Markscheme

Volume $= 649.519\ldots \times 120$ ***(M1)***
$= 77900\ \text{m}^3$ (
$77942.2\ldots\ \text{m}^3$) ***(A1)(G2)***

Note: The answer is
$77900\ \text{m}^3$; the units are required. Do not penalise lack of units if already penalized in part (b). Accept
$78000\ \text{m}^3$ from use of 3sf answer
$650\ \text{m}^2$ from part (b).

Examiners report

[N/A]

22d. *[2 marks]*

Markscheme

$\text{CQ}^2 = 50^2 + 120^2$ ***(M1)***
$\text{CQ} = 130\ (\text{m})$ ***(A1)(G2)***

Note: The units are **not** required.

Examiners report

[N/A]

22e. *[2 marks]*

Markscheme

$\tan \mathrm{QCB} = \frac{120}{50}$ ***(M1)***

Note: Award ***(M1)*** for correct substituted trig formula.

$\mathrm{QCB} = 67.4^\circ$ (
$67.3801\ldots$) ***(A1)(G2)***

Note: Accept equivalent methods.

Examiners report

[N/A]

23a. *[7 marks]*

Markscheme

(i)
$\mathrm{Area} = \pi(5)^2$ ***(M1)***
$= 78.5\ (\mathrm{cm}^2)$ (
$78.5398\ldots$) ***(A1)(G2)***

Note: Accept
25π .

(ii)
$8000 = 78.5398\ldots \times h$ ***(M1)***
$h = 102\ (\mathrm{cm})$ (
$101.859\ldots$) ***(A1)*****(ft)*****(G2)***

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

(iii)
$\mathrm{Area} = \pi(5)^2 + 2\pi(5)(101.859\ldots)$ ***(M1)(M1)***

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

$= 3280\ (\mathrm{cm}^2)$ (
$3278.53\ldots$) ***(A1)*****(ft)*****(G2)***

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

Examiners report

[N/A]

23b. *[2 marks]*

Markscheme

No, it is too tall/narrow. ***(A1)*****(ft)*****(R1)***

Note: Follow through from their value for
h.

Examiners report

[N/A]

23c. *[1 mark]*

Markscheme

$8000 = \pi r^2 h$ ***(A1)***

Examiners report

[N/A]

23d. *[2 marks]*

Markscheme

$A = \pi r^2 + 2\pi r\left(\frac{8000}{\pi r^2}\right)$ ***(A1)(M1)***

Note: Award ***(A1)*** for correct rearrangement of **their** part (c), ***(M1)*** for substitution of **their** rearrangement into area formula.

$= \pi r^2 + \frac{16000}{r}$ ***(AG)***

Examiners report

[N/A]

23e. *[3 marks]*

Markscheme

$\frac{\mathrm{d}A}{\mathrm{d}r} = 2\pi r - 16000r^{-2}$ ***(A1)(A1)(A1)***

Note: Award ***(A1)*** for
$2\pi r$, ***(A1)*** for
-16000 ***(A1)*** for
r^{-2} . If an extra term is present award at most ***(A1)(A1)(A0)***.

Examiners report

[N/A]

23f. *[5 marks]*

Markscheme

(i)

$\frac{dA}{dr} = 0$ ***(M1)***

$2\pi r^3 - 16000 = 0$ ***(M1)***

$r = 13.7$ cm ($13.6556\ldots$) ***(A1)*****(ft)**

Note: Follow through from their part (e).

(ii)

$h = \frac{8000}{\pi(13.65\ldots)^2}$ ***(M1)***

$= 13.7$ cm ($13.6556\ldots$) ***(A1)*****(ft)**

Note: Accept 13.6 if 13.7 used.

Examiners report

[N/A]

23g. *[2 marks]*

Markscheme

Yes or No, accompanied by a consistent and sensible reason. ***(A1)(R1)***

Note: Award ***(A0)(R0)*** if no reason is given.

Examiners report

[N/A]

24. *[3 marks]*

Markscheme

$2\pi r + 4r + 4l$ ***(A1)(A1)(A1)***

Notes: Award ***(A1)*** for $2\pi r$ (“π” must be seen), ***(A1)*** for $4r$, ***(A1)*** for $4l$. Accept equivalent forms. Accept $T = 2\pi r + 4r + 4l$. Award a maximum of ***(A1)(A1)(A0)*** if extra terms are seen.

[3 marks]

Examiners report

[N/A]