SL Paper 1

a. The equation of the straight line L_1 is $y = 2x - 3$. [1]

Write down the y-intercept of L_1 .

b. Write down the gradient of L_1 . [1]

c. The line L_2 is parallel to L_1 and passes through the point $(0,\ 3)$. [1]

Write down the equation of L_2 .

d. The line L_3 is perpendicular to L_1 and passes through the point $(-2,\ 6)$. [1]

Write down the gradient of L_3.

e. Find the equation of L_3 . Give your answer in the form $ax + by + d = 0$, where a , b and d are integers. [2]

Markscheme

a. $(0,\ -3)$ ***(A1)*** ***(C1)***

Note: Accept -3 or $y = -3$.

b. 2 ***(A1)*** ***(C1)***

c. $y = 2x + 3$ ***(A1)*(ft)** ***(C1)***

Note: Award ***(A1)*(ft)** for correct equation. Follow through from part (b)
Award ***(A0)*** for $L_2 = 2x + 3$.

d. $-\frac{1}{2}$ ***(A1)*(ft)** ***(C1)***

Note: Follow through from part (b).

e. $6 = -\frac{1}{2}(-2) + c$ ***(M1)***

$c = 5$ (may be implied)

OR

$y - 6 = -\frac{1}{2}(x + 2)$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of their gradient in part (d) and the point $(-2,\ 6)$. Follow through from part (d).

$x + 2y - 10 = 0$ (or any integer multiple) ***(A1)*(ft)** ***(C2)***

Note: Follow through from (d). The answer must be in the form $ax + by + d = 0$ for the ***(A1)*(ft)** to be awarded. Accept any integer multiple.

Examiners report

a. Question 12: Linear function.

Many candidates demonstrated a good understanding of linear functions so successfully found the y-intercepts, gradient and equation in the form $y = mx + c$. However only the very best were able to rewrite this in the form $ax + by + d = 0$ where a, b and d are integers.

b. Question 12: Linear function.

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e. Question 12: Linear function.

Many candidates demonstrated a good understanding of linear functions so successfully found the y-intercepts, gradient and equation in the form $y = mx + c$. However only the very best were able to rewrite this in the form $ax + by + d = 0$ where a, b and d are integers.

The equation of a line L_1 is $2x + 5y = -4$.

a. Write down the gradient of the line L_1. [1]

b. A second line L_2 is perpendicular to L_1. [1]

Write down the gradient of L_2.

c. The point (5, 3) is on L_2. [2]

Determine the equation of L_2.

d. Lines L_1 and L_2 intersect at point P. [2]

Using your graphic display calculator or otherwise, find the coordinates of P.

Markscheme

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

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

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

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

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

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

OR

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

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

d. (3, –2) ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

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

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

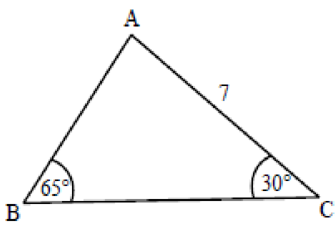
Triangle ABC is such that AC is 7 cm, angle ABC is 65° and angle ACB is 30°.

a. Sketch the triangle writing in the side length and angles. [1]

b. Calculate the length of AB. [2]

c. Find the area of triangle ABC. [3]

Markscheme

a. 

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

Note: ***(A1)*** for fully labelled sketch.

[1 mark]

b. *Unit penalty **(UP)** may apply in this question.*

$\frac{\mathrm{AB}}{\sin 30} = \frac{7}{\sin 65}$ ***(M1)***

(UP) $\mathrm{AB} = 3.86\ \mathrm{cm}$ ***(A1)*(ft)** ***(C2)***

Note: ***(M1)*** for use of sine rule with correct values substituted.

[2 marks]

c. *Unit penalty **(UP)** may apply in this question.*

$\text{Angle BAC} = 85^\circ$ ***(A1)***

Area $= \frac{1}{2} \times 7 \times 3.86 \times \sin 85°$ ***(M1)***

(UP) $= 13.5 \text{ cm}^2$ ***(A1)*(ft)** ***(C3)***

[3 marks]

Examiners report

a. The triangle was drawn correctly by most and a majority correctly found the length of AB - a few did not write down the units (cm) and so lost a Unit penalty mark. There was still a significant number who tried to use right-angled trigonometry to find the length.

Finding the area of the triangle was mixed with many again assuming the existence of a right angle. Some candidates had their calculators in radian mode rather than degree mode.

b. The triangle was drawn correctly by most and a majority correctly found the length of AB - a few did not write down the units (cm) and so lost a Unit penalty mark. There was still a significant number who tried to use right-angled trigonometry to find the length.

Finding the area of the triangle was mixed with many again assuming the existence of a right angle. Some candidates had their calculators in radian mode rather than degree mode.

c. The triangle was drawn correctly by most and a majority correctly found the length of AB - a few did not write down the units (cm) and so lost a Unit penalty mark. There was still a significant number who tried to use right-angled trigonometry to find the length.

Finding the area of the triangle was mixed with many again assuming the existence of a right angle. Some candidates had their calculators in radian mode rather than degree mode.

The equation of the line R_1 is $2x + y - 8 = 0$. The line R_2 is perpendicular to R_1 .

a. Calculate the gradient of R_2 . [2]

b. The point of intersection of R_1 and R_2 is $(4, k)$. [4]

Find

(i) the value of k ;

(ii) the equation of R_2 .

Markscheme

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

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

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

[2 marks]

b. (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.

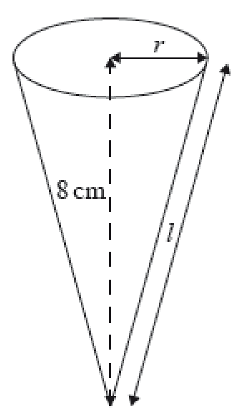
[4 marks]

Examiners report

a. 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.

b. 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.

A type of candy is packaged in a right circular cone that has volume $100\ \mathrm{cm}^3$ and vertical height 8 cm.



a. Find the radius, r, of the circular base of the cone. [2]

b. Find the slant height, l, of the cone. [2]

c. Find the curved surface area of the cone. [2]

Markscheme

a. $100 = \frac{1}{3}\pi r^2(8)$ ***(M1)***

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

$r = 3.45\ (\text{cm})\ \ (3.45494\ldots\ (\text{cm}))$ ***(A1)*** ***(C2)***

[2 marks]

b. $l^2 = 8^2 + (3.45494\ldots)^2$ ***(M1)***

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

$l = 8.71\ (\text{cm})\ \ (8.71416\ldots\ (\text{cm}))$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. $\pi \times 3.45494\ldots \times 8.71416\ldots$ ***(M1)***

Note: Award ***(M1)*** for their correct substitutions into curved surface area of a cone formula.

$= 94.6\ \text{cm}^2\ (94.5836\ldots\ \text{cm}^2)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from parts (a) and (b). Accept $94.4\ \text{cm}^2$ from use of 3 sf values.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The straight line, L_1, has equation $y = -2x + 5$.

a. Write down the gradient of L_1 . [1]

b. Line L_2, is perpendicular to line L_1, and passes through the point (4, 5) . [3]

(i) Write down the gradient of L_2 .

(ii) Find the equation of L_2 .

c. Line L_2, is perpendicular to line L_1, and passes through the point (4, 5) . [2]

Write down the coordinates of the point of intersection of L_1 and L_2 .

Markscheme

a. –2 ***(A1)*** ***(C1)***

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

[1 mark]

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

Note: Follow through from their part (a).

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

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

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

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

OR

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

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

[3 marks]

c. (0.8, 3.4) or $\left(\frac{4}{5}, \frac{17}{5}\right)$ ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

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

[2 marks]

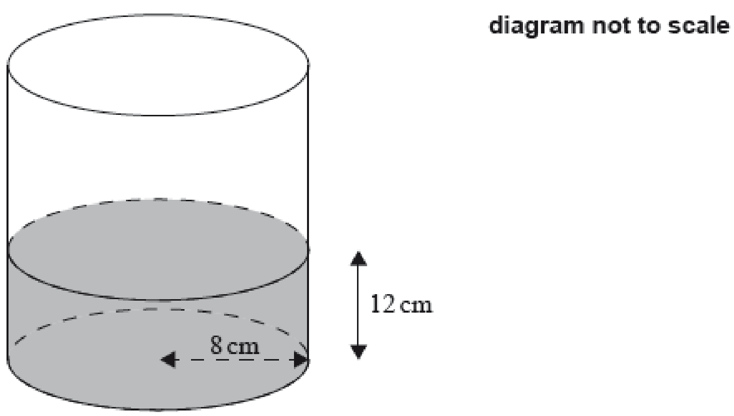
Examiners report

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

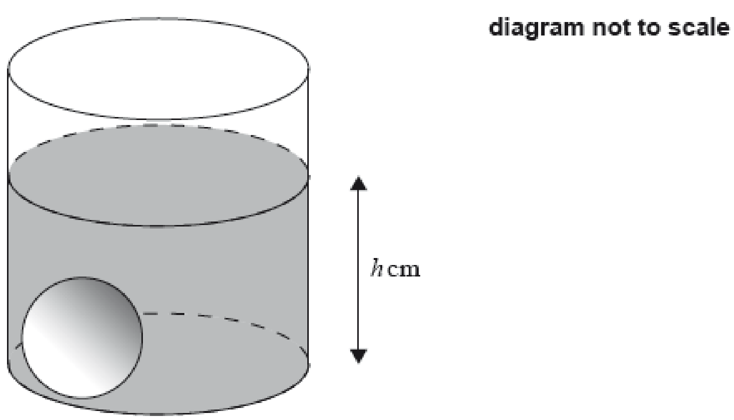
b. The majority of candidates were able to write down the gradient of the straight line in part (a) but a correct answer for the gradient of the perpendicular proved to be more elusive in part (b)(i). Many however recovered in the remainder of the question as they were able to find the equation of a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

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

A cylindrical container with a radius of 8 cm is placed on a flat surface. The container is filled with water to a height of 12 cm, as shown in the following diagram.



A heavy ball with a radius of 2.9 cm is dropped into the container. As a result, the height of the water increases to h cm, as shown in the following diagram.



a. Find the volume of water in the container. [2]

b. Find the value of h. [4]

Markscheme

a. $\pi \times 8^2 \times 12$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the volume of a cylinder formula.

$2410\ \mathrm{cm}^3\ (2412.74\ldots\ \mathrm{cm}^3,\ 768\pi\ \mathrm{cm}^3)$ ***(A1)*** ***(C2)***

[2 marks]

b. $\frac{4}{3}\pi \times 2.9^3 + 768\pi = \pi \times 8^2 h$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correct substitution into the volume of a sphere formula (this may be implied by seeing 102.160…), ***(M1)*** for adding their volume of the ball to their part (a), ***(M1)*** for equating **a** volume to the volume of a cylinder with a height of h.

OR

$\frac{4}{3}\pi \times 2.9^3 = \pi \times 8^2(h - 12)$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correct substitution into the volume of a sphere formula (this may be implied by seeing 102.160…), ***(M1)*** for equating to the volume of a cylinder, ***(M1)*** for the height of the water level increase, $h - 12$. Accept h for $h - 12$ if adding 12 is implied by their answer.

$(h =)\ 12.5\ (\mathrm{cm})\ \ (12.5081\ldots\ (\mathrm{cm}))$ ***(A1)*****(ft)** ***(C4)***

Note: If 3 sf answer used, answer is 12.5 (12.4944…). Follow through from part (a) if first method is used.

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

P (4, 1) and Q (0, –5) are points on the coordinate plane.

a. Determine the [4]

(i) coordinates of *M*, the midpoint of *P* and *Q*.

(ii) gradient of the line drawn through *P* and *Q*.

(iii) gradient of the line drawn through *M*, perpendicular to *PQ*.

b. The perpendicular line drawn through *M* meets the *y*-axis at *R* (0, *k*). [2]

Find *k*.

Markscheme

a. (i) (2, – 2) *parentheses not required.* ***(A1)***

(ii) gradient of PQ $= \left(\frac{-5-1}{0-4}\right) = \frac{6}{4} = \frac{3}{2}(1.5)$ ***(M1)(A1)***

(M1) *for gradient formula with correct substitution*

Award ***(A1)*** *for* $y = \frac{3}{2}x - 5$ *with no other working*

(iii) gradient of perpendicular is $-\frac{2}{3}$ ***(A1)*(ft)** ***(C4)***

[4 marks]

b. $\left(\frac{k+2}{0-2}\right) = -\frac{2}{3}, k = -\frac{2}{3}$ **or** $y = -\frac{2}{3}x + c, c = -\frac{2}{3} \therefore k = -\frac{2}{3}$ ***(M1)(A1)*(ft)**

Allow $(0, -\frac{2}{3})$

(M1) *is for equating gradients or substituting gradient into* $y = mx + c$ ***(C2)***

[2 marks]

Examiners report

a. There were some good answers, but many candidates showed a shaky understanding of coordinate geometry and some difficulty in dealing with negative numbers. Evidently a favourite question for some centres that consistently scored high marks here.

a) This was done quite well by most candidates with the main errors being reversal of the x, y values in the formula and using the negative, rather than the negative reciprocal for the perpendicular.

b. There were some good answers, but many candidates showed a shaky understanding of coordinate geometry and some difficulty in dealing with negative numbers. Evidently a favourite question for some centres that consistently scored high marks here.

b) Poorly answered though many candidates did gain a mark by substituting the correct value for gradient into $y = mx + c$.

The area of a circle is equal to 8 cm^2.

a. Find the radius of the circle. [2]

b. This circle is the base of a **solid** cylinder of height 25 cm. [1]

Write down the volume of the **solid** cylinder.

c. This circle is the base of a **solid** cylinder of height 25 cm. [3]

Find the **total** surface area of the **solid** cylinder.

Markscheme

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

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

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

[2 marks]

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

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

[1 mark]

c. Surface area = 16 + 2π(1.59576...)25 ***(M1)(M1)***

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

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

Note: Follow through from their part (a).

[3 marks]

Examiners report

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

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

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Triangle ABC is drawn such that angle ABC is 90°, angle ACB is 60° and AB is 7.3 cm.

a. (i) Sketch a diagram to illustrate this information. Label the points A, B, C. Show the angles 90°, 60° and the length 7.3 cm on your diagram. [3]

(ii) Find the length of BC.

b. Point D is on the straight line AC extended and is such that angle CDB is 20°. [3]

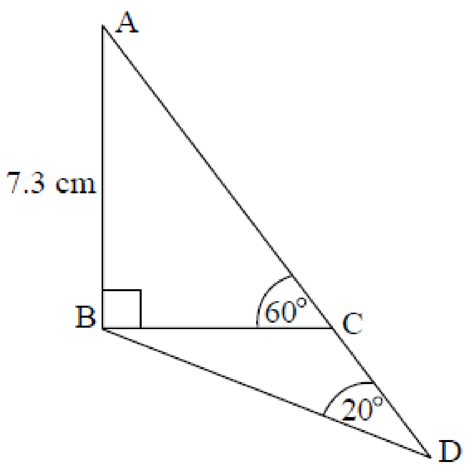
(i) Show the point D and the angle 20° on your diagram.

(ii) Find the size of angle CBD.

Markscheme

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

(i)



(A1)

For A, B, C, 7.3, 60°, 90°, shown in correct places ***(A1)***

Note: The 90° should look like 90° (allow $\pm 10^\circ$)

(ii) Using $\tan 60$ or $\tan 30$ ***(M1)***

(UP) 4.21 cm ***(A1)*****(ft)**

Note: (ft) on their diagram

Or

Using sine rule with their correct values ***(M1)***

(UP) $= 4.21\text{ cm}$ ***(A1)*****(ft)**

Or

Using special triangle $\frac{7.3}{\sqrt{3}}$ ***(M1)***

(UP) 4.21 cm ***(A1)*****(ft)**

Or

Any other valid solution

Note: If A and B are swapped then $\mathrm{BC} = 8.43\text{ cm}$ ***(C3)***

[3 marks]

b. (i) For ACD in a straight line and all joined up to B, for 20° shown in correct place and D labelled. D must be on AC extended. ***(A1)***

(ii) $\mathrm{B\hat{C}D} = 120^{\circ}$ ***(A1)***

$\mathrm{C\hat{B}D} = 40^{\circ}$ ***(A1)*** ***(C3)***

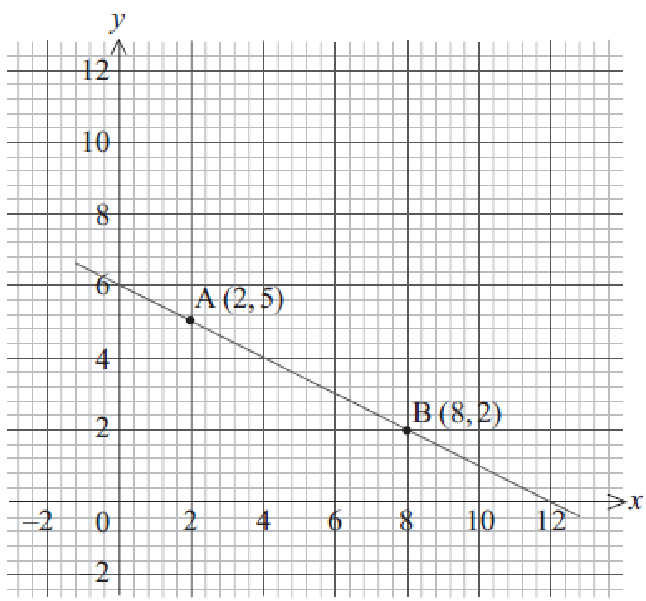
[3 marks]

Examiners report

a. The initial diagram was well drawn by most candidates but few could extend AC to find D. The point D was either drawn between A and C or on CA extended. When on CA extended the candidates could be awarded $\mathrm{A1}$ follow through for the angle. A surprising number of candidates could not find the correct answer for the length of BC.

b. The initial diagram was well drawn by most candidates but few could extend AC to find D. The point D was either drawn between A and C or on CA extended. When on CA extended the candidates could be awarded $\mathrm{A1}$ follow through for the angle. A surprising number of candidates could not find the correct answer for the length of BC.

A and B are points on a straight line as shown on the graph below.



a. Write down the *y*-intercept of the line AB. [1]

b. Calculate the gradient of the line AB. [2]

c. The acute angle between the line AB and the *x*-axis is *θ*. [1]

Show *θ* on the diagram.

d. The acute angle between the line AB and the *x*-axis is *θ*. [2]

Calculate the size of *θ*.

Markscheme

a. 6

OR

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

[1 mark]

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

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

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

[2 marks]

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

[1 mark]

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

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

Note: (ft) from (b).

Accept alternative correct trigonometrical methods.

[2 marks]

Examiners report

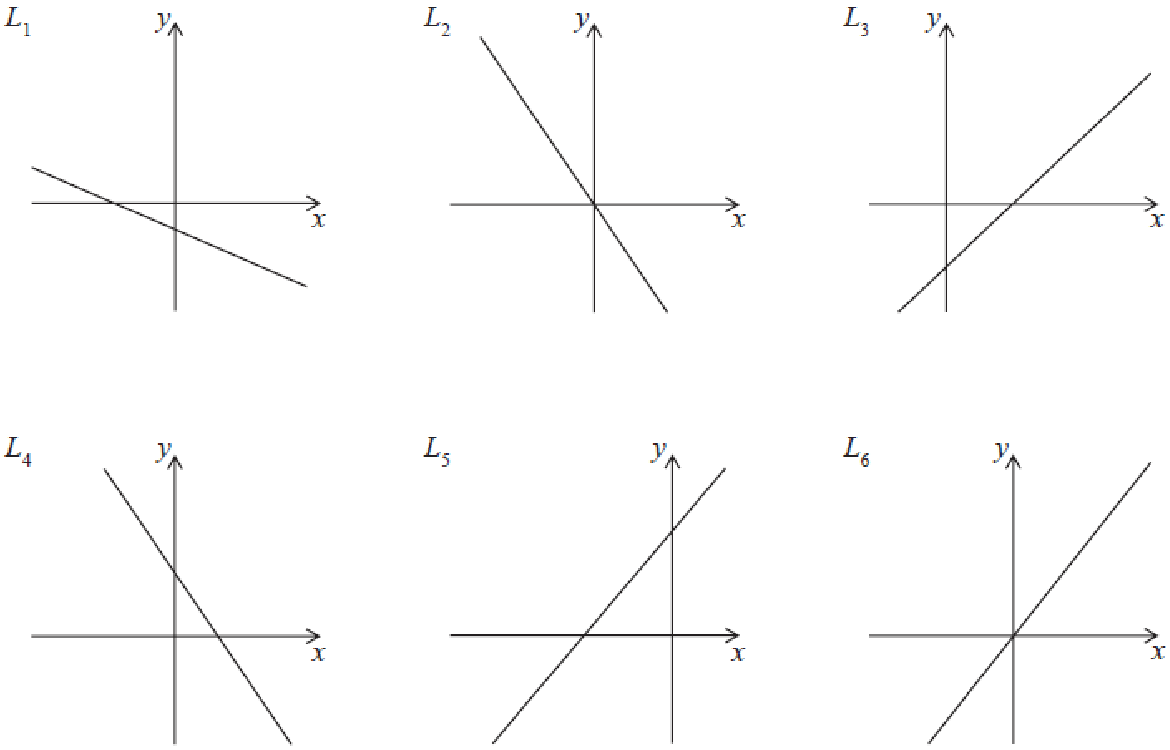
a. This was generally well answered.

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

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

d. [N/A]

The following diagrams show six lines with equations of the form *y* =*mx* +*c*.



In the table below there are four possible conditions for the pair of values *m* and *c*. Match each of the given conditions with one of the lines drawn above.

Condition	Line
$m>0$ and $c>0$	
$m<0$ and $c>0$	
$m<0$ and $c<0$	
$m>0$ and $c<0$	

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.

---

a. A ladder is standing on horizontal ground and leaning against a vertical wall. The length of the ladder is 4.5 metres. The distance between the bottom of the ladder and the base of the wall is 2.2 metres. [1]

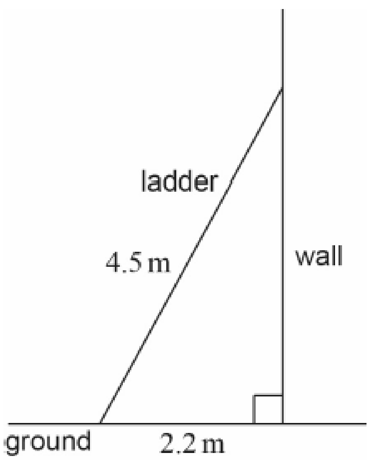
Use the above information to sketch a labelled diagram showing the ground, the ladder and the wall.

b. Calculate the distance between the top of the ladder and the base of the wall. [2]

c. Calculate the **obtuse** angle made by the ladder with the ground. [3]

Markscheme

a.



(A1) (C1)

Notes: Award ***(A1)*** for drawing an approximately right angled triangle, with correct labelling of the distances $4.5\ (\mathrm{m})$ and $2.2\ (\mathrm{m})$.

b. $\sqrt{4.5^2 - 2.2^2}$ (accept eqivalent eg $d^2 + 2.2^2 = 4.5^2$) ***(M1)***

$= 3.93\ (\mathrm{m})\ \left(\sqrt{15.41}\ (\mathrm{m}),\ 3.92555...\ (\mathrm{m})\right)$ ***(A1) (C2)***

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

c. $180^\circ - \cos^{-1}\left(\frac{2.2}{4.5}\right)$ ***(M1)(M1)***

OR

$180^\circ - \tan^{-1}\left(\frac{3.92555...}{2.2}\right)$ ***(M1)(M1)***

OR

$180^\circ - \sin^{-1}\left(\frac{3.92555...}{4.5}\right)$ ***(M1)(M1)***

Note: Award ***(M1)*** for a correct substitution in the correct trigonometric ratio.
Award ***(M1)*** for subtraction from 180° (this may be implied if the sum of their inverse of the trigonometric ratio and their final answer equals 180).

$= 119^\circ\ (119.267...^\circ)$ ***(A1)*(ft) *(C3)***

Note: Follow through from their part (b) if cosine is not used. Accept $119.239...$ or $119.151...$ from use of 3 sf values.

Examiners report

a. Question 3: Right angle trigonometry.

   Candidates sketched the ladder leaning against the wall and recognized that Pythagoras' theorem was needed to find the distance between the top of the ladder and the base of the wall (but not always correctly). Although it was a right triangle a number of the candidates used the law of sines (instead of Pythagoras' theorem) and law of cosines (instead of a trigonometry ratio). Many candidates failed to find the obtuse angle made by the ladder with the ground even though the word obtuse was in bold type in the question.

b. Question 3: Right angle trigonometry.

   Candidates sketched the ladder leaning against the wall and recognized that Pythagoras' theorem was needed to find the distance between the top of the ladder and the base of the wall (but not always correctly). Although it was a right triangle a number of the candidates used the law of sines (instead of Pythagoras' theorem) and law of cosines (instead of a trigonometry ratio). Many candidates failed to find the obtuse angle made by the ladder with the ground even though the word obtuse was in bold type in the question.

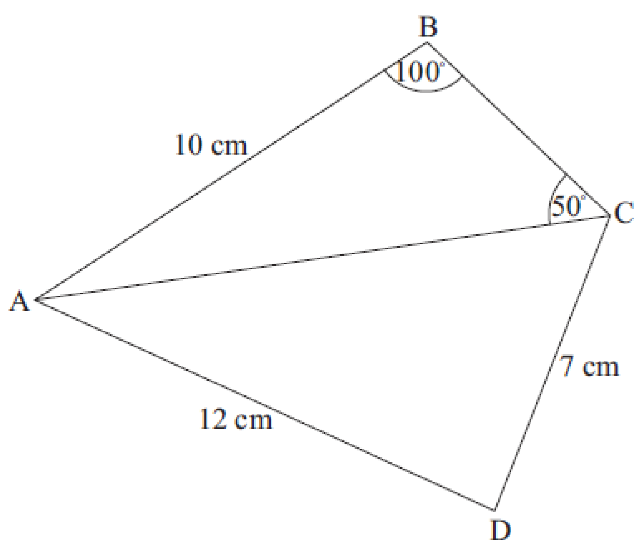
c. Question 3: Right angle trigonometry.

   Candidates sketched the ladder leaning against the wall and recognized that Pythagoras' theorem was needed to find the distance between the top of the ladder and the base of the wall (but not always correctly). Although it was a right triangle a number of the candidates used the law of sines (instead of Pythagoras' theorem) and law of cosines (instead of a trigonometry ratio). Many candidates failed to find the obtuse angle made by the ladder with the ground even though the word obtuse was in bold type in the question.

The quadrilateral ABCD has AB = 10 cm, AD = 12 cm and CD = 7 cm.

The size of angle ABC is 100° and the size of angle ACB is 50 °.

diagram not to scale



a. Find the length of AC in centimetres. [3]

b. Find the size of angle ADC. [3]

Markscheme

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

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

$= 12.9(12.8557...)$ ***(A1)*** ***(C3)***

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

b. $\frac{12^2+7^2-12.8557...^2}{2\times12\times7}$ ***(M1)(A1)*****(ft)**

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

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

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

Examiners report

a. [N/A]
b. [N/A]

The straight line, L_1, has equation $2y - 3x = 11$. The point A has coordinates (6, 0).

a. Give a reason why L_1 **does not** pass through A. [1]

b. Find the gradient of L_1. [2]

c. L_2 is a line perpendicular to L_1. The equation of L_2 is $y = mx + c$. [1]

Write down the value of m.

d. L_2 **does** pass through A. [2]

Find the value of c.

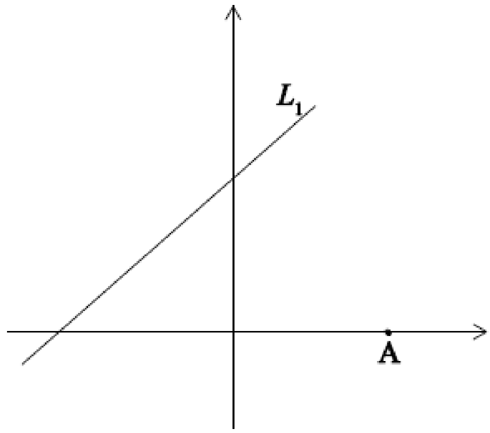
Markscheme

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

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

OR

Clear sketch of L_1 and A.



(R1)

OR

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

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

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

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

Note: Do not accept 1.5*x*.

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

Notes: Follow through from their part (b).

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

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

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

Note: Follow through from part (c).

Examiners report

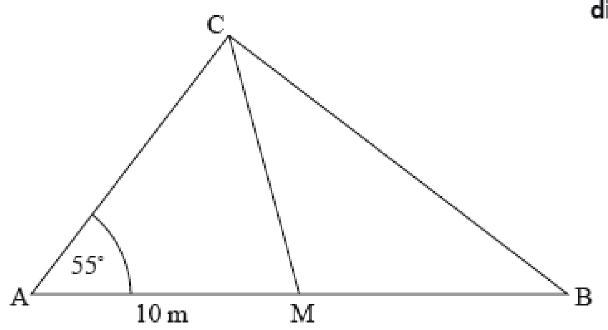
a. There were multiple acceptable reasons why the line did not pass through a given point (including numerically substituting values in the equation; drawing a graph or algebraically finding the *x*-intercept of the line). This was one of two reasoning marks in the paper.

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

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

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

The diagram shows a triangle ABC. The size of angle $\mathrm{C\hat{A}B}$ is 55° and the length of AM is 10 m, where M is the midpoint of AB. Triangle CMB is isosceles with $\mathrm{CM} = \mathrm{MB}$.



a. Write down the length of MB. [1]

b. Find the size of angle $\mathrm{C\hat{M}B}$. [2]

c. Find the length of CB. [3]

Markscheme

a. 10 m ***(A1)(C1)***

b. $\mathrm{A\hat{M}C} = 70^\circ$ **OR** $\mathrm{A\hat{C}M} = 55^\circ$ ***(A1)***

$\mathrm{C\hat{M}B} = 110^\circ$ ***(A1)*** ***(C2)***

c. $\mathrm{CB}^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \times \cos 110^\circ$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution into the cosine rule formula, ***(A1)*****(ft)** for correct substitution. Follow through from their answer to part (b).

OR

$\frac{\mathrm{CB}}{\sin 110^\circ} = \frac{10}{\sin 35^\circ}$ ***(M1)(A1)*****(ft)**

Notes: Award ***(M1)*** for substitution into the sine rule formula, ***(A1)*****(ft)** for correct substitution. Follow through from their answer to part (b).

OR

$\mathrm{A\hat{C}B} = 90^\circ$ ***(A1)***

$\sin 55^\circ = \frac{\mathrm{CB}}{55}$ **OR** $\cos 35^\circ = \frac{\mathrm{CB}}{20}$ ***(M1)***

Note: Award ***(A1)*** for some indication that $\mathrm{A\hat{C}B} = 90^\circ$, ***(M1)*** for correct trigonometric equation.

OR

Perpendicular MN is drawn from M to CB. ***(A1)***

$\frac{\frac{1}{2}\mathrm{CB}}{10} = \cos 35^\circ$ ***(M1)***

Note: Award ***(A1)*** for some indication of the perpendicular bisector of BC, ***(M1)*** for correct trigonometric equation.

$\text{CB} = 16.4\ (\text{m}) \quad (16.3830\ldots\ (\text{m}))$ ***(A1)(ft)(C3)***

Notes: Where a candidate uses $\text{C}\hat{\text{M}}\text{B} = 90^\circ$ and finds $\text{CB} = 14.1\ (\text{m})$ award, at most, ***(M1)(A1)(A0)***.

Where a candidate uses $\text{C}\hat{\text{M}}\text{B} = 60^\circ$ and finds $\text{CB} = 10\ (\text{m})$ award, at most, ***(M1)(A1)(A0)***.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The coordinates of point A are $(-4, p)$ and the coordinates of point B are $(2, -3)$.

The mid-point of the line segment AB, has coordinates $(q, 1)$.

a. Find the value of [4]

(i) q ;

(ii) p .

b. Calculate the distance AB. [2]

Markscheme

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

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

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

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

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

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

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

[4 marks]

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

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

$\text{AB} = 10$ ***(A1)(ft)*** ***(C2)***

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

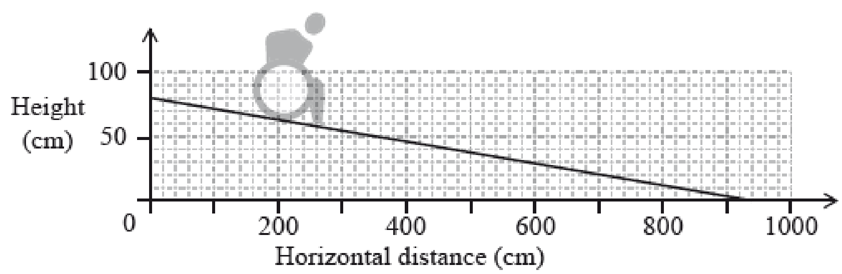
[2 marks]

Examiners report

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

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

The diagram shows a wheelchair ramp, A, designed to descend from a height of 80 cm.

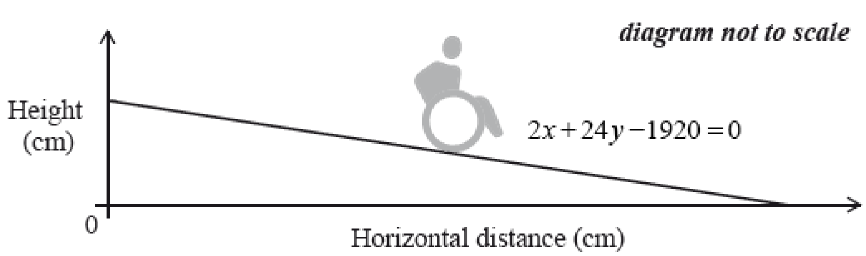


a. Use the diagram above to calculate the gradient of the ramp. [1]

b. The gradient for a **safe** descending wheelchair ramp is $-\frac{1}{12}$. [1]

Using your answer to part (a), comment on why wheelchair ramp A is **not safe**.

c. The equation of a second wheelchair ramp, B, is $2x + 24y - 1920 = 0$. [4]



(i) Determine whether wheelchair ramp B is safe or not. Justify your answer.

(ii) Find the horizontal distance of wheelchair ramp B.

Markscheme

a. $-\frac{80}{940}$ $\left(-0.0851, -0.085106\ldots, -\frac{4}{47}\right)$ ***(A1)*** ***(C1)***

[1 mark]

b. $-0.0851\ (-0.085106\ldots) < -\frac{1}{12}(-0.083333\ldots)$ ***(A1)*(ft)** ***(C1)***

Notes: Accept "less than" in place of inequality.

Award ***(A0)*** if incorrect inequality seen.

Follow through from part (a).

[1 mark]

c. (i) ramp B is safe ***(A1)***

the gradient of ramp B is $-\frac{1}{12}$ ***(R1)***

Notes: Award ***(R1)*** for "the gradient of ramp B is $-\frac{1}{12}$" seen.

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

(ii) $2x = 1920$ ***(M1)***

Note: Accept alternative methods.

$960\ (\mathrm{cm})$ ***(A1)*** ***(C4)***

[4 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

In the diagram, $\mathrm{B\hat{A}C} = 90^\circ$. The length of the three sides are x cm, $(x + 7)$ cm and $(x + 8)$ cm.

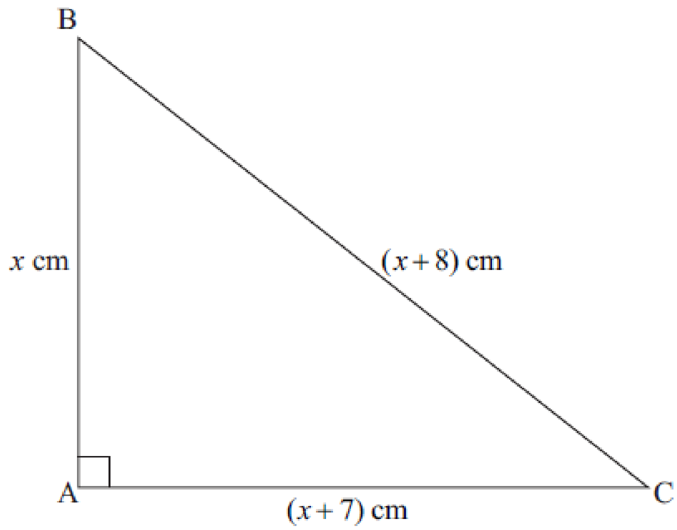


diagram not to scale

a. Write down and **simplify** a quadratic equation in x which links the three sides of the triangle. [3]

b. Solve the quadratic equation found in part (a). [2]

c. Write down the value of the perimeter of the triangle. [1]

Markscheme

a. $(x+8)^2=(x+7)^2+x^2$ ***(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]

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

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

[2 marks]

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

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

[1 mark]

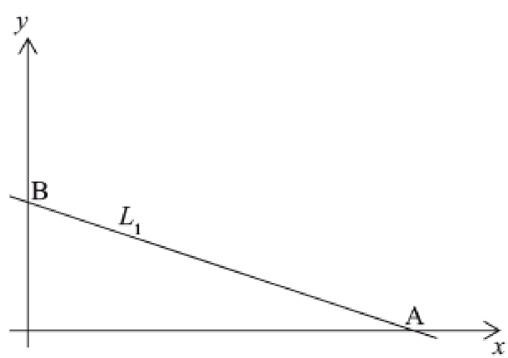
Examiners report

a. 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).

b. 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).

c. 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).

The diagram shows the straight line L_1, which intersects the x-axis at $\mathrm{A}(6,\ 0)$ and the y-axis at $\mathrm{B}(0,\ 2)$.



a. Write down the coordinates of M, the midpoint of line segment AB. [2]

b. Calculate the gradient of L_1. [2]

c. The line L_2 is parallel to L_1 and passes through the point $(3,\ 2)$. [2]

Find the equation of L_2. Give your answer in the form $y = mx + c$.

Markscheme

a. $(3,\ 1)$ ***(A1)(A1)*** ***(C2)***

Note: Accept $x = 3$, $y = 1$. Award ***(A0)(A1)*** if parentheses are missing.

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

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

$= -\frac{1}{3}(-0.333333\ldots)$ ***(A1)*** ***(C2)***

Note: Accept $-\frac{2}{6}$.

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

OR

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

Note: Award ***(M1)*** for substitution of their gradient from part (b).

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

Note: Follow through from part (b).

The answer must be an equation in the form $y = mx + c$ for the ***(A1)*****(ft)** to be awarded.

Examiners report

a. Parts (a), finding the midpoint, and (b) finding the gradient, of this question were done well by the majority of candidates.

b. Parts (a), finding the midpoint, and (b) finding the gradient, of this question were done well by the majority of candidates. Some candidates substituted incorrectly into the gradient formula or reversed the numerator and denominator.

c. There was a significant number of candidates who calculated the equation of the normal to the given line and not the equation of a parallel line. It seemed those candidates answered the question they expected and not the question asked.

A straight line, L_1 , has equation $x + 4y + 34 = 0$.

a. Find the gradient of L_1 . [2]

b. The equation of line L_2 is $y = mx$. L_2 is perpendicular to L_1 . [2]

Find the value of m.

c. The equation of line L_2 is $y = mx$. L_2 is perpendicular to L_1 . [2]

Find the coordinates of the point of intersection of the lines L_1 and L_2 .

Markscheme

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

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

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

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

[2 marks]

c. *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

a. The omission of the negative sign was a common fault.

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

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

---

a. The equation of line L_1 is $y = 2.5x + k$. Point $\mathrm{A}\ \ (3,\ -2)$ lies on L_1. [2]

Find the value of k.

b. The line L_2 is perpendicular to L_1 and intersects L_1 at point A. [1]

Write down the gradient of L_2.

c. Find the equation of L_2. Give your answer in the form $y = mx + c$. [2]

d. Write your answer to part (c) in the form $ax + by + d = 0$ where a, b and $d \in \mathbb{Z}$. [1]

Markscheme

a. $-2 = 2.5\ \times 3 + k$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of $(3,\ -2)$ into equation of L_1.

$(k =) - 9.5$ ***(A1) (C2)***

b. $-0.4\ \left(-\frac{2}{5}\right)$ ***(A1)*** ***(C1)***

c. $y - (-2) = -0.4\,(x - 3)$ ***(M1)***

OR

$-2 = -0.4\,(3) + c$ ***(M1)***

Note: Award ***(M1)*** for their gradient and given point substituted into equation of a straight line. Follow through from part (b).

$y = -0.4x - 0.8$ $\left(y = -\frac{2}{5}x - \frac{4}{5}\right)$ ***(A1)*****(ft)** ***(C2)***

d. $2x + 5y + 4 = 0$ (or any integer multiple) ***(A1)*****(ft)** ***(C1)***

Note: Follow through from part (c).

Examiners report

a. Question 7: Perpendicular Line

The response to this question was mixed.

Part (a) was well attempted by the majority.

b. In part (b), the gradient was not fully calculated (being left as a reciprocal) by a large number of candidates.

c. In part (c), the common error was the use of c from part (a) in the line.

d. In part (d), the notation for integer was not understood by a large number of candidates.

The straight line, L_1, has equation $y = -\frac{1}{2}x - 2$.

a. Write down the *y* intercept of L_1. [1]

b. Write down the gradient of L_1. [1]

c. The line L_2 is perpendicular to L_1 and passes through the point (3, 7). [1]

Write down the gradient of the line L_2.

d. The line L_2 is perpendicular to L_1 and passes through the point (3, 7). [3]

Find the equation of L_2. Give your answer in the form $ax + by + d = 0$ where $a,\ b,\ d \in \mathbb{Z}$.

Markscheme

a. –2 ***(A1)*** ***(C1)***

Note: Accept (0, –2).

[1 mark]

b. $-\frac{1}{2}$ ***(A1)*** ***(C1)***

[1 mark]

c. 2 ***(A1)*****(ft)** ***(C1)***

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

[1 mark]

d. $y = 2x + c$ (*can be implied*)

$7 = 2 \times 3 + c$ ***(M1)***

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

$y = 2x + 1$

Notes: Award ***(M1)*** for substitution of (3, 7), ***(A1)*****(ft)** for c.

Follow through from their answer to part (c).

OR

$y - 7 = 2(x - 3)$ ***(M1)(M1)***

Note: Award ***(M1)*** for substitution of their answer to part (c), ***(M1)*** for substitution of (3, 7).

$2x - y + 1 = 0$ **or** $-2x + y - 1 = 0$ ***(A1)*****(ft)** ***(C3)***

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

[3 marks]

Examiners report

a. Although the first three parts of this question were well answered, with most candidates knowing how to find the y intercept, gradient of a given line and gradient of the perpendicular line, very few candidates could find the equation of the perpendicular line and correctly state it in the required form.

b. Although the first three parts of this question were well answered, with most candidates knowing how to find the y intercept, gradient of a given line and gradient of the perpendicular line, very few candidates could find the equation of the perpendicular line and correctly state it in the required form.

c. Although the first three parts of this question were well answered, with most candidates knowing how to find the y intercept, gradient of a given line and gradient of the perpendicular line, very few candidates could find the equation of the perpendicular line and correctly state it in the required form.

d. Although the first three parts of this question were well answered, with most candidates knowing how to find the y intercept, gradient of a given line and gradient of the perpendicular line, very few candidates could find the equation of the perpendicular line and correctly state it in the required form.

A hotel has a rectangular swimming pool. Its length is x metres, its width is y metres and its perimeter is 44 metres.

a. Write down an equation for x and y. [1]

b. The area of the swimming pool is $112\mathrm{m}^2$. [1]

Write down a second equation for x and y.

c. Use your graphic display calculator to find the value of x and the value of y. [2]

d. An Olympic sized swimming pool is 50 m long and 25 m wide. [2]

Determine the area of the hotel swimming pool as a percentage of the area of an Olympic sized swimming pool.

Markscheme

a. $2x + 2y = 44$ ***(A1)*** ***(C1)***

Note: Accept equivalent forms.

b. $xy = 112$ ***(A1) (C1)***

c. $8, 14$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Notes: Accept $x = 8, y = 14$ **OR** $x = 14, y = 8$

Follow through from their answers to parts (a) and (b) only if both values are positive.

d. $\frac{112}{1250} \times 100$ ***(M1)***

Note: Award ***(M1)*** for 112 divided by 1250.

$= 8.96$ ***(A1)*** ***(C2)***

Note: Do not penalize if percentage sign seen.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

A cuboid has the following dimensions: length = 8.7 cm, width = 5.6 cm and height = 3.4 cm.

a. Calculate the **exact** value of the volume of the cuboid, in cm^3. [2]

b. Write your answer to part (a) correct to [2]

(i) one decimal place;

(ii) three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10, k \in \mathbb{Z}$. [2]

Markscheme

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

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

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

b. (i) 165.6 ***(A1)*(ft)**

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

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

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

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

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

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The coordinates of the vertices of a triangle ABC are A (4, 3), B (7, –3) and C (0.5, *p*).

a. Calculate the gradient of the line AB. [2]

b, i. Given that the line AC is perpendicular to the line AB [1]

write down the gradient of the line AC.

b, ii. Given that the line AC is perpendicular to the line AB [3]

find the value of *p*.

Markscheme

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

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

[2 marks]

b, i. $m(\mathrm{AC}) = \frac{1}{2}$ ***(A1)*(ft)**

[1 mark]

b, ii. $\frac{p-3}{0.5-4} = \frac{1}{2}$ *(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

a. 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.

b, i. 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.

b, ii. 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.

The coordinates of point A are $(6,\ -7)$ and the coordinates of point B are $(-6,\ 2)$. Point M is the midpoint of AB.

L_1 is the line through A and B.

The line L_2 is perpendicular to L_1 and passes through M.

a. Find the coordinates of M. [2]

b. Find the gradient of L_1. [2]

c.i. Write down the gradient of L_2. [1]

c.ii. Write down, in the form $y = mx + c$, the equation of L_2. [1]

Markscheme

a. $(0,\ 2.5)$ **OR** $\left(0,\ -\frac{5}{2}\right)$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for 0 and ***(A1)*** for –2.5 written as a coordinate pair. Award at most ***(A1)(A0)*** if brackets are missing. Accept "$x = 0$ and $y = -2.5$".

[2 marks]

b. $\frac{2-(-7)}{-6-6}$ ***(M1)***

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

$= -\frac{3}{4}\ (-0.75)$ ***(A1)*** ***(C2)***

[2 marks]

c.i. $\frac{4}{3}\ (1.33333\ldots)$ ***(A1)*(ft)** ***(C1)***

Note: Award ***(A0)*** for $\frac{1}{0.75}$. Follow through from part (b).

[1 mark]

c.ii. $y = \frac{4}{3}x - \frac{5}{2}\ (y = 1.33\ldots x - 2.5)$ ***(A1)*(ft)** ***(C1)***

Note: Follow through from parts (c)(i) and (a). Award ***(A0)*** if final answer is not written in the form $y = mx + c$.

[1 mark]

Examiners report

a. [N/A]
b. [N/A]
c.i. [N/A]
c.ii. [N/A]

A satellite travels around the Earth in a circular orbit 500 kilometres above the Earth's surface. The radius of the Earth is taken as 6400 kilometres.

a. Write down the radius of the satellite's orbit. [1]

b. Calculate the distance travelled by the satellite in one orbit of the Earth. Give your answer correct to the nearest km. [3]

c. Write down your answer to (b) in the form $a \times 10^{k}$, where $1 \leqslant a < 10, k \in \mathbb{Z}$. [2]

Markscheme

a. 6900 km ***(A1)*** ***(C1)***

[1 mark]

b. $2\pi(6900)$ ***(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]

c. 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

a. 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.

b. 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.

c. 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.

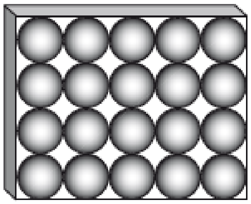
Chocolates in the shape of spheres are sold in boxes of 20.

Each chocolate has a radius of 1 cm.

a. Find the volume of 1 chocolate. [2]

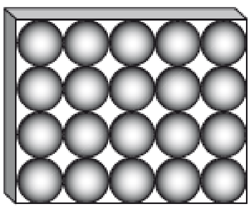
b. Write down the volume of 20 chocolates. [1]

c. The diagram shows the chocolate box from above. The 20 chocolates fit perfectly in the box with each chocolate touching the ones around it or the sides of the box. [2]



Calculate the volume of the box.

d. The diagram shows the chocolate box from above. The 20 chocolates fit perfectly in the box with each chocolate touching the ones around it or the sides of the box. [1]



Calculate the volume of empty space in the box.

Markscheme

a. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$\frac{4}{3}\pi(1)^3$ ***(M1)***

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

$= 4.19 \left(4.18879\ldots,\ \frac{4}{3}\pi\right)\ \text{cm}^3$ ***(A1)*** ***(C2)***

[2 marks]

b. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$83.8 \left(83.7758\ldots,\ \frac{80}{3}\pi\right)\ \text{cm}^3$ ***(A1)*(ft)** ***(C1)***

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

[1 mark]

c. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$10 \times 8 \times 2$ ***(M1)***

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

$= 160\ \text{cm}^3$ ***(A1)*** ***(C2)***

[2 marks]

d. ***The first time a correct answer has incorrect or missing units, the final (A1) is not awarded.***

$76.2\ \left(76.2241\ldots,\ \left(160 - \frac{80}{3}\pi\right)\right)\ \text{cm}^3$ ***(A1)*****(ft)** ***(C1)***

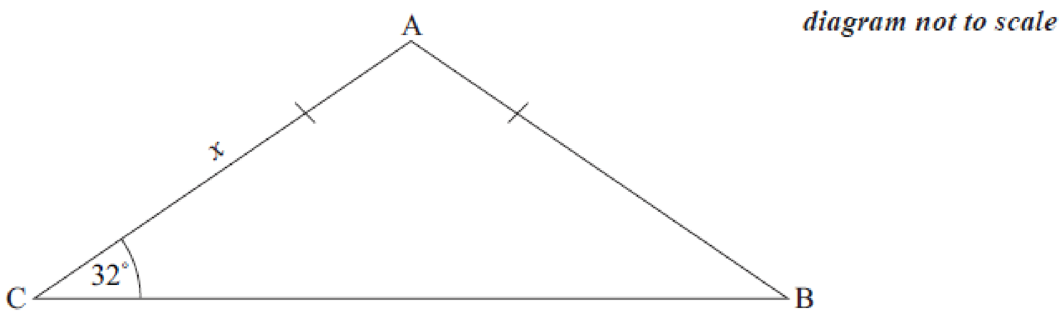
Note: Follow through from their part (b) and their part (c).

[1 mark]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

In the diagram, triangle ABC is isosceles. AB = AC and angle ACB is 32° . The length of side AC is *x* cm.



a. Write down the size of angle CBA. [1]

b. Write down the size of angle CAB. [1]

c. The area of triangle ABC is 360 cm^2. Calculate the length of side AC. Express your answer in **millimetres**. [4]

Markscheme

a. 32° ***(A1)*** ***(C1)***

[1 mark]

b. 116° ***(A1)*** ***(C1)***

[1 mark]

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

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

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

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

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

[4 marks]

Examiners report

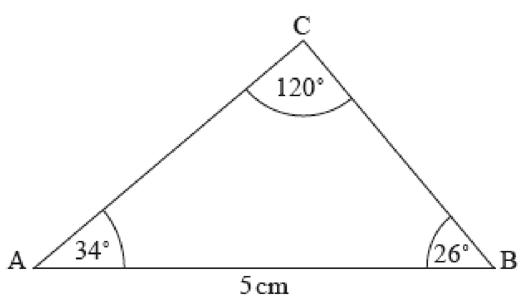
a. Candidates had difficulties finding the length of the side of the isosceles triangle and chose an incorrect angle in their substitution into the area formula. Many candidates thought this question related to right angle triangle trigonometry.

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

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

A triangular postage stamp, ABC, is shown in the diagram below, such that $\mathrm{AB} = 5\text{ cm}, \mathrm{B\hat{A}C} = 34^\circ, \mathrm{A\hat{B}C} = 26^\circ$ and $\mathrm{A\hat{C}B} = 120^\circ$.

diagram not to scale



a. Find the length of BC. [3]

b. Find the area of the postage stamp. [3]

Markscheme

a. $\frac{\mathrm{BC}}{\sin 34^\circ} = \frac{5}{\sin 120^\circ}$ ***(M1)(A1)***

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

$\mathrm{BC} = 3.23\ (\mathrm{cm})\ (3.22850\ldots\ (\mathrm{cm}))$ ***(A1)*** ***(C3)***

[3 marks]

b. $\frac{1}{2}(5)(3.22850)\sin 26^\circ$ ***(M1)(A1)*(ft)**

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

$= 3.54\ (\text{cm}^2)\ \left(3.53820\ldots\ (\text{cm}^2)\right)$ ***(A1)*(ft)** ***(C3)***

Note: Follow through from part (a).

[3 marks]

Examiners report

a. [N/A]
b. [N/A]

The equation of the line L_1 is $2x + y = 10$.

a. Write down [2]

(i) the gradient of L_1;

(ii) the y-intercept of L_1.

b. The line L_2 is parallel to L_1 and passes through the point $\mathrm{P}(0,\ 3)$. [2]

Write down the equation of L_2.

c. The line L_2 is parallel to L_1 and passes through the point $\mathrm{P}(0,\ 3)$. [2]

Find the x-coordinate of the point where L_2 crosses the x-axis.

Markscheme

a. (i) -2 ***(A1)*** ***(C1)***

(ii) 10 ***(A1)*** ***(C1)***

b. $2x + y - 3 = 0$ ***(A1)*(ft)*(A1)*** ***(C2)***

Notes: Award ***(A1)*(ft)** for gradient, ***(A1)*** for correct y-intercept.

The answer must be an equation.

c. $-2x + 3 = 0$ or equivalent ***(M1)***

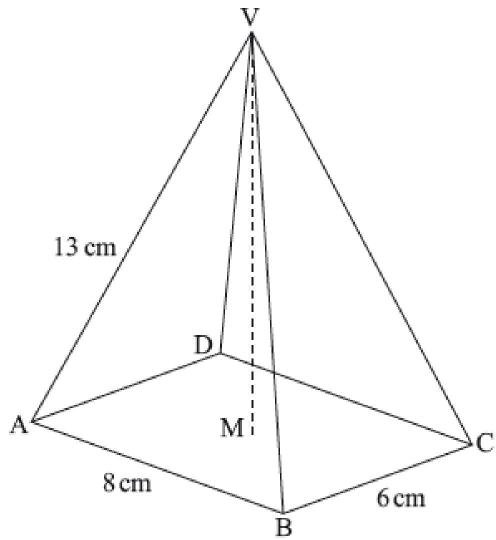
$(x =)\ 1.5$ ***(A1)*(ft)** ***(C2)***

Notes: Follow through from their equation in part (b). If answer given as coordinates $(1.5,\ 0)$ award at most ***(M1)(A0)*** if working seen or ***(A1)(A0)*** if no working seen.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

A right pyramid has apex V and rectangular base ABCD, with $\mathrm{AB} = 8\ \mathrm{cm}$, $\mathrm{BC} = 6\ \mathrm{cm}$ and $\mathrm{VA} = 13\ \mathrm{cm}$. The vertical height of the pyramid is VM.



a. Calculate VM. [4]

b. Calculate the volume of the pyramid. [2]

Markscheme

a. $\mathrm{AC}^2 = 8^2 + 6^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into Pythagoras, or recognition of Pythagorean triple.

$\mathrm{AC} = 10$ ***(A1)***

Note: Award ***(A2)*** for $\mathrm{AC} = 10$ **OR** $\mathrm{AM} = 5$ with no working seen.

$\mathrm{VM}^2 = 13^2 - 5^2$ ***(M1)***

Note: Award ***(M1)*** for correct second use of Pythagoras, using the result from the first use of Pythagoras.

$\mathrm{VM} = 12\ (\mathrm{cm})$ ***(A1)*** ***(C4)***

Notes: Accept alternative methods and apply the markscheme as follows: Award ***(M1)(A1)*** for first correct use of Pythagoras with lengths from the question, ***(M1)*** for a correct second use of Pythagoras, consistent with the method chosen, ***(A1)*** for correct height.

b. $\frac{1}{3} \times 8 \times 6 \times 12$ ***(M1)***

Note: Award ***(M1)*** for their correct substitutions into volume formula.

$= 192 \text{ cm}^3$ ***(A1)*(ft)** ***(C2)***

Notes: Follow through from part (a), only if working seen.

Examiners report

a. In part (a) many candidates struggled to identify right angled triangles correctly. A regular mistake was to calculate the slant height and not the vertical height. Often values were used which did not correspond to a right angled triangle in the diagram, such as 13 and 8. Another common mistake was incorrect use of Pythagoras, where the hypotenuse was not correctly identified or was incorrectly substituted into the formula.

b. Despite the problems to obtain a correct answer for part (a), in part (b) many candidates wrote down a correctly substituted formula for the volume of a pyramid (with their height substituted) and received follow through marks. Very few, having calculated their volume correctly, failed to give the correct units. Some candidates used the perimeter (28) of the base and not the area.

The straight line, L, has equation $2y - 27x - 9 = 0$.

a. Find the gradient of *L*. [2]

b. Sarah wishes to draw the tangent to $f(x) = x^4$ parallel to *L*. [1]

Write down $f'(x)$.

c, i.Find the *x* coordinate of the point at which the tangent must be drawn. [2]

c, iiWrite down the value of $f(x)$ at this point. [1]

Markscheme

a. *y* = 13.5*x* + 4.5 ***(M1)***

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

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

[2 marks]

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

[1 mark]

c, i.$4x^3 = 13.5$ ***(M1)***

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

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

[2 marks]

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

Note: Award ***(A1)*(ft)** for substitution of their (c)(i) into *x*4 with working seen.

[1 mark]

Examiners report

a. 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.

b. 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.

c, i. 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.

c, ii. 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.

---

a. The length of one side of a rectangle is 2 cm longer than its width. [1]

If the smaller side is *x* cm, find the perimeter of the rectangle in terms of *x*.

b. The length of one side of a rectangle is 2 cm longer than its width. [1]

The perimeter of a square is equal to the perimeter of the rectangle in part (a).

Determine the length of each side of the square in terms of *x*.

c. The length of one side of a rectangle is 2 cm longer than its width. [4]

The perimeter of a square is equal to the perimeter of the rectangle in part (a).

The sum of the areas of the rectangle and the square is $2x^2 + 4x + 1$ (cm^2).

(i) Given that this sum is 49 cm^2, find *x*.

(ii) Find the area of the square.

Markscheme

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

(UP) $\text{P (rectangle)} = 2x + 2(x + 2) = 4x + 4 \text{ cm}$ ***(A1)*** ***(C1)***

(UP) *Simplification not required*

[1 mark]

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

(UP) Side of square = (4*x* + 4)/4 = *x* + 1 cm ***(A1)*****(ft)** ***(C1)***

[1 mark]

c. (i) $2x^2 + 4x + 1 = 49$ or equivalent ***(M1)***

$(x + 6)(x - 4) = 0$

$x = -6$ and 4 ***(A1)***

*Note: award **(A1)** for the values or for correct factors*

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

*Award **(A1)**(ft) for choosing positive value.* ***(C3)***

(ii) $\text{Area of square} = 5 \times 5 = 25 \text{ cm}^2$ ***(A1)*****(ft)**

Note: Follow through from both (b) and (c)(i). ***(C1)***

[4 marks]

Examiners report

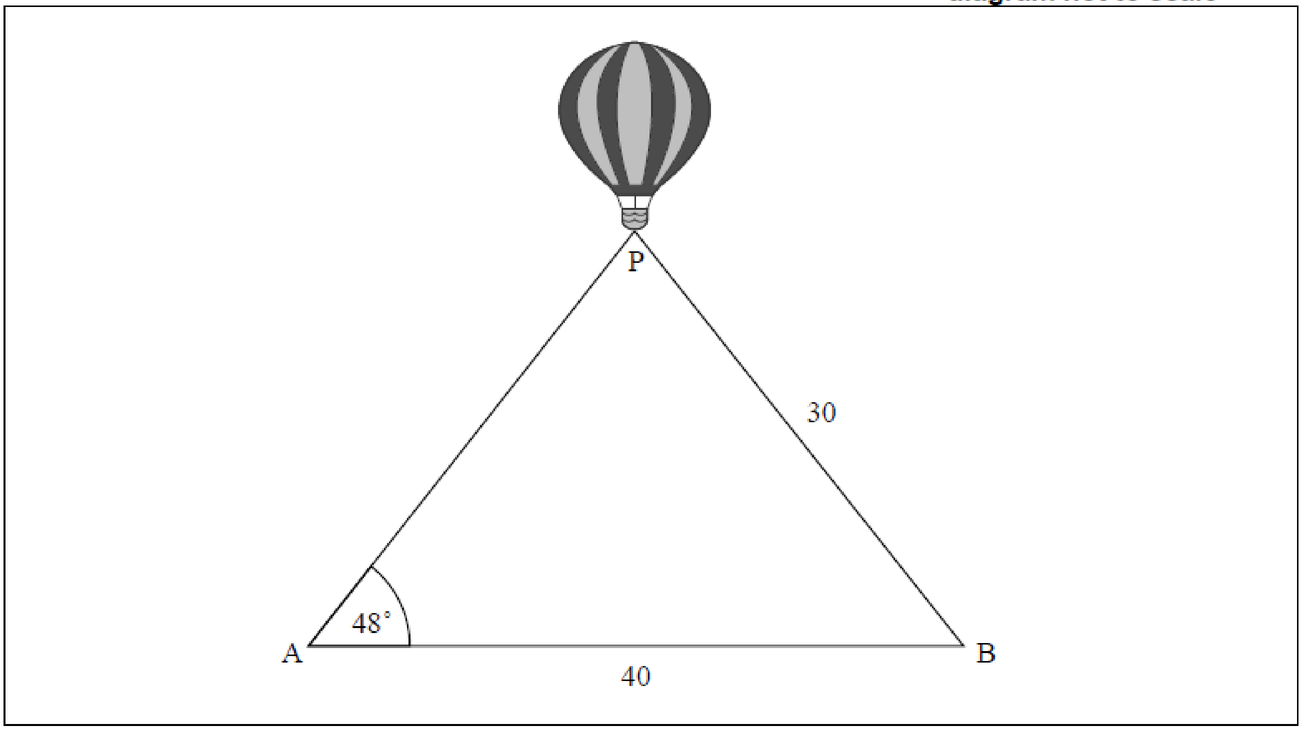
a. a) and b) Two thirds of the candidates found the perimeter of the rectangle and the side of the square correctly, though most of them did not include units (thereby incurring a unit penalty).

b. a) and b) Two thirds of the candidates found the perimeter of the rectangle and the side of the square correctly, though most of them did not include units (thereby incurring a unit penalty).

c. c) Although a majority of candidates produced the quadratic equation many were unable to solve it correctly. This could easily be done using the GDC so it was disappointing.

Two fixed points, A and B, are 40m apart on horizontal ground. Two straight ropes, AP and BP, are attached to the same point, P, on the base of a hot air balloon which is vertically above the line AB. The length of BP is 30m and angle BAP is 48°.

diagram not to scale



Angle APB is acute.

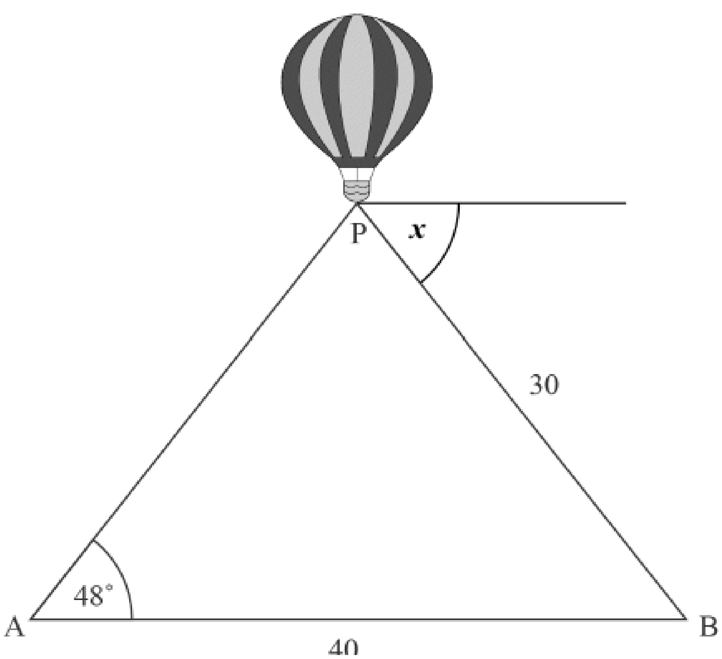
a. On the diagram, draw and label with an *x* the angle of depression of B from P. [1]

b. Find the size of angle APB. [3]

c. Find the size of the angle of depression of B from P. [2]

Markscheme

a.



(A1) (C1)

[1 mark]

b. $\frac{40}{\sin \text{APB}} = \frac{30}{\sin 48^\circ}$ ***(M1)(A1)***

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

(angle APB =) 82.2° (82.2473…°) ***(A1) (C3)***

[3 marks]

c. 180 – 48 – 82.2473… ***(M1)***

49.8° (49.7526…°) ***(A1)*(ft) *(C2)***

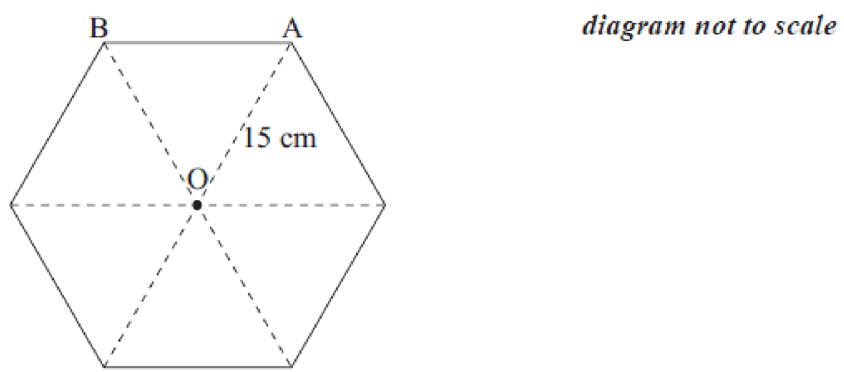
Note: Follow through from parts (a) and (b).

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The base of a prism is a **regular hexagon**. The centre of the hexagon is O and the length of OA is 15 cm.



a. Write down the size of angle AOB. [1]

b. Find the area of the triangle AOB. [3]

c. The height of the prism is 20 cm. [2]

Find the volume of the prism.

Markscheme

a. 60° ***(A1) (C1)***

[1 mark]

b. $\frac{15\times\sqrt{15^2-7.5^2}}{2}=97.4\text{ cm}^2$ (97.5 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 cm^2 from taking the height to be 13 cm.

OR

$\frac{1}{2} \times 15^2 \times \sin 60^\circ = 97.4\ \text{cm}^2$ ***(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]

c. 97.4 × 120 = 11700 cm^3 ***(M1)(A1)*(ft)** ***(C2)***

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

[2 marks]

Examiners report

a. 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.

b. 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.

c. 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.

A line joins the points A(2, 1) and B(4, 5).

a. Find the gradient of the line AB. [2]

b. Let M be the midpoint of the line segment AB. [1]

Write down the coordinates of M.

c. Let M be the midpoint of the line segment AB. [3]

Find the equation of the line perpendicular to AB and passing through M.

Markscheme

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

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

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

[2 marks]

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

[1 mark]

c. $\text{Gradient of perpendicular} = -\frac{1}{2}$ ***(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

a. 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.

b. 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.

c. 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.

In this question, give all answers to two decimal places.

Karl invests 1000 US dollars (USD) in an account that pays a nominal annual interest of 3.5%, **compounded quarterly**. He leaves the money in the account for 5 years.

a.i. Calculate the amount of money he has in the account after 5 years. [3]

a.ii. Write down the amount of **interest** he earned after 5 years. [1]

b. Karl decides to donate this **interest** to a charity in France. The charity receives 170 euros (EUR). The exchange rate is 1 USD = *t* EUR. [2]

Calculate the value of *t*.

Markscheme

a.i. $1000\left(1+\frac{3.5}{4\times100}\right)^{4\times5}$ ***(M1)(A1)***

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

OR

$N = 5$

$I = 3.5$

$PV = 1000$

$P/Y = 1$

$C/Y = 4$

Note: Award ***(A1)*** for $C/Y = 4$ seen, ***(M1)*** for other correct entries.

OR

$N = 5 \times 4$

$I = 3.5$

$PV = 1000$

$P/Y = 1$

$C/Y = 4$

Note: Award ***(A1)*** for $C/Y = 4$ seen, ***(M1)*** for other correct entries.

= 1190.34 (USD) ***(A1)***

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

[3 marks]

a.ii. 190.34 (USD) ***(A1)*(ft)** ***(C4)***

Note: Award ***(A1)*(ft)** for subtraction of 1000 from their part (a)(i). Follow through from (a)(i).

[1 mark]

b. $\frac{170}{190.34}$ ***(M1)***

Note: Award ***(M1)*** for division of 170 by their part (a)(ii).

= 0.89 ***(A1)*(ft)** ***(C2)***

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

[2 marks]

Examiners report

a.i. [N/A]
a.ii. [N/A]
b. [N/A]

A rectangle is 2680 cm long and 1970 cm wide.

a. Find the perimeter of the rectangle, giving your answer in the form $a \times 10^k$, where $1 \leqslant a \leqslant 10$ and $k \in \mathbb{Z}$. [3]

b. Find the area of the rectangle, giving your answer correct to the nearest thousand square centimetres. [3]

Markscheme

a. ***Note: Unit penalty (UP) applies in this part***

(2680 + 1970) × 2 ***(M1)***

(UP) = 9.30 × 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]

b. 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

a. 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.

b. 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.

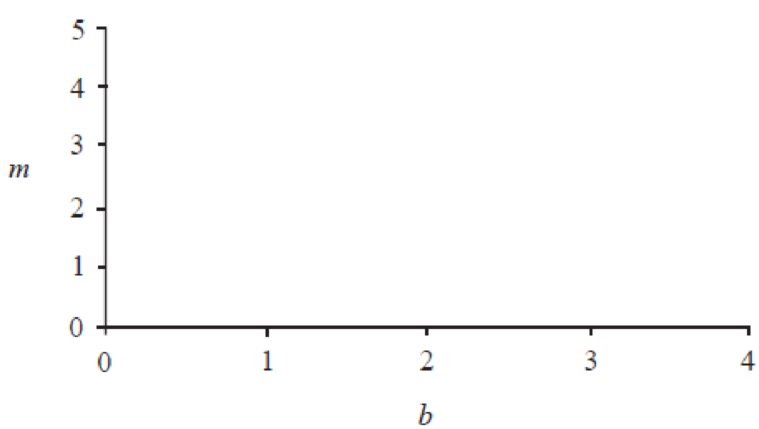
A store sells bread and milk. On Tuesday, 8 loaves of bread and 5 litres of milk were sold for \$21.40. On Thursday, 6 loaves of bread and 9 litres of milk were sold for \$23.40.

If $b =$ the price of a loaf of bread and $m =$ the price of one litre of milk, Tuesday's sales can be written as $8b + 5m = 21.40$.

a. Using simplest terms, write an equation in *b* and *m* for Thursday's sales. [2]

b. Find *b* and *m*. [2]

c. Draw a sketch, in the space provided, to show how the prices can be found graphically. [2]



Markscheme

a. Thursday's sales, $6b + 9m = 23.40$ ***(A1)***

$2b + 3m = 7.80$ ***(A1)*** ***(C2)***

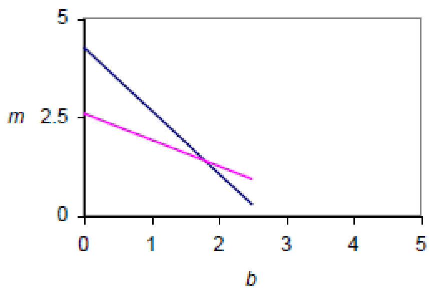
[2 marks]

b. $m = 1.40$ *(accept 1.4)* ***(A1)*(ft)**

$b = 1.80$ *(accept 1.8)* ***(A1)*(ft)**

*Award **(A1)**(d) for a reasonable attempt to solve by hand and answer incorrect.* ***(C2)***

[2 marks]

c. 

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

***(A1)** each for two reasonable straight lines. The intersection point must be approximately correct to earn both marks, otherwise penalise at least one line.*

Note: The follow through mark is for candidate's line from (a). ***(C2)***

[2 marks]

Examiners report

a. a) Nearly all the candidates were able to write the equation but very few simplified it.

b. b) A majority of candidates were able to find the values of b and m. Some used the right method but made arithmetical errors, many of which were due to them using the method of substitution which involved fractions. GDC use was expected.

c. c) A majority of candidates did not attempt this part. For those who did, very few were able to sketch the graph correctly. Common errors were to plot the point (1.4, 1.8) or draw a straight line through that point and the origin.

The straight line L passes through the points $\mathrm{A}(-1, 4)$ and $\mathrm{B}(5, 8)$.

a. Calculate the gradient of L . [2]

b. Find the equation of L . [2]

c. The line L also passes through the point $\mathrm{P}(8, y)$. Find the value of y . [2]

Markscheme

a. $\frac{8-4}{5-(-1)}$ ***(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]

b. $y = \frac{2}{3}x + c$ ***(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]

c. $y = \frac{2}{3} \times 8 + \frac{14}{3}$ **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]

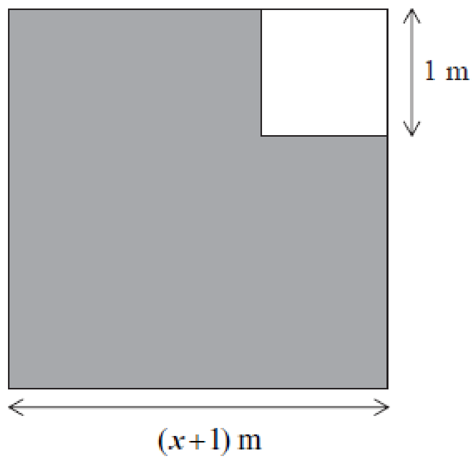
Examiners report

a. 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 $8 - 4 \div 5 + 1$.

b. 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.

c. 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.

The length of a square garden is $(x + 1)$ m. In one of the corners a square of 1 m length is used only for grass. The rest of the garden is only for planting roses and is shaded in the diagram below.



The area of the shaded region is A .

a. Write down an expression for A in terms of x. [1]

b. Find the value of x given that $A = 109.25$ m^2. [3]

c. The owner of the garden puts a fence around the shaded region. Find the length of this fence. [2]

Markscheme

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

[1 mark]

b. $(x + 1)^2 - 1 = 109.25$ ***(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]

c. $4 \times (9.5 + 1) = 42$ 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

a. 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.

b. 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.

c. 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.

A rectangular cuboid has the following dimensions.

Length	0.80 metres	(AD)
Width	0.50 metres	(DG)
Height	1.80 metres	(DC)

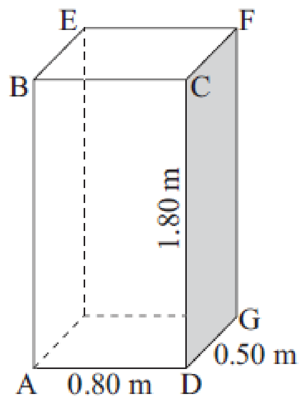


diagram not to scale

a. Calculate the length of AG. [2]

b. Calculate the length of AF. [2]

c. Find the size of the angle between AF and AG. [2]

Markscheme

a. $\mathrm{AG} = \sqrt{0.8^2 + 0.5^2}$ ***(M1)***

AG = 0.943 m ***(A1)*** ***(C2)***

[2 marks]

b. $\mathrm{AF} = \sqrt{\mathrm{AG}^2 + 1.80^2}$ ***(M1)***

= 2.03 m ***(A1)*(ft)** ***(C2)***

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

[2 marks]

c. $\cos \mathrm{G\hat{A}F} = \frac{0.943(39\ldots)}{2.03(22\ldots)}$ ***(M1)***

$\mathrm{G\hat{A}F} = 62.3^\circ$ ***(A1)*(ft)** ***(C2)***

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

Accept alternative ratios which give 62.4° **or** 62.5°.

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

[2 marks]

Examiners report

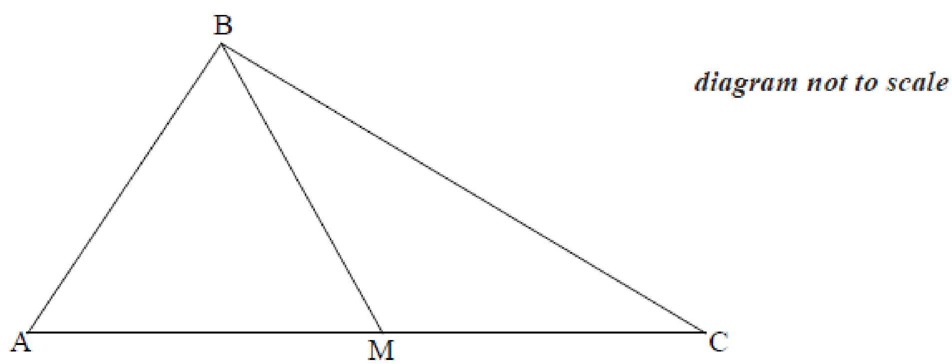
a. This question was well answered. Surprisingly few candidates used the basic trigonometric ratios (for right angle triangles), opting instead to use the sine or cosine laws.

b. This question was well answered. Surprisingly few candidates used the basic trigonometric ratios (for right angle triangles), opting instead to use the sine or cosine laws.

c. This question was well answered. Surprisingly few candidates used the basic trigonometric ratios (for right angle triangles), opting instead to use the sine or cosine laws.

The diagram shows a triangle ABC in which AC = 17 cm. M is the midpoint of AC.

Triangle ABM is equilateral.



a.1 Write down the size of angle MCB. [1]

a.i. Write down the length of BM in cm. [1]

a.ii. Write down the size of angle BMC. [1]

b. Calculate the length of BC in cm. [3]

Markscheme

a.1 30° ***(A1)*** ***(C3)***

[1 mark]

a.i. 8.5 (cm) ***(A1)***

[1 mark]

a.ii. 120° ***(A1)***

[1 mark]

b. $\frac{\mathrm{BC}}{\sin 120} = \frac{8.5}{\sin 30}$ ***(M1)(A1)*(ft)**

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

$\mathrm{BC} = 14.7\left(\frac{17\sqrt{3}}{2}\right)$ ***(A1)*(ft)**

[3 marks]

Examiners report

a.1. Part (a) was generally well answered with many candidates gaining full marks. Some candidates went on to make incorrect assumptions about triangle BMC being right angled and used Pythagorus theorem incorrectly. Those who used either the Sine rule or the Cosine rule correctly were generally able to substitute correctly and gain at least two marks.

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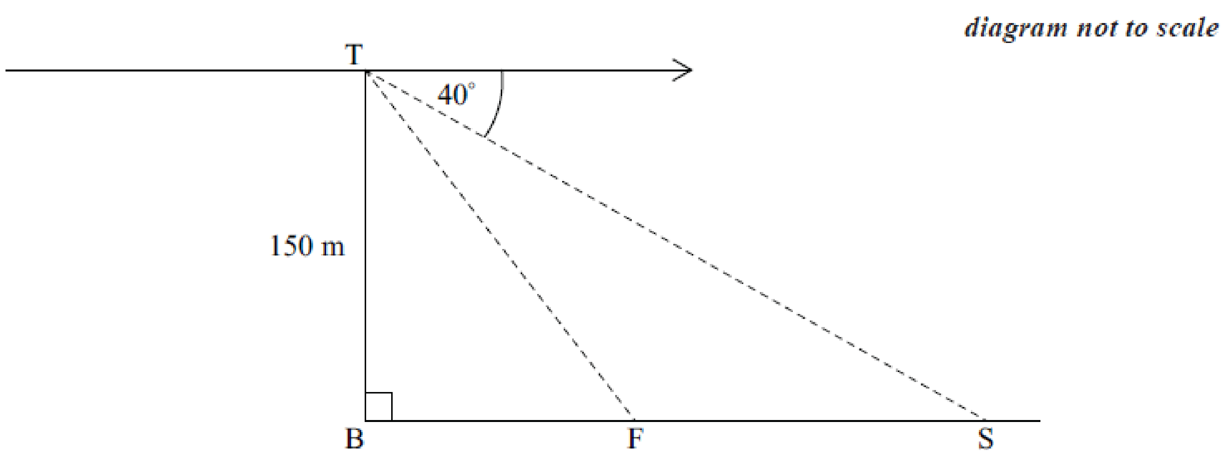
a.ii. Part (a) was generally well answered with many candidates gaining full marks. Some candidates went on to make incorrect assumptions about triangle BMC being right angled and used Pythagorus theorem incorrectly. Those who used either the Sine rule or the Cosine rule correctly were generally able to substitute correctly and gain at least two marks.

b. Part (a) was generally well answered with many candidates gaining full marks. Some candidates went on to make incorrect assumptions about triangle BMC being right angled and used Pythagorus theorem incorrectly. Those who used either the Sine rule or the Cosine rule correctly were generally able to substitute correctly and gain at least two marks.

Tom stands at the top, T , of a vertical cliff 150 m high and sees a fishing boat, F , and a ship, S . B represents a point at the bottom of the cliff directly below T . The angle of depression of the ship is 40° and the angle of depression of the fishing boat is 55° .



a. Calculate, SB, the distance between the ship and the bottom of the cliff. [2]

b. Calculate, SF, the distance between the ship and the fishing boat. Give your answer correct to the nearest metre. [4]

Markscheme

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

OR

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

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

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

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

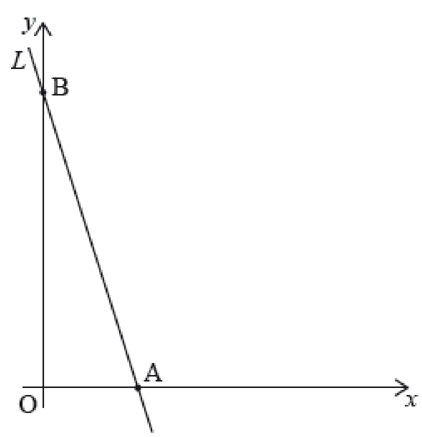
$= 73.7\ (\mathrm{m})\ (73.7319\ldots)$ ***(A1)*****(ft)**
$= 74\ (\mathrm{m})$ ***(A1)*****(ft)** ***(C4)***

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

Examiners report

a. [N/A]
b. [N/A]

Line L intersects the x-axis at point A and the y-axis at point B, as shown on the diagram.



The length of line segment OB is three times the length of line segment OA, where O is the origin.

Point $(2, 6)$ lies on L.

a. Find the gradient of L. [2]

b. Find the equation of L in the form $y = mx + c$. [2]

c. Find the x-coordinate of point A. [2]

Markscheme

a. -3 ***(A1)(A1)*** ***(C2)***

Notes: Award ***(A1)*** for 3 and ***(A1)*** for a negative value.

Award ***(A1)(A0)*** for either $3x$ or $-3x$.

[2 marks]

b. $6 = -3(2) + c$ **OR** $(y - 6) = -3(x - 2)$ ***(M1)***

Note: Award ***(M1)*** for substitution of their gradient from part (a) into a correct equation with the coordinates $(2,\ 6)$ correctly substituted.

$y = -3x + 12$ ***(A1)*(ft)** ***(C2)***

Notes: Award ***(A1)*(ft)** for their correct equation. Follow through from part (a).

If no method seen, award ***(A1)(A0)*** for $y = -3x$.

Award ***(A1)(A0)*** for $-3x + 12$.

[2 marks]

c. $0 = -3x + 12$ ***(M1)***

Note: Award ***(M1)*** for substitution of $y = 0$ in their equation from part (b).

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

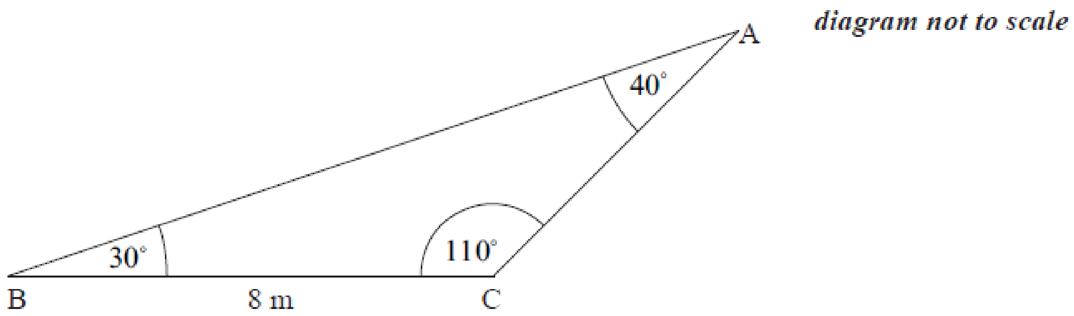
Notes: Follow through from their equation from part (b). Do not follow through if no method seen. Do not award the final ***(A1)*** if the value of x is negative or zero.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

In triangle ABC, BC = 8 m, angle ACB = 110 °, angle CAB = 40°, and angle ABC = 30 °.



a. Find the length of AC. [3]

b. Find the area of triangle ABC. [3]

Markscheme

a. $\frac{\text{AC}}{\sin 30^\circ} = \frac{8}{\sin 40^\circ}$ ***(M1)(A1)***

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

AC = 6.22 (m) (6.22289…) ***(A1)*** ***(C3)***

[3 marks]

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

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

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

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

[3 marks]

Examiners report

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

b. Whilst using the sine rule to find an angle was tested in question 10, here the sine rule was required to be used to find a length. Many scripts showed the correct value of 6.22 m, but a significant number of candidates calculated AB instead of AC and the answer of 11.7 m proved to be a popular, but erroneous, answer. Some candidates turned the problem into two right angled triangles by dropping the perpendicular from C to the line AB. Much working was then required to find AC and again, some of these candidates simply determined the length of AB. Despite a

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Assume the Earth is a perfect sphere with radius 6371 km.

a. Calculate the volume of the Earth in km^3. Give your answer in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [3]

b. The volume of the Moon is $2.1958 \times 10^{10}\ \mathrm{km}^3$. [3]

Calculate how many times greater in volume the Earth is compared to the Moon.

Give your answer correct to the nearest **integer**.

Markscheme

a. $\frac{4}{3}\pi(6371)^3$ ***(M1)***

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

$= 1.08 \times 10^{12} \quad (1.08320\ldots \times 10^{12})$ ***(A2)*** ***(C3)***

Notes: Award ***(A1)(A0)*** for correct mantissa between 1 and 10, with incorrect index.

Award ***(A1)(A0)*** for $1.08\mathrm{E}12$

Award ***(A0)(A0)*** for answers of the type: 108×10^{10}.

b. $\frac{1.08320\ldots \times 10^{12}}{2.1958 \times 10^{10}}$ ***(M1)***

Note: Award ***(M1)*** for dividing their answer to part (a) by 2.1958×10^{10}.

$= 49.3308\ldots$ ***(A1)*****(ft)**

Note: Accept $49.1848\ldots$ from use of 3 sf answer to part (a).

$= 49$ ***(A1)*** ***(C3)***

Notes: Follow through from part (a).

The final ***(A1)*** is awarded for their unrounded non-integer answer seen and given correct to the nearest integer.

Do not award the final ***(A1)*** for a rounded answer of 0 or if it is incorrect by a large order of magnitude.

Examiners report

a. In part (a) many candidates correctly substituted the volume formula and wrote correctly their answer using scientific notation. The calculator notation E12 was very rarely used. A minority converted to metres, resulting in an incorrect exponent. Some candidates used an incorrect equation or used their calculator incorrectly.

b. In part (b) many candidates subtracted the values, where they should be divided, resulting in an answer of an unrealistic magnitude. Some reversed the numerator and denominator, leading to an answer of 0.02, which would have rounded to the unrealistic answer of 0. When a reasonable answer was found, the final mark for rounding was lost by some candidates when there was no rounding or when rounding was incorrect. There seemed to be little understanding of whether or not an answer was reasonable.

In triangle ABC, $\mathrm{AC} = 20$ cm, $\mathrm{BC} = 12$ cm and $\mathrm{A\hat{B}C} = 90^\circ$.

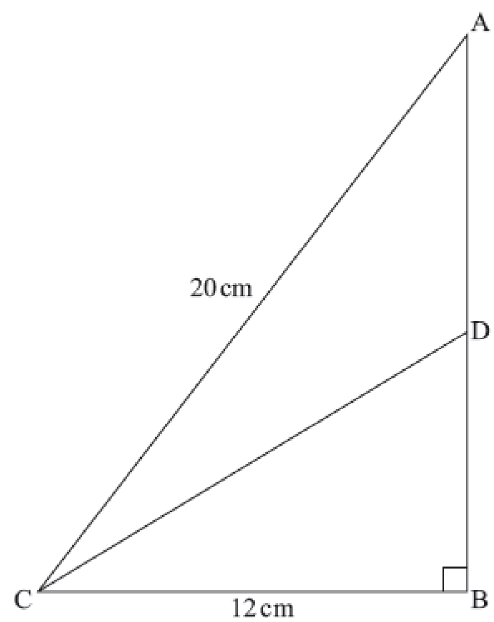


diagram not to scale

a. Find the length of AB. [2]

b. D is the point on AB such that $\tan(\mathrm{D\hat{C}B}) = 0.6$. [2]

Find the length of DB.

c. D is the point on AB such that $\tan(\mathrm{D\hat{C}B}) = 0.6$. [2]

Find the area of triangle ADC.

Markscheme

a. $(\mathrm{AB}^2) = 20^2 - 12^2$ ***(M1)***

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

$\mathrm{AB} = 16$ cm ***(A1)*** ***(C2)***

[2 marks]

b. $\frac{\mathrm{DB}}{12} = 0.6$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in tangent ratio or equivalent *ie* seeing 12×0.6.

$\mathrm{DB} = 7.2\ \mathrm{cm}$ ***(A1)*** ***(C2)***

Note: Award ***(M1)(A0)*** for using $\tan 31$ to get an answer of 7.21.

Award ***(M1)(A0)*** for $\frac{12}{\sin 59} = \frac{\mathrm{DB}}{\sin 31}$ to get an answer of $7.2103\ldots$ or any other incorrect answer.

[2 marks]

c. $\frac{1}{2} \times 12 \times (16 - 7.2)$ ***(M1)***

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

OR

$\frac{1}{2} \times 12 \times 16 - \frac{1}{2} \times 12 \times 7.2$ ***(M1)***

Note: Award ***(M1)*** for subtraction of their two correct area formulas.

$= 52.8\ \mathrm{cm}^2$ ***(A1)*(ft)** ***(C2)***

Notes: Follow through from parts (a) and (b).

Accept alternative methods.

[2 marks]

Examiners report

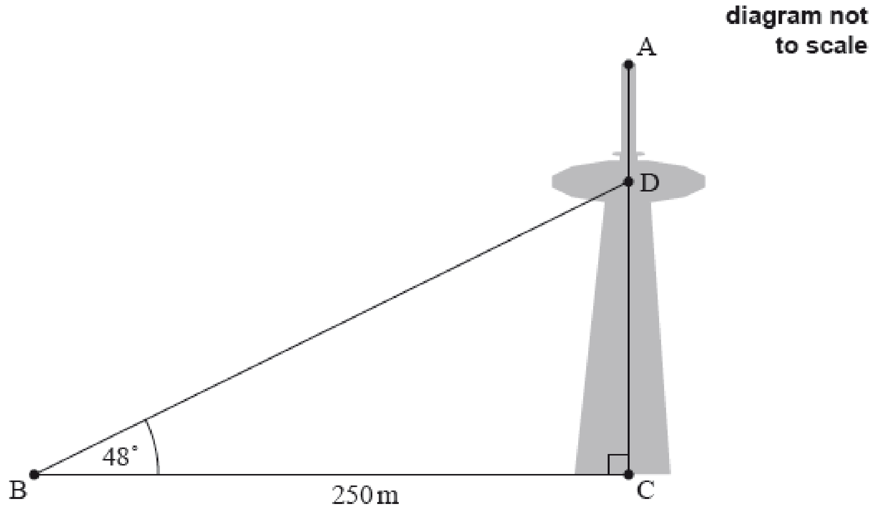
a. This question was not well answered. Many candidates could not use Pythagoras' theorem correctly and many failed to appreciate the significance of $\tan(< \mathrm{DCB}) = 0.6$ and calculated the size of the angle DCB, rounding it to $31°$. Unfortunately, this method led to an inaccurate value for DB. Finding the area of triangle ADC was also difficult for many who did not realize that they needed to do a subtraction of triangle areas. Candidates who tried to find side lengths and angles for triangle ADC were generally unsuccessful in calculating its area.

b. This question was not well answered. Many candidates could not use Pythagoras' theorem correctly and many failed to appreciate the significance of $\tan(< \mathrm{DCB}) = 0.6$ and calculated the size of the angle DCB, rounding it to $31°$. Unfortunately, this method led to an inaccurate value for DB. Finding the area of triangle ADC was also difficult for many who did not realize that they needed to do a subtraction of triangle areas. Candidates who tried to find side lengths and angles for triangle ADC were generally unsuccessful in calculating its area.

c. This question was not well answered. Many candidates could not use Pythagoras' theorem correctly and many failed to appreciate the significance of $\tan(< \mathrm{DCB}) = 0.6$ and calculated the size of the angle DCB, rounding it to $31°$. Unfortunately, this method led to an inaccurate value for DB. Finding the area of triangle ADC was also difficult for many who did not realize that they needed to do a subtraction of triangle areas. Candidates who tried to find side lengths and angles for triangle ADC were generally unsuccessful in calculating its area.

AC is a vertical communications tower with its base at C.

The tower has an observation deck, D, three quarters of the way to the top of the tower, A.



From a point B, on horizontal ground 250 m from C, the angle of elevation of D is 48°.

a. Calculate CD, the height of the observation deck above the ground. [2]

b. Calculate the angle of depression from A to B. [4]

Markscheme

a. $\tan 48^\circ = \frac{\text{CD}}{250}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the tangent ratio.

$(\text{CD} =)\ 278\ (\text{m})\ (277.653\ldots)$ ***(A1)*** ***(C2)***

[2 marks]

b. $\tan \text{ABC (or equivalent)} = \frac{\frac{4}{3} \times 277.653\ldots}{250}$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for $\frac{4}{3}$ multiplying their part (a), ***(M1)*** for substitution into the tangent ratio, ***(M1)*** for correct substitution.

OR

$90 - \tan^{-1}\left(\frac{250}{\frac{4}{3} \times 277.653\ldots}\right)$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for $\frac{4}{3}$ multiplying their part (a), ***(M1)*** for substitution into the tangent ratio, ***(M1)*** for subtracting from 90 and for correct substitution.

$(\text{angle of depression} =)\ 56.0^{\circ}\ (55.9687\ldots)$ ***(A1)(ft)*** ***(C4)***

Note: Follow through from part (a).

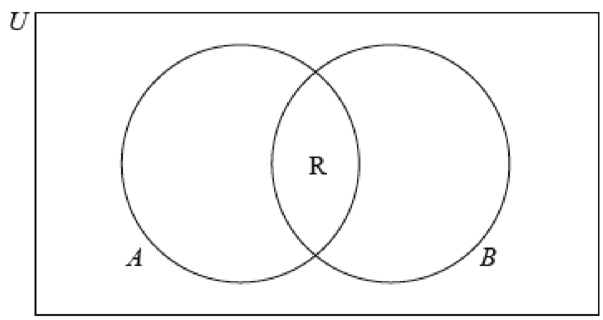
[4 marks]

Examiners report

a. [N/A]
b. [N/A]

Tuti has the following polygons to classify: rectangle (R), rhombus (H), isosceles triangle (I), regular pentagon (P), and scalene triangle (T).

In the Venn diagram below, set A consists of the polygons that have at least one pair of parallel sides, and set B consists of the polygons that have at least one pair of equal sides.



a. Complete the Venn diagram by placing the letter corresponding to each polygon in the appropriate region. For example, R has already been placed, and represents the rectangle. [3]

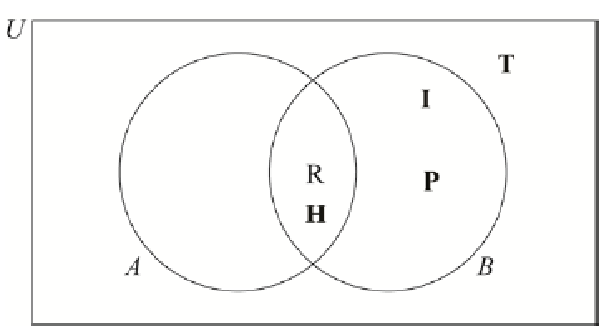
b. State which polygons from Tuti's list are elements of [3]

(i) $A \cap B$;

(ii) $(A \cup B)'$.

Markscheme

a.



(A3) ***(C3)***

Note: Award ***(A3)*** if all four letters placed correctly,

(A2) if three letters are placed correctly,

(A1) if two letters are placed correctly.

b. (i) Rhombus and rectangle **OR** H and R ***(A1)*(ft)**

(ii) Scalene triangle **OR** T ***(A2)*(ft)** ***(C3)***

Notes: Award ***(A1)*** for a list R, H, I, P seen (identifying the union).

Follow through from their part (a).

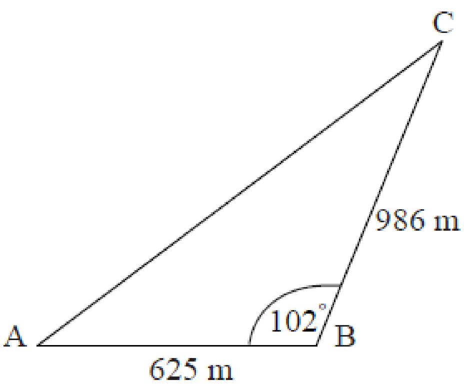
Examiners report

a. [N/A]
b. [N/A]

On a map three schools A, B and C are situated as shown in the diagram.

Schools A and B are 625 metres apart.

Angle ABC = 102° and BC = 986 metres.



a. Find the distance between A and C. [3]

b. Find the size of angle BAC. [3]

Markscheme

a. *Unit penalty **(UP)** is applicable in question part (a) **only**.*

$\mathrm{AC}^2 = 625^2 + 986^2 - 2 \times 625 \times 986 \times \cos 102^\circ$ ***(M1)(A1)***

(= 1619072.159)

AC = 1272.43

(UP) =1270 m ***(A1)*** ***(C3)***

[3 marks]

b. $\frac{986}{\sin \mathrm{A}} = \frac{1270}{\sin 102^\circ}$ ***(M1)(A1)*(ft)**

$\mathrm{A} = 49.4^\circ$ ***(A1)*(ft)**

OR

$\frac{986}{\sin \mathrm{A}} = \frac{1272.43}{\sin 102^\circ}$ ***(M1)(A1)*(ft)**

$\mathrm{A} = 49.3^{\circ}$ ***(A1)*(ft)**

OR

$\cos \mathrm{A} = \left(\frac{625^2+1270^2-986^2}{2\times 625\times 1270}\right)$ ***(M1)(A1)*(ft)**

$\mathrm{A} = 49.5^{\circ}$ ***(A1)*(ft)** ***(C3)***

[3 marks]

Examiners report

a. The candidates who used the cosine and sine rules for this question were successful on the whole. Some had their calculators in radian mode (and hence the second answer for the angle was unrealistic) but this was less frequent than in previous sessions. Those candidates who used right-angled trigonometry scored no marks. Many candidates lost an accuracy penalty in this question.

b. The candidates who used the cosine and sine rules for this question were successful on the whole. Some had their calculators in radian mode (and hence the second answer for the angle was unrealistic) but this was less frequent than in previous sessions. Those candidates who used right-angled trigonometry scored no marks. Many candidates lost an accuracy penalty in this question.

An observatory is built in the shape of a cylinder with a hemispherical roof on the top as shown in the diagram. The height of the cylinder is 12 m and its radius is 15 m.

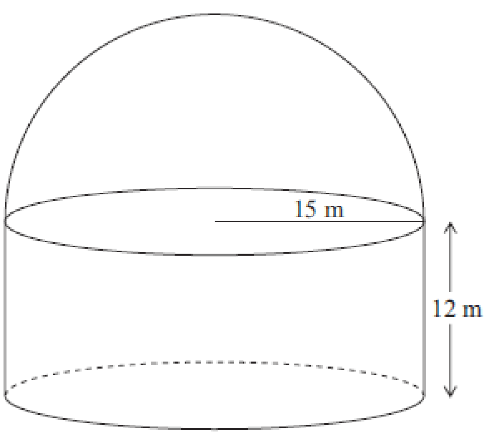


diagram not to scale

a. Calculate the volume of the observatory. [4]

b. The hemispherical roof is to be painted. [2]

Calculate the area that is to be painted.

Markscheme

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

$= 15550.8\ldots$

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

Notes: The final answer is $15600\ \mathrm{m}^3$; 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]

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

$= 1413.71\ldots$

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

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

[2 marks]

Examiners report

a. 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.

b. 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.

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a. Write down the gradient of the line $y = 3x + 4$. [1]

b. Find the gradient of the line which is perpendicular to the line $y = 3x + 4$. [1]

c. Find the equation of the line which is perpendicular to $y = 3x + 4$ and which passes through the point $(6, 7)$. [2]

d. Find the coordinates of the point of intersection of these two lines. [2]

Markscheme

a. 3 ***(A1)*** ***(C1)***

[1 mark]

b. $-1/3$ **(ft)** *from (a)* ***(A1)*(ft)** ***(C1)***

[1 mark]

c. Substituting $(6, 7)$ in $y = \text{their } mx + c$ or equivalent to find c. ***(M1)***

$y = \frac{-1}{3}x + 9$ or equivalent ***(A1)*(ft)** ***(C2)***

[2 marks]

d. $(1.5, 8.5)$ ***(A1)(A1)*(ft)** ***(C2)***

Note: Award ***(A1)*** for 1.5, ***(A1)*** for 8.5. **(ft)** from (c), brackets not required.

[2 marks]

Examiners report

a. This question was well answered by some candidates and poorly answered by others. It seemed to be part of the syllabus that might have been fully taught by some schools and not by others. It was surprising to see how many candidates could not find the gradient of a perpendicular line when this has been tested for many years.

b. This question was well answered by some candidates and poorly answered by others. It seemed to be part of the syllabus that might have been fully taught by some schools and not by others. It was surprising to see how many candidates could not find the gradient of a perpendicular line when this has been tested for many years.

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d. This question was well answered by some candidates and poorly answered by others. It seemed to be part of the syllabus that might have been fully taught by some schools and not by others. It was surprising to see how many candidates could not find the gradient of a perpendicular line when this has been tested for many years.

A room is in the shape of a cuboid. Its floor measures 7.2 m by 9.6 m and its height is 3.5 m.

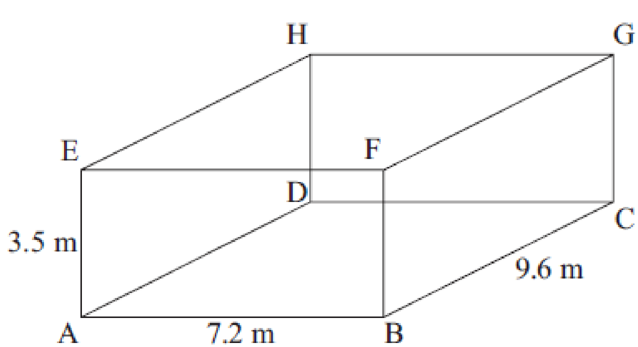


diagram not to scale

a. Calculate the length of AC. [2]

b. Calculate the length of AG. [2]

c. Calculate the angle that AG makes with the floor. [2]

Markscheme

a. $\mathrm{AC}^2 = 7.2^2 + 9.6^2$ ***(M1)***

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

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

[2 marks]

b. $\mathrm{AG}^2 = 12^2 + 3.5^2$ ***(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]

c. $\tan\theta = \frac{3.5}{12}$ 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

a. 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.

b. 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.

c. 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.

Let $f(x) = x^4$.

a. Write down $f'(x)$. [1]

b. Point $\mathrm{P}(2, 6)$ lies on the graph of f. [2]

Find the gradient of the tangent to the graph of $y = f(x)$ at P.

c. Point $\mathrm{P}(2, 16)$ lies on the graph of f. [3]

Find the equation of the normal to the graph at P. Give your answer in the form $ax + by + d = 0$, where a, b and d are integers.

Markscheme

a. $(f'(x) =)\ \ 4x^3$ ***(A1)*** ***(C1)***

[1 mark]

b. 4×2^3 ***(M1)***

Note: Award ***(M1)*** for substituting 2 into their derivative.

$= 32$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from their part (a).

[2 marks]

c. $y - 16 = -\frac{1}{32}(x - 2)$ **or** $y = -\frac{1}{32}x + \frac{257}{16}$ ***(M1)(M1)***

Note: Award ***(M1)*** for their gradient of the normal seen, ***(M1)*** for point substituted into equation of a straight line in only x and y (with any constant 'c' eliminated).

$x + 32y - 514 = 0$ **or** any integer multiple ***(A1)*(ft)** ***(C3)***

Note: Follow through from their part (b).

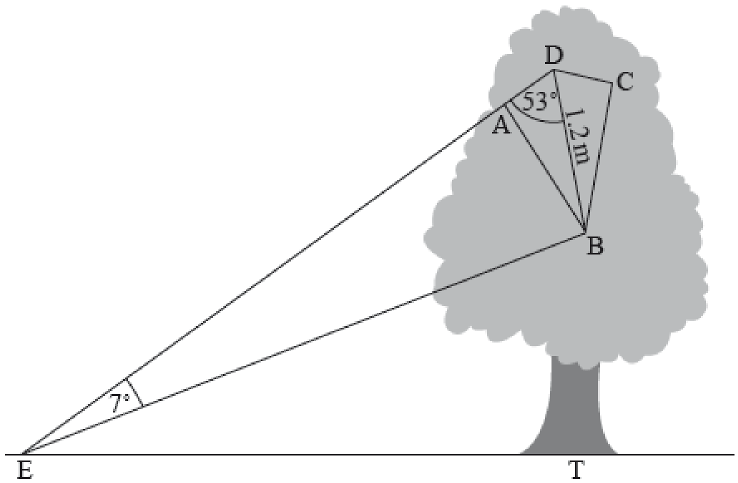
[3 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Emily's kite ABCD is hanging in a tree. The plane ABCDE is vertical.

Emily stands at point E at some distance from the tree, such that EAD is a straight line and angle BED = 7°. Emily knows BD = 1.2 metres and angle BDA = 53°, as shown in the diagram



T is a point at the base of the tree. ET is a horizontal line. The angle of elevation of A from E is 41°.

a. Find the length of EB. [3]

b. Write down the angle of elevation of B from E. [1]

c. Find the vertical height of B above the ground. [2]

Markscheme

a. **Units are required in parts (a) and (c).**

$\frac{\text{EB}}{\sin 53^\circ} = \frac{1.2}{\sin 7^\circ}$ ***(M1)(A1)***

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

$(\text{EB} =)\ 7.86\ \text{m}$ **OR** $786\ \text{cm}\ (7.86385\ldots\ \text{m}$ **OR** $786.385\ldots\ \text{cm})$ ***(A1)*** ***(C3)***

[3 marks]

b. 34° ***(A1)*** ***(C1)***

[1 mark]

c. **Units are required in parts (a) and (c).**

$\sin 34^\circ = \frac{\text{height}}{7.86385\ldots}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into a trigonometric ratio.

$(\text{height} =)\ 4.40\ \text{m}$ **OR** $440\ \text{cm}\ (4.39741\ldots\ \text{m}$ **OR** $439.741\ldots\ \text{cm})$ ***(A1)(ft)*** ***(C2)***

Note: Accept “BT” used for height. Follow through from parts (a) and (b). Use of 7.86 gives an answer of 4.39525….

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

A cuboid has a rectangular base of width x cm and length $2x$ cm . The height of the cuboid is h cm . The total length of the edges of the cuboid is 72 cm.

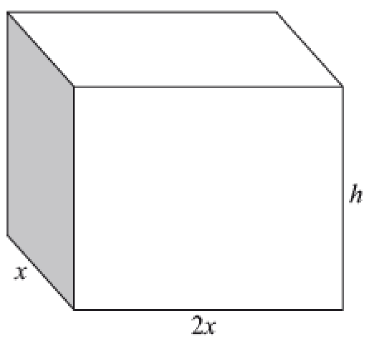


diagram not to scale

The volume, V, of the cuboid can be expressed as $V = ax^2 - 6x^3$.

a. Find the value of a. [3]

b. Find the value of x that makes the volume a maximum. [3]

Markscheme

a. $72 = 12x + 4h$ (or equivalent) ***(M1)***

Note: Award ***(M1)*** for a correct equation obtained from the total length of the edges.

$V = 2x^2(18 - 3x)$ ***(A1)***

$(a =)\ 36$ ***(A1)*** ***(C3)***

b. $\frac{\mathrm{d}V}{\mathrm{d}x} = 72x - 18x^2$ ***(A1)***

$72x - 18x^2 = 0$ **OR** $\frac{\mathrm{d}V}{\mathrm{d}x} = 0$ ***(M1)***

Notes: Award ***(A1)*** for $-18x^2$ seen. Award ***(M1)*** for equating derivative to zero.

$(x =)\ 4$ ***(A1)*(ft)*** ***(C3)***

Note: Follow through from part (a).

OR

Sketch of V with visible maximum ***(M1)***

Sketch with $x \geqslant 0,\ V \geqslant 0$ and indication of maximum (e.g. coordinates) ***(A1)*(ft)**

$(x =)\ 4$ ***(A1)*(ft)** ***(C3)***

Notes: Follow through from part (a).

Award ***(M1)(A1)(A0)*** for $(4,\ 192)$.

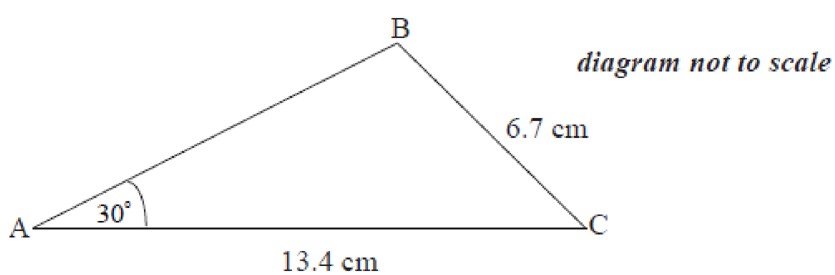
Award ***(C3)*** for $x = 4,\ y = 192$.

Examiners report

a. The model in this question seemed to be too difficult for the vast majority of the candidates, and therefore was a strong discriminator between grade 6 and grade 7 candidates. An attempt to find an equation for the volume of the cube often started with *V* = *x* x 2*x* x *h* . Many struggled to translate the total length of the edges into a correct equation, and consequently were unable to substitute *h*. Some tried to write *x* in terms of *h* and got lost, others tried to work backwards from the expression given in the question.

b. As very few found a value for *a*, often part (b) was not attempted. When a derivative was calculated this was usually done correctly.

The diagram shows triangle ABC in which angle $\text{BAC} = 30^\circ$, $\text{BC} = 6.7\text{ cm}$ and $\text{AC} = 13.4\text{ cm}$.



a. Calculate the size of angle ACB. [4]

b. Nadia makes an accurate drawing of triangle ABC. She measures angle BAC and finds it to be 29°. [2]

Calculate the percentage error in Nadia's measurement of angle BAC.

Markscheme

a. $\frac{\sin \text{A}\hat{\text{B}}\text{C}}{13.4} = \frac{\sin 30^\circ}{6.7}$ ***(M1)(A1)***

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

$\text{A}\hat{\text{B}}\text{C}$ = 90° ***(A1)***

$\text{A}\hat{\text{C}}\text{B}$ = 60° ***(A1)*(ft)** ***(C4)***

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

[4 marks]

b. $\frac{29-30}{30} \times 100$ ***(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

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

b. The incorrect denominator was often seen in the error formula.

Consider $f : x \mapsto x^2 - 4$.

a. Find $f'(x)$. [1]

b. Let *L* be the line with equation *y* = 3*x* + 2. [1]

Write down the gradient of a line parallel to *L*.

c. Let *L* be the line with equation *y* = 3*x* + 2. [4]

Let P be a point on the curve of *f*. At P, the tangent to the curve is parallel to *L*. Find the coordinates of P.

Markscheme

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

[1 mark]

b. 3 ***(A1)*** ***(C1)***

[1 mark]

c. $2x = 3$ ***(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

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

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

c. 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*.

The number of apartments in a housing development has been increasing by a constant amount every year.

At the end of the first year the number of apartments was 150, and at the end of the sixth year the number of apartments was 600.

The number of apartments, y, can be determined by the equation $y = mt + n$, where t is the time, in years.

a. Find the value of m. [2]

b. State what m represents **in this context**. [1]

c. Find the value of n. [2]

d. State what n represents **in this context**. [1]

Markscheme

a. $\frac{600-150}{6-1}$ ***(M1)***

OR

$600 = 150 + (6 - 1)m$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into gradient formula or arithmetic sequence formula.

$= 90$ ***(A1)*** ***(C2)***

b. the annual rate of growth of the number of apartments ***(A1)*** ***(C1)***

Note: Do not accept common difference.

c. $150 = 90 \times (1) + n$ ***(M1)***

Note: Award ***(M1)*** for correct substitution of their gradient and one of the given points into the equation of a straight line.

$n = 60$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from part (a).

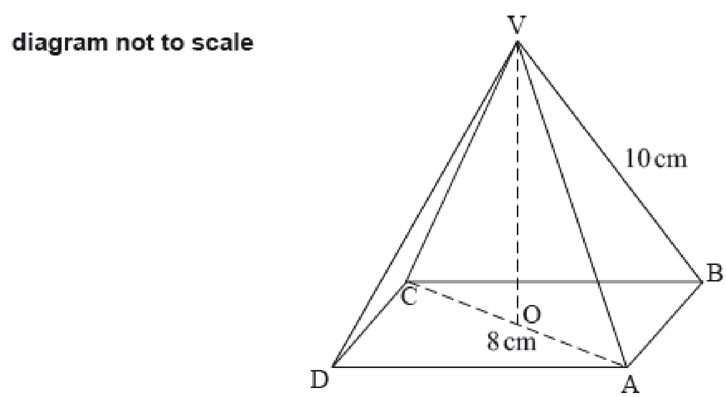
d. the initial number of apartments ***(A1)*** ***(C1)***

Note: Do not accept "first number in the sequence".

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

In the following diagram, ABCD is the square base of a right pyramid with vertex V. The centre of the base is O. The diagonal of the base, AC, is 8 cm long. The sloping edges are 10 cm long.



a. Write down the length of AO. [1]

b. Find the size of the angle that the sloping edge VA makes with the base of the pyramid. [2]

c. Hence, or otherwise, find the area of the triangle CAV. [3]

Markscheme

a. $\mathrm{AO} = 4\ (\mathrm{cm})$ ***(A1)*** ***(C1)***

b. $\cos \mathrm{O\hat{A}V} = \frac{4}{10}$ ***(M1)***

Note: Award ***(M1)*** for their correct trigonometric ratio.

OR

$\cos \mathrm{O\hat{A}V} = \frac{10^2+8^2-10^2}{2\times10\times8}$ **OR** $\frac{10^2+4^2-(9.16515\ldots)^2}{2\times10\times4}$ ***(M1)***

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

$\mathrm{O\hat{A}V} = 66.4^\circ \quad (66.4218\ldots)$ ***(A1)*(ft)** ***(C2)***

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

c. $\text{area} = \frac{8\times10\times\sin(66.4218\ldots^\circ)}{2}$ **OR** $\frac{1}{2}\times 8 \times \sqrt{10^2-4^2}$

OR $\frac{1}{2}\times 10 \times 10 \times \sin(47.1563\ldots^\circ)$ ***(M1)(A1)*(ft)**

Notes: Award ***(M1)*** for substitution into the area formula, ***(A1)*(ft)** for correct substitutions. Follow through from their answer to part (b) and/or part (a).

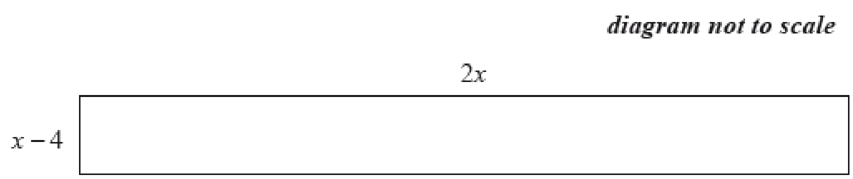
$\text{area} = 36.7\ \text{cm}^2 \quad (36.6606\ldots\ \text{cm}^2)$ ***(A1)*(ft)** ***(C3)***

Notes: Accept an answer of $8\sqrt{21}\ \text{cm}^2$ which is the exact answer.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The surface of a red carpet is shown below. The dimensions of the carpet are in metres.



a. Write down an expression for the area, A, in m^2, of the carpet. [1]

b. The area of the carpet is $10\ \mathrm{m}^2$. [3]

Calculate the value of x.

c. The area of the carpet is $10\ \mathrm{m}^2$. [2]

Hence, write down the value of the length and of the width of the carpet, in metres.

Markscheme

a. $2x(x-4)$ **or** $2x^2-8x$ ***(A1)*** ***(C1)***

Note: Award ***(A0)*** for $x - 4 \times 2x$.

[1 mark]

b. $2x(x-4)=10$ ***(M1)***

Note: Award ***(M1)*** for equating their answer in part (a) to 10.

$x^2-4x-5=0$ ***(M1)***

OR

Sketch of $y=2x^2-8x$ and $y=10$ ***(M1)***

OR

Using GDC solver $x=5$ and $x=-1$ ***(M1)***

OR

$2(x+1)(x-5)$ ***(M1)***

$x=5\ (\text{m})$ ***(A1)*****(ft)** ***(C3)***

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

Award at most ***(M1)(M1)(A0)*** if both 5 and -1 are given as final answer.

Final ***(A1)*****(ft)** is awarded for choosing only the positive solution(s).

[3 marks]

c. $2\times 5=10\ (\text{m})$ ***(A1)*****(ft)**

$5-4=1\ (\text{m})$ ***(A1)*****(ft)** ***(C2)***

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

Do not accept negative answers.

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

---

75 metal spherical cannon balls, each of diameter 10 cm, were excavated from a Napoleonic War battlefield.

a. Calculate the total volume of all 75 metal cannon balls excavated. [3]

b. The cannon balls are to be melted down to form a sculpture in the shape of a cone. The base radius of the cone is $20\ \text{cm}$. [3]

Calculate the height of the cone, assuming that no metal is wasted.

Markscheme

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

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

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

$h = 93.8\text{ cm}$ ***(A1)*(ft)** ***(C3)***

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

[3 marks]

Examiners report

a. 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.

b. 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.

A balloon in the shape of a sphere is filled with helium until the radius is 6 cm.

The volume of the balloon is increased by 40%.

a. Calculate the volume of the balloon. [2]

b. Calculate the radius of the balloon following this increase. [4]

Markscheme

a. **Units are required in parts (a) and (b).**

$\frac{4}{3}\pi \times 6^3$ ***(M1)***

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

$= 905 \text{ cm}^3 \ (288\pi \text{ cm}^3, \ 904.778\ldots \text{ cm}^3)$ ***(A1)*** ***(C2)***

Note: Answers derived from the use of approximations of π (3.14; 22/7) are awarded ***(A0)***.

[2 marks]

b. **Units are required in parts (a) and (b).**

$\frac{140}{100} \times 904.778\ldots = \frac{4}{3}\pi r^3$ **OR** $\frac{140}{100} \times 288\pi = \frac{4}{3}\pi r^3$ **OR** $1266.69\ldots = \frac{4}{3}\pi r^3$ ***(M1)(M1)***

Note: Award ***(M1)*** for multiplying their part (a) by 1.4 or equivalent, ***(M1)*** for equating to the volume of a sphere formula.

$r^3 = \frac{3 \times 1266.69\ldots}{4\pi}$ **OR** $r = \sqrt[3]{\frac{3 \times 1266.69\ldots}{4\pi}}$ **OR** $r = \sqrt[3]{(1.4) \times 6^3}$ **OR** $r^3 = 302.4$ ***(M1)***

Note: Award ***(M1)*** for isolating r.

$(r =) \ 6.71 \text{ cm} \ (6.71213\ldots)$ ***(A1)*(ft)** ***(C4)***

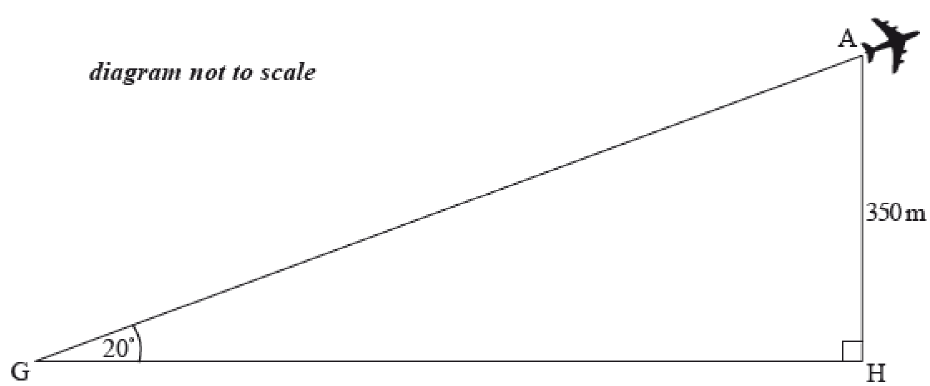
Note: Follow through from part (a).

[4 marks]

Examiners report

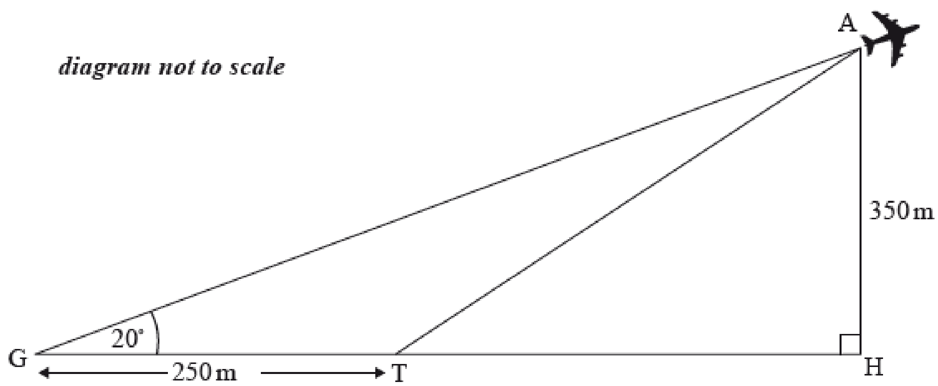
a. [N/A]
b. [N/A]

Günter is at Berlin Tegel Airport watching the planes take off. He observes a plane that is at an angle of elevation of 20° from where he is standing at point G. The plane is at a height of 350 metres. This information is shown in the following diagram.



a. Calculate the horizontal distance, GH, of the plane from Günter. **Give your answer to the nearest metre.** [3]

b. The plane took off from a point T, which is 250 metres from where Günter is standing, as shown in the following diagram. [3]



Using your answer from part (a), calculate the angle ATH, the takeoff angle of the plane.

Markscheme

a. $\frac{350}{\tan 20^\circ}$ ***(M1)***

$= 961.617\ldots$ ***(A1)***

$= 962\ (\mathrm{m})$ ***(A1)*****(ft)** ***(C3)***

Notes: Award ***(M1)*** for correct substitution into correct formula, ***(A1)*** for correct answer, ***(A1)*****(ft)** for correct rounding to the nearest metre.

Award ***(M0)(A0)(A0)*** for 961 without working.

[3 marks]

b. $961.617\ldots - 250 = 711.617\ldots$ ***(A1)*****(ft)**

$\tan^{-1}\left(\frac{350}{711.617\ldots}\right)$ ***(M1)***

$= 26.2^\circ\ (26.1896\ldots)$ ***(A1)*****(ft)** ***(C3)***

Notes: Accept $26.1774\ldots$ from use of 3 sf answer 962 from part (a). Follow through from their answer to part (a).

Accept alternative methods.

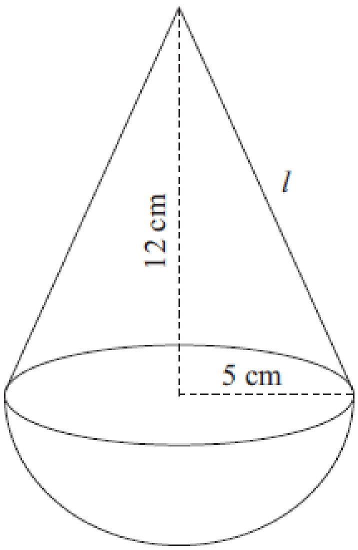
[3 marks]

Examiners report

a. [N/A]

b. [N/A]

A child’s toy consists of a hemisphere with a right circular cone on top. The height of the cone is 12 cm and the radius of its base is 5 cm . The toy is painted red.



a. Calculate the length, l, of the slant height of the cone. [2]

b. Calculate the area that is painted red. [4]

Markscheme

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

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

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

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

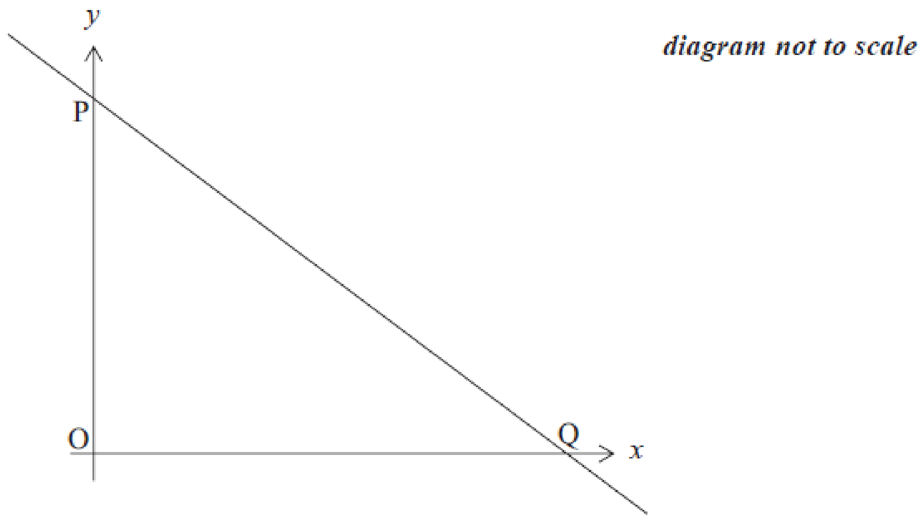
Note: The answer is $361\ \text{cm}^2$, the units are required.

Examiners report

a. [N/A]

b. [N/A]

The diagram below shows the line PQ, whose equation is $x + 2y = 12$. The line intercepts the axes at P and Q respectively.



a. Find the coordinates of P and of Q. [3]

b. A second line with equation $x - y = 3$ intersects the line PQ at the point A. Find the coordinates of A. [3]

Markscheme

a. $0 + 2y = 12$ 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]

b. $x + 2(x - 3) = 12$ ***(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

a. 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.

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

The mid-point, M, of the line joining A(s , 8) to B(−2, t) has coordinates M(2, 3).

a. Calculate the values of s and t. [2]

b. Find the equation of the straight line perpendicular to AB, passing through the point M. [4]

Markscheme

a. $s = 6$ ***(A1)***

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

[2 marks]

b. gradient of $\mathrm{AB} = \frac{-2-8}{-2-6} = \frac{-10}{-8} = \frac{5}{4}$ ***(A1)*(ft)**

***(A1)** for gradient of AM or BM* $= \frac{5}{4}$

$\text{Perpendicular gradient} = -\frac{4}{5}$ ***(A1)*(ft)**

Equation of perpendicular bisector is

$y = -\frac{4}{5}x + c$

$3 = -\frac{4}{5}(2) + c$ ***(M1)***

$c = 4.6$

$y = -0.8x + 4.6$

or $5y = -4x + 23$ ***(A1)*(ft)** ***(C4)***

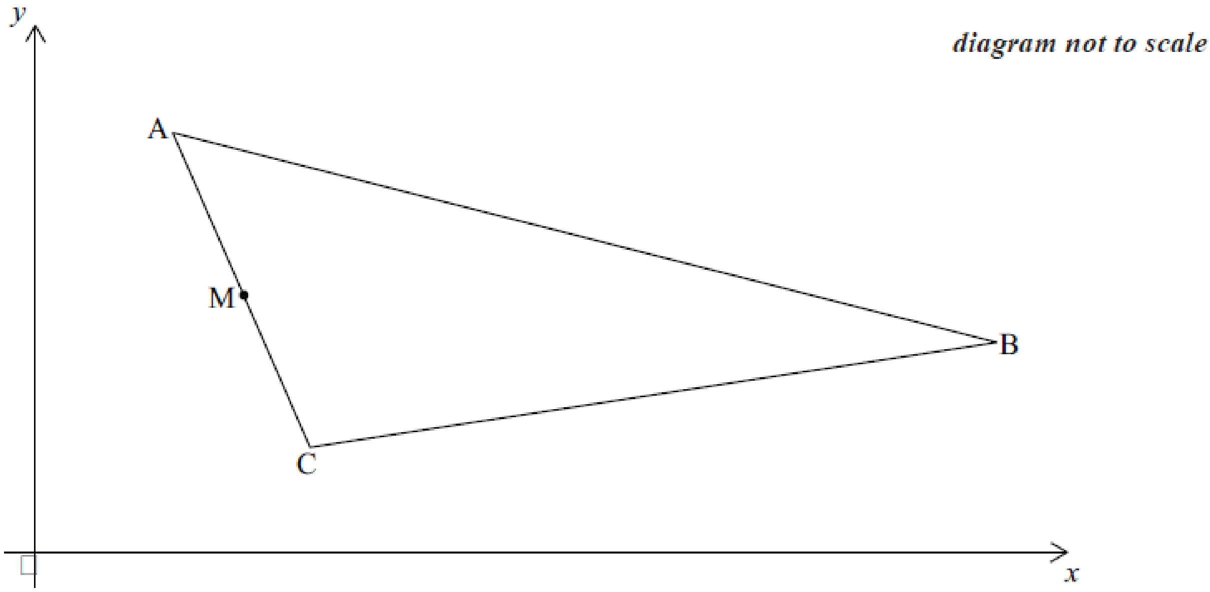
[4 marks]

Examiners report

a. (a) It was surprising how many errors were made in finding the values for s and t

b. (b) The candidates had difficulty in finding the equation of a straight line. They could find the gradient of the line AB and a number could give the gradient of the perpendicular line but most did not substitute the correct midpoint to find the equation of the line.

The diagram shows points A(2, 8), B(14, 4) and C(4, 2). M is the midpoint of AC.



a. Write down the coordinates of M. [2]

b. Calculate the gradient of the line AB. [2]

c. Find the equation of the line parallel to AB that passes through M. [2]

Markscheme

a. $\left(\frac{2+4}{2}, \frac{8+2}{2}\right)$ ***(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]

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

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

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

[2 marks]

c. $(y-5) = -\frac{1}{3}(x-3)$ ***(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

a. 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).

b. 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.

c. 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 $y = 3x + 5$.

Line L is given by the equation $3y + 2x = 9$ and point P has coordinates (6 , –5).

a. Explain why point P is not on the line *L*. [1]

b. Find the gradient of line *L*. [2]

c. (i) Write down the gradient of a line perpendicular to line *L*. [3]

(ii) Find the equation of the line perpendicular to *L* and passing through point P.

Markscheme

a. 3 × (–5) + 2 × 6 ≠ 9 ***(A1)*** ***(C1)***

Note: Also accept 3 × (–5) + 2*x* = 9 gives *x* =12 ≠ 6 or 3*y* + 2 × (6) = 9 gives *y* = –1 ≠ –5.

[1 mark]

b. 3*y* = –2*x* + 9 ***(M1)***

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

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

[2 marks]

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

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

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

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

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

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

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

OR

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

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

[3 marks]

Examiners report

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

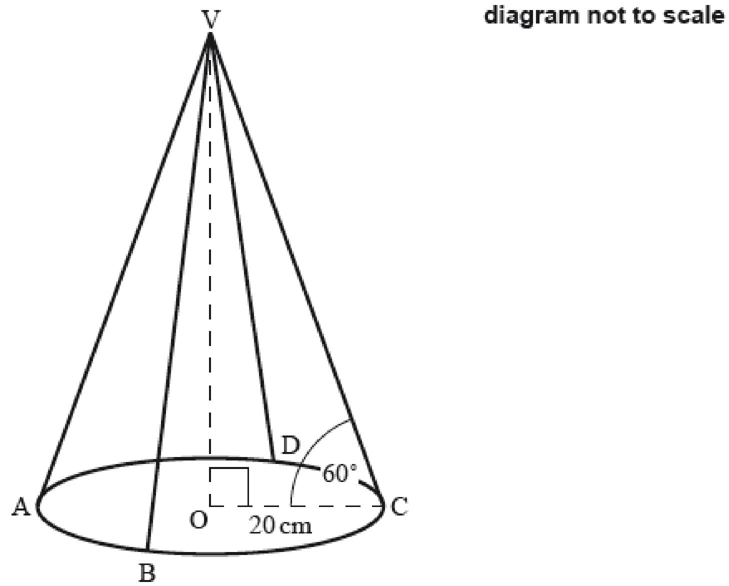
b. In part (a), the word *'explain'* required more than simply stating that '*I put the coordinates into my GDC and it did not work*'. A written statement, showing the substitution of one or both of the coordinates leading to an inequality was required for this first mark. It was pleasing to see that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

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

A lampshade, in the shape of a cone, has a wireframe consisting of a circular ring and four straight pieces of equal length, attached to the ring at points A, B, C and D.

The ring has its centre at point O and its radius is 20 centimetres. The straight pieces meet at point V, which is vertically above O, and the angle they make with the base of the lampshade is 60°.

This information is shown in the following diagram.



a. Find the length of one of the straight pieces in the wireframe. [2]

b. Find the total length of wire needed to construct this wireframe. Give your answer in centimetres correct to the nearest millimetre. [4]

Markscheme

a. $\cos 60^\circ = \frac{20}{b}$ **OR** $b = \frac{20}{\cos 60^\circ}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into a correct trig. ratio.

$(b =)\ 40\ (\text{cm})$ ***(A1)*** ***(C2)***

[2 marks]

b. $4 \times 40 + 2\pi(20)$ ***(M1)(M1)***

Note: Award ***(M1)*** for correct substitution in the circumference of the circle formula, ***(M1)*** for adding 4 times their answer to part (a) to their circumference of the circle.

285.6637… ***(A1)*(ft)**

Note: Follow through from part (a). This ***(A1)*** may be implied by a correct rounded answer.

285.7 (cm) ***(A1)*(ft)** ***(C4)***

Notes: Award ***(A1)*(ft)** for rounding their answer (consistent with their method) to the nearest millimetre, irrespective of unrounded answer seen.

The final ***(A1)*(ft)** is not dependent on any of the previous ***M*** marks. It is for rounding their unrounded answer correctly.

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

A building company has many rectangular construction sites, of varying widths, along a road.

The area, A, of each site is given by the function

$$A(x) = x(200 - x)$$

where x is the **width** of the site in metres and $20 \leqslant x \leqslant 180$.

a. Site S has a width of 20 m. Write down the area of S. [1]

b. Site T has the same area as site S, but a different width. Find the width of T. [2]

c. When the width of the construction site is b metres, the site has a maximum area. [2]

(i) Write down the value of b.

(ii) Write down the maximum area.

d. The range of $A(x)$ is $m \leqslant A(x) \leqslant n$. [1]

Hence write down the value of m and of n.

Markscheme

a. $3600\ (\mathrm{m}^2)$ ***(A1)(C1)***

b. $x(200 - x) = 3600$ ***(M1)***

Note: Award ***(M1)*** for setting up an equation, equating to their 3600.

$180\ (\mathrm{m})$ ***(A1)*****(ft)** ***(C2)***

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

c. (i) $100\ (\mathrm{m})$ ***(A1)*** ***(C1)***

(ii) $10\,000\ (\mathrm{m}^2)$ ***(A1)*****(ft)*****(C1)***

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

d. $m = 3600$ **and** $n = 10\,000$ ***(A1)*****(ft)** ***(C1)***

Notes: Follow through from part (a) and part (c)(ii), but only if their m is less than their n. Accept the answer $3600 \leqslant A \leqslant 10\,000$.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

The distance d from a point $\mathrm{P}(x,\ y)$ to the point $\mathrm{A}(1,\ -2)$ is given by $d = \sqrt{(x-1)^2 + (y+2)^2}$

a. Find the distance from $\mathrm{P}(100,\ 200)$ to A. Give your answer correct to two decimal places. [3]

b. Write down your answer to **part (a)** correct to three significant figures. [1]

c. Write down your answer to **part (b)** in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. $\sqrt{(100-1)^2 + (200+2)^2}$ ***(M1)***

$\sqrt{50605} \quad (= 224.955\ldots)$ ***(A1)***

Note: Award ***(M1)(A1)*** if $\sqrt{50605}$ seen.

224.96 ***(A1)*** ***(C3)***

Note: Award ***(A1)*** for their answer given correct to 2 decimal places.

b. 225 ***(A1)*****(ft)** ***(C1)***

Note: Follow through from their part (a).

c. 2.25×10^2 ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

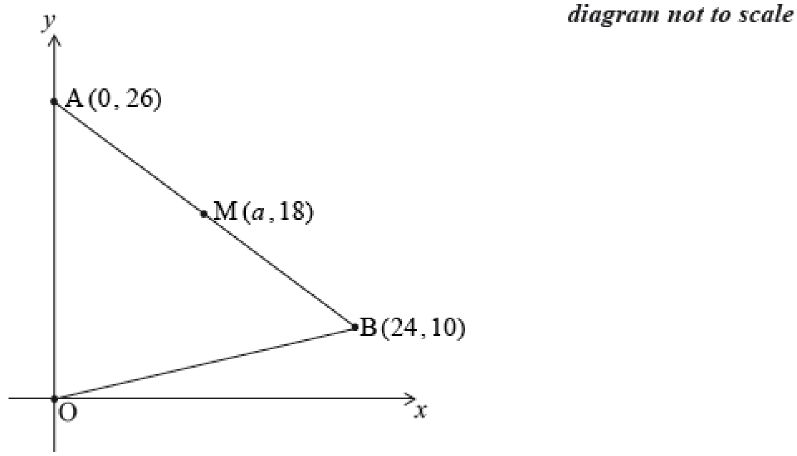
Notes: Award ***(A1)(A0)*** for 2.25 and an incorrect index value.

Award ***(A0)(A0)*** for answers such as 22.5×10^1.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The diagram shows the points M(a, 18) and B(24, 10) . The straight line BM intersects the y-axis at A(0, 26). M is the midpoint of the line segment AB.



a. Write down the value of a. [1]

b. Find the gradient of the line AB. [2]

c. Decide whether triangle OAM is a right-angled triangle. Justify your answer. [3]

Markscheme

a. 12 ***(A1)*** ***(C1)***

Note: Award ***(A1)*** for $(12, 18)$.

[1 mark]

b. $\frac{26-10}{0-24}$ ***(M1)***

Note: Accept $\frac{26-18}{0-12}$ or $\frac{18-10}{12-24}$ (or equivalent).

$= -\frac{2}{3}$ $\left(-\frac{16}{24},\ -0.666666\ldots\right)$ ***(A1)*** ***(C2)***

Note: If either of the alternative fractions is used, follow through from their answer to part (a).

The answer is now ***(A1)*****(ft)**.

[2 marks]

c. gradient of $\mathrm{OM} = \frac{3}{2}$ ***(A1)*****(ft)**

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

$-\frac{2}{3} \times \frac{3}{2}$ ***(M1)***

Note: Award ***(M1)*** for multiplying their gradients.

Since the product is -1, OAM is a right-angled triangle ***(R1)*****(ft)**

Notes: Award the final ***(R1)*** only if their conclusion is consistent with their answer for the product of the gradients.

The statement that OAM is a right-angled triangle without justification is awarded no marks.

OR

$(26-18)^2+12^2$ and 12^2+18^2 ***(A1)*****(ft)**

$\left((26-18)^2+12^2\right)+(12^2+18^2)=26^2$ ***(M1)***

Note: This method can also be applied to triangle OMB.

Follow through from (a).

Hence a right angled triangle ***(R1)*****(ft)**

Note: Award the final ***(R1)*** only if their conclusion is consistent with their ***(M1)*** mark.

OR

$OA=OB=26$ (cm) an isosceles triangle ***(A1)***

Note: Award ***(A1)*** for $OA=26$ (cm) and $OB=26$ (cm).

Line drawn from vertex to midpoint of base is perpendicular to the base ***(M1)***

Conclusion ***(R1)*** ***(C3)***

Note: Award, at most ***(A1)(M0)(R0)*** for stating that OAB is an isosceles triangle without any calculations.

[3 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The equation of line L_1 is $y=-\frac{2}{3}x-2$.

Point P lies on L_1 and has x-coordinate -6.

The line L_2 is perpendicular to L_1 and intersects L_1 when $x = -6$.

a. Write down the gradient of L_1. [1]

b. Find the y-coordinate of P. [2]

c. Determine the equation of L_2. Give your answer in the form $ax + by + d = 0$, where a, b and d are integers. [3]

Markscheme

a. $-\frac{2}{3}$ ***(A1)*** ***(C1)***

[1 mark]

b. $y = -\frac{2}{3}(-6) - 2$ ***(M1)***

Note: Award ***(M1)*** for correctly substituting -6 into the formula for L_1.

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

Note: Award ***(A0)(A1)*** for $(-6,\ 2)$ with or without working.

[2 marks]

c. gradient of L_2 is $\frac{3}{2}$ ***(A1)*****(ft)**

Note: Follow through from part (a).

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

Note: Award ***(M1)*** for substituting their part (b), their gradient and -6 into equation of a straight line.

$3x - 2y + 22 = 0$ ***(A1)*****(ft)** ***(C3)***

Note: Follow through from parts (a) and (b). Accept any integer multiple.

Award ***(A1)(M1)(A0)*** for $y = \frac{3}{2}x + 11$.

[3 marks]

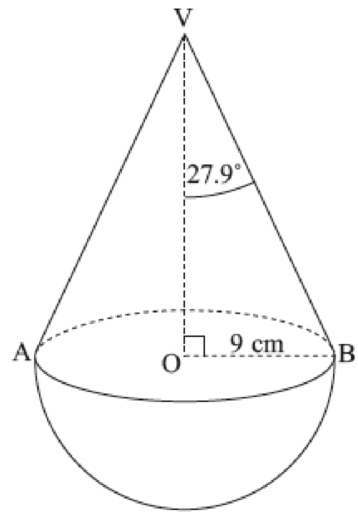
Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

A child's wooden toy consists of a hemisphere, of radius 9 cm , attached to a cone with the same base radius. O is the centre of the base of the cone and V is vertically above O.

Angle OVB is 27.9°.

Diagram not to scale.



a. Calculate OV, the height of the cone. [2]

b. Calculate the volume of wood used to make the toy. [4]

Markscheme

a. $\tan 27.9^{\circ} = \frac{9}{\mathrm{OV}}$ ***(M1)***

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

$\mathrm{OV} = 17.0\,(\mathrm{cm})\,(16.9980\ldots)$ ***(A1)*** ***(C2)***

[2 marks]

b. $\frac{\pi(9)^2(16.9980\ldots)}{3} + \frac{1}{2} \times \frac{4\pi(9)^3}{3}$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correctly substituted volume of the cone, ***(M1)*** for correctly substituted volume of a sphere divided by two (hemisphere), ***(M1)*** for adding the correctly substituted volume of the cone to *either* a correctly substituted sphere *or* hemisphere.

$= 2970\ \mathrm{cm}^3\ (2968.63\ldots)$ ***(A1)*****(ft)** ***(C4)***

Note: The answer is $2970\ \mathrm{cm}^3$, the units are required.

[4 marks]

Examiners report

a. [N/A]
b. [N/A]

A shipping container is a cuboid with dimensions 16 m, $1\frac{3}{4} \text{ m}$ and $2\frac{2}{3} \text{ m}$.

a. Calculate the **exact** volume of the container. Give your answer as a fraction. [3]

b. Jim estimates the dimensions of the container as 15 m, 2 m and 3 m and uses these to estimate the volume of the container. [3]

Calculate the percentage error in Jim's estimated volume of the container.

Markscheme

a. $V = 16 \times 1\frac{3}{4} \times 2\frac{2}{3}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in volume formula. Accept decimal substitution of 2.66 or better.

$= 74.6666\ \ldots$ ***(A1)***
$= 74\frac{2}{3} \text{ m}^3 \left(\frac{224}{3} \text{ m}^3\right)$ ***(A1) (C3)***

Note: Correct answer only.

[3 marks]

b. $\% \text{ error} = \frac{\left(90-74\frac{2}{3}\right)\times 100}{74\frac{2}{3}}$ ***(A1)(M1)***

Note: Award ***(A1)*** for 90 seen, or inferred in numerator, ***(M1)*** for correct substitution into percentage error formula.

$= 20.5$ ***(A1)*(ft)** ***(C3)***

Note: Accept -20.5.

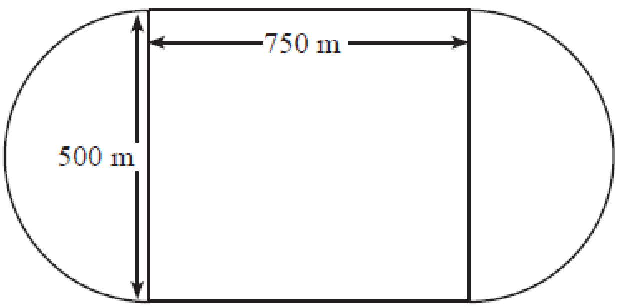
[3 marks]

Examiners report

a. This question was well answered by the majority of candidates. Candidates encountered difficulty in part (a) with using fractions finding the exact volume. Nearly all candidates could use the formula for volume and most could achieve at least 2 marks in this first part. Most candidates could find the percentage error correctly using the formula once they found the estimate for the volume. Very few candidates substituted the formula incorrectly, or had an incorrect denominator.

b. This question was well answered by the majority of candidates. Candidates encountered difficulty in part (a) with using fractions finding the exact volume. Nearly all candidates could use the formula for volume and most could achieve at least 2 marks in this first part. Most candidates could find the percentage error correctly using the formula once they found the estimate for the volume. Very few candidates substituted the formula incorrectly, or had an incorrect denominator.

A race track is made up of a rectangular shape 750 m by 500 m with semi-circles at each end as shown in the diagram.



Michael drives around the track once at an average speed of 140 kmh^{-1}.

a. Calculate the distance that Michael travels. [2]

b. Calculate how long Michael takes in **seconds**. [4]

Markscheme

a. *Unit penalty **(UP)** may apply in this question.*

$\text{Distance} = \pi \times 500 + 2 \times 750$ ***(M1)***

(UP) $= 3070 \text{ m}$ ***(A1)*** ***(C2)***

[2 marks]

b. *Unit penalty **(UP)** may apply in this question.*

$140 \text{ kmh}^{-1} = \frac{140 \times 1000}{60 \times 60} \text{ ms}^{-1}$ ***(M1)***

$= 38.9 \text{ ms}^{-1}$ ***(A1)***

$\text{Time} = \frac{3070}{38.889}$ ***(M1)***

(UP) $= 78.9$ seconds *(accept* 79.0 *seconds)* ***(A1)*(ft)** ***(C4)***

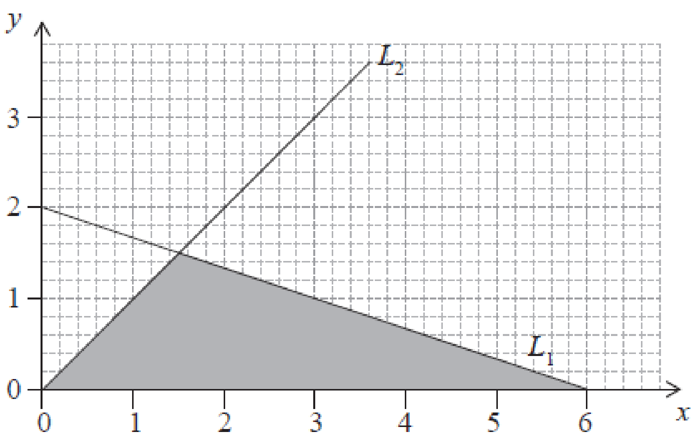
[4 marks]

Examiners report

a. Candidates generally answered part (a) well. A usual mistake was taking 500 as the radius. Some candidates worked out the area rather than the circumference. A good number of candidates correctly answered part (b). Others seemed to get lost in the conversion with multiplication by 3600 and not multiplying by 1000 being common errors. Again follow through marks could be awarded from the candidate’s answer to part (a) provided working was shown.

b. Candidates generally answered part (a) well. A usual mistake was taking 500 as the radius. Some candidates worked out the area rather than the circumference. A good number of candidates correctly answered part (b). Others seemed to get lost in the conversion with multiplication by 3600 and not multiplying by 1000 being common errors. Again follow through marks could be awarded from the candidate's answer to part (a) provided working was shown.

The diagram shows the straight lines L_1 and L_2 . The equation of L_2 is $y = x$.



a. Find [3]

(i) the gradient of L_1 ;

(ii) the equation of L_1 .

b. Find the area of the shaded triangle. [2]

Markscheme

a. (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]

b. $\text{area} = \frac{6\times1.5}{2}$ ***(A1)(M1)***

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

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

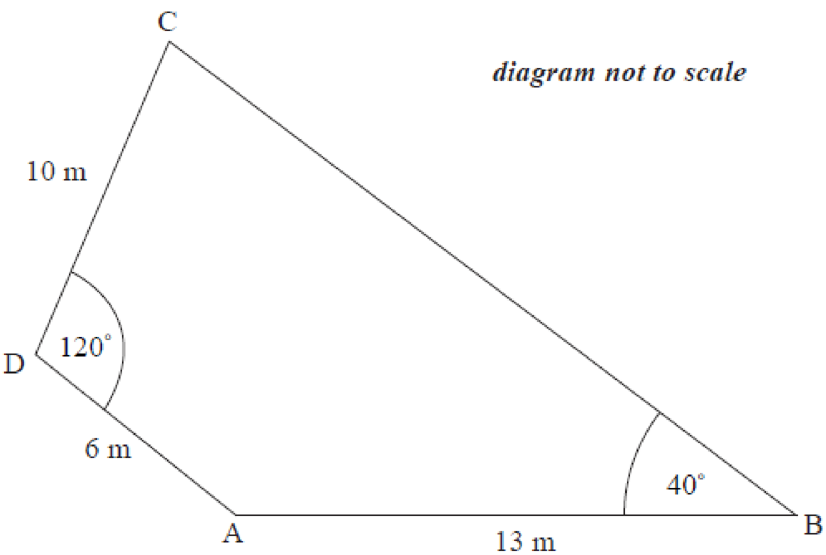
[2 marks]

Examiners report

a. 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.

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

The diagram shows quadrilateral ABCD in which AB = 13 m , AD = 6 m and DC = 10 m. Angle ADC =120° and angle ABC = 40 °.



a. Calculate the length of AC. [3]

b. Calculate the size of angle ACB. [3]

Markscheme

a. $AC^2 = 6^2 + 10^2 - 2\times10\times6\times\cos120°$ ***(M1)(A1)***

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

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

[3 marks]

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

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

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

Note: Follow through from their (a).

[3 marks]

Examiners report

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

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

In a television show there is a transparent box completely filled with identical cubes. Participants have to estimate the number of cubes in the box. The box is 50 cm wide, 100 cm long and 40 cm tall.

a. Find the volume of the box. [2]

b. Joaquin estimates the volume of one cube to be 500 cm^3. He uses this value to estimate the number of cubes in the box. [2]

Find Joaquin's estimated number of cubes in the box.

c. The actual number of cubes in the box is 350. [2]

Find the percentage error in Joaquin's estimated number of cubes in the box.

Markscheme

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

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

[2 marks]

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

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

[2 marks]

c. $\frac{400-350}{350} \times 100 = 14.3\ \%$ ***(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

a. 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.

b. 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.

c. 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.

The equation of a curve is given as $y = 2x^2 - 5x + 4$.

a. Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. [2]

b. The equation of the line *L* is $6x + 2y = -1$. [4]

Find the *x*-coordinate of the point on the curve $y = 2x^2 - 5x + 4$ where the tangent is parallel to *L*.

Markscheme

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

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

[2 marks]

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

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

gradient of line is –3 ***(A1)***

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

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

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

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

[4 marks]

Examiners report

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

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

The volume of a sphere is $V = \sqrt{\frac{S^3}{36\pi}}$, where S is its surface area.

The surface area of a sphere is 500 cm^2 .

a. Calculate the volume of the sphere. Give your answer correct to **two decimal places**. [3]

b. Write down your answer to (a) correct to the nearest integer. [1]

c. Write down your answer to (b) in the form $a \times 10^n$, where $1 \leqslant a < 10$ and $n \in \mathbb{Z}$. [2]

Markscheme

a. $V = \sqrt{\frac{500^3}{36\pi}}$ ***(M1)***

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

V = 1051.305 … ***(A1)***
V = 1051.31 cm^3 ***(A1)*(ft)** ***(C3)***

Note: Award last ***(A1)*(ft)** for correct rounding to 2 decimal places of their answer. Unrounded answer must be seen so that the follow through can be awarded.

[3 marks]

b. 1051 ***(A1)*(ft)**

[1 mark]

c. 1.051×10^3 ***(A1)*(ft)*(A1)*(ft)** ***(C2)***

Note: Award ***(A1)*** for 1.051 (accept 1.05) ***(A1)*** for $\times 10^3$.

[2 marks]

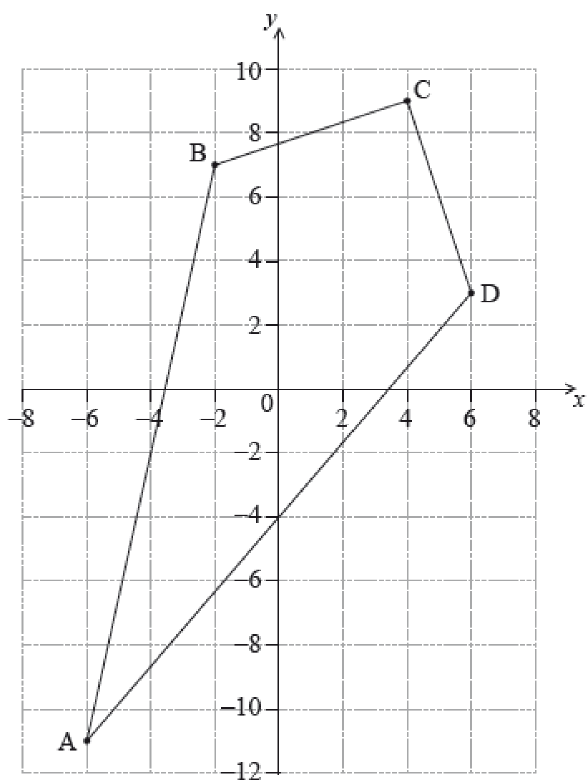
Examiners report

a. This question was well answered by many of the candidates. A significant number of candidates lost two marks in part (a) for not using the calculator correctly and omitting brackets in the denominator when entering the volume expression in their GDC. Also, those students who did not show the unrounded answer in the working box could not be awarded the last mark in part a). Follow through marks were awarded for parts (b) and (c) which most candidates gained.

b. This question was well answered by many of the candidates. A significant number of candidates lost two marks in part (a) for not using the calculator correctly and omitting brackets in the denominator when entering the volume expression in their GDC. Also, those students who did not show the unrounded answer in the working box could not be awarded the last mark in part (a). Follow through marks were awarded for parts (b) and (c) which most candidates gained.

c. This question was well answered by many of the candidates. A significant number of candidates lost two marks in part (a) for not using the calculator correctly and omitting brackets in the denominator when entering the volume expression in their GDC. Also, those students who did not show the unrounded answer in the working box could not be awarded the last mark in part a). Follow through marks were awarded for parts (b) and (c) which most candidates gained.

The four points A(−6, −11) , B(−2, 7) , C(4, 9) and D(6, 3) define the vertices of a kite.



a. Calculate the distance between points B and D. [2]

b. The distance between points A and C is $\sqrt{500}$. [4]

Calculate the area of the kite ABCD.

Markscheme

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

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

$= 8.94 \left(8.94427\ldots,\ \sqrt{80},\ 4\sqrt{5}\right)$ ***(A1)*** ***(C2)***

b. Area $\mathrm{ABCD} = 2 \times \left(0.5 \times \frac{\text{their BD}}{2} \times \sqrt{500}\right)$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for dividing their BD by 2, ***(M1)*** for **correct** substitution into the area of triangle formula, ***(M1)*** for adding two triangles (or multiplied by 2).

Accept alternative methods:

Area of kite $= 0.5 \times \sqrt{500} \times$ their part (a).

Award ***(M1)*** for stating kite formula.

Award ***(M1)*** for correctly substituting in $\sqrt{500}$.

Award ***(M1)*** for correctly substituting in their part (a).

$= 100$ ***(A1)*** ***(C4)***

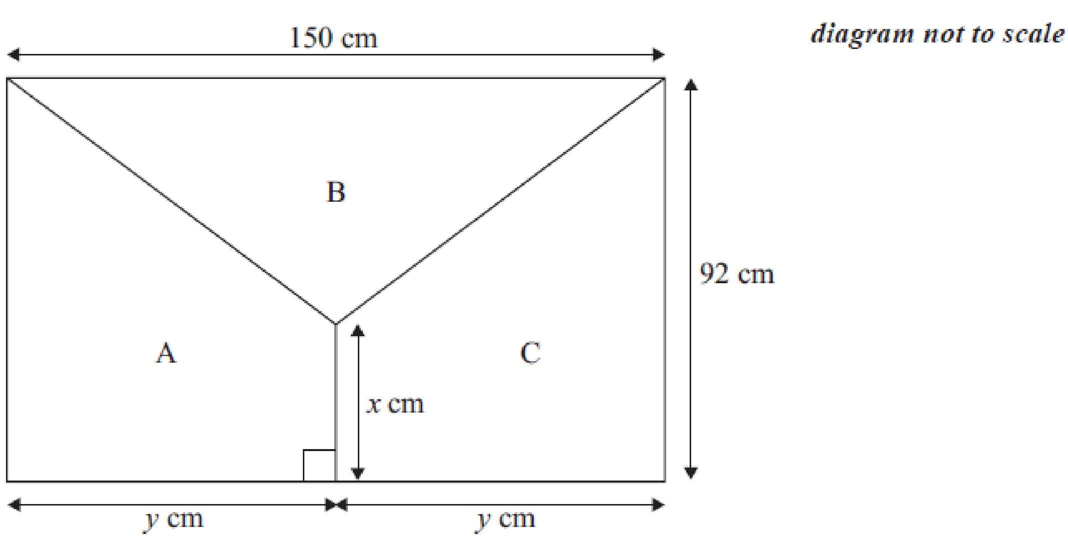
Note: Accept 99.9522 if 3 sf answer is used from part (a).

Examiners report

a. [N/A]

b. [N/A]

The diagram below represents a rectangular flag with dimensions 150 cm by 92 cm. The flag is divided into three regions A, B and C.



a. Write down the total area of the flag. [1]

b. Write down the value of *y*. [1]

c. The areas of regions A, B, and C are equal. [1]

Write down the area of region A.

d. Using your answers to **parts (b) and (c)**, find the value of *x*. [3]

Markscheme

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

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

b. 75 ***(A1)*** ***(C1)***

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

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

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

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

OR

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

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

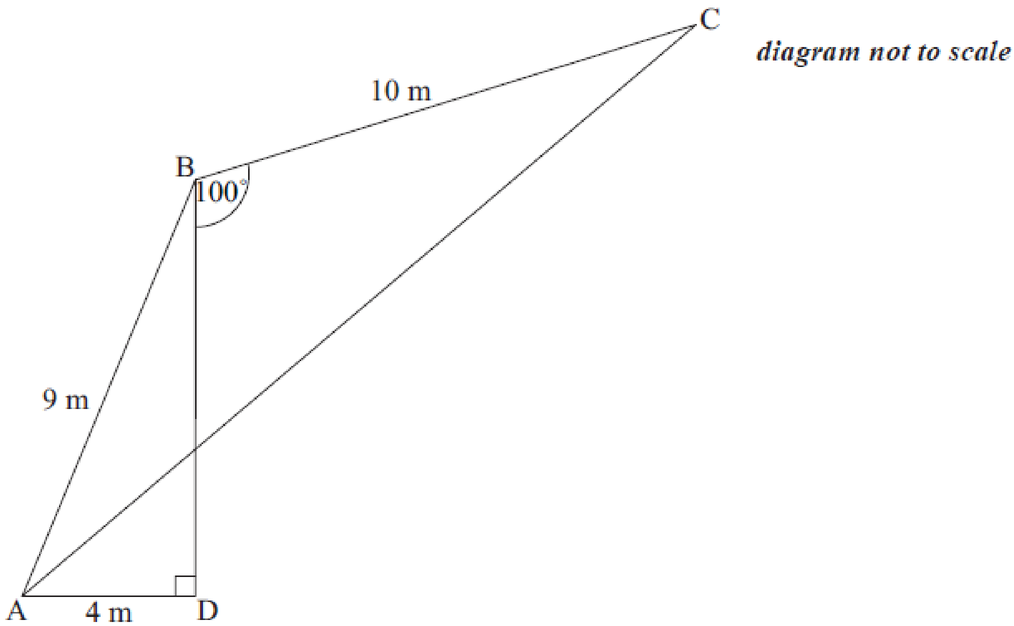
(= 30.7 (cm)(30.6666...(cm)) ***(A1)*(ft)** ***(C3)***

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

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

In the diagram, $\text{AD} = 4\text{ m}$, $\text{AB} = 9\text{ m}$, $\text{BC} = 10\text{ m}$, $\text{B}\hat{\text{D}}\text{A} = 90^\circ$ and $\text{D}\hat{\text{B}}\text{C} = 100^\circ$.



a. Calculate the size of $\mathrm{A\hat{B}C}$. [3]

b. Calculate the length of AC. [3]

Markscheme

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

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

[3 marks]

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

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

$\mathrm{AC} = 17.0 \text{ m}$ ***(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]

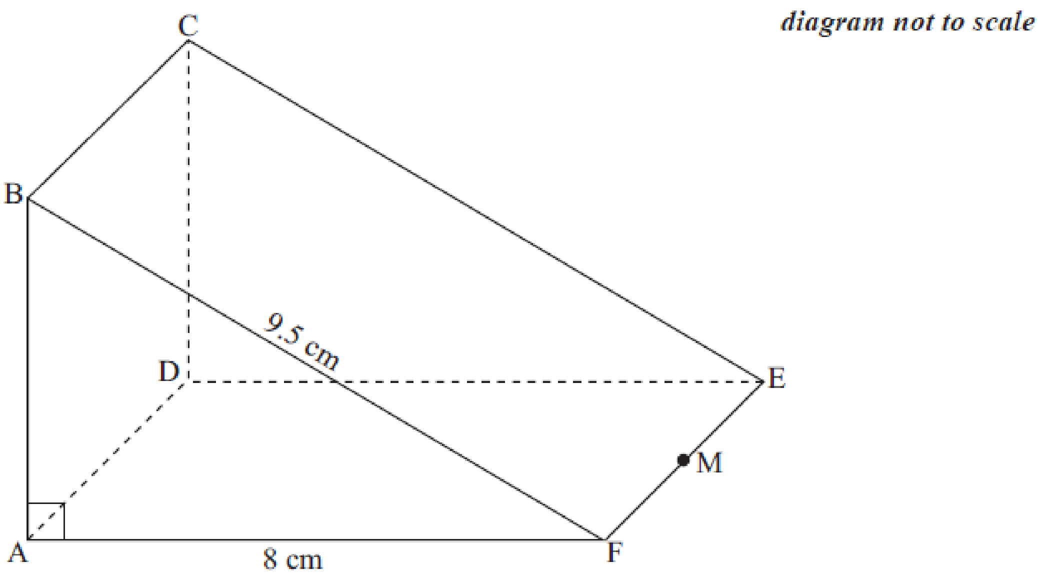
Examiners report

a. 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).

b. 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).

The diagram shows a right triangular prism, ABCDEF, in which the face ABCD is a square.

AF = 8 cm, BF = 9.5 cm, and angle BAF is 90°.



a. Calculate the length of AB . [2]

b. M is the midpoint of EF . [2]

Calculate the length of BM .

c. M is the midpoint of EF . [2]

Find the size of the angle between BM and the face ADEF .

Markscheme

a. $9.5^2 = 8^2 + AB^2$ ***(M1)***

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

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

[2 marks]

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

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

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

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

[2 marks]

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

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

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

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

[2 marks]

Examiners report

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

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

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

Tennis balls are sold in cylindrical tubes that contain four balls. The radius of each tennis ball is 3.15 cm and the radius of the tube is 3.2 cm. The length of the tube is 26 cm.

a. Find the volume of one tennis ball. [2]

b. Calculate the volume of the empty space in the tube when four tennis balls have been placed in it. [4]

Markscheme

a. ***Unit penalty (UP) applies***

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

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

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

[2 marks]

b. ***Unit penalty (UP) applies***

$\text{Volume of empty space} = \pi 3.2^2 \times 26 - 4 \times 130.9$ ***(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

a. 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.

b. 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.

Consider the statement p:

“If a quadrilateral is a square then the four sides of the quadrilateral are equal”.

a. Write down the inverse of statement p in words. [2]

b. Write down the converse of statement p in words. [2]

c. Determine whether the converse of statement p is always true. Give an example to justify your answer. [2]

Markscheme

a. 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]

b. 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]

c. 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

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

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

c. 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.

The diagram shows a pyramid VABCD which has a square base of length 10 cm and edges of length 13 cm. M is the midpoint of the side BC.

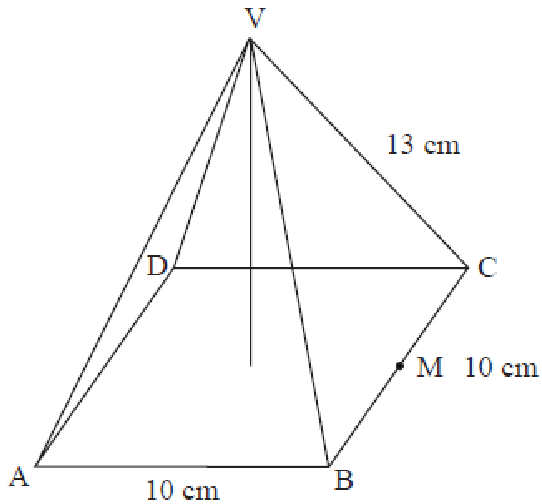


diagram not to scale

a. Calculate the length of VM. [2]

b. Calculate the vertical height of the pyramid. [2]

Markscheme

a. *Unit penalty **(UP)** applies in this question.*

$\mathrm{VM}^2 = 13^2 - 5^2$ ***(M1)***

UP $= 12 \text{ cm}$ ***(A1)*** ***(C2)***

[2 marks]

b. *Unit penalty **(UP)** applies in this question.*

$h^2 = 12^2 - 5^2$ *(or equivalent)* ***(M1)***

UP $= 10.9 \text{ cm}$ ***(A1)*(ft)** ***(C2)***

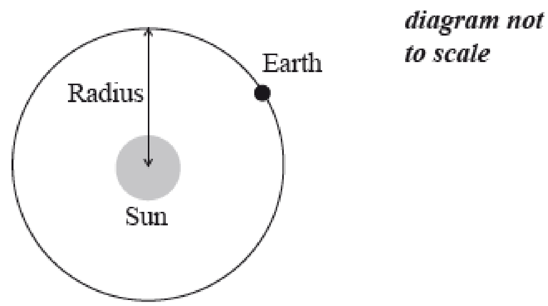
[2 marks]

Examiners report

a. This question was poorly answered by many of the candidates. Pythagoras was improperly applied and candidates were unable to identify right angled triangles.

b. This question was poorly answered by many of the candidates. Pythagoras was improperly applied and candidates were unable to identify right angled triangles.

The average radius of the orbit of the Earth around the Sun is 150 million kilometres.



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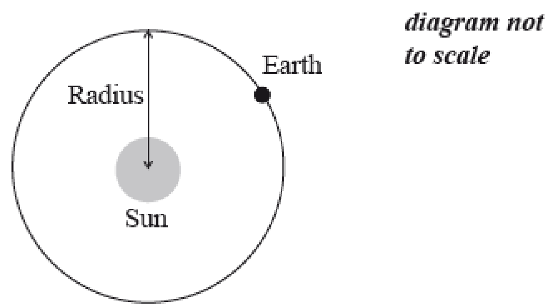


a. Write down this radius, in kilometres, in the form $a \times 10^k$, where $1 \leqslant a < 10,\ k \in \mathbb{Z}$. [2]

b. The Earth travels around the Sun in one orbit. It takes one year for the Earth to complete one orbit. [2]

Calculate the distance, in kilometres, the Earth travels around the Sun in one orbit, assuming that the orbit is a circle.

c. Today is Anna's 17th birthday. [2]

Calculate the total distance that Anna has travelled around the Sun, since she was born.

Markscheme

a. 1.5×10^8 (km) ***(A2)*** ***(C2)***

Notes: Award ***(A2)*** for the correct answer.

Award ***(A1)(A0)*** for 1.5 and an incorrect index.

Award ***(A0)(A0)*** for answers of the form 15×10^7.

[2 marks]

b. $2\pi 1.5 \times 10^8$ ***(M1)***

$= 942\,000\,000$ (km) $(942\,477\,796.1\ldots,\ 3 \times 10^8\pi,\ 9.42 \times 10^8)$ ***(A1)*(ft)** ***(C2)***

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

Do not accept calculator notation $9.42\mathrm{E}8$.

Do not accept use of $\frac{22}{7}$ or 3.14 for π.

[2 marks]

c. $17 \times 942\,000\,000$ ***(M1)***

$= 1.60 \times 10^{10}\ (\text{km})\ \left(1.60221\ldots \times 10^{10},\ 1.6014 \times 10^{10},\ 16\,022\,122\,530,\ (5.1 \times 10^{9})\pi\right)$ ***(A1)(ft)*** ***(C2)***

Note: Follow through from part (b).

[2 marks]

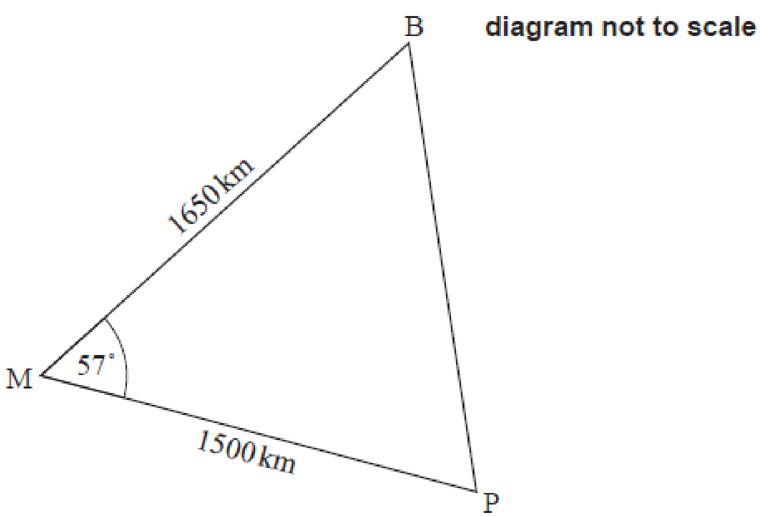
Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

---

a. When Bermuda (B), Puerto Rico (P), and Miami (M) are joined on a map using straight lines, a triangle is formed. This triangle is known as the Bermuda triangle. [3]

According to the map, the distance MB is $1650\,\text{km}$, the distance MP is $1500\,\text{km}$ and angle BMP is 57°.



Calculate the distance from Bermuda to Puerto Rico, BP.

b. Calculate the area of the Bermuda triangle. [3]

Markscheme

a. $\text{BP}^2 = 1650^2 + 1500^2 - 2 \times 1650 \times 1500\ \cos(57^\circ)$ ***(M1)(A1)***

$1510\,(\text{km})\ \ (1508.81\ldots(\text{km}))$ ***(A1)*** ***(C3)***

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

b. $\frac{1}{2} \times 1650 \times 1500 \times \sin 57^\circ$ ***(M1)(A1)***

$= 1\,040\,000\,(\text{km}^2)\quad (1\,037\,854.82...\,(\text{km}^2))$ ***(A1) (C3)***

Note: Award ***(M1)*** for substitution in the area of triangle formula, ***(A1)*** for correct substitution.

Examiners report

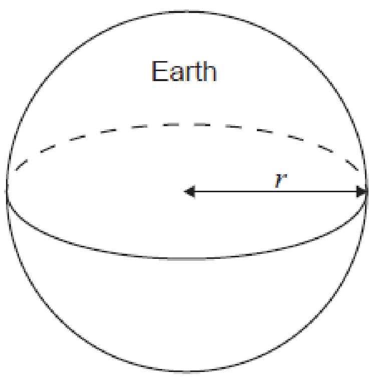
a. Question 6: Non-right angle trigonometry.

Instead of using the law of cosines weaker candidates substituted into Pythagoras' theorem and likewise used $A = \frac{1}{2}bh$ instead of $A = \frac{1}{2}ab\sin C$. Those that did select the correct formula almost always made correct substitutions but were not always able to calculate the correct answer.

b. Question 6: Non-right angle trigonometry. Instead of using the law of cosines weaker candidates substituted into Pythagoras' theorem and likewise used $A = \frac{1}{2}bh$ instead of $A = \frac{1}{2}ab\sin C$. Those that did select the correct formula almost always made correct substitutions but were not always able to calculate the correct answer.

---

a. Assume that the Earth is a sphere with a radius, r , of $6.38 \times 10^3\,\text{km}$. [4]



i) Calculate the surface area of the Earth in km^2.

ii) Write down your answer to part (a)(i) in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$.

b. The surface area of the Earth that is covered by water is approximately $3.61 \times 10^8\text{km}^2$. [2]

Calculate the percentage of the surface area of the Earth that is covered by water.

Markscheme

a. i) $4\pi(6.38 \times 10^3)^2$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into the surface area of a sphere formula.

$= 512\,000\,000\quad (511506576,\ 162\,817\,600\pi)$ ***(A1) (C2)***

Note: Award at most ***(M1)(A0)*** for use of 3.14 for π, which will give an answer of $511\,247\,264$.

ii) $5.12 \times 10^8\quad (5.11506... \times 10^8,\ 1.628176\pi \times 10^8)$ ***(A1)*****(ft)*****(A1)*****(ft)*** ***(C2)***

Note: Award ***(A1)*** for 5.12 and ***(A1)*** for $\times 10^8$.
Award ***(A0)(A0)*** for answers of the type: 5.12×10^7.
Follow through from part (a)(i).

b. $\frac{3.61 \times 10^8}{5.11506... \times 10^8} \times 100$ **OR** $\frac{3.61}{5.11506...} \times 100$ **OR** $0.705758... \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution. Multiplication by 100 must be seen.

$= 70.6\,(\%) \quad (70.5758...\,(\%))$ ***(A1)*(ft)** ***(C2)***

Note: Follow through from part (a). Accept the use of 3 sf answers, which gives a final answer of $70.5\,(\%) \quad (70.5758...\,(\%))$.

Examiners report

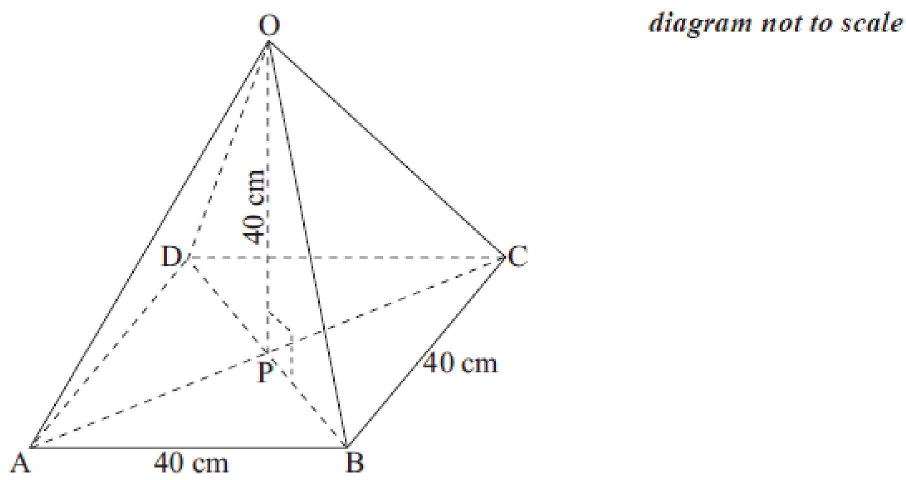
a. Question 1: Surface area of a sphere; scientific notation and percentage.

The weakest candidates were unable to square a number given in scientific notation or write the answer in scientific notation. Weaker candidates used the area of a circle formula rather than the surface area of a sphere. Premature rounding caused some candidates to obtain an incorrect final answer. Many candidates confused percentage of a quantity with percentage error or found the reciprocal of the correct answer. Overall this question was well attempted.

b. Question 1: Surface area of a sphere; scientific notation and percentage.

The weakest candidates were unable to square a number given in scientific notation or write the answer in scientific notation. Weaker candidates used the area of a circle formula rather than the surface area of a sphere. Premature rounding caused some candidates to obtain an incorrect final answer. Many candidates confused percentage of a quantity with percentage error or found the reciprocal of the correct answer. Overall this question was well attempted.

The right pyramid shown in the diagram has a square base with sides of length 40 cm. The height of the pyramid is also 40 cm.



a. Find the length of OB. [4]

b. Find the size of angle OBP. [2]

Markscheme

a. ***Note: Unit penalty (UP) applies in this part***

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

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

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

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

[4 marks]

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

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

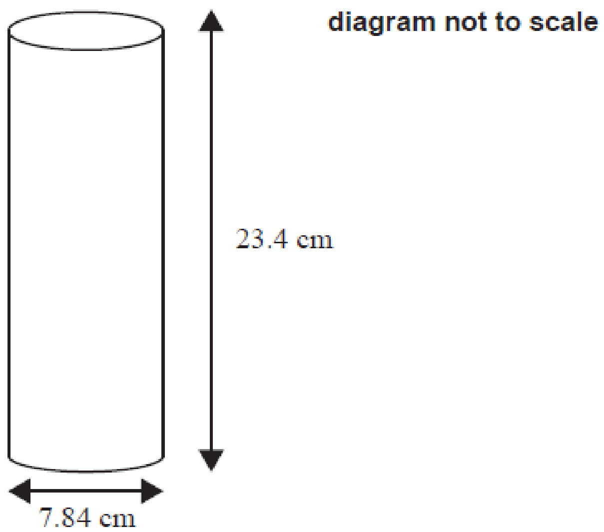
[2 marks]

Examiners report

a. 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.

b. 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.

a. A snack container has a cylindrical shape. The diameter of the base is $7.84\ \mathrm{cm}$. The height of the container is $23.4\ \mathrm{cm}$. This is shown in the following diagram. [1]



Write down the radius, in cm, of the base of the container.

b. Calculate the area of the base of the container. [2]

c. Dan is going to paint the curved surface and the base of the snack container. [3]

Calculate the area to be painted.

Markscheme

a. $3.92\ (\mathrm{cm})$ ***(A1)*** ***(C1)***

b. $\pi \times 3.92^2$ ***(M1)***

$= 48.3\ \mathrm{cm}^2 \ \ (15.3664\,\pi\ \mathrm{cm}^2,\ 48.2749...\ \mathrm{cm}^2)$ ***(A1)*(ft)** ***(C2)***

Note: Award ***(M1)*** for correct substitution in area of circle formula. Follow through from their part (a). The answer is $48.3\ \mathrm{cm}^2$, units are required.

c. $2 \times \pi \times 3.92 \times 23.4 + 48.3$ ***(M1)(M1)***

$625\ \mathrm{cm}^2 \ \ (624.618...\ \mathrm{cm}^2)$ ***(A1)*(ft)** ***(C3)***

Note: Award ***(M1)*** for correct substitution in curved surface area formula, ***(M1)*** for adding their answer to part (b). Follow through from their parts (a) and (b). The answer is $625\ \mathrm{cm}^2$, units are required.

Examiners report

a. Question 11: Cylinder base area and curved surface area.

In responses to this question, units were sometimes missing or the wrong units were given. The question explicitly asked for the base and curved surface area but many gave both the top and bottom as well as the curved surface area, or omitted the ends.

b. Question 11: Cylinder base area and curved surface area.

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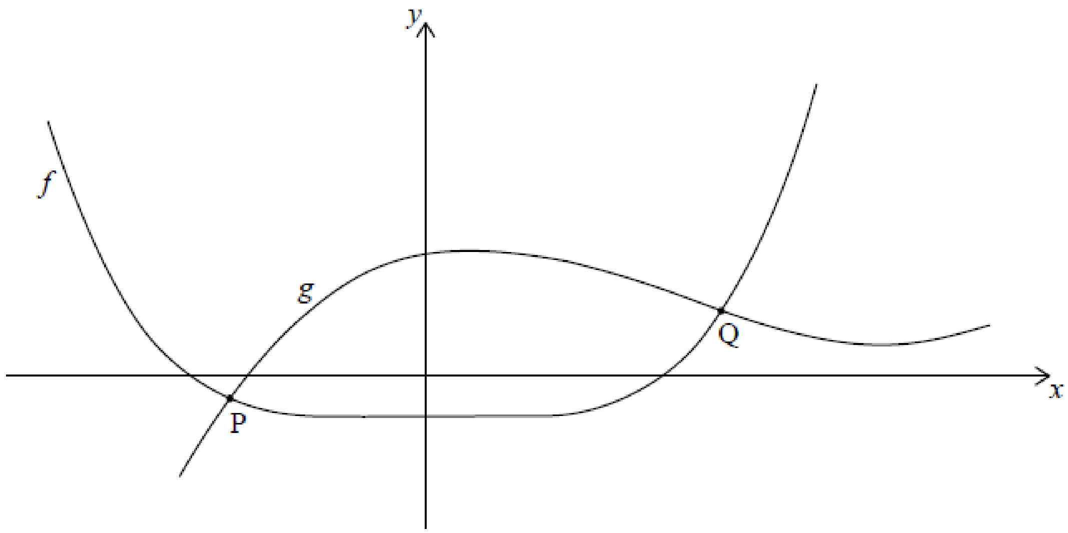
c. Question 11: Cylinder base area and curved surface area.

In responses to this question, units were sometimes missing or the wrong units were given. The question explicitly asked for the base and curved surface area but many gave both the top and bottom as well as the curved surface area, or omitted the ends.

Consider the functions $f\left(x\right) = x^4 - 2$ and $g\left(x\right) = x^3 - 4x^2 + 2x + 6$

The functions intersect at points P and Q. Part of the graph of $y = f\left(x\right)$ and part of the graph of $y = g\left(x\right)$ are shown on the diagram.



a. Find the range of *f*. [2]

b. Write down the *x*-coordinate of P and the *x*-coordinate of Q. [2]

c. Write down the values of *x* for which $f\left(x\right) > g\left(x\right)$. [2]

Markscheme

a. $[-2,\ \infty[\ \text{or}\ [-2,\ \infty)$ **OR** $f\left(x\right) \geqslant -2\ \text{or}\ y \geqslant -2$ **OR** $-2 \leqslant f\left(x\right) < \infty$ ***(A1)(A1) (C2)***

Note: Award ***(A1)*** for –2 and ***(A1)*** for completely correct mathematical notation, including weak inequalities. Accept $f \geqslant -2$.

[2 marks]

b. –1 and 1.52 (1.51839…) ***(A1)(A1) (C2)***

Note: Award ***(A1)*** for –1 and ***(A1)*** for 1.52 (1.51839).

[2 marks]

c. $x < -1,\ \ x > 1.52$ **OR** $(-\infty,\ -1) \cup (1.52,\ \infty)$. ***(A1)*****(ft)*****(A1)*****(ft)** ***(C2)***

Note: Award ***(A1)*****(ft)** for **both** critical values in inequality or range statements such as $x < -1,\ (-\infty,\ -1),\ x > 1.52\ \text{or}\ (1.52,\ \infty)$.

Award the second ***(A1)*****(ft)** for correct strict inequality statements used with their critical values. If an incorrect use of strict and weak inequalities has already been penalized in (a), condone weak inequalities for this second mark and award ***(A1)*****(ft)**.

[2 marks]

Examiners report

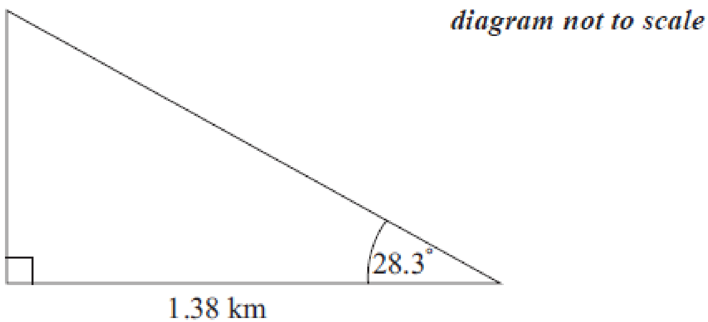
[N/A]

b. [N/A]
c. [N/A]

José stands 1.38 kilometres from a vertical cliff.

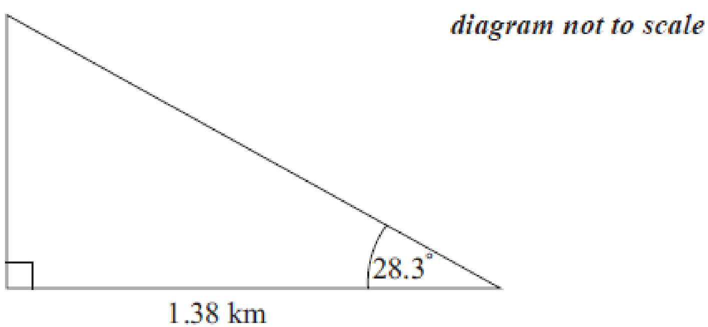
a. Express this distance in metres. [1]

b. José estimates the angle between the horizontal and the top of the cliff as 28.3° and uses it to find the height of the cliff. [3]



Find the height of the cliff according to José's calculation. **Express your answer in metres, to the nearest whole metre.**

c. José estimates the angle between the horizontal and the top of the cliff as 28.3° and uses it to find the height of the cliff. [2]



The actual height of the cliff is 718 metres. Calculate the percentage error made by José when calculating the height of the cliff.

Markscheme

a. 1380 (m) ***(A1) (C1)***

[1 mark]

b. $1380 \tan 28.3$ ***(M1)***

$= 743.05\ldots.$ ***(A1)*(ft)**

$= 743$ (m) ***(A1)*(ft)** ***(C3)***

Notes: Award ***(M1)*** for correct substitution in tan formula or equivalent, ***(A1)*(ft)** for their 743.05 seen, ***(A1)*(ft)** for their answer correct to the nearest m.

[3 marks]

c. $\text{percentage error} = \frac{743.05\ldots - 718}{718} \times 100$ ***(M1)***

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

= 3.49 % (% *symbol not required*) ***(A1)*(ft)** ***(C2)***

Notes: Accept 3.48 % for use of 743.
Accept negative answer.

[2 marks]

Examiners report

a. This question was well answered by the majority of candidates although it was surprising to find some who could not express the given distance in metres. Where working was present, follow through marks could be awarded in the remainder of the question. Most candidates could give their answer correct to the nearest metre and find the percentage error correctly, using the formula. A common error was to use the calculated value in the denominator.

b. This question was well answered by the majority of candidates although it was surprising to find some who could not express the given distance in metres. Where working was present, follow through marks could be awarded in the remainder of the question. Most candidates could give their answer correct to the nearest metre and find the percentage error correctly, using the formula. A common error was to use the calculated value in the denominator.

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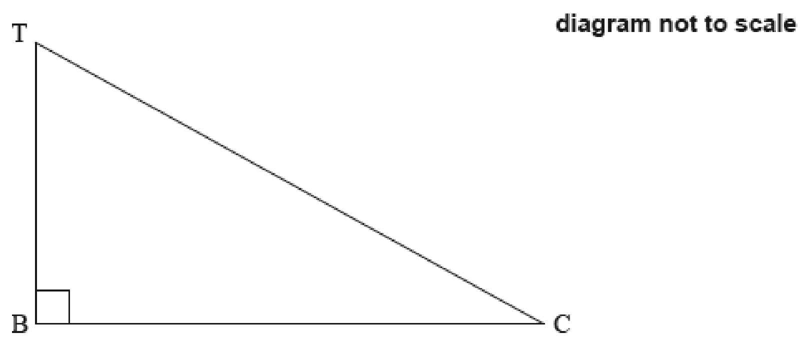
Fabián stands on top of a building, T, which is on a horizontal street.

He observes a car, C, on the street, at an angle of depression of 30°. The base of the building is at B. The height of the building is 80 metres.

The following diagram indicates the positions of T, B and C.



a. Show, in the appropriate place on the diagram, **the values** of [2]

(i) the height of the building;

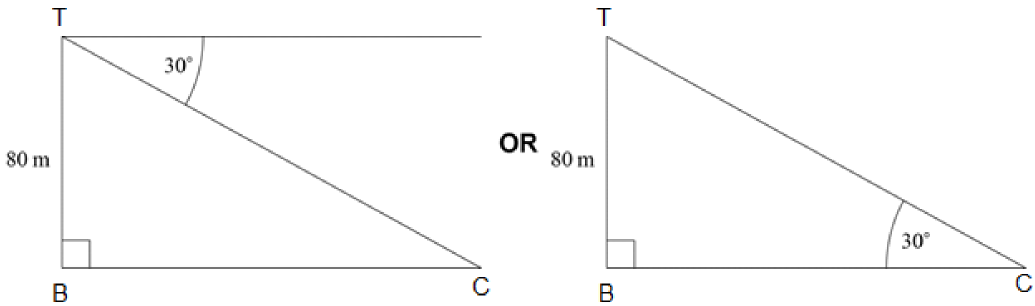
(ii) the angle of depression.

b. Find the distance, BC, from the base of the building to the car. [2]

c. Fabián estimates that the distance from the base of the building to the car is 150 metres. Calculate the percentage error of Fabián's estimate. [2]

Markscheme

a.



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

Notes: Award ***(A1)*** for 80 m in the correct position on diagram.

Award ***(A1)*** for 30° in a correct position on diagram.

b. $\tan 30^\circ = \frac{80}{\text{BC}}$ **OR** $\tan 60^\circ = \frac{\text{BC}}{80}$ **OR** $\frac{80}{\sin 30^\circ} = \frac{\text{BC}}{\sin 60^\circ}$ ***(M1)***

Note: Award ***(M1)*** for a correct trigonometric or Pythagorean equation for BC with correctly substituted values.

$(\text{BC} =)\ 139\ (\text{m}) \quad (138.564\ldots\ (\text{m}))$ ***(A1)*****(ft)** ***(C2)***

Notes: Accept an answer of $80\sqrt{3}$ which is the exact answer.

Follow through from part (a).

Do not penalize use of radians unless it leads to a negative answer.

c. $\left|\frac{150-138.564\ldots}{138.564\ldots}\right| \times 100$ ***(M1)***

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

$= 8.25(\%) \quad (8.25317\ldots\%)$ ***(A1)*****(ft)** ***(C2)***

Notes: Accept $7.91(\%)$ (7.91366... if 139 is used.

Accept $8.23(\%)$ (8.22510... if 138.6 is used.

Follow through from their answer to part (b).

If answer to part (b) is 46.2, answer to part (c) is 225%, award ***(M1)(A1)*****(ft)** with or without working seen. If answer to part (b) is negative, award at most ***(M1)(A0)***.

Examiners report

a. [N/A]

b. [N/A]

c. [N/A]

The diagram shows a rectangular based right pyramid VABCD in which $AD = 20$ cm, $DC = 15$ cm and the height of the pyramid, $VN = 30$ cm.

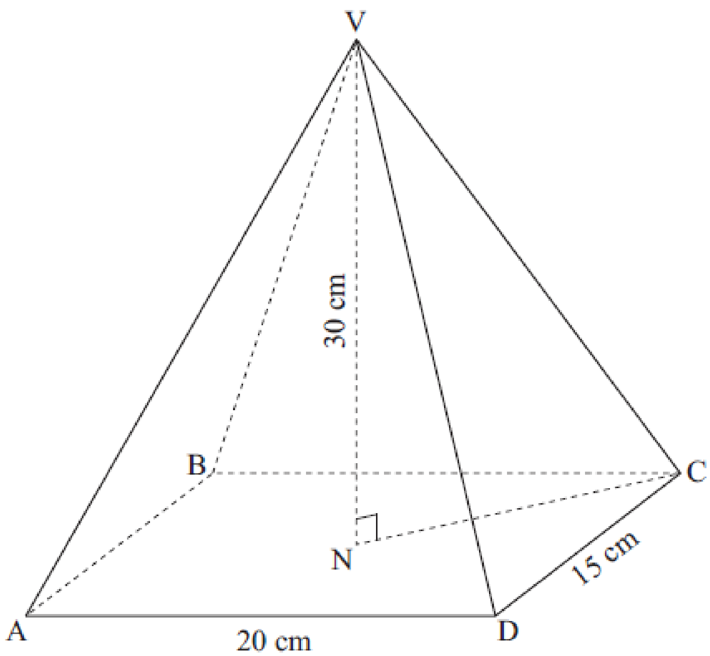


diagram not to scale

a. Calculate [4]

(i) the length of AC;

(ii) the length of VC.

b. Calculate the angle between VC and the base ABCD. [2]

Markscheme

a. (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).

b. $\sin \text{VCN} = \frac{30}{32.5}$ **OR** $\tan \text{VCN} = \frac{30}{12.5}$ **OR** $\cos \text{VCN} = \frac{12.5}{32.5}$ ***(M1)***

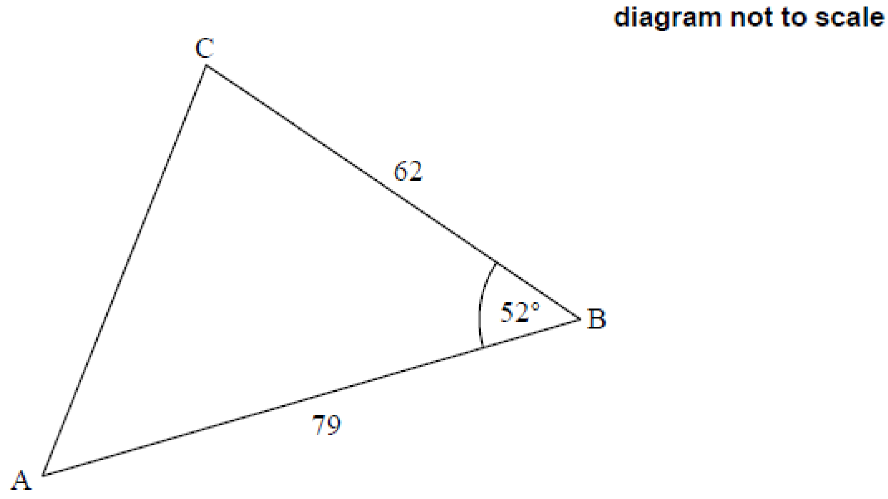
$= 67.4^\circ\ (67.3801\ldots)$ ***(A1)*****(ft)** ***(C2)***

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

Examiners report

a. [N/A]
b. [N/A]

A park in the form of a triangle, ABC, is shown in the following diagram. AB is 79km and BC is 62km. Angle $A\hat{B}C$ is 52°.



a. Calculate the length of side AC in km. [3]

b. Calculate the area of the park. [3]

Markscheme

a. $(AC^2 =)\ 62^2 + 79^2 - 2 \times 62 \times 79 \times \cos(52°)$ ***(M1)(A1)***

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

63.7 (63.6708…) (km) ***(A1) (C3)***

[3 marks]

b. $\frac{1}{2} \times 62 \times 79 \times \sin(52°)$ ***(M1)(A1)***

Note: Award ***(M1)*** for substituting in the area of triangle formula, ***(A1)*** for correct substitution.

1930 km^2 (1929.83…km^2) ***(A1) (C3)***

[3 marks]

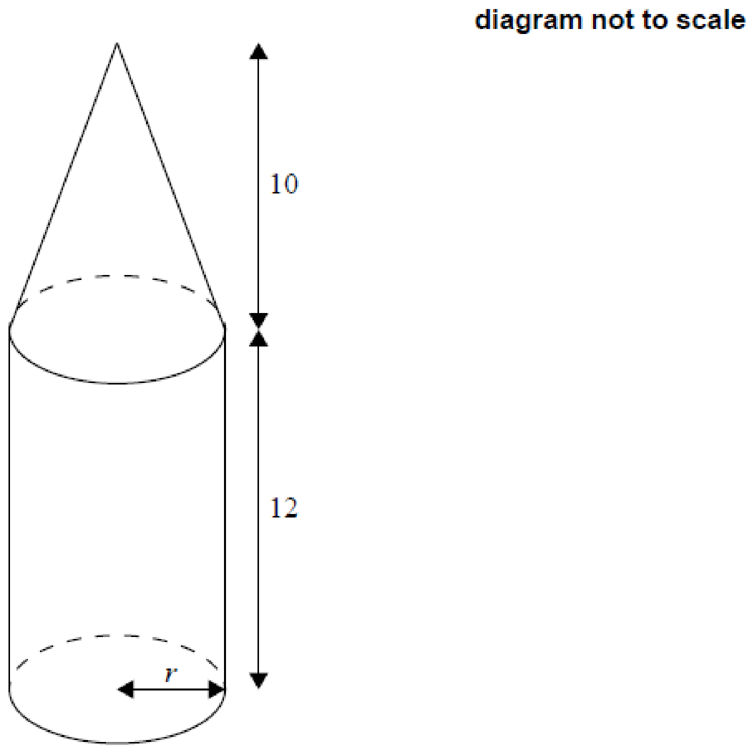
Examiners report

a. [N/A]
b. [N/A]

Julio is making a wooden pencil case in the shape of a large pencil. The pencil case consists of a cylinder attached to a cone, as shown.

The cylinder has a radius of *r* cm and a height of 12 cm.

The cone has a base radius of *r* cm and a height of 10 cm.



a. Find an expression for the slant height of the cone **in terms of *r***. [2]

b. The total external surface area of the pencil case rounded to 3 significant figures is 570 cm^2. [4]

Using your graphic display calculator, calculate the value of *r*.

Markscheme

a. (slant height^2 =) $10^2 + r^2$ ***(M1)***

Note: For correct substitution of 10 and *r* into Pythagoras' Theorem.

$\sqrt{10^2 + r^2}$ ***(A1) (C2)***

[2 marks]

b. $\pi r^2 + 2\pi r \times 12 + \pi r\sqrt{100 + r^2} = 570$ ***(M1)(M1)(M1)***

Note: Award ***(M1)*** for correct substitution in curved surface area of cylinder and area of the base, ***(M1)*** for their correct substitution in curved surface area of cone, ***(M1)*** for adding their 3 surface areas and equating to 570. Follow through their part (a).

= 4.58 (4.58358...) ***(A1)*(ft) *(C4)***

Note: Last line must be seen to award final ***(A1)***. Follow through from part (a).

[4 marks]

Examiners report

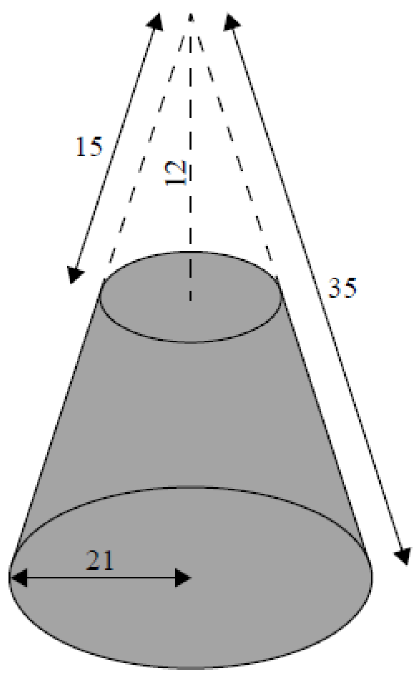
a. [N/A]

b. [N/A]

A solid right circular cone has a base radius of 21 cm and a slant height of 35 cm.

A smaller right circular cone has a height of 12 cm and a slant height of 15 cm, and is removed from the top of the larger cone, as shown in the diagram.

diagram not to scale



a. Calculate the radius of the base of the cone which has been removed. [2]

b. Calculate the curved surface area of the cone which has been removed. [2]

c. Calculate the curved surface area of the remaining solid. [2]

Markscheme

a. $\sqrt{15^2 - 12^2}$ ***(M1)***

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

OR

$\frac{\text{radius}}{21} = \frac{15}{35}$ ***(M1)***

Note: Award ***(M1)*** for a correct equation.

= 9 (cm) ***(A1) (C2)***

[2 marks]

b. $\pi \times 9 \times 15$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution into curved surface area of a cone formula.

$= 424 \text{ cm}^2 \quad \left(135\pi,\ 424.115\ldots\text{cm}^2\right)$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from part (a).

[2 marks]

c. $\pi \times 21 \times 35 - 424.115\ldots$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution into curved surface area of a cone formula and for subtracting their part (b).

$= 1880\ \text{cm}^2 \quad \left(600\pi,\ 1884.95...\text{cm}^2\right)$ ***(A1)*(ft) *(C2)***

Note: Follow through from part (b).

[2 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

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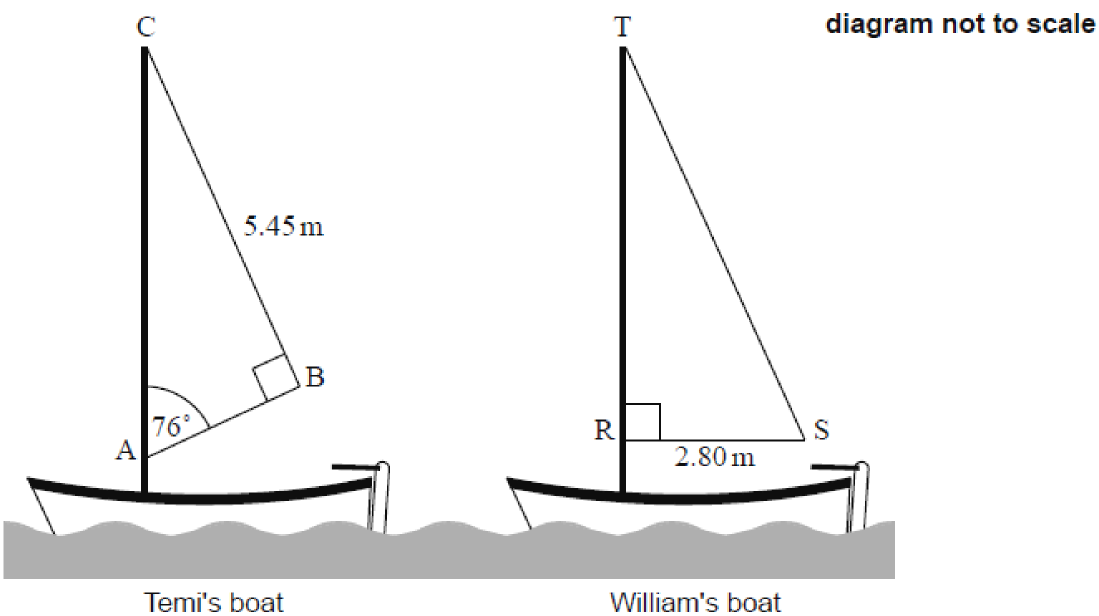
a. Temi's sailing boat has a sail in the shape of a right-angled triangle, ABC. $\text{BC} = 5.45\text{m}$, [2]

angle $\text{CAB} = 76^\text{o}$ and angle $\text{ABC} = 90^\text{o}$.

Calculate AC, the height of Temi's sail.

b. [2]



William also has a sailing boat with a sail in the shape of a right-angled triangle, TRS. $\text{RS} = 2.80\text{m}$. The area of William's sail is $10.7\,\text{m}^2$.

Calculate RT, the height of William's sail.

Markscheme

a. **Units are required in parts (a) and (b).**

$\sin 76^\text{o} = \frac{5.45}{\text{AC}}$ ***(M1)***

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

$\text{AC} = 5.62\text{m}\ (= 5.61684...\text{m})$ ***(A1) (C2)***

Note: The answer is 5.62m, **the units are required.**

[2 marks]

b. $\frac{1}{2} \times 2.80 \times \text{RT} = 10.7$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into area of a triangle formula or equivalent.

$\mathrm{RT} = 7.64\,\mathrm{m} \quad (7.64285\ldots\mathrm{m})$ ***(A1) (C2)***

Note: The answer is $7.64\,\mathrm{m}$, **the units are required.**

[2 marks]

Examiners report

a. Question 2: Trigonometry and area

The response to this question was mixed, with many fully correct attempts. Those failing to score 6 marks often either lost a mark due to the use of Pythagoras and premature rounding or due to an incorrect trigonometric ratio used in a right angled triangle. The use of sine and cosine rule often led to errors.

b. Question 2: Trigonometry and area

The response to this question was mixed, with many fully correct attempts. Those failing to score 6 marks often either lost a mark due to the use of Pythagoras and premature rounding or due to an incorrect trigonometric ratio used in a right angled triangle. The use of sine and cosine rule often led to errors.

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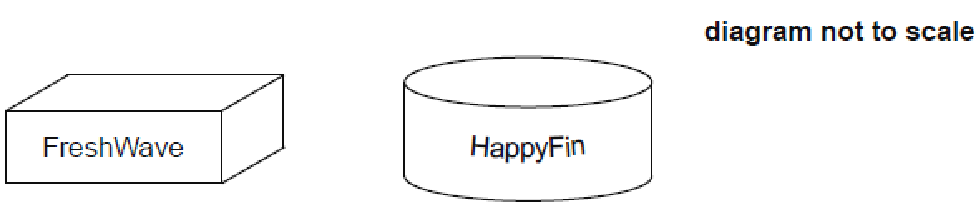
a. FreshWave brand tuna is sold in cans that are in the shape of a cuboid with length $8\,\mathrm{cm}$, width $5\,\mathrm{cm}$ and height $3.5\,\mathrm{cm}$. HappyFin brand tuna is sold in cans that are cylindrical with diameter $7\,\mathrm{cm}$ and height $4\,\mathrm{cm}$. [4]



Find the volume, in cm^3, of a can of

i) FreshWave tuna;

ii) HappyFin tuna.

b. The price of tuna per cm^3 is the same for each brand. A can of FreshWave tuna costs 90 cents. [2]

Calculate the price, in cents, of a can of HappyFin tuna.

Markscheme

a. i) $8 \times 5 \times 3.5$ ***(M1)***

$= 140$ ***(A1)***

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

ii) $\pi \times 3.5^2 \times 4$ ***(M1)***

$= 154 \quad (153.938\ldots,\ 49\pi)$ ***(A1) (C4)***

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

b. $\frac{90 \ \times \ \text{their } 154}{\text{their } 140}$ ***(M1)***

Note: Award ***(M1)*** for multiplying the given 90 by their part (a)(ii) and dividing by their part (a)(i). Follow through from (a). Accept correct alternative methods.

$= 99$ ***(A1)*(ft) *(C2)***

Note: Award a maximum of ***(M1)(A0)*** if the final answer is not an integer.

Examiners report

a. Question 4: Volume

Part (a) was generally answered well, as was part (b); misreading of the question was the main problem.

b. Question 4: Volume

Part (a) was generally answered well, as was part (b); misreading of the question was the main problem. Part (c), though straightforward in concept, was not well understood by a number of candidates, and many did not give the answer as a number of cents as instructed in the question.

The planet Earth takes one year to revolve around the Sun. Assume that a year is 365 days and the path of the Earth around the Sun is the circumference of a circle of radius 150000000 km.

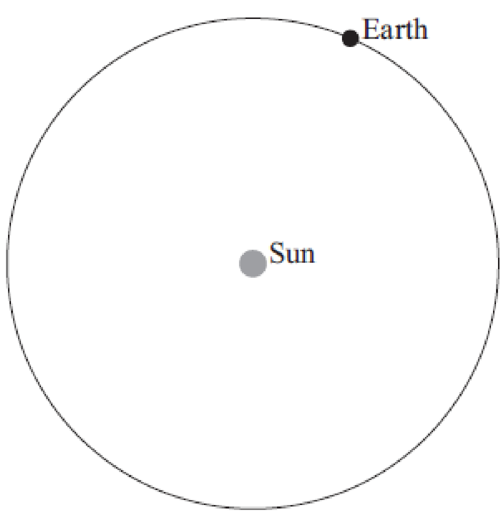


diagram not to scale

a. Calculate the distance travelled by the Earth in **one day**. [4]

b. Give your answer to part (a) in the form $a \times 10^k$ where $1 \leqslant a \leqslant 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

a. $2\pi\frac{150000000}{365}$ ***(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]

b. 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. 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.

b. 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.