Question 1

Response 1

MARKS | DO NOT WRITE IN THIS MARGIN

Total marks — 60

Attempt ALL questions

1. A charity distributed 80 000 emergency packages during 2018.
   This number is expected to increase by 15% each year.
   Calculate how many emergency packages the charity expects to distribute in 2021. **3**

2019 : 0.15 × 80 000 = 12 000

= 80 000 + 12 000 = 92 000

2020: 0.15 × 92 000 = 13 800

= 92 000 + 13 800 = 105 800

2021: 0.15 × 105 800 = 15 870

= 105 800 + 15 870 = 121 670

Response 2

MARKS | DO NOT WRITE IN THIS MARGIN

Total marks — 60

Attempt ALL questions

1. A charity distributed 80 000 emergency packages during 2018.
   This number is expected to increase by 15% each year.
   Calculate how many emergency packages the charity expects to distribute in 2021. **3**

~~[illegible]~~

3 years
1.15

$80\,000 \times 1.15^3$

$= 27375.75$ packages

$= 27375$ packages

Response 3

MARKS | DO NOT WRITE IN THIS MARGIN

Total marks — 60

Attempt ALL questions

1. A charity distributed 80 000 emergency packages during 2018.
   This number is expected to increase by 15% each year.
   Calculate how many emergency packages the charity expects to distribute in 2021. **3**

$80000 \times 1{\cdot}015^3 = 83654{\cdot}27$

$= 83654$

Response 4

MARKS | DO NOT WRITE IN THIS MARGIN

Total marks — 60

Attempt ALL questions

1. A charity distributed 80 000 emergency packages during 2018.
   This number is expected to increase by 15% each year.
   Calculate how many emergency packages the charity expects to distribute in 2021. 3

$80\,000 \times 15\% \times 3 \quad \frac{2021}{-2018} = 3.$

$= 120000$

$= 120000$ by 2021, Emergency packages

Question 2

Response 5

2. Find $|\mathbf{p}|$, the magnitude of vector $\mathbf{p} = \begin{pmatrix} 6 \\ 27 \\ -18 \end{pmatrix}$. 2

$\sqrt{(6)^2 + (27)^2 + (18)^2}$

$= 486.03$

$|p| = 486$

Response 6

2. Find $|\mathbf{p}|$, the magnitude of vector $\mathbf{p} = \begin{pmatrix} 6 \\ 27 \\ -18 \end{pmatrix}$. 2

$x^2 = 6^2 + 27^2 + (-18^2)$

$x^2 = \sqrt{441}$

$x = 21$

Response 7

2. Find $|\mathbf{p}|$, the magnitude of vector $\mathbf{p} = \begin{pmatrix} 6 \\ 27 \\ -18 \end{pmatrix}$. 2

$\sqrt{6^2+27^2+(-18)^2}$

$=\sqrt{1.5}$

$= 3.8729833462$

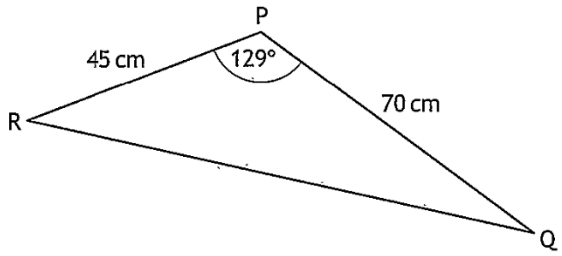
$= 3.87$ (2 d.p)

Question 3

Response 8

MARKS | DO NOT WRITE IN THIS MARGIN

3. The diagram shows triangle PQR.



- PR = 45 centimetres
- PQ = 70 centimetres
- Angle QPR = 129°

Calculate the area of triangle PQR. 2

$A = \frac{1}{2}\,ab\sin C$

$A = \frac{1}{2}\,45 \times 70 \times \sin 129$

$A = \frac{1}{2}\,115.7771146$

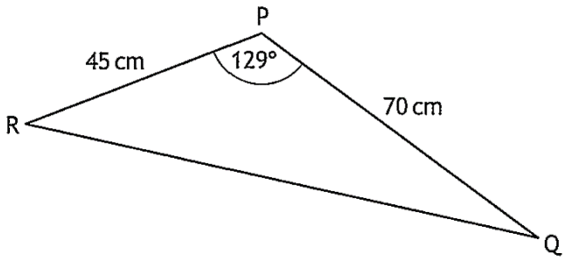
$A = 57.88857298$

$= 57.89 m^2$

Response 9

MARKS | DO NOT WRITE IN THIS MARGIN

3. The diagram shows triangle PQR.



- PR = 45 centimetres
- PQ = 70 centimetres
- Angle QPR = 129°

Calculate the area of triangle PQR. 2

Area $A^2 = b^2 + c^2 - 2bc\cos A°$

$= 45^2 + 70^2 - 2 \times 45 \times 70 \cos 129°$

$= 10889.71846$

$= 104.358138$

$= 104.4$ cm

Question 4

Response 10

4. A sesame seed weighs $3{\cdot}6 \times 10^{-6}$ kilograms.
The weight of a poppy seed is 8% of the weight of a sesame seed.
Calculate the weight of a poppy seed in kilograms.
Give your answer in scientific notation. 2

$3{\cdot}6 \times 10^{-6} \div 8 = 4{\cdot}5 \times 10^{-7}$

Response 11

4. A sesame seed weighs $3{\cdot}6\times10^{-6}$ kilograms.
The weight of a poppy seed is 8% of the weight of a sesame seed.
Calculate the weight of a poppy seed in kilograms.
Give your answer in scientific notation. 2

8% : $3{\cdot}6\times10^{-6}$
1% : $0{\cdot}0000036 \div 8 = 0{\cdot}00000045$
100% : $0{\cdot}00000045 \times 100 = 0{\cdot}000045$

Weight of poppy seed = $4{\cdot}5\times10^{-5}$

Response 12

4. A sesame seed weighs $3{\cdot}6\times10^{-6}$ kilograms.
The weight of a poppy seed is 8% of the weight of a sesame seed.
Calculate the weight of a poppy seed in kilograms.
Give your answer in scientific notation. 2

$3{\cdot}6\times10^{-6} \div 8\%$

$= 4{\cdot}5\times10^{-7}$

Response 13

4. A sesame seed weighs $3{\cdot}6\times10^{-6}$ kilograms.
The weight of a poppy seed is 8% of the weight of a sesame seed.
Calculate the weight of a poppy seed in kilograms.
Give your answer in scientific notation. 2

$3{\cdot}6\times10^{-6} \div 92$

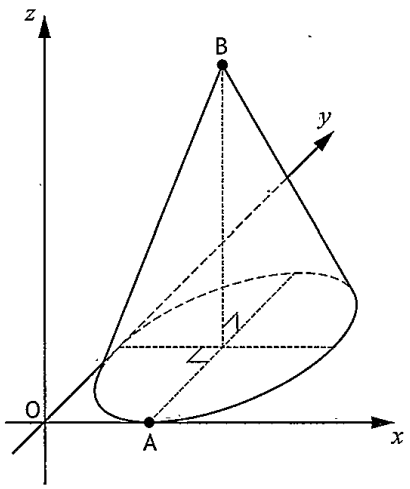
$= 3{\cdot}913043478\times10^{-8}$

Question 5

Response 14

MARKS | DO NOT WRITE IN THIS MARGIN

5. The diagram shows a cone with diameter 6 units and height 8 units.



- The x-axis and the y-axis are tangents to the base
- A is the point of contact between the base and the x-axis
- B is directly above the centre of the base

Write down the coordinates of A and B. **2**

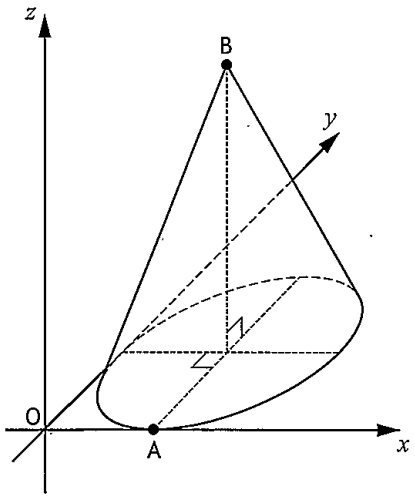
A = (6, 0, 0)

B = (6, 6, 8)

Response 15

MARKS | DO NOT WRITE IN THIS MARGIN

5. The diagram shows a cone with diameter 6 units and height 8 units.



- The x-axis and the y-axis are tangents to the base
- A is the point of contact between the base and the x-axis
- B is directly above the centre of the base

Write down the coordinates of A and B. **2**

A(0,0,0)

B(0,3,8)

Question 6

Response 16

MARKS | DO NOT WRITE IN THIS MARGIN

6. Solve the equation $3x^2+9x-2=0$.
Give your answers correct to 1 decimal place. **3**

$3x^2 + 9x - 2 = 0$

$b^2 - 4ac$

$9^2 - 4 \times 3 \times (-2)$

$81 - (-24)$

~~$=105,0$~~

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\frac{-9 \pm \sqrt{9^2 - 4 \times 3 \times (-2)}}{2 \times 3}$$

$$\frac{-9 \pm \sqrt{105}}{6}$$

$\frac{-9+\sqrt{105}}{6} = 0,20$ $\frac{-9-\sqrt{105}}{6} = -3,20$

Response 17

MARKS | DO NOT WRITE IN THIS MARGIN

6. Solve the equation $3x^2+9x-2=0$.
Give your answers correct to 1 decimal place. 3

$3x^2+9x-2=0$

$a=1 \quad b=9 \quad c=-2$

$x = \frac{-b \pm \sqrt{(b^2-4ac)}}{2a}$

$= \frac{-9 \pm \sqrt{(9)^2-4(1)(-2)}}{2(9)}$

$= \frac{-9 \pm \sqrt{81+8}}{18}$

$= \frac{-9 \pm \sqrt{89}}{18}$

$= \frac{-9+\sqrt{89}}{18} = -8.475\ldots$
$= -8.5$ (1dp)

$= \frac{-9-\sqrt{89}}{18} = -9.524\ldots$
$= -9.5$ (1dp)

Response 18

MARKS | DO NOT WRITE IN THIS MARGIN

6. Solve the equation $3x^2+9x-2=0$.
Give your answers correct to 1 decimal place. 3

$a=3 \quad b=9 \quad c=2$

$\frac{-b \pm \sqrt{(b^2-4ac)}}{2a}$

$= \frac{-9 \pm \sqrt{9^2-4\times3\times2}}{2\times3}$

$= \frac{-9 \pm \sqrt{81-24}}{6}$

$= \frac{-9 \pm \sqrt{57}}{6}$

$\frac{-9+\sqrt{57}}{6} = -0.2$

$\frac{-9-\sqrt{67}}{6} = -2.75$
$= -2.8$

Response 19

MARKS | DO NOT WRITE IN THIS MARGIN

6. Solve the equation $3x^2 + 9x - 2 = 0$.

Give your answers correct to 1 decimal place. **3**

$a = 3$

$b = 9$

$c = -2$

$b^2 - 4ac$

$= 9^2 - 4 \times 3 \times -2$

$= 81 + 24$

$= 105$

roots are real and distinct.

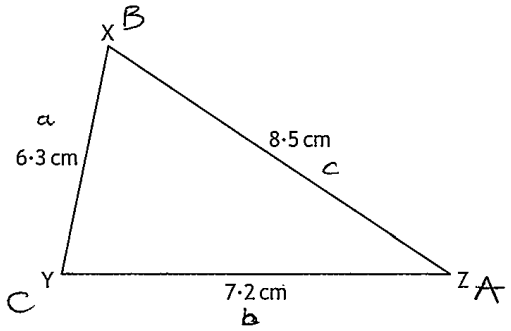
~~$3x^2 + 9x - 2 = 0$~~

Question 7

Response 20

MARKS | DO NOT WRITE IN THIS MARGIN

7. Triangle XYZ is shown below.



Calculate the size of the smallest angle in triangle XYZ. **3**

$a^2 = b^2 + c^2 - 2bc\cos A$

$6.3^2 = 7.2^2 + 8.5^2 - 2 \times 7.2 \times 8.5 \cos A$

$39.69 = 1.69 \cos A$

$\cos A = \frac{1.69}{39.69}$

$A^\circ = \cos^{-1}\left(\frac{1.69}{39.69}\right)$

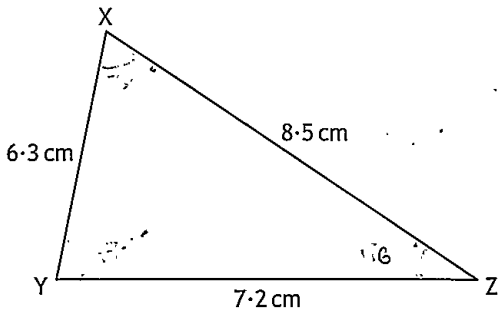
$= 87.55960819$

$Z^\circ = 88^\circ$

Response 21

MARKS | DO NOT WRITE IN THIS MARGIN

7. Triangle XYZ is shown below.



Calculate the size of the smallest angle in triangle XYZ. **3**

$\cos A = \frac{b^2+c^2-a^2}{2bc}$

$\cos A = \frac{6{\cdot}3^2+7{\cdot}2^2-8{\cdot}5^2}{2\times 6{\cdot}3\times 7{\cdot}2}$

$= \cos^{-1}(0.212522\ldots)$

$= 77{\cdot}7°$

$\frac{\sin X}{x} = \frac{\sin Y}{y} = \frac{\sin Z}{z}$

$\sin X = \frac{\sin 77{\cdot}7}{8{\cdot}5} \times 7{\cdot}2$

$X = \sin^{-1}(0.827615\ldots)$

$= 55{\cdot}854\ldots$

$= 55{\cdot}9°$

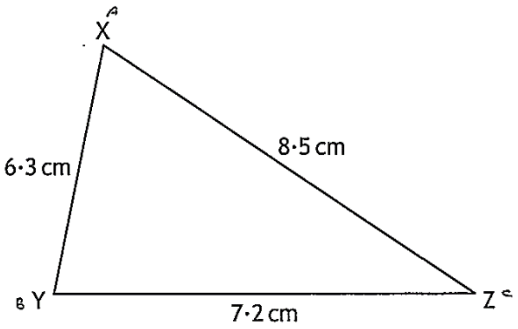
$Z = 180 - 77 - 55{\cdot}9 = 46{\cdot}4°$

Smallest angle

Response 22

MARKS | DO NOT WRITE IN THIS MARGIN

7. Triangle XYZ is shown below.



Calculate the size of the smallest angle in triangle XYZ. **3**

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

~~$\cos A = \frac{7.2^2 +}{}$~~

$$\cos A = \frac{8.5^2 + 6.3^2 - 7.2^2}{2 \times 8.5 \times 6.3}$$

$$\cos A = \frac{60.1}{107.1}$$

$$\cos A = 0.56$$

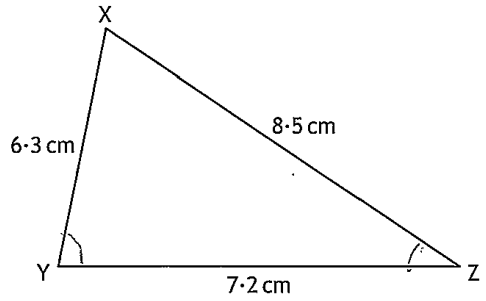
$$A = \cos^{-1}(0.56)$$

$$= 56°$$

Response 23

MARKS | DO NOT WRITE IN THIS MARGIN

7. Triangle XYZ is shown below.



Calculate the size of the smallest angle in triangle XYZ. 3

$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

$= \frac{6.3^2 + 7.2^2 - 8.5^2}{2 \times 6.3 \times 7.2}$

$= \frac{19.28}{90.72}$

$\cos A = 0.21^\circ$

$\angle XYZ = 0.21^\circ$

$\cos = \frac{8.5^2 + 7.2^2 - 6.3^2}{2 \times 8.5 \times 7.2}$

$= \frac{84.4}{107.1}$

Question 8

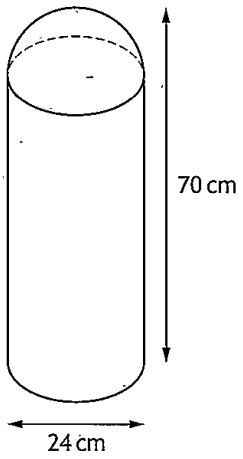
Response 24

MARKS | DO NOT WRITE IN THIS MARGIN

8. A traffic bollard is in the shape of a cylinder with a hemisphere on top.

The bollard has

- diameter 24 centimetres
- height 70 centimetres.



Calculate the volume of the bollard.

Give your answer correct to 3 significant figures. 5

$V_{sphere} = \frac{4}{3}\pi r^3$

$= \frac{4}{3} \times \pi \times 12^3$

$= 7240$ (to 3 s.f.) cm^3

$r = 12$ h of cylinder $= 70 - 12$

$= 58$

$V_{cylinder} = \pi r^2 h$

$= \pi \times 12^2 \times 58$

$= 26200$ (to 3 s.f.) cm^3

$V_{hemisphere} = 7240 \div 2$

$= 3620 cm^3$

$V_{Bollard} = 26200 + 3620$

$= 29820 cm^3$

$= 29800 cm^3$ (to 3 s.f.)

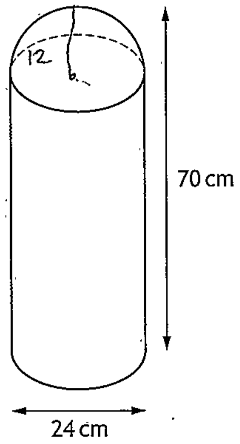
Response 25

MARKS | DO NOT WRITE IN THIS MARGIN

8. A traffic bollard is in the shape of a cylinder with a hemisphere on top.

The bollard has

- diameter 24 centimetres
- height 70 centimetres.



Calculate the volume of the bollard.

Give your answer correct to 3 significant figures. **5**

$r = 12$

$D = 24$

$H = 70$

Cylinder height = 58

Cylinder

$V = \pi r^2 H$

~~$= \pi \times 12^2 \times 70$~~

~~$= 10080\pi$~~

~~$= 31667.25...$~~

$V = \pi r^2 H$

$= \pi \times 12^2 \times 58$

$= 8352\pi$

$= 26238.58184$

Sphere

$\frac{4}{3}\pi r^3$

$\frac{4}{3}\pi \times 12^3$

$= 2304$

7238.229474

$V = 26238.58184 + 7238.229474$

$V = 33476.81131$

$V = 33500$ (3 sig. fig)

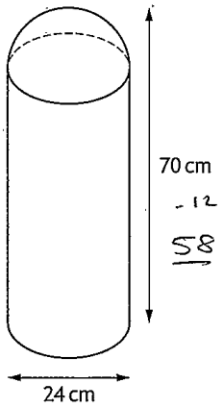
Response 26

MARKS | DO NOT WRITE IN THIS MARGIN

8. A traffic bollard is in the shape of a cylinder with a hemisphere on top.

The bollard has

- diameter 24 centimetres 24 ÷ 12 sphere
- height 70 centimetres.



Calculate the volume of the bollard.

Give your answer correct to 3 significant figures. **5**

hemi sphere – $V = \left(\frac{4}{3}\pi r^3\right) \div 2$

$= \left(\frac{4}{3} \times \pi \times 12^2\right) \div 2$

$= 192\pi \div 2$

$= 96\pi$

cylinder $= \frac{4}{3}\pi r^2 h$

$= \frac{4}{3} \times \pi \times 12^2 \times 58$

$= 1136\pi$

Total Volume $= 1136\pi + 96\pi$

$= 11232\pi$

$= 35286.36869.$

$= 35300$ (to 3 s.f) cm^3

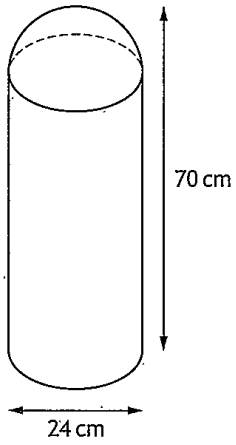
Response 27

MARKS | DO NOT WRITE IN THIS MARGIN

8. A traffic bollard is in the shape of a cylinder with a hemisphere on top.

The bollard has

- diameter 24 centimetres
- height 70 centimetres.



Calculate the volume of the bollard.

Give your answer correct to 3 significant figures. 5

sphere

$V = \frac{4}{3}\pi r^3$

$= \frac{4}{3} \times \pi \times 12^3$

$= 2304\pi$

$= 7238.229474$

$= 7240 cm^3$

$V = \frac{1}{2} hr^2$

$= \frac{1}{2} \times 70 \times 12^2$

$= 5040 cm^3$

Total $V = 7238.22... + 5040$

$= 12278.22947$

$= 12300 cm^3$

Question 9

Response 28

MARKS | DO NOT WRITE IN THIS MARGIN

9. Georgie had her roof repaired.
She was charged an extra 2·5% for late payment.
She had to pay a total of £977·85.
Calculate how much she would have **saved** if she had paid on time. 3

102·5% → £977·85
1% → £9·54
100% → £954

Response 29

MARKS | DO NOT WRITE IN THIS MARGIN

9. Georgie had her roof repaired.
She was charged an extra 2·5% for late payment.
She had to pay a total of £977·85.
Calculate how much she would have **saved** if she had paid on time. 3

977,85 ÷102,5

~~977,85 ÷ 102,5~~

977,85 ÷ 102,5

9,53170̇7̇ = 1%

9,53170̇7̇ X100

100% = £953,170̇7̇3̇

Response 30

MARGIN

9. Georgie had her roof repaired.
She was charged an extra 2·5% for late payment.
She had to pay a total of £977·85.
Calculate how much she would have **saved** if she had paid on time. 3

102·5% → 977·85

102·5% − 2·5%

977·85
24·00
953·85

2·5% of 977·85
≈ 24

£24 saved.

Response 31

MARKS | DO NOT WRITE IN THIS MARGIN

9. Georgie had her roof repaired.
She was charged an extra 2·5% for late payment.
She had to pay a total of £977·85.
Calculate how much she would have **saved** if she had paid on time. 3

$\frac{977,85}{1} \times \frac{2,5}{100} = 24,4$

~~977,85 − 24,44~~

She would have saved £24.44

Question 10

Response 32

10. Express $x^2+10x-15$ in the form $(x+p)^2+q$. **2**

$x^2+10x-15 = (x+p)^2+q$

$(x+5)^2 - 15$

$= (x+5)^2 - 5 - 15$

$= (x+5)^2 - 20$

$(-5, -20)$

Response 33

10. Express $x^2+10x-15$ in the form $(x+p)^2+q$. **2**

$x^2+10x-15$

$= (x^2+10x+25) - 25 - 15$

$= (x+5) - 40$

Response 34

10. Express $x^2+10x-15$ in the form $(x+p)^2+q$. **2**

$(x-5)^2+5^2-15$

$= (x-5)^2+25-15$

$= (x-5)^2+10$

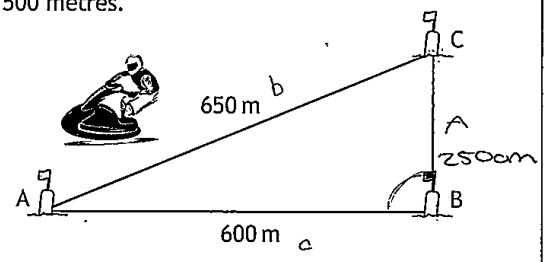
Question 11

Response 35

MARKS | DO NOT WRITE IN THIS MARGIN

11. The diagram shows the course for a jet-ski race.
The course is indicated by markers A, B and C.
The total length of the course is 1500 metres.

- B is 600 metres from A
- C is 650 metres from A
- C is due north of B



Determine whether B is due east of A.
Justify your answer. 4

$A^2 = b^2 - c^2$

$= 650^2 - 600^2$

$= 422500 - 360000$

$= 62500$

$A = \sqrt{62500}$

$A = 250$

A (B) C

~~a b c~~

c

∴ yes, B is due east of A as it is 90° from north.

$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$

$= \frac{250^2 + 600^2 - 650^2}{2 \times 250 \times 600}$

$= 0$ ∴ $\cos^{-1}(0)$

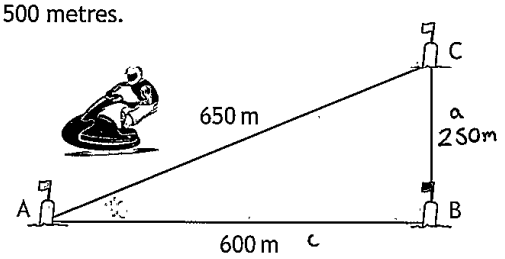
$= 90°$

Response 36

MARKS | DO NOT WRITE IN THIS MARGIN

11. The diagram shows the course for a jet-ski race.
The course is indicated by markers A, B and C.
The total length of the course is 1500 metres.

- B is 600 metres from A
- C is 650 metres from A
- C is due north of B



Determine whether B is due east of A.
Justify your answer. 4

$600 + 650 = 1250$

$1500 - 1250 = 250m$

$\cos A = \frac{b^2+c^2-a^2}{2bc}$

$= \frac{650^2+600^2-250^2}{2 \times 650 \times 600}$

$= 0.923$

$\cos^{-1}(0.923) = 22.61m$

B is not due east of A as it doesn't meet the distance required as it only reaches to 22.61m.

Response 37

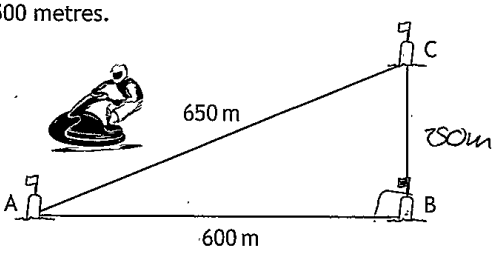
MARKS | DO NOT WRITE IN THIS MARGIN

11. The diagram shows the course for a jet-ski race.

The course is indicated by markers A, B and C.

The total length of the course is 1500 metres.

- B is 600 metres from A
- C is 650 metres from A
- C is due north of B



Determine whether B is due east of A.

Justify your answer. 4

$a^2 = b^2 - c^2$

$= 650^2 - 600^2$

$= 62500$

$a = \sqrt{62500}$

$= 250\text{ m}$

$650^2 = 422500$

$600^2 + 250^2 = 422500$

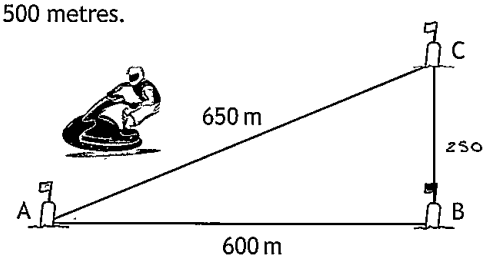
Since $650^2 = 600^2 + 250^2$ by converse of pythagoras B is due east of A.

Response 38

MARKS | DO NOT WRITE IN THIS MARGIN

11. The diagram shows the course for a jet-ski race.
The course is indicated by markers A, B and C.
The total length of the course is 1500 metres.

- B is 600 metres from A
- C is 650 metres from A
- C is due north of B



Determine whether B is due east of A.
Justify your answer. 4

$650^2 = 600^2 + 250^2$

$422500 = 360000 + 62500$

$422500 = 422500$

$\therefore$ B is due east of A because 422500 is equal to 422500

Converse of pythagoras proves that B is due east of A.

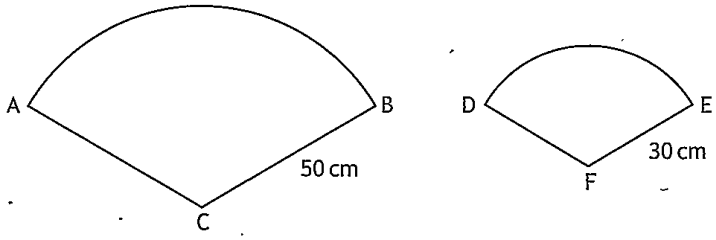
Question 12

Response 39

MARKS | DO NOT WRITE IN THIS MARGIN

12. In the diagram

- ABC is a sector of a circle, centre C
- DEF is a sector of a circle, centre F.



The sectors are mathematically similar.

The area of the larger sector, ABC, is 2750 square centimetres.

(a) Calculate the area of the smaller sector, DEF. 3

S.F $\frac{30}{50} = \frac{3}{5}$

L S

~~Area~~ : ~~length~~

$2750 : x$

$50 : 30$

$50x = 82500$

$x = 1650\text{cm}^2$

(b) Calculate the size of angle ACB. 3

$A = \frac{x}{360} \times \pi \times r^2$

$1650 = \frac{x}{360} \times \pi \times 50^2$

$1650 \times 360 = x \times 7853.98$

$\frac{594000}{7853.98} = x$

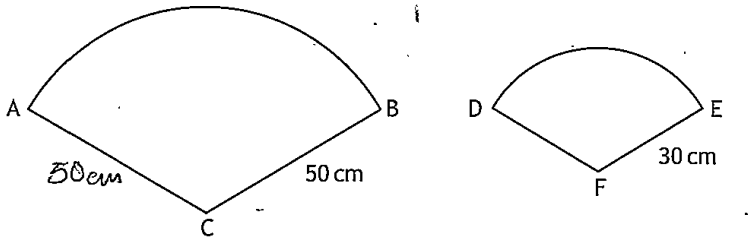
$75.630^\circ = x$

Response 40

MARKS | DO NOT WRITE IN THIS MARGIN

12. In the diagram

- ABC is a sector of a circle, centre C
- DEF is a sector of a circle, centre F.



The sectors are mathematically similar.

The area of the larger sector, ABC, is 2750 square centimetres.

(a) Calculate the area of the smaller sector, DEF. 3

RSf = $\frac{30}{50}$

$= 0.6^2$

$= 0.36$

Area of Small Sector:

2750×0.36

$= 990\ cm^2$

(b) Calculate the size of angle ACB. 3

Area of Sector $= \frac{a}{360} \times \pi r^2$

$2750 = \frac{a}{360} \times 3.14 \times 50^2$

$\frac{2750}{\sqrt{50^2}} = \frac{a}{360} \times 3.14$

$\frac{2750}{\sqrt{50^2} \times 3.14} = \frac{a}{360}$

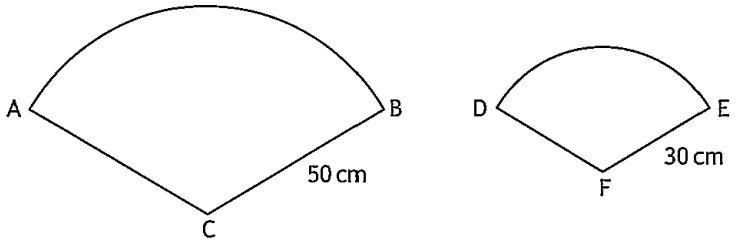
ACB $= 1221.17$

Response 41

MARKS | DO NOT WRITE IN THIS MARGIN

12. In the diagram

- ABC is a sector of a circle, centre C
- DEF is a sector of a circle, centre F.



The sectors are mathematically similar.

The area of the larger sector, ABC, is 2750 square centimetres.

(a) Calculate the area of the smaller sector, DEF. 3

$\left(\frac{30}{50}\right)^3 \times 2750$

$= 594 \text{ cm}^2$

(b) Calculate the size of angle ACB. 3

Question 13

Response 42

MARKS | DO NOT WRITE IN THIS MARGIN

13. Find an expression for the gradient of the line joining point A(6,9) to point B($4p$,$4p^2$).

Give your answer in its simplest form. 3

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{4p^2 - 9}{4p - 6}$$

$$m = \frac{(2p+3)(2p-3)}{\cancel{3(2p)}\ 2(2p-1)}$$

$$m = \frac{(2p+3)(2p-3)}{2(2p-1)}$$

Response 43

MARKS | DO NOT WRITE IN THIS MARGIN

13. Find an expression for the gradient of the line joining point A(6,9) to point B($4p$,$4p^2$).

Give your answer in its simplest form. 3

$$m = \frac{dy}{dx} = \frac{4R^2 - 9}{4R - 6} = \frac{2-9}{1-6} = \frac{-7}{-5} = \frac{7}{5}$$

Question 14

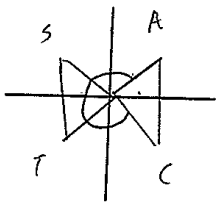
Response 44

14. Solve the equation $5\cos x° + 2 = 1, \quad 0 \leq x < 360.$ 3

$\min 5\cos x + 2 = 1$

$5\cos x = -1$

$\cos x = \frac{-1}{5}$



[basic angle $\cos^{-1}\left(\frac{1}{5}\right)$]

$= 78.46304097$

$A = 101.5$

$x = 180 - 74.46304097$

$= 101.5369595$

$B = 281.5$

$360 - 74.46304097 = 281.5369595$

Response 45

14. Solve the equation $5\cos x° + 2 = 1, \quad 0 \leq x < 360.$ 3

$-2 \quad -2$

$5\cos x° = -1$

$\div 5 \quad \div 5$

$\cos x° = \frac{1}{5}$

$x =$

$\therefore \cos^{-1}\left(\frac{1}{5}\right)$

$= 78.46304097$

$= 78.5°$

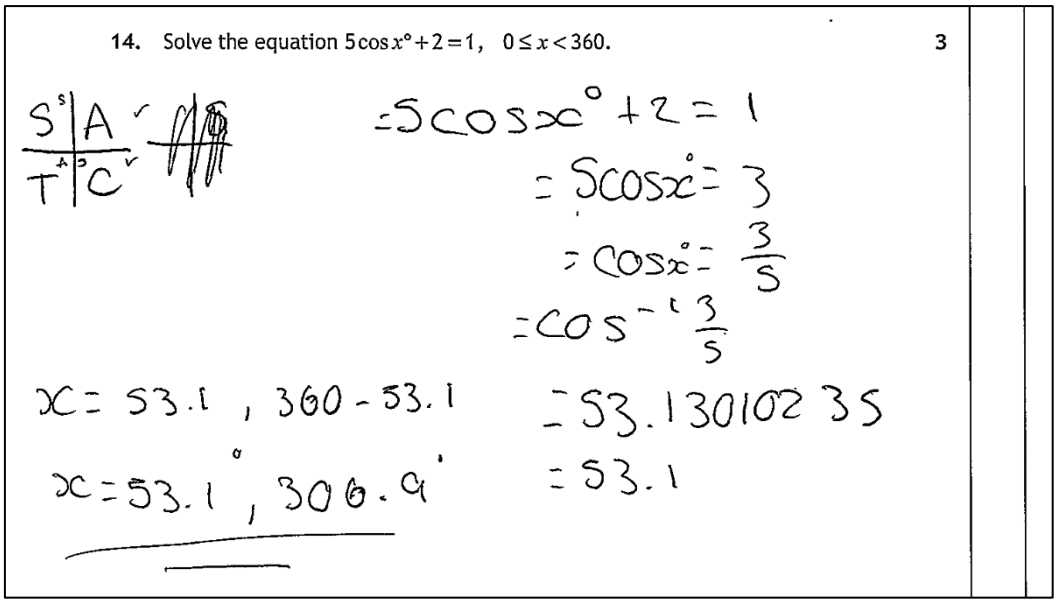
$\therefore x = 360 - 78.5$

$= 281.536959$

$= 281.5°$

Response 46

14. Solve the equation $5\cos x° + 2 = 1, \quad 0 \leq x < 360.$ 3



Question 15

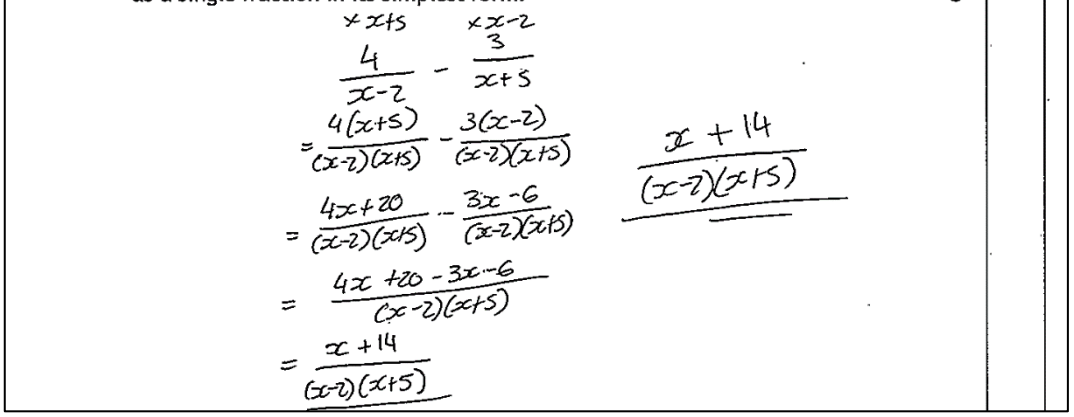
Response 47

MARKS | DO NOT WRITE IN THIS MARGIN

15. Express

$$\frac{4}{x-2} - \frac{3}{x+5}, \quad x \neq 2, x \neq -5$$

as a single fraction in its simplest form. 3



Response 48

MARKS | DO NOT WRITE IN THIS MARGIN

15. Express

$$\frac{4}{x-2}-\frac{3}{x+5}, \quad x \neq 2, x \neq -5$$

as a single fraction in its simplest form. **3**

$\frac{4}{x-2} - \frac{3}{x+5}$ $\frac{12}{(x-2)(x+5)}$

Question 16

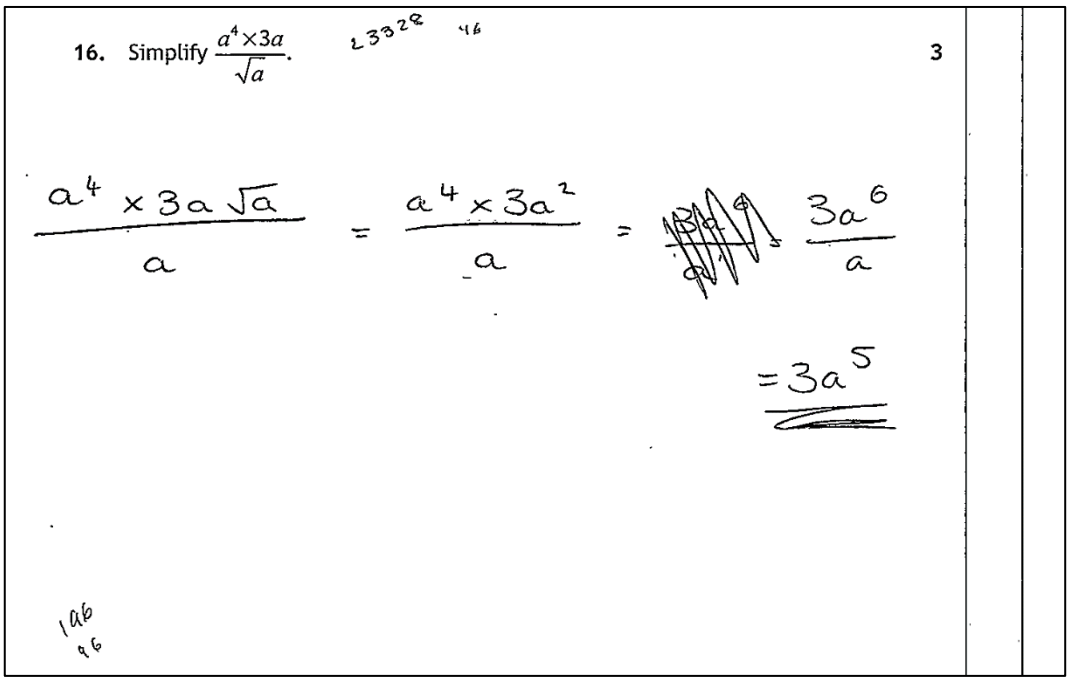
Response 49

16. Simplify $\frac{a^4 \times 3a}{\sqrt{a}}$. **3**

$\frac{3a^5}{\sqrt{a}} \times \sqrt{a} = \frac{3a^5\sqrt{a}}{a}$

$= \frac{3\sqrt{a^6}}{a}$

Response 50



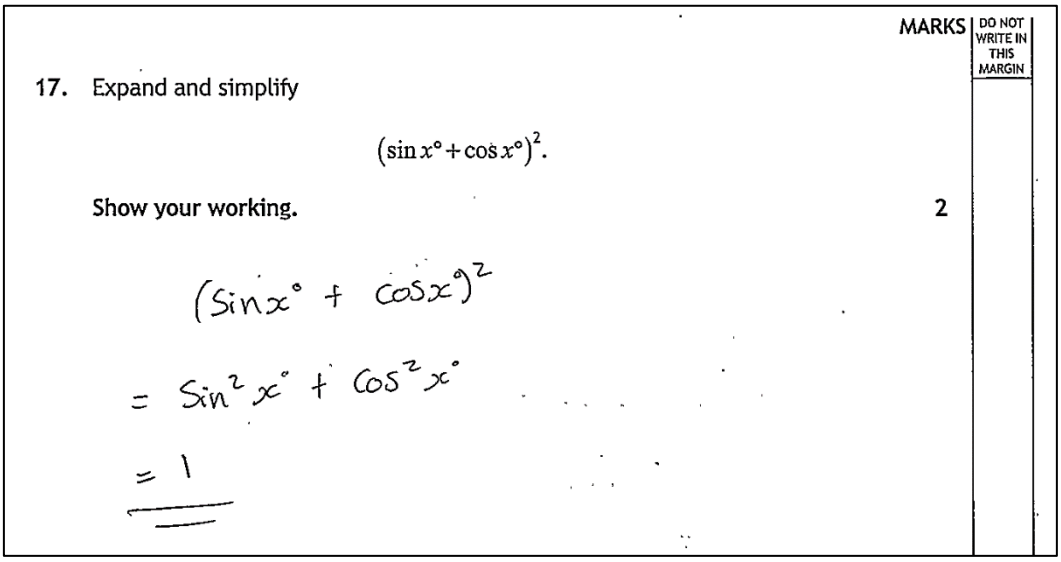
16. Simplify $\frac{a^4 \times 3a}{\sqrt{a}}$. 3

$\frac{a^4 \times 3a\sqrt{a}}{a} = \frac{a^4 \times 3a^2}{a} = \frac{3a^6}{a}$

$= 3a^5$

Question 17

Response 51



MARKS | DO NOT WRITE IN THIS MARGIN

17. Expand and simplify

$(\sin x° + \cos x°)^2$.

Show your working. 2

$(\sin x° + \cos x°)^2$

$= \sin^2 x° + \cos^2 x°$

$= 1$

Response 52

	MARKS	DO NOT WRITE IN THIS MARGIN
17. Expand and simplify $(\sin x° + \cos x°)^2$.		
Show your working.	2	

$(\sin x + \cos x)^2$

$(\sin x + \cos x)(\sin x + \cos x)$

$\sin x^2 + \sin x \cos x + \cos x \sin x + \cos x^2$

$\sin x^2 + \cos x^2 + ~~\sin\cos~~ \sin x \cos x^2$

Question 18

Response 53

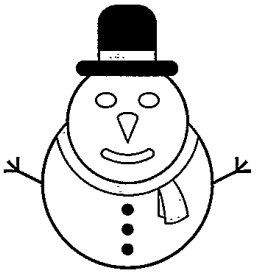
MARKS | DO NOT WRITE IN THIS MARGIN

18. The picture shows a cartoon snowman.

$h = 10.6 + 10.6 + 7.5$

$= 28.713203kk$

$= 28.7\text{cm}$



The diagram below represents the snowman.

$x^2 = 7.5^2 + 7.5^2$

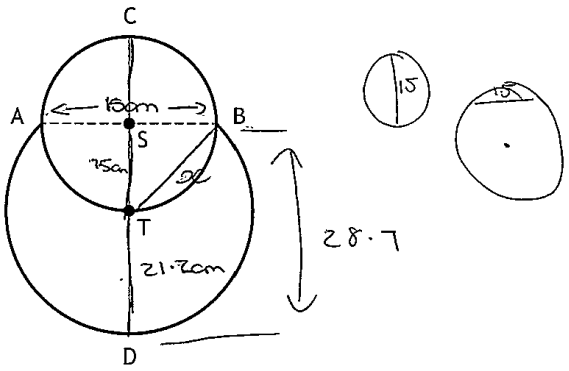
$= 56.25 + 56.25$

$= 112.5$

$x = \sqrt{112.5}$

$x = 10.60660172$

$= 10.6\text{cm}$



- The head is a small circle, centre S, with diameter 15 centimetres
- The body is part of a larger circle, centre T
- The point T lies on the circumference of the small circle
- The points A and B lie on the circumferences of both circles

Calculate CD, the height of the snowman. 4

$x^2 = 15^2 + 15^2$

$x^2 = 225 + 225$

$x^2 = 450$

$x = \sqrt{450}$

$x = 21.21320\ldots$

$x = 21.2\text{cm}$

$h = 15 + 21.2$

$= 36.2\text{cm}$

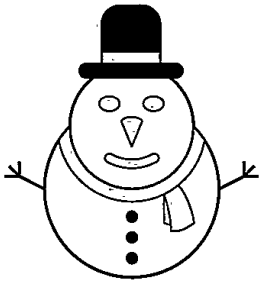
$h = 21.2 + 21.2 + 7.5$

$= 49.9\text{cm}$

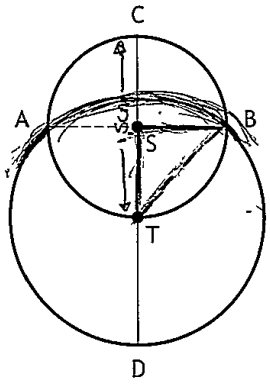
Response 54

MARKS | DO NOT WRITE IN THIS MARGIN

18. The picture shows a cartoon snowman.

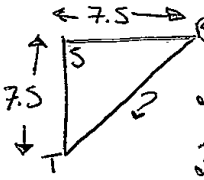


The diagram below represents the snowman.



- The head is a small circle, centre S, with diameter 15 centimetres
- The body is part of a larger circle, centre T
- The point T lies on the circumference of the small circle
- The points A and B lie on the circumferences of both circles

Calculate CD, the height of the snowman. 4



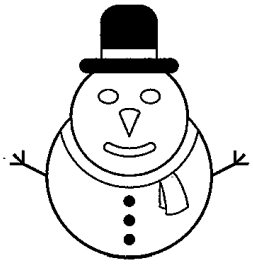
$?^2 = 7.5^2 + 7.5^2$
$= 58.5$
$? = \sqrt{58.5}$
$= 7.6485\,2927\text{cm}$

$h = 15\text{cm} + 7.6485\,2927\text{cm}$
$= 22.6485\,2927\text{cm}$
$= 22.65\text{cm}$

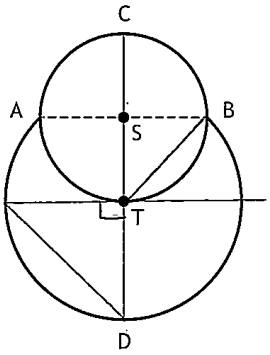
Response 55

MARKS | DO NOT WRITE IN THIS MARGIN

18. The picture shows a cartoon snowman.



The diagram below represents the snowman.



$\vec{CT} = 15\text{cm}$

- The head is a small circle, centre S, with diameter 15 centimetres
- The body is part of a larger circle, centre T
- The point T lies on the circumference of the small circle
- The points A and B lie on the circumferences of both circles

Calculate CD, the height of the snowman. 4

$r^2 = 15^2 + 15^2$

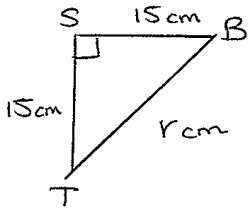
$= 450$

$r = \sqrt{450}$

$= 15\sqrt{2}$

$= 21{\cdot}213203\ldots$

$= 21{\cdot}2\text{cm}$ $\therefore$ TD also $= 21{\cdot}2\text{cm}$



total height $= 15 + 21{\cdot}2$

$= 36{\cdot}2\text{cm}$

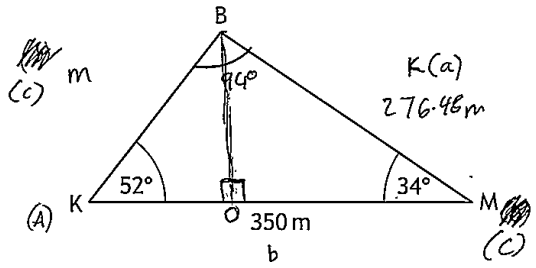
Question 19

Response 56

MARKS | DO NOT WRITE IN THIS MARGIN

19. Katy and Mona are looking up at a hot-air balloon.

In the diagram below, K, M and B represent the positions of Katy, Mona and the balloon respectively.



- The angle of elevation of the balloon from Katy is 52°
- The angle of elevation of the balloon from Mona is 34°
- Katy and Mona are 350 metres apart on level ground

Calculate the height of the hot-air balloon above the ground. **5**

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $\frac{K}{\sin k} \times \frac{b}{\sin B}$

$\sin B = 180 - 52 - 34$
$= 94°$

$\frac{K}{\sin K} = \frac{b}{\sin B} = \frac{m}{\sin M}$

SOH CAH TOA

$K = \frac{\sin K b}{\sin B}$
$= \frac{\sin 52° \times 350}{\sin 94°}$
$= 276.48$ (to 2dp)

MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS

19. $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $\frac{k}{\sin K} \times \frac{b}{\sin B}$

$\frac{K}{\sin K} = \frac{b}{\sin B} = \frac{m}{\sin M}$

$K = \frac{\sin K b}{\sin B}$

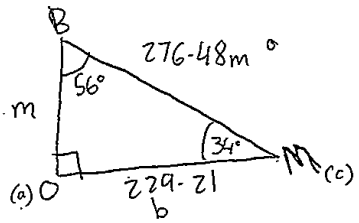
$= \frac{\sin 52° \times 350}{\sin 94°}$

$= 276.48\text{m}$ (to 2 d.p.)

$\sin B = 180 - 52 - 34$

$= 94°$

$\angle BOM = 90°$



$\angle OBM = 180 - 34 - 90$

$= 56°$

$\angle KOB = 180 - 52 - 90$

$= 38°$

$\frac{O}{\sin O} = \frac{b}{\sin B} = \frac{m}{\sin M}$

$b = \frac{\sin B O}{\sin O}$

$= \frac{\sin 56° \times 276.48}{\sin 90°}$

$= 229.21\text{m}$ (to 2 d.p.)

$a^2 = c^2 - b^2$

$= 276.48^2 - 229.21^2$

$= 76441.1904 - 52537.2241$

$= 23903.97$ (to 2 d.p.)

$a = \sqrt{23903.97}$

$= \pm 154.61$ (to 2 d.p.)

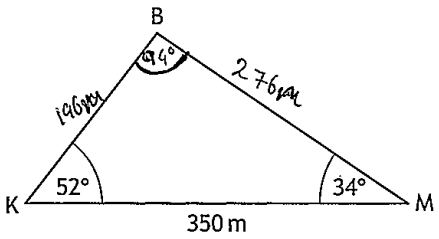
The height of the hot-air balloon above ground is 154.61m

Response 57

MARKS | DO NOT WRITE IN THIS MARGIN

19. Katy and Mona are looking up at a hot-air balloon.

In the diagram below, K, M and B represent the positions of Katy, Mona and the balloon respectively.



- The angle of elevation of the balloon from Katy is 52°
- The angle of elevation of the balloon from Mona is 34°
- Katy and Mona are 350 metres apart on level ground

Calculate the height of the hot-air balloon above the ground. **5**

$\frac{b}{\sin B} = \frac{k}{\sin K} = \frac{m}{\sin M}$

$180 - 52 + 34 = 94$

$KBM = 94°$

$\frac{b}{\sin B} = \frac{k}{\sin K}$ $\frac{m}{\sin M}$?

$k = \frac{b \sin k}{\sin B}$

$k = \frac{350 \sin 52}{\sin 94}$

$k = 276m$

$M = \frac{b \sin M}{\sin B}$

$M = 196m$

$M = \frac{350 \sin 34°}{\sin 94°}$

$M = 196m$

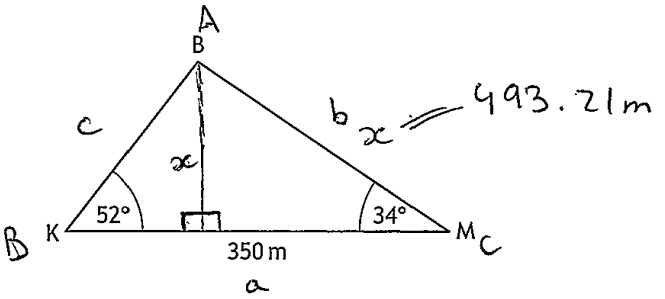
Katy sees the ballon as 196m in the air whereas Mona sees the ballon as 276m in the air.

Response 58

MARKS | DO NOT WRITE IN THIS MARGIN

19. Katy and Mona are looking up at a hot-air balloon.

In the diagram below, K, M and B represent the positions of Katy, Mona and the balloon respectively.



- The angle of elevation of the balloon from Katy is 52°
- The angle of elevation of the balloon from Mona is 34°
- Katy and Mona are 350 metres apart on level ground

Calculate the height of the hot-air balloon above the ground. **5**

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{350}{\sin A} = \frac{x}{\sin 52^\circ} = \frac{c}{\sin 34^\circ}$$

$$\frac{350}{\sin 34} = \frac{x}{\sin 52}$$

$$\sin 34 x = 350 \sin 52$$

$$x = \frac{350 \sin 52}{\sin 34}$$

$$= 493.217...$$

$$= 493.21 \text{m} (2\text{dp})$$

$$a^2 = b^2 - c^2$$

$$a^2 = 493.21^2 - 350^2$$

$$= 243256.1041 - 122500$$

$$= \sqrt{120756.1041...}$$

$$= 347.499...$$

Height = 347.50m (2dp)