Dr Oliver Mathematics
Mathematics: National Qualifications N5
2019 Paper 2: Calculator
1 hour 50 minutes

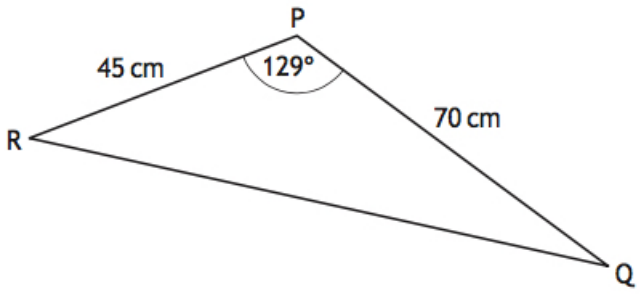
The total number of marks available is 60.
You must write down all the stages in your working.

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

2. Find $|\mathbf{p}|$, the magnitude of vector (2)

$$\mathbf{p} = \begin{pmatrix} 6 \\ 27 \\ -18 \end{pmatrix}.$$

3. The diagram shows triangle PQR. (2)

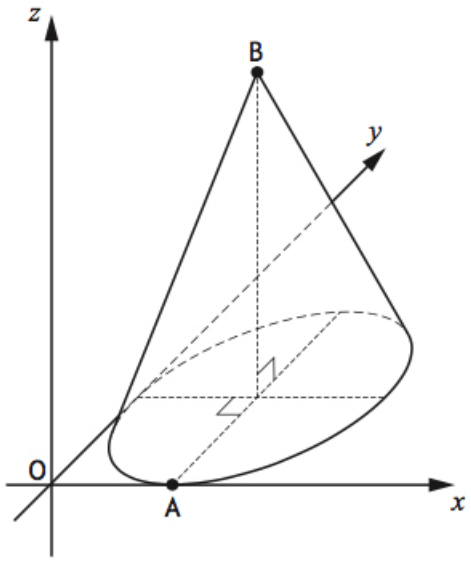


   - $PR = 45$ centimetres,
   - $PQ = 70$ centimetres, and
   - angle $QPR = 129°$.

   Calculate the area of triangle PQR.

4. A sesame seed weighs 3.6×10^{-6} kilograms. (2)
   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.

5. The diagram shows a cone with diameter 6 units and height 8 units. (2)



- 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.

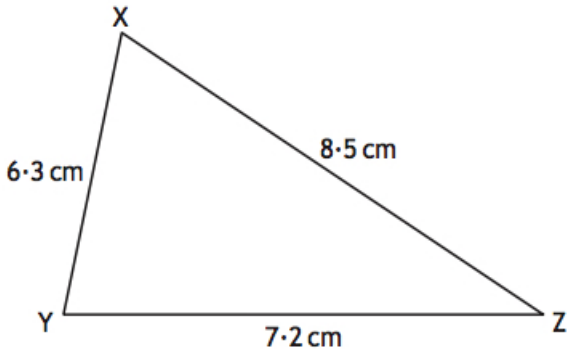
Write down the coordinates of A and B.

6. Solve the equation (3)

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

Give your answers correct to 1 decimal place.

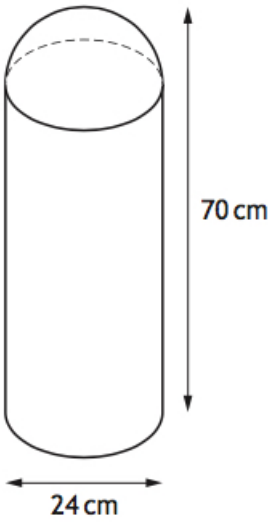
7. Triangle XYZ is shown below. (3)



Calculate the size of the smallest angle in triangle XYZ.

8. A traffic bollard is in the shape of a cylinder with a hemisphere on top. (5)
The bollard has

- diameter 24 centimetres and
- height 70 centimetres.



Calculate the volume of the bollard.
Give your answer correct to 3 significant figures.

9. Georgie had her roof repaired. (3)
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.

10. Express (2)

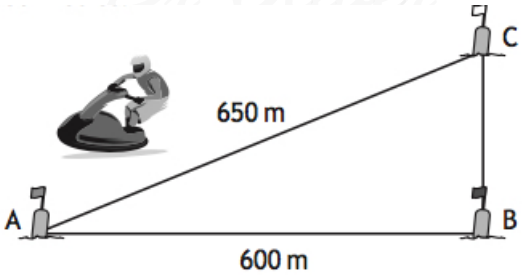
$$x^2 + 10x - 15$$

in the form

$$(x + p)^2 + q.$$

11. The diagram shows the course for a jet-ski race. (4)
The course is indicated by markers A, B, and C.
The total length of the course is 1500 metres.

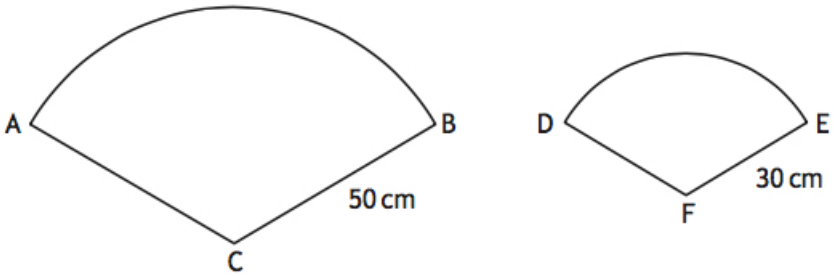
- B is 600 metres from A,
- C is 650 metres from A, and
- C is due north of B



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

12. In the diagram,

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



The sectors are mathematically similar.
The area of the larger sector, ABC, is 2 750 square centimetres.

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

(b) Calculate the size of angle ACB. (3)

13. Find an expression for the gradient of the line joining point $A(6, 9)$ to point $B(4p, 4p^2)$. (3)
Give your answer in its simplest form.

14. Solve the equation (3)

$$5\cos x^\circ + 2 = 1,\ 0 \leqslant x < 360.$$

15. Express (3)

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

as a single fraction in its simplest form.

16. Simplify (3)

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

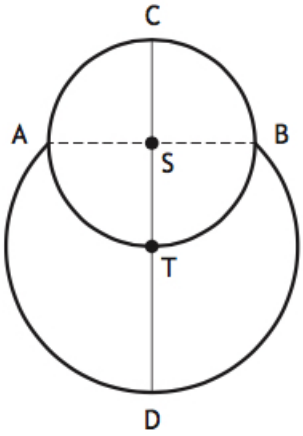
17. Expand and simplify (2)

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

Show your working.

18. The picture shows a cartoon snowman. (4)

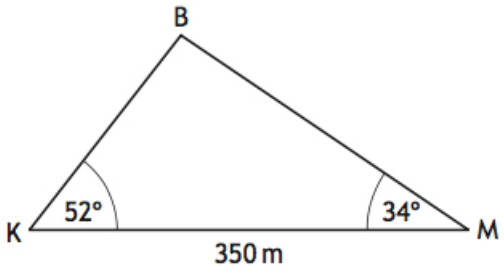
The diagram below represents the snowman.



- 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.

19. Katy and Mona are looking up at a hot-air balloon. (5)
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.