GCSE MATHEMATICS

S21-C300

With Calculator Assessment Resource Q

Higher Tier

Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

Volume of a sphere = $\frac{4}{3}\pi r^3$

Volume of a cone = $\frac{1}{3}\pi r^2 h$

Kinematics formulae

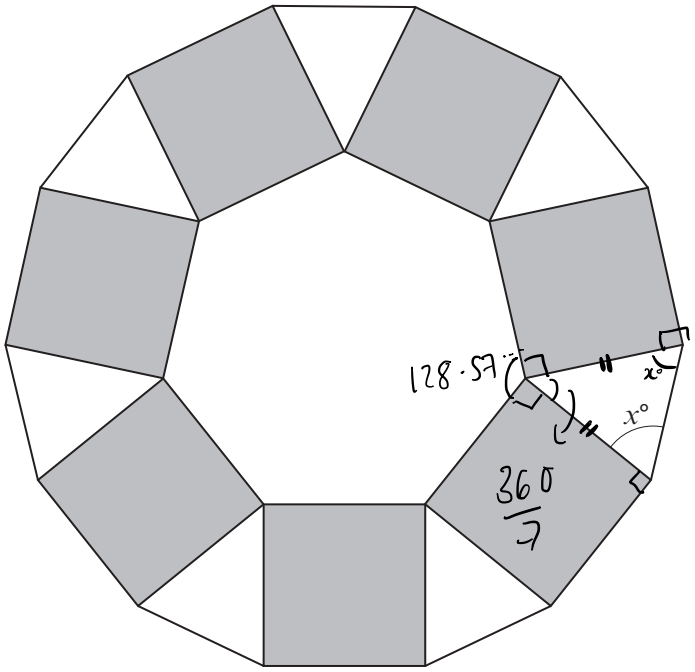
Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

1.

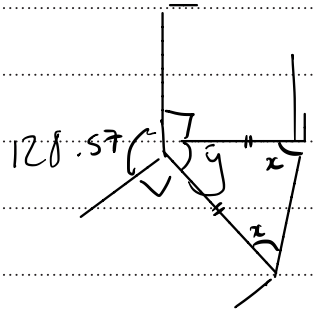


This pattern is made from a regular seven-sided polygon surrounded by squares and isosceles triangles.

Show that the value of x is 64·3 correct to 1 decimal place. [4]

You must show all your working.

$\frac{(n-2)180}{n} \rightarrow \frac{(7-2)180}{7} = \frac{900}{7} = 128.5714286$



$y = 360 - 90 - 90 - 128.57$
$= 51.4285°$

$180 - 51.4285 = 128.57°$

$128.57 \div 2 = 64.285...$
$\approx \boxed{64.3°}$

7

2. A cylindrical glass contains 500 cm^3 of water.
The glass has an internal radius of 3·5 cm.

Calculate the height of the water in the glass. [3]

volume of a cylinder $= \pi r^2 h$

$500 = \pi (3.5)^2 h$

$500 = 12.25 \pi h$

$12.99224025 = h$

$13.0 \text{ cm} = h$

3. The diagram shows two right-angled triangles.

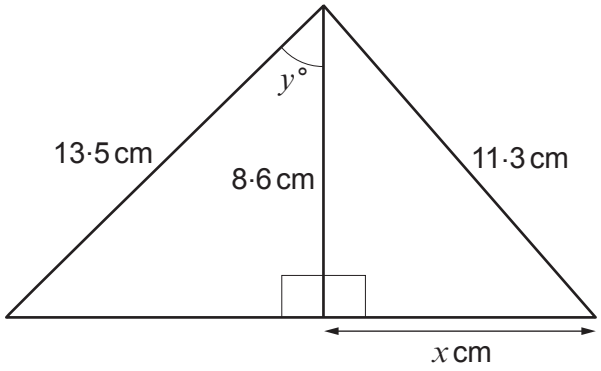
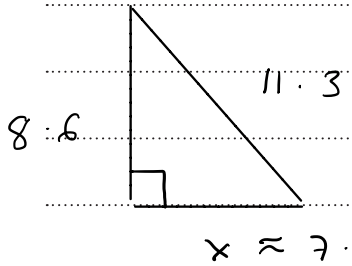


Diagram not drawn to scale

(a) Calculate the value of x. [3]



$a^2 + b^2 = c^2$

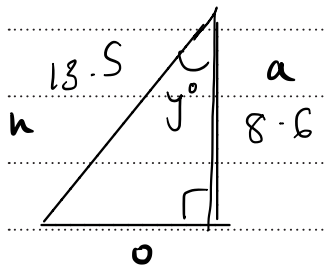
$x^2 = 11.3^2 - 8.6^2$

$x = \sqrt{11.3^2 - 8.6^2}$

$x = 7.330075034$

≈ 7.3 cm (1dp)

(b) Calculate the value of y. [3]



$\cos y = \frac{8.6}{13.5}$

$y = 50.4287...$

$= 50.43°$

4. The speed limit on a road is decreased from 70 mph to 50 mph.
The road is 7·3 miles long.

How much longer does it take to travel along the road at 50 mph than at 70 mph?
Give your answer in minutes correct to 1 decimal place. [4]

Speed = $\frac{\text{distance}}{\text{time}}$

$t = \frac{7.3}{70}$ $t_1 = \frac{7.3}{50}$

$t = 0.104$ hrs $t_1 = 0.146$ hrs

$t_1 - t = 0.146 - 0.104 = 0.042$ hrs

$0.042 \times 60 = 2.52$ minutes

$\approx$ 2.5 minutes

5.

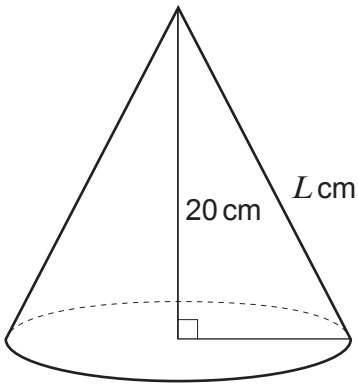


Diagram not drawn to scale

(a) A cone has vertical height 20 cm.
The volume of the cone is 2400 cm^3.

Calculate L, the slant height of the cone. [4]

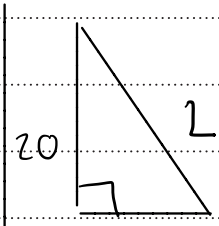
$2400 = \frac{1}{3} \pi r^2 h$

$= 2400 = \frac{1}{3} \pi r^2 20$

$360 = \pi r^2$

$114.59... = r^2$

$r = 10.7047447$



$10.7...$

$L = \sqrt{20^2 + 10.7...^2}$

$= 22.6846106^2$

≈ 23 cm

(3sf)

(b) Cones *A* and *B* are mathematically similar.

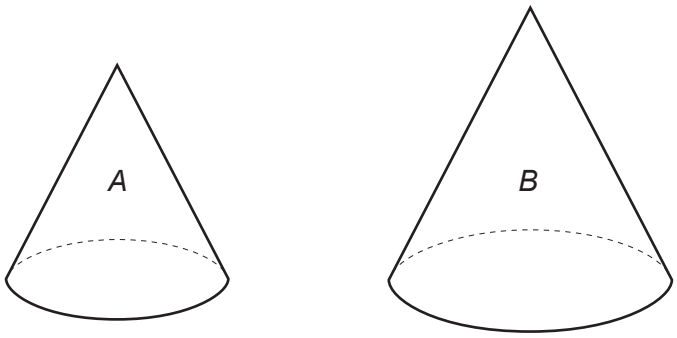


Diagram not drawn to scale

The diameter of the base of cone *A* is 12 cm.
The diameter of the base of cone *B* is 18 cm.

The total surface area of cone *A* is 300 cm^2.

Calculate the total surface area of cone *B*. [3]

d : A : B

12 : 18

1 : 1.5

∴ Surface area of B

$= 300 \times 1.5^2$

$= 675\ cm^2$

6. A pet hotel is allowed to have a maximum of 10 pets at one time.
It takes only cats and dogs.
Each cat requires 1 unit of accommodation and each dog requires 3 units of accommodation.
For the hotel to make a profit, there must be at least 15 units occupied each day.

Let x be the number of cats and y the number of dogs in the pet hotel.

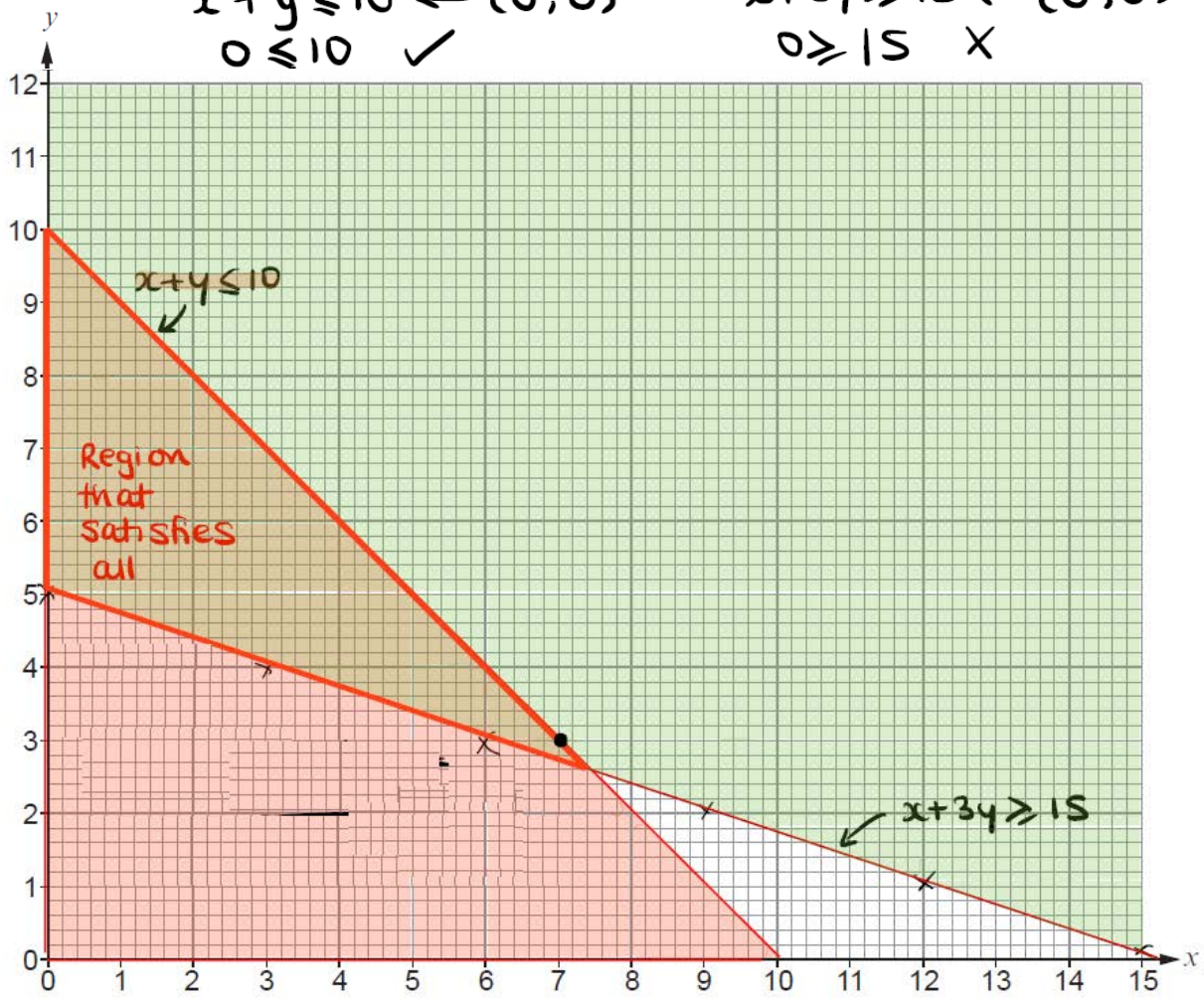
(a) Two inequalities that represent this information are $x \geqslant 0$ and $y \geqslant 0$.
Write down **two** *further* inequalities that represent the information. [2]

$x + y \leq 10$ $\quad$ $x + 3y \geqslant 15$

(b) On the graph paper below, draw the region that satisfies all of these inequalities.
Indicate clearly the region that is your answer. [3]

$x + y \leqslant 10 \leftarrow (0,0)$
$0 \leqslant 10$ ✓

$x + 3y \geqslant 15 \leftarrow (0,0)$
$0 \geqslant 15$ X



(c) One Wednesday there are enough pets staying for the hotel to make a profit.
What is the fewest number of **dogs** that could be in the hotel? [1]

3 dogs.

7.

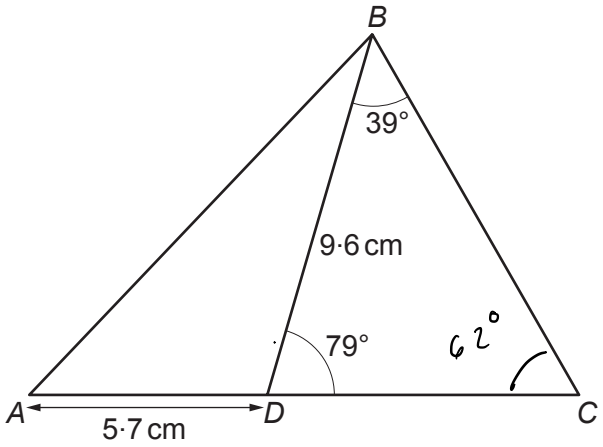


Diagram not drawn to scale

In the diagram, $AD = 5{\cdot}7$ cm, $BD = 9{\cdot}6$ cm, $B\hat{D}C = 79°$ and $D\hat{B}C = 39°$.

ADC is a straight line.

(a) Calculate the length of DC. [3]

$\frac{9.6}{\sin 62} \times \sin 39 = DC$

$6.842394501 = DC$

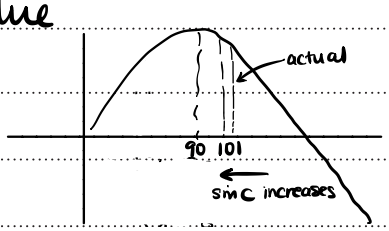
$6.8 \text{ cm} = DC$

(b) Mona assumes that the values in the diagram are all exact and uses these to work out the area of triangle ABD.
In fact, the lengths are correct but $B\hat{D}C$ has been **rounded up** to the nearest whole number.

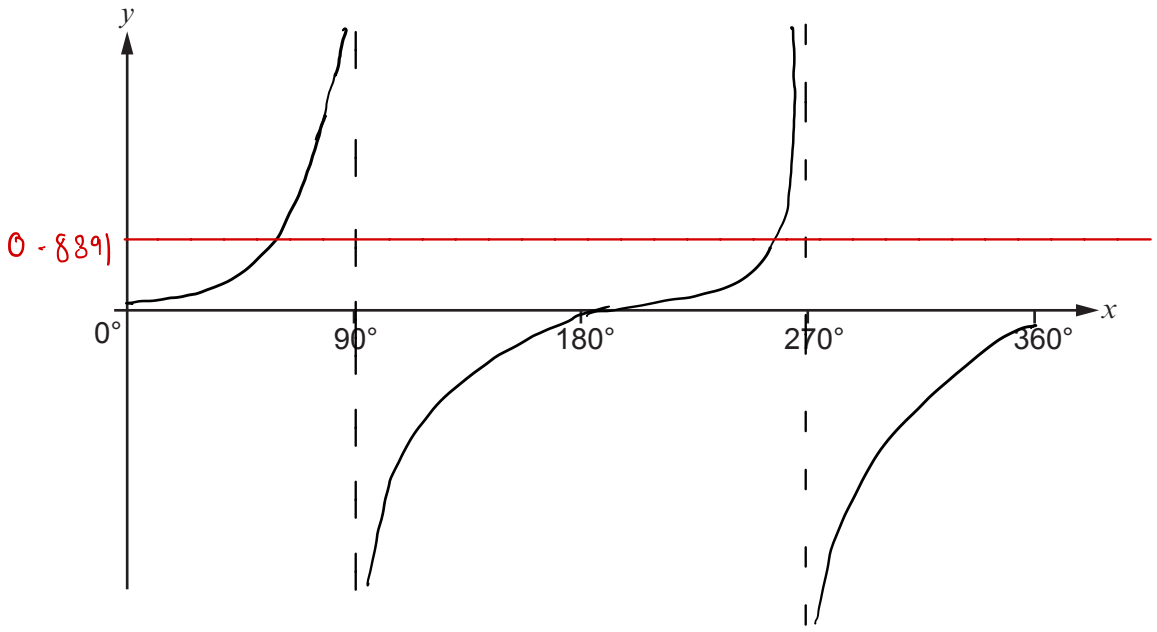
Is Mona's answer too large or too small?
Use calculations to justify your decision. [3]

Too large ☑ Too small ☐

$B\hat{D}C$ is rounded up so the actual value is smaller than 79°. The $\triangle ABD$'s area is $\frac{1}{2}ab\sin C$ and $C = A\hat{D}B = 180 - B\hat{D}C$. Because $B\hat{D}C$ used is bigger than actual, the calculated $A\hat{D}B$ is smaller than actual. Thus sinC comes out higher than actual. As a result area calculated is too large.



8. *(a)* On the axes below, sketch the graph of $y = \tan x°$ where $0° \leqslant x \leqslant 360°$. [2]



(b) Solve the equation $\tan x = 0{\cdot}8391$ in the range $0° \leqslant x \leqslant 360°$. [2]

2 solutions

$x_1 = \tan^{-1}(0{\cdot}8391)$

$x_1 = 40{\cdot}0000124$

$x_1 \approx 40°$

$x_2 = 180 + 40{\cdot}0000124$

$x_2 = 220{\cdot}0000124$

$x_2 = 220°$

$\therefore x = 40°, 220°$