1 Festival A will be in a rectangular field with an area of $80\,000\,m^2$
The greatest number of people allowed to attend Festival A is 425

Festival B will be in a rectangular field 700 m by 2000 m.
The greatest number of people allowed to attend Festival B is 6750

The area per person allowed for Festival B is greater than the area per person allowed
for Festival A.

(a) How much greater?
Give your answer correct to the nearest whole number.

Field A
area = 80,000 m²
max people = 425

area per person
= $\dfrac{80,000}{425}$ = 188.2... ①

Field B ①
area = 700 × 2000 = 1,400,000
max people = 6750

area per person
= $\dfrac{1,400,000}{6750}$ = 207.4... ①

difference is 207.4... − 188.2...
= 19.17...
= 19 to the nearest
whole number ①

tip: 'per'
means 'divided by'

19

m^2

(4)

Callum says,

"$300\,cm^2$ is the same as $3\,m^2$ because there are 100 cm in 1 m so you divide by 100"

Callum's method is wrong.

(b) Explain why.

Because there are 10,000cm² in 1m² ①

1m² = 1m × 1m = 100cm × 100cm = 10,000cm².

(1)

(Total for Question 1 is 5 marks)

2 A box in the shape of a cuboid is placed on a horizontal floor.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

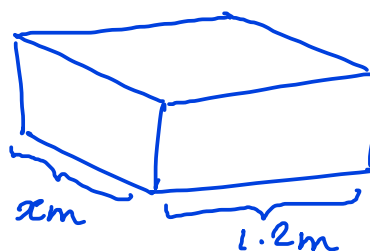The box exerts a force of 180 newtons on the floor.
The box exerts a pressure of 187.5 newtons/m² on the floor.

The face in contact with the floor is a rectangle of length 1.2 metres and width x metres.

Work out the value of x.

USIng area = $\dfrac{\text{force}}{\text{pressure}}$

$= \dfrac{180}{187.5} = 0.96 \text{m}^2$ ①

x $\boxed{A = 0.96}$
    1·2

xm $1.2m$

$x = \dfrac{0.96}{1.2} = 0.8m$ ①
              ①

$x =$ 0.8

(Total for Question 2 is 3 marks)

3 A solid cone is joined to a solid hemisphere to make the solid **T** shown below.

y cm

y - 3.5

3.5

—7 cm—
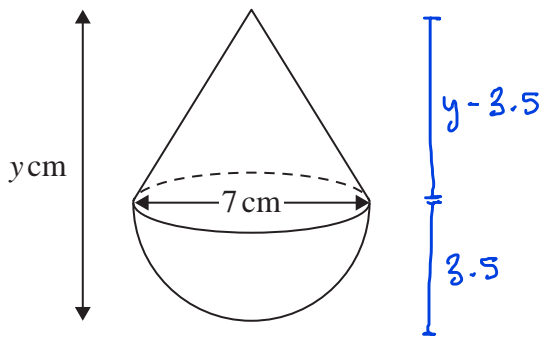
Volume of sphere = $\dfrac{4}{3}\pi r^3$

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

r

l

h

r

The diameter of the base of the cone is 7 cm.
The diameter of the hemisphere is 7 cm.

The total volume of **T** is $120\pi\,\text{cm}^3$
The total height of **T** is *y* cm.

(a) Calculate the value of *y*.
   Give your answer correct to 3 significant figures.

Method: find area of T in terms of y.

Diameter of hemisphere = 7cm
so radius = 3.5 cm
∴ height of cone = y - 3.5

given area T
= 120π so equate
& cancel π

Volume of cone = $\frac{1}{3}\pi(3.5)^2(y-3.5)$

$= \frac{49\pi}{12}(y-3.5)$

volume of hemisphere = $\frac{1}{2} \times \frac{4}{3}\pi(3.5)^3 = \frac{343}{12}\pi$ ①

∴ Volume of T

$= \frac{49\pi}{12}(y-3.5) + \frac{343}{12}\pi$

$= \frac{49\pi}{12}y + \frac{343\pi}{24}$

$\Rightarrow 120 = \frac{49y}{12} + \frac{343}{24}$ ①

$y = \frac{12}{49}\left(120 - \frac{343}{24}\right) = 25.88..$ ①

y = ...25.9........ ①

(4)

The diameter of the base of the cone and the diameter of the hemisphere are both increased by the same amount.
Assuming the total volume of **T** does not change,

(b) explain the effect this would have on your answer to part (a).

The height would decrease ①
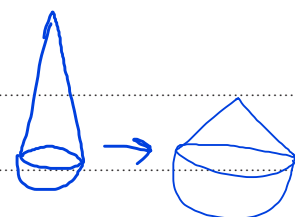
height decreases. **(1)**

(Total for Question 3 is 5 marks)

4 A car factory is going to make four different car models **A**, **B**, **C** and **D**.

80 people are asked which of the four models they would be most likely to buy.

The table shows information about the results.

Car model	Number of people
A	23
B	15
C	30
D	12

The factory is going to make 40 000 cars next year.

Work out how many model **B** cars the factory should make next year.

Proportion of people who chose B

$= \dfrac{15}{80} = \dfrac{3}{16}$

$\dfrac{3}{16} \times 40,000$ ①

$$\begin{array}{r} 0\,2\,5\,0\,0 \\ 16\,\overline{)40{,}000} \end{array}$$

$= 3 \times 2500$

$= 7500$ ①

.... 7500 ....

(Total for Question 4 is 2 marks)

5

A storage tank exerts a force of 10 000 newtons on the ground.

The base of the tank in contact with the ground is a 4 m by 2 m rectangle.

Work out the pressure on the ground due to the tank.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

area = 4 × 2 = 8m²

pressure = $\frac{\text{force}}{\text{area}}$ = $\frac{10,000}{8}$ = $\frac{2,500}{2}$ = 1250

.... 1250 .... newtons / m²

(Total for Question 5 is 2 marks)

6 A race is measured to have a distance of 10.6 km, correct to the nearest 0.1 km.
Sam runs the race in a time of 31 minutes 48 seconds, correct to the nearest second.

Sam's average speed in this race is *V* km/hour.

By considering bounds, calculate the value of *V* to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

upper boundary = 10.65 km

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

Distance = 10.6 km

lower boundary = 10.55 km ①

CONVERSION

×60 ×60

hour   minute   second

÷60   ÷60

time = 31 minutes 48 seconds

U.B   1908.5 s

= (31 × 60) + 48 = 1908 seconds

L.B   1907.5 s

$\text{Speed}_{\text{upper}} = \dfrac{\text{distance}_{\text{upper}}}{\text{time}_{\text{lower}}} = \dfrac{10.65 \text{ km}}{\frac{1907.5}{3600} \text{ hours}} = 20.0996 \dots \text{ km/h}$ ①

$\text{Speed}_{\text{lower}} = \dfrac{\text{distance}_{\text{lower}}}{\text{time}_{\text{upper}}} = \dfrac{10.55 \text{ km}}{\frac{1908.5}{3600} \text{ hours}} = 19.9004 \dots \text{ km/h}$ ① ①

Since the upper and lower bound both round to 20 km/h

correct to 2 s.f., V = 20 km/h. ①

(Total for Question 6 is 5 marks)

7 Karina has 4 tanks on her tractor.
Each tank is a cylinder with diameter 80 cm and height 160 cm.

$\leftarrow$80 cm$\rightarrow$

160 cm
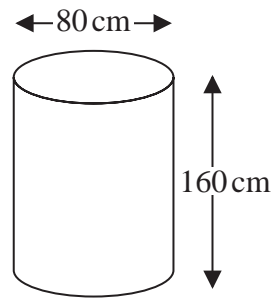
The 4 tanks are to be filled completely with a mixture of fertiliser and water.

The fertiliser has to be mixed with water in the ratio $1 : 100$ by volume.
Karina has 32 litres of fertiliser.

1 litre = 1000 cm³

Has Karina enough fertiliser for the 4 tanks?
You must show how you get your answer.

Volume of the cylinder = $\pi r^2 h$ r = radius
h = height

we have $r = \frac{80}{2} = 40\,cm$

$h = 160\,cm$

$\therefore$ volume is $\pi(40)^2(160) = 256000\pi\,cm^3$ $\Big)\div 1000$

$= 256\pi$ litres ①

So four tanks have a volume
of $4 \times 256\pi = 1024\pi$ litres ①

we need fertiliser : water
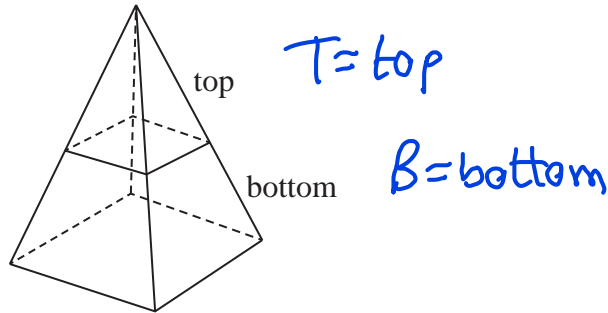   1 : 100

$1 + 100 = 101$

$1024\pi \div 101 = 31.85...$ ①

So Karina needs at least 31.9
litres of fertiliser.

$32 > 31.9$ so ①
Karina has enough
fertiliser

(Total for Question 7 is 4 marks)

8 The pyramid **P** is formed from two parts made of different materials.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

top

T = top

bottom

B = bottom

The top part of **P** has a mass of 92.8 g and is made from material with a density of 2.9 g/cm³
The bottom part of **P** has a mass of 972.8 g
The average density of **P** is 4.7 g/cm³

Calculate the volume of the top part of **P** as a percentage of the total volume of **P**.
Give your answer correct to 1 decimal place.
You must show all your working.

$$\text{volume } T = \frac{\text{mass}}{\text{density}} = \frac{92.8}{2.9} = 32 \ ①$$

$$\text{Total mass of } P = \overset{\text{mass } T}{92.8} + \overset{\text{mass } B}{972.8} = 1065.6 \ ①$$

$$\text{Total volume of } P = \frac{\text{mass of } P}{\text{density of } P}$$

$$= \frac{1065.6}{4.7} = 226.7234 \ ①$$

∴ volume T as a percentage of volume P

$$= \frac{32}{226.7234} \times 100 = 14.114... \ ①$$
$$= 14.1 \ (1dp)$$

14.1 ① %

(Total for Question 8 is 5 marks)