Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

Pearson
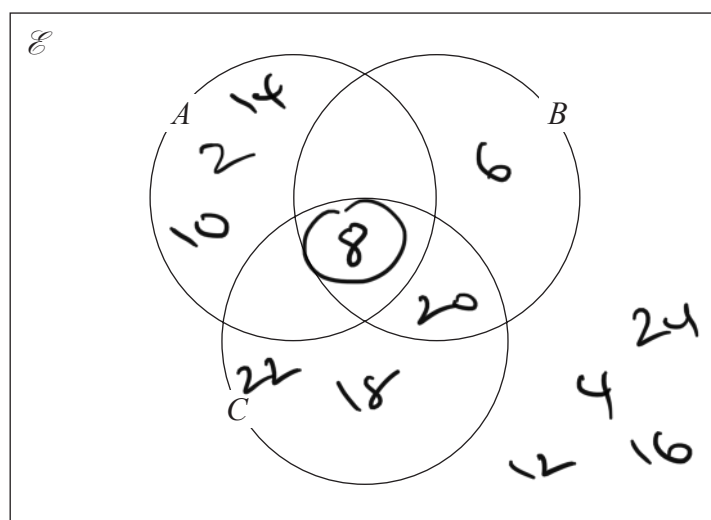
1    $\mathscr{E}=$ {even numbers between 1 and 25}
    $A = \{2, 8, 10, 14\}$
    $B = \{6, 8, 20\}$
    $C = \{8, 18, 20, 22\}$

(a) Complete the Venn diagram for this information.
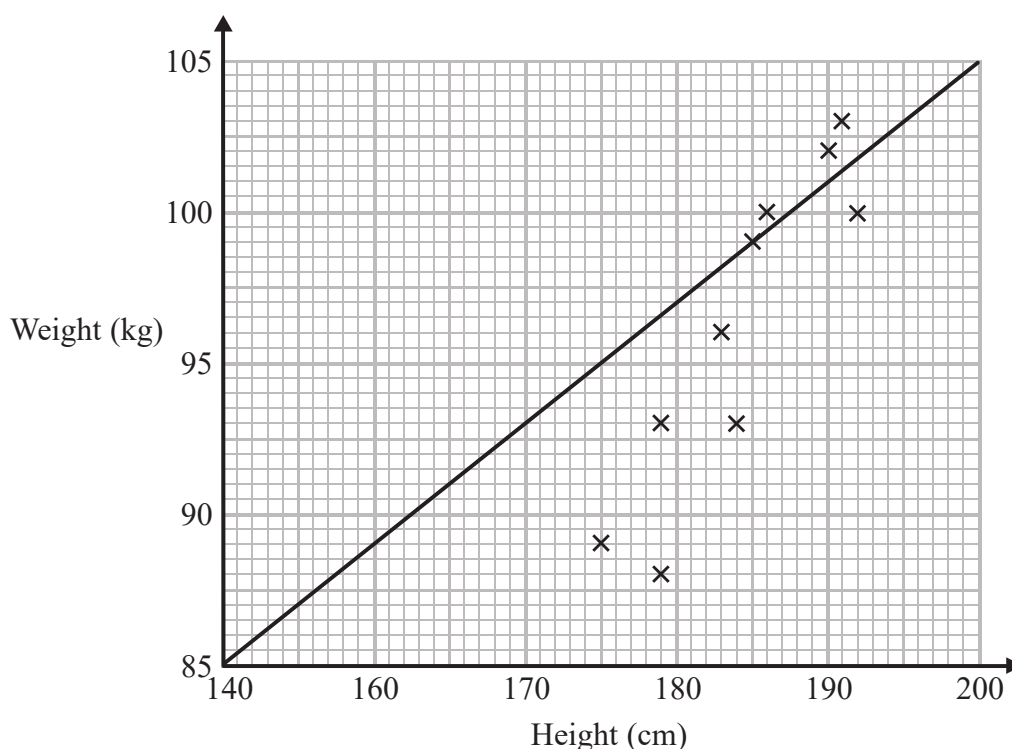

(4)

A number is chosen at random from $\mathscr{E}$.

(b) Find the probability that the number is a member of $A \cap B$.

$\frac{1}{12}$

(2)

(Total for Question 1 is 6 marks)

2 Sean has information about the height, in cm, and the weight, in kg, of each of ten rugby players.

He is asked to draw a scatter graph and a line of best fit for this information.

Here is his answer.

Sean has plotted the points accurately.

Write down two things that are wrong with his answer.

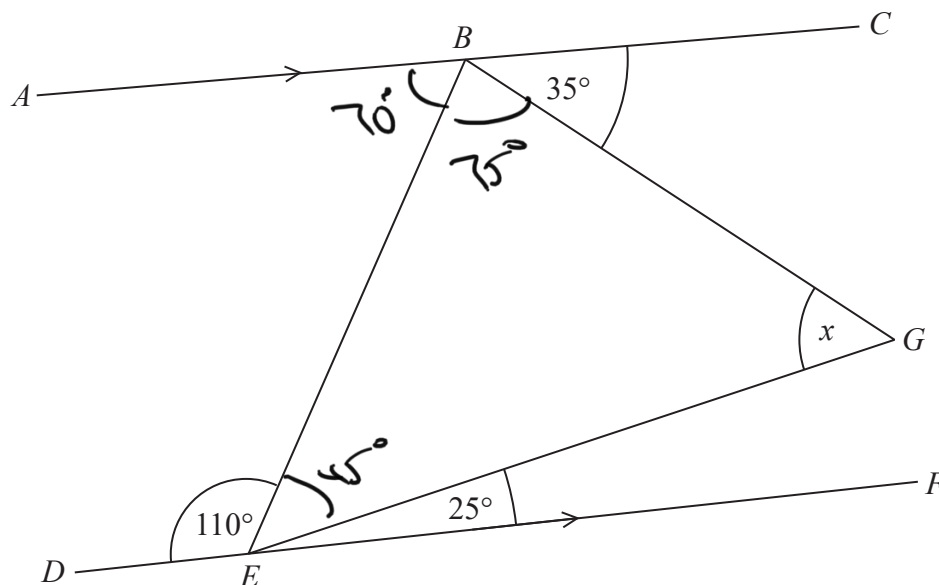1 ....Line of best fit incorrectly drawn.......... ✓

....

2 ....150 incorrectly placed on weight (x) axis.... ✓

....

(Total for Question 2 is 2 marks)

Turn over ▶

3 *BEG* is a triangle.

ABC and *DEF* are parallel lines.

Work out the size of angle *x*.
Give a reason for each stage of your working.

$\angle BEG = 180 - 135 = 45°$ (Angles on a straight line add to 180°)

$\angle ABE = 70°$ (Alternate angle to $\angle BEF$)

$\angle EBG = 180 - 70 - 35 = 75°$ (Angles on straight line)

$\angle EGB (x) = 180 - 75 - 45 = 60°$ (Angles in a triangle add to 180°)

60°

(Total for Question 3 is 4 marks)

4 Northern Bank has two types of account.
Both accounts pay compound interest.

Cash savings account		**Shares account**
Interest		Interest
2.5% per annum		3.5% per annum

Ali invests £2000 in the cash savings account.
Ben invests £1600 in the shares account.

(a) Work out who will get the most interest by the end of 3 years.
You must show all your working.

Ali:
$$2000 \times 1.025^3 = 2153.78$$
$$\underline{2000.00}$$
$$153.78 \text{ interest}$$

Ben:
$$1600 \times 1.035^3 = 1773.95$$
$$\underline{1600.00}$$
$$= 173.95 \text{ interest}$$

Ben achieves more interest

(4)

In the 3rd year the rate of interest for the shares account is changed to 4% per annum.

(b) Does this affect who will get the most interest by the end of 3 years?
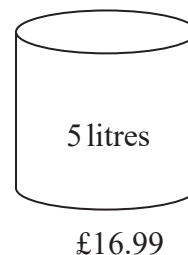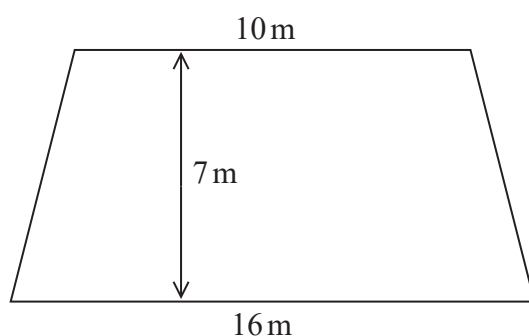Give a reason for your answer.

No Ben will get an increase from
3.5% → 4.00%, e will still get
more than Ali

(1)

(Total for Question 4 is 5 marks)

5 The diagram shows a floor in the shape of a trapezium.

10 m

7 m

16 m

5 litres

£16.99

John is going to paint the floor.

Each 5 litre tin of paint costs £16.99
1 litre of paint covers an area of $2\,m^2$ ⟹ 5 litres = 10 m²

John has £160 to spend on paint.

Has John got enough money to buy all the paint he needs?
You must show how you get your answer.

Area of trapezium = $\frac{1}{2}(a+b)h$.

= $\frac{1}{2}(10+16)7$

= 91 m²

No. of ~~litres~~ = $\frac{91}{2}$ = (10 tins)

45.5 litres

Total ~~cost~~ required = 10 × 16.99 = £169.90

John doesn't have enough money.

(Total for Question 5 is 5 marks)

6 *A* is the point with coordinates (5, 9)
B is the point with coordinates (*d*, 15)

The gradient of the line *AB* is 3

Work out the value of *d*.

when (5,9)

$y = mx + c$.

$9 = 3(5) + c$.

$9 = 15 + c$.

$-6 = c$

Equation of line

$y = 3x - 6$

when (d, 15)

$15 = 3(d) - 6$

$15 = 3d - 6$

$21 = 3d$

$7 = d$

$d = 7$

(Total for Question 6 is 3 marks)

7 (a) Write the number 0.00008623 in standard form.

8.623×10^{-5}

(1)

(b) Work out $\dfrac{3.2 \times 10^{3} + 5.1 \times 10^{-2}}{4.3 \times 10^{-4}}$

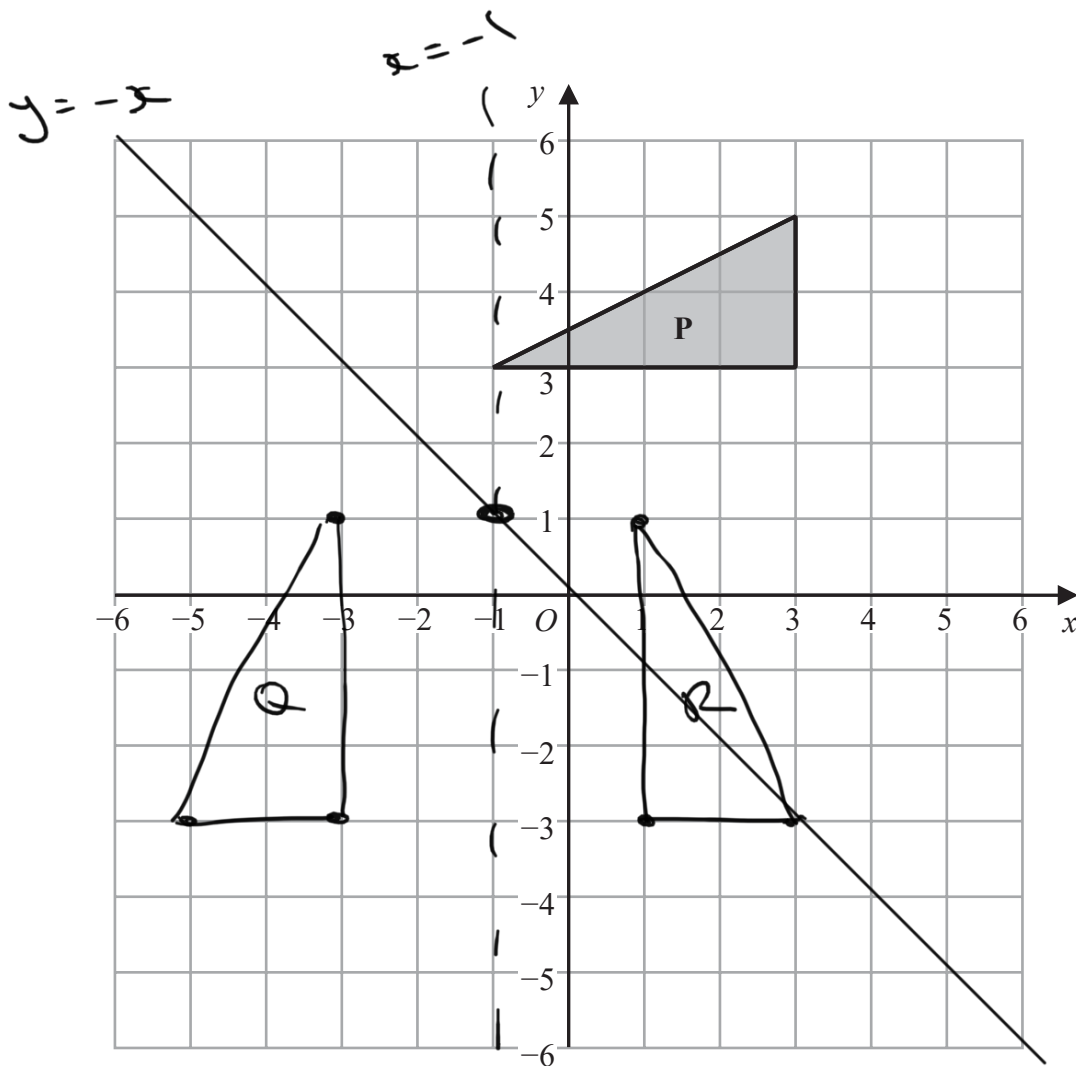Give your answer in standard form, correct to 3 significant figures.

7441979.07

7440000

7.44×10^{6}

(2)

(Total for Question 7 is 3 marks)

8

$y = -x$

$x = -1$

Triangle **P** is reflected in the line $y = -x$ to give triangle **Q**.
Triangle **Q** is reflected in the line $x = -1$ to give triangle **R**.

Describe fully the single transformation that maps triangle **R** to triangle **P**.

Rotation 90° anticlockwise (-1, 1)

* use tracing paper.

(Total for Question 8 is 3 marks)

9 Martin truncates the number N to 1 digit.
The result is 7

Write down the error interval for N.

$7 \leq N < 8$

(Total for Question 9 is 2 marks)

10 Robert makes 50 litres of green paint by mixing litres of yellow paint and litres of blue paint in the ratio $2:3$

Yellow paint is sold in 5 litre tins.
Each tin of yellow paint costs £26

Blue paint is sold in 10 litre tins.
Each tin of blue paint costs £48

Robert sells all the green paint he makes in 10 litre tins.
He sells each tin of green paint for £66.96

Work out Robert's percentage profit on each tin of green paint he sells.

$Y:B$
$2:3$ 5
$20:30$ 50 litres green.

4 tins 3 tins $= £248$ total cost.
$£104$ $£144$

$Sale = 66.96 \times 5$
$= 334.80$

% Profit $= \dfrac{Diff}{Orig}$

$= \dfrac{334.80 - 248}{248}$

$= 0.35$ $= 35\%$

35% .... %

(Total for Question 10 is 5 marks)

11 In a restaurant there are

> 9 starter dishes
> 15 main dishes
> 8 dessert dishes

Janet is going to choose one of the following combinations for her meal.

> a starter dish and a main dish
> or a main dish and a dessert dish
> or a starter dish, a main dish and a dessert dish

Show that there are 1335 different ways to choose the meal.

$$\begin{array}{ccc} S & M & \\ 9 & \times 15 & = & 135 \end{array}$$

or

$$\begin{array}{ccc} M & \times D & \\ 15 & \times 8 & = & 120 \end{array}$$

or

$$\begin{array}{ccc} S & \times M & \times D \\ 9 & \times 15 & \times 8 \end{array} = \dfrac{1080}{1335} \checkmark$$
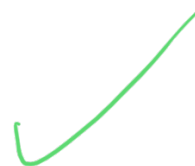
(Total for Question 11 is 3 marks)

12 (a) Write $\dfrac{4x^2 - 9}{6x + 9} \times \dfrac{2x}{x^2 - 3x}$ in the form $\dfrac{ax + b}{cx + d}$ where a, b, c and d are integers.

$$\frac{(2x+3)(2x-3)}{3(2x+3)} \times \frac{2x}{x(x-3)}$$

$$\frac{2x(2x-3)}{3x(x-3)}$$

$$\frac{4x-6}{3x-9}$$

$$\frac{4x-6}{3x-9}$$

(3)

(b) Express $\dfrac{3}{x+1} + \dfrac{1}{x-2} - \dfrac{4}{x}$ as a single fraction in its simplest form.

$$\frac{3(x)(x-2)}{x(x+1)(x-2)} + \frac{1(x)(x+1)}{x(x+1)(x-2)} - \left[\frac{4(x+1)(x-2)}{x(x+1)(x-2)}\right]$$

$$\frac{3(x^2-2x) + x^2+x}{x(x+1)(x-2)} - \left[\frac{4(x^2-x-2)}{x(x+1)(x-2)}\right]$$

$$\frac{3x^2-6x+x^2+x}{x(x+1)(x-4)} - \left[\frac{4x^2-4x-8}{x(x+1)(x-2)}\right]$$

$$\frac{4x^2-5x-4x^2+4x+8}{x(x+1)(x-2)} = \frac{-x+8}{x(x+1)(x-2)}$$

$$= \frac{8-x}{x(x+1)(x-2)}$$

(3)

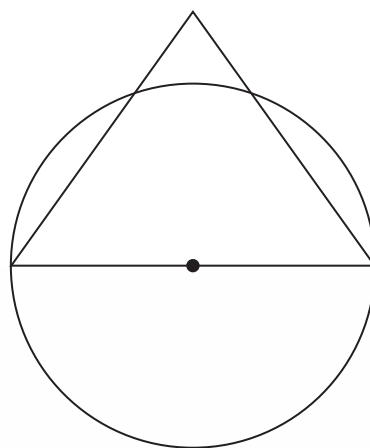**(Total for Question 12 is 6 marks)**

13 The diagram shows a circle and an equilateral triangle.

One side of the equilateral triangle is a diameter of the circle.
The circle has a circumference of 44 cm.

Work out the area of the triangle.
Give your answer correct to 3 significant figures.

$$\text{circumference} = \pi D$$
$$44 = \pi D$$
$$\frac{44}{\pi} = D$$

$$\text{Area} = \frac{1}{2} ab \sin C.$$
$$= \frac{1}{2} \times \frac{44}{\pi} \times \frac{44}{\pi} \times \sin 60°$$
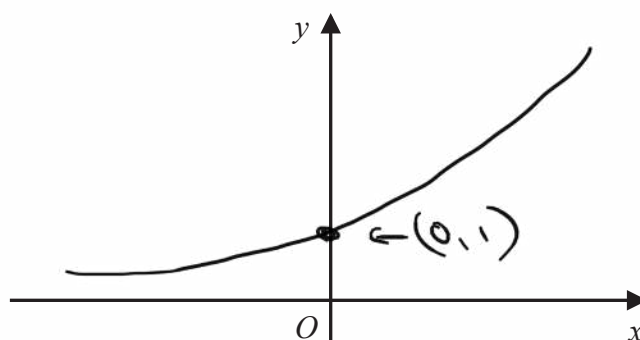$$= 84.94 \text{ cm}^2$$

(3ß)

......84.9......cm²

(Total for Question 13 is 3 marks)

14 On the grid, sketch the curve with equation $y = 2^x$
Give the coordinates of any points of intersection with the axes.

← (0,1)

Intersects y axis at (0,1)
Doesn't cross x axis
'asymtote'

(Total for Question 14 is 2 marks)

15 The equation of a circle is $x^2 + y^2 = 42.25$

Find the radius of the circle.

$$x^2 + y^2 = r^2$$

$$r = \sqrt{42.25} \quad = \frac{13}{2}$$

6.5

(Total for Question 15 is 1 mark)

16 There are only red counters and blue counters in a bag.

Joe takes at random a counter from the bag.
The probability that the counter is red is 0.65
Joe puts the counter back into the bag.

Mary takes at random a counter from the bag.
She puts the counter back into the bag.

(a) What is the probability that Joe and Mary take counters of different colours?

Joe R + B
0.65 × 0.35 $= \frac{91}{400}$

Mary R × B
0.65 × 0.35 $= \frac{91}{400}$

$$\frac{91}{400} + \frac{91}{400} = \frac{182}{400} = \frac{91}{200}$$

$\frac{91}{200}$

(2)

There are 78 red counters in the bag.

(b) How many blue counters are there in the bag?

Red = 78 = 65% of Total

78 = 0.65 T

120 = T

Blue = 120 - 78

= 42

42 blue

(2)

(Total for Question 16 is 4 marks)

17 p and q are two numbers such that $p > q$

When you subtract 5 from p and subtract 5 from q the answers are in the ratio $5:1$
When you add 20 to p and add 20 to q the answers are in the ratio $5:2$

Find the ratio $p:q$
Give your answer in its simplest form.

$$p-5 : q-5$$
$$5 : 1$$

$$\frac{p-5}{5} = \frac{q-5}{1}$$

$$p-5 = 5(q-5) \implies p-5 = 5q-25$$
$$p = 5q-20$$

$$p+20 : q+20$$
$$5 : 2$$

$$\frac{p+20}{5} = \frac{q+20}{2}$$

$$2(p+20) = 5(q+20)$$
$$2p + 40 = 5q + 100$$
$$2(5q-20) + 40 = 5q + 100$$
$$10q - 40 + 40 = 5q + 100$$
$$5q = 100$$
$$q = 20$$

$$p = 5q - 20$$
$$p = 5(20) - 20$$
$$= 100 - 20$$
$$p = 80$$

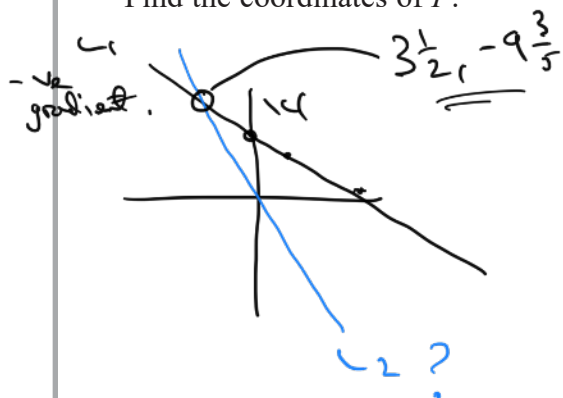$$\therefore p : q$$
$$80 : 20$$
$$4 : 1$$

.... $4 : 1$ ....

(Total for Question 17 is 5 marks)

18 The straight line L_1 passes through the points with coordinates (4, 6) and (12, 2)
The straight line L_2 passes through the origin and has gradient -3

The lines L_1 and L_2 intersect at point P.

Find the coordinates of P.

L_1 $y = mx + c$.

$3\frac{1}{2}, -9\frac{3}{5}$

$\frac{y - y_1}{x - x_1} = \frac{2 - 6}{12 - 4} = \frac{-4}{8} = -\frac{1}{2}$

At $(4, 6)$

$6 = -\frac{1}{2}(4) + c$.

$6 = -2 + c$.

$8 = c$ $\therefore L_1 \Rightarrow y = -\frac{1}{2}x + 8$

line L_2

$y = mx + c \leftarrow 0$.

$y = -3x$

As both equal y then $-3x = -\frac{1}{2}x + 8$

$-2.5x = 8$

$x = \frac{8}{2.5} = \frac{16}{5}$ or $3\frac{1}{5}$.

$y = -3x$

So $y = -3\left(\frac{16}{5}\right)$

$= -\frac{48}{5}$ or $-9\frac{3}{5}$

$(\underline{\quad \frac{16}{5} \quad}, \underline{\quad \frac{-48}{5} \quad})$

(Total for Question 18 is 4 marks)

19 Solve $22 < \dfrac{m^2 + 7}{4} < 32$

Show all your working.

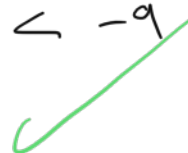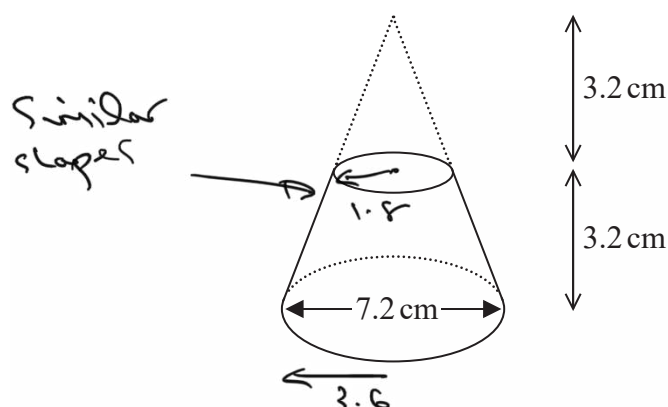$$88 < m^2 + 7$$

$$81 < m^2$$

$$\pm 9 < m$$

$$9 < m < 11.$$

$$m^2 + 7 < 128$$

$$m^2 < 121$$

$$m < \pm 11$$

$$-11 < m < -9$$

....

(Total for Question 19 is 5 marks)

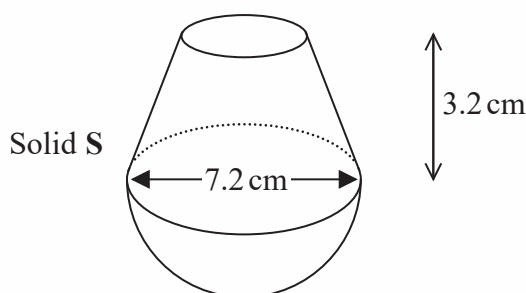**20** Here is a frustum of a cone.

Similar slopes

3.2 cm

3.2 cm

1.8

7.2 cm

3.6

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

Volume of cone = $\frac{1}{3}\pi r^2 h$
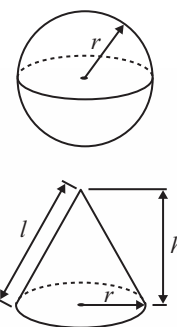
The diagram shows that the frustum is made by removing a cone with height 3.2 cm from a solid cone with height 6.4 cm and base diameter 7.2 cm.

The frustum is joined to a solid hemisphere of diameter 7.2 cm to form the solid **S** shown below.

Solid **S**

3.2 cm

7.2 cm

The density of the frustum is 2.4 g/cm³
The density of the hemisphere is 4.8 g/cm³

Calculate the average density of solid **S**.

FRUSTRUM.

Density $= \frac{Mass}{Volume}$.

$2.4 g/cm^3 = \frac{Mass}{Volume}$.

Volume $=$ Big cone $-$ Little cone

$= \frac{1}{3}\pi \, 3.6^2 \, 6.4 - \frac{1}{3}\pi \, 1.8^2 \, 3.2$

$= 76.0014094 \, cm^3$ ✓

Frustum

Density $= \frac{Mass}{Volume}$.

$2.4 = \frac{Mass}{76.0014094}$

FRUSTUM $\rightarrow 182.4033827 =$ Mass grams

3.6
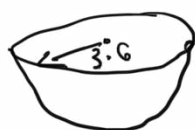
HEMISPHERE

Density $= \frac{Mass}{Volume}$

$4.8 = \frac{Mass}{\left(\frac{4}{3}\times\pi\times 3.6^3\right)}$

97.71609079

$= \frac{1}{2}$!

HEMISPHERE

469.0372699 ... = Mass grams

AVERAGE DENSITY OF SOLID S

Density = $\dfrac{Mass}{Volume}$

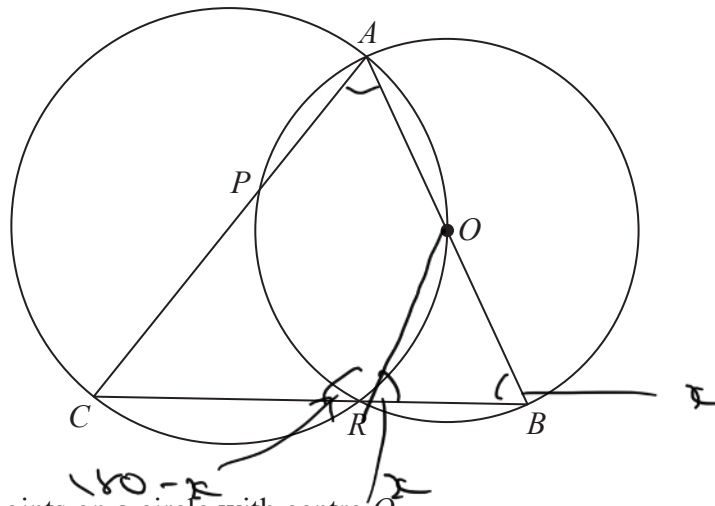$= \dfrac{182.4033827 + 469.0372699}{76.00140948 + 97.71609979}$

fourthway   *Hemisphere*

=

Average Density = 3.75 g/cm^3 ✓

....g/cm^3

(Total for Question 20 is 5 marks)

Turn over ▶

21

A, B, R and P are four points on a circle with centre O.
A, O, R and C are four points on a different circle.
The two circles intersect at the points A and R.

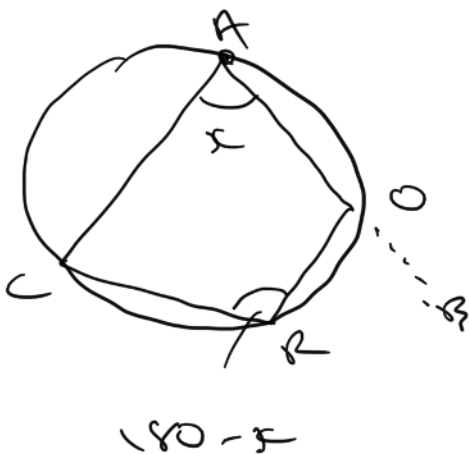CPA, CRB and AOB are straight lines.

Prove that angle CAB = angle ABC.

$\angle ABC = x$

$ORB = x$ ($OR = OB$ as OB radius)
△ ORB is isosceles)

$CRO = 180 - x$

$180 - x$

$\angle CAB = x$ as opp.
angles in a cyclic
quadrilateral add to $180°$

So $\angle CAB = \angle ABC$
$x = x$

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS

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