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**MATHEMATICS**

**0580/04**

Paper 4 (Extended)

**For examination from 2020**

SPECIMEN PAPER

**2 hours 30 minutes**

You must answer on the question paper.

You will need: Geometrical instruments

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For  $\pi$ , use either your calculator value or 3.142.

## INFORMATION

- The total mark for this paper is 130.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Blank pages are indicated.

- 1 (a) Kristian and Stephanie share some money in the ratio 3 : 2.  
Kristian receives \$72.

(i) Work out how much Stephanie receives.

\$ ..... [2]

(ii) Kristian spends 45% of his \$72 on a computer game.

Calculate the price of the computer game.

\$ ..... [1]

(iii) Kristian also buys a meal for \$8.40 .

Calculate the fraction of the \$72 Kristian has left after buying the computer game and the meal.

Give your answer in its lowest terms.

..... [2]

(iv) Stephanie buys a book in a sale for \$19.20 .  
This sale price is after a reduction of 20%.

Calculate the original price of the book.

\$ ..... [3]

- (b) Boris invests \$550 at a rate of 2% per year simple interest.

Calculate the value of the investment at the end of 10 years.

\$ ..... [3]

- (c) Marlene invests \$550 at a rate of 1.9% per year compound interest.

Calculate the value of the investment at the end of 10 years.

\$ ..... [2]

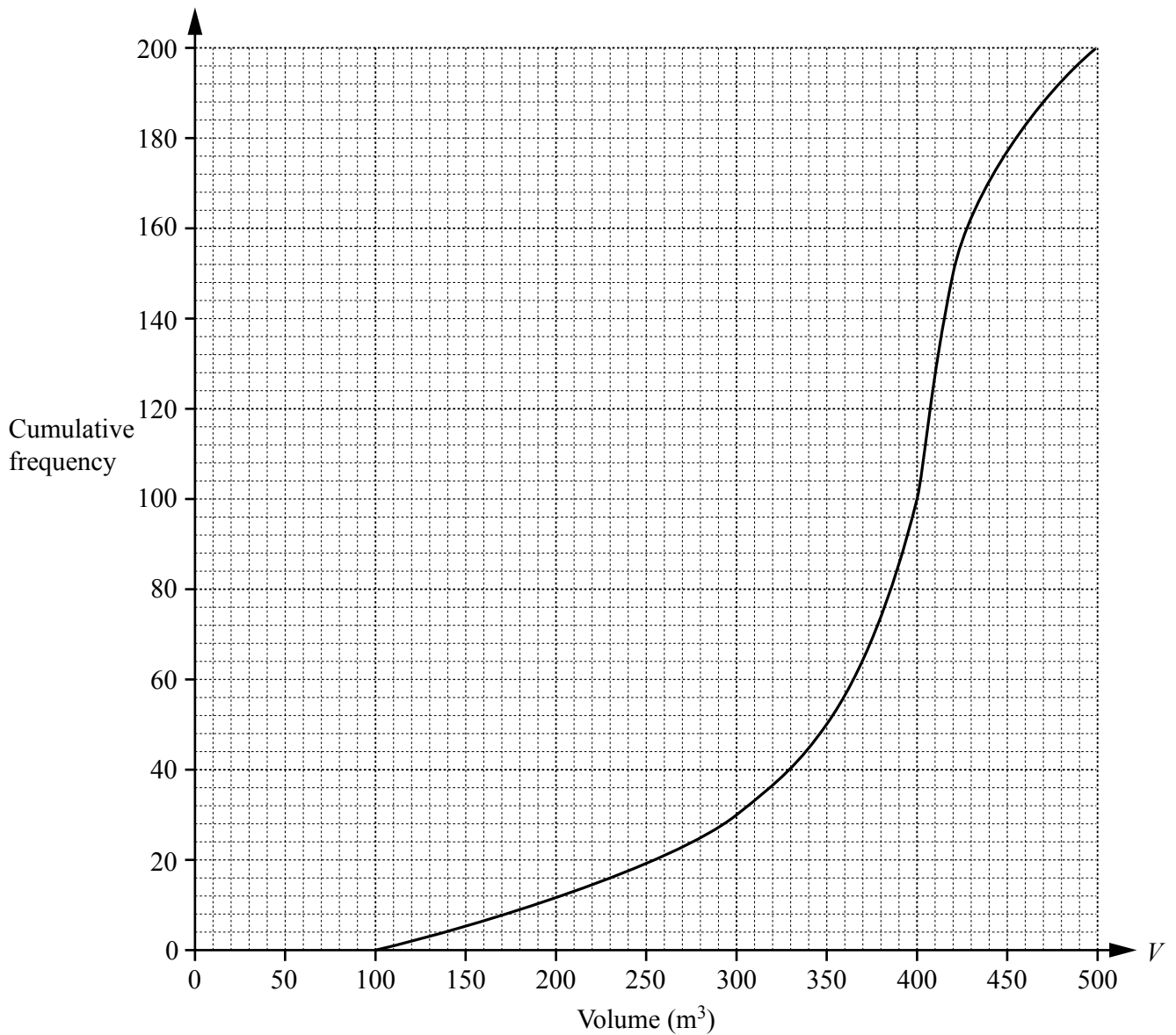
- (d) Hans invests \$550 at a rate of  $x\%$  per year compound interest.

At the end of 10 years, the value of the investment is \$638.30, correct to the nearest cent.

Find the value of  $x$ .

$x =$  ..... [3]

- 2 (a) 200 students estimate the volume,  $V \text{ m}^3$ , of a classroom. The cumulative frequency diagram shows their results.



Use the graph to find an estimate of

- (i) the median,

.....  $\text{m}^3$  [1]

- (ii) the interquartile range,

.....  $\text{m}^3$  [2]

- (iii) the 60th percentile,

.....  $\text{m}^3$  [1]

- (iv) the number of students who estimate that the volume is greater than  $300 \text{ m}^3$ .

..... [2]

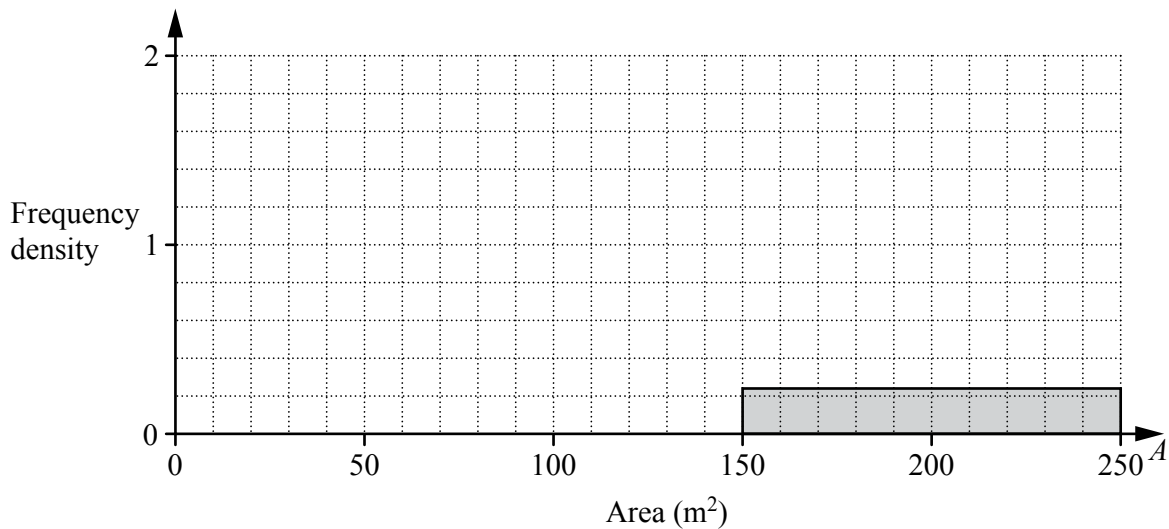
- (b) The 200 students also estimate the total area,  $A \text{ m}^2$ , of the windows in the classroom. The table shows their results.

Area ( $A \text{ m}^2$ )	$20 < A \leq 60$	$60 < A \leq 100$	$100 < A \leq 150$	$150 < A \leq 250$
Frequency	32	64	80	24

- (i) Calculate an estimate of the mean.  
You must show all your working.

.....  $\text{m}^2$  [4]

- (ii) Complete the histogram to show the information in the table.



[4]

- (iii) Two students are chosen at random from those students that estimated the area of the windows to be more than  $100 \text{ m}^2$ .

Find the probability that one of the two students estimates the area to be greater than  $150 \text{ m}^2$  and the other student estimates the area to be  $150 \text{ m}^2$  or less.

..... [3]

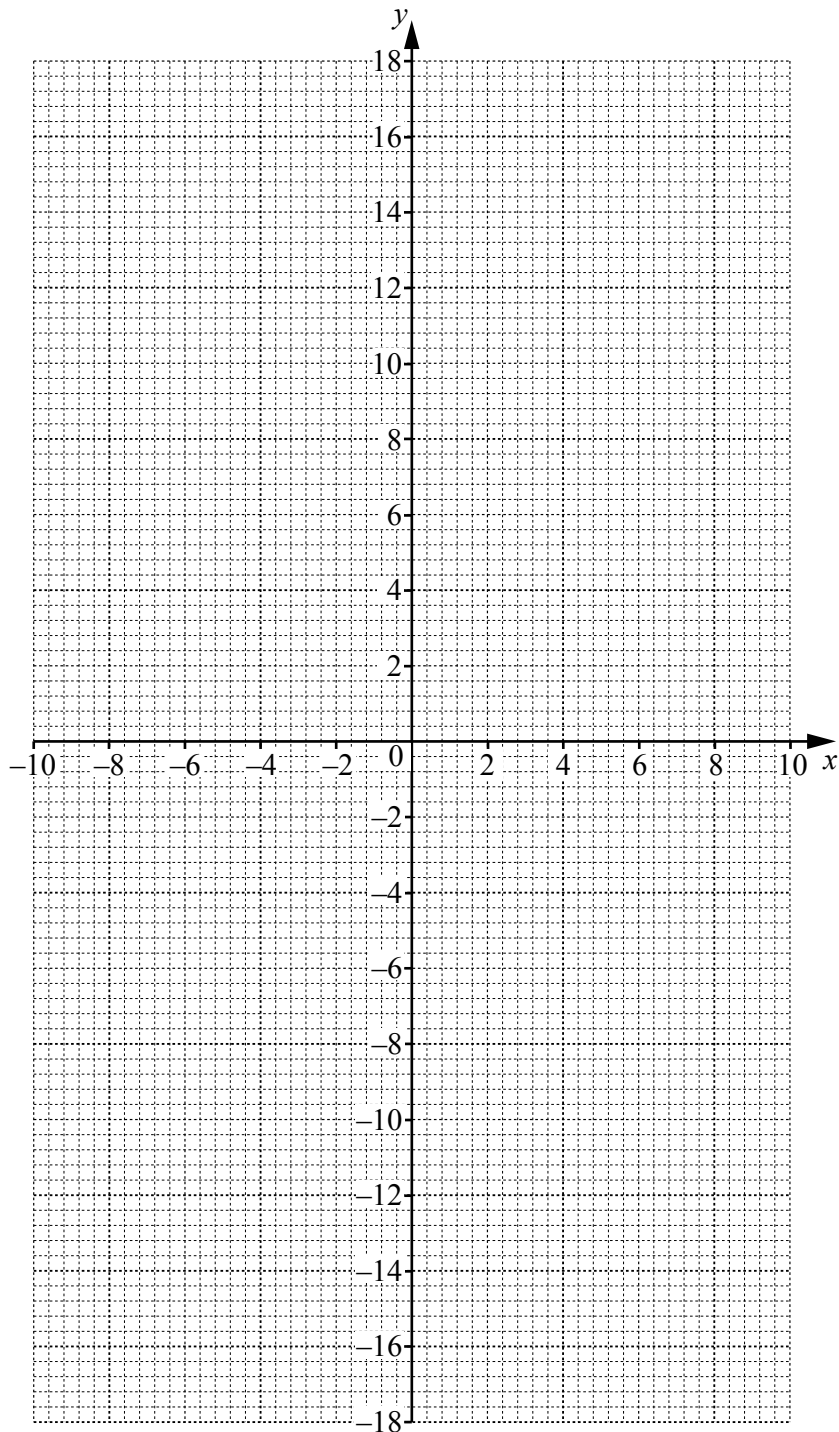
3  $f(x) = \frac{20}{x} + x, x \neq 0$

(a) Complete the table.

$x$	-10	-8	-5	-2	-1.6		1.6	2	5	8	10
$f(x)$	-12	-10.5	-9	-12	-14.1		14.1	12			12

[2]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-10 \leq x \leq -1.6$  and  $1.6 \leq x \leq 10$ .



[5]

(c) Using your graph, solve the equation  $f(x) = 11$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(d)  $k$  is a prime number and  $f(x) = k$  has no solutions.

Find the possible values of  $k$ .

$\dots\dots\dots$  [2]

(e) The gradient of the graph of  $y = f(x)$  at the point  $(2, 12)$  is  $-4$ .

Write down the coordinates of the other point on the graph of  $y = f(x)$  where the gradient is  $-4$ .

$(\dots\dots\dots, \dots\dots\dots)$  [1]

(f) (i) The equation  $f(x) = x^2$  can be written as  $x^3 + px^2 + q = 0$ .

Show that  $p = -1$  and  $q = -20$ .

[2]

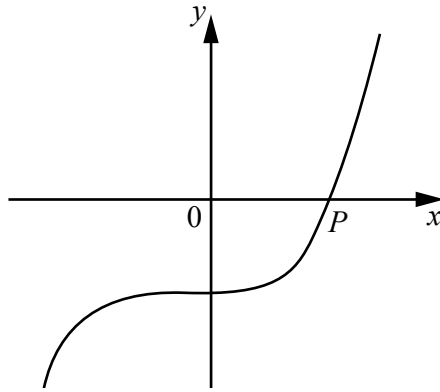
(ii) On the grid opposite, draw the graph of  $y = x^2$  for  $-4 \leq x \leq 4$ .

[2]

(iii) Using your graphs, solve the equation  $x^3 - x^2 - 20 = 0$ .

$x = \dots\dots\dots$  [1]

(iv)

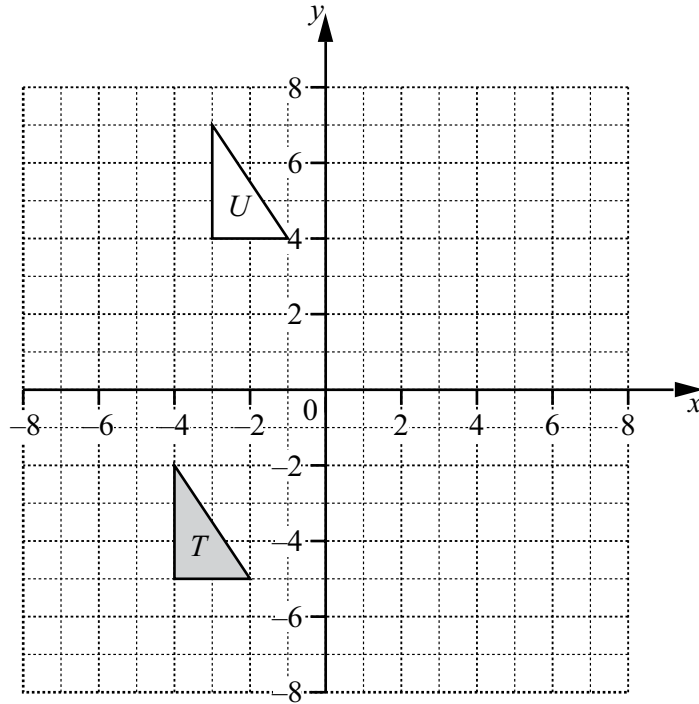
NOT TO  
SCALE

The diagram shows a **sketch** of the graph of  $y = x^3 - x^2 - 20$ .  
 $P$  is the point  $(n, 0)$ .

Write down the value of  $n$ .

$n = \dots\dots\dots$  [1]





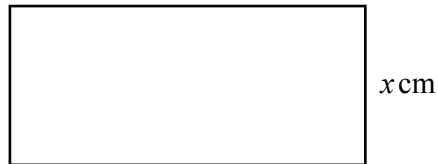
- (a) (i) Draw the reflection of triangle  $T$  in the line  $x = 0$ . [2]
- (ii) Draw the rotation of triangle  $T$  about  $(-2, -1)$  through  $90^\circ$  clockwise. [2]

(b) Describe fully the **single** transformation that maps triangle  $T$  onto triangle  $U$ .

.....

..... [2]

5 (a)

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The perimeter of the rectangle is 80 cm.  
The area of the rectangle is  $A \text{ cm}^2$ .

(i) Show that  $x^2 - 40x + A = 0$ .

[3]

(ii) When  $A = 300$ , solve the equation  $x^2 - 40x + A = 0$  by factorising.

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(iii) When  $A = 200$ , solve the equation  $x^2 - 40x + A = 0$  using the quadratic formula.  
Show all your working and give your answers correct to 2 decimal places.

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

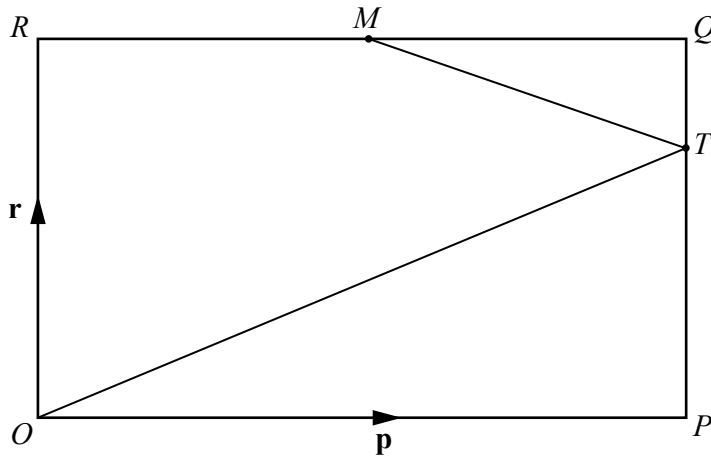
- (b) A car completes a 200 km journey at an average speed of  $x$  km/h.  
The car completes **the return journey** of 200 km at an average speed of  $(x + 10)$  km/h.
- (i) Show that the difference between the time taken for each of the two journeys is  $\frac{2000}{x(x + 10)}$  hours.

[3]

- (ii) Find the difference between the time taken for each of the two journeys when  $x = 80$ .  
Give your answer in **minutes** and **seconds**.

..... min ..... s [3]

6



NOT TO SCALE

$OPQR$  is a rectangle and  $O$  is the origin.  
 $M$  is the midpoint of  $RQ$  and  $PT : TQ = 2 : 1$ .  
 $\vec{OP} = \mathbf{p}$  and  $\vec{OR} = \mathbf{r}$ .

(a) Find, in terms of  $\mathbf{p}$  and/or  $\mathbf{r}$ , in its simplest form

(i)  $\vec{MQ}$ ,

$\vec{MQ} = \dots\dots\dots [1]$

(ii)  $\vec{MT}$ ,

$\vec{MT} = \dots\dots\dots [1]$

(iii)  $\vec{OT}$ .

$\vec{OT} = \dots\dots\dots [1]$

(b)  $RQ$  and  $OT$  are extended and meet at  $U$ .

Find the position vector of  $U$  in terms of  $\mathbf{p}$  and  $\mathbf{r}$ .  
 Give your answer in its simplest form.

$\dots\dots\dots [2]$

(c)  $\overrightarrow{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$  and  $|\overrightarrow{MT}| = \sqrt{180}$ .

Find the positive value of  $k$ .

$k = \dots\dots\dots$  [3]

7

$$f(x) = 2x + 1$$

$$g(x) = x^2 + 4$$

$$h(x) = 2^x$$

(a) Solve the equation  $f(x) = g(1)$ .

$$x = \dots\dots\dots [2]$$

(b) Find  $f^{-1}(x)$ .

$$f^{-1}(x) = \dots\dots\dots [2]$$

(c) Find  $gf(x)$  in its simplest form.

$$\dots\dots\dots [3]$$

(d) Solve the equation  $h^{-1}(x) = 0.5$ .

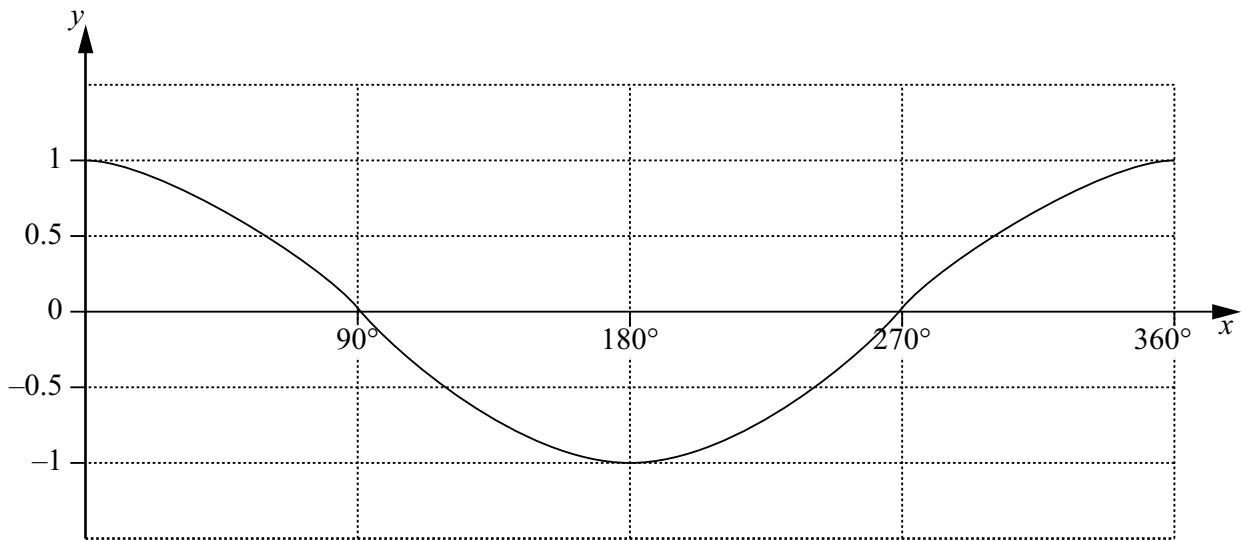
$$x = \dots\dots\dots [1]$$

(e)  $\frac{1}{h(x)} = 2^{kx}$

Write down the value of  $k$ .

$$k = \dots\dots\dots [1]$$

- 8 The grid shows the graph of  $y = \cos x$  for  $0^\circ \leq x \leq 360^\circ$ .



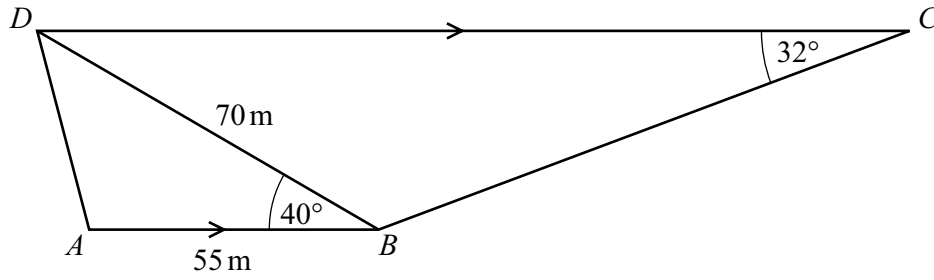
- (a) Solve the equation  $3\cos x = 1$  for  $0^\circ \leq x \leq 360^\circ$ .  
Give your answers correct to 1 decimal place.

..... and ..... [4]

- (b) On the same grid, sketch the graph of  $y = \sin x$  for  $0^\circ \leq x \leq 360^\circ$ .

[2]

9

NOT TO  
SCALE

The diagram shows a trapezium  $ABCD$ .

$AB$  is parallel to  $DC$ .

$AB = 55\text{ m}$ ,  $BD = 70\text{ m}$ , angle  $ABD = 40^\circ$  and angle  $BCD = 32^\circ$ .

(a) Calculate  $AD$ .

$AD = \dots\dots\dots\text{ m [4]}$

(b) Calculate  $BC$ .

$BC = \dots\dots\dots\text{ m [4]}$



(c) Calculate the area of  $ABCD$ .

.....  $\text{m}^2$  [3]

(d) Calculate the shortest distance from  $A$  to  $BD$ .

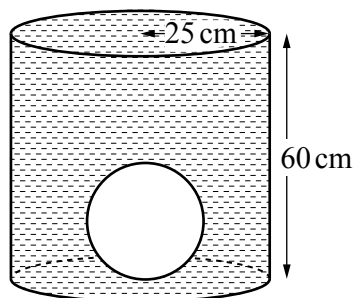
.....  $\text{m}$  [2]

- 10 (a) Show that the volume of a metal sphere of radius 15 cm is  $14\,140\text{ cm}^3$ , correct to 4 significant figures.

[The volume,  $V$ , of a sphere with radius  $r$  is  $V = \frac{4}{3}\pi r^3$ .]

[2]

- (b) (i) The sphere is placed inside an empty cylindrical tank of radius 25 cm and height 60 cm. The tank is filled with water.

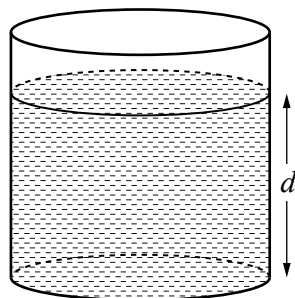


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Calculate the volume of water needed to fill the tank.

.....  $\text{cm}^3$  [3]

- (ii) The sphere is removed from the tank.

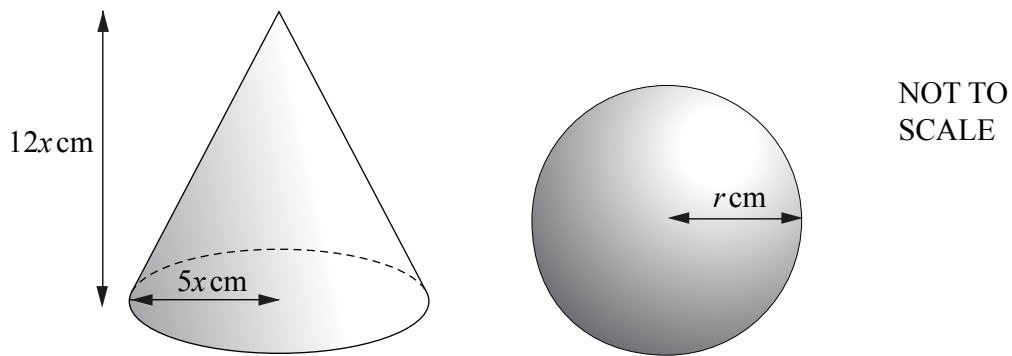


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Calculate the depth,  $d$ , of water in the tank.

$d =$  ..... cm [2]

- (c) The diagram below shows a solid circular cone and a solid sphere.



The cone has radius  $5x \text{ cm}$  and height  $12x \text{ cm}$ .

The sphere has radius  $r \text{ cm}$ .

The cone has the same **total** surface area as the sphere.

Show that  $r^2 = \frac{45}{2}x^2$ .

[The curved surface area,  $A$ , of a cone with radius  $r$  and slant height  $l$  is  $A = \pi rl$ .]

[The surface area,  $A$ , of a sphere with radius  $r$  is  $A = 4\pi r^2$ .]

[5]

11 A curve has equation  $y = x^3 - 6x^2 + 16$ .

(a) Find the coordinates of the two turning points.

(..... , ..... ) and (..... , ..... ) [6]

(b) Determine whether each of the turning points is a maximum or a minimum.  
Give reasons for your answers.

[3]

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