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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 may use tracing paper.
- 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 π , 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]

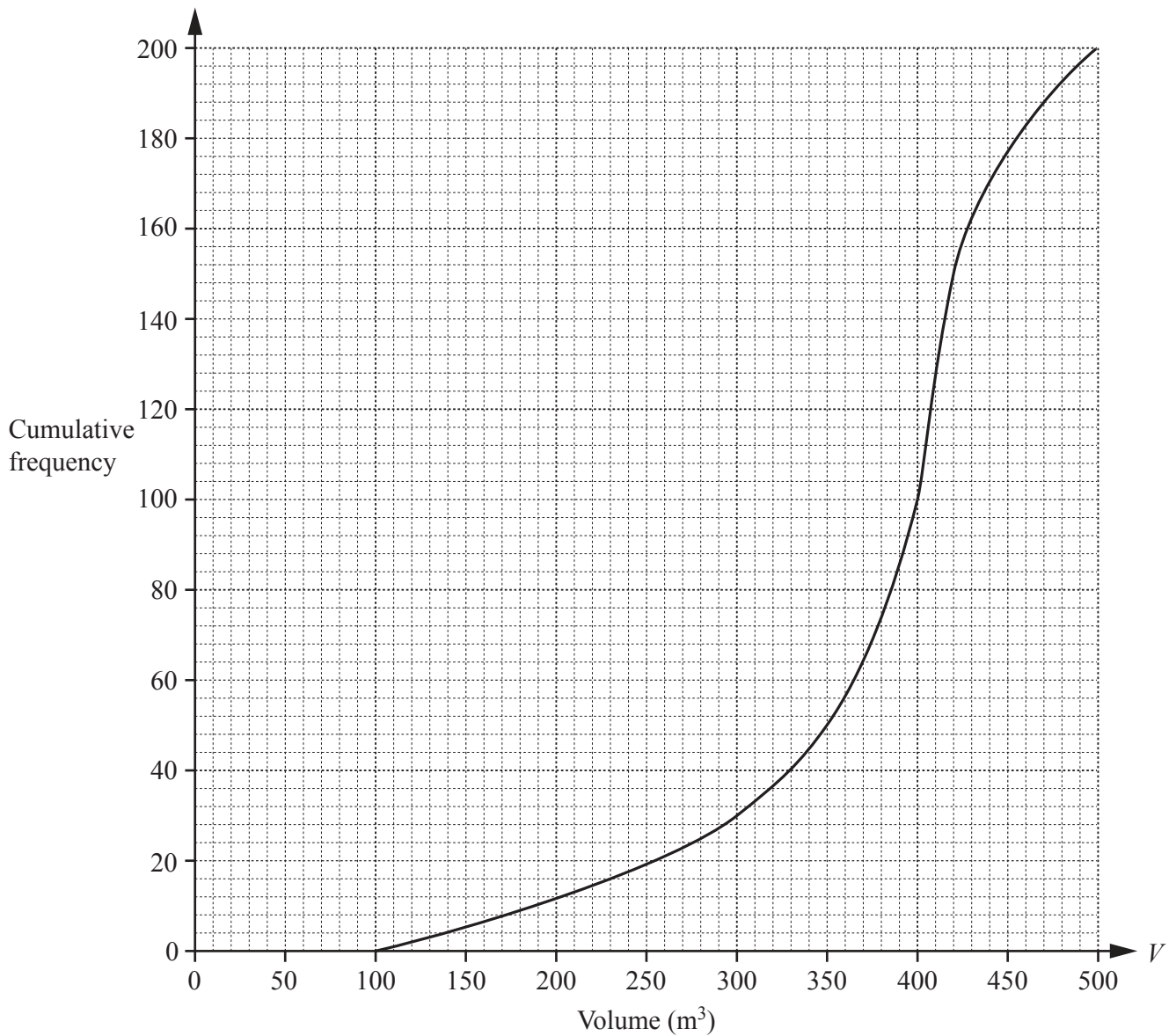
- (d) Hans invests \$550 at a rate of $x\%$ per year compound interest.

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,

..... m^3 [1]

- (ii) the interquartile range,

..... m^3 [2]

- (iii) the 60th percentile,

..... m^3 [1]

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

..... [2]

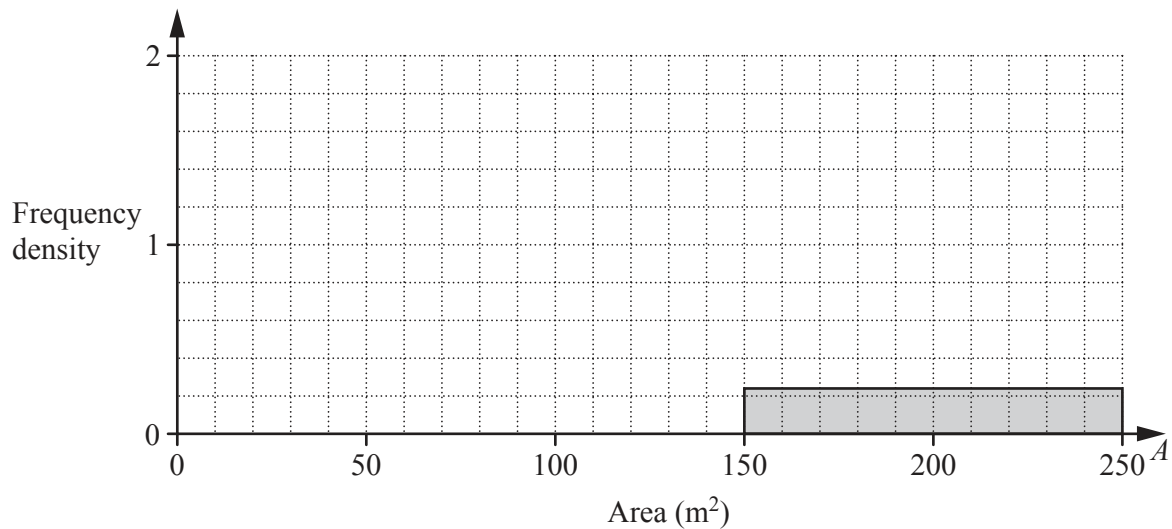
- (b) The 200 students also estimate the total area, $A \text{ m}^2$, of the windows in the classroom. The table shows their results.

| 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.

..... 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 m^2 .

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

..... [3]

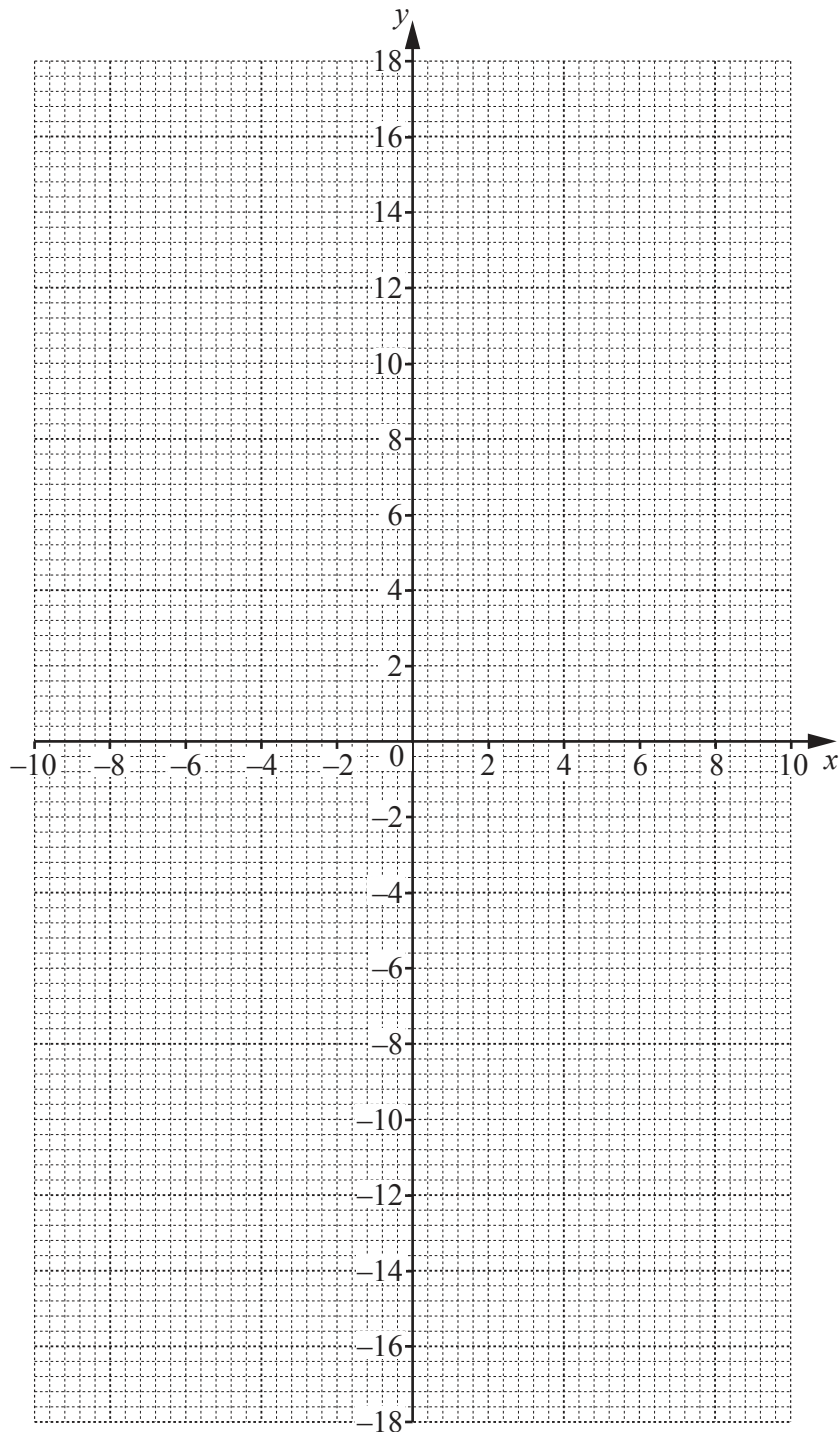
3 $f(x) = \frac{20}{x} + x, x \neq 0$

(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]

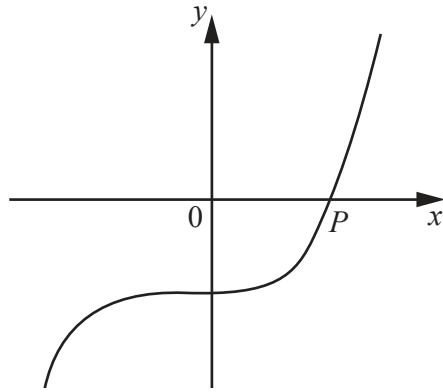
(ii) On the grid opposite, draw the graph of $y = x^2$ for $-4 \leq x \leq 4$.

[2]

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

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

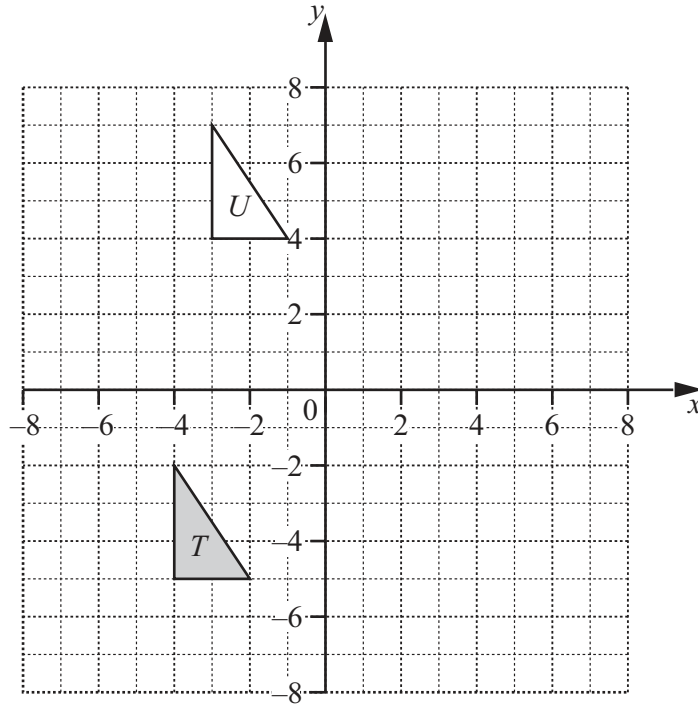
(iv)

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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]



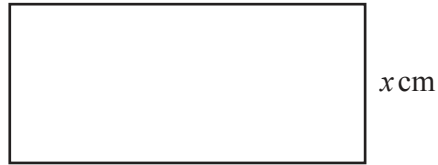
- (a) (i) Draw the reflection of triangle T in the line $x = 0$. [2]
- (ii) Draw the rotation of triangle T about $(-2, -1)$ through 90° clockwise. [2]

(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]

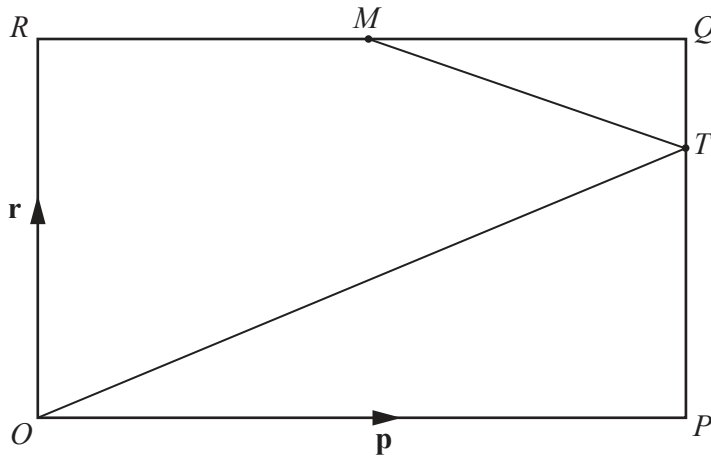
- (b) A car completes a 200 km journey at an average speed of x km/h.
The car completes **the return journey** of 200 km at an average speed of $(x + 10)$ km/h.
- (i) Show that the difference between the time taken for each of the two journeys is $\frac{2000}{x(x + 10)}$ hours.

[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



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$OPQR$ 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 $h^{-1}(x) = 0.5$.

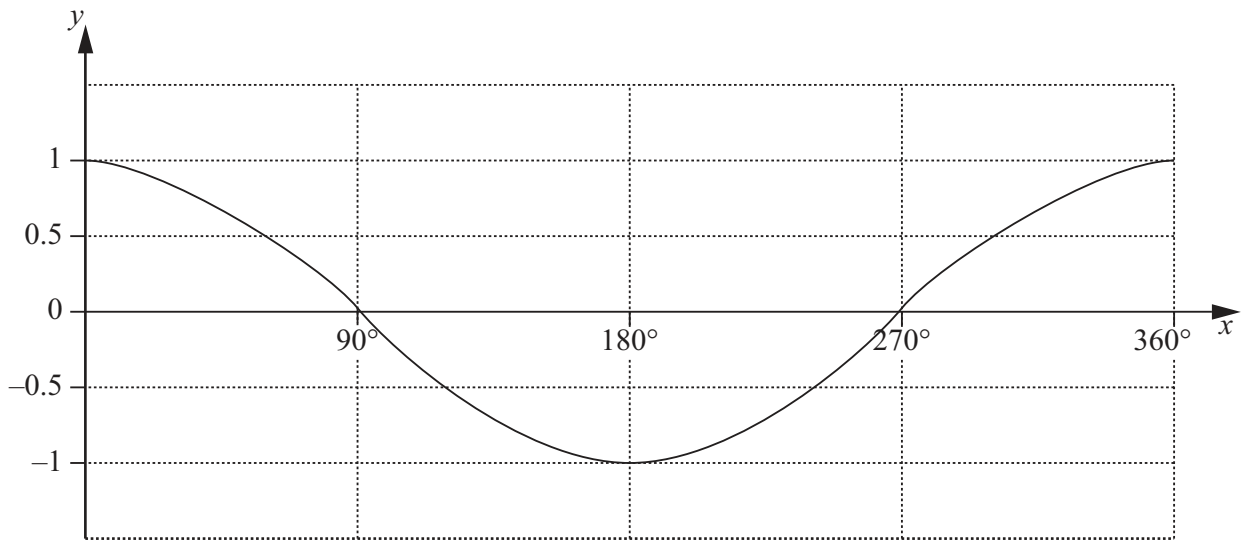
$$x = \dots\dots\dots [1]$$

(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 $0^\circ \leq x \leq 360^\circ$.

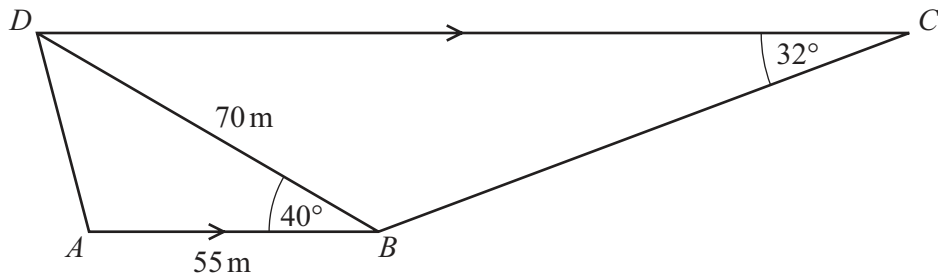


- (a) Solve the equation $3\cos x = 1$ for $0^\circ \leq x \leq 360^\circ$.
Give your answers correct to 1 decimal place.

..... 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 $ABCD$.

..... m^2 [3]

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

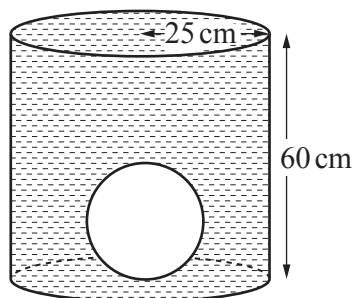
..... m [2]

- 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.

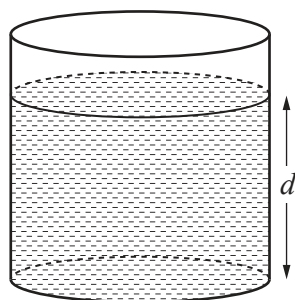


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Calculate the volume of water needed to fill the tank.

..... cm^3 [3]

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

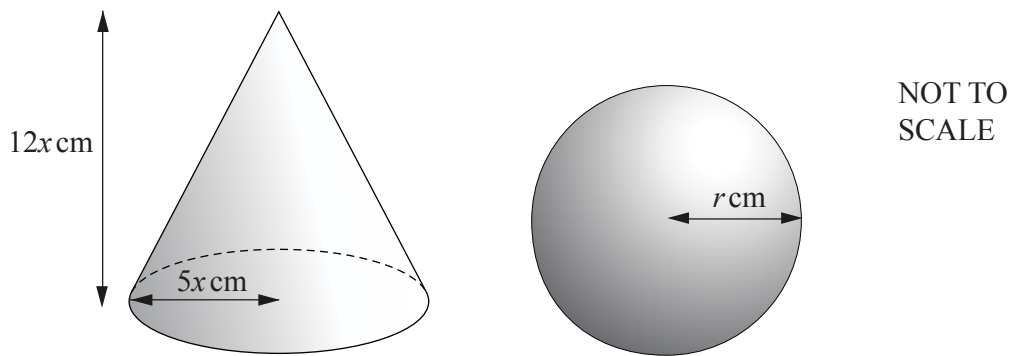


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Calculate the depth, d , of water in the tank.

$d =$ 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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