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MATHEMATICS

0580/41

Paper 4 (Extended)

October/November 2022

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. Any blank pages are indicated.



1 (a) Calculate the volume of

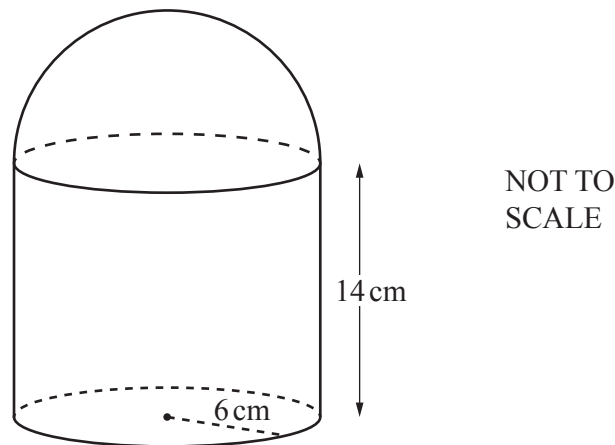
(i) a solid cylinder with radius 6 cm and height 14 cm,

..... cm³ [2]

(ii) a solid hemisphere with radius 6 cm.
 [The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... cm³ [2]

(b)



The cylinder and hemisphere in **part (a)** are joined to form the solid in the diagram. The solid is made of steel and 1 cm³ of steel has a mass of 7.85 g.

(i) Show that 1 cm³ of steel has a mass of 0.00785 kg.

[1]

(ii) Calculate the total mass of the solid.

..... kg [2]

(c) 2000 cm^3 of iron is melted down and some of it is used to make 50 spheres with radius 2 cm.

- (i) Calculate the percentage of iron that is left over.
 [The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... % [3]

- (ii) The iron left over is then made into a cube.

Calculate the length of an edge of the cube.

..... cm [1]

(d) A solid cone has radius $3R$ cm and slant height $9R$ cm.

A solid cylinder has radius x cm and height $7x$ cm.

The **total** surface area of the cone is equal to the **total** surface area of the cylinder.

Given that $R = kx$, find the value of k .

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

$k =$ [4]

2 (a) Write

(i) 2994.99 correct to the nearest 10,

..... [1]

(ii) 0.983 correct to 1 decimal place,

..... [1]

(iii) 2090 correct to 2 significant figures.

..... [1]

(b) Write down a prime number between 90 and 100.

..... [1]

(c) Write 2^{-6} as a fraction.

..... [1]

(d) Write 0.00701 in standard form.

..... [1]

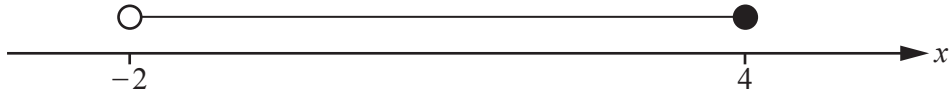
(e) Simplify $1.5 \times 10^x + 1.5 \times 10^{x-1}$ giving your answer in standard form.

..... [2]

(f) Write $0.\dot{3}7$ as a fraction.
You must show all your working.

..... [2]

3 (a)



Write down the inequality shown by the number line.

..... [1]

(b) $-3 \leq 2x + 3 < 9$

(i) Solve the inequality.

..... [3]

(ii) Write down all the integer values of x that satisfy the inequality.

..... [2]

(c) Solve the equations.

(i) $3(3-x) - \frac{2(x+2)}{5} = 1$

$x =$ [4]

(ii) $\frac{5}{x+3} = \frac{3}{x+5}$

$x =$ [3]

- 4 (a) (i) Zak invests \$500 at a rate of 2% per year simple interest.

Calculate the value of Zak's investment at the end of 5 years.

\$ [3]

- (ii) Yasmin invests \$500 at a rate of 1.8% per year compound interest.

Calculate the value of Yasmin's investment at the end of 5 years.

\$ [2]

- (iii) Zak and Yasmin continue with these investments.

How many **more complete** years is it before the value of Yasmin's investment is greater than the value of Zak's investment?

..... [3]

- (b) Xavier buys a car for \$2500.
The value of the car decreases exponentially at a rate of 10% each year.

Calculate the value of Xavier's car at the end of 5 years.
Give your answer correct to the nearest dollar.

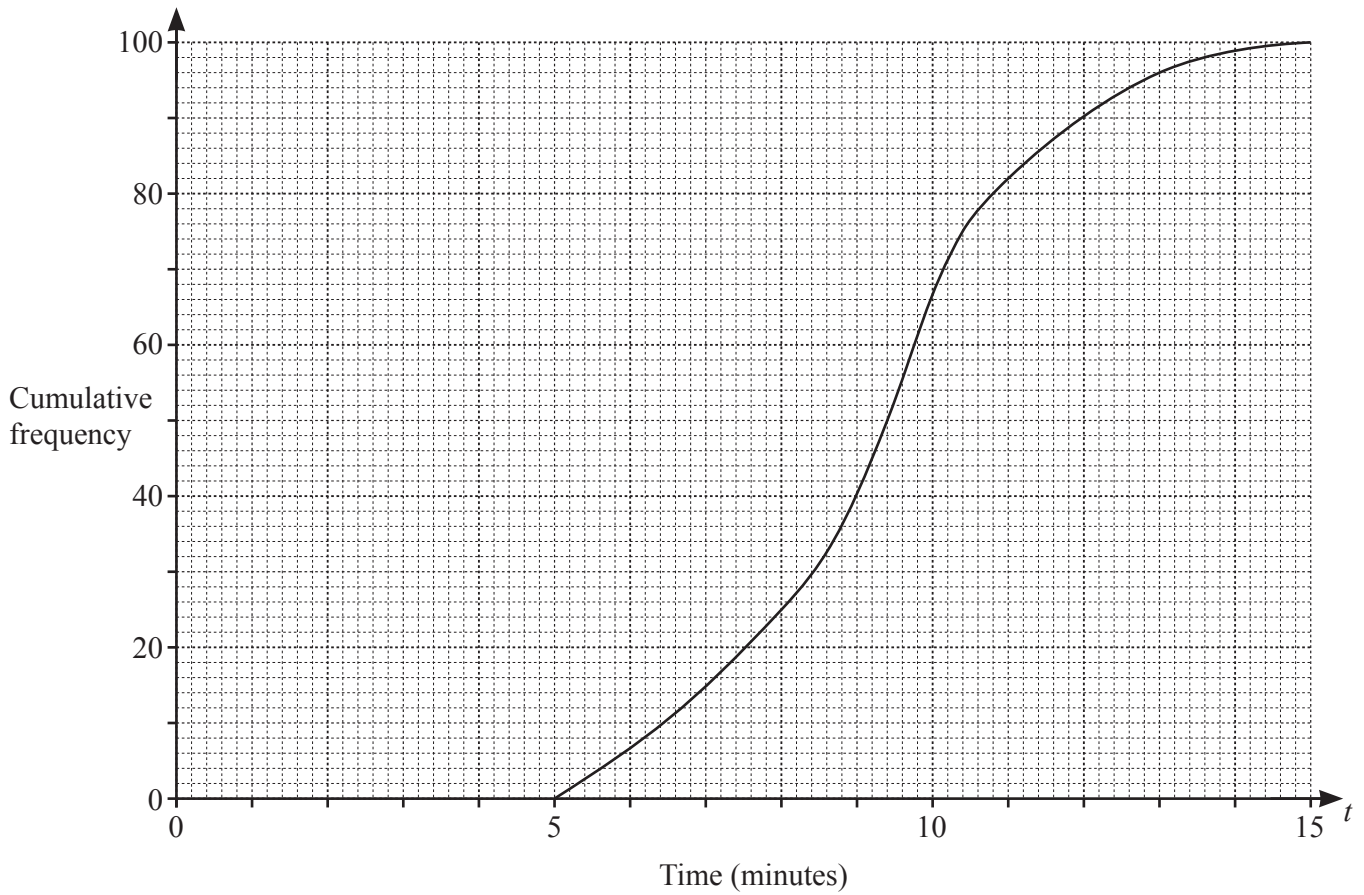
\$ [3]

- (c) The number of a certain type of bacteria increases exponentially at a rate of $r\%$ each day.
After 22 days, the number of this bacteria has doubled.

Find the value of r .

$r =$ [3]

- 5 (a) 100 students each record the time, t minutes, taken to eat a pizza.
The cumulative frequency diagram shows the results.



Find an estimate of

- (i) the median,

..... min [1]

- (ii) the interquartile range,

..... min [2]

- (iii) the number of students taking more than 11 minutes to eat a pizza.

..... [2]

- (b) 150 students each record how far they can throw a tennis ball.
The table shows the results.

Distance (d metres)	$0 < d \leq 20$	$20 < d \leq 30$	$30 < d \leq 35$	$35 < d \leq 45$	$45 < d \leq 60$
Frequency	4	38	40	53	15

- (i) Calculate an estimate of the mean.

..... m [4]

- (ii) A histogram is drawn to show this information.
The height of the bar representing $30 < d \leq 35$ is 12 cm.

Calculate the height of each of the other bars.

Distance (d metres)	Frequency	Height of bar (cm)
$0 < d \leq 20$	4	
$20 < d \leq 30$	38	
$30 < d \leq 35$	40	12
$35 < d \leq 45$	53	
$45 < d \leq 60$	15	

[3]

- (iii) Two students are chosen at random.

Find the probability that they both threw the ball more than 45 m.

..... [2]

6 (a) $\mathbf{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

Find

(i) $3\mathbf{q}$,

$$\left(\begin{array}{c} \\ \end{array} \right) \quad [1]$$

(ii) $\mathbf{p} - \mathbf{q}$,

$$\left(\begin{array}{c} \\ \end{array} \right) \quad [1]$$

(iii) $|\mathbf{p}|$.

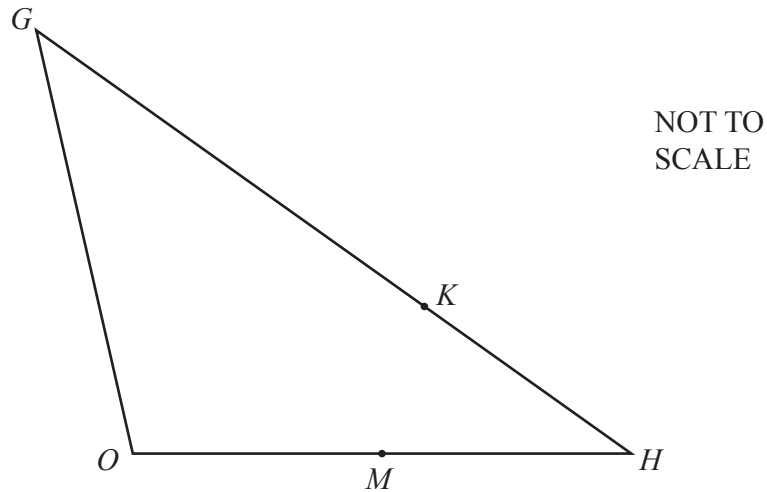
..... [2]

(b) B is the point $(2, 7)$ and $\overrightarrow{AB} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$.

Find the coordinates of A .

(.....,) [2]

(c)



In triangle OGH , M is the midpoint of OH and K divides GH in the ratio $5 : 2$.

$\overrightarrow{OG} = \mathbf{g}$ and $\overrightarrow{OH} = \mathbf{h}$.

Find \overrightarrow{MK} in terms of \mathbf{g} and \mathbf{h} .

Give your answer in its simplest form.

$\overrightarrow{MK} = \dots\dots\dots$ [4]

7 $f(x) = 10 - x$ $g(x) = \frac{2}{x}, x \neq 0$ $h(x) = 2^x$ $j(x) = 5 - 2x$

(a) (i) Find $g\left(\frac{1}{2}\right)$.

..... [1]

(ii) Find $hg\left(\frac{1}{2}\right)$.

..... [1]

(b) Find x when $f(x) = 7$.

$x =$ [1]

(c) Find x when $g(x) = h(3)$.

$x =$ [2]

(d) Find $j^{-1}(x)$.

$j^{-1}(x) =$ [2]

(e) Write $f(x) + g(x) + 1$ as a single fraction in its simplest form.

..... [3]

(f) $(f(x))^2 - ff(x) = ax^2 + bx + c$

Find the values of a , b and c .

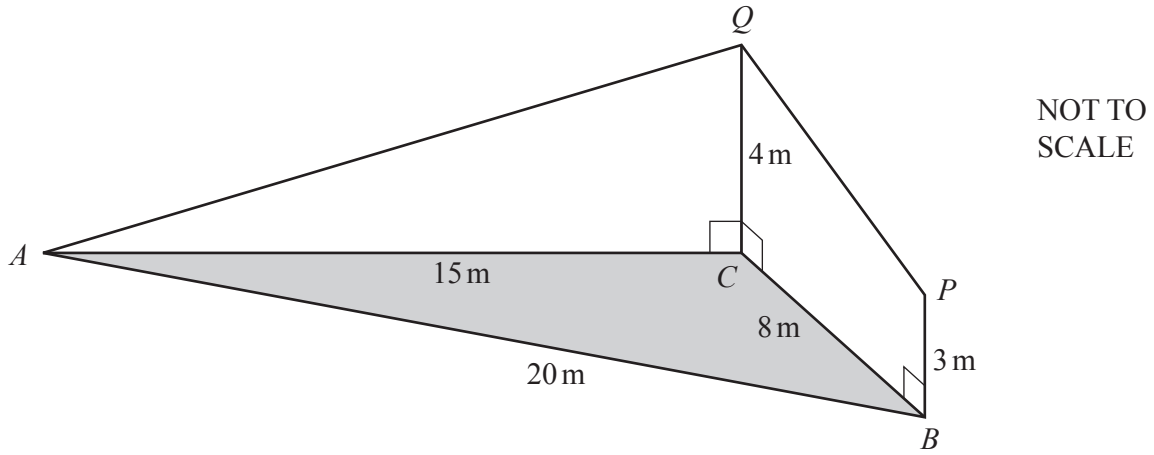
$a = \dots\dots\dots$

$b = \dots\dots\dots$

$c = \dots\dots\dots$ [4]

(g) Find x when $h^{-1}(x) = 10$.

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



The diagram shows triangle ABC on horizontal ground.
 $AC = 15$ m, $BC = 8$ m and $AB = 20$ m.

BP and CQ are vertical poles of different heights.
 $BP = 3$ m and $CQ = 4$ m.
 AQ and PQ are straight wires.

(a) Show that angle $ACB = 117.5^\circ$, correct to 1 decimal place.

[4]

(b) Calculate the area of triangle ABC .

..... m^2 [2]

(c) Calculate the length of AQ .

..... m [2]

(d) Calculate the angle of elevation of Q from P .

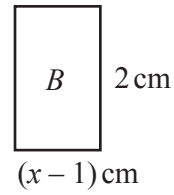
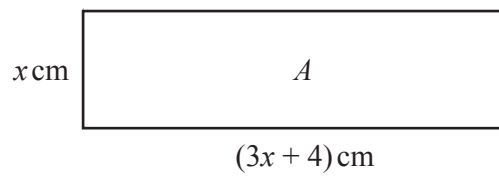
..... [3]

(e) Another straight wire connects A to the midpoint of PQ .

Calculate the angle between this wire and the horizontal ground.

..... [5]

9 (a)

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The total of the areas of rectangles A and B is 20 cm^2 .

(i) Show that $3x^2 + 6x - 22 = 0$.

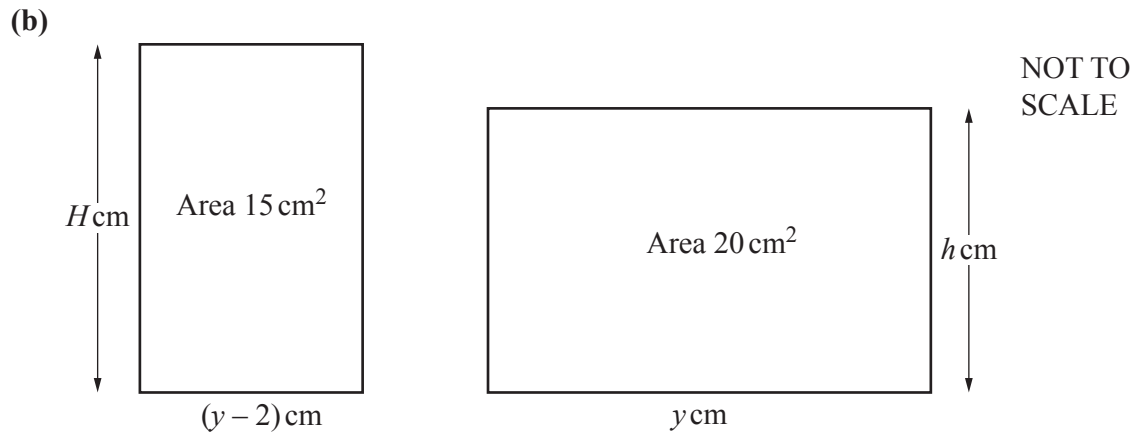
[2]

(ii) Solve the equation $3x^2 + 6x - 22 = 0$, giving your answers correct to 4 significant figures. You must show all your working.

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

(iii) Find the perimeter of rectangle B .

$\dots\dots\dots$ cm [1]

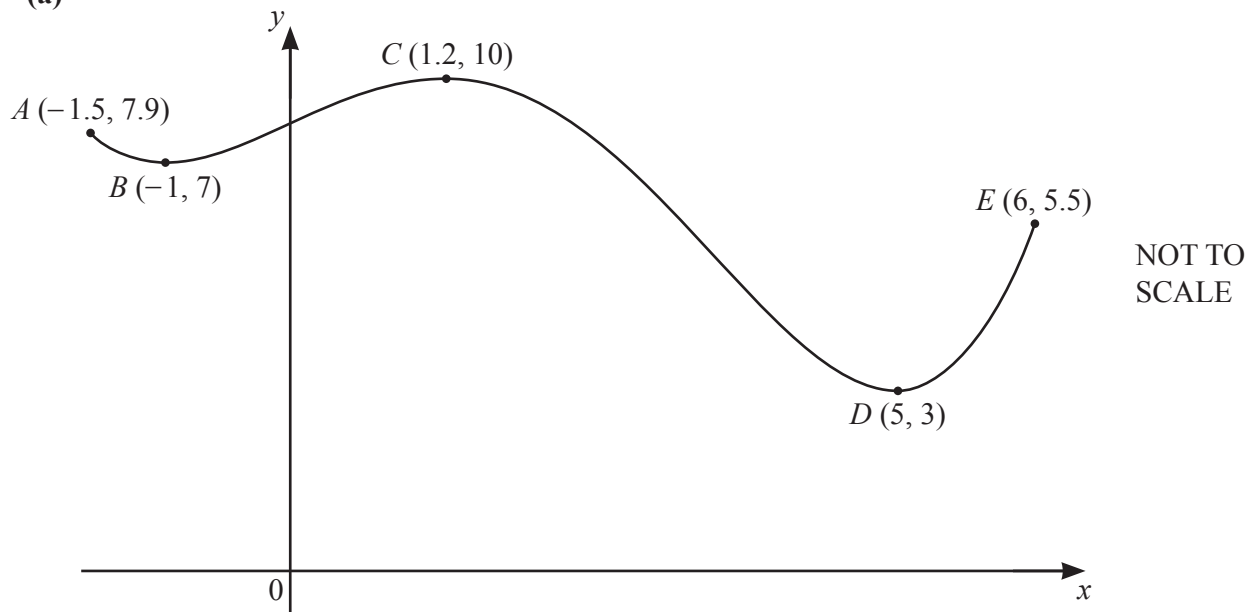


The diagram shows two rectangles where $H - h = 1$.

By forming a quadratic equation and factorising, find the value of y .

$y = \dots\dots\dots [7]$

10 (a)



The diagram shows a sketch of the graph of $y = f(x)$ for $-1.5 \leq x \leq 6$.
The coordinates of five points on the graph of $y = f(x)$ are shown on the diagram.

- (i) $f(x) = k$ has two solutions in the interval $-1.5 \leq x \leq 6$.

Write down a possible integer value of k .

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

- (ii) $f(x) = j$ has no solutions in the interval $-1.5 \leq x \leq 6$ when $j < a$ or $j > b$.

Find the maximum value of a and the minimum value of b .

$a = \dots\dots\dots$

$b = \dots\dots\dots$ [2]

- (b) Find the coordinates of the two stationary points on the graph of $y = x^6 - 6x^5$.
You must show all your working.

(.....,))

(.....,) [5]

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