



Cambridge O Level

CANDIDATE
NAME

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CENTRE
NUMBER

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2021

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 100.
- 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 In 2019 Nicole's annual income was \$22 000.

(a) She spent \$7200 on accommodation in 2019.

Calculate the percentage of her income she spent on accommodation.

..... % [2]

(b) Her annual income of \$22 000 increased by 4% in 2020.

Calculate her annual income in 2020.

\$ [2]

(c) Nicole invests \$2000 in an account.

The account pays compound interest at a rate of $K\%$ per year.
At the end of the first year, the money in the account is \$2036.

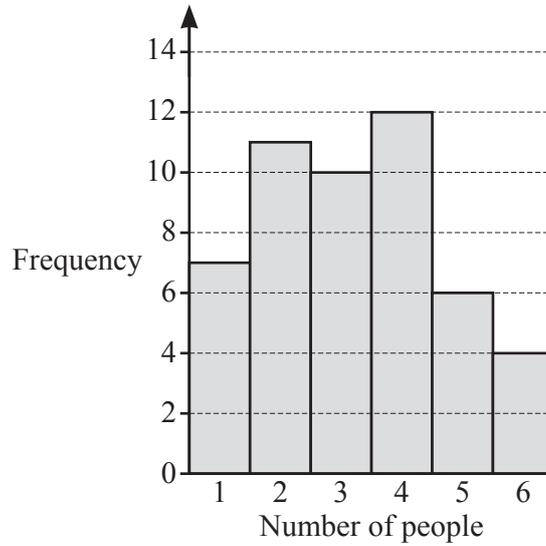
(i) Show that $K = 1.8$.

[2]

(ii) Find the number of complete years before Nicole has at least \$2150 in the account.
Show your working.

..... years [3]

- 2 A survey recorded the number of people living in each of 50 houses. The bar chart shows the results.



- (a) Find the mode.

..... [1]

- (b) Find the median.

..... [1]

- (c) Calculate the mean.

..... [3]

- (d) One of these houses is chosen at random.

Find the probability that exactly 3 people live there.

..... [1]

- (e) Two houses are chosen at random from these 50 houses.

Find the probability that only one of the two houses has exactly 5 people living there.

..... [3]

3 (a) $p = \frac{3q+5}{r^2}$

Calculate p when $q = 15$ and $r = -4$.

$p = \dots\dots\dots$ [2]

(b) Expand and simplify $3(2x+1) + 4(x-5)$.

$\dots\dots\dots$ [2]

(c) Solve $\frac{3-k}{4} = 1$.

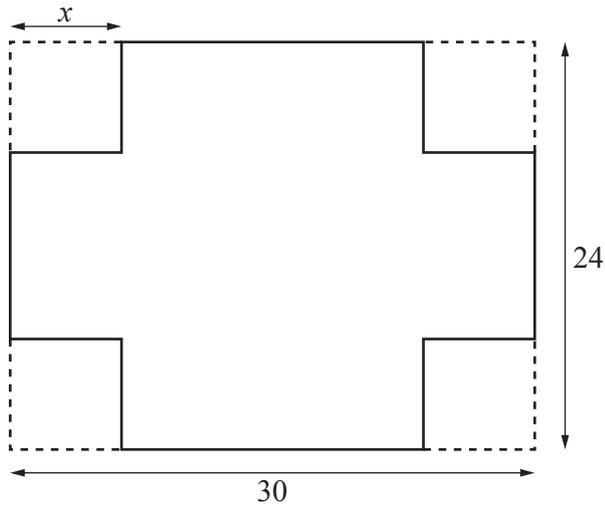
$k = \dots\dots\dots$ [2]

(d) $\frac{x^6}{x^m} = x^{-3}$

Find m .

$m = \dots\dots\dots$ [1]

(e)

NOT TO
SCALE

A rectangular piece of card measures 30 cm by 24 cm.
 The net of an open box is made by removing a square from each corner of this piece of card.
 Each square that is removed has side x cm.
 The area of the net is 576 cm^2 .

(i) Form an equation in x and solve it to find the value of x .

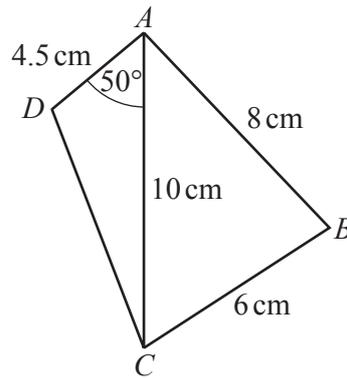
$$x = \dots\dots\dots [3]$$

(ii) The net is made into an open box.
 1000 cm^3 of sand is placed inside the box.

Find the fraction of the box that is filled with sand.
 Give your answer in its simplest form.

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

4 (a) The diagram shows a sketch of quadrilateral $ABCD$.



NOT TO SCALE

(i) Construct an accurate drawing of $ABCD$.
 AC has been drawn for you.



[3]

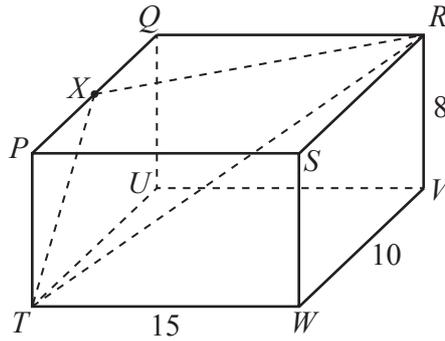
(ii) Measure \hat{ADC} .

..... [1]

(iii) By taking a suitable measurement from your diagram, find the perimeter of quadrilateral $ABCD$.

..... cm [1]

(b)



The diagram shows a cuboid.
 $TW = 15$ cm, $WV = 10$ cm and $RV = 8$ cm.

(i) Show that $TR = 19.7$ cm, correct to 1 decimal place.

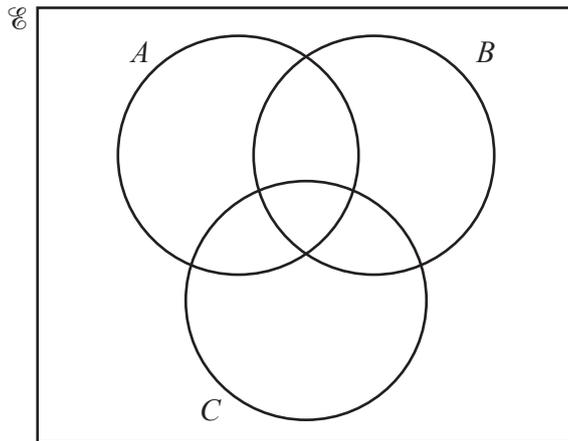
[3]

(ii) X is the midpoint of PQ .

Calculate \hat{TRX} .

$\hat{TRX} = \dots\dots\dots$ [5]

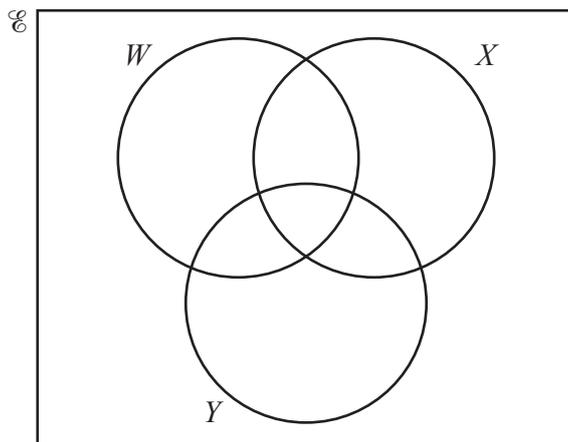
5 (a) Shade the subset $A' \cap B \cap C$.



[1]

- (b) $U = \{ A, C, E, G, H, J, N, R, T, Z \}$
 $W = \{ x : x \text{ has rotational symmetry of order } 2 \}$
 $X = \{ x : x \text{ has line symmetry} \}$
 $Y = \{ R, A, N, G, E \}$

(i) Complete the Venn diagram.



[3]

(ii) List the elements of $X \cap (W \cup Y)'$.

..... [1]

(iii) Find $n(W \cup X \cup Y)'$.

..... [1]

(iv) Using set notation, complete this statement.

..... = \emptyset [1]

6 $f(x) = 2x + 3$ $g(x) = \frac{12 - 3x}{5}$

(a) Find $g(-1)$.

..... [1]

(b) Solve $f(x) = 2$.

$x =$ [2]

(c) Find $g^{-1}(x)$.

$g^{-1}(x) =$ [3]

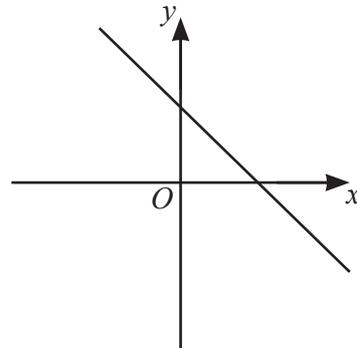
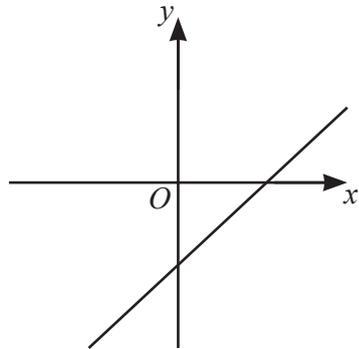
(d) Find the value of x when $f(x)$ is 4 more than $g(x)$.

$x =$ [4]

7 (a) $y = 2x + 1$ $y = 2x - 1$ $y = -2x + 1$ $y = -2x - 1$

The diagrams below show sketches of two of these lines.

Write the correct equation below each diagram.

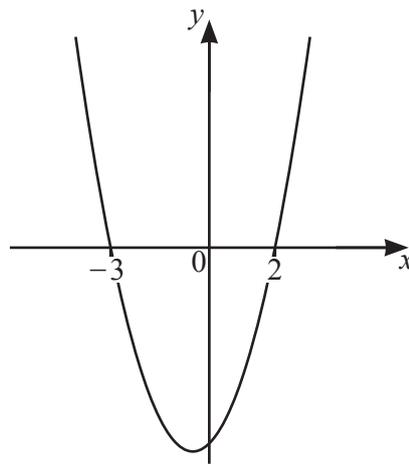


.....

.....

[2]

(b)

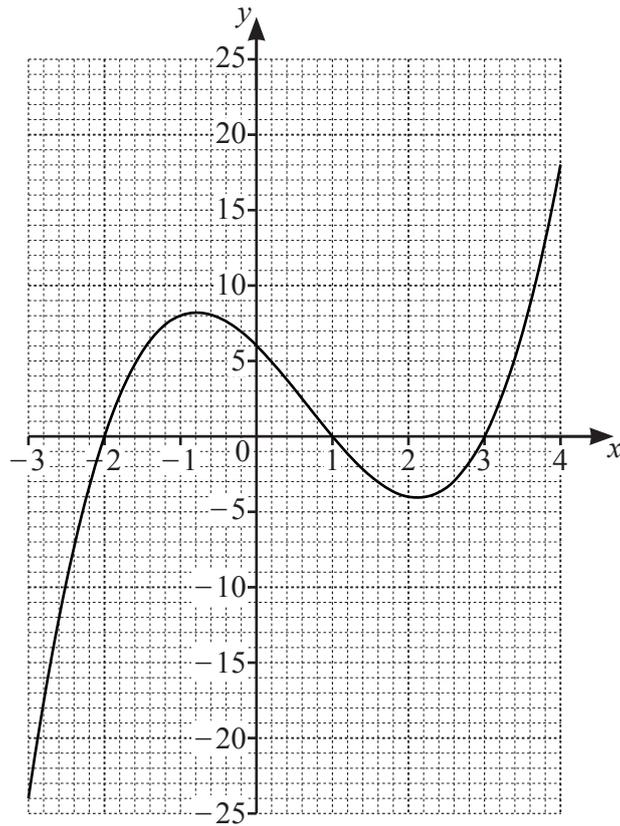


This diagram shows a sketch of the graph of $y = x^2 + ax + b$.

Find the value of a and the value of b .

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

(c)



The grid shows the graph of $y = x^3 - 2x^2 - 5x + 6$.

(i) $x^3 - 2x^2 - 5x + 6 = k$ has exactly 2 solutions.

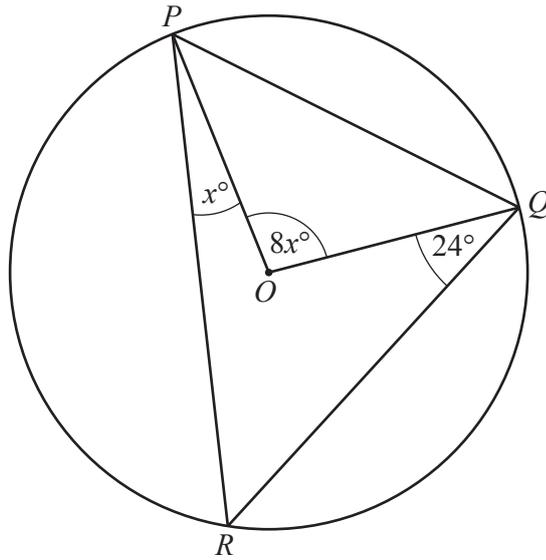
Use the graph to find the possible values of k .

..... [2]

(ii) By drawing a suitable line on the grid, find the solutions of $x^3 - 2x^2 - 7x + 5 = 0$.

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

8 (a)

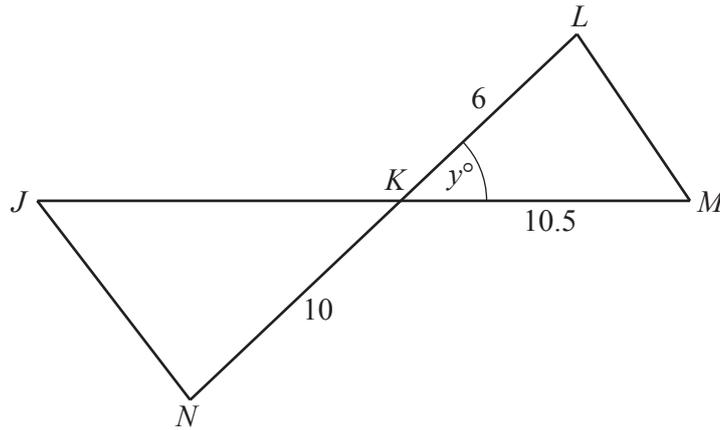
NOT TO
SCALE

P , Q and R are points on the circumference of a circle, centre O .
Angle $POQ = 8x^\circ$, angle $RPO = x^\circ$ and angle $OQR = 24^\circ$.

Calculate angle PQO .

Angle $PQO = \dots\dots\dots$ [4]

(b)

NOT TO
SCALE

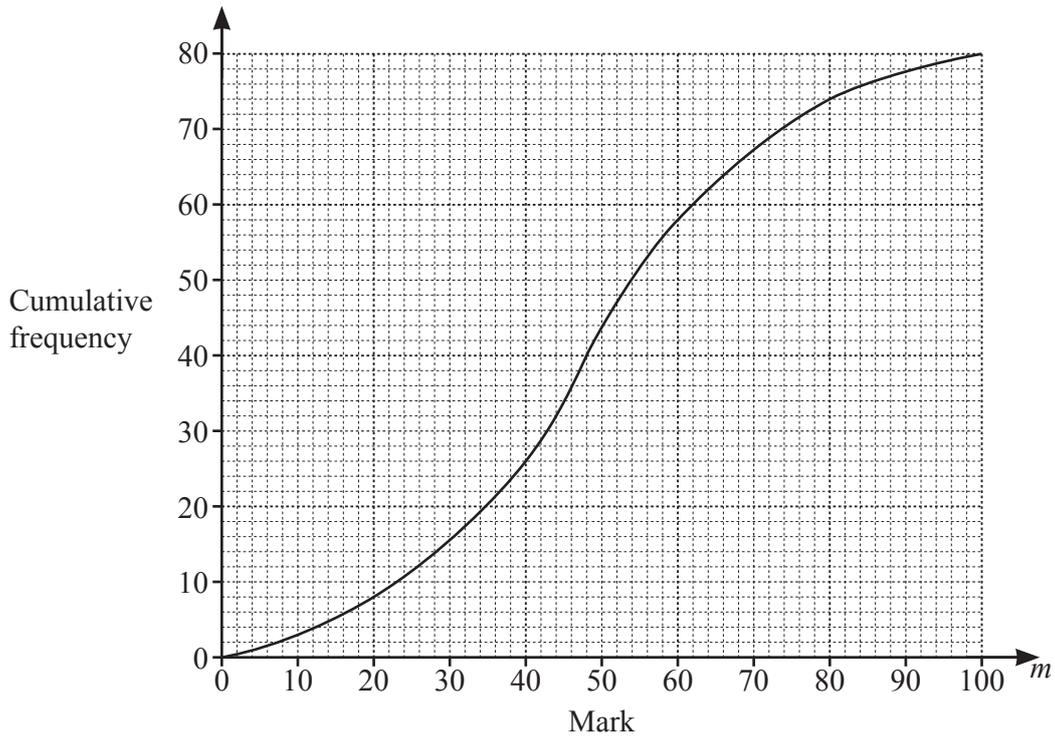
Triangle KLM is similar to triangle KNJ .
 JKM and NKL are straight lines.

$\hat{KLM} = \hat{KNJ}$ and $\hat{LKM} = y^\circ$.
 $KL = 6$ cm, $KM = 10.5$ cm and $KN = 10$ cm.
 The area of triangle JKN is 75 cm².

Calculate y .

$y = \dots\dots\dots$ [5]

9 (a) The cumulative frequency diagram shows the marks obtained by 80 students in a Maths test.



(i) Use the diagram to find an estimate of the median.

..... [1]

(ii) 60% of the students passed the test.

Use the diagram to find the number of marks needed to pass the test.

..... [2]

(iii) Using the information on the diagram, complete the frequency table.

Mark (m)	$0 \leq m < 20$	$20 \leq m < 40$	$40 \leq m < 60$	$60 \leq m < 80$	$80 \leq m < 100$
Frequency	8				

[2]

(b) The times taken by the 80 students to complete a Science test are shown in the frequency table.

Time (m minutes)	$40 < m \leq 50$	$50 < m \leq 60$	$60 < m \leq 70$	$70 < m \leq 80$	$80 < m \leq 90$
Frequency	8	13	p	20	q

An estimate for the mean time taken to complete the test is 67.625 minutes.
This is calculated using the mid-interval value as an estimate of the time in each interval.

Calculate the value of p and the value of q .

$p = \dots\dots\dots q = \dots\dots\dots$ [5]

10 (a) $\vec{AB} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$

(i) Calculate $|\vec{AB}|$.

$$|\vec{AB}| = \dots\dots\dots [2]$$

(ii) $\vec{AC} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$ and C is the point $(10, -1)$.

(a) Find the coordinates of the point A .

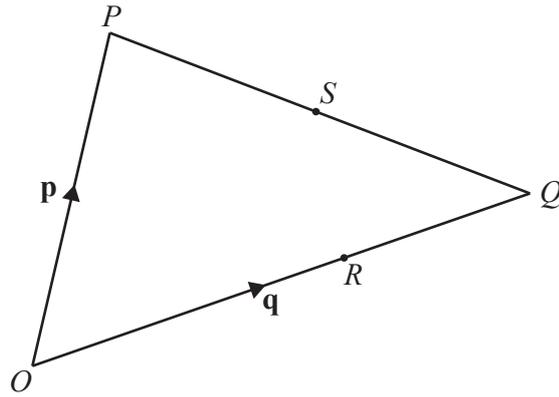
$$(\dots\dots\dots, \dots\dots\dots) [1]$$

(b) B is the midpoint of AD .

Find the coordinates of the point D .

$$(\dots\dots\dots, \dots\dots\dots) [2]$$

(b)

NOT TO
SCALE

The diagram shows triangle OPQ .

$\vec{OP} = \mathbf{p}$ and $\vec{OQ} = \mathbf{q}$.

R is the point on OQ such that $OR = 2RQ$.

S is the midpoint of PQ .

Express, as simply as possible, in terms of \mathbf{p} and/or \mathbf{q}

(i) \vec{PQ} ,

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

(ii) \vec{OS} ,

$$\vec{OS} = \dots\dots\dots [2]$$

(iii) \vec{SR} .

$$\vec{SR} = \dots\dots\dots [2]$$

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