Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

MATHEMATICS (SYLLABUS D) **4024/21**

Paper 2 **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 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.

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1 **(a)** Abid works in an office for 5 days each week.
Each day he works from 08 15 until 12 40 and then from 13 30 until 17 00.

Work out the total time Abid works in one week.
Give your answer in hours and minutes.

..... hours ..... minutes [2]

(b) Abid earns \$14.20 per hour.
He is given a pay increase of 5%.

Calculate the amount Abid earns per hour after the increase.

\$ ..... [2]

(c) Each month Abid divides his earnings between rent, bills and savings.
He uses 20% of his earnings for rent.
He uses $\frac{3}{8}$ of his earnings for bills.
The rest of his earnings are savings.

Find the ratio rent : bills : savings.
Give your answer in its simplest form.

..... : ..... : ..... [3]

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(d) Abid invests \$2400 in a savings account for 4 years.
The account pays simple interest at a rate of r% per year.
At the end of 4 years he receives a total of \$153.60 in interest.

Calculate the value of r.

r = ... [2]

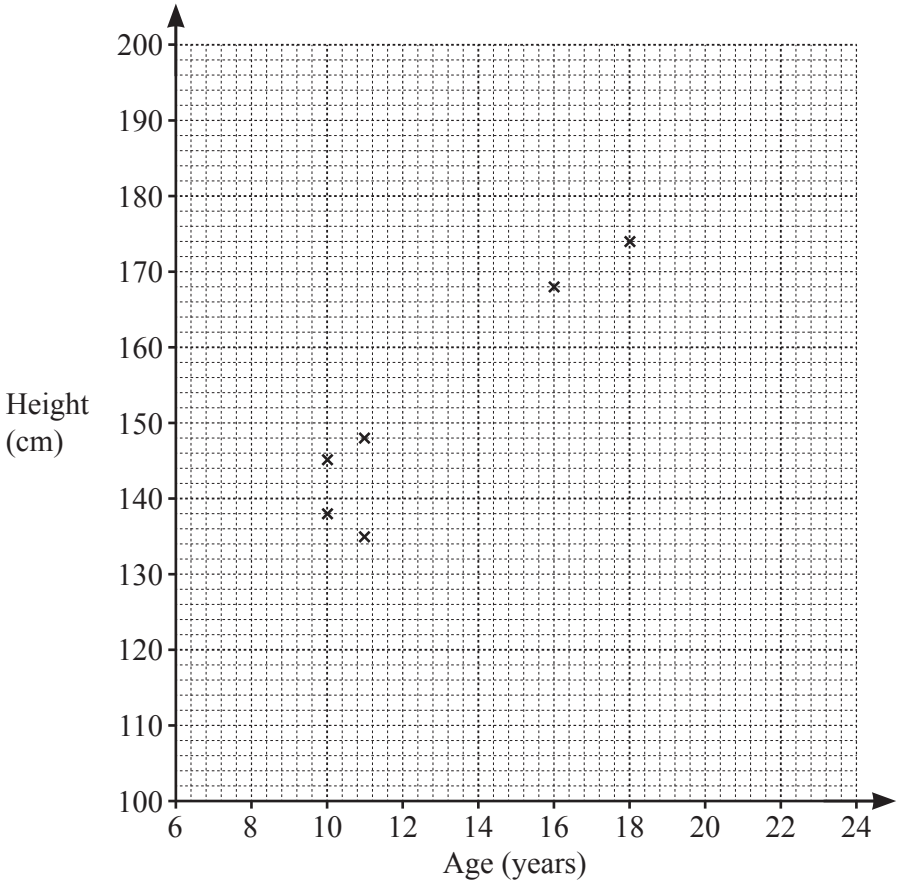
(e) Abid invests some money in a different savings account.
This account pays compound interest at a rate of 1.4% per year.
At the end of 5 years there is \$1822.38 in the account.

Calculate the amount of money Abid invests in this account.

\$ ..... [3]

2 **(a)** The table shows the ages and heights of 10 boys.

Age (years)	10	16	11	18	10	11	13	17	13	16
Height (cm)	138	168	135	174	145	148	158	175	150	160



(i) Complete the scatter diagram.
The first six points have been plotted for you. [2]

(ii) Draw a line of best fit. [1]

(iii) Use your line of best fit to estimate the height of a 14-year-old boy.

..... cm [1]

(iv) Simon is 22 years old.

Explain why your line of best fit should not be used to estimate his height.

.....

..... [1]

(b) The table summarises the heights of 180 girls in Year 7 of a school.

Height (h cm)	$125 < h \leqslant 135$	$135 < h \leqslant 140$	$140 < h \leqslant 145$	$145 < h \leqslant 150$	$150 < h \leqslant 160$
Frequency	8	31	55	62	24

(i) Work out the percentage of girls who are taller than 145 cm.

..... % [2]

(ii) Calculate an estimate of the mean height.

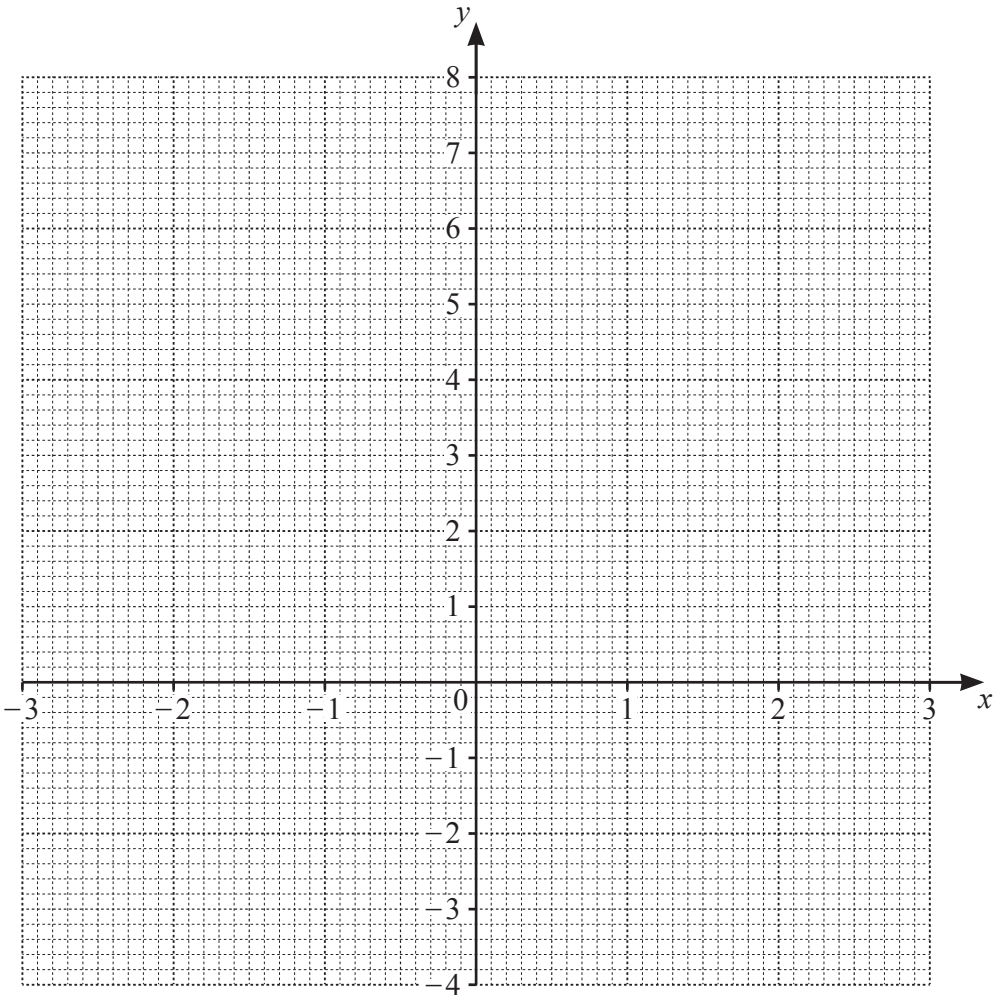
..... cm [3]

3 **(a)** Complete the table for $y = \frac{x^3}{2} - 3x + 2$.

x	–3	–2	–1	0	1	2	3
y	–2.5	4	4.5	2	–0.5	0	

[1]

(b) On the grid, draw the graph of $y = \frac{x^3}{2} - 3x + 2$ for $-3 \leqslant x \leqslant 3$.



[3]

(c) Write down the coordinates of the minimum point of your graph for $x > 0$.

(..... , ...) [2]

(d) Use your graph to solve the equation $\frac{x^3}{2} - 3x + 2 = 0$.

$x =$ ..... , $x =$ ..... , $x =$ ..... [2]

4 $f(x) = x^2 - 7$ $g(x) = \dfrac{4-3x}{2}$

(a) Find $f(8)$.

..... [1]

(b) Find $g(-2)$.

..... [1]

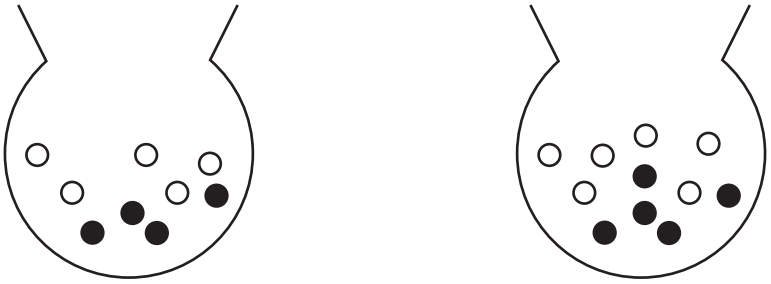
(c) Find $g^{-1}(x)$.

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

(d) Solve $f(2x-1)+3 = 0$.

$x =$ ..... or $x =$ ..... [4]

5 **(a)**



Bag 1 Bag 2

George has two bags each containing black balls and white balls.

(i) George says:

I am more likely to take a black ball from bag 2 than from bag 1.

Show that George is correct.

[2]

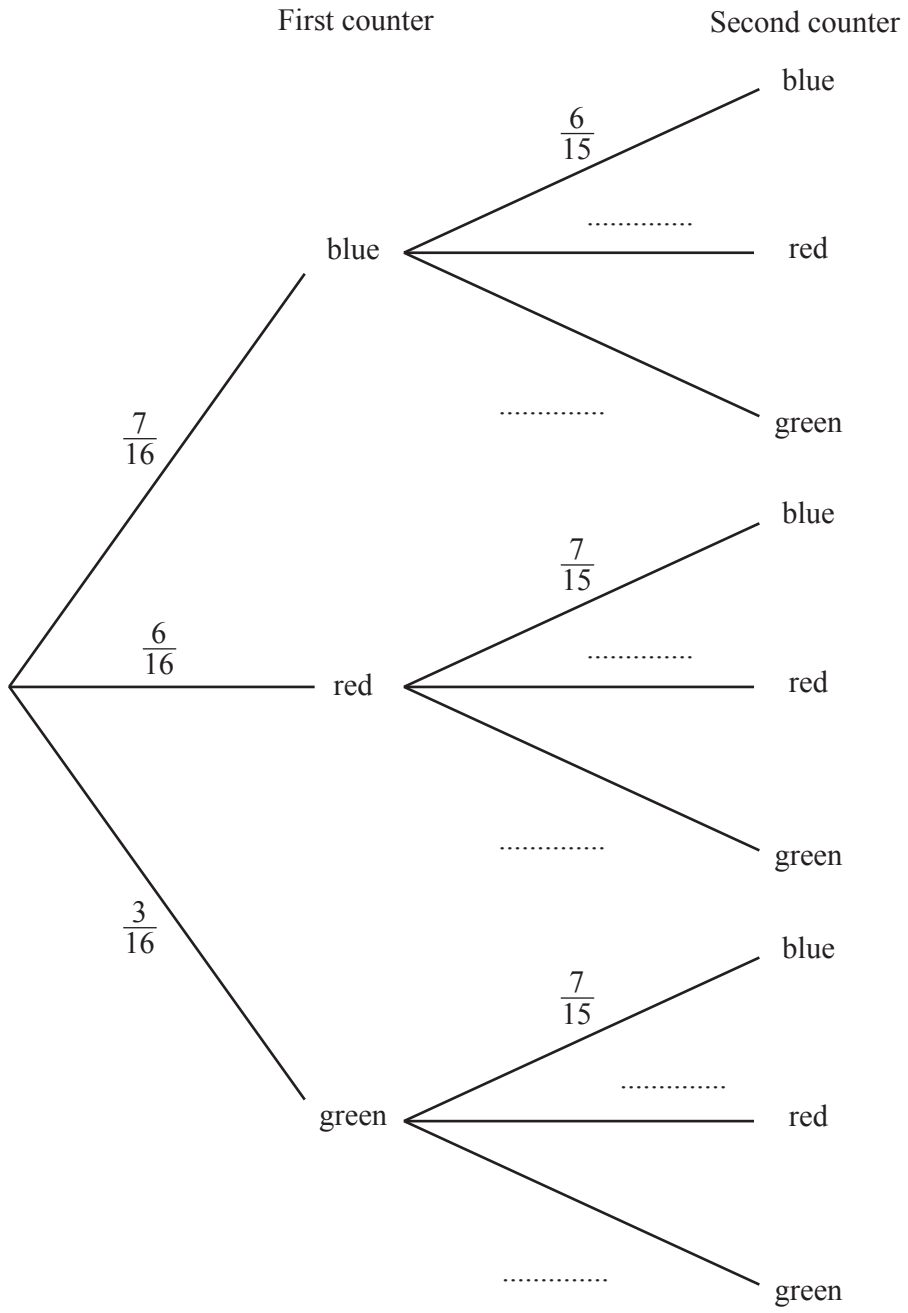
(ii) George takes a ball at random from Bag 2, notes its colour and replaces it.
He repeats this 220 times.

How many times would he expect to take a white ball?

..... [2]

(b) A bag contains 7 blue counters, 6 red counters and 3 green counters.
Yasmin takes two counters from the bag at random without replacement.

(i) Complete the tree diagram.



[2]

(ii) Find the probability that at least one of the counters is red.

..... [3]

6 **(a)** The position vector of point A is $\begin{pmatrix} 4 \\ 7 \end{pmatrix}$ and the position vector of point B is $\begin{pmatrix} 9 \\ 2 \end{pmatrix}$.

(i) Find the column vector $\overrightarrow{AB}$.

$\overrightarrow{AB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(ii) Find $\left|\overrightarrow{AB}\right|$.

$\left|\overrightarrow{AB}\right| =$ ..... [2]

(iii) $ABCD$ is a parallelogram with sides AB, BC, CD and DA.

$\overrightarrow{BC} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

Find the coordinates of point C and point D.

$C =$ (..... , ...)

$D =$ (..... , ...) [2]

(b) P is the point $(r, 4)$ and Q is the point (t, u).

The midpoint of line PQ is $(1, 3)$.
The gradient of line PQ is $-\frac{1}{4}$.

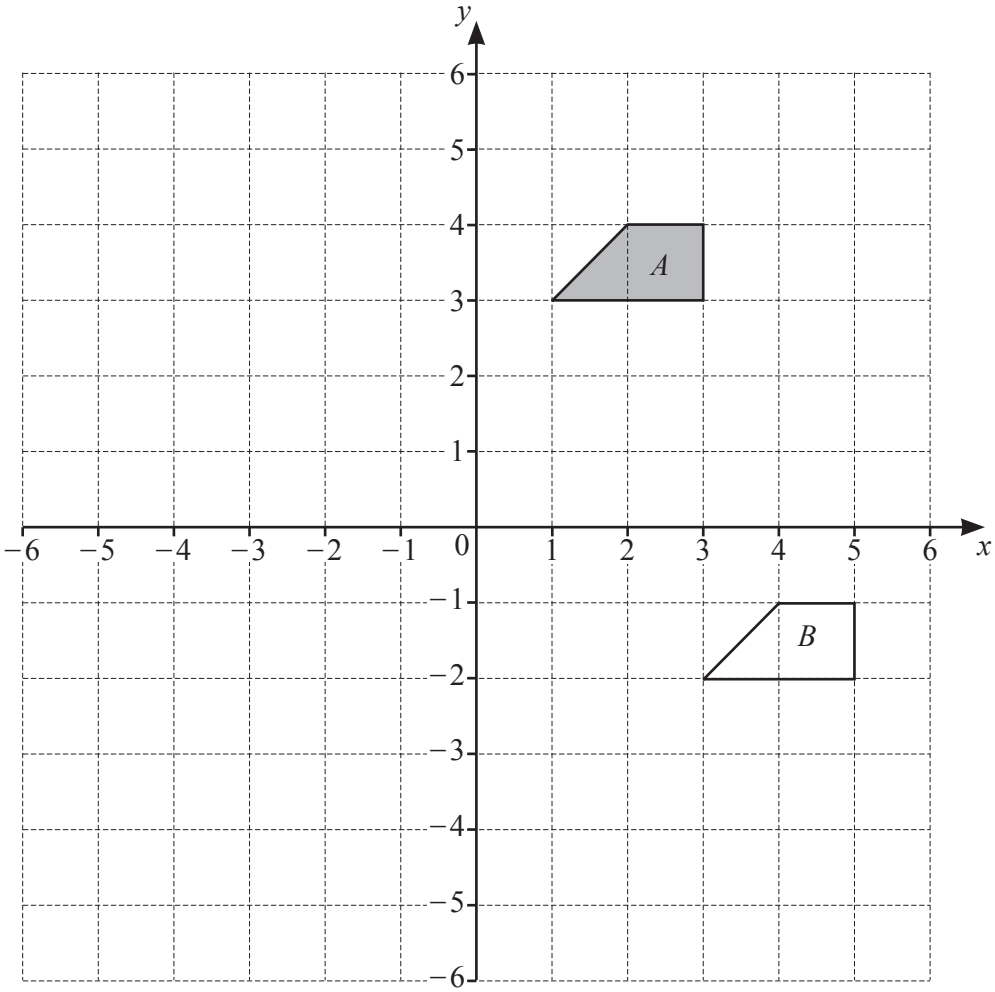
Find the value of each of r, t and u.

$r =$ .....

$t =$ .....

$u =$ ..... [4]

7



(a) Describe fully the **single** transformation that maps shape *A* onto shape *B*.

.....

..... [2]

(b) Reflect shape *A* in the *x*-axis. [1]

(c) Enlarge shape *A* by scale factor 2, centre (5, 4). [2]

(d) Transformation P is represented by the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

P maps shape *A* onto shape *C*.

(i) Draw and label shape *C*.

[2]

(ii) Describe fully the **single** transformation that maps shape *A* onto shape *C*.

.....

..... [3]

(iii) Find the matrix representing the transformation that maps shape *C* onto shape *A*.

$\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$ [1]

8 Lara and Marco each cycle 50 km on a cycle trail.
Lara cycles at an average speed of x km/h.
Marco cycles at an average speed of $(x-3)$ km/h.

(a) Write down an expression for the time, in hours, Lara takes to complete the trail.

..... hours [1]

(b) Marco takes 15 minutes longer than Lara to complete the trail.

Hence form an equation and show that it simplifies to $x^2 - 3x - 600 = 0$.

[4]

(c) Solve the equation $x^2 - 3x - 600 = 0$.
Show your working and give your answers correct to 2 decimal places.

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

(d) Find the time Marco takes to complete the trail.
Give your answer in hours and minutes, correct to the nearest minute.

..... hours ..... minutes [2]

9 **(a)** Kate thinks of a number, n.
She subtracts 8 from the number and multiplies the result by 3.
The answer is 11 less than the number she thought of.

Form an equation in n and solve it to find Kate's number.

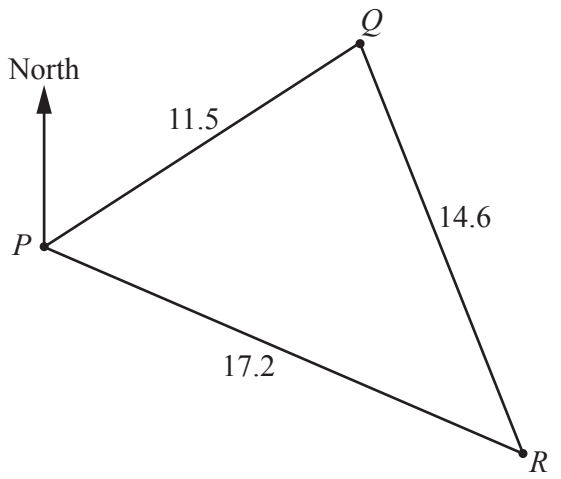
$n =$ ..... [4]

(b) Write as a single fraction in its simplest form.

$$\frac{x^2 - 4}{2} \div \frac{x^2 + 2x}{4}$$

..... [3]

10 (a)



NOT TO SCALE

The diagram shows the positions of three towns, P, Q and R.
Q is on a bearing of 052° from P.
$PQ = 11.5\,\text{km}$, $QR = 14.6\,\text{km}$ and $PR = 17.2\,\text{km}$.

Calculate the bearing of R from Q.

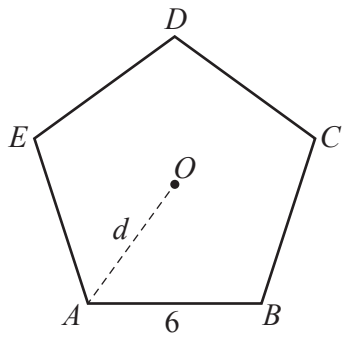
..... [4]

(b) A is a point on horizontal ground.
The angle of elevation of the top of a vertical mast from A is 68°, correct to the nearest degree.
The distance of the base of the mast from A is 45 m, correct to the nearest metre.

Calculate the lower bound of the height of the mast.

..... m [3]

11



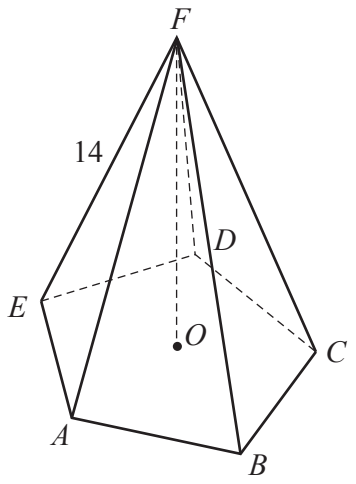
NOT TO SCALE

The diagram shows a regular pentagon $ABCDE$ with centre O.
$AB = 6\,\text{cm}$ and $OA = d\,\text{cm}$.

(a) Show that $d = 5.10\,\text{cm}$, correct to 2 decimal places.

[3]

(b) [Volume of a pyramid = $\frac{1}{3}$ × base area × height]



The regular pentagon *ABCDE* forms the base of a pyramid.
The vertex *F* is vertically above *O*.
The length of each sloping edge of the pyramid is 14 cm.

Calculate the volume of the pyramid.

..... cm^3 [5]

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