UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4084400163

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

Paper 2 **October/November 2011**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.
Omission of essential working will result in loss of marks.
You are expected to use an electronic calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

For Examiner's Use

This document consists of **20** printed pages.

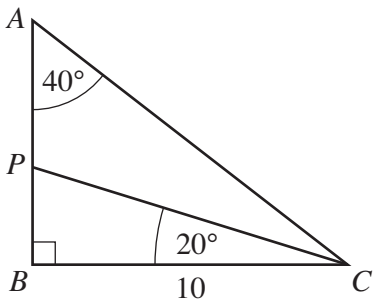
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Section A [52 marks]

Answer **all** the questions in this section.

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1 ABC is a triangle in which $A\hat{B}C = 90°$, $B\hat{A}C = 40°$ and $BC = 10$ cm.
P is the point on AB such that $P\hat{C}B = 20°$.



Calculate

(a) PB,

Answer ..... cm [2]

(b) AP,

Answer ..... cm [2]

(c) the perimeter of triangle PBC.

Answer ..... cm [3]

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2 **(a)** Solve $5t(3t + 7) = 0$.

Do not write in this margin

Answer $t =$ ..... or ..... [2]

(b) Solve the simultaneous equations.

$$3x + 4y = 1$$
$$5x - 8y = 9$$

Answer $x =$ .....

$y =$ ..... [3]

(c) Express as a single fraction $\frac{5}{p-2} - \frac{4}{2p+3}$.

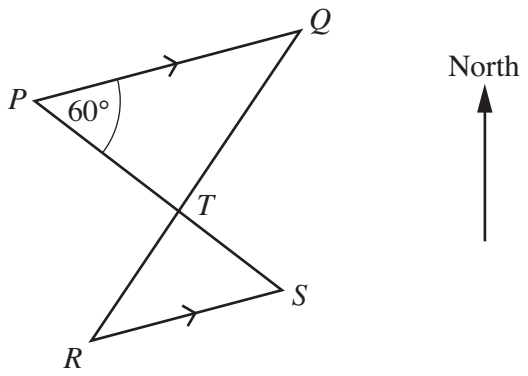
Answer ..... [3]

(d) Simplify $\frac{q^2 - 1}{2q^2 - 3q + 1}$.

Answer ..... [3]

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3 P, Q, R and S are four points on level ground.
PQ is parallel to RS and $Q\hat{P}S = 60°$.
PS and RQ intersect at T.



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(a) Write down the value of $P\hat{S}R$. Give a reason for your answer.

Answer $P\hat{S}R$ = ... because .....

.....[1]

(b) The bearing of Q from P is 070°.
Find the bearing of

(i) S from P,

Answer ..... [1]

(ii) P from S,

Answer ..... [1]

(iii) R from S.

Answer ..... [1]

(c) **(i)** Explain why triangles PQT and SRT are similar.

Answer .....

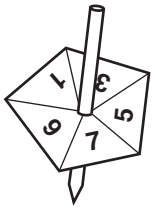
.....[1]

(ii) Given that $PT = 54$ m, $TS = 36$ m and $RQ = 85$ m, find TQ.

Answer ..... m [3]

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4 A fair five-sided spinner is numbered 1, 3, 5, 7 and 9.



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(a) Maria spins it once. Find the probability that the number obtained is

(i) 7,

Answer ..... [1]

(ii) an odd number.

Answer ..... [1]

(b) Pedro spins it twice and adds the two numbers obtained.
Some of the results are shown in the possibility diagram below.

+	1	3	5	7	9
1	2	4			
3					12
5					
7				14	
9					

(i) Complete the possibility diagram. [2]

(ii) Find the probability that the sum of the two numbers is

(a) odd,

Answer ..... [1]

(b) 14 or more.

Answer ..... [1]

(c) Katrina spins it three times.

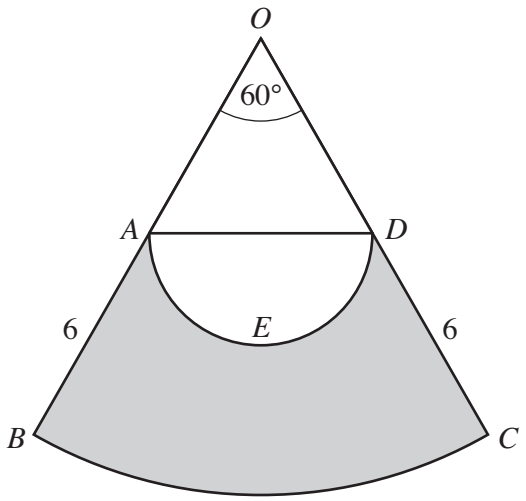
Calculate the probability that the three numbers obtained are the same.
Express your answer as a fraction in its lowest terms.

Answer ..... [2]

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5

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In the diagram, OBC is the sector of a circle, centre O, and $B\hat{O}C = 60°$.
A and D are the midpoints of OB and OC respectively, and $AB = DC = 6\,\text{cm}$.
AED is a semicircle with AD as diameter.

(a) Show that $AD = 6\,\text{cm}$.

[1]

(b) The length of the arc BC is $n\pi$ centimetres.

(i) Find n.

Answer ..... [1]

(ii) Find $\dfrac{\text{the length of the arc } AED}{\text{the length of the arc } BC}$.

Answer ..... [2]

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(c) **(i)** Find the area of the sector BOC.

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Answer ..... cm^2 [2]

(ii) Hence find the area of the shaded region.

Answer ..... cm^2 [3]

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6 **(a)** Ada and Bill own a company.
In 2008 Ada invests \$22 500 in the company and Bill invests \$37 500.

(i) Express 22 500 : 37 500 in the form $m : n$, where m and n are the smallest possible integers.

Answer ..... : ..... [1]

(ii) The profit made by the company in 2008 is shared in the ratio of the amounts invested.

Given that Ada's share of the profit is \$3 600, calculate the total profit made by the company.

Answer \$..... [1]

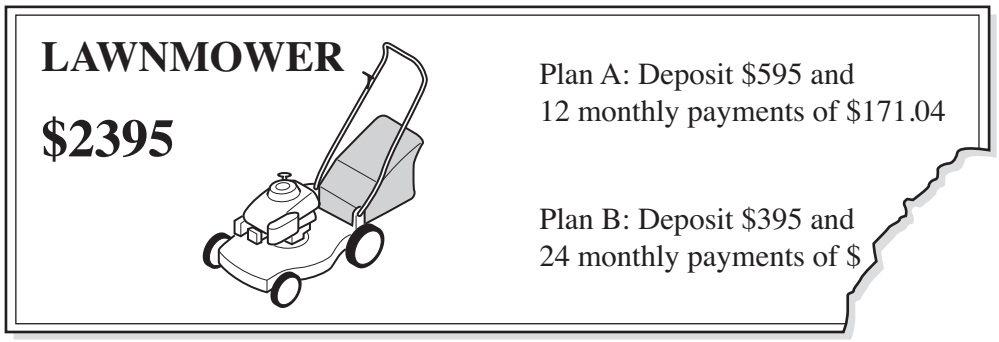
(iii) Ada's investment in 2008 is $12\frac{1}{2}\%$ more than the amount she invested in 2007.

Calculate the amount that Ada invested in 2007.

Answer \$..... [2]

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(b)



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(i) Rashid buys one of these lawnmowers for $2395.
Sayeed buys one of these lawnmowers using Plan A.

In total, how much **more** than Rashid will Sayeed pay?

Answer $..... [1]

(ii) When one of these lawnmowers is bought using Plan B, the total cost is $3054.20.

Calculate the monthly payment.

Answer $..... [2]

(iii) In a sale, the price of the lawnmower is reduced from $2395 to $1595.

Calculate the percentage discount.

Answer ..... % [2]

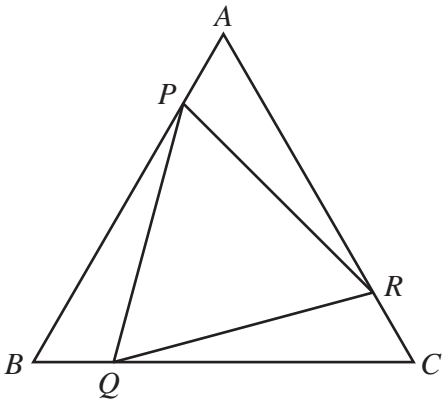
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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7 (a)



In the diagram, ABC is an equilateral triangle.
The points P, Q and R lie on AB, BC and CA respectively, such that $AP = BQ = CR$.

(i) Show that triangles APR, BQP and CRQ are congruent.

[3]

(ii) It is given that $AB = 5\,\text{cm}$ and $PQ = 4\,\text{cm}$.

(a) Find $\dfrac{\text{Area of triangle } PQR}{\text{Area of triangle } ABC}$.

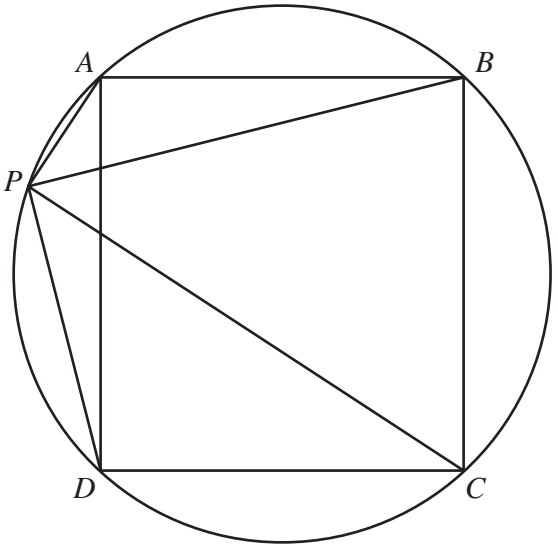
Answer .....[1]

(b) Find $\dfrac{\text{Area of triangle } APR}{\text{Area of triangle } ABC}$.

Answer .....[1]

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(b) In the diagram, $ABCD$ is a square. The point P lies on the circle through A, B, C and D.



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(i) Explain why $A\hat{P}C = 90°$.

Answer .....[1]

(ii) Explain why $A\hat{P}B = B\hat{P}C$.

Answer .....[2]

(iii) Hence find

(a) $A\hat{P}B$,

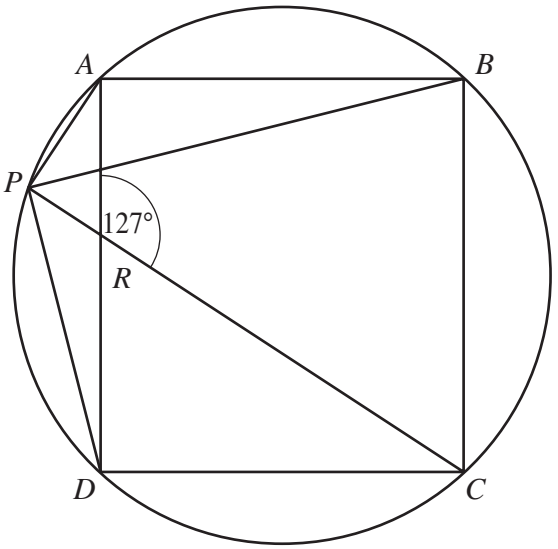
Answer .....[1]

(b) $A\hat{P}D$.

Answer .....[1]

(iv) PC and AD intersect at R.

Given that $A\hat{R}C = 127°$, find $P\hat{D}C$.



Answer .....[2]

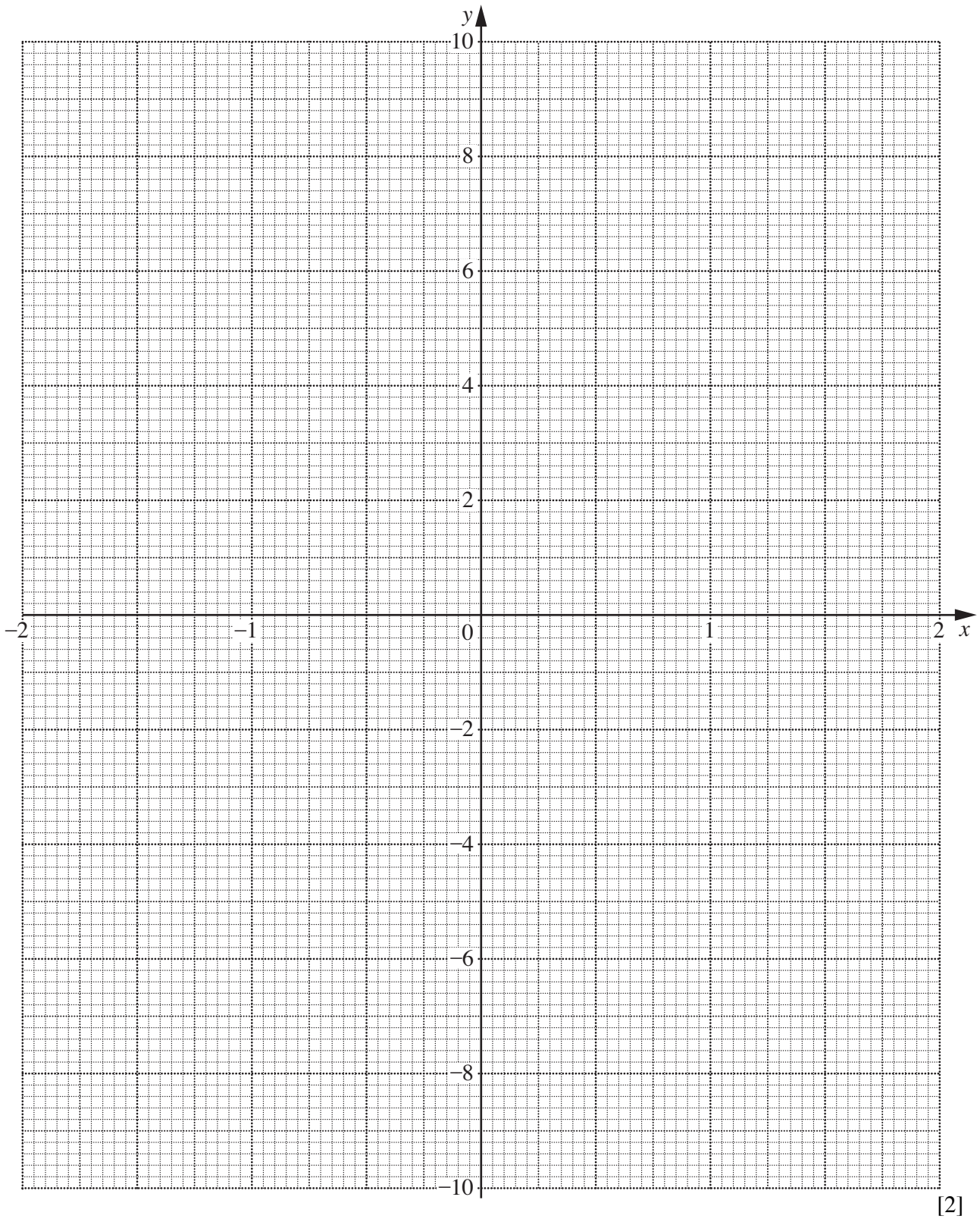
8 The variables x and y are connected by the equation $y = 2x - \frac{5}{2x}$.

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The table below shows some values of x and the corresponding values of y.
The values of y are correct to 1 decimal place where appropriate.

x	0.25	0.5	0.75	1	1.25	1.5	1.75	2
y	–9.5	–4	–1.8	–0.5	0.5	1.3	2.1	2.8

(a) On the grid, plot the points given in the table and join them with a smooth curve.



[2]

(b) By drawing a tangent, find the gradient of the curve at the point $(0.75, -1.8)$.

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Answer ..... [2]

(c) The line $y = 2 - x$ intersects the curve $y = 2x - \frac{5}{2x}$ at the point P.

(i) On the grid, draw the graph of the straight line $y = 2 - x$.

[2]

(ii) Write down the x coordinate of P.

Answer ..... [1]

(iii) This value of x is a solution of the equation $6x^2 - Bx - C = 0$.

Find B and C.

Answer $B =$ .....

$C =$ ..... [3]

(d) Let $f(x) = 2x - \frac{5}{2x}$.

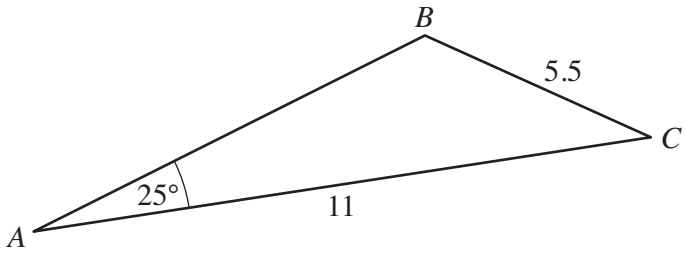
(i) Given that $f(a) = b$, show that $f(-a) = -b$.

[1]

(ii) **Hence**, using the table on the previous page, draw the graph of $y = 2x - \frac{5}{2x}$ for $-2 \leqslant x \leqslant -0.25$.

[1]

9 (a)



In the diagram, $AC = 11$ cm, $BC = 5.5$ cm and $B\hat{A}C = 25°$.
It is given that $A\hat{B}C$ is an **obtuse** angle.

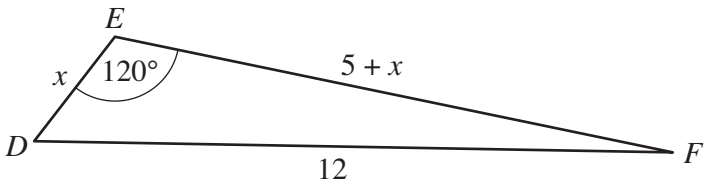
Calculate $A\hat{B}C$.

Answer ..... [4]

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(b)



In the diagram, $DF = 12\,\text{cm}$, $DE = x$ centimetres and $EF = (5 + x)$ centimetres.

(i) Form an equation in x and show that it reduces to $3x^2 + 15x - 119 = 0$.

[3]

(ii) Solve the equation $3x^2 + 15x - 119 = 0$, giving each answer correct to 3 decimal places.

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

(iii) Find the length of EF in millimetres, correct to the nearest millimetre.

Answer ..... mm [1]

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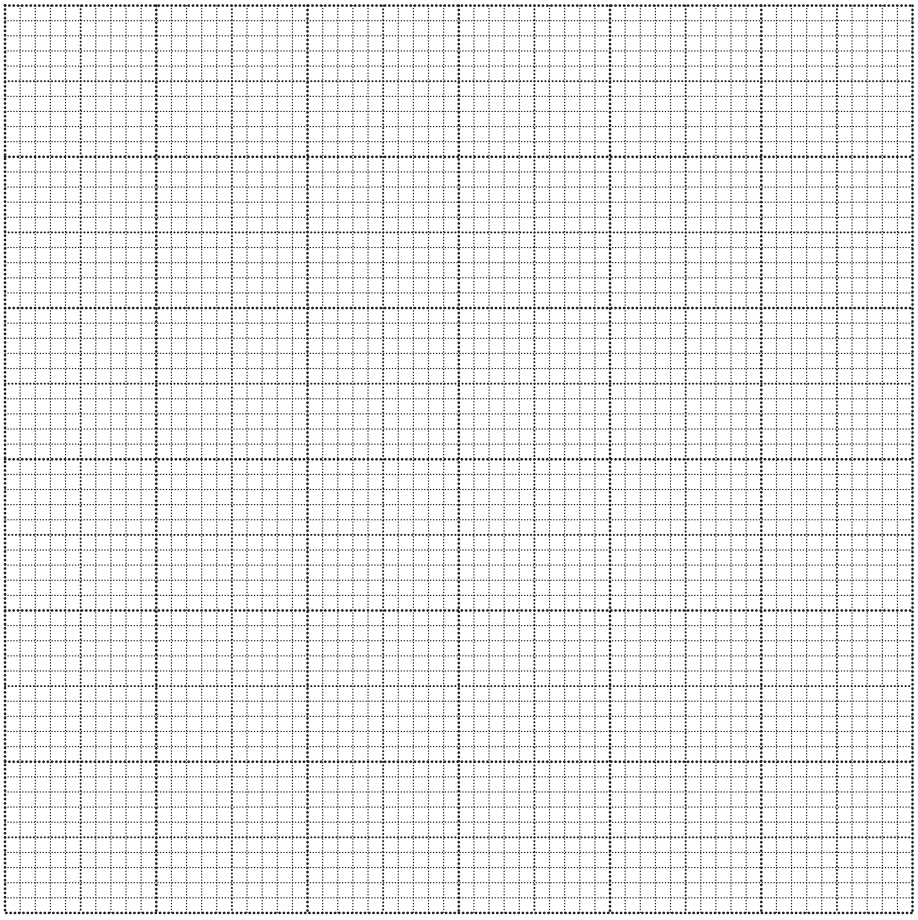
10 The distribution of the masses of 140 eggs is given in the table below.

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Mass (m grams)	$35 < m \leqslant 40$	$40 < m \leqslant 45$	$45 < m \leqslant 50$	$50 < m \leqslant 55$	$55 < m \leqslant 60$	$60 < m \leqslant 70$
Number of eggs	15	20	30	35	28	12

(a) Using a scale of 1 cm to represent 5 grams, draw a horizontal axis for $30 \leqslant m \leqslant 70$.
Using a scale of 1 cm to 1 unit, draw a vertical axis to represent frequency density.

Draw a histogram to represent the information in the table.



[3]

(b) (i) Complete the cumulative frequency table below.

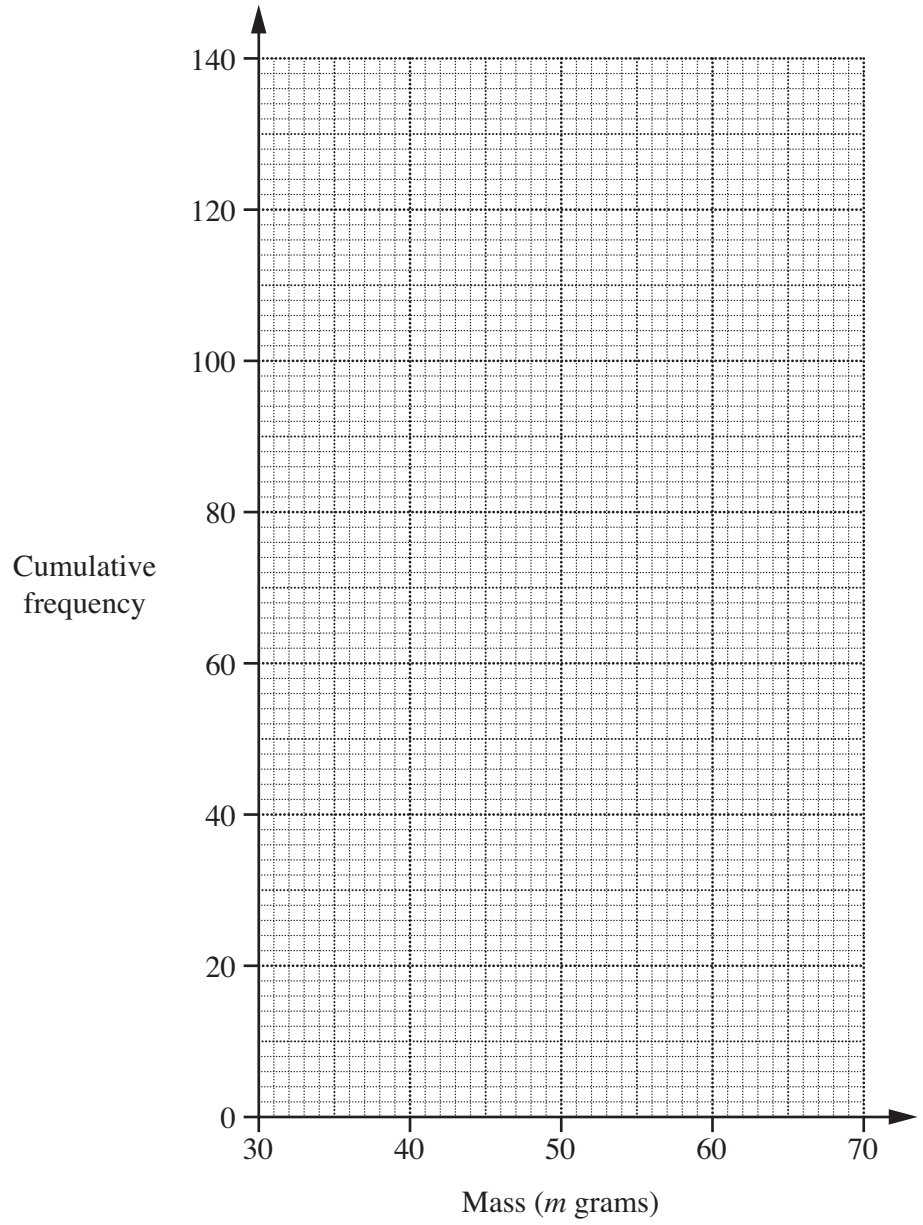
Mass (m grams)	$m \leqslant 35$	$m \leqslant 40$	$m \leqslant 45$	$m \leqslant 50$	$m \leqslant 55$	$m \leqslant 60$	$m \leqslant 70$
Cumulative frequency	0	15					140

[1]

(ii) On the grid on the next page, draw a smooth cumulative frequency curve to represent this information.

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[3]

(c) Use your graph to find

(i) the median mass of the eggs,

Answer ..... g [1]

(ii) the interquartile range.

Answer ..... g [2]

(d) The 12 eggs with the greatest mass are classed as extra large.
The 30 eggs with the least mass are classed as small.

Use your graph to find an estimate of the smallest difference in mass between an extra large egg and a small egg.

Answer ..... g [2]

11 **(a)** Some transformations of the plane are given in the following table.

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M_x	Reflection in the x-axis
M_y	Reflection in the y-axis
M_d	Reflection in the line $y = -x$
R_{90}	Rotation of 90°, anti-clockwise, centre the origin
R_{180}	Rotation of 180°, centre the origin
R_{270}	Rotation of 270°, anti-clockwise, centre the origin.

You may use the grid on the next page to help answer the following questions.

(i) The point A has coordinates (2, 3).

(a) Find the coordinates of $M_y(A)$.

Answer (..... , ...) [1]

(b) Find the coordinates of $M_d M_y(A)$.

Answer (..... , ...) [1]

(c) The inverse of R_{90} maps B onto A.

Find the coordinates of B.

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

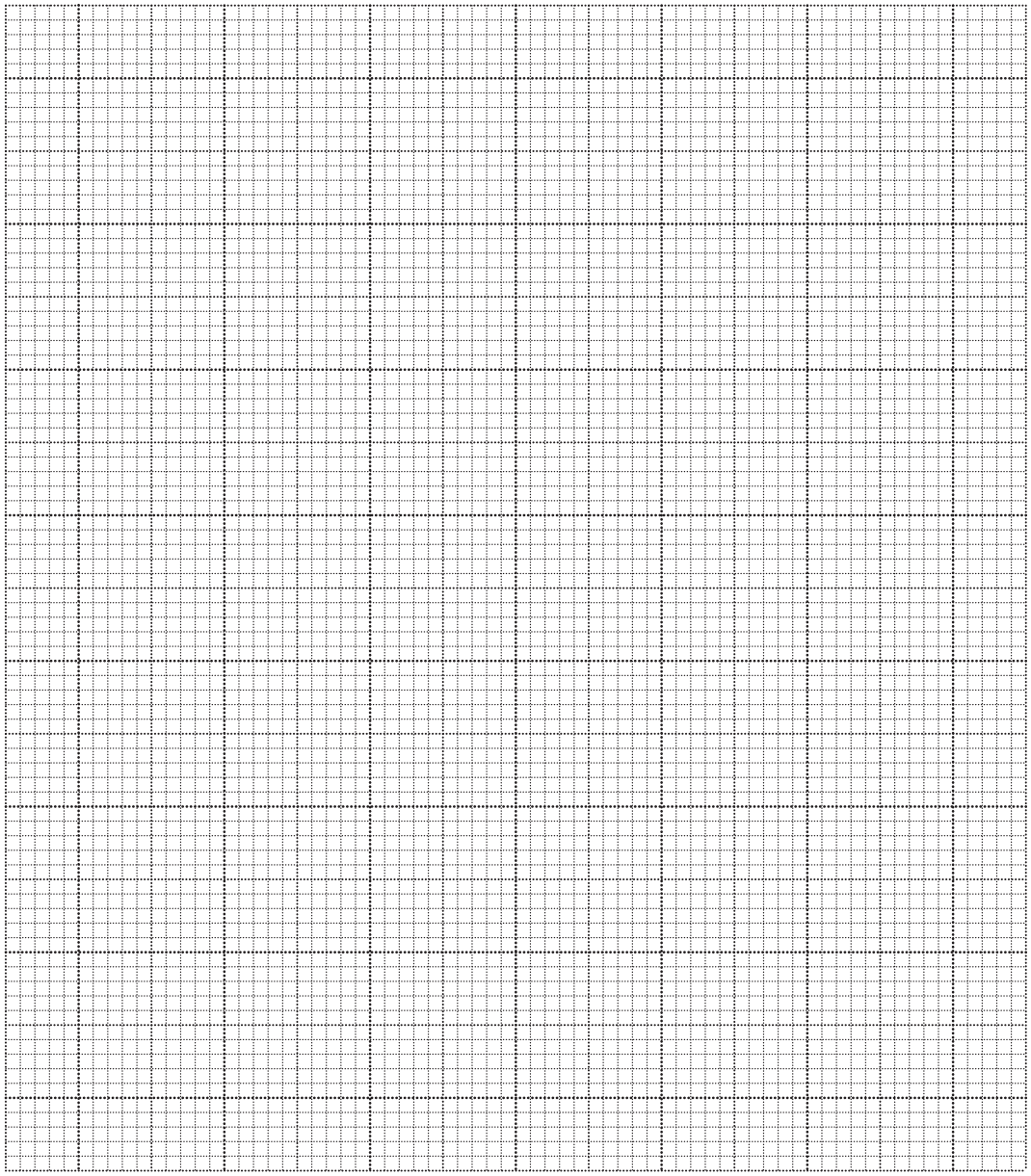
(ii) **(a)** Write down the matrix which represents M_x.

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

(b) Which single transformation given in the table is equivalent to $R_{180}M_x$?

Answer ..... [1]

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Turn over for the rest of this question.

(b) The points P and Q have coordinates $(4, 0)$ and $(9, 0)$ respectively.
The points P' and Q' have coordinates $(4, 4)$ and $(7, 8)$ respectively.

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(i) Write down the length of PQ.

Answer $PQ =$ ..... units [1]

(ii) **Calculate** the length of $P'Q'$.

Answer $P'Q' =$ ..... units [2]

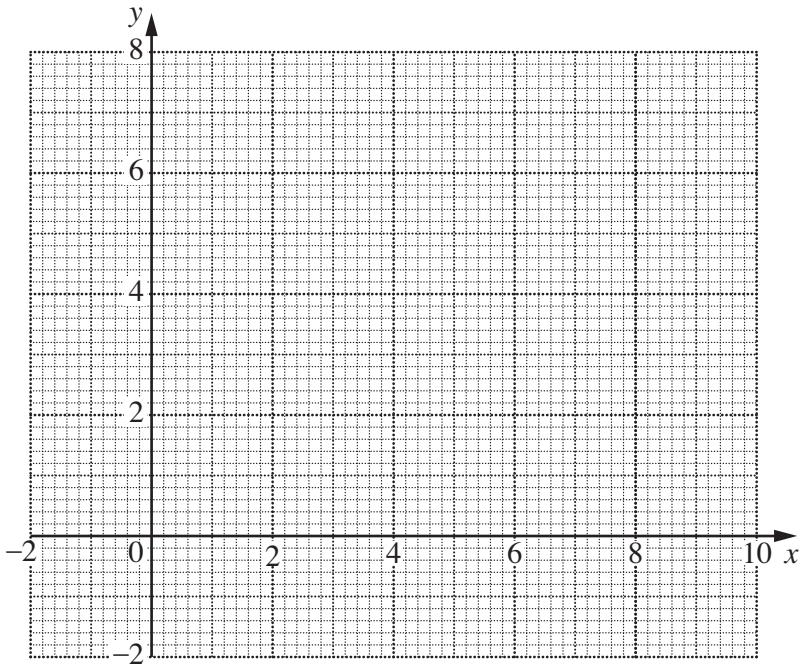
(iii) PQ is mapped onto $P'Q'$ by a single rotation.
By using the grid below,

(a) find, by drawing, the coordinates of the centre of this rotation,

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

(b) measure the clockwise angle of rotation.

Answer ..... [1]



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