Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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

Paper 2 **May/June 2015**

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, 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.

Section A [52 marks]

Answer **all** questions in this section.

1 **(a)** A furniture salesman earned $36 200 last year.

(i) He had to pay 22% of this amount as tax.

How much was left after paying tax?

Answer $ ..... [2]

(ii) His earnings of $36 200 were made up of $25 000 basic salary plus 8% of the value of the furniture that he sold.

Calculate the value of the furniture that he sold.

Answer $ ..... [3]

(iii) He bought a bookcase from the shop where he worked.
Its marked price was \$1080 but because he worked there, he only paid \$756.

Calculate the percentage discount on the marked price that he had been given.

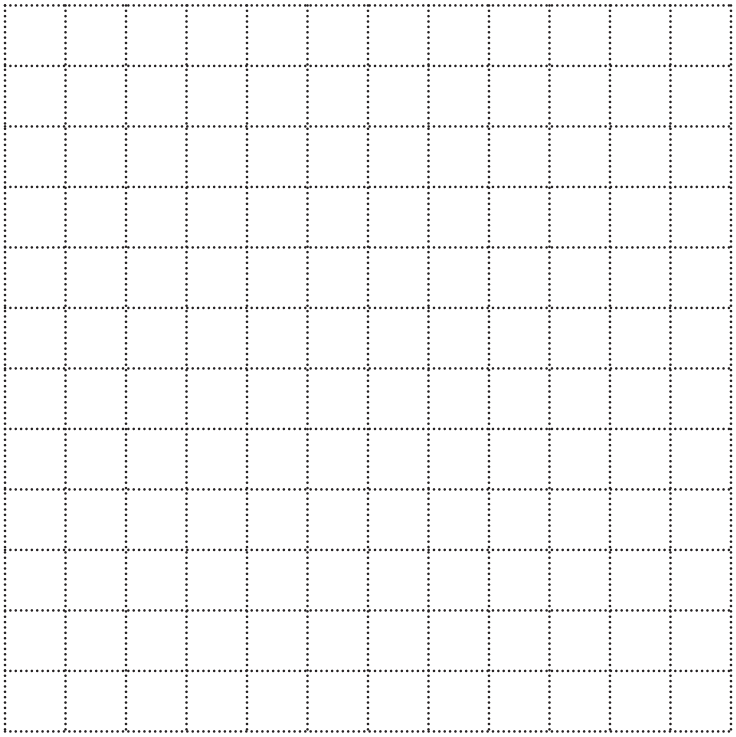
Answer .....% [2]

(b) George opened an account and invested a sum of money at 4.5% simple interest per year for 3 years. At the end of the 3 years he closed the account, withdrawing a total of \$681.

Calculate the amount that George invested.

Answer \$ ..... [3]

2



Q is the point (–1, 2), R is the point (3, 10) and S is the point (–4, 2).

(a) Calculate the length of QR.

Answer .....units [2]

(b) Calculate the value of $\cos S\hat{Q}R$.

Answer ..... [2]

(c) A point $P\,(x, y)$ is such that $PQ = PR$.

(i) Show that $x + 2y = 13$.

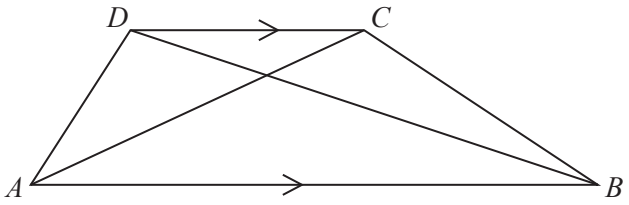
[2]

(ii) P is on the line $y = 7$.

Find the coordinates of P.

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

3 (a) (i)

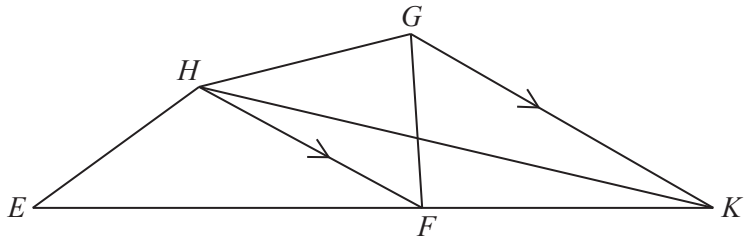


In trapezium *ABCD*, *AB* is parallel to *DC*. *DB* and *AC* are straight lines.

Explain why the area of triangle *ACB* = the area of triangle *ADB*.

[1]

(ii)



The diagram shows the quadrilateral *EHGK*.
HF is parallel to *GK* and *EFK* is a straight line.

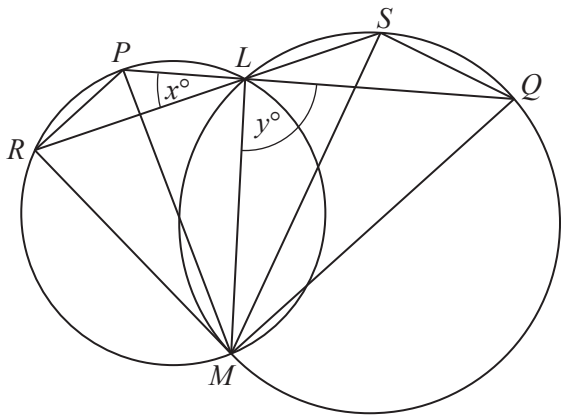
(a) Name a triangle equal in area to triangle *HFK*.

Answer ..... [1]

(b) Hence show that the area of triangle *HEK* = the area of quadrilateral *HEFG*.

[1]

(b)



Two circles intersect at L and M.
R and P are on the circumference of one circle. S and Q are on the circumference of the other circle.
PLQ and RLS are straight lines.
$P\hat{L}R = x°$ and $M\hat{L}Q = y°$.

(i) Complete the proof that $S\hat{M}Q = x°$.

Statement	Reason
$x° = P\hat{L}R = S\hat{L}Q$	.....
$S\hat{L}Q = S\hat{M}Q = x°$	..... [2]

(ii) Prove that $P\hat{R}M = y°$.

Statement	Reason

[2]

(iii) Complete the following statement, giving your reasons.

The triangles PRM and QSM are .....

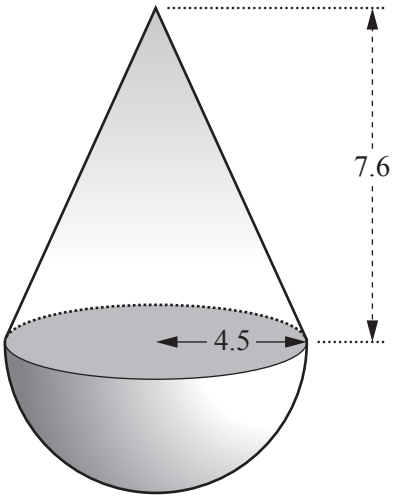
Reasons .....

.....

.....

..... [3]

4 **[The volume of a cone = $\frac{1}{3}\pi r^2 h$] [The volume of a sphere = $\frac{4}{3}\pi r^3$]**



A solid is formed by joining a cone of radius 4.5 cm and height 7.6 cm to a hemisphere of radius 4.5 cm as shown.

(a) Calculate the area of the circle where they are joined.

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

(b) Calculate the total volume of the solid.

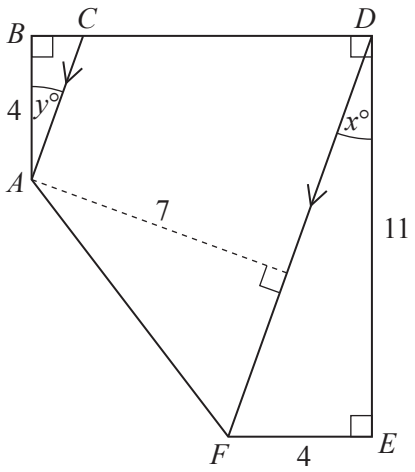
Answer ..... cm^3 [2]

(c) Another solid of the same type is made by joining a cone of radius 5 cm and height h cm to a hemisphere of radius 5 cm.
The cone and hemisphere have equal volumes.

Calculate the height of the cone.

Answer ..... cm [2]

5



In the framework $ABCDEF$, BCD is a straight line, and CA is parallel to DF.
$A\hat{B}D$, $B\hat{D}E$ and $D\hat{E}F$ are right angles.
$AB = 4$ m, $DE = 11$ m and $EF = 4$ m.

(a) $F\hat{D}E = x°$.

Show that $x = 20.0$ correct to 3 significant figures.

[2]

(b) $B\hat{A}C = y°$.

Stating your reasons, explain why $y = x$.

[1]

(c) Calculate AC.

Answer ..... m [3]

(d) The perpendicular distance between the parallel lines CA and DF is 7 m.

Calculate the area of $ACDF$.

Answer ..... m^2 [4]

6 **(a)** Expand the brackets and simplify $(x - 1)(x^2 + x + 1)$.

Answer ..... [2]

(b) Solve the equation $\frac{3x}{x+2} - \frac{4}{x-2} = 3$.

Answer ..... [3]

(c) Solve these simultaneous equations.

$$4x - 3y = 4$$
$$4y - 3x = -6.5$$

Answer $x =$ .....

$y =$ ..... [4]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

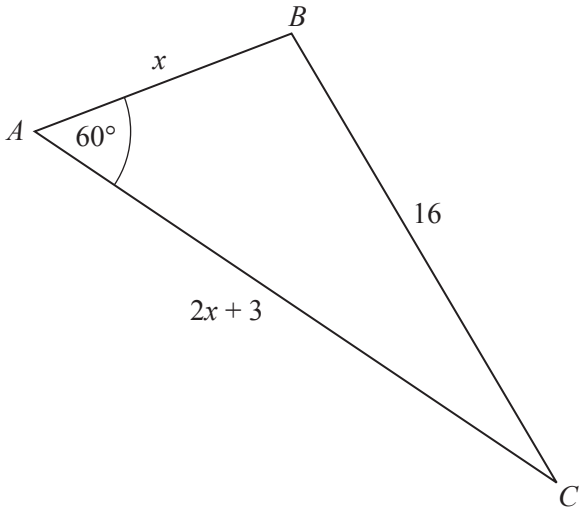
7 **(a)** **(i)** Evaluate $\frac{8\sin 54°}{\sin 18°}$.

Answer ..... [1]

(ii) Evaluate $\sqrt{4.73^2 - 1.65\sin 43°}$.

Answer ..... [1]

(b)



In the triangle ABC, $BC = 16\,\text{cm}$ and $B\hat{A}C = 60°$.
$AB = x\,\text{cm}$ and $AC = 2x + 3\,\text{cm}$.

(i) Form an equation in x and show that it simplifies to $3x^2 + 9x - 247 = 0$.

[4]

(ii) Solve the equation $3x^2 + 9x - 247 = 0$, giving your answers correct to 2 decimal places.

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

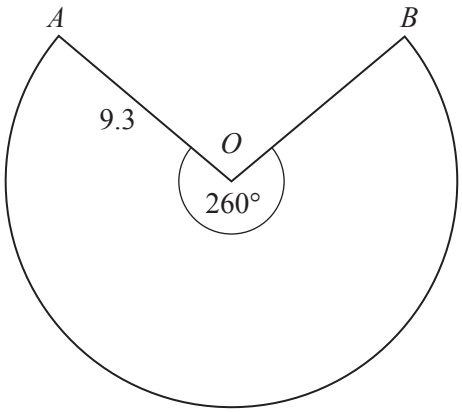
(iii) Hence write down the lengths of AB and AC.

Answer $AB =$ .....cm $AC =$ .....cm [1]

(iv) Find the area of triangle ABC.

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

8 The diagram shows a sector AOB of a circle with centre O and radius 9.3 cm.
The angle of the sector is 260°.



(a) (i) Calculate the length of the major arc AB.

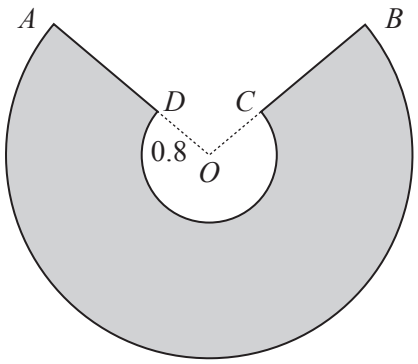
Answer ..... cm [2]

(ii) Calculate the area of the major sector AOB.

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

(b) A sector of radius 0.8 cm, centre O, is removed from the sector AOB as shown in Diagram I.
The shaded shape is used to make part of a conical funnel.
AD is joined to BC as shown in Diagram II.

Diagram I



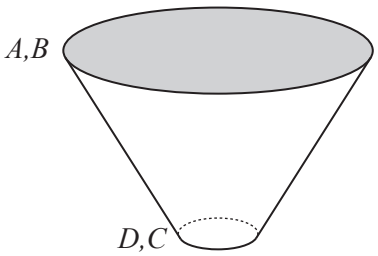


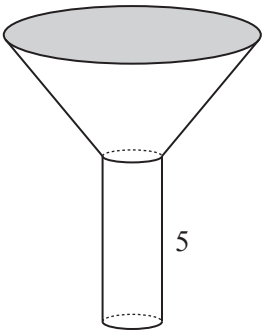
Diagram II

The circumference of the top of the conical funnel is the major arc AB, and the circumference of the bottom of the conical funnel is the major arc CD.

(i) Calculate the external surface area of this part of the funnel.

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

(ii) The funnel is completed by attaching an open cylinder of height 5 cm to the bottom of the conical part.



(a) Show that the radius of the cylinder is 0.578 cm, correct to 3 significant figures.

[2]

(b) Calculate the external curved surface area of this cylinder.

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

(c) Calculate the volume of this cylinder.

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

9 $f(x) = x^3$

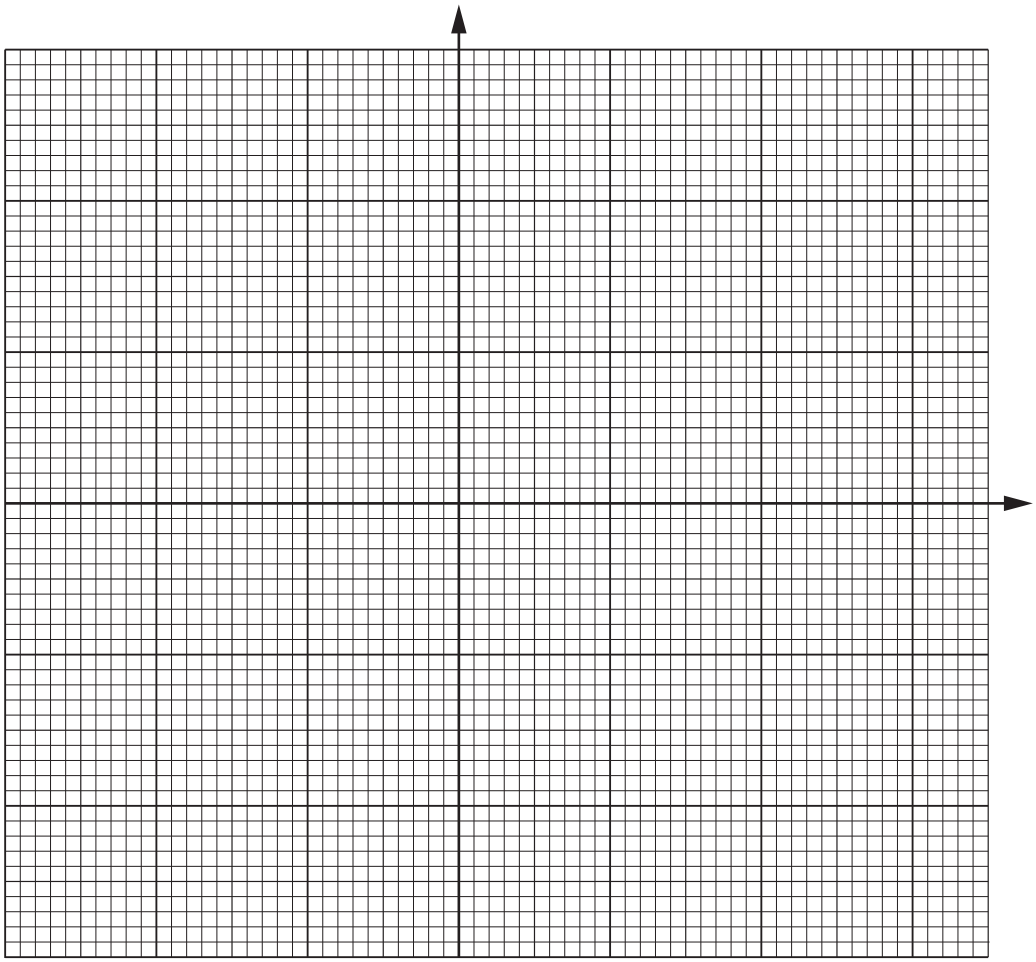
(a) Complete the following table.

x	–3	–2	–1	0	1	2	3
$f(x)$							

[1]

(b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x-axis for $-3 \leqslant x \leqslant 3$.
Using a scale of 2 cm to represent 10 units, draw a vertical y-axis for $-30 \leqslant y \leqslant 30$.
Using your axes, plot the points in the table and join them with a smooth curve.

Answer



[2]

(c) **(i)** Use your graph to solve $f(x) = -15$.

Answer ..... [1]

(ii) Use your graph to find a such that $f^{-1}(a) = 1.7$.

Answer ..... [1]

(iii) Given that $f^{-1}(t) = u$, express t in terms of u.

Answer $t =$ ..... [1]

(iv) By drawing a tangent to $y = f(x)$, estimate the gradient of the curve when $x = 2$.

Answer ..... [2]

(d) (i) Using the same axes draw the line that represents the function $g(x) = 5x + 3$.

[2]

(ii) Hence find the three solutions of the equation $f(x) = g(x)$.

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

10 One day a farmer collected 300 eggs from his chickens.
The table below shows the distribution of the masses of the eggs.

Mass (m grams)	$42 < m \leqslant 46$	$46 < m \leqslant 48$	$48 < m \leqslant 50$	$50 < m \leqslant 54$	$54 < m \leqslant 58$	$58 < m \leqslant 66$
Frequency	60	40	48	72	56	24

(a) (i) An egg is chosen at random.

Calculate the probability that the mass of this egg is not greater than 48 grams.

Answer ..... [1]

(ii) An egg is chosen at random from the 300 eggs.
Another egg is chosen at random from those that remain.

Calculate the probability that the mass of one egg is at most 46 grams, and the mass of the other is more than 58 grams.

Answer ..... [2]

(b) Calculate an estimate of the mean mass of an egg.

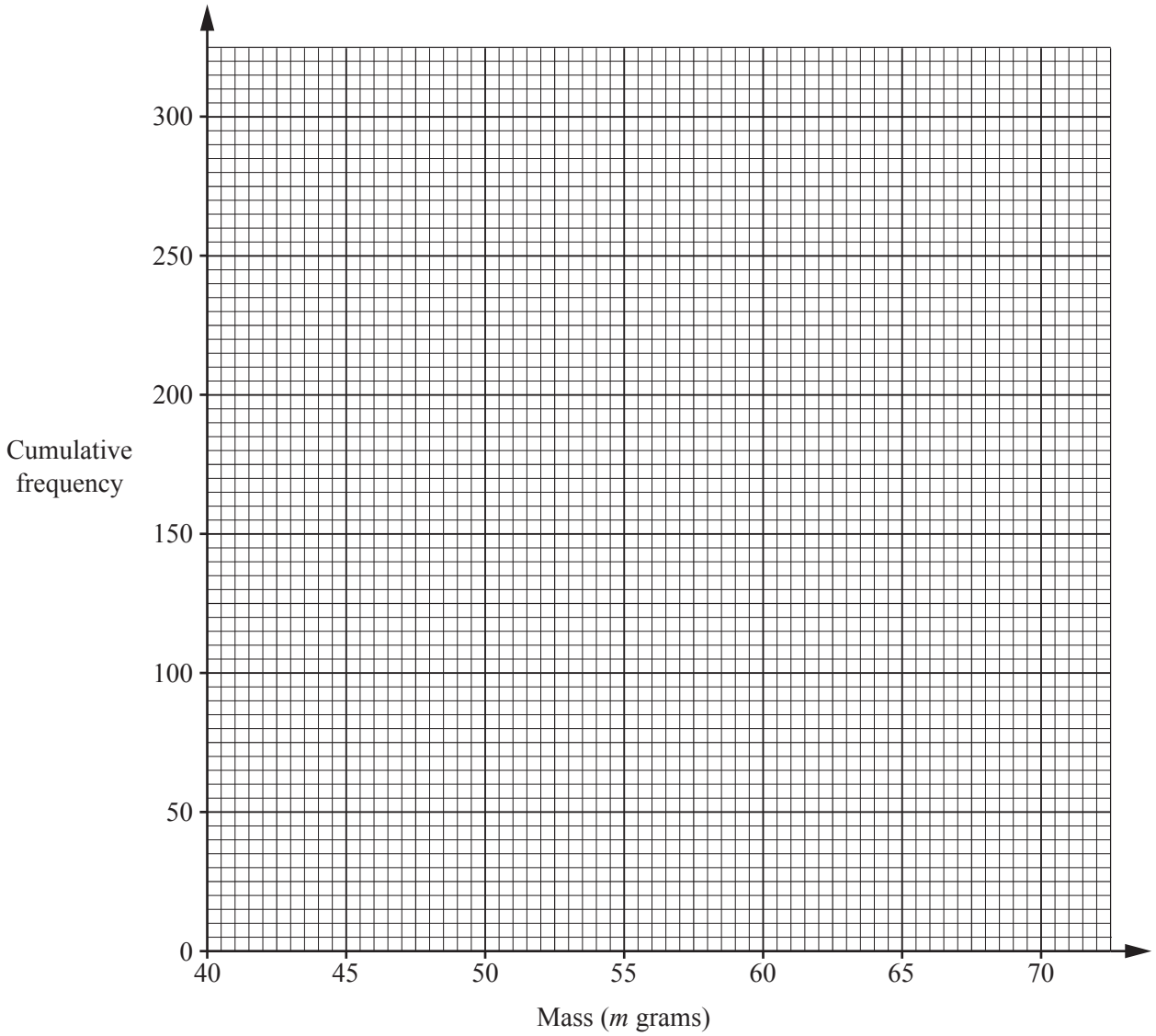
Answer ..... g [3]

(c) (i) Complete the cumulative frequency table.

Mass (m grams)	$m \leqslant 42$	$m \leqslant 46$	$m \leqslant 48$	$m \leqslant 50$	$m \leqslant 54$	$m \leqslant 58$	$m \leqslant 66$
Cumulative Frequency	0	60					300

[1]

(ii) On the grid, draw a smooth cumulative frequency curve to illustrate this information.



[2]

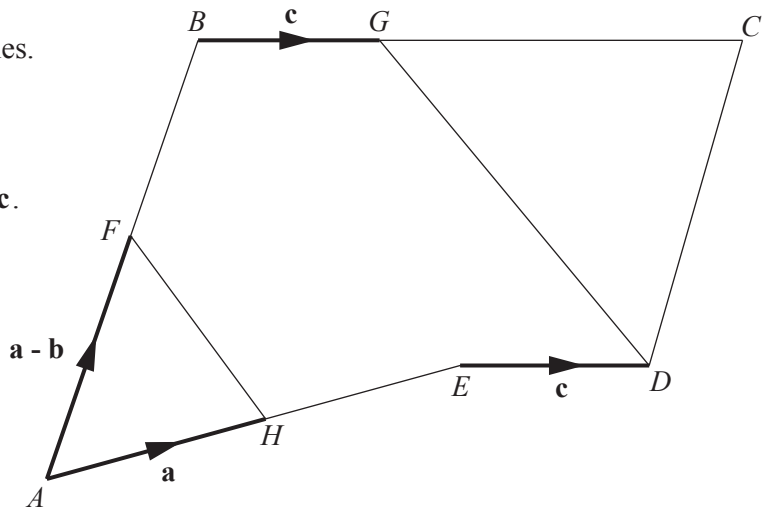
(d) (i) Use your graph to find the median mass of the eggs.

Answer ..... g [1]

(ii) Use your graph to find the interquartile range.

Answer ..... g [2]

11 **(a)** *ABCDE* is a pentagon.
AFB, *AHE* and *BGC* are straight lines.
F is the midpoint of *AB*.
H is the midpoint of *AE*.
G divides *BC* in the ratio 1 : 2.
$\overrightarrow{AH} = \mathbf{a}$, $\overrightarrow{AF} = \mathbf{a} - \mathbf{b}$, $\overrightarrow{BG} = \overrightarrow{ED} = \mathbf{c}$.



(i) Find $\overrightarrow{FH}$.

Answer ..... [1]

(ii) Using vectors, show that *GD* is parallel to *FH*.

[2]

(iii) It is given that $\mathbf{c} = \frac{4}{5}\mathbf{a} + \frac{1}{5}\mathbf{b}$.

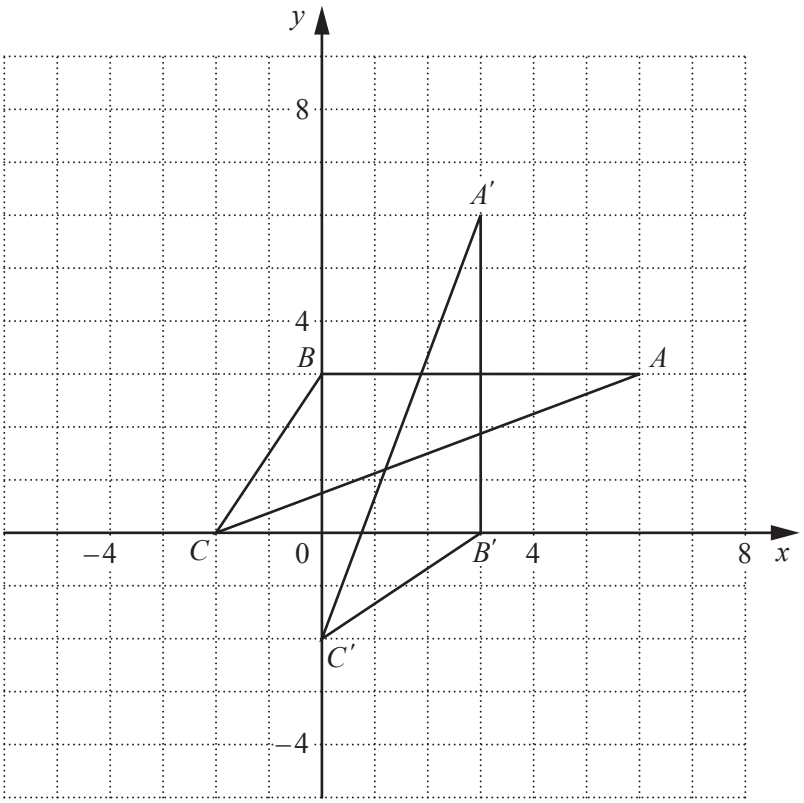
(a) Express $\overrightarrow{DC}$ in terms of **a** and **b**.

Answer ..... [2]

(b) Find $|\overrightarrow{AF}| : |\overrightarrow{DC}|$.

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

(b)



(i) The transformation T maps triangle ABC onto triangle $A'B'C'$.

(a) Describe fully the transformation T.

Answer ..... [2]

(b) The matrix M represents the transformation T.

Find the matrix M.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) Triangle $A'B'C'$ is mapped onto triangle $A''B''C''$ by a reflection in the y-axis.

Draw and label triangle $A''B''C''$. [1]

(iii) Triangle ABC is mapped onto triangle $A''B''C''$ by an anticlockwise rotation about the origin.

State the angle of rotation.

Answer ..... [1]

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