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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

4859035620

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

Paper 2 **May/June 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 **24** printed pages.

Section A [52 marks]

Answer **all** questions in this section.

1 **(a)** Ahmed's internet provider offers two payment schemes.

Scheme A : \$30 per month for unlimited use.
Scheme B : \$0.05 per minute on weekdays and \$0.03 per minute at the weekend.

Each month Ahmed uses the internet for a **total** of $5\frac{1}{4}$ hours at the weekday rate and a **total** of 12 hours at the weekend rate.

Find the cost per month, in dollars, for Scheme B and decide which payment scheme is cheaper.

Answer Scheme B costs \$.....

Scheme .....is cheaper [2]

(b) Ahmed's printer can use large or small black cartridges.
A large cartridge costs \$48.50 and prints 1000 pages.
A small cartridge prints 650 pages.
2 small cartridges cost \$65.

(i) Find the cost per page, in dollars, if Ahmed buys 2 small cartridges.

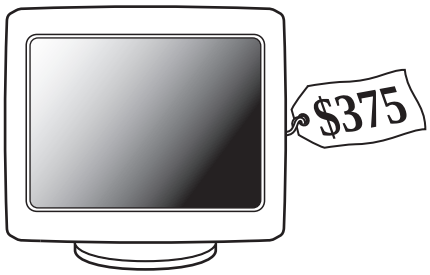
Answer \$ ..... [1]

(ii) Is it cheaper per page for Ahmed to buy 2 small cartridges or a large cartridge?
Show your working.

[1]

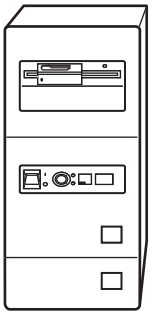
(c)

Monitor



Keyboard

Computer



Ahmed buys a new monitor, keyboard and computer.
He is given a 15% discount off the total price.
The discounted price that Ahmed pays is $1134.75.
The price of the monitor before the discount was $375.
The price of the keyboard before the discount was $70.

Calculate the price of the computer before the discount.

Answer $..... [3]

2 **(a)** A is the point (3, 6) and B is the point (11, 12).

Find the coordinates of the midpoint of AB.

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

(b) C and D have coordinates (10, 15) and (–8, –21).

(i) Find the equation of the line CD in the form $y = mx + c$.

Answer $y =$ ..... [2]

(ii) Does the point (–2, –9) lie on the line CD?
Show your working to justify your answer.

[1]

(c) The line l has equation $4y = 3x + 15$.

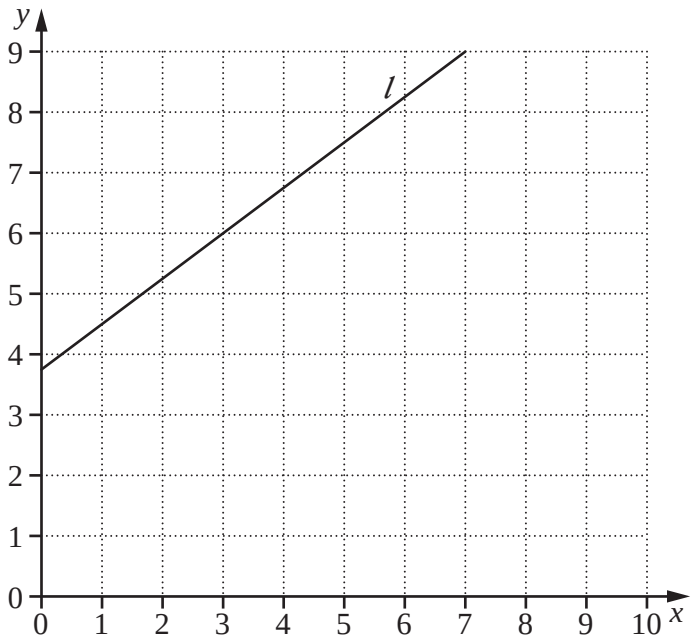
(i) **(a)** Find the coordinates of the point where l crosses the x axis.

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

(b) Find the coordinates of the point where l intersects the line $y = p$.
Express each coordinate in terms of p.

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

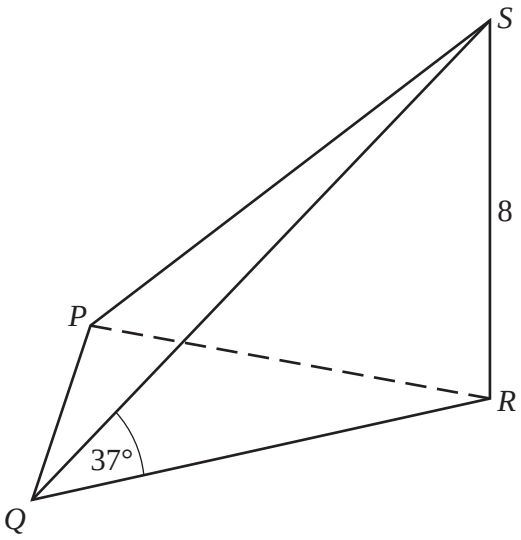
(ii) The line l is drawn on the grid below.



By drawing the line $3x + 2y = 30$ on the grid, find the coordinates of the point where these two lines intersect.

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

3 (a)

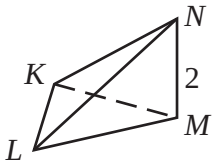


PQRS is a triangular-based pyramid.
RS is perpendicular to the base *PQR*.
$RS = 8\,\text{cm}$ and $R\hat{Q}S = 37°$.

(i) Find *QR*.

Answer ..... cm [2]

(ii)



Pyramid *KLMN* is similar to pyramid *PQRS*.
$MN = 2\,\text{cm}$ and the volume of *KLMN* is $3\,\text{cm}^3$.

Find the volume of *PQRS*.

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

(b)

Exchange Rate
$1 = £0.45

Jean-Pierre bought a watch for $110.
Simon bought an identical watch for £46.62.

Find the difference, in dollars, between the amount Jean-Pierre paid and the amount Simon paid.

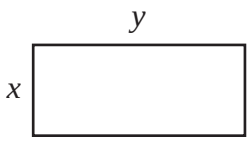
Answer $..... [2]

(c) The time taken to build a brick wall is inversely proportional to the number of workers.
3 workers took 30 hours to build a wall.

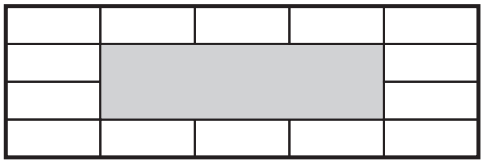
Calculate the time it would have taken 5 workers to build this wall.

Answer ..... hours [2]

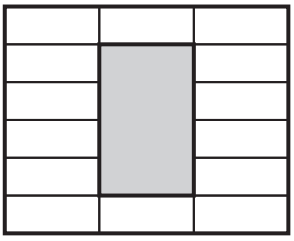
4



Rectangular paving slabs measure x centimetres by y centimetres, where $x < y$.
Fourteen of these slabs form a path around each of two different rectangular gardens.
These two gardens are shaded in the designs below.



Design 1



Design 2

(a) The **outside** perimeter of the path in **Design 1** is 10.2 metres.
The **total** perimeter of the path in **Design 2** is 13.6 metres.

Show that $4x + 5y = 510$ and $5x + 2y = 340$.

[2]

(b) Solve the simultaneous equations.

$$4x + 5y = 510$$
$$5x + 2y = 340$$

Answer x = ...

y = ... [3]

(c) Find the difference between the areas of the two gardens.
Give your answer in square metres.

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

5 **(a)** $\mathbf{A} = \begin{pmatrix} -1 & 2 \\ 3 & -1 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 4 & 2 \\ -3 & -1 \end{pmatrix}$.

(i) Find **AB**.

Answer [2]

(ii) Find $\mathbf{B}^{-1}$.

Answer [2]

(b) $\overrightarrow{PQ} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

(i) Calculate $|\overrightarrow{PQ}|$.

Answer ..... [2]

(ii) Find $\overrightarrow{PR}$.

Answer [1]

(c) You may use the grid below to help you answer this question.
T is the point (13, 7) and U is the point (8, 9).

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

Answer [1]

(ii) TUV is an isosceles triangle with $TU = TV$.
The y-coordinates of the points U and V are equal.

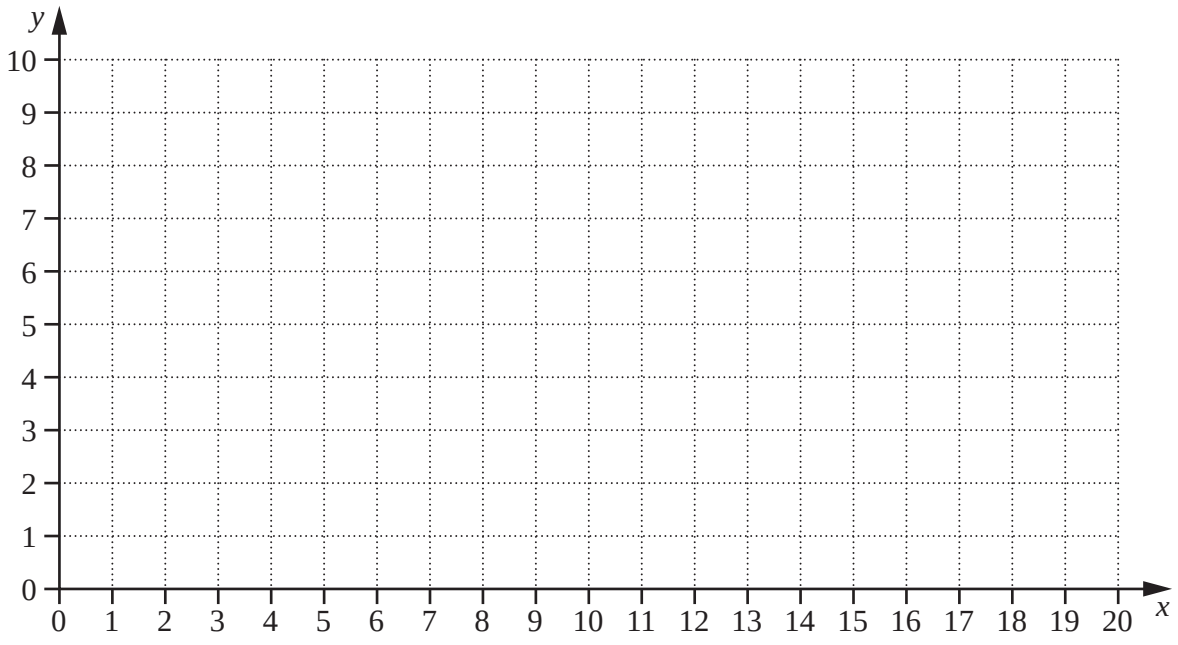
Find the coordinates of V.

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

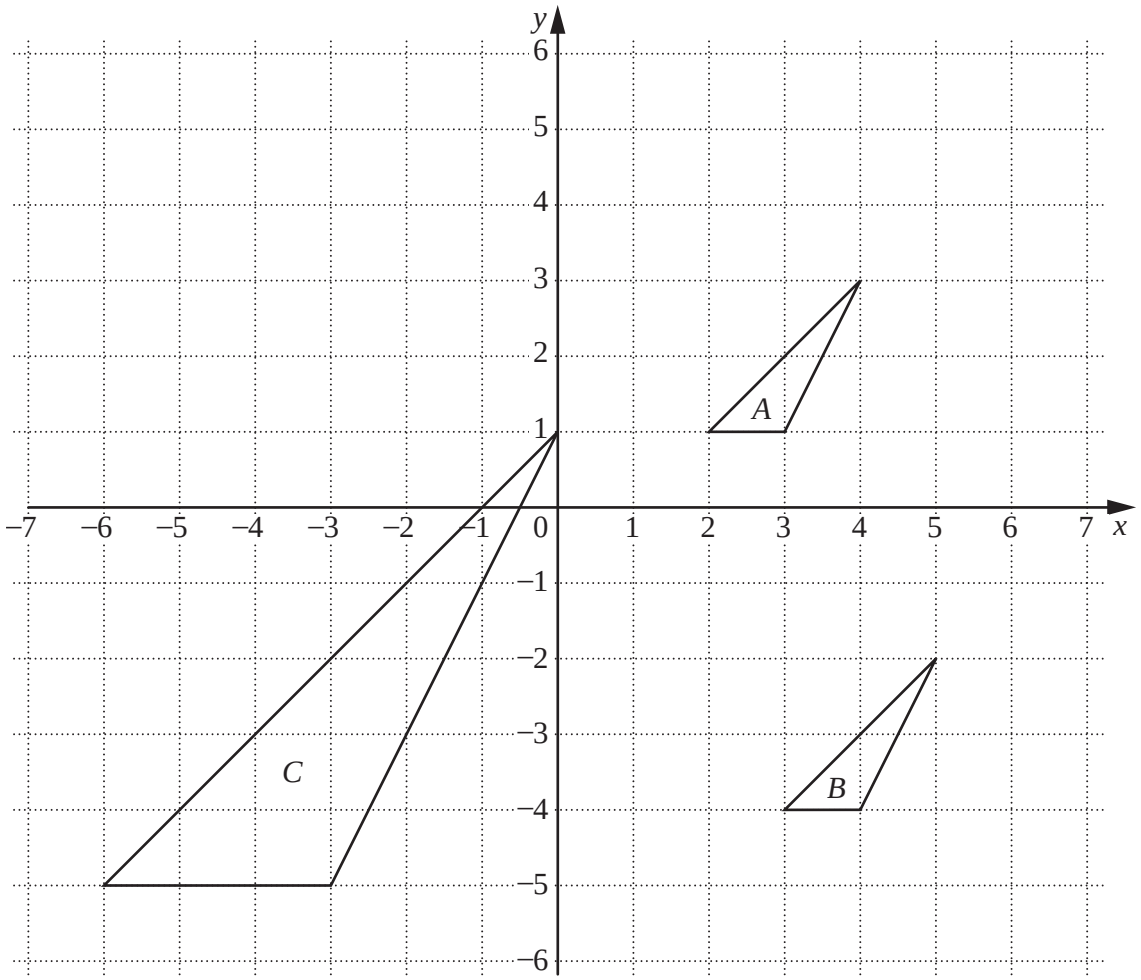
(iii) W is the point (1, 3).

Calculate the area of triangle TUW.

Answer ..... units^2 [3]



6 **(a)** The diagram shows triangles *A*, *B* and *C*.



(i) Describe fully the **single** transformation that maps

(a) triangle *A* onto triangle *B*,

Answer .....

.....

..... [2]

(b) triangle *A* onto triangle *C*.

Answer .....

.....

..... [2]

(ii) One vertex of triangle A is (2, 1).

Find the coordinates of this point when it is

(a) reflected in the line $y = -x$,

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

(b) rotated through 90° anticlockwise about (1, –1).

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

(b) You may use the grid below to help you answer this question.

The points (2, 1), (4, 3), (3, 1) and (p, q) form a quadrilateral.
This quadrilateral has rotational symmetry order 1 and one line of symmetry.

(i) One possible position of (p, q) is (2, 2).

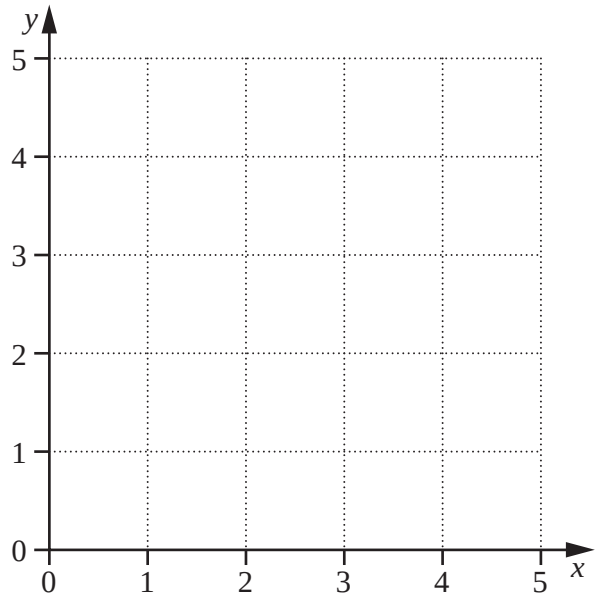
Write down the name of this special quadrilateral.

Answer ..... [1]

(ii) Given that p and q are integers, find two other possible positions of (p, q).

Answer (..... , ...)

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

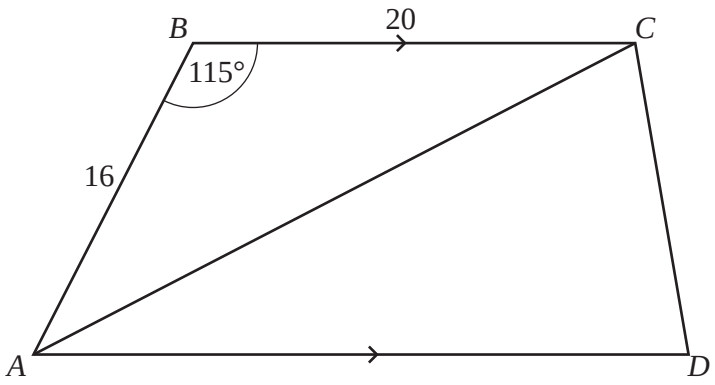


Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7



ABCD is a trapezium with *AD* parallel to *BC*.
AB = 16 cm, *BC* = 20 cm and $A\hat{B}C = 115°$.

(a) Find *AC*.

Answer ..... cm [4]

(b) Show that the perpendicular distance between *BC* and *AD* is 14.5 cm.

(c) The area of the trapezium $ABCD$ is $348\,\text{cm}^2$.

(i) Find AD.

Answer ..... cm [2]

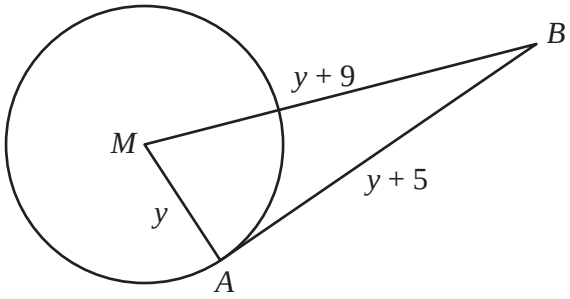
(ii) Show that the area of triangle ACD is $203\,\text{cm}^2$.

[1]

(iii) Hence, or otherwise, find $C\hat{A}D$.

Answer ..... [3]

8 (a)



A is a point on the circle, centre M, and AB is a tangent at A.
$AM = y$ centimetres, $AB = (y + 5)$ centimetres and $MB = (y + 9)$ centimetres.

(i) Show that $y^2 - 8y - 56 = 0$.

[2]

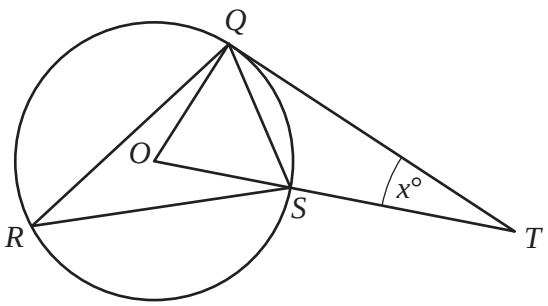
(ii) Solve the equation $y^2 - 8y - 56 = 0$, giving each answer correct to 1 decimal place.

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

(iii) Find the length of the longest side of triangle ABM.

Answer ..... cm [1]

(b)



Q, R and S are points on a circle, centre O.
QT is the tangent at Q and $Q\hat{T}O = x°$.

(i) **(a)** Show that $Q\hat{R}S$ is $\frac{1}{2}(90 - x)$.

[1]

(b) Find an expression, in terms of x, for $O\hat{Q}S$.

Answer ..... [2]

(ii) It is given that three times $Q\hat{R}S$ is twice $O\hat{Q}S$.

(a) Show that $180 + 2x = 270 - 3x$.

[2]

(b) Hence find $Q\hat{T}O$.

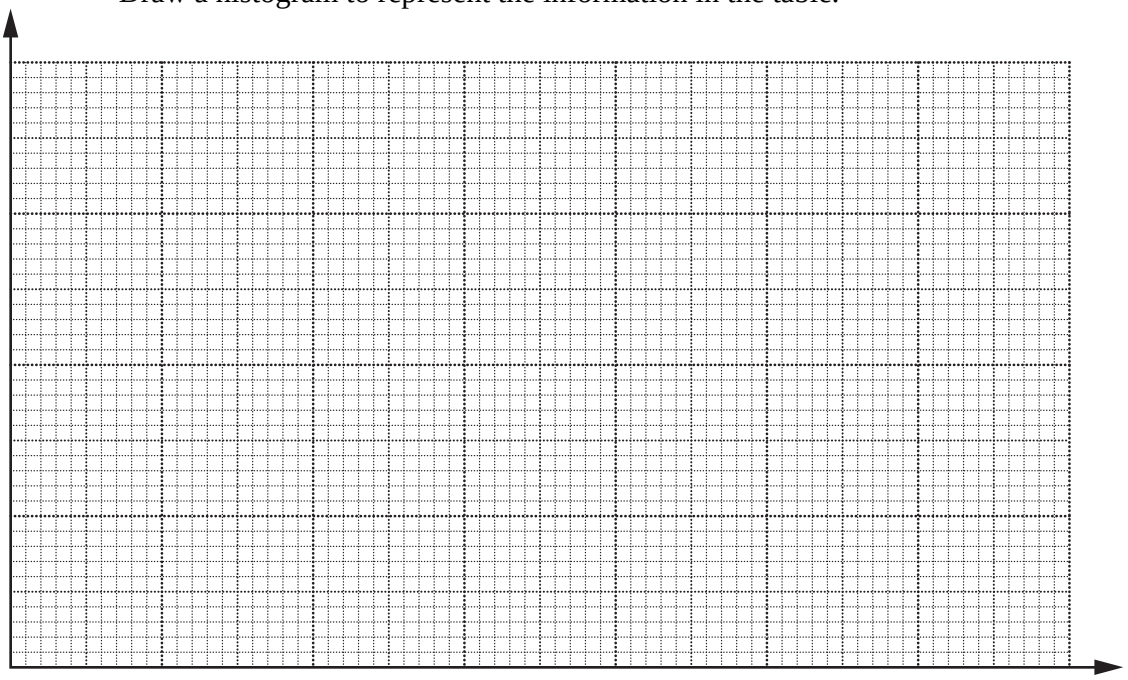
Answer ..... [1]

9 The masses of 120 potatoes were recorded.
The table below shows the distribution of their masses.

Mass (m grams)	$0 \leqslant m < 100$	$100 \leqslant m < 150$	$150 \leqslant m < 200$	$200 \leqslant m < 250$	$250 \leqslant m < 350$
Frequency	14	28	37	21	20

(a) (i) Using a scale of 2 cm to represent 50 grams, label the horizontal axis for masses from 0 to 350 grams.
Using a scale of 1 cm to represent 0.1 unit, label the vertical axis for frequency densities from 0 to 0.8 units.

Draw a histogram to represent the information in the table.



[3]

(ii) Estimate the number of potatoes with a mass greater than 270 grams.

Answer ..... [1]

(iii) In which interval is the upper quartile of the distribution?

Answer ..... [1]

(iv) Find the probability that a potato chosen at random has a mass less than 150 grams.
Give your answer as a fraction in its simplest form.

The masses of some oranges were recorded.
The table below shows the distribution of their masses.

Mass (n grams)	$100 \leqslant n < 150$	$150 \leqslant n < 200$	$200 \leqslant n < 250$
Frequency	14	p	26

(b) The estimated mean mass of an orange is 183 grams.

Find the value of p.

Answer ..... [3]

(c) **(i)** An orange is chosen at random.

Find the probability that it has a mass less than 250 grams.

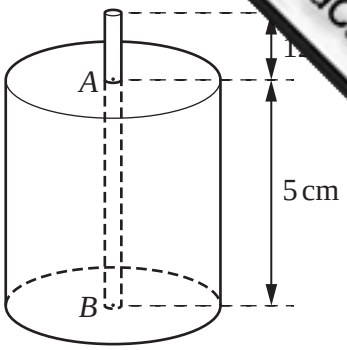
Answer ..... [1]

(ii) A potato and an orange are chosen at random.

Calculate the probability that they both have a mass less than 150 grams.

Answer ..... [2]

10 A cylindrical candle has a height of 5 cm.
A is the centre of the top of the candle and *B* is the centre of the base of the candle.
The wick runs from *B* through *A* and extends 12 mm above *A*.



(a) How many of these candles can be made using a 2 m length of wick?

Answer ..... [2]

(b) The wick is in the form of a solid cylinder.
The volume of the wick **inside** the candle from *A* to *B* is $0.2\,cm^3$.

(i) Calculate the radius of the wick.
Give your answer in millimetres.

Answer ..... mm [3]

(ii) One candle was made by pouring candle wax into a cylindrical mould so that it surrounded the wick.
This mould has an internal radius of 1.9 cm.

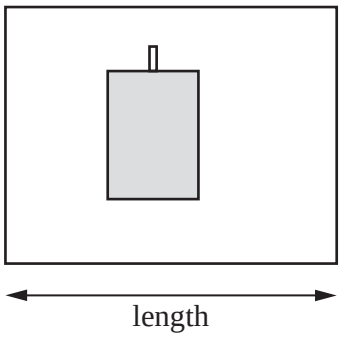
(a) Calculate the volume of candle wax required to make this candle.

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

(b) How many of these candles can be made using 3 litres of candle wax?

Answer ..... [2]

(c)

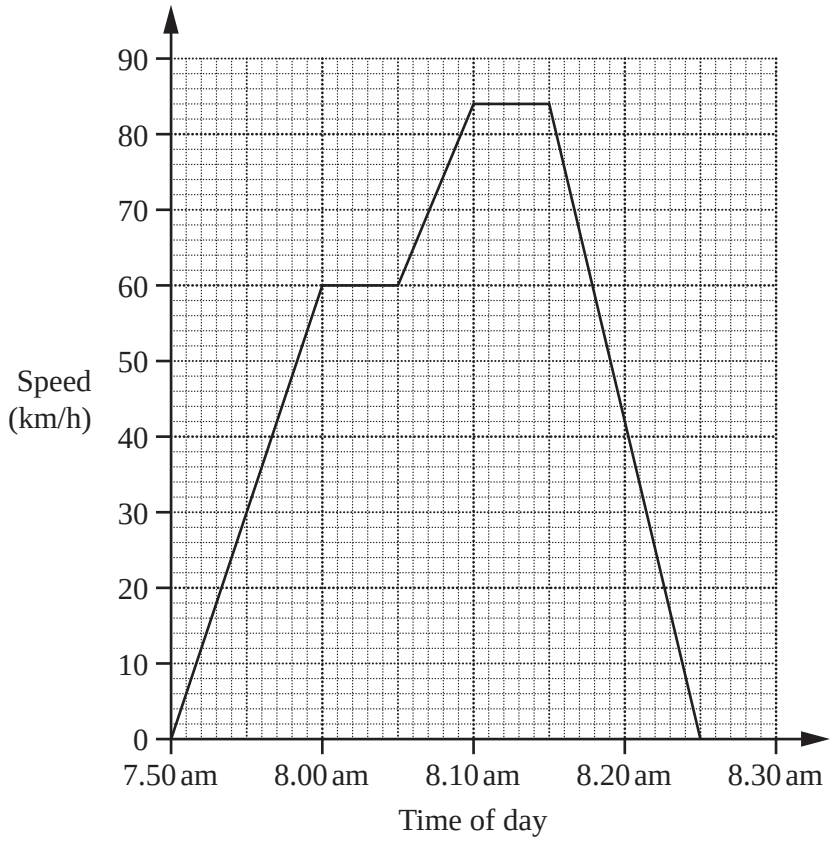


One of these candles is placed on a rectangular piece of wrapping paper.
The paper is wrapped around the candle so that it covers the outside and there is an extra 1 cm for an overlap.

What is the length, in centimetres, of paper required to wrap one candle?

Answer ..... cm [2]

11 (a)



The speed-time graph represents Brian's car journey to work on Monday.

(i) How long does his journey take?

Answer ..... minutes [1]

(ii) During the first 10 minutes he travels with a constant acceleration.

Find this acceleration in kilometres per hour per hour.

Answer ..... km/h^2 [1]

(iii) How far does Brian travel at his maximum speed?

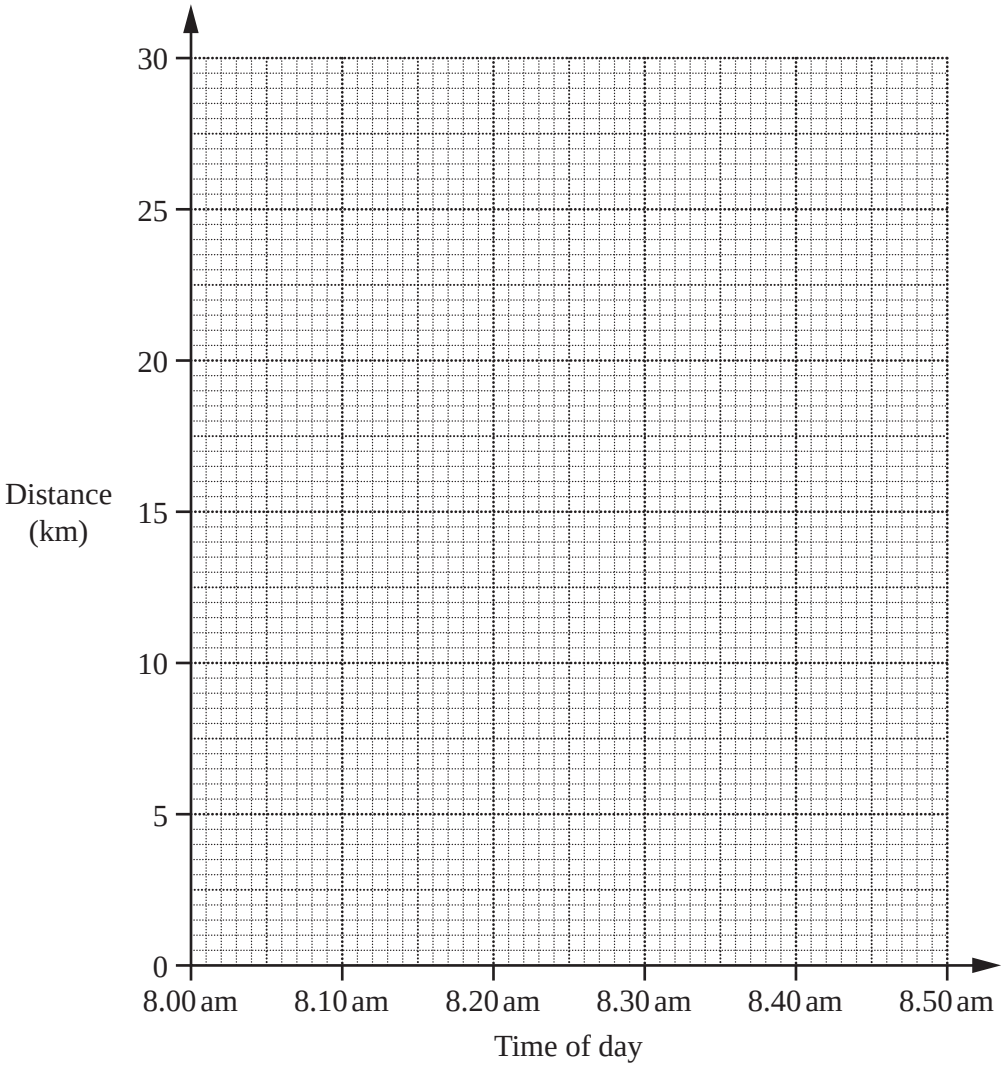
Answer ..... km [1]

(b) On Tuesday Brian leaves home at 8.00 am and travels 30 km to work.
On the first part of his journey he travels for 15 minutes at a speed of 40 km/h.
On the second part of his journey he travels 12 km in 8 minutes at a constant speed.
On the third part of his journey he travels at a constant speed.
He arrives at work at 8.47 am.

(i) Find the distance he travels on the first part of his journey.

Answer ..... km [1]

(ii) On the axes below, draw a distance-time graph to represent his journey to work on Tuesday.



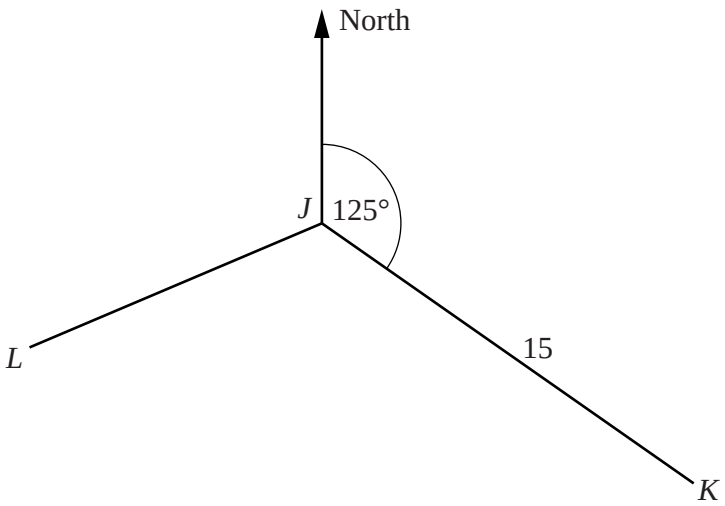
[2]

(iii) Calculate the speed, in kilometres per hour, for the third part of his journey.

Answer ..... km/h [2]

Please turn over for the rest of this question

(c)



The scale drawing shows a map of three towns, *J*, *K* and *L*.
The distance of *K* from *J* is 15 km and the bearing of *K* from *J* is 125°.

(i) *M* is due south of *J* and due west of *K*.

Calculate the distance, in kilometres, of *M* from *K*.
Give your answer correct to 2 decimal places.

Answer ..... km [2]

(ii) Using measurements from the diagram, find

(a) the bearing of *L* from *J*,

Answer ..... [1]

(b) the actual distance, in kilometres, of *L* from *J*.

Answer ..... km [1]