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CANDIDATE NAME
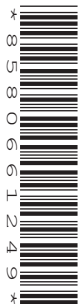
CENTRE NUMBER

CANDIDATE NUMBER

MATHEMATICS **0580/41**

Paper 4 (Extended) **October/November 2020**

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 130.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Blank pages are indicated.

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1
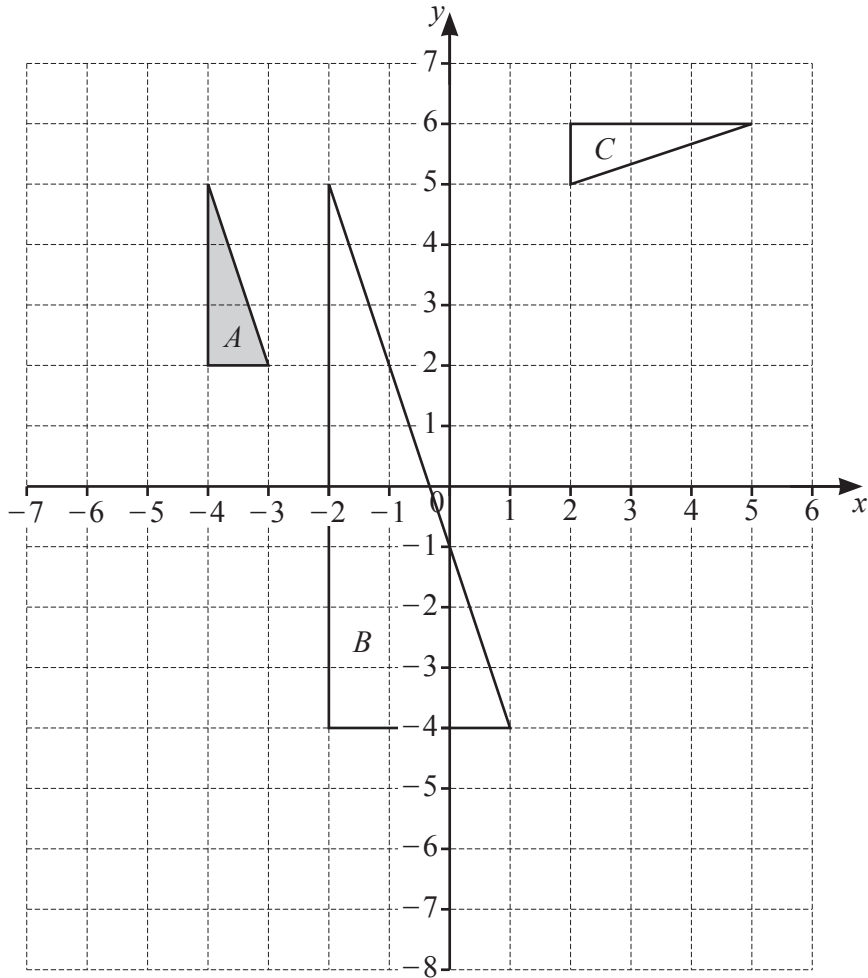
(a) Draw the image of shape *A* after a translation by the vector $\begin{pmatrix} 8 \\ -6 \end{pmatrix}$. [2]

(b) Draw the image of shape *A* after a reflection in the line $y = -1$. [2]

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

....

.... [3]

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

....

.... [3]

2 **(a)** A plane has 14 First Class seats, 70 Premium seats and 168 Economy seats.

Find the ratio   First Class seats : Premium seats : Economy seats.
Give your answer in its simplest form.

.... : .... : .... [2]

(b) (i) For a morning flight, the costs of tickets are in the ratio

First Class : Premium : Economy = 14 : 6 : 5.

The cost of a Premium ticket is $114.

Calculate the cost of a First Class ticket and the cost of an Economy ticket.

First Class $ ....

Economy $ .... [3]

(ii) For an afternoon flight, the cost of a Premium ticket is reduced from $114 to $96.90 .

Calculate the percentage reduction in the cost of a ticket.

.... % [2]

(c) When the local time in Athens is 09 00, the local time in Berlin is 08 00.
A plane leaves Athens at 13 15.
It arrives in Berlin at 15 05 local time.

(i) Find the flight time from Athens to Berlin.

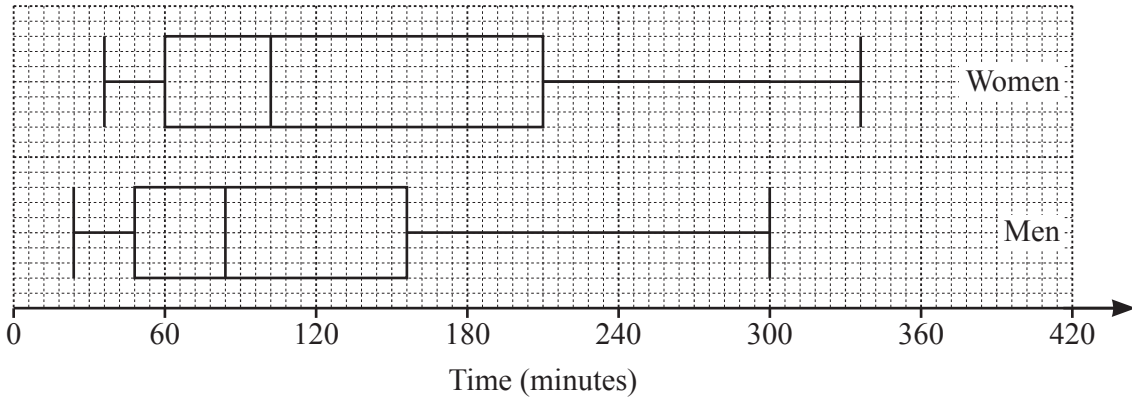........................ h .... min [1]

(ii) The distance the plane flies from Athens to Berlin is 1802 km.

Calculate the average speed of the plane.
Give your answer in kilometres per hour.

.... km/h [2]

3 (a)

The box-and-whisker plots show the times spent exercising in one week by a group of women and a group of men.

Below are two statements comparing these times.
For each one, write down whether you agree or disagree, giving a reason for your answer.

| Statement	Agree or disagree	Reason
On average, the women spent less time exercising than the men.		
The times for the women show less variation than the times for the men.		

[2]

(b) The frequency table shows the times, t minutes, each of 100 children spent exercising in one week.

Time (t minutes)	$0 < t \leqslant 60$	$60 < t \leqslant 100$	$100 < t \leqslant 160$	$160 < t \leqslant 220$	$220 < t \leqslant 320$
Frequency	41	24	23	8	4

(i) Calculate an estimate of the mean time.

.... min [4]

(ii) The information in the frequency table is shown in this cumulative frequency diagram.
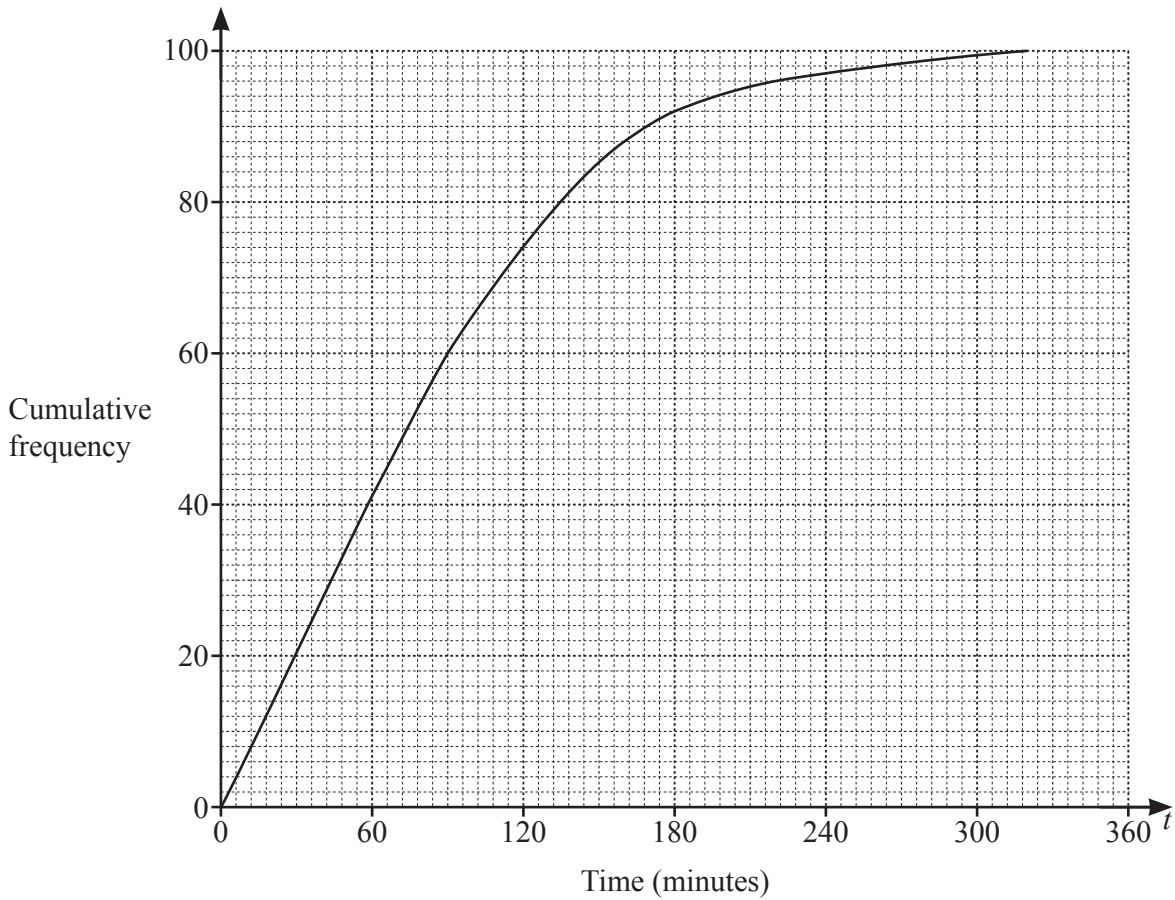
Use the cumulative frequency diagram to find an estimate of

(a) the 60th percentile,

.... min [1]

(b) the number of children who spent more than 3 hours exercising.

.... [2]

(iii) A histogram is drawn to show the information in the frequency table.
The height of the bar for the interval $60 < t \leqslant 100$ is 10.8 cm.

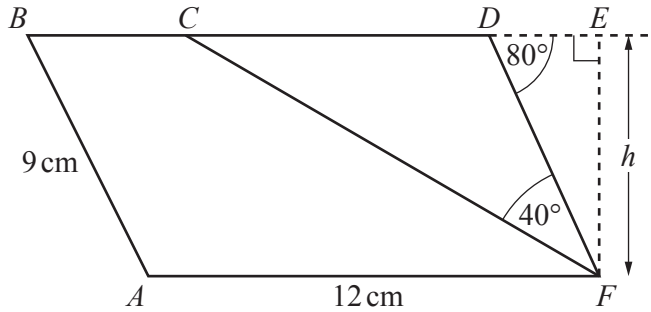Calculate the height of the bar for the interval $160 < t \leqslant 220$.

.... cm [2]

4 **(a)** A rectangle measures 8.5 cm by 10.7 cm, both correct to 1 decimal place.

Calculate the upper bound of the perimeter of the rectangle.

.... cm [3]

(b)

ABDF is a parallelogram and *BCDE* is a straight line.
$AF = 12$ cm, $AB = 9$ cm, angle $CFD = 40°$ and angle $FDE = 80°$.

(i) Calculate the height, h, of the parallelogram.

$h =$ .... cm [2]

(ii) Explain why triangle *CDF* is isosceles.

....

.... [2]

(iii) Calculate the area of the **trapezium** *ABCF*.

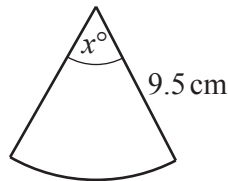... cm² [3]

(c)
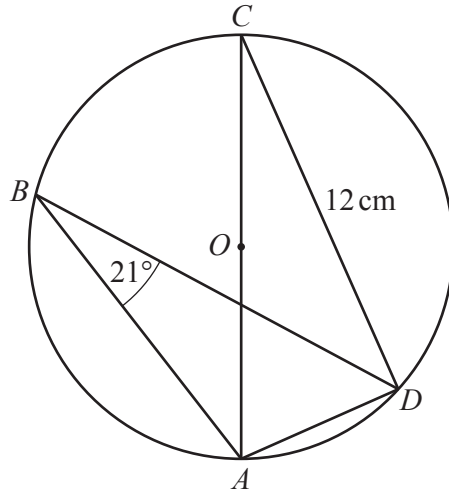
NOT TO
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A, *B*, *C* and *D* are points on the circle, centre *O*.
Angle *ABD* = 21° and *CD* = 12 cm.

Calculate the area of the circle.

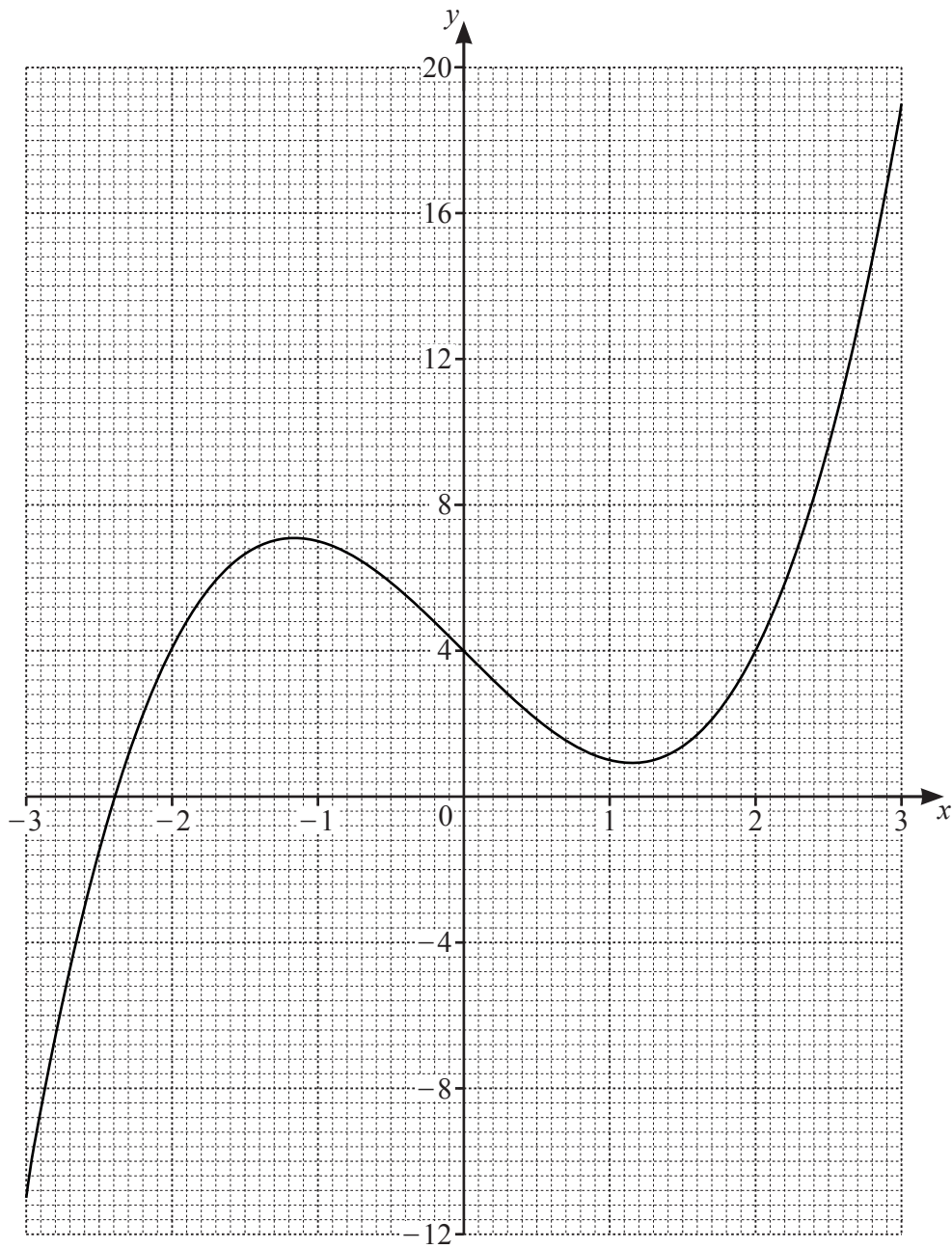.. cm² [5]

(d)

NOT TO
SCALE

The diagram shows a square with side length 8 cm and a sector of a circle with radius 9.5 cm and sector angle *x*°.
The perimeter of the square is equal to the perimeter of the sector.

Calculate the value of *x*.

x = ... [3]

5 **(a)** The diagram shows the graph of $y = \mathrm{f}(x)$ for $-3 \leqslant x \leqslant 3$.

(i) Solve $\mathrm{f}(x) = 14$.

$x = $ .... [1]

(ii) By drawing a suitable tangent, find an estimate of the gradient of the graph at the point $(-2, 4)$.

.... [3]

(iii) By drawing a suitable straight line on the grid, solve $f(x) = 2x - 2$ for $-3 \leqslant x \leqslant 3$.

.

$x =$ .... [3]
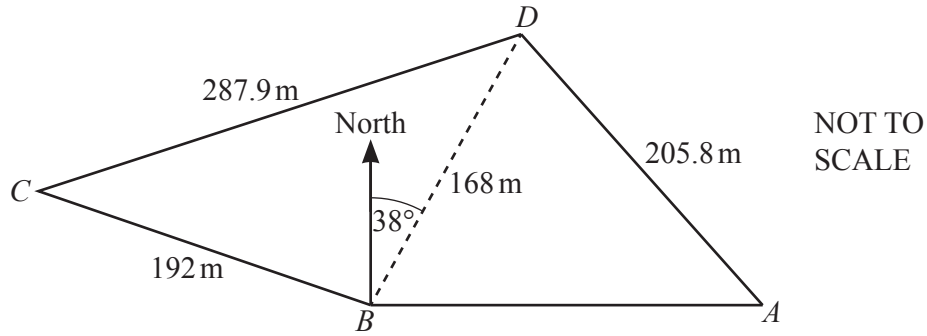
(b)
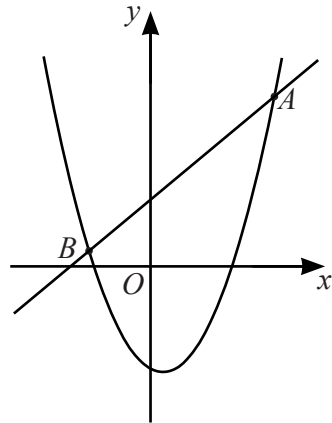
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The diagram shows a curve with equation $y = 2x^2 - 2x - 7$.
The straight line with equation $y = 3x + 5$ intersects the curve at the points A and B.

Find the coordinates of the points A and B.

A (.................... , ...)

B (.................... , ...) [5]

6

The diagram shows a field, *ABCD*, on horizontal ground.
BC = 192 m, *CD* = 287.9 m, *BD* = 168 m and *AD* = 205.8 m.

(a) (i) Calculate angle *CBD* and show that it rounds to 106.0°, correct to 1 decimal place.

[4]

(ii) The bearing of *D* from *B* is 038°.

Find the bearing of *C* from *B*.

.... [1]

(iii) *A* is **due east** of *B*.

Calculate the bearing of *D* from *A*.

.... [5]

(b) (i) Calculate the area of triangle *BCD*.

.... m^2 [2]

(ii) Tomas buys the triangular part of the field, *BCD*.
The cost is $35 750 per hectare.

Calculate the amount he pays.
Give your answer correct to the nearest $100.
[1 hectare = 10 000 m^2]

$ .... [2]

7

Diagram 1   Diagram 2   Diagram 3   Diagram 4
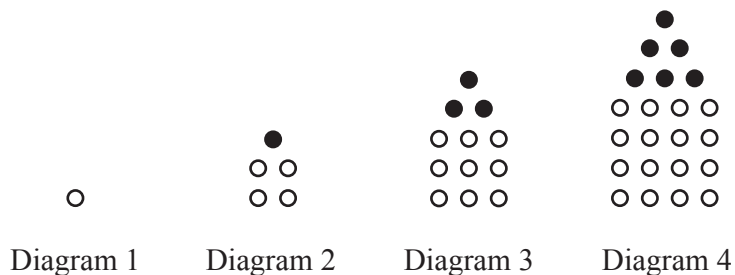
These are the first four diagrams of a sequence.
The diagrams are made from white dots and black dots.

(a) Complete the table for Diagram 5 and Diagram 6.

Diagram	1	2	3	4	5	6
Number of white dots	1	4	9	16		
Number of black dots	0	1	3	6		
Total number of dots	1	5	12	22		

[2]

(b) Write an expression, in terms of n, for the number of white dots in Diagram n.

.... [1]

(c) The expression for the total number of dots in Diagram n is $\frac{1}{2}(3n^2 - n)$.

(i) Find the total number of dots in Diagram 8.

.... [1]

(ii) Find an expression for the number of black dots in Diagram n.
Give your answer in its simplest form.

.... [2]

(d) *T* is the total number of dots used to make **all** of the first *n* diagrams.

$$T = an^3 + bn^2$$

Find the value of *a* and the value of *b*.
You must show all your working.

$a =$ ....

$b =$ .... [5]

8 **(a)** Factorise completely.

$$3a^2b - ab^2$$

.... [2]

(b) Solve the inequality.

$$3x + 12 < 5x - 3$$

.... [2]

(c) Simplify.

$$\left(3x^2y^4\right)^3$$

.... [2]

(d) Solve.

$$\frac{2}{x} = \frac{6}{2-x}$$

$x =$ .... [3]

(e) Expand and simplify.

$$(x-2)(x+5)(2x-1)$$

.... [3]

(f) Alan invests \$200 at a rate of r% per year compound interest.
After 2 years the value of his investment is \$206.46 .

(i) Show that $r^2 + 200r - 323 = 0$.

[3]

(ii) Solve the equation $r^2 + 200r - 323 = 0$ to find the rate of interest.
Show all your working and give your answer correct to 2 decimal places.

$r =$ .... [3]

9 **(a)** There are 32 students in a class.

> 5 do not study any languages.
> 15 study German (G).
> 18 study Spanish (S).
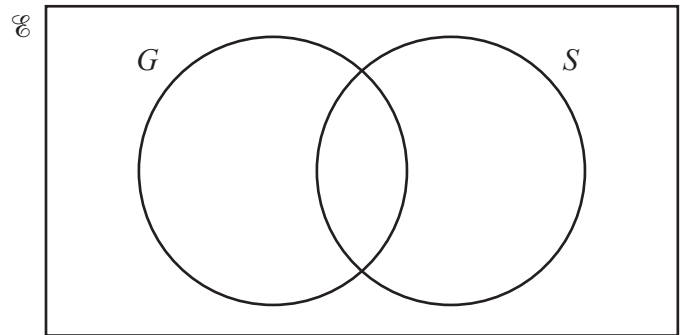
(i) Complete the Venn diagram to show this information. [2]

(ii) A student is chosen at random.

Find the probability that the student studies Spanish but not German.

.... [1]

(iii) A student who studies German is chosen at random.

Find the probability that this student also studies Spanish.

.... [1]

(b) A bag contains 54 red marbles and some blue marbles.
36% of the marbles in the bag are red.

Find the number of blue marbles in the bag.

.... [2]

(c) Another bag contains 15 red beads and 10 yellow beads.
Ariana picks a bead at random, records its colour and replaces it in the bag.
She then picks another bead at random.

   (i) Find the probability that she picks two red beads.

.... [2]

   (ii) Find the probability that she does not pick two red beads.

.... [1]

(d) A box contains 15 red pencils, 8 yellow pencils and 2 green pencils.
Two pencils are picked at random without replacement.

Find the probability that at least one pencil is red.

.... [3]

10 (a)
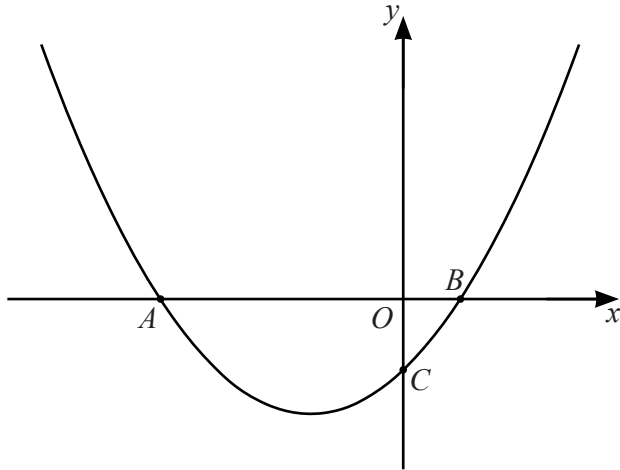
The diagram shows a sketch of the curve $y = x^2 + 3x - 4$.

(i) Find the coordinates of the points A, B and C.

A (.............. , ...)
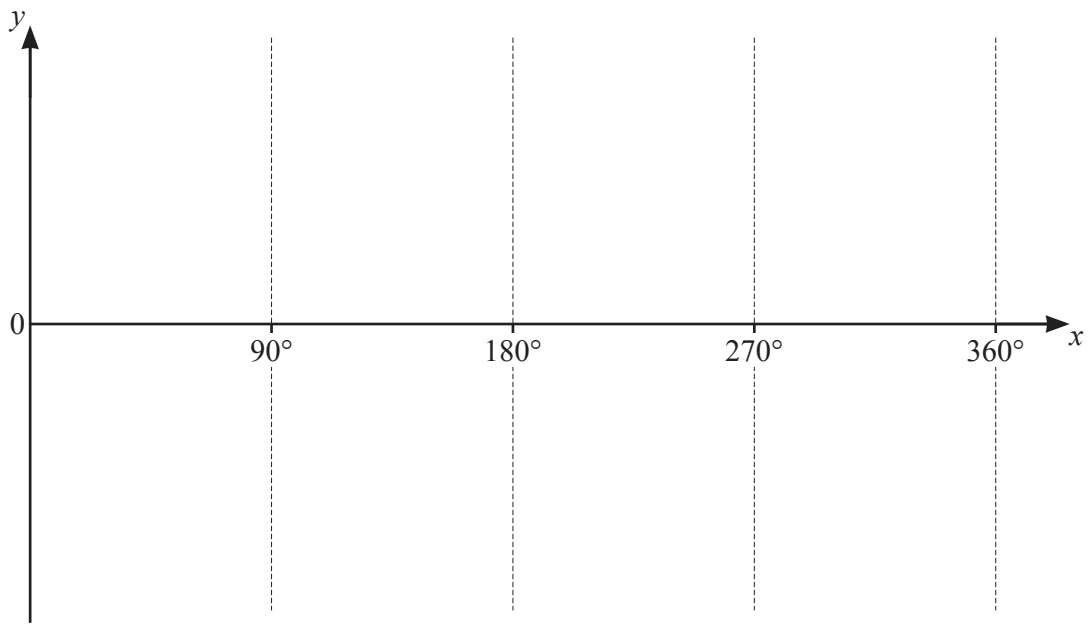
B (.............. , ...)

C (.............. , ...) [4]

(ii) Differentiate $x^2 + 3x - 4$.

.... [2]

(iii) Find the equation of the tangent to the curve at the point $(2, 6)$.

.... [3]

(b)

(i) On the diagram, sketch the graph of $y = \tan x$ for $0° \leqslant x \leqslant 360°$. [2]

(ii) Solve the equation $5 \tan x = -7$ for $0° \leqslant x \leqslant 360°$.

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

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