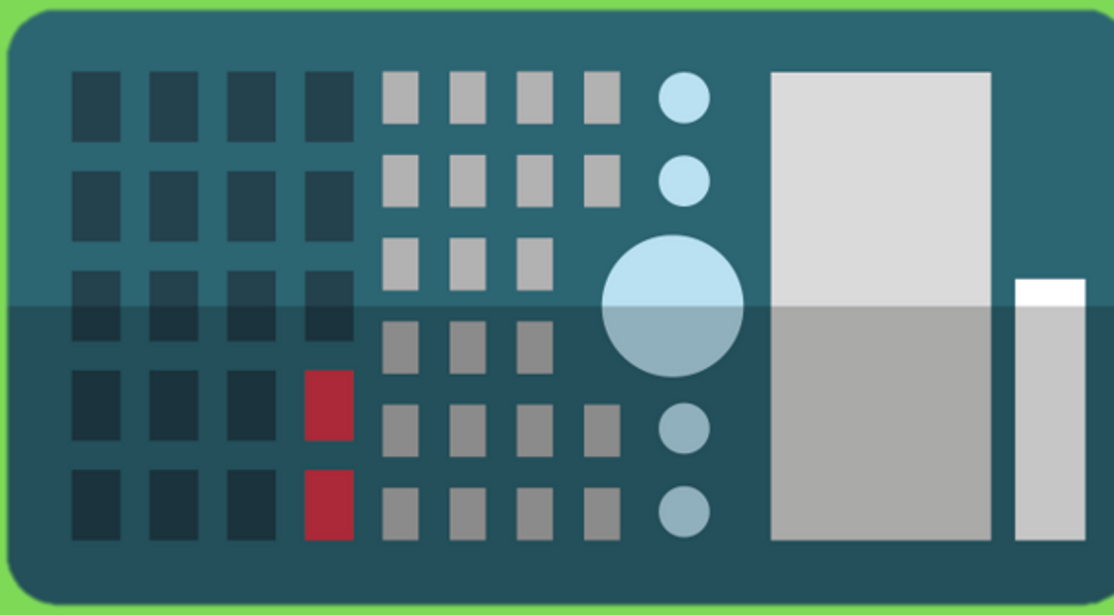
HARDEST QUESTION FOR YEAR 2012



D. MATH ACADEMY

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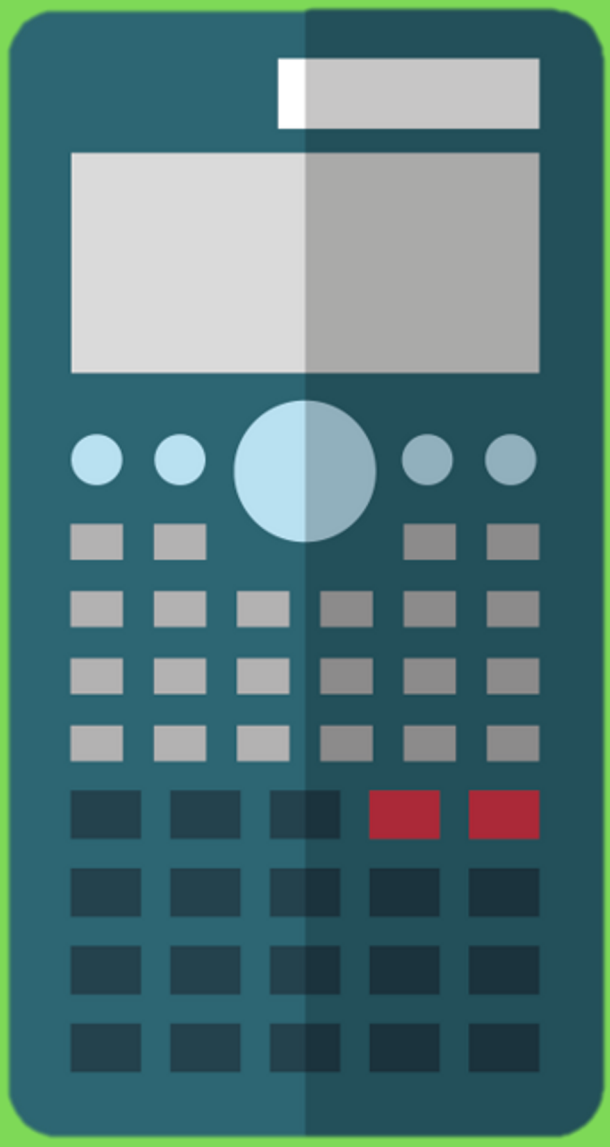
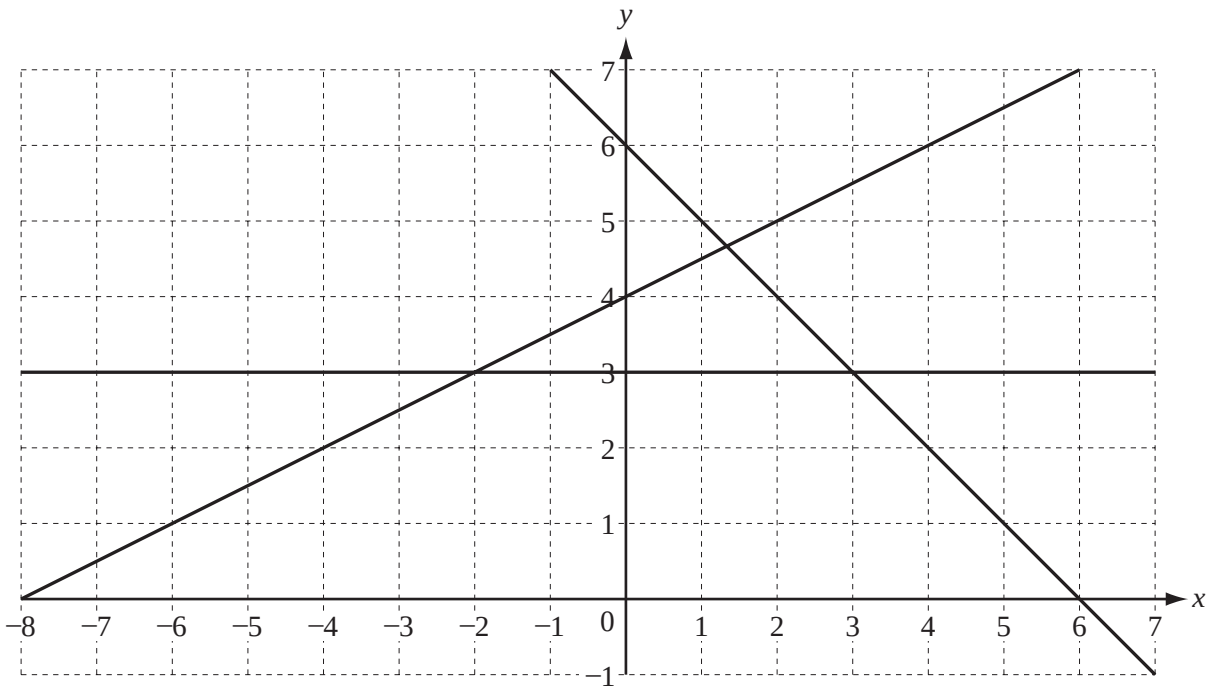


D. MATH ACADEMY

14

For Examiner's Use



The region ***R*** contains points which satisfy the inequalities

$$y \leqslant \frac{1}{2}x + 4, \qquad y \geqslant 3 \quad \text{and} \quad x + y \geqslant 6.$$

On the grid, label with the letter ***R*** the region which satisfies these inequalities.

You must shade the **unwanted** regions. [3]

---

15 The scale of a map is 1 : 500 000 .

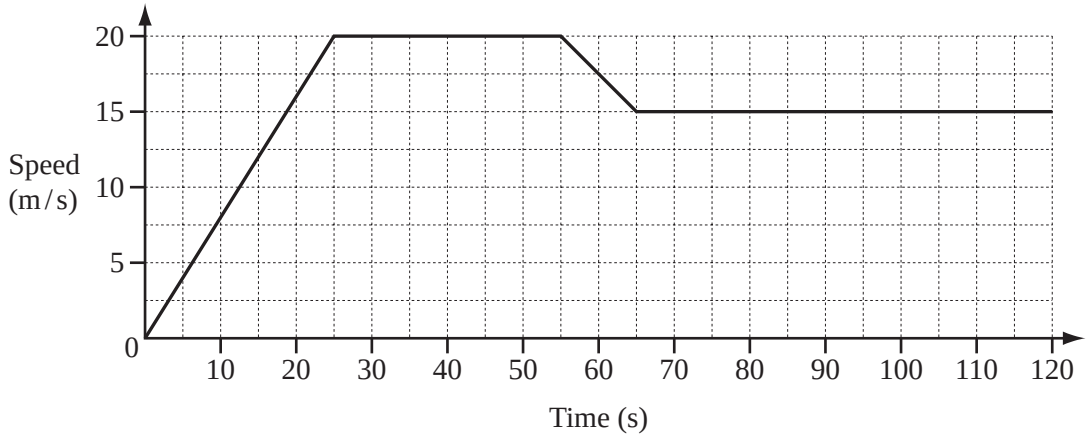
(a) The actual distance between two towns is 172 km.
Calculate the distance, in centimetres, between the towns on the map.

Answer(a) ..... cm [2]

(b) The area of a lake on the map is 12 cm^2.
Calculate the actual area of the lake in km^2.

Answer(b) ..... km^2 [2]

18



The diagram shows the speed-time graph for the first 120 seconds of a car journey.

(a) Calculate the acceleration of the car during the first 25 seconds.

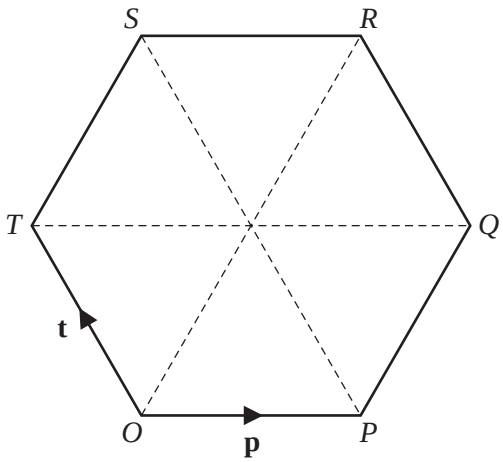
Answer(a) ..... m/s^2 [1]

(b) Calculate the distance travelled by the car in the first 120 seconds.

Answer(b) ..... m [4]

For Examiner's Use

19



O is the origin and $OPQRST$ is a regular hexagon.

$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OT} = \mathbf{t}$.

Find, in terms of **p** and **t**, in their simplest forms,

(a) $\overrightarrow{PT}$,

Answer(a) $\overrightarrow{PT} =$ ..... [1]

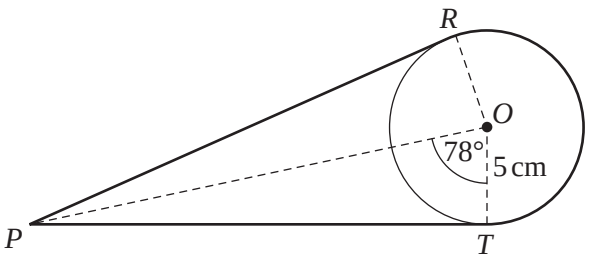
(b) $\overrightarrow{PR}$,

Answer(b) $\overrightarrow{PR} =$ ..... [2]

(c) the position vector of R.

Answer(c) ..... [2]

20



NOT TO SCALE

For Examiner's Use

R and *T* are points on a circle, centre *O*, with radius 5 cm.
PR and *PT* are tangents to the circle and angle *POT* = 78°.

A thin rope goes from *P* to *R*, around the major arc *RT* and then from *T* to *P*.

Calculate the length of the rope.

Answer ..... cm [6]

Question 21 is printed on the next page.

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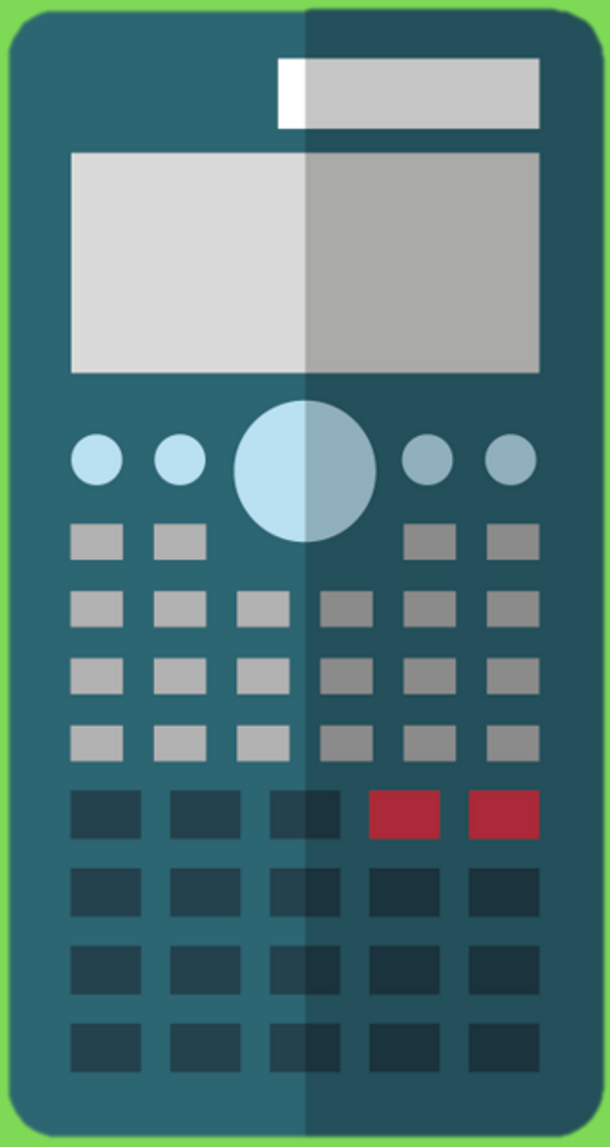
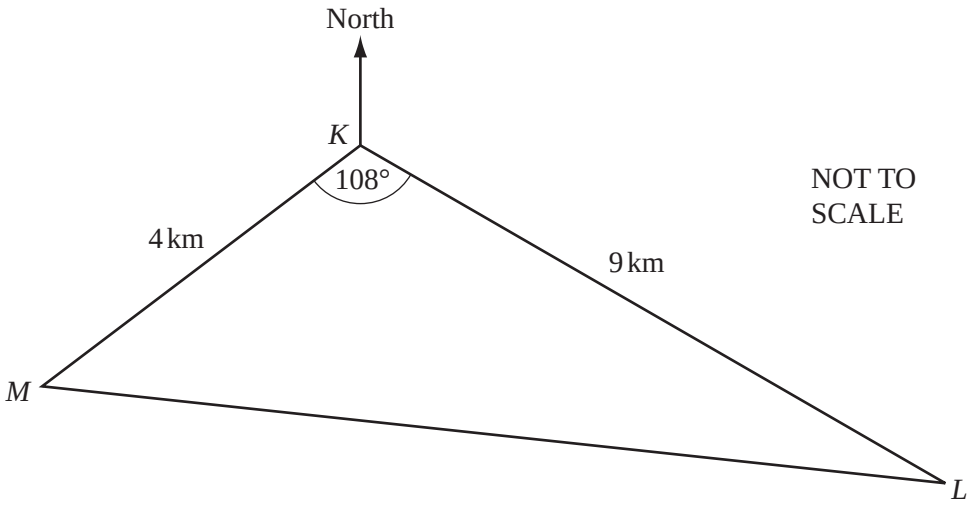


D. MATH ACADEMY

2



Three buoys *K*, *L* and *M* show the course of a boat race.
MK = 4 km, *KL* = 9 km and angle *MKL* = 108°.

(a) Calculate the distance *ML*.

Answer(a) ML = ... km [4]

(b) The bearing of *L* from *K* is 125°.

(i) Calculate how far *L* is south of *K*.

Answer(b)(i) ..... km [3]

(ii) Find the three figure bearing of *K* from *M*.

Answer(b)(ii) ..... [2]

For Examiner's Use

9 $f(x) = 3x + 5$ $g(x) = 7 - 2x$ $h(x) = x^2 - 8$

(a) Find

(i) f(3),

Answer(a)(i) ..... [1]

(ii) $g(x - 3)$ in terms of x in its simplest form,

Answer(a)(ii) ..... [2]

(iii) $h(5x)$ in terms of x in its simplest form.

Answer(a)(iii) ..... [1]

(b) Find the inverse function $g^{-1}(x)$.

Answer(b) $g^{-1}(x) =$ ..... [2]

(c) Find $hf(x)$ in the form $ax^2 + bx + c$.

Answer(c) $hf(x) =$ ..... [3]

(d) Solve the equation $ff(x) = 83$.

Answer(d) $x =$ ..... [3]

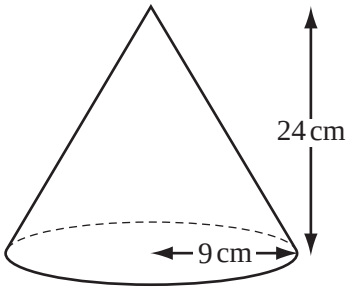
(e) Solve the inequality $2f(x) < g(x)$.

Answer(e) ..... [3]

Question 10 is printed on the next page.

10

For Examiner's Use



NOT TO SCALE

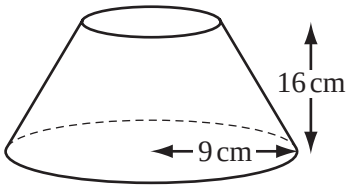
A solid metal cone has base radius 9 cm and vertical height 24 cm.

(a) Calculate the volume of the cone.

[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(a) ..... cm^3 [2]

(b)



NOT TO SCALE

A cone of height 8 cm is removed by cutting parallel to the base, leaving the solid shown above. Show that the volume of this solid rounds to 1960 cm^3, correct to 3 significant figures.

Answer (b)

[4]

(c) The 1960 cm^3 of metal in the solid in **part (b)** is melted and made into 5 identical cylinders, each of length 15 cm.
Show that the radius of each cylinder rounds to 2.9 cm, correct to 1 decimal place.

Answer (c)

[4]

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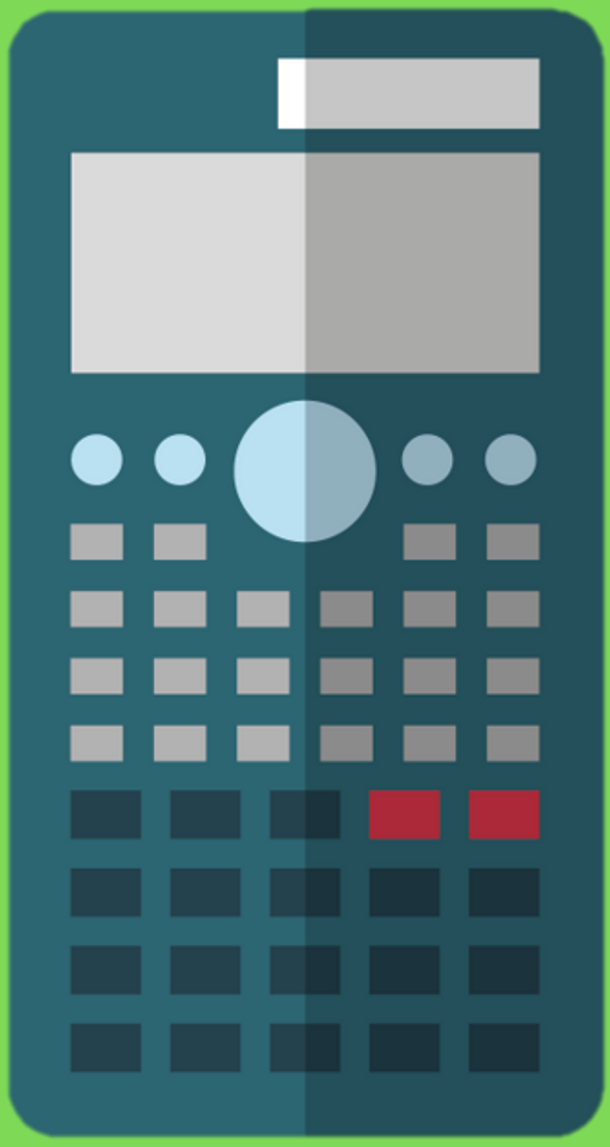


D. MATH ACADEMY

For Examiner's Use

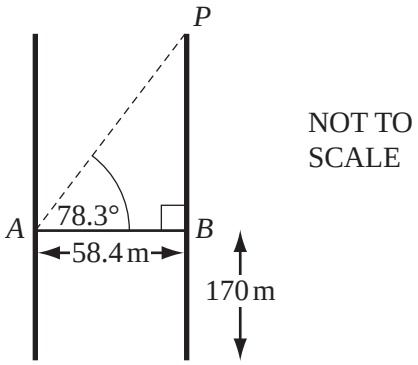
8 A car company sells a scale model $\frac{1}{10}$ of the size of one of its cars.

Complete the following table.

	Scale Model	Real Car
Area of windscreen (cm^2)	135	
Volume of storage space (cm^3)		408 000

[3]

9



NOT TO SCALE

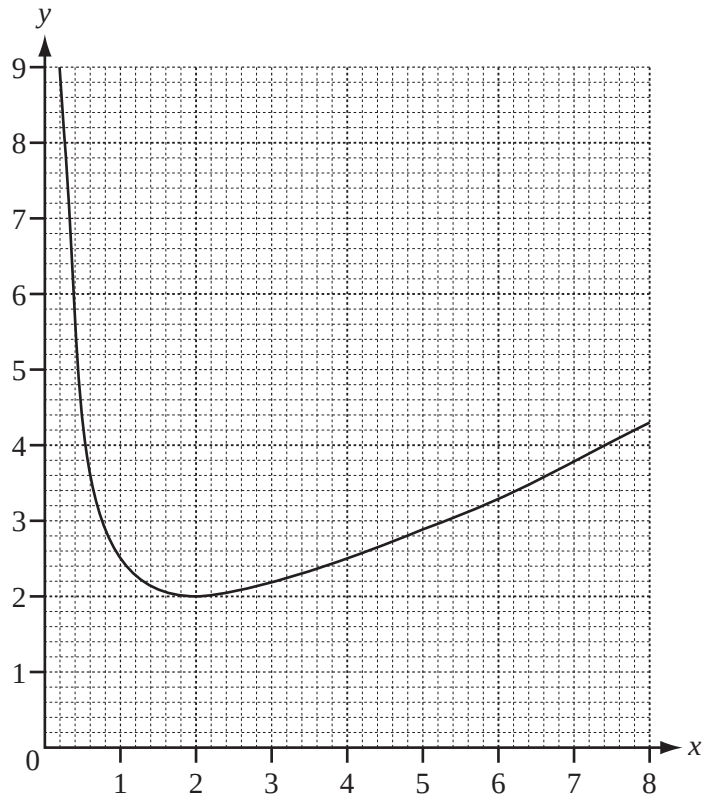
The line *AB* represents the glass walkway between the Petronas Towers in Kuala Lumpur.
The walkway is 58.4 metres long and is 170 metres above the ground.
The angle of elevation of the point *P* from *A* is 78.3°.

Calculate the height of *P* above the ground.

Answer ..... m [3]

16

For Examiner's Use



The diagram shows the graph of $y = \frac{x}{2} + \frac{2}{x}$, for $0 < x \leqslant 8$.

(a) Use the graph to solve the equation $\frac{x}{2} + \frac{2}{x} = 3$.

Answer (a) $x =$ ..... or $x =$ ..... [2]

(b) By drawing a suitable tangent, work out an estimate of the gradient of the graph where $x = 1$.

Answer(b) ..... [3]

17 **(a)** Find the co-ordinates of the midpoint of the line joining $A(-8, 3)$ and $B(-2, -3)$.

For Examiner's Use

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

(b) The line $y = 4x + c$ passes through (2, 6).

Find the value of c.

Answer(b) $c =$ ..... [1]

(c) The lines $5x = 4y + 10$ and $2y = kx - 4$ are parallel.

Find the value of k.

Answer(c) $k =$ ..... [2]

For Examiner's Use

19 Find the values of x for which

(a) $\begin{pmatrix} 1 & 0 \\ 0 & 2x-7 \end{pmatrix}$ has no inverse,

Answer(a) $x =$ ..... [2]

(b) $\begin{pmatrix} 1 & 0 \\ 0 & x^2-8 \end{pmatrix}$ is the identity matrix,

Answer (b) $x =$ ..... or $x =$ ..... [3]

(c) $\begin{pmatrix} 1 & 0 \\ 0 & x-2 \end{pmatrix}$ represents a stretch with factor 3 and the x axis invariant.

Answer (c) $x =$ ..... [2]

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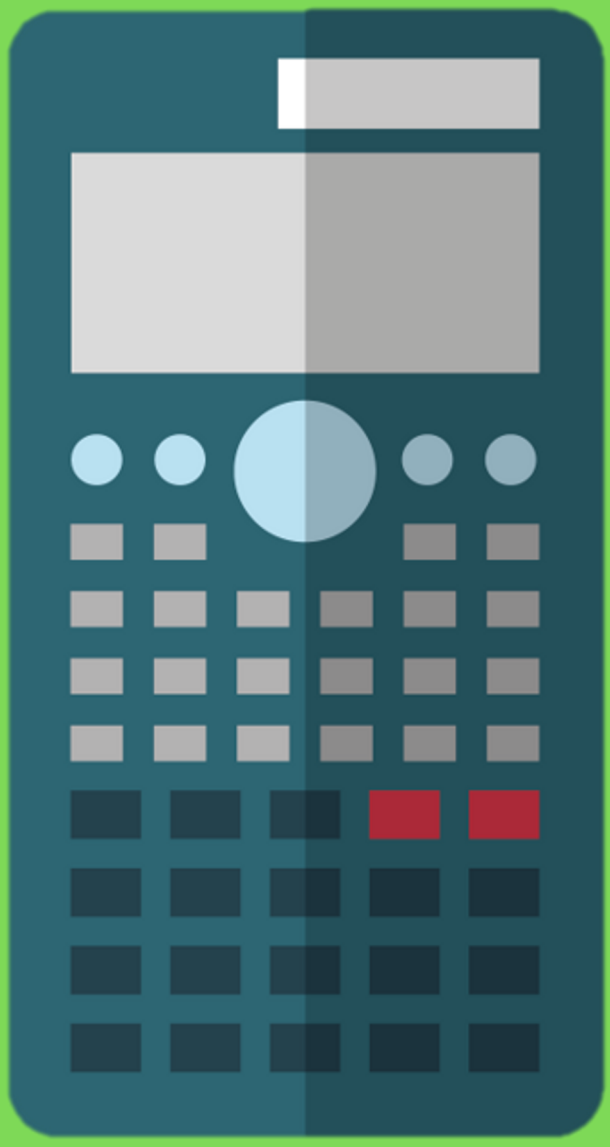
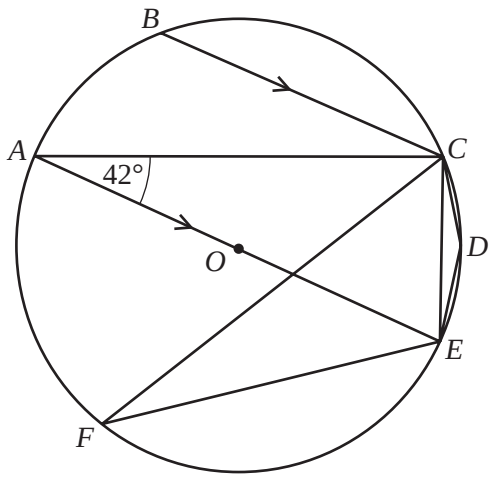


D. MATH ACADEMY

For Examiner's Use

4 (a)



NOT TO SCALE

A, *B*, *C*, *D*, *E* and *F* are points on the circumference of a circle centre *O*.
AE is a diameter of the circle.
BC is parallel to *AE* and angle *CAE* = 42°.

Giving a reason for each answer, find

(i) angle *BCA*,

Answer(a)(i) Angle *BCA* = ...

Reason ..... [2]

(ii) angle *ACE*,

Answer(a)(ii) Angle *ACE* = ...

Reason ..... [2]

(iii) angle *CFE*,

Answer(a)(iii) Angle *CFE* = ...

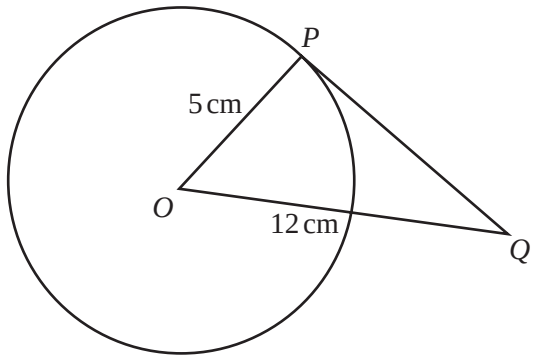
Reason ..... [2]

(iv) angle *CDE*.

Answer(a)(iv) Angle *CDE* = ...

Reason ..... [2]

(b)



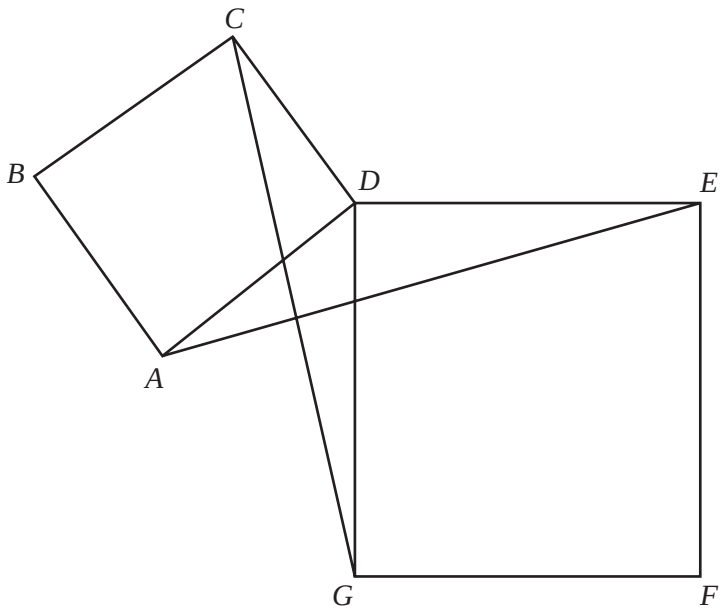
NOT TO SCALE

In the diagram, O is the centre of the circle and PQ is a tangent to the circle at P.
$OP = 5$ cm and $OQ = 12$ cm.

Calculate PQ.

Answer(b) $PQ =$ ..... cm [3]

(c)



NOT TO SCALE

In the diagram, $ABCD$ and $DEFG$ are squares.

(i) In the triangles CDG and ADE, explain with a reason which sides and/or angles are equal.

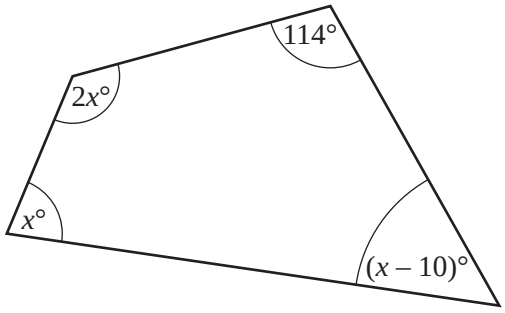
Answer (c)(i)

[3]

(ii) Complete the following statement.

Triangle CDG is ..... to triangle ADE. [1]

6 (a)



NOT TO SCALE

Find the value of x.

Answer(a) $x =$ ..... [3]

(b) (i) Write the four missing terms in the table for sequences A, B, C and D.

Term	1	2	3	4	5		n
Sequence A	–4		2	5	8		$3n - 7$
Sequence B	1	4	9	16	25		
Sequence C	5	10	15	20	25		
Sequence D	6	14	24	36	50		

[4]

(ii) Which term in sequence D is equal to 500?

Answer(b)(ii) ..... [2]

(c) Simplify $\dfrac{x^2 - 16}{2x^2 + 7x - 4}$.

Answer(c) ..... [4]

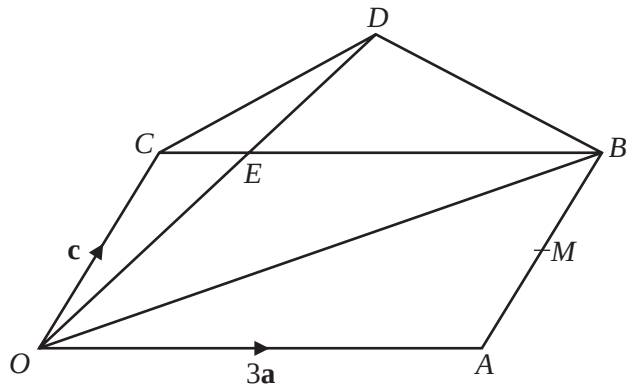
For Examiner's Use

7 **(a)** P is the point (2, 5) and $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$.

Write down the co-ordinates of Q.

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

(b)



NOT TO SCALE

O is the origin and $OABC$ is a parallelogram.
M is the midpoint of AB.

$\overrightarrow{OC} = \mathbf{c}$, $\overrightarrow{OA} = 3\mathbf{a}$ and $CE = \frac{1}{3}CB$.

OED is a straight line with $OE : ED = 2 : 1$.

Find in terms of **a** and **c**, in their simplest forms

(i) $\overrightarrow{OB}$,

Answer(b)(i) $\overrightarrow{OB}$ = ... [1]

(ii) the position vector of M,

Answer(b)(ii) ..... [2]

(iii) $\overrightarrow{OE}$,

Answer(b)(iii) $\overrightarrow{OE}$ = ... [1]

(iv) $\overrightarrow{CD}$.

Answer(b)(iv) $\overrightarrow{CD}$ = ... [2]

(c) Write down two facts about the lines CD and OB.

Answer (c) .....

..... [2]

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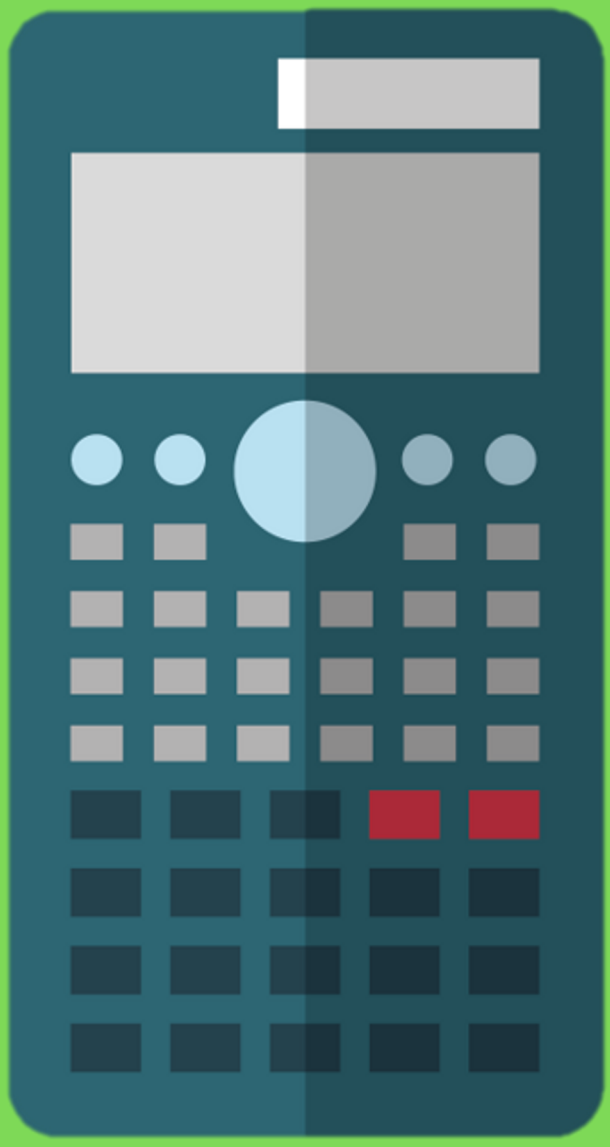
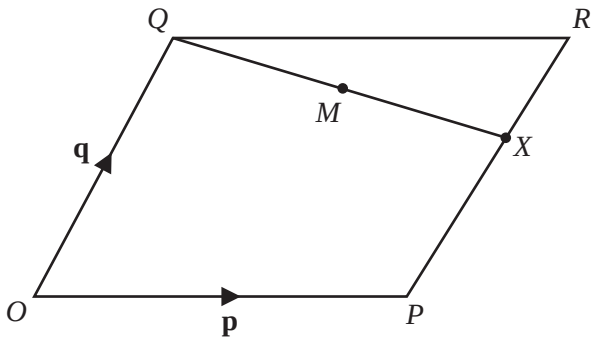


D. MATH ACADEMY

18



NOT TO SCALE

For Examiner's Use

O is the origin and *OPRQ* is a parallelogram.
The position vectors of *P* and *Q* are **p** and **q**.
X is on *PR* so that $PX = 2XR$.

Find, in terms of **p** and **q**, in their simplest forms

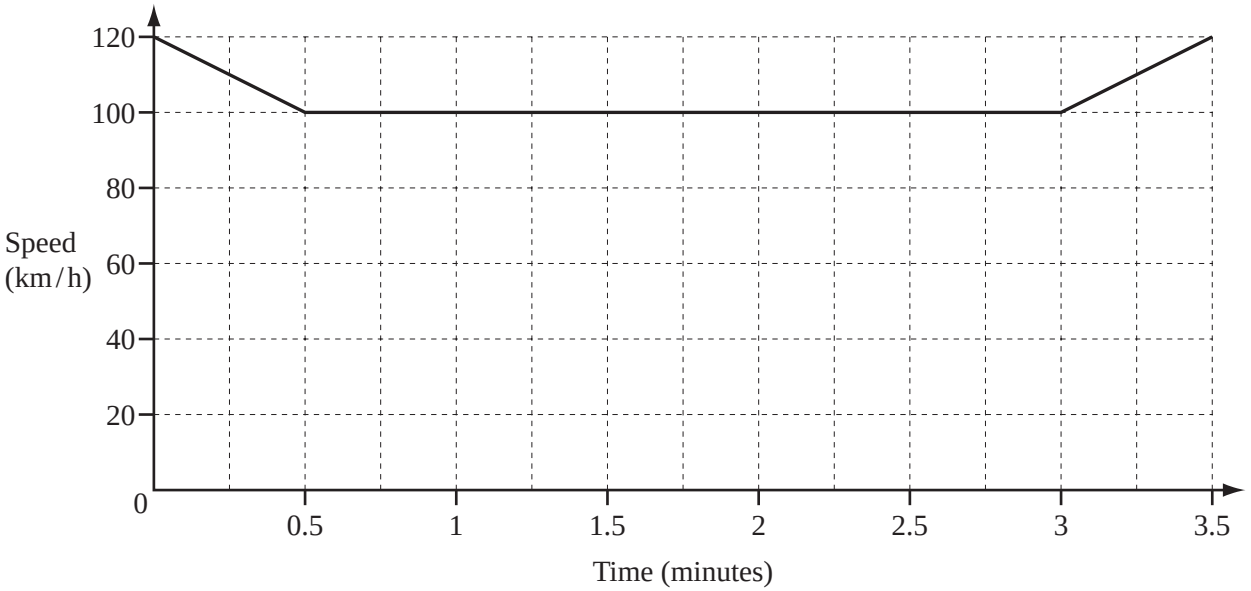
(a) $\overrightarrow{QX}$,

Answer(a) $\overrightarrow{QX}$ = ... [2]

(b) the position vector of *M*, the midpoint of *QX*.

Answer(b) ..... [2]

19



The diagram shows the speed-time graph for part of a car journey.
The speed of the car is shown in kilometres/**hour**.

Calculate the distance travelled by the car during the 3.5 **minutes** shown in the diagram.
Give your answer in kilometres.

Answer ..... km [4]

For Examiner's Use

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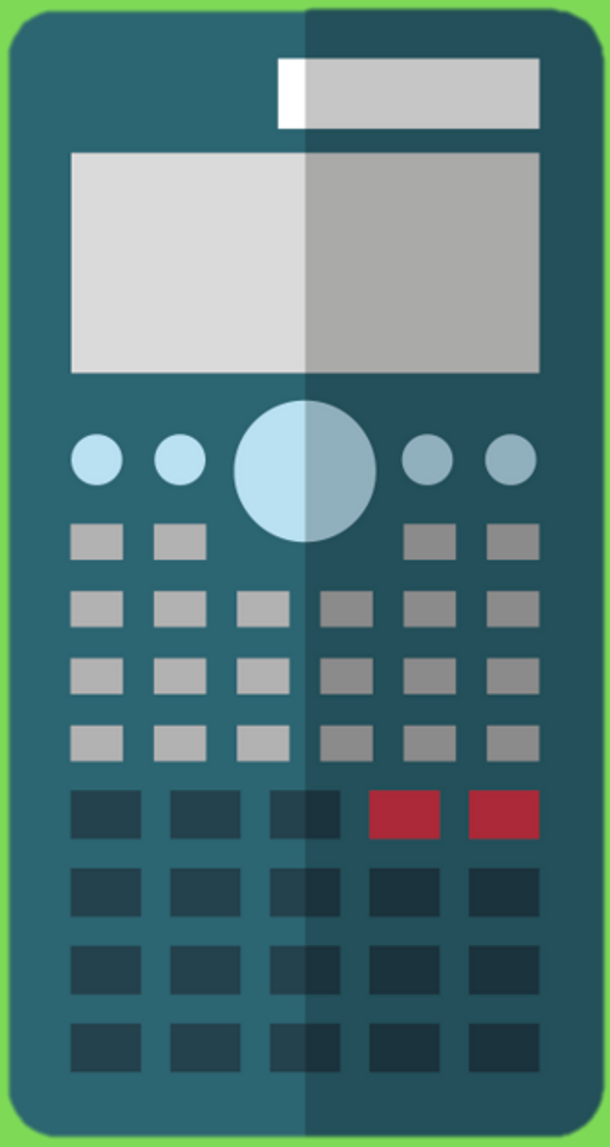
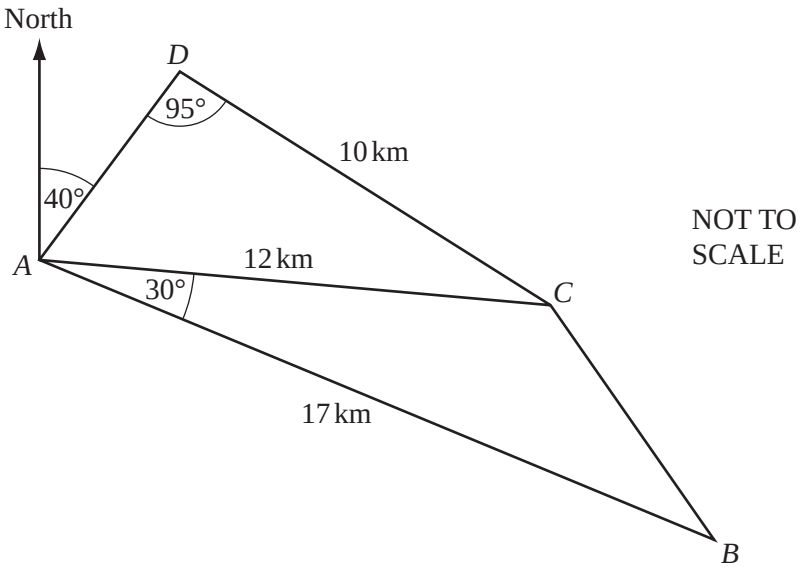


D. MATH ACADEMY

2



The diagram shows straight roads connecting the towns A, B, C and D.

$AB = 17$ km, $AC = 12$ km and $CD = 10$ km.

Angle $BAC = 30°$ and angle $ADC = 95°$.

(a) Calculate angle CAD.

Answer(a) Angle CAD = ... [3]

(b) Calculate the distance BC.

Answer(b) BC = ... km [4]

For Examiner's Use

For Examiner's Use

(c) The bearing of D from A is 040°.

Find the bearing of

(i) B from A,

Answer(c)(i) ..... [1]

(ii) A from B.

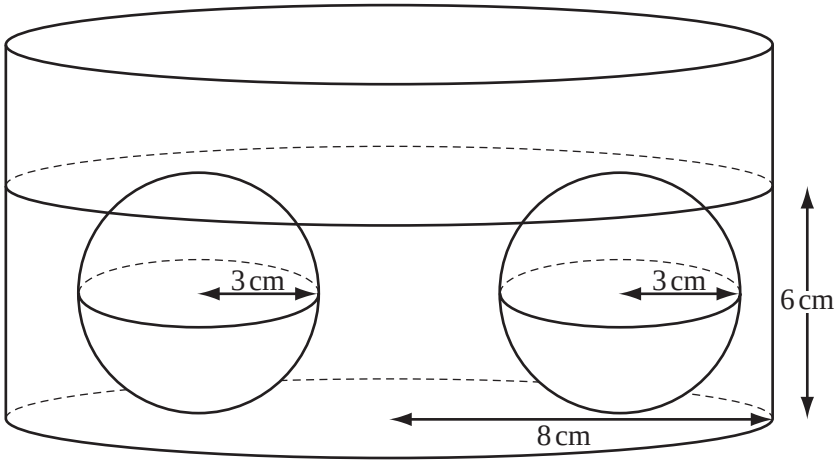
Answer(c)(ii) ..... [1]

(d) Angle ACB is obtuse.

Calculate angle BCD.

Answer(d) Angle BCD = ... [4]

5



NOT TO SCALE

The diagram shows two solid spheres of radius 3 cm lying on the base of a cylinder of radius 8 cm.

Liquid is poured into the cylinder until the spheres are just covered.

[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

(a) Calculate the volume of liquid in the cylinder in

(i) cm^3,

Answer(a)(i) ..... cm^3 [4]

(ii) litres.

Answer(a)(ii) ..... litres [1]

For Examiner's Use

(b) One cubic centimetre of the liquid has a mass of 1.22 grams.

Calculate the mass of the liquid in the cylinder.

Give your answer in kilograms.

Answer(b) ..... kg [2]

(c) The spheres are removed from the cylinder.

Calculate the new height of the liquid in the cylinder.

Answer(c) ..... cm [2]

7 $f(x) = 2^x$

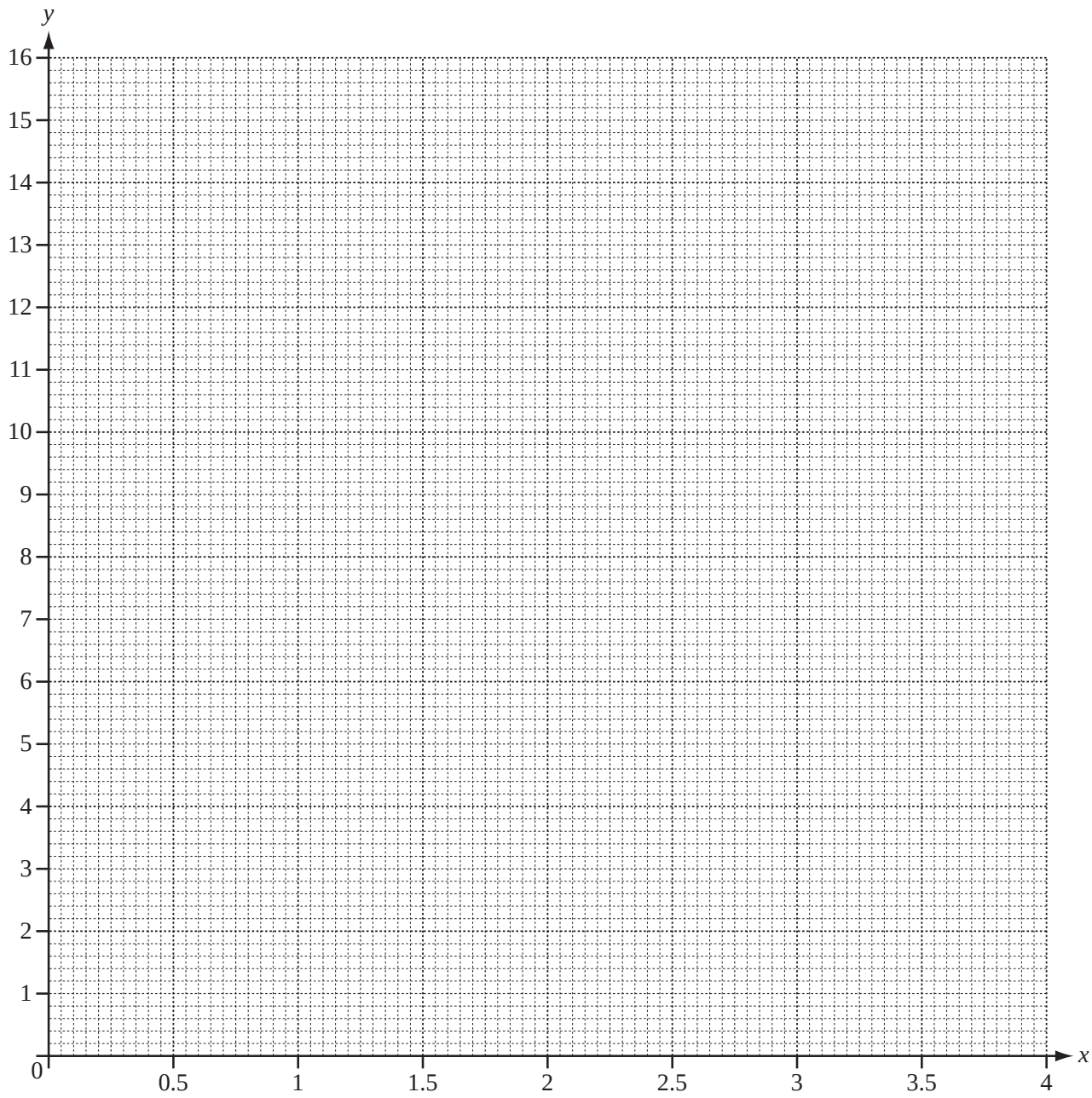
For Examiner's Use

(a) Complete the table.

x	0	0.5	1	1.5	2	2.5	3	3.5	4
f(x)		1.4	2	2.8	4	5.7	8		

[3]

(b) Draw the graph of $y = f(x)$ for $0 \leqslant x \leqslant 4$.



[4]

(c) Use your graph to solve the equation $2^x = 5$.

For Examiner's Use

Answer(c) $x =$ ..... [1]

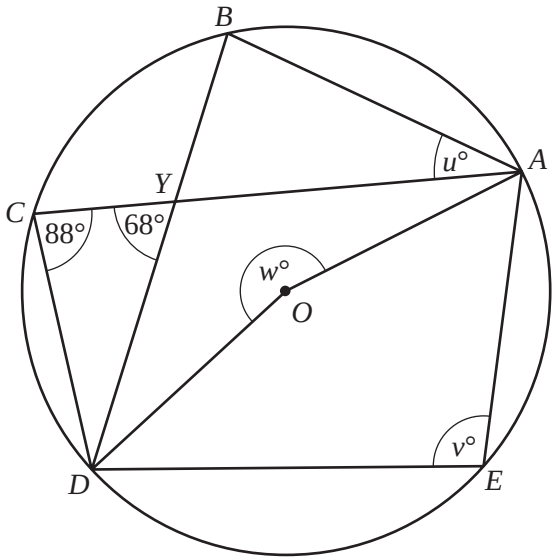
(d) Draw a suitable straight line and use it to solve the equation $2^x = 3x$.

Answer(d) $x =$ ..... or $x =$ ..... [3]

(e) Draw a suitable tangent and use it to find the co-ordinates of the point on the graph of $y = f(x)$ where the gradient of the graph is 3.

Answer(e) (..... , ...) [3]

8 (a)



NOT TO SCALE

A, B, C, D and E lie on the circle, centre O.
CA and BD intersect at Y.
Angle $DCA = 88°$ and angle $CYD = 68°$.
Angle $BAC = u°$, angle $AED = v°$ and reflex angle $AOD = w°$.

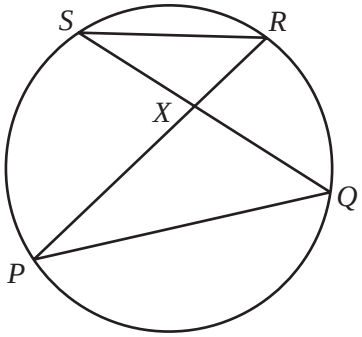
Calculate the values of u, v and w.

Answer(a) $u =$ .....

$v =$ .....

$w =$ ..... [4]

(b)



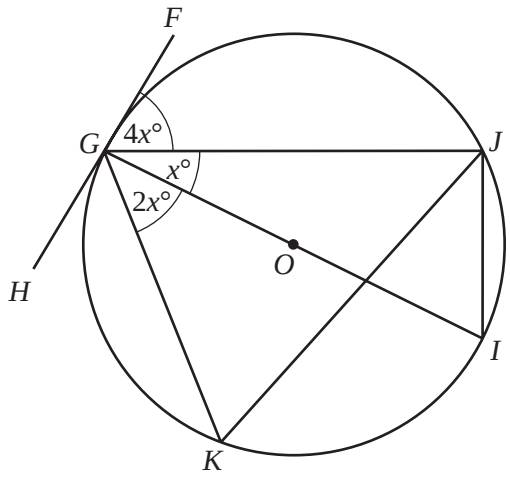
NOT TO SCALE

P, Q, R and S lie on the circle. PR and QS intersect at X.
The area of triangle $RSX = 1.2\,\text{cm}^2$ and $PX = 3\,SX$.

Calculate the area of triangle PQX.

Answer(b) ..... cm^2 [2]

(c)



NOT TO SCALE

GI is a diameter of the circle.
FGH is a tangent to the circle at *G*.
J and *K* also lie on the circle.
Angle *JGI* = $x°$, angle *FGJ* = $4x°$ and angle *KGI* = $2x°$.

Find

(i) the value of x,

Answer(c)(i) x = ... [2]

(ii) the size of angle *JKG*,

Answer(c)(ii) Angle *JKG* = ... [2]

(iii) the size of angle *GJK*.

Answer(c)(iii) Angle *GJK* = ... [1]

For Examiner's Use

For Examiner's Use

9 $f(x) = 1 - 2x$ $\quad g(x) = \frac{1}{x},\ x \neq 0$ $\quad h(x) = x^3 + 1$

(a) Find the value of

(i) gf(2),

Answer(a)(i) ..... [2]

(ii) h(–2).

Answer(a)(ii) ..... [1]

(b) Find fg(x).
Write your answer as a single fraction.

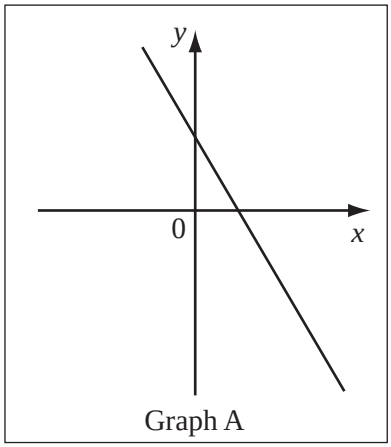
Answer(b) fg(x) = ... [2]

(c) Find $h^{-1}(x)$, the inverse of h(x).

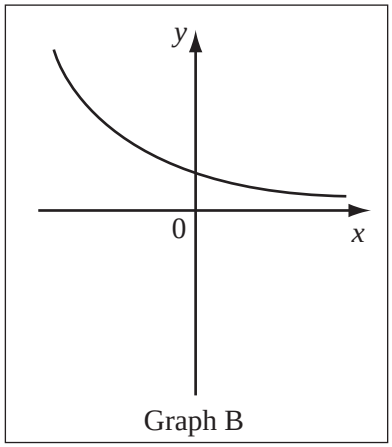
Answer(c) $h^{-1}(x)$ = ... [2]

For Examiner's Use

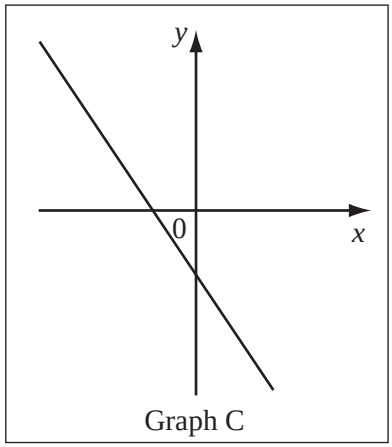
(d) Write down which of these sketches shows the graph of each of $y = f(x)$, $y = g(x)$ and $y = h(x)$.



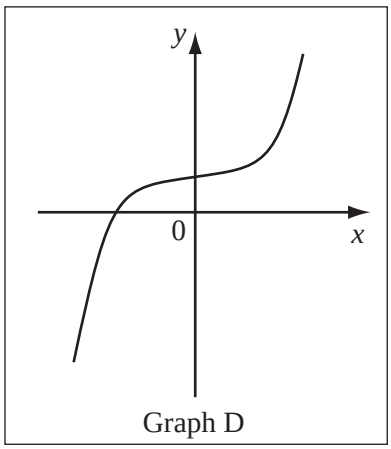
Graph A



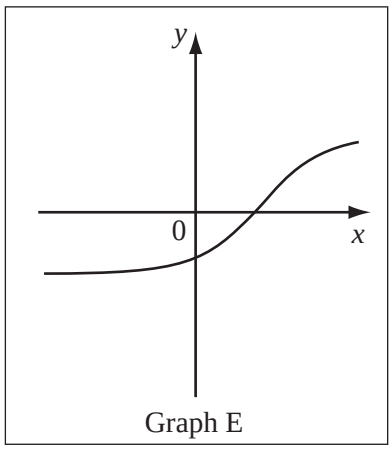
Graph B



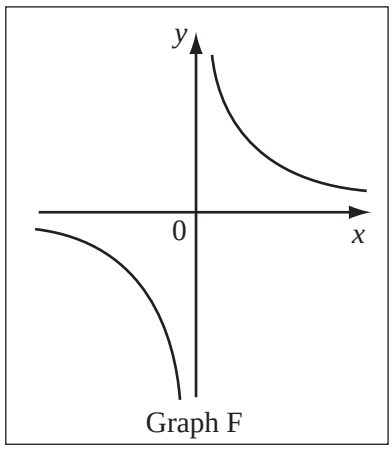
Graph C



Graph D



Graph E



Graph F

Answer(d) $y = f(x)$ Graph .....

$y = g(x)$ Graph .....

$y = h(x)$ Graph ..... [3]

(e) $k(x) = x^5 - 3$

Solve the equation $k^{-1}(x) = 2$.

Answer(e) $x =$ ..... [2]

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For Examiner's Use

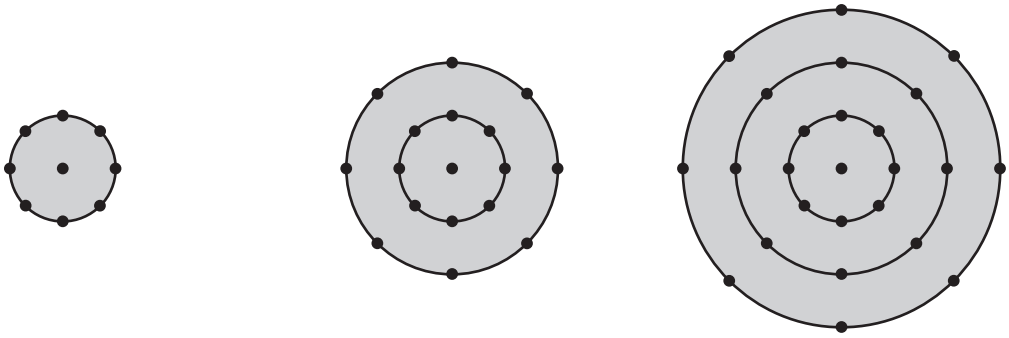

Diagram 1 Diagram 2 Diagram 3

The diagrams show a sequence of dots and circles.
Each diagram has one dot at the centre and 8 dots on each circle.
The radius of the first circle is 1 unit.
The radius of each new circle is 1 unit greater than the radius of the previous circle.

(a) Complete the table for diagrams 4 and 5.

Diagram	1	2	3	4	5
Number of dots	9	17	25		
Area of the largest circle	π	4π	9π		
Total length of the circumferences of the circles	2π	6π	12π		

[4]

(b) **(i)** Write down, in terms of n, the number of dots in diagram n.

Answer(b)(i) ..... [2]

(ii) Find n, when the number of dots in diagram n is 1097.

Answer(b)(ii) n = ... [2]

(c) Write down, in terms of n and π, the area of the largest circle in

(i) diagram n,

Answer(c)(i) ..... [1]

(ii) diagram $3n$.

Answer(c)(ii) ..... [1]

(d) Find, in terms of n and π, the total length of the circumferences of the circles in diagram n.

Answer(d) ..... [2]

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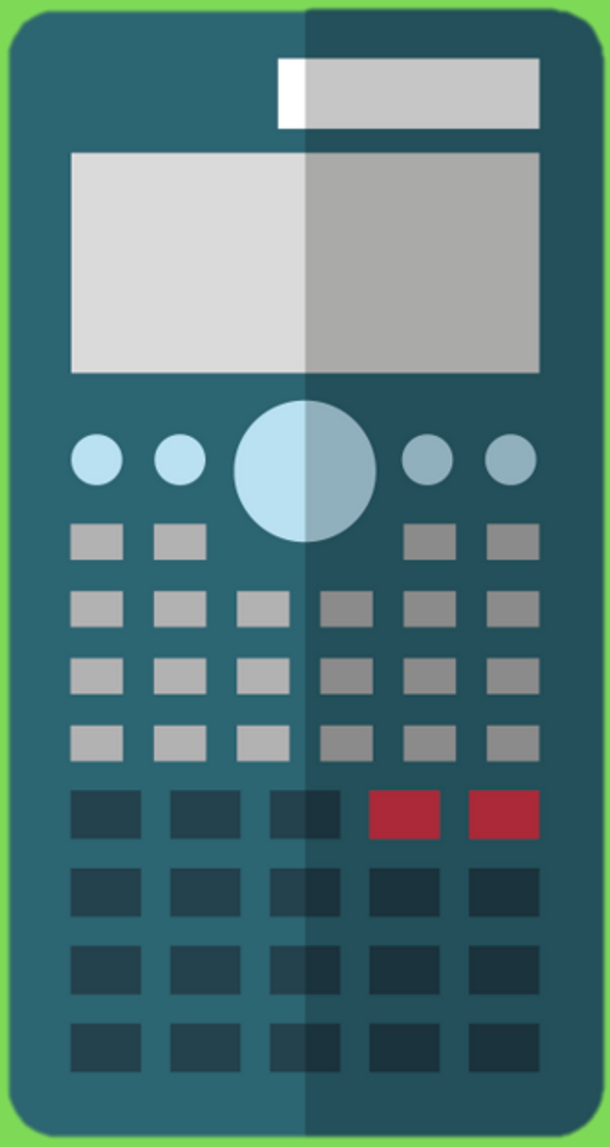

D. MATH ACADEMY

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

5203274567

MATHEMATICS **0580/21**

Paper 2 (Extended) **October/November 2012**

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator
Mathematical tables (optional)
Geometrical instruments
Tracing paper (optional)

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.

Answer **all** questions.
If working is needed for any question it must be shown below that question.
Electronic calculators should be used.
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.

At the end of the examination, fasten all your work securely together.
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 70.

This document consists of **12** printed pages.

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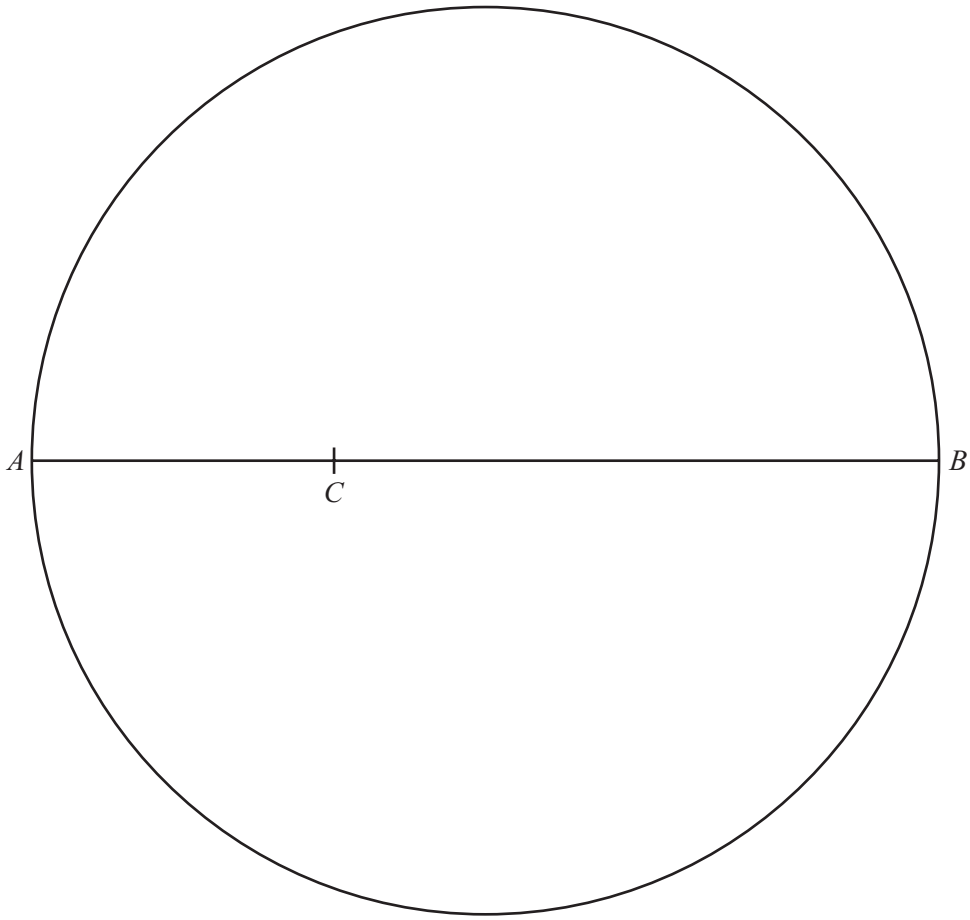


AB is the diameter of a circle.
C is a point on *AB* such that $AC = 4$ cm.

(a) **Using a straight edge and compasses only**, construct

(i) the locus of points which are equidistant from *A* and from *B*, [2]

(ii) the locus of points which are 4 cm from *C*. [1]

(b) Shade the region in the diagram which is

- nearer to *B* than to *A*

and

- less than 4 cm from *C*. [1]

19

For Examiner's Use

$$\mathbf{M} = \begin{pmatrix} 5 & -4 \\ 2 & 3 \end{pmatrix}$$

Find

(a) $\mathbf{M}^2$,

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

(b) $2\mathbf{M}$,

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

(c) $|\mathbf{M}|$, the determinant of $\mathbf{M}$,

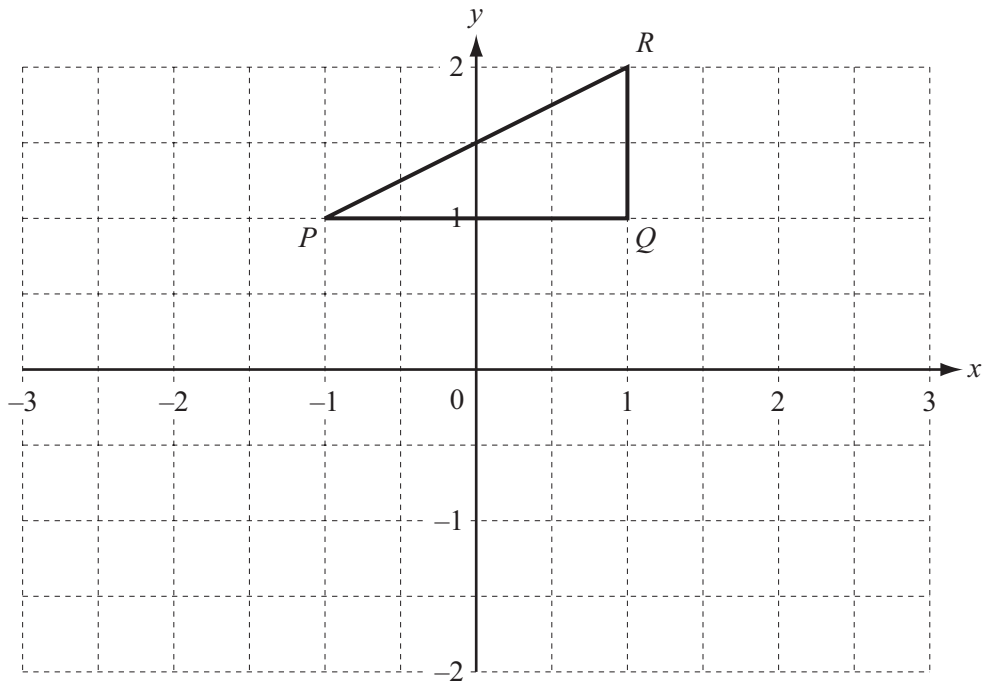
Answer(c) ..... [1]

(d) $\mathbf{M}^{-1}$.

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

21

For Examiner's Use



The triangle PQR has co-ordinates $P(-1, 1)$, $Q(1, 1)$ and $R(1, 2)$.

(a) Rotate triangle PQR by 90° clockwise about (0, 0).
Label your image $P'Q'R'$. [2]

(b) Reflect **your triangle** $P'Q'R'$ in the line $y = -x$.
Label your image $P''Q''R''$. [2]

(c) Describe fully the **single** transformation which maps triangle PQR onto triangle $P''Q''R''$.

Answer(c) ..... [2]

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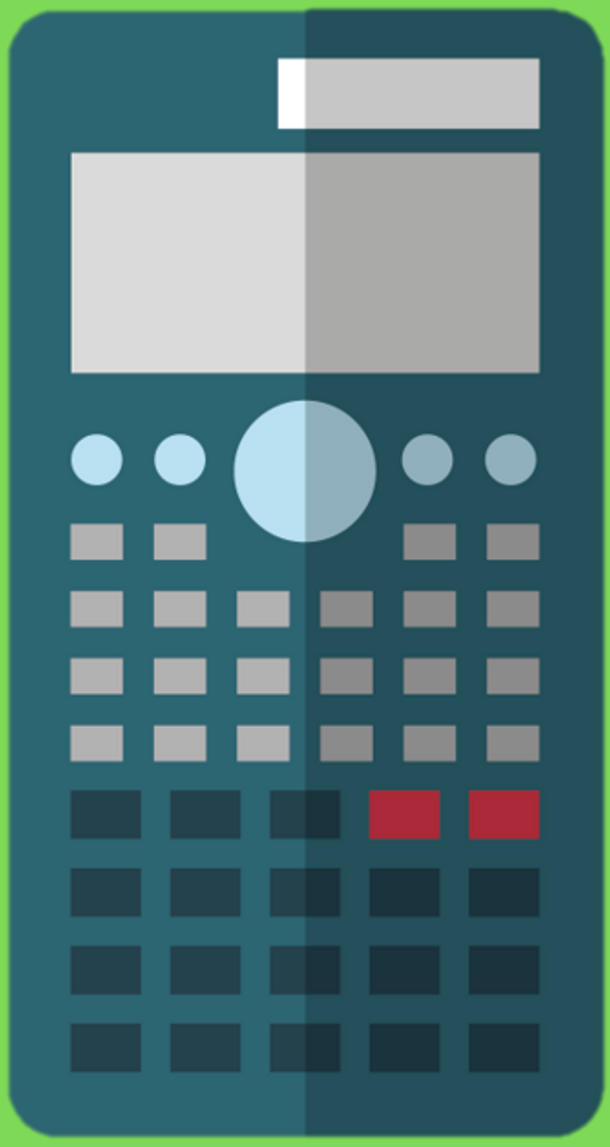
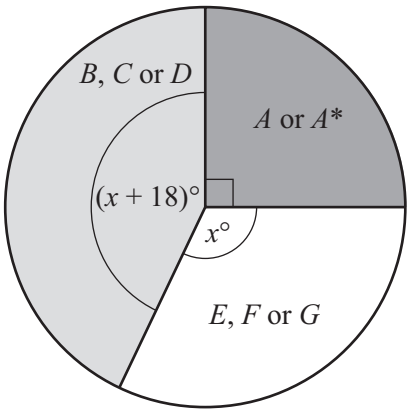
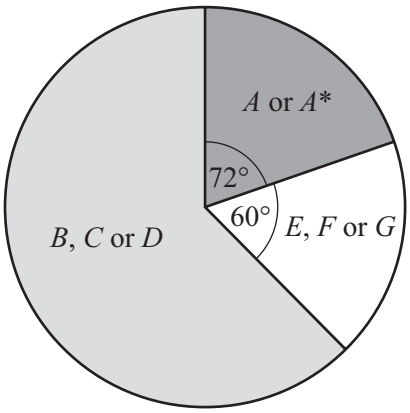


D. MATH ACADEMY

1



Girls



Boys

NOT TO SCALE

For Examiner's Use

The pie charts show information on the grades achieved in mathematics by the girls and boys at a school.

(a) For the **Girls'** pie chart, calculate

(i) x,

Answer(a)(i) x = ... [2]

(ii) the angle for grades B, C or D.

Answer(a)(ii) ..... [1]

(b) Calculate the percentage of the **Boys** who achieved grades E, F or G.

Answer(b) ..... % [2]

(c) There were 140 girls and 180 boys.

(i) Calculate the percentage of students (girls and boys) who achieved grades A or A^*.

Answer(c)(i) ..... % [3]

(ii) How many more boys than girls achieved grades *B*, *C* or *D*?

Answer(c)(ii) ..... [2]

(d) The table shows information about the times, t minutes, taken by 80 of the girls to complete their mathematics examination.

Time taken (t minutes)	$40 < t \leqslant 60$	$60 < t \leqslant 80$	$80 < t \leqslant 120$	$120 < t \leqslant 150$
Frequency	5	14	29	32

(i) Calculate an estimate of the mean time taken by these 80 girls to complete the examination.

Answer(d)(i) ..... min [4]

(ii) On a histogram, the height of the column for the interval $60 < t \leqslant 80$ is 2.8 cm.

Calculate the heights of the other three columns.
Do not draw the histogram.

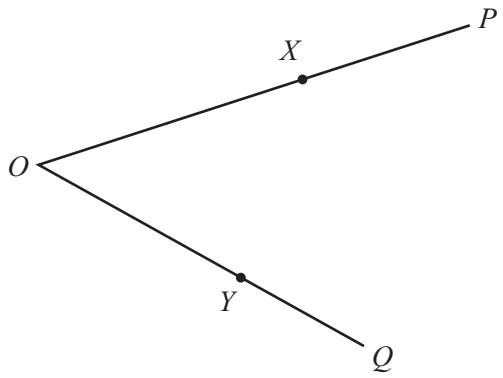
Answer(d)(ii) $40 < t \leqslant 60$ column height = ... cm

$80 < t \leqslant 120$ column height = ... cm

$120 < t \leqslant 150$ column height = ... cm [4]

[Turn over

(b)



NOT TO SCALE

In the diagram, $OX : XP = 3 : 2$ and $OY : YQ = 3 : 2$.
$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$.

(i) Write $\overrightarrow{PQ}$ in terms of **p** and **q**.

Answer(b)(i) $\overrightarrow{PQ}$ = ... [1]

(ii) Write $\overrightarrow{XY}$ in terms of **p** and **q**.

Answer(b)(ii) $\overrightarrow{XY}$ = ... [1]

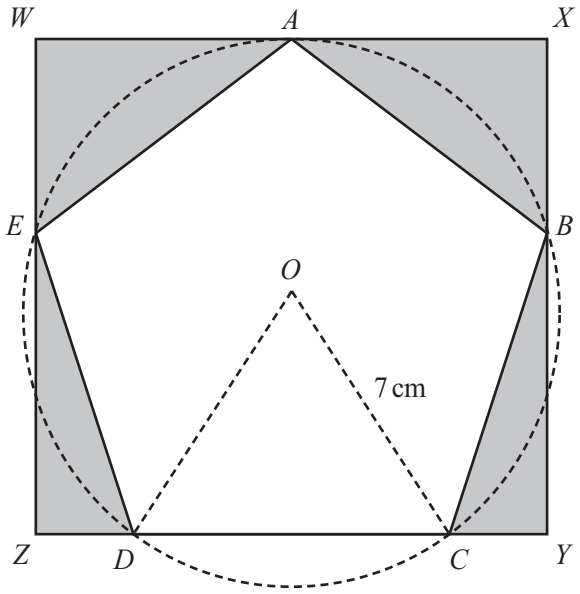
(iii) Complete the following sentences.

The lines XY and PQ are .....

The triangles OXY and OPQ are .....

The ratio of the area of triangle OXY to the area of triangle OPQ is ..... : ..... [3]

7



NOT TO SCALE

For Examiner's Use

The vertices *A*, *B*, *C*, *D* and *E* of a regular pentagon lie on the circumference of a circle, centre *O*, radius 7 cm.
They also lie on the sides of a rectangle *WXYZ*.

(a) Show that

(i) angle $DOC = 72°$,

Answer(a)(i)

[1]

(ii) angle $DCB = 108°$,

Answer(a)(ii)

[2]

(iii) angle $CBY = 18°$.

Answer(a)(iii)

[1]

(b) Show that the length CD of one side of the pentagon is 8.23 cm correct to three significant figures.

Answer(b)

[3]

(c) Calculate

(i) the area of the triangle DOC,

Answer(c)(i) ..... cm^2 [2]

(ii) the area of the pentagon $ABCDE$,

Answer(c)(ii) ..... cm^2 [1]

(iii) the area of the sector ODC,

Answer(c)(iii) ..... cm^2 [2]

(iv) the length XY.

Answer(c)(iv) ..... cm [2]

(d) Calculate the ratio
area of the pentagon $ABCDE$: area of the rectangle $WXYZ$.

Give your answer in the form 1 : n.

Answer(d) 1 : ..... [5]

For Examiner's Use

9 Distances from the Sun can be measured in astronomical units, AU.
Earth is a distance of 1 AU from the Sun.
One AU is approximately 1.496×10^8 km.

The table shows distances from the Sun.

Name	Distance from the Sun in AU	Distance from the Sun in kilometres
Earth	1	1.496×10^8
Mercury	0.387	.....
Jupiter	.....	7.79×10^8
Pluto	.....	5.91×10^9

(a) Complete the table. [3]

(b) Light travels at approximately 300 000 kilometres per second.

(i) How long does it take light to travel from the Sun to Earth?
Give your answer in seconds.

Answer(b)(i) ..... s [2]

(ii) How long does it take light to travel from the Sun to Pluto?
Give your answer in minutes.

Answer(b)(ii) ..... min [2]

(c) One light year is the distance that light travels in one year (365 days).

How far is one light year in kilometres?
Give your answer in standard form.

Answer(c) ..... km [3]

(d) How many astronomical units (AU) are equal to one light year?

Answer(d) ..... AU [2]

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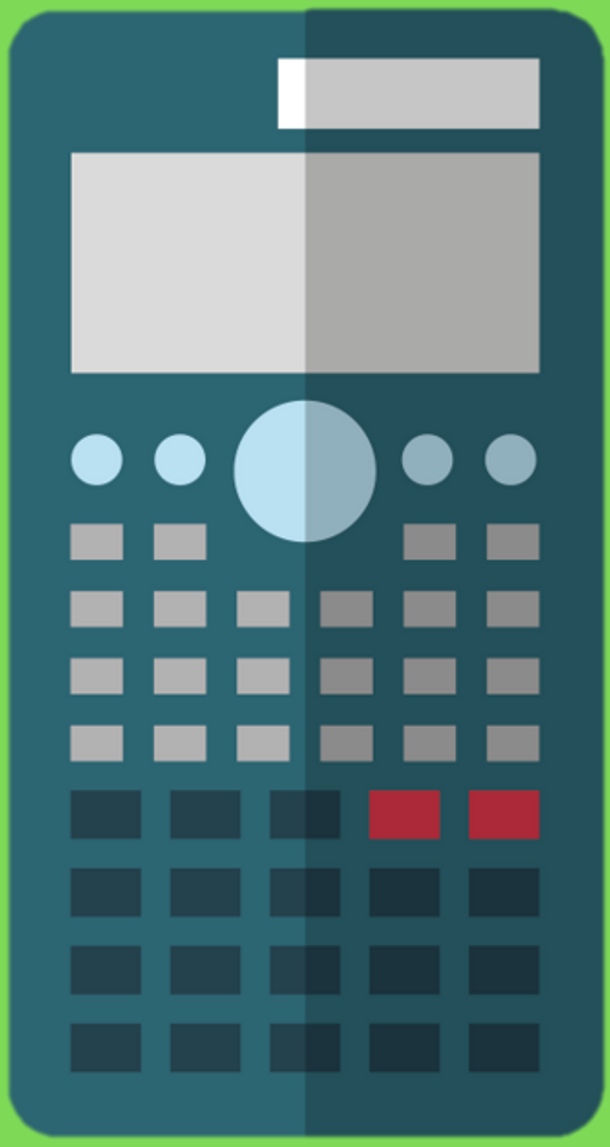
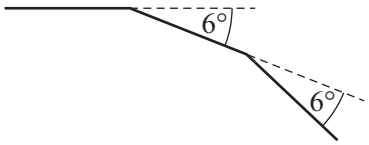


D. MATH ACADEMY

4



NOT TO SCALE

The diagram shows two of the exterior angles of a regular polygon with n sides.
Calculate n.

Answer $n =$ ..... [2]

---

5 The Tiger Sky Tower in Singapore has a viewing capsule which holds 72 people.
This number is 75% of the population of Singapore when it was founded in 1819.
What was the population of Singapore in 1819?

Answer ..... [2]

---

6 In a traffic survey of 125 cars the number of people in each car was recorded.

Number of people in each car	1	2	3	4	5
Frequency	50	40	10	20	5

Find

(a) the range,

Answer(a) ..... [1]

(b) the median,

Answer(b) ..... [1]

(c) the mode.

Answer(c) ..... [1]

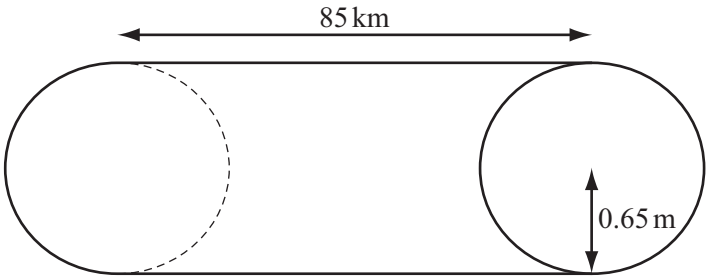
[Turn over

For Examiner's Use

7 The number of spectators at the 2010 World Cup match between Argentina and Mexico was 82 000 correct to the nearest thousand.
If each spectator paid 2600 Rand (R) to attend the game, what is the lower bound for the total amount paid?
Write your answer in standard form.

Answer R ..... [3]

8



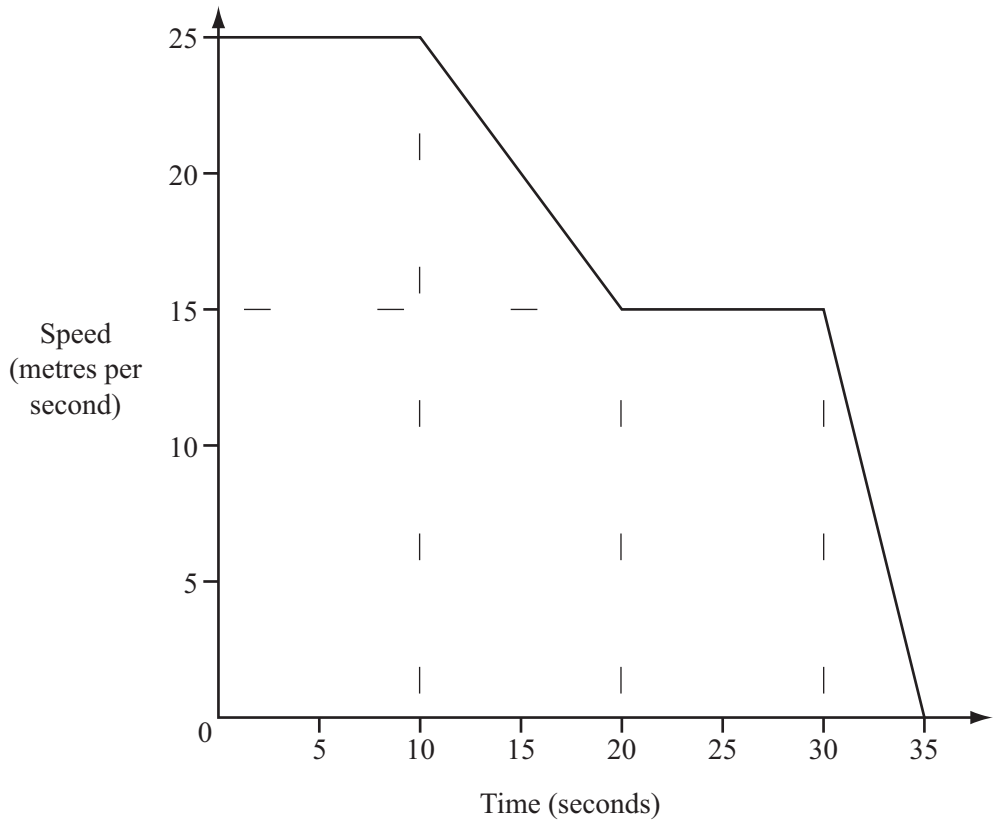
NOT TO SCALE

A water pipeline in Australia is a cylinder with **radius** 0.65 **metres** and length 85 **kilometres**.

Calculate the volume of water the pipeline contains when it is full.
Give your answer in cubic metres.

Answer ..... m^3 [3]

15



The diagram shows the speed-time graph for the last 35 seconds of a car journey.

(a) Find the deceleration of the car as it came to a stop.

Answer(a) ..... m/s^2 [1]

(b) Calculate the total distance travelled by the car in the 35 seconds.

Answer(b) ..... m [3]

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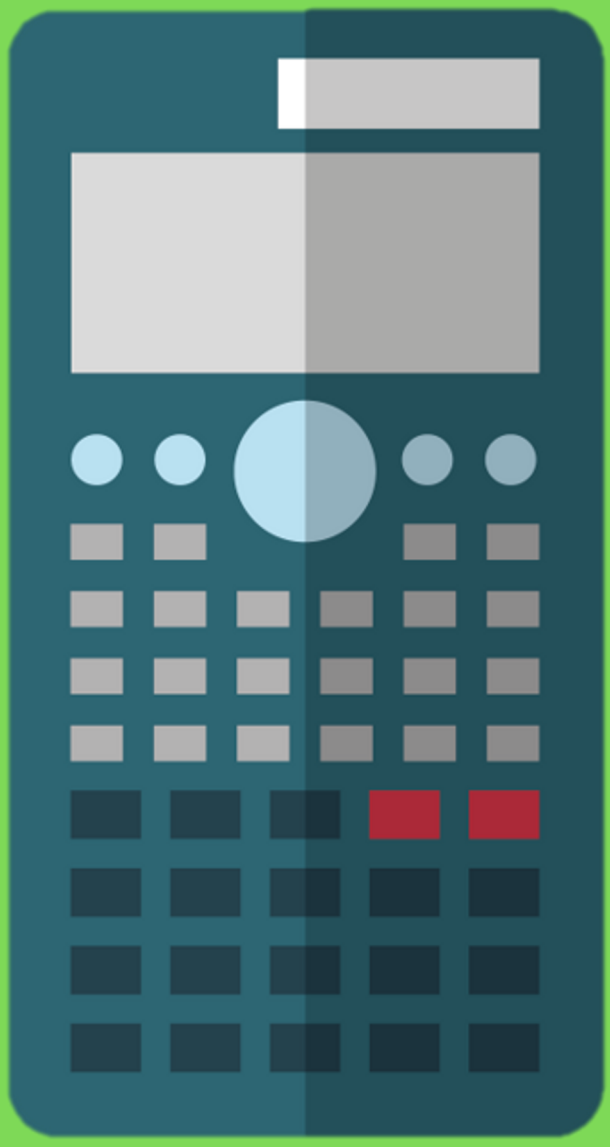
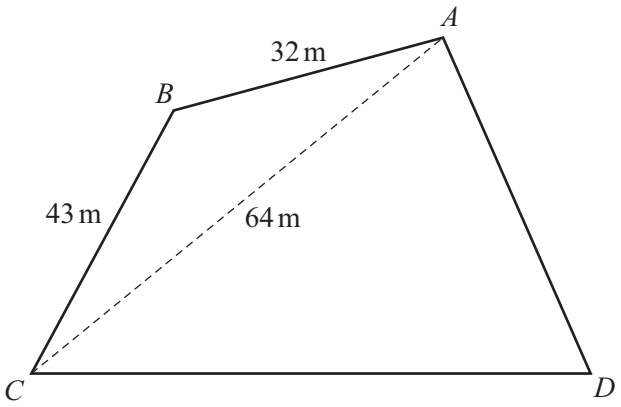


D. MATH ACADEMY

2



NOT TO SCALE

The diagram represents a field in the shape of a quadrilateral $ABCD$.
$AB = 32$ m, $BC = 43$ m and $AC = 64$ m.

(a) (i) Show clearly that angle $CAB = 37.0°$ correct to one decimal place.

Answer(a)(i)

[4]

(ii) Calculate the area of the triangle ABC.

Answer(a)(ii) ..... m^2 [2]

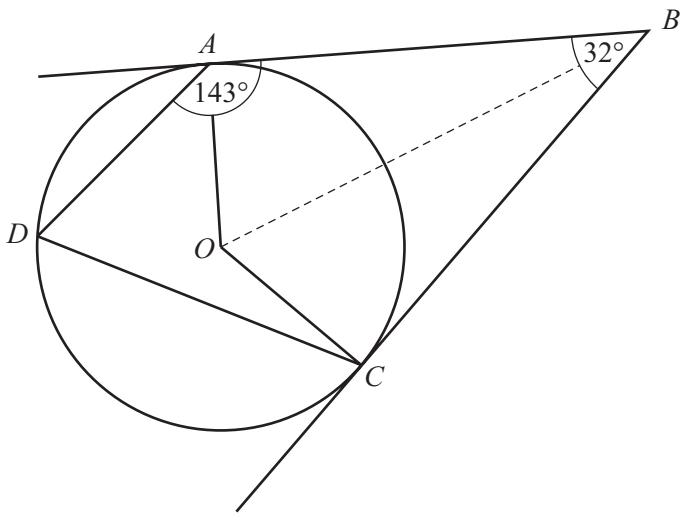
(b) $CD = 70$ m and angle $DAC = 55°$.

Calculate the perimeter of the whole field $ABCD$.

Answer(b) ..... m [6]

For Examiner's Use

4 (a)



NOT TO SCALE

Points A, C and D lie on a circle centre O.
BA and BC are tangents to the circle.
Angle $ABC = 32°$ and angle $DAB = 143°$.

(i) Calculate angle AOC in quadrilateral $AOCB$.

Answer(a)(i) Angle AOC = ... [2]

(ii) Calculate angle ADC.

Answer(a)(ii) Angle ADC = ... [1]

(iii) Calculate angle OCD.

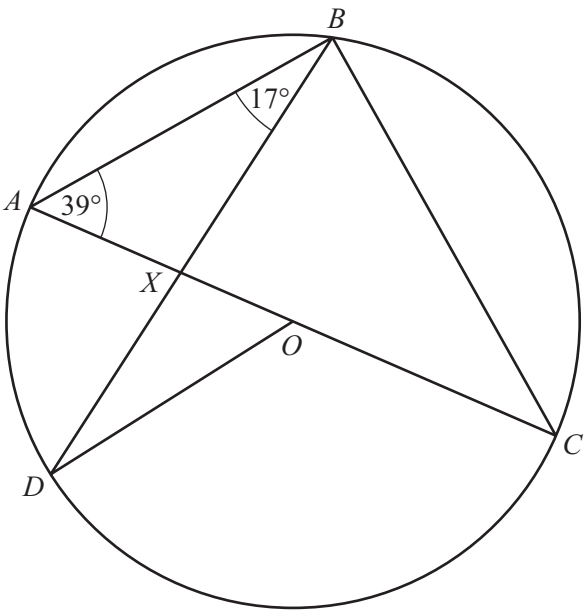
Answer(a)(iii) Angle OCD = ... [2]

(iv) $OA = 6$ cm.

Calculate the length of AB.

Answer(a)(iv) AB = ... cm [3]

(b)



NOT TO SCALE

A, B, C and D are on the circumference of the circle centre O.
AC is a diameter.
Angle $CAB = 39°$ and angle $ABD = 17°$.

(i) Calculate angle ACB.

Answer(b)(i) Angle ACB = ... [2]

(ii) Calculate angle BXC.

Answer(b)(ii) Angle BXC = ... [2]

(iii) Give the reason why angle DOA is 34°.

Answer(b)(iii) ..... [1]

(iv) Calculate angle BDO.

Answer(b)(iv) Angle BDO = ... [1]

(v) The radius of the circle is 12 cm. Calculate the length of major arc $ABCD$.

Answer(b)(v) Arc $ABCD$ = ... cm [3]

10 Consecutive integers are set out in rows in a grid.

(a) This grid has 5 columns.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

a		*b*
	n	
c		*d*

The shape drawn encloses five numbers 7, 9, 13, 17 and 19. This is the $n = 13$ shape.

In this shape, $a = 7$, $b = 9$, $c = 17$ and $d = 19$.

(i) Calculate $bc - ad$ for the $n = 13$ shape.

Answer(a)(i) ..... [1]

(ii) For the 5 column grid, $a = n - 6$.

Write down b, c and d in terms of n for this grid.

Answer(a)(ii) $b =$ .....

$c =$ .....

$d =$ ..... [2]

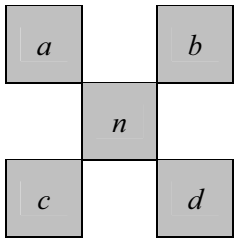
(iii) Write down $bc - ad$ in terms of n.
Show clearly that it simplifies to 20.

Answer(a)(iii)

[2]

(b) This grid has 6 columns. The shape is drawn for $n = 10$.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36



(i) Calculate the value of $bc - ad$ for $n = 10$.

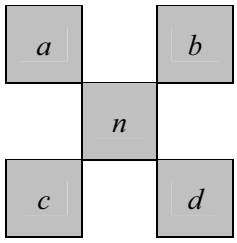
Answer(b)(i) ..... [1]

(ii) Without simplifying, write down $bc - ad$ in terms of n for this grid.

Answer(b)(ii) ..... [2]

(c) This grid has 7 columns.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35



Show clearly that $bc - ad = 28$ for $n = 17$.

Answer(c)

[1]

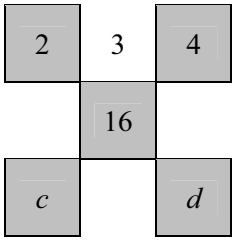
Question 10 continues on the next page.

For Examiner's Use

(d) Write down the value of $bc - ad$ when there are t columns in the grid.

Answer(d) ..... [1]

(e) Find the values of c, d and $bc - ad$ for this shape.



Answer (e) $c =$ .....

$d =$ .....

$bc - ad =$ ..... [2]

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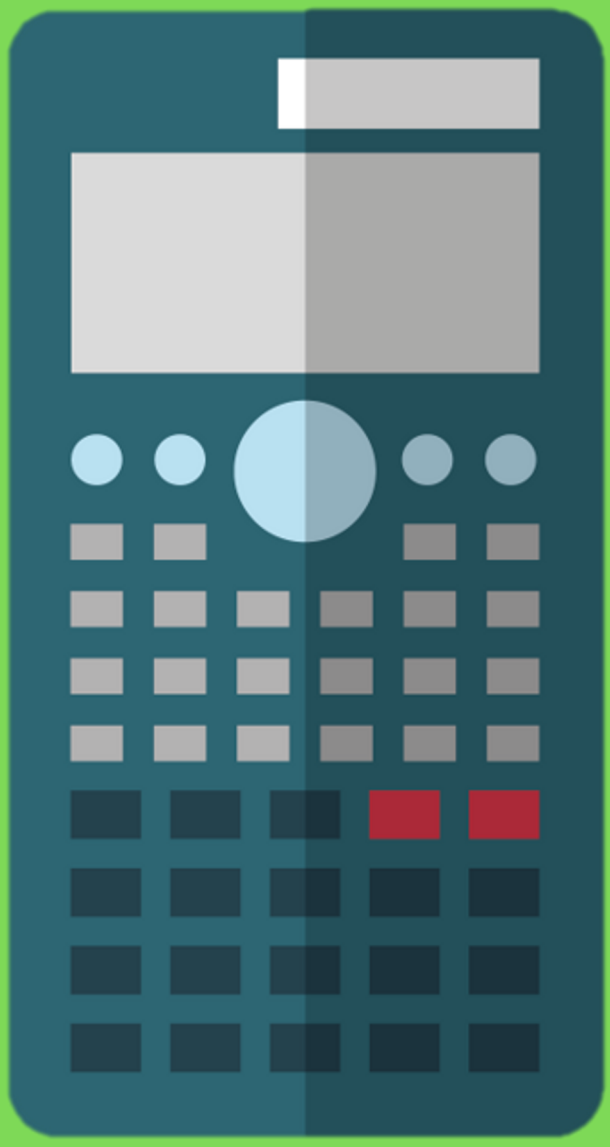

D. MATH ACADEMY

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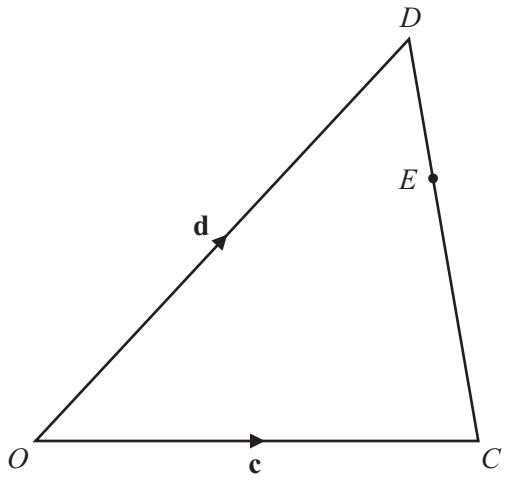


NOT TO SCALE

In the diagram, O is the origin.
$\overrightarrow{OC}$ = **c** and $\overrightarrow{OD}$ = **d**.
E is on CD so that $CE = 2ED$.

Find, in terms of **c** and **d**, in their simplest forms,

(a) $\overrightarrow{DE}$,

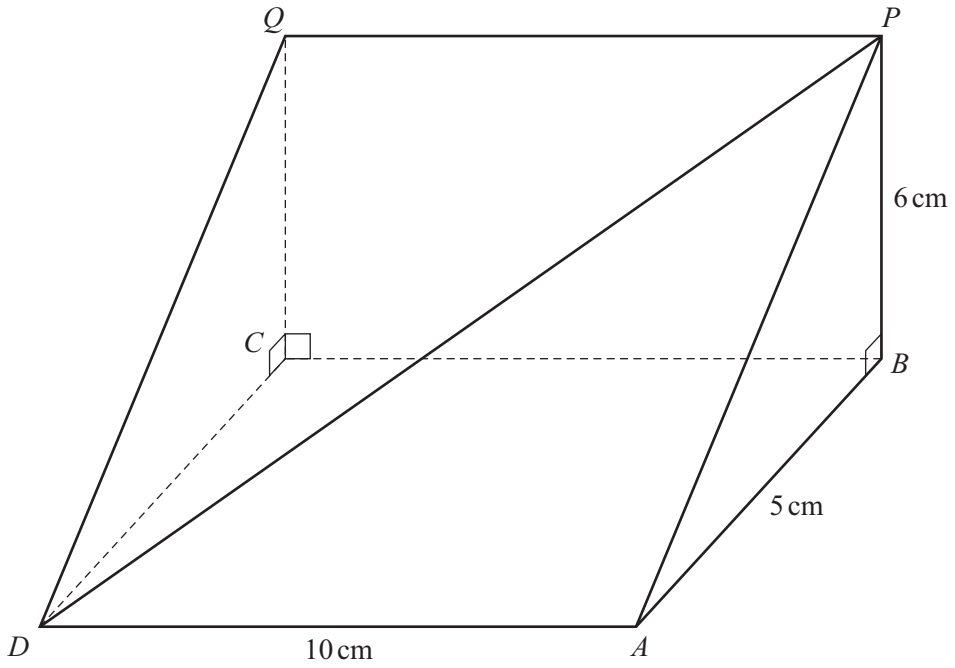
Answer(a) $\overrightarrow{DE}$ = ... [2]

(b) the position vector of E.

Answer(b) ..... [2]

[Turn over

24



NOT TO SCALE

For Examiner's Use

The diagram shows a triangular prism.
ABCD is a horizontal rectangle with $DA = 10$ cm and $AB = 5$ cm.
BCQP is a vertical rectangle and $BP = 6$ cm.

Calculate

(a) the length of *DP*,

Answer(a) DP = ... cm [3]

(b) the angle between *DP* and the horizontal rectangle *ABCD*.

Answer(b) ..... [3]

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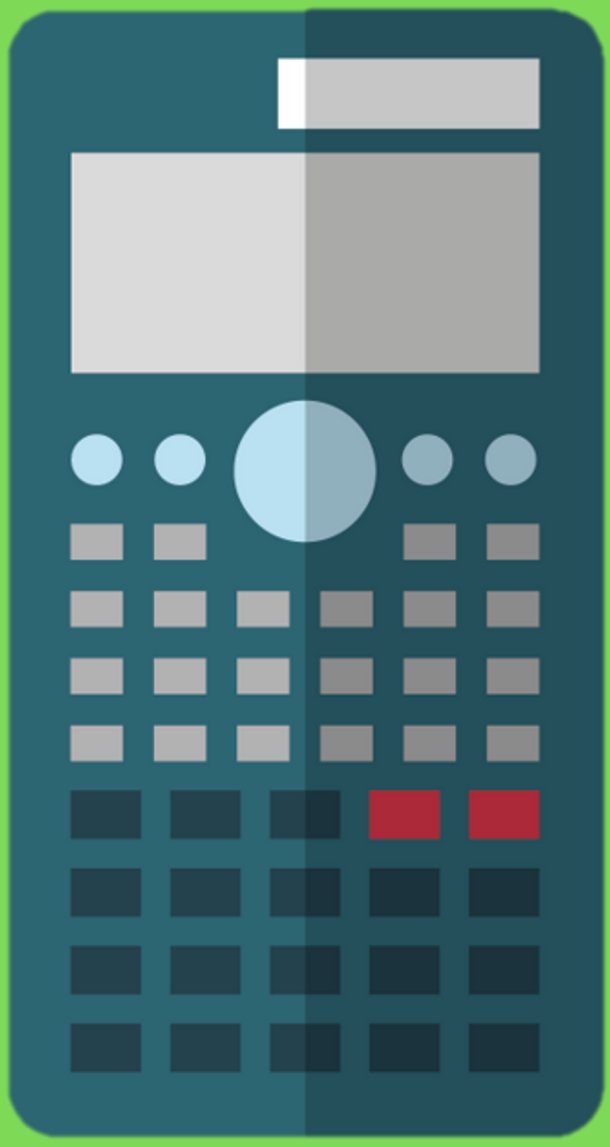


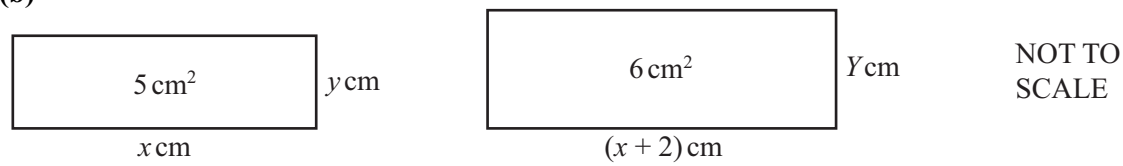
D. MATH ACADEMY

For Examiner's Use

5 **(a)** Marcos buys 2 bottles of water and 3 bottles of lemonade.
The total cost is \$3.60.
The cost of one bottle of lemonade is \$0.25 more than the cost of one bottle of water.
Find the cost of one bottle of water.

Answer(a) \$ ..... [4]

(b)



The diagram shows two rectangles.
The first rectangle measures x cm by y cm and has an area of 5 cm^2.
The second rectangle measures $(x + 2)$ cm by Y cm and has an area of 6 cm^2.

(i) When $y + Y = 1$, show that $x^2 - 9x - 10 = 0$.

Answer (b)(i)

[4]

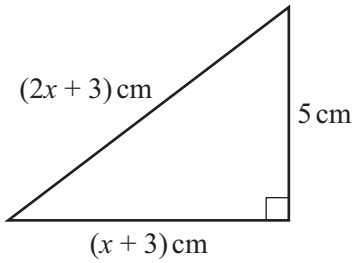
(ii) Factorise $x^2 - 9x - 10$.

Answer(b)(ii) ..... [2]

(iii) Calculate the perimeter of the first rectangle.

Answer(b)(iii) ..... cm [2]

(c)



NOT TO SCALE

The diagram shows a right-angled triangle with sides of length 5 cm, $(x + 3)$ cm and $(2x + 3)$ cm.

(i) Show that $3x^2 + 6x - 25 = 0$.

Answer (c)(i)

[4]

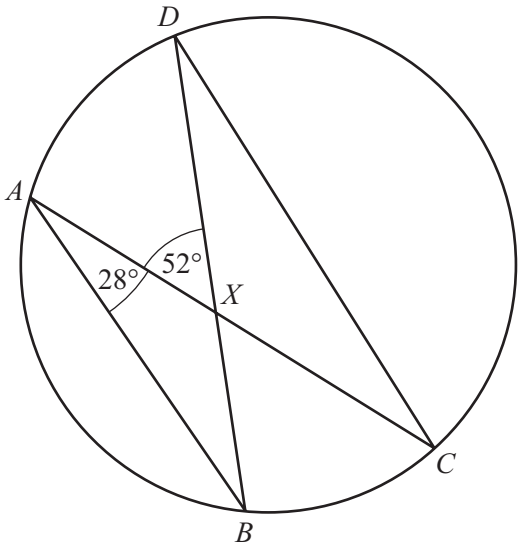
(ii) Solve the equation $3x^2 + 6x - 25 = 0$.
Show all your working and give your answers correct to 2 decimal places.

Answer(c)(ii) $x =$ ..... or $x =$ ..... [4]

(iii) Calculate the area of the triangle.

Answer(c)(iii) ..... cm^2 [2]

8 (a)

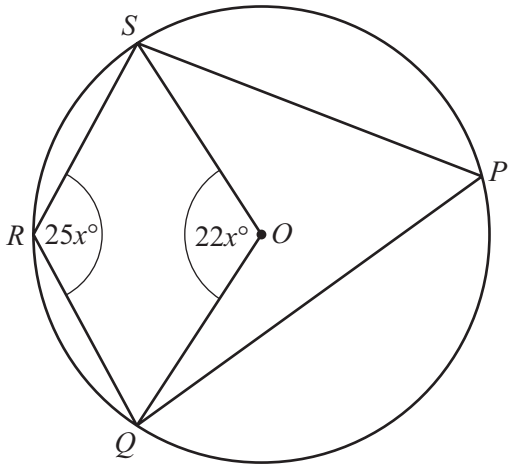


NOT TO SCALE

A, B, C and D lie on a circle.
The chords AC and BD intersect at X.
Angle $BAC = 28°$ and angle $AXD = 52°$.
Calculate angle XCD.

Answer(a) Angle XCD = ... [3]

(b)

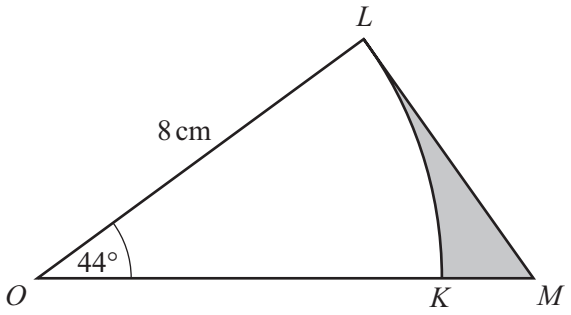


NOT TO SCALE

$PQRS$ is a cyclic quadrilateral in the circle, centre O.
Angle $QOS = 22x°$ and angle $QRS = 25x°$.
Find the value of x.

Answer(b) x = ... [3]

(c)



NOT TO SCALE

In the diagram *OKL* is a sector of a circle, centre *O* and radius 8 cm.
OKM is a straight line and *ML* is a tangent to the circle at *L*.
Angle *LOK* = 44°.

Calculate the area shaded in the diagram.

Answer(c) ..... cm^2 [5]

For Examiner's Use

For Examiner's Use

10 **(a)** Complete the table for the 6th term and the nth term in each sequence.

	Sequence	6th term		nth term
A	11, 9, 7, 5, 3			
B	1, 4, 9, 16, 25			
C	2, 6, 12, 20, 30			
D	3, 9, 27, 81, 243			
E	1, 3, 15, 61, 213			

[12]

(b) Find the value of the 100th term in

(i) Sequence A,

Answer(b)(i) ..... [1]

(ii) Sequence C.

Answer(b)(ii) ..... [1]

(c) Find the value of n in Sequence D when the nth term is equal to 6561.

For Examiner's Use

Answer(c) $n =$ ..... [1]

(d) Find the value of the 10th term in Sequence E.

Answer(d) ..... [1]