

Please check the examination details below before entering your candidate information

Candidate surname WRITTEN MS	Other names
Pearson Edexcel International GCSE	Centre Number
Candidate Number 	
Tuesday 3 November 2020	
Morning (Time: 1 hour 30 minutes)	Paper Reference 4MB1/01R
Mathematics B Paper 1R	
	
You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.	
Total Marks 	

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- **Calculators may be used.**

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.
- Without sufficient working, correct answers may be awarded no marks.

Turn over ►

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Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 Ali, Beth and Chari pay rent on a piece of woodland.

The annual rent that they pay is such that

the amount Ali pays : the amount Beth pays : the amount Chari pays = 13 : 8 : 11

The amount that Chari pays = \$2563

Calculate how much more rent Ali pays than Beth pays.

- ① Find scale factor

$$\frac{2563}{11} = 233$$

$$\begin{array}{ccc} A & B & C \\ 13 & 8 & 11 \\ 3029 & 1864 & 2563 \end{array} \left. \begin{array}{c} \\ \\ \end{array} \right\} \times 233$$

- ② Multiply all by 233

- ③ Subtract how much Beth pays from how much Ali pays

$$3029 - 1864 = 1165$$

\$ 1165

(Total for Question 1 is 2 marks)

- 2 Simplify fully $\frac{8(2x+3)^2}{8x+12}$

$$\frac{8(2x+3)^2}{8x+12} = \frac{\cancel{4} \times 2 (2x+3)^2}{\cancel{4} (2x+3)}$$

Take out factor of 4

$$= 4x+6$$

4x+6

(Total for Question 2 is 2 marks)

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- 3 Without using a calculator and showing all your working, evaluate

$$5\frac{1}{3} \div 2\frac{3}{5}$$

Give your answer as a mixed number in its simplest form.

① Write all fractions as improper

$$\begin{aligned} 5\frac{1}{3} &= \frac{5 \times 3}{3} + \frac{1}{3} & 2\frac{3}{5} &= \frac{2 \times 5}{5} + \frac{3}{5} \\ &= \frac{15}{3} + \frac{1}{3} & &= \frac{10}{5} + \frac{3}{5} \\ &= \frac{16}{3} & &= \frac{13}{5} \end{aligned}$$

② Flip second fraction and multiply

$$\begin{aligned} \frac{16}{3} \div \frac{13}{5} &= \frac{16}{3} \times \frac{5}{13} \\ &= \frac{80}{39} \\ &= 2\frac{2}{39} \end{aligned}$$

$$2\frac{2}{39}$$

(Total for Question 3 is 3 marks)

- 4 Ashley takes 3 hours and 36 minutes to walk around a lake.
The distance she walks is 11 520 m.

Calculate Ashley's average speed.

Give your answer in kilometres per hour.

① Convert everything to km and hours

$$\begin{aligned} \frac{36 \text{ min}}{60} &= 0.6 \text{ hours} & \frac{11\,520}{1000} &= 11.52 \text{ km} \\ 3 + 0.6 &= 3.6 \text{ hours} \end{aligned}$$

② Calculate speed:

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

$$\frac{11.52}{3.6} = 3.2 \text{ km/h}$$

$$3.2 \text{ kilometres per hour}$$

(Total for Question 4 is 3 marks)



5 Liam started a new job on a salary of \$45 500

At the end of 1 year he is given a pay increase of 5.5%

At the end of each subsequent year he is given a pay increase of 1.25%

Calculate, to the nearest \$, Liam's salary at the end of 3 years after he started the job.

① Find pay after 1 year.

$$100\% + 5.5\% = 105.5\%$$

$$45\,500 \times \frac{105.5}{100} = 48002.5$$

② Find pay after 2 more years.

$$100\% + 1.25\% = 101.25\%$$

$$48002.5 \times \left(\frac{101.25}{100}\right)^2 = 49210.06...$$

$$\approx 49210$$

① Find 5.5% of \$45 500 and add this on

$$\frac{5.5}{100} \times 45\,500 = 2502.5$$

$$45\,500 + 2502.5 = 48002.5$$

② Find 1.25% of \$48002.5 and add it on.

$$\frac{1.25}{100} \times 48002.5 = 600.03125$$

$$48002.5 + 600.03125 = 48602.53...$$

③ Find 1.25% of \$48602.5... and add this

$$\frac{1.25}{100} \times 48602.5... = 607.53...$$

$$48602.5... + 607.53...$$

$$= 49210.06...$$

$$\approx 49210$$

$$\$ 49\,210$$

(Total for Question 5 is 3 marks)

6 The straight line L has equation $2y - 5 = 3x$

(a) Find the gradient of L

Rearrange in terms of $y = mx + c$, where m is the gradient.

$$2y - 5 = 3x$$

$$+5 \rightarrow 2y = 3x + 5$$

$$\div 2 \rightarrow y = \frac{3}{2}x + \frac{5}{2}$$

$$y = m'x + c$$

$$\frac{3}{2}$$

(2)

(b) Find the coordinates of the point where L meets the y-axis.

c is the y-intercept

$$c = \frac{5}{2}$$

and the x -coordinate is 0 where L meets y-axis

$$\left(0, \frac{5}{2}\right)$$

(1)

(Total for Question 6 is 3 marks)

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9 The function f is defined by

$$f : x \mapsto \frac{3x}{2(x+2)} \quad x \neq -2$$

Express the inverse function f^{-1} in the form $f^{-1} : x \mapsto \dots$

① Replace $f(x)$ with y and rearrange to make x the subject.

$$\begin{aligned}
 y &= \frac{3x}{2(x+2)} \\
 \times 2(x+2) \quad & \rightarrow 2(x+2) \times y = 3x \quad \times 2(x+2) \\
 \text{Expand brackets} \quad & (2x+4)y = 3x \\
 & 2xy + 4y = 3x \\
 -2xy \quad & \rightarrow 4y = 3x - 2xy \quad -2xy \\
 & 4y = x(3-2y) \quad \text{Take out factor of } x \\
 \div (3-2y) \quad & \rightarrow \frac{4y}{3-2y} = x \quad \div (3-2y)
 \end{aligned}$$

② Replace x with $f^{-1}:x$ and y with x

$$f^{-1}:x = \frac{4x}{3-2x}$$

$$f^{-1} : x \mapsto \frac{4x}{3-2x}$$

(Total for Question 9 is 3 marks)

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10 Without using a calculator and showing all your working, express $\frac{6 - \sqrt{8}}{2 + \sqrt{8}}$ in the form $a + \sqrt{b}$ where a and b are integers.

① Make denominator rational by multiplying by $2 - \sqrt{8}$

$$\frac{6 - \sqrt{8}}{2 + \sqrt{8}} \times \frac{2 - \sqrt{8}}{2 - \sqrt{8}} = \frac{20 - 8\sqrt{8}}{-4}$$

② Divide by -4 and make one surd

$$\begin{aligned} \frac{20 - 8\sqrt{8}}{-4} &= \frac{-4(-5 + 2\sqrt{8})}{-4} \\ &= -5 + \sqrt{4}\sqrt{8} \\ &= -5 + \sqrt{32} \end{aligned}$$

	6	$-\sqrt{8}$
2	12	$-2\sqrt{8}$
$-\sqrt{8}$	$-6\sqrt{8}$	8

$$12 - 2\sqrt{8} - 6\sqrt{8} + 8 = 20 - 8\sqrt{8}$$

	2	$\sqrt{8}$
2	4	$2\sqrt{8}$
$-\sqrt{8}$	$-2\sqrt{8}$	-8

$$4 + 2\sqrt{8} - 2\sqrt{8} - 8 = -4$$

$$-5 + \sqrt{32}$$

(Total for Question 10 is 3 marks)

11 Given that $-3x^2 + 6x + 2$ can be written in the form $a(x + b)^2 + c$ where a , b and c are integers,

find the value of a , the value of b and the value of c .

Here you need to complete the square.

① Take out factor of -3 from first two terms

$$-3 \left[x^2 - 2x \right] + 2$$

② Complete square as you would normally

$$-3 \left[(x - 1)^2 - 1 \right] + 2$$

③ Multiply terms in bracket by -3

$$-3(x - 1)^2 + 3 + 2$$

$$= -3(x - 1)^2 + 5$$

$$= a(x + b)^2 + c$$

$$a = -3$$

$$b = -1$$

$$c = 5$$

(Total for Question 11 is 3 marks)

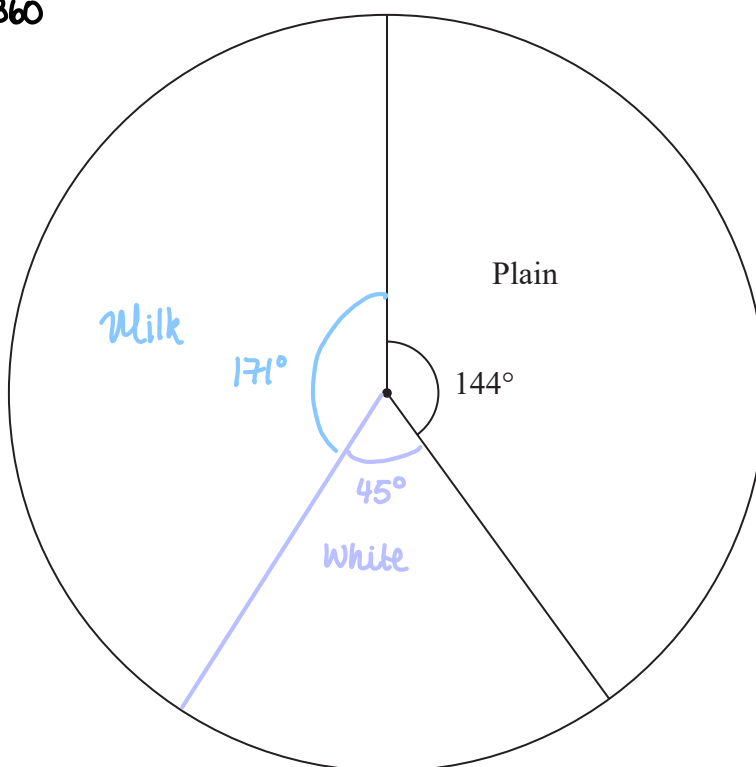
- 12 The incomplete table and pie chart below show information about the favourite type of chocolate of 440 adults.

Type of chocolate	Number of adults
Milk	209
Plain	176
White	55
Total	440

Find angles for White and milk by
no. adults for flavour
440 $\times 360$

$$\text{Milk} \rightarrow \frac{209}{440} \times 360 = 171^\circ$$

$$\text{White} \rightarrow \frac{55}{440} \times 360 = 45^\circ$$



Complete the table and the pie chart.

The total angle around the centre is 360° and Plain takes up 144° of that.

$$\frac{144}{360} \times 440 = 176$$

Subtract Plain and Milk from total for White.

$$440 - 209 - 176 = 55$$

(Total for Question 12 is 4 marks)



- 13 Here is information about the age, in years, of each of Jelina's five children when written in order.

$$a \quad b \quad \frac{b}{2} + a \quad 2b + a + 3 \quad 2b + a + 5$$

It is given that

a is the age of the youngest child

$$a \neq b$$

two of the children have the same age

the mean age of the five children is 10.6 years

Calculate the value of a and the value of b

Show clear algebraic working.

$$\text{Mean} = \frac{\text{sum of all ages}}{5}$$

$$\frac{a + b + \frac{b}{2} + a + 2b + a + 3 + 2b + a + 5}{5} = \frac{4a + \frac{11}{2}b + 8}{5}$$

$$\frac{4a + \frac{11}{2}b + 8}{5} = 10.6$$

$$4a + \frac{11}{2}b + 8 = 53$$

$$4a + \frac{11}{2}b = 45$$

$$8a + 11b = 90$$

$$\begin{array}{l} b = \frac{b}{2} + a \\ \times 2 \quad \quad \quad \times 2 \\ \hline 2b = b + 2a \\ -b \quad \quad \quad -b \\ \hline b = 2a \end{array}$$

Sub $b = 2a$

$$8a + 11(2a) = 90$$

$$8a + 22a = 90$$

$$\begin{array}{l} 30a = 90 \\ \div 30 \quad \quad \quad \div 30 \\ \hline a = 3 \end{array}$$

$$\begin{array}{l} b = 2(3) \\ \quad = 6 \end{array}$$

$$a = 3$$

$$b = 6$$

(Total for Question 13 is 4 marks)

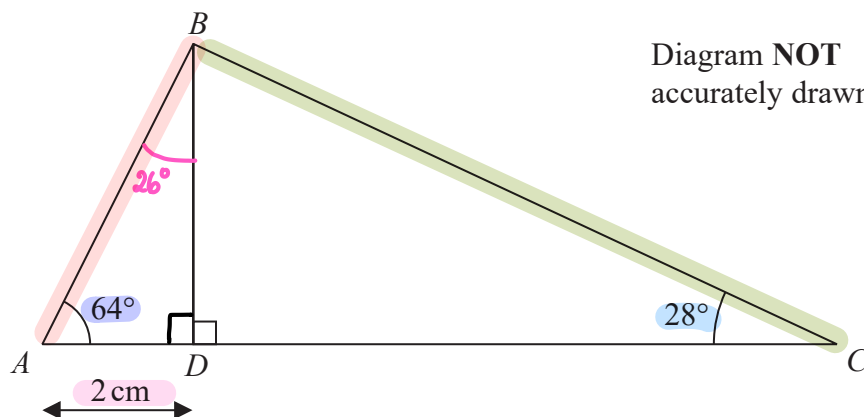
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14



The diagram shows a triangle ABC .

The point D lies on AC so that BD is perpendicular to AC .

$$\angle BAD = 64^\circ$$

$$\angle ACB = 28^\circ$$

$$AD = 2 \text{ cm}$$

Calculate the length, in cm to one decimal place, of BC .

① Find angles on the triangle ABD . Angles in a triangle add to 180° .

$$\begin{aligned}\angle ABD &= 180 - 90 - 64 \\ &= 26^\circ\end{aligned}$$

② Use sine rule to find AB

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

$$\frac{AB}{\sin 90} = \frac{2}{\sin 26}$$

$$\begin{aligned}AB &= \frac{2}{\sin 26} \times \sin 90 \\ &= 4.5623...\end{aligned}$$

③ Use sine rule again to find BC by considering $\triangle ABC$.

$$\frac{BC}{\sin 64} = \frac{4.56...}{\sin 28}$$

$$BC = \frac{4.56...}{\sin 28} \times \sin 64$$

$$= 8.734...$$

$$\approx 8.7 \text{ (1.d.p.)}$$

8.7 cm

(Total for Question 14 is 4 marks)



15 (a)

$$A = \begin{pmatrix} 3 & -1 \\ -4 & 2 \end{pmatrix} \quad B = \begin{pmatrix} 2 & -\frac{1}{2} \\ 2 & -2 \end{pmatrix}$$

Calculate $3A - 2B$

Subtraction of 2×2 Matrices:

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} - \begin{pmatrix} e & f \\ g & h \end{pmatrix} = \begin{bmatrix} a-e & b-f \\ c-g & d-h \end{bmatrix}$$

$$3 \begin{pmatrix} 3 & -1 \\ -4 & 2 \end{pmatrix} - 2 \begin{pmatrix} 2 & -\frac{1}{2} \\ -4 & 2 \end{pmatrix} = \begin{pmatrix} 9 & -3 \\ -12 & 6 \end{pmatrix} - \begin{pmatrix} 4 & -1 \\ -8 & 4 \end{pmatrix}$$

$$= \begin{bmatrix} 9-4 & -3-(-1) \\ -12-(-8) & 6-4 \end{bmatrix}$$

$$= \begin{bmatrix} 5 & -2 \\ -4 & 2 \end{bmatrix}$$

$$\begin{pmatrix} 5 & -2 \\ -4 & 2 \end{pmatrix} \quad (2)$$

(b)

$$P = \begin{pmatrix} 5 & -3 \\ -3 & 2 \end{pmatrix} \quad QP^{-1} = \begin{pmatrix} 0 & 1 \\ -10 & -17 \end{pmatrix}$$

Find the matrix Q

$$QP^{-1} = Q \div P$$

$$Q = QP^{-1} \times P$$

Multiplying 2×2 Matrices:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} ae+bg & af+bh \\ ce+dg & cf+dh \end{bmatrix}$$

$$\begin{bmatrix} 0 & 1 \\ -10 & -17 \end{bmatrix} \times \begin{bmatrix} 5 & -3 \\ -3 & 2 \end{bmatrix} = \begin{bmatrix} (0)(5) + (1)(-3) & (0)(-3) + (1)(2) \\ (-10)(5) + (-17)(-3) & (-10)(-3) + (-17)(2) \end{bmatrix}$$

$$= \begin{bmatrix} -3 & 2 \\ 1 & -4 \end{bmatrix}$$

$$\begin{pmatrix} -3 & 2 \\ 1 & -4 \end{pmatrix} \quad (2)$$

(Total for Question 15 is 4 marks)

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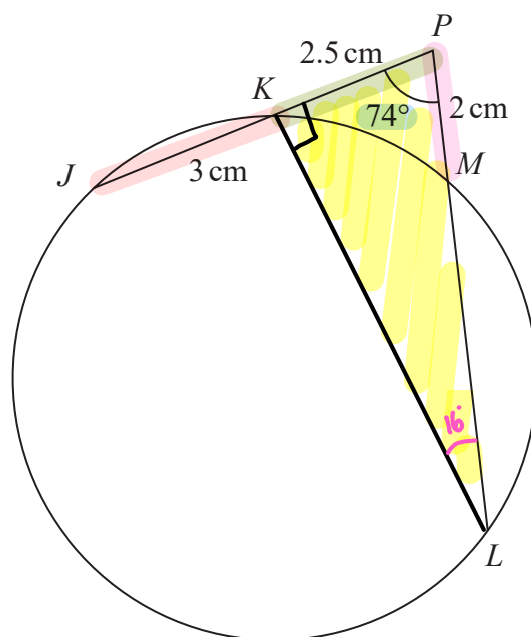


Diagram NOT
accurately drawn

The diagram shows a circle $JKML$.

JKP and LMP are straight lines.

$JK = 3$ cm, $KP = 2.5$ cm and $PM = 2$ cm.

$\angle JPL = 74^\circ$

Calculate the area, in cm^2 to 2 decimal places, of triangle LKP.

Triangle LJP is similar to triangle PMK.

$$\begin{aligned} KP &: PJ \\ 2.5 &: 5.5 \\ &\times \frac{5.5}{2.5} \end{aligned}$$

$$\begin{aligned} PM &: PL \\ 2 &: 6.875 \\ &\times \frac{5.5}{2.5} \end{aligned}$$

Area of a triangle = $\frac{1}{2}ab\sin C$

$$a = 6.875$$

$$b = 2.5$$

$$C = 74$$

$$\begin{aligned} \frac{1}{2} \times 6.875 \times 2.5 \times \sin 74 &= 8.2608... \\ &\approx 8.26 \end{aligned}$$

8.26 cm^2

(Total for Question 16 is 4 marks)



- 17 (a) Write 0.0234 in standard form. → Number must be between 1 and 10.

$$0.0234 = 2.34 \times 10^{-2}$$

$10^{-1} 10^{-2}$

$$2.34 \times 10^{-2}$$

(1)

- (b) Write 2.40×10^5 as an ordinary number.

$$2.40 \times 10^5 = 240,000$$

$10^1 10^2 10^3 10^4 10^5$

$$240,000$$

(1)

- (c) Calculate, giving your answer in standard form

$$\frac{2.5 \times 10^{101}}{5 \times 10^{-98}}$$

Show your working clearly.

$$\begin{aligned} \frac{2.5 \times 10^{101}}{5 \times 10^{-98}} &= \frac{2.5}{5} \times 10^{101 - (-98)} \\ &= 0.5 \times 10^{199} \\ &= 5 \times 10^{198} \end{aligned}$$

Laws of Indices:

$$a^m \div a^n = a^{m-n}$$

$$5 \times 10^{198}$$

(2)

(Total for Question 17 is 4 marks)

- 18 (a) Simplify $3w^7y^{-3} \times 4w^2y^3$

$$\begin{aligned} 3w^7y^{-3} \times 4w^2y^3 &= (3 \times 4) \times w^{7+2} \times y^{-3+3} \\ &= 12w^9y^0 \quad \text{Anything to the power of 0 equals 1.} \\ &= 12w^9 \end{aligned}$$

Indices Laws:

$$a^m \times a^n = a^{m+n}$$

$$a^m \div a^n = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$a^{\frac{1}{b}} = \sqrt[b]{a}$$

$$12w^9$$

(2)

- (b) Simplify $(25x^4)^{\frac{3}{2}}$

$$\begin{aligned} (25x^4)^{\frac{3}{2}} &= (\sqrt{25x^4})^3 \\ &= (5x^2)^3 \\ &= 125x^6 \end{aligned}$$

$$125x^6$$

(2)

(Total for Question 18 is 4 marks)

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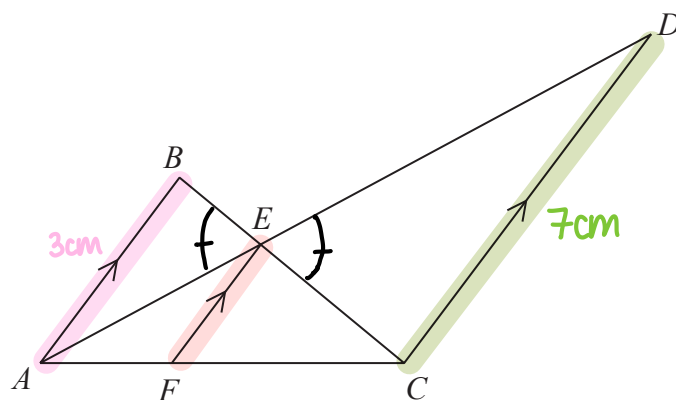


Diagram NOT accurately drawn

The diagram shows triangle ABC and triangle ADC .

E is the point on BC and AD .

F is the point on AC such that AB , FE and CD are parallel.

Given that $AB = 3\text{ cm}$ and that $CD = 7\text{ cm}$,

calculate the length of FE .

Triangles ABC and FEC are similar

$$AB : FE = AC : FC$$

$$\frac{3}{FE} = \frac{AC}{FC}$$

$$\frac{3}{FE} \times FC = AC$$

$$FC = AC \times \frac{FE}{3}$$

Triangles AFE and ADC are similar

$$DC : FE = AC : AF$$

$$\frac{7}{FE} = \frac{AC}{AF}$$

$$\frac{7}{FE} \times AF = AC$$

$$FC = \left(\frac{7}{FE} \times AF \right) \times \frac{FE}{3}$$

$$= \frac{7}{3} AF$$

$$AC = AF + FC$$

$$= AF + \frac{7}{3} AF$$

$$= \frac{10}{3} AF$$

$$FE = 3 \times \frac{FC}{AC}$$

$$FE = 3 \times \frac{\frac{7}{3} AF}{\frac{10}{3} AF}$$

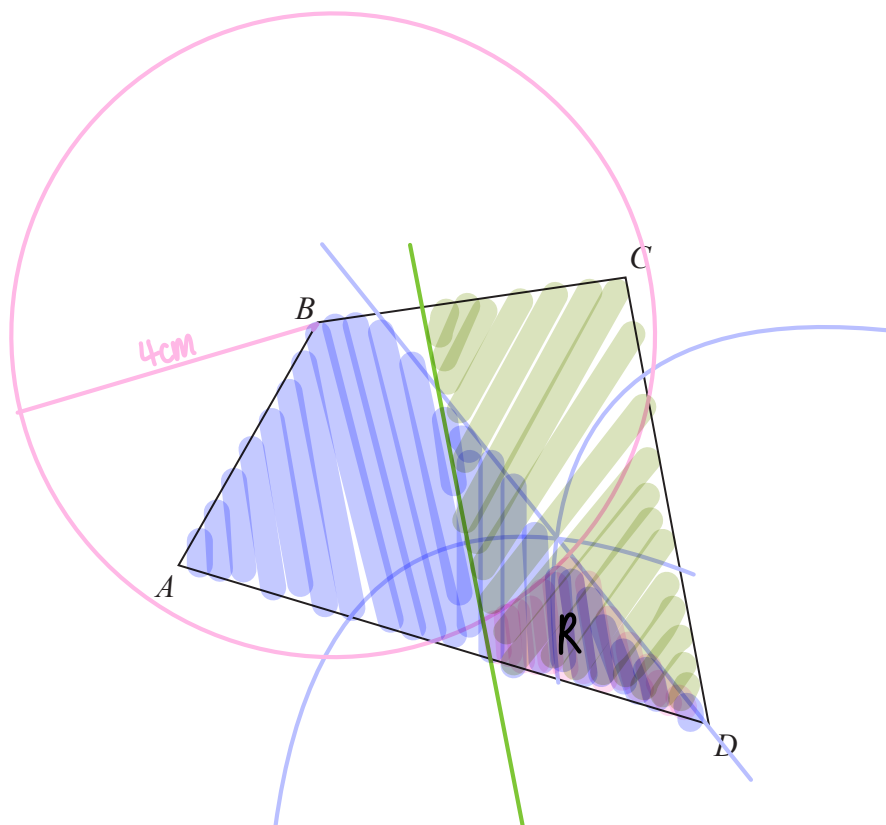
$$= 3 \times \frac{7}{10}$$

$$= 2.1$$

.....2.1..... cm

(Total for Question 19 is 5 marks)





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The diagram shows quadrilateral $ABCD$.

The region **R** consists of all the points inside the quadrilateral that are

- (i) closer to DA than to DC , *Construct angle bisector of $\angle ADC$ using a ruler and compass. Side of angle towards DA contains all points closer to DA than to DC .*
- (ii) less than 3 cm from the side DC , *Measure 3cm to the left of DC and draw a line parallel to DC .*
- (iii) more than 4 cm from B . *Use a compass to draw an arc of radius 4cm centered at B . Required region is outside this circle but inside quadrilateral*

Using ruler and compasses only and **showing all your construction lines**, construct and show, by shading, the region **R**.

Label the region **R**.

(Total for Question 20 is 5 marks)

21

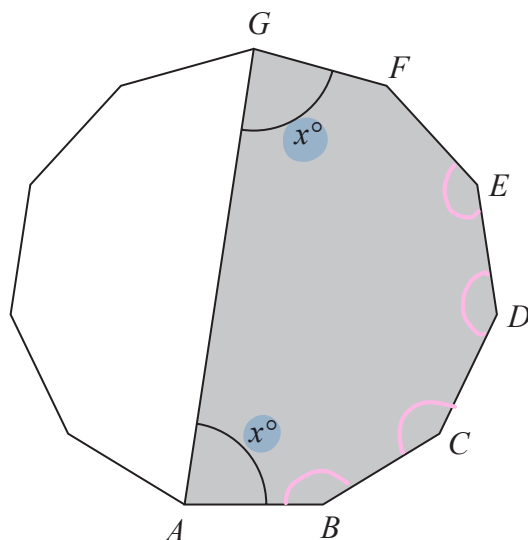


Diagram NOT
accurately drawn

The diagram shows a shaded 7-sided shape $ABCDEFG$.

The points A, B, C, D, E, F and G are 7 vertices of a regular polygon with 11 sides.

$$\angle GAB = \angle AGF = x^\circ$$

Calculate the value, to 3 significant figures, of x .

Show your working clearly.

To find the interior angle of a regular polygon,

$$\frac{(n-2) \times 180}{n}$$

$$\frac{(11-2) \times 180}{11} = 147.27...$$

Total sum of angles of a polygon: $(n-2) \times 180$

sum angles of shaded region: $(7-2) \times 180 = 900$

$$4(147.27...) + 2x = 900$$

$$589.09... + 2x = 900$$

$$2x = 310.90...$$

$$x = 155.45...$$

$$\approx 155$$

$$x = 155$$

(Total for Question 21 is 5 marks)



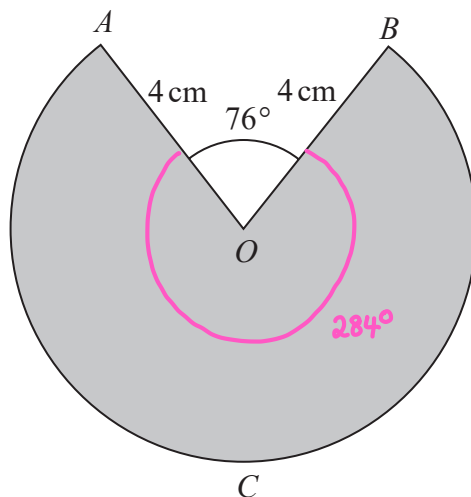


Diagram NOT
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The diagram shows a sector $OACB$ of a circle, centre O .

$$OA = OB = 4 \text{ cm}$$

$$\text{Angle } AOB = 76^\circ$$

(a) Calculate the area, in cm^2 to 3 significant figures, of the shaded sector $OACB$.

$$\text{Area of a circle} = \pi r^2$$

$$360 - 76 = 284$$

$$\frac{284}{360} \times \pi \times (4)^2 = 39.6538...$$

$$\approx 39.7 \text{ (3 s.f.)}$$

$$\underline{\quad 39.7 \quad} \text{ cm}^2$$

(2)

(b) Calculate the perimeter, in cm to 3 significant figures, of the shaded sector $OACB$.

$$\text{Perimeter of a circle} = 2\pi r$$

$$ACB \rightarrow \frac{284}{360} \times 2\pi \times 4 = 19.82...$$

$$OACB \rightarrow 19.826... + 4 + 4 = 27.826...$$

$$\approx 27.8$$

$$\underline{\quad 27.8 \quad} \text{ cm}$$

(3)

(Total for Question 22 is 5 marks)



- 23 y is directly proportional to x^3
 x is inversely proportional to the square root of w .

$$y = 729 \text{ when } x = 4.5$$

$$x = 25 \text{ when } w = 0.16$$

Find a formula for y in terms of w .

$$y \propto x^3$$

$$y = kx^3$$

$$k = \frac{y}{x^3}$$

$$k = \frac{729}{4.5^3}$$

$$= 8$$

$$y = 8x^3$$

$$x \propto \frac{1}{\sqrt{w}}$$

$$x = \frac{a}{\sqrt{w}}$$

$$a = x\sqrt{w}$$

$$a = 25 \times \sqrt{0.16}$$

$$= 10$$

$$\therefore x = \frac{10}{\sqrt{w}}$$

Substitute $x = \frac{10}{\sqrt{w}}$ into $y = 8x^3$

$$y = 8 \left(\frac{10}{\sqrt{w}} \right)^3$$

$$y = 8 \left(\frac{1000}{w\sqrt{w}} \right)$$

$$y = \frac{8000}{w\sqrt{w}} \text{ or } 8000w^{-\frac{3}{2}}$$

$$\frac{8000}{w\sqrt{w}}$$

(Total for Question 23 is 5 marks)



24 $(2x + 1)$, $(10x - 10)$ and $(35x - 5)$ are the first three terms of a sequence.

The first term of the sequence is $(2x + 1)$ where $(2x + 1) \neq 0$

After the first term, all other terms of the sequence are found by using the rule

'multiply the previous term by d '

Given that x is an integer,

find the value of d .

$$\begin{array}{ccc} (2x + 1) & (10x - 10) & (35x - 5) \\ & \swarrow \times d & \swarrow \times d \end{array}$$

Form 2 equations and solve simultaneously for x and d .

$$(2x + 1) \times d = (10x - 10) \quad (10x - 10) \times d = (35x - 5)$$

$$d = \frac{(10x - 10)}{(2x + 1)}$$

Substitute d into the second equation and solve for x .

$$(10x - 10) \times \frac{(10x - 10)}{(2x + 1)} = (35x - 5)$$

$$\frac{100x^2 - 200x + 100}{2x + 1} = (35x - 5)$$

$$100x^2 - 200x + 100 = (35x - 5)(2x + 1)$$

$$100x^2 - 200x + 100 = 70x^2 + 25x - 5$$

$$30x^2 - 225x + 105 = 0$$

$$6x^2 - 45x + 21 = 0$$

$$\div 3 \rightarrow 2x^2 - 15x + 7 = 0 \quad \div 3$$

$$2x^2 - 15x + 7 = 0$$

$$(2x - 14 - 7)(2x - 1) = 0$$

$$2$$

$$(x - 7)(2x - 1) = 0$$

$$x - 7 = 0$$

$$x = 7$$

$$2x - 1 = 0$$

$$2x = 1$$

$$\div 2 \rightarrow x = \frac{1}{2}$$

x is an integer

Sub $x = 7$

$$d = \frac{10(7) - 10}{2(7) + 1}$$

$$= \frac{70 - 10}{14 + 1} = 4$$

$$d = 4$$

(Total for Question 24 is 5 marks)

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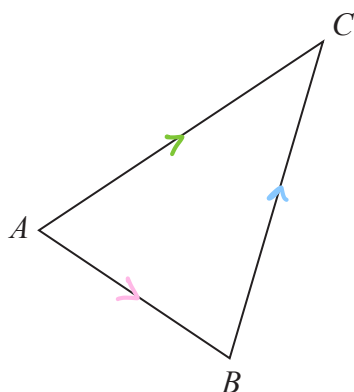


Diagram **NOT** accurately drawn

ABC is a triangle.

$$\vec{AB} = \begin{pmatrix} 3 \\ -2 \end{pmatrix} \quad \vec{BC} = \begin{pmatrix} x \\ 5x \end{pmatrix} \text{ where } x > 0 \text{ and } |\vec{AC}| = 5$$

Find $\vec{AC}$ as a column vector.
Show clear algebraic working.

$$\vec{AC} = \vec{AB} + \vec{BC}$$

$$\vec{AC} = \begin{pmatrix} 3 \\ -2 \end{pmatrix} + \begin{pmatrix} x \\ 5x \end{pmatrix}$$

$$\vec{AC} = \begin{pmatrix} 3+x \\ -2+5x \end{pmatrix}$$

$$|\vec{AC}| = 5$$

$$(3+x)^2 + (5x-2)^2 = 5^2$$

$$9 + 6x + x^2 + 25x^2 - 20x + 4 = 25$$

$$26x^2 - 14x - 12 = 0$$

$$\div 2 \rightarrow 13x^2 - 7x - 6 = 0 \quad \div 2$$

$$13x - 6 = -$$

$$\cancel{13x - 6} (13x + 6) = 0$$

$$(x-1)(13x+6) = 0$$

$$x-1=0$$

$$x=1$$

$$\hookrightarrow x > 0$$

$$\therefore x = 1$$

Sub $x = 1$

$$\vec{AC} = \begin{pmatrix} 3 + (1) \\ 5(1) - 2 \end{pmatrix}$$

$$= \begin{pmatrix} 4 \\ 3 \end{pmatrix}$$

$$\begin{pmatrix} 4 \\ 3 \end{pmatrix}$$

(Total for Question 25 is 5 marks)



26 A small ball is thrown into the air from a point that is 1 m above horizontal ground.

The ball moves vertically upwards so that at time t seconds after the ball was thrown, the height, h metres, of the ball above the ground is given by

$$h = 1 + kt - 5t^2 \quad \text{where } k \text{ is a constant.}$$

At time t seconds after the ball was thrown, the velocity of the ball is v m/s.

(a) Find an expression for v in terms of k and t .

To find an expression for velocity, you must differentiate the expression for displacement
The general rule for differentiation is to "bring down the power and subtract 1"

$$h = 1 + kt - 5t^2$$

$$v = k - (2)5t^{2-1}$$

$$v = k - 10t$$

$$v = k - 10t$$

(1)

Given that the total distance travelled by the ball between the instant when the ball is thrown and when it hits the ground for the first time is 161 m,

(b) calculate the value of k .

The velocity will be 0 when the ball is on the ground.

(5)

$$\begin{aligned} k - 10t &= 0 \\ +10t \quad \rightarrow \quad k &= 10t \quad \rightarrow +10t \\ \div 10 \quad \rightarrow \quad \frac{k}{10} &= t \quad \rightarrow \div 10 \end{aligned}$$

Substitute $t = \frac{k}{10}$ to h

$$1 + kt - 5t^2 = h$$

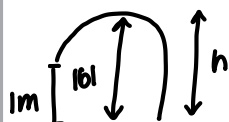
$$1 + k\left(\frac{k}{10}\right) - 5\left(\frac{k}{10}\right)^2 = h$$

$$1 + \frac{k^2}{10} - \frac{5k^2}{100} = h$$

$$1 + \frac{k^2}{20} = h$$

Substitute $h = 81$

$$\begin{aligned} 1 + \frac{k^2}{20} &= 81 \\ \times 20 \quad \rightarrow \quad 20 + k^2 &= 1620 \\ -20 \quad \rightarrow \quad k^2 &= 1600 \\ \sqrt{\quad} \quad \rightarrow \quad k &= 40 \end{aligned}$$



$$\begin{aligned} (h \times 2) - 1 &= 161 \\ \rightarrow \quad 2h &= 162 \\ \div 2 \quad \rightarrow \quad h &= 81 \end{aligned}$$

$$k = 40$$

(Total for Question 26 is 6 marks)

TOTAL FOR PAPER IS 100 MARKS



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