

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
International GCSE**

Centre Number

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Candidate Number

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Tuesday 21 May 2019

Morning (Time: 1 hour 30 minutes)

Paper Reference **4MB1/01**

Mathematics B

Paper 1



You must have: Ruler graduated in centimetres and millimetres, protractor, 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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Pearson

Answer ALL TWENTY EIGHT questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 (a) Write 8693 to 2 significant figures.

$$\begin{array}{r} 8693 \approx 8700 \\ \underline{\quad} \\ \rightarrow 6 \text{ rounds UP} \end{array}$$

..... 8700
(1)

- (b) Write 0.0374 to 2 significant figures.

$$\begin{array}{r} 0.0374 \approx 0.038 \\ \downarrow \rightarrow 7 \text{ rounds UP} \\ \text{0s before a} \\ \text{whole number} \\ \text{do not count} \end{array}$$

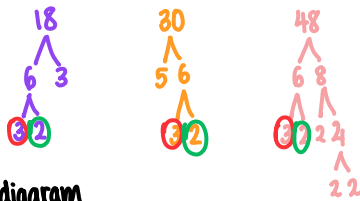
..... 0.038
(1)

(Total for Question 1 is 2 marks)

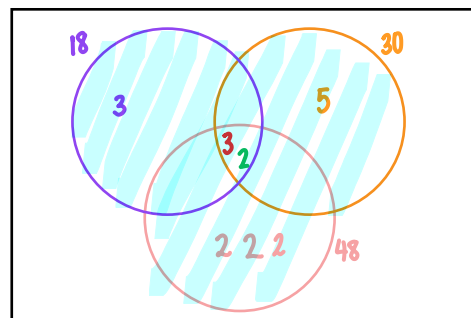
- 2 Find the Lowest Common Multiple (LCM) of 18, 30 and 48
Show your working clearly.

The ideal way to find the LCM is with a Venn diagram.

- ① Draw factor trees for each



- ② Draw a Venn diagram



- ③ The LCM is the product of all the Venn diagram

$$\text{LCM} = 3 \times 2 \times 3 \times 5 \times 2 \times 2 \times 2 = 720$$

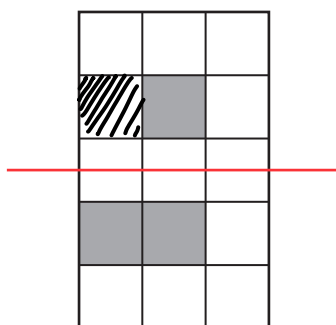
..... 720

(Total for Question 2 is 2 marks)



- 3 A pattern is made with white squares and shaded squares.

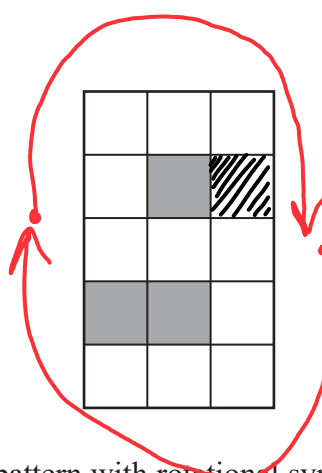
(a)



Shade **one** more square to make a pattern with exactly 1 line of symmetry.

(1)

(b)



Shade **one** more square to make a pattern with rotational symmetry of order 2

(1)

(Total for Question 3 is 2 marks)

- 4 Work out $2\frac{1}{4} \div 3\frac{5}{6}$

Show your working clearly and give your answer as a fraction in its simplest form.

$$2\frac{1}{4} \div 3\frac{5}{6} = \frac{2(4)+1}{4} \div \frac{3(6)+5}{6}$$

$$= \frac{8+1}{4} \div \frac{18+5}{6}$$

$$= \frac{9}{4} \div \frac{23}{6}$$

$$= \frac{9}{4} \times \frac{6}{23}$$

$$= \frac{27}{46}$$

Turn into mixed numbers

→ Invert second fraction to multiply and simplify

→ Cannot be simplified further

$\frac{27}{46}$

(Total for Question 4 is 2 marks)



5 Given that $y = 2x^4 - \frac{3}{x^2}$
find $\frac{dy}{dx}$ } Differentiate

The general rule for differentiation is "bring down a power and subtract 1".
But here you first need to rewrite your equation.

$$y = 2x^4 - \frac{3}{x^2} \rightarrow \frac{1}{x} = x^{-1} \quad \frac{1}{x^2} = x^{-2}$$

$$= 2x^4 - 3x^{-2}$$

$$\frac{dy}{dx} = 8x^3 + 6x^{-3}$$

Now you can differentiate

$$\frac{dy}{dx} = (4)2x^{4-1} - (-2)3x^{-2-1}$$

$$= 8x^3 + 6x^{-3}$$

(Total for Question 5 is 2 marks)

6 A straight line passes through the points with coordinates (2, -10) and (-3, 5)

Calculate the gradient of the line.

$$\text{gradient} = \frac{\text{change in } y}{\text{change in } x}$$

$$\text{gradient} = \frac{5 - (-10)}{-3 - 2}$$

$$= \frac{15}{-5}$$

$$= -3$$

-3

(Total for Question 6 is 2 marks)

7 Expand and simplify $(4x - 5)(2x + 3)$

$$(4x - 5)(2x + 3) = 8x^2 + 12x - 10x - 15$$

$$= 8x^2 + 2x - 15$$

Or

	4x	-5
2x	8x ²	-10x
3	12x	-15

$$8x^2 + 12x - 10x - 15$$

$$= 8x^2 + 2x - 15$$

$$8x^2 + 2x - 15$$

(Total for Question 7 is 2 marks)



DO NOT WRITE IN THIS AREA

11 (a) Simplify $2x^2 \times 3x^5$

$$2x^2 \times 3x^5 = (2 \times 3)x^{2+5} \\ = 6x^7$$

Laws of indices:

$$x^a \times x^b = x^{a+b}$$

$$x^a \div x^b = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

$$6x^7$$

(1)

(b) Simplify $(4a^2b^3)^3$

$$(4a^2b^3)^3 = (4^3 \times a^{2 \times 3} \times b^{3 \times 3}) \\ = 16 \times a^{2 \times 3} \times b^{3 \times 3} \\ = 16a^6b^9$$

$$16a^6b^9$$

(2)

(Total for Question 11 is 3 marks)

12 The function f is defined for all values of x by $f: x \mapsto x^2 - 2$

(a) Write down the range of f .

(1)

The function g is given by $g: x \mapsto \frac{12}{x^3 + 4}$ where $x \neq \sqrt[3]{-4}$

(b) Calculate $fg(2)$

To find $fg(2)$, you first need to find $fg(x)$ by substituting $g(x)$ into $f(x)$.

$$fg(x) = \left(\frac{12}{x^3 + 4} \right)^2 - 2$$

You can now substitute $x=2$ and solve using your calculator.

$$fg(2) = \left(\frac{12}{2^3 + 4} \right)^2 - 2 \\ = -1$$

$$-1$$

(2)

(Total for Question 12 is 3 marks)



13 (a) Find the value of $3c^2$ when $c = -8$

Substitute $c = 8$ into $3c^2$

$$3(8)^2 = 192$$

192

(1)

(b) Factorise completely $3c^2 + 6c$

$$3c^2 + 6c = 3c(c+2)$$

Take out a common factor of $3c$

$3c(c+2)$

(2)

(Total for Question 13 is 3 marks)

14 Simplify fully $\frac{3x^2 - 8x - 3}{4x^2 - 36}$

In order to simplify, you first need to separately factorise both the numerator and denominator.

$$3x^2 - 8x - 3 = (3x - 3)(x + 1)$$

What two numbers add to give -8 and multiply to give -9? -9 and 1

$$= (x-3)(3x+1)$$

$$4x^2 - 36 = 4(x^2 - 9)$$

Take out a factor of 4

$$= 4(x-3)(x+3) \rightarrow \text{This is a difference of 2 squares and is important to recognise.}$$

$$\frac{3x^2 - 8x - 3}{4x^2 - 36} = \frac{(x-3)(3x+1)}{4(x-3)(x+3)}$$

$$= \frac{(3x+1)}{4(x+3)}$$

$\frac{3x+1}{4(x+3)}$

(Total for Question 14 is 3 marks)



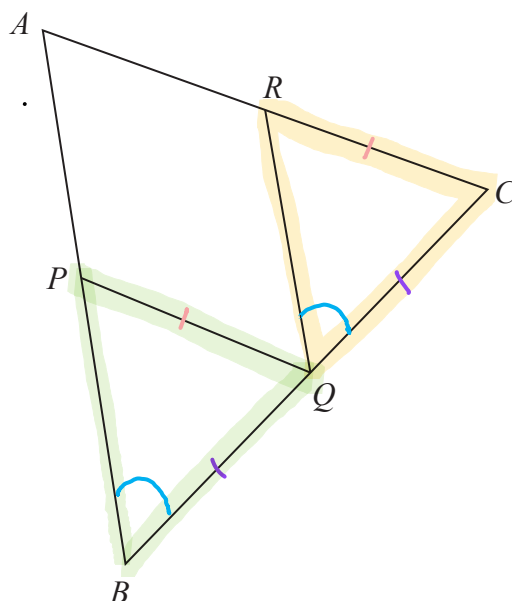


Diagram NOT
accurately drawn

The diagram shows $\triangle ABC$.

$APQR$ is a parallelogram where P is the midpoint of AB , Q is the midpoint of BC and R is the midpoint of AC .

Prove that $\triangle PBQ$ and $\triangle RQC$ are congruent.

Since Q is the midpoint of BC , BQ and QC are equal in length

$$BQ = QC$$

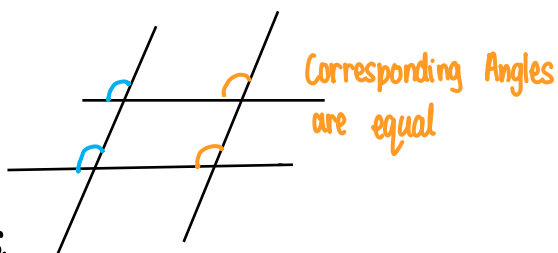
Since R is the midpoint of AC , $AR = RC$. And, since PQ and AR are opposite sides of a parallelogram, they are equal

$$PQ = AR.$$

$$\therefore PQ = RC$$

$\angle PBQ$ and $\angle RQC$ are corresponding angles

$$\angle PBQ = \angle RQC$$

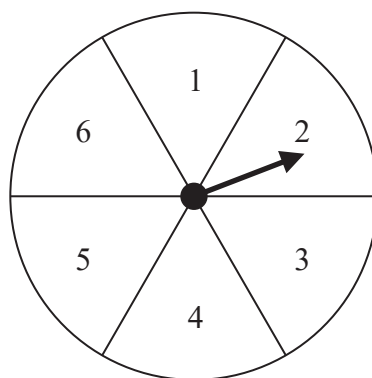


$\therefore \triangle PBQ$ and $\triangle RQC$ are congruent by SAS.

(Total for Question 15 is 3 marks)



16 Here is a biased spinner labelled 1, 2, 3, 4, 5, 6



The table below shows information about the probability that when the spinner is spun once it will land on each of the numbers 1, 2, 3, 4, 5, 6

Number	1	2	3	4	5	6
Probability	0.05	0.1	$2x - 0.1$	0.2	0.3	$3x + 0.2$

Abdul is going to spin the spinner 300 times.

(a) Calculate an estimate for the number of times the spinner will land on number 1

$$\begin{array}{c} \text{Probability of 1} \\ \downarrow \\ \underline{300} \times 0.05 = 15 \\ \downarrow \\ \text{number of} \\ \text{times spun} \end{array}$$

15

(1)

(b) Calculate the probability that when the spinner is spun once it lands on number 6

Probability always adds to 1.

$$(0.05) + (0.1) + (2x - 0.1) + (0.2) + (0.3) + (3x + 0.2) = 1$$

$$\begin{array}{l} 0.35 + 5x = 1 \\ -0.35 \quad \left(\begin{array}{l} \rightarrow 5x = 0.25 \\ \rightarrow x = 0.05 \end{array} \right) \end{array}$$

Sub $x = 0.05$ into probability of 6:

$$\begin{aligned} 3(0.05) + 0.2 &= 0.15 + 0.2 \\ &= 0.35 \end{aligned}$$

0.35

(3)

(Total for Question 16 is 4 marks)



17 Here is $\triangle ABC$.

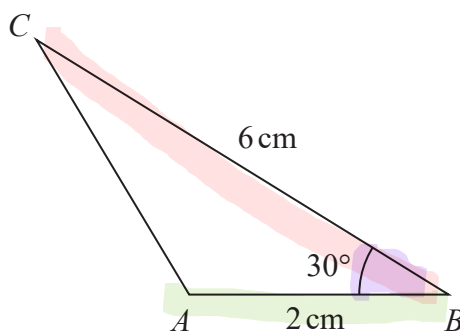


Diagram **NOT**
accurately drawn

(a) Calculate the area, in cm^2 , of $\triangle ABC$.

Here, since you have a known angle and two known sides, you can find area using:

$$\text{Area} = \frac{1}{2}ab\sin C$$

where $a = 6 \text{ cm}$

$b = 2 \text{ cm}$

$C = 30^\circ$

$$\begin{aligned}\text{Area} &= \frac{1}{2}(6) \times (2) \times \sin 30^\circ \\ &= 3 \text{ cm}^2\end{aligned}$$

..... 3 cm^2
(2)

Here is $\triangle PQR$.

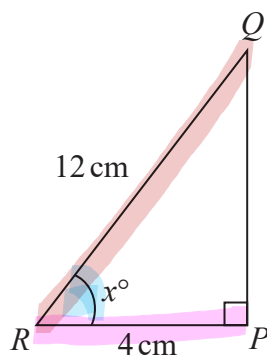


Diagram **NOT**
accurately drawn

(b) Calculate the value, to 3 significant figures, of x .

You can find x using $\text{S}^\circ\text{H}^\circ\text{C}^\circ\text{H}^\circ\text{T}^\circ\text{A}$.

Since you have the hypotenuse and adjacent and you want to find the angle, you can use

$$\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$$

where $\theta = x^\circ$

$A = 4 \text{ cm}$

$H = 12 \text{ cm}$

$$\begin{aligned}\cos x &= \frac{4}{12} \\ x &= \cos^{-1}\left(\frac{4}{12}\right) \\ &= 70.5^\circ\end{aligned}$$

$x = 70.5$
(2)

(Total for Question 17 is 4 marks)



18 There are 9 marbles in bag A and 11 marbles in bag B .

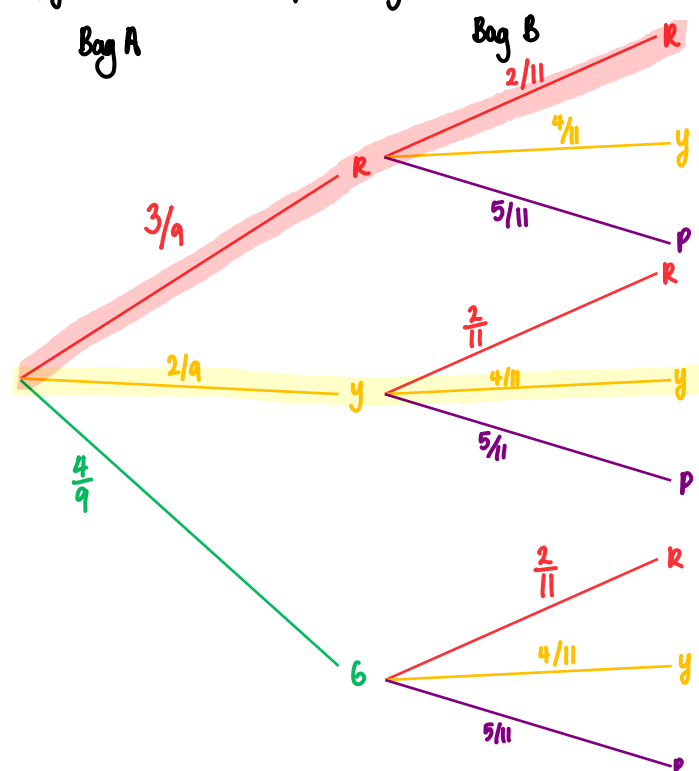
In bag A , there are 3 red marbles, 2 yellow marbles and 4 green marbles.

In bag B , there are 2 red marbles, 4 yellow marbles and 5 purple marbles.

Ted takes at random one marble from bag A and one marble from bag B .

Calculate the probability that the two marbles are not the same colour.

For this question, you need to draw a probability tree.



Since you only want the probability of NOT picking the same colour and you know that probabilities always add to 1, you can calculate the probability of choosing the same colours and subtract from 1.

$$\text{Probability of R and R} \rightarrow \frac{3}{9} \times \frac{2}{11} = \frac{6}{99}$$

$$\text{Probability of Y and Y} \rightarrow \frac{2}{9} \times \frac{4}{11} = \frac{8}{99}$$

$$\text{Total probability of same colours} \rightarrow \frac{6}{99} + \frac{8}{99} = \frac{14}{99}$$

Probability of NOT choosing the same colour:

$$1 - \frac{14}{99} = \frac{99}{99} - \frac{14}{99} = \frac{85}{99}$$

$\frac{85}{99}$

(Total for Question 18 is 4 marks)



19 The period, T seconds, of a simple pendulum of length L metres is given by the formula

$$T = 6.28 \sqrt{\frac{L}{g}}$$

$L = 1.32$ to 3 significant figures.

$g = 9.8$ to 2 significant figures.

Calculate the upper bound, to 3 significant figures, of T .

To gain the upper bound by division:

$$\text{Upper bound} = \text{upper bound} \div \text{lower bound}$$

So if we want the upper bound of T , you need the upper bound of L and lower bound of g .

First, write the boundaries of both:

$$\begin{array}{c} \text{Lower bound} \nwarrow 1.315 \leq L < 1.325 \nearrow \text{Upper bound} \\ \nwarrow 9.75 \leq g < 9.85 \nearrow \end{array}$$

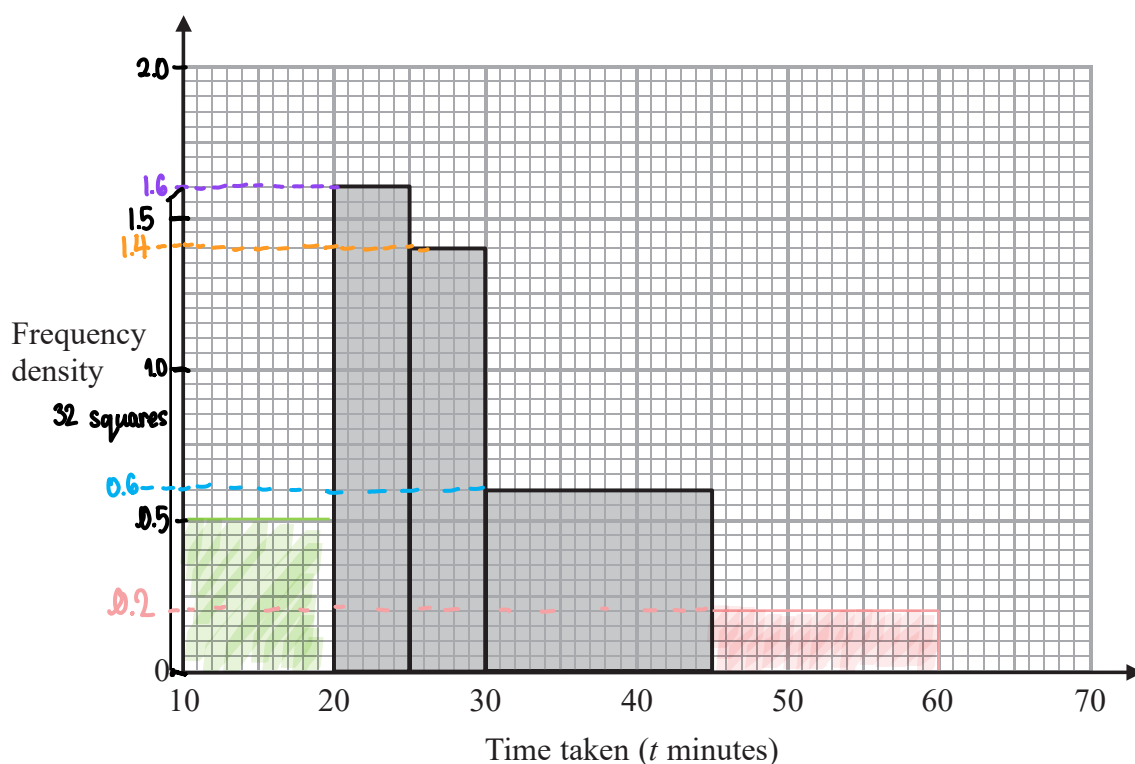
$$\begin{aligned} T &= 6.28 \times \sqrt{\frac{1.325}{9.75}} \\ &= 2.315... \\ &\approx 2.32 \text{ (3sf)} \end{aligned}$$

2.32

(Total for Question 19 is 4 marks)



- 20 The incomplete histogram and the incomplete table give information about the time taken, in minutes, for some students to each complete a piece of homework. No student took less than 10 minutes to complete the homework and no student took longer than 60 minutes to complete the homework.



Time taken (t minutes)	Number of students	Class width	Frequency Density
$10 \leq t < 20$	5	10	$\frac{5}{10} = 0.5$
$20 \leq t < 25$	8	5	$\frac{8}{5} = 1.6$
$25 \leq t < 30$	$5 \times 1.4 = 7$	5	1.4
$30 \leq t < 45$	$15 \times 1.6 = 24$	15	0.6
$45 \leq t < 60$	3	15	$\frac{3}{15} = 0.2$

Complete the histogram and the table.

$$\text{frequency density} = \text{frequency} \div \text{class width}$$

$$\text{frequency} = \text{frequency density} \times \text{class width}$$

We know that for the time interval $25 \leq t < 30$, the frequency density is 1.6 and the histogram is 32 units tall. From this we can find out the height of each square.

$$\frac{1.6}{32} = 0.05$$

So 10 squares must be $10 \times 0.05 = 0.5$ units.

(Total for Question 20 is 4 marks)



21 Make x the subject of

$$\frac{x}{3} - 5 = \frac{x + 2y}{3w - 2y}$$

Give your answer as a single fraction.

$$\begin{aligned} \frac{x}{3} - 5 &= \frac{x + 2y}{3w - 2y} \\ \times 3 & \quad \times 3 \\ x - 15 &= \frac{3x + 6y}{3w - 2y} \\ \times (3w - 2y) & \quad \times (3w - 2y) \\ (x - 15)(3w - 2y) &= 3x + 6y \\ \text{Expand} & \\ 3xw - 2yx - 45w + 30y &= 3x + 6y \\ -3x & \quad -3x \\ 3xw - 2yx - 3x - 45w + 30y &= 6y \\ -30y & \quad -30y \\ 3xw - 2yx - 3x - 45w &= -24y \\ \text{factorise } x & \\ x(3w - 2y - 3) - 45w &= -24y \\ +45w & \quad +45w \\ x(3w - 2y - 3) &= -24y + 45w \\ \div (3w - 2y - 3) & \quad \div (3w - 2y - 3) \\ x &= \frac{-24y + 45w}{3w - 2y - 3} \end{aligned}$$

$$x = \frac{-24y + 45w}{3w - 2y - 3}$$

(Total for Question 21 is 4 marks)



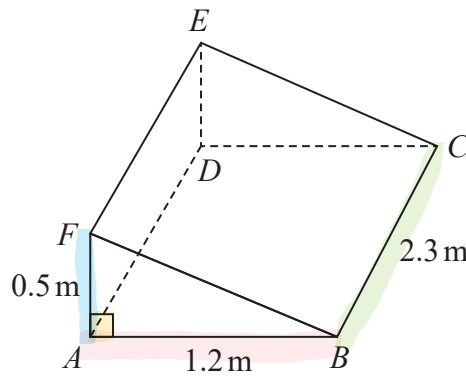


Diagram NOT
accurately drawn

$ABCDEF$ is a right triangular prism in which

$$AB = 1.2 \text{ m}$$

$$BC = 2.3 \text{ m}$$

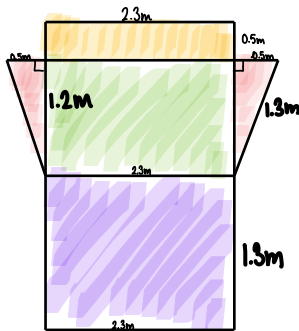
$$AF = 0.5 \text{ m}$$

$$\angle FAB = 90^\circ$$

Calculate the total surface area, in m^2 , of the prism.

The surface area is the sum of the areas of each side.

It is easier to find if you visualise a plan for the 3D shape.



First, find FB using pythagoras's theorem:

$$\begin{aligned} a^2 + b^2 &= c^2 \\ AF^2 + AB^2 &= FB^2 \\ (0.5)^2 + (1.2)^2 &= FB^2 \\ \sqrt{(0.5)^2 + (1.2)^2} &= FB \\ 1.3 \text{ m} &= FB \end{aligned}$$

Area of a triangle: $\frac{1}{2} \times \text{base} \times \text{height}$

Area of a rectangle: $\text{base} \times \text{height}$

Surface area:

$$\begin{aligned} &(2.3 \times 0.5) + (1.2 \times 2.3) + (2.3 \times 1.3) + 2 \left(\frac{1}{2} \times 1.2 \times 0.5 \right) \\ &= (1.15) + (2.76) + (2.99) + (0.60) \\ &= 7.5 \text{ m}^2 \end{aligned}$$

..... 7.5 m^2

(Total for Question 22 is 5 marks)



- 23 In a survey, 60 students were asked whether they study any of History (H), Geography (G) or Latin (L).

Of these students

27 study History

25 study Geography

18 study Latin

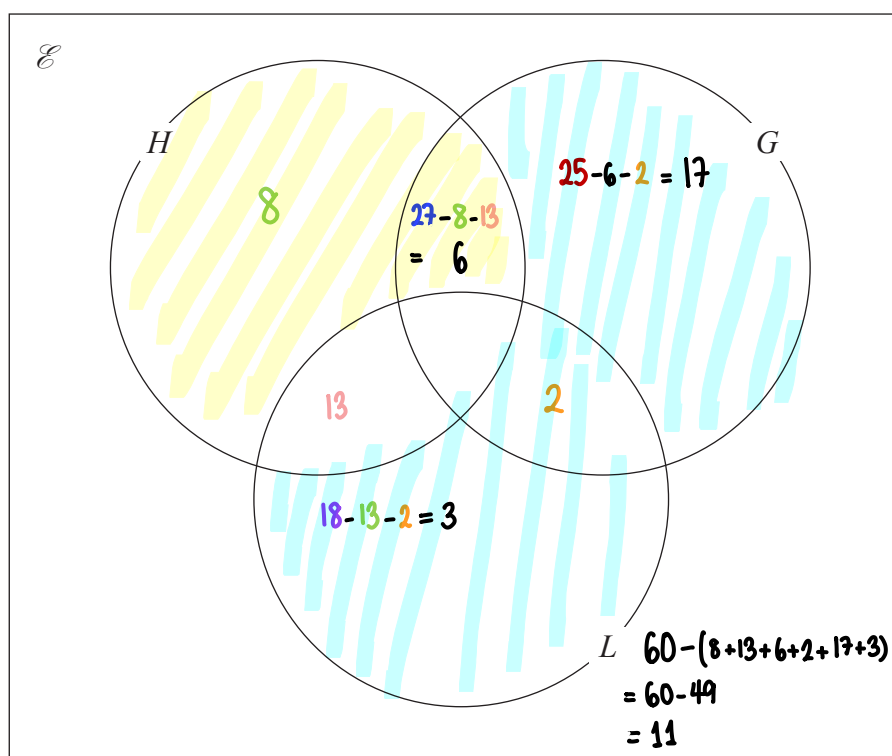
13 study both History and Latin

2 study both Geography and Latin

8 study History only

No students study History and Geography and Latin.

- (a) Use the information to complete the Venn diagram.



(3)

- (b) Find the number of students who study History but not Latin.

$$8 + 6 = 14$$

14

(1)

- (c) Find $n(H' \cap [L \cup G])$

$$17 + 2 + 3 = 22$$

22

(1)

(Total for Question 23 is 5 marks)



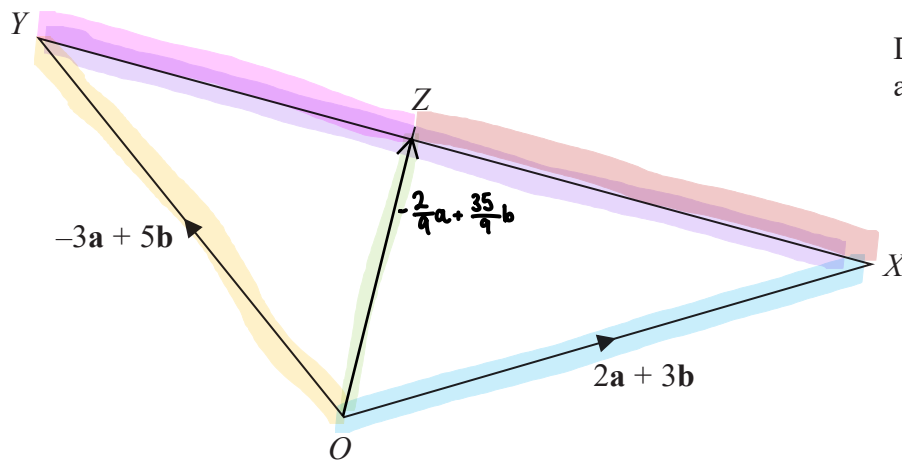


Diagram NOT
accurately drawn

The diagram shows $\triangle OXY$ where $\vec{OX} = 2\mathbf{a} + 3\mathbf{b}$ and $\vec{OY} = -3\mathbf{a} + 5\mathbf{b}$

(a) Find and simplify an expression, in terms of $\mathbf{a}$ and $\mathbf{b}$, for $\vec{YX}$.

$$\vec{YX} = -\vec{OY} + \vec{OX}$$

$$\vec{YX} = -(-3\mathbf{a} + 5\mathbf{b}) + (2\mathbf{a} + 3\mathbf{b})$$

$$= 3\mathbf{a} - 5\mathbf{b} + 2\mathbf{a} + 3\mathbf{b}$$

$$= 5\mathbf{a} - 2\mathbf{b}$$

$$5\mathbf{a} - 2\mathbf{b}$$

(2)

The point Z on YX is such that $\vec{OZ} = -\frac{2}{9}\mathbf{a} + \frac{35}{9}\mathbf{b}$

(b) Calculate, in its simplest form, the ratio of $YZ:ZX$

Find $\vec{YZ}$ and $\vec{ZX}$ separately:

$$\vec{YZ} = \vec{YO} + \vec{OZ}$$

$$\vec{YZ} = -(-3\mathbf{a} + 5\mathbf{b}) + \left(-\frac{2}{9}\mathbf{a} + \frac{35}{9}\mathbf{b}\right)$$

$$= 3\mathbf{a} - 5\mathbf{b} - \frac{2}{9}\mathbf{a} + \frac{35}{9}\mathbf{b}$$

$$= \frac{25}{9}\mathbf{a} - \frac{10}{9}\mathbf{b}$$

$$\vec{ZX} = \vec{ZO} + \vec{OX}$$

$$\vec{ZX} = -\left(-\frac{2}{9}\mathbf{a} + \frac{35}{9}\mathbf{b}\right) + (2\mathbf{a} + 3\mathbf{b})$$

$$= \frac{2}{9}\mathbf{a} - \frac{35}{9}\mathbf{b} + 2\mathbf{a} + 3\mathbf{b}$$

$$= \frac{20}{9}\mathbf{a} - \frac{8}{9}\mathbf{b}$$

Compare and simplify:

$$\vec{YZ} : \vec{ZX}$$

$$\frac{25}{9}\mathbf{a} - \frac{10}{9}\mathbf{b} : \frac{20}{9}\mathbf{a} - \frac{8}{9}\mathbf{b}$$

$$\begin{array}{l} \times 9 \quad \left(\frac{25}{9}\mathbf{a} - \frac{10}{9}\mathbf{b} : \frac{20}{9}\mathbf{a} - \frac{8}{9}\mathbf{b} \right) \times 9 \\ \text{factor out } 5 \quad \left(5(5\mathbf{a} - 2\mathbf{b}) : 4(5\mathbf{a} - 2\mathbf{b}) \right) \text{ factor out } 4 \end{array}$$

$$\div (5\mathbf{a} - 2\mathbf{b}) \quad \left(5 : 4 \right) \div (5\mathbf{a} - 2\mathbf{b})$$

$$5 : 4$$

$$5:4$$

(3)

(Total for Question 24 is 5 marks)



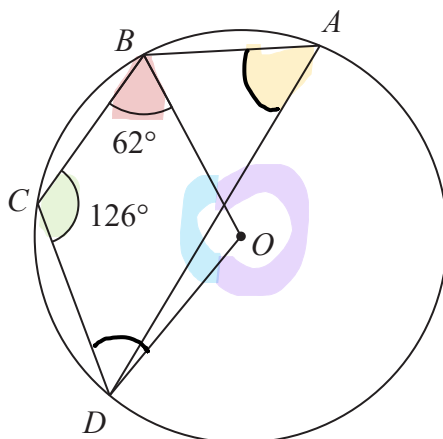


Diagram NOT
accurately drawn

In the diagram, A , B , C and D are points on a circle, centre O .

$$\angle CBO = 62^\circ \text{ and } \angle BCD = 126^\circ$$

- (a) Find the size, in degrees, of $\angle BAD$.

Give a reason for your answer.

The sum of opposite angles in a cyclic quadrilateral is 180.

$$180 - 126 = 54^\circ$$

$$\angle BAD = \underline{54}^\circ \quad (2)$$

- (b) Find the size, in degrees, of $\angle ODC$.

Give reasons for your working.

The angle at the centre is twice the angle at the circumference.

$$\angle BOD \text{ reflex} = 2 \times \angle BCD$$

$$\begin{aligned} \angle BOD \text{ reflex} &= 2 \times 126 \\ &= 252^\circ \end{aligned}$$

Angles round a point add to 360° .

$$\angle BOD \text{ reflex} + \angle BOD = 360$$

$$252 + \angle BOD = 360$$

$$\angle BOD = 108^\circ$$

Angles in a quadrilateral add to 360° .

$$\angle BCD + \angle CBO + \angle BOD + \angle ODC = 360$$

$$126 + 62 + 108 + \angle ODC = 360$$

$$\angle ODC = 64^\circ$$

$$\angle ODC = \underline{64}^\circ \quad (4)$$

(Total for Question 25 is 6 marks)



$$A = \begin{pmatrix} 2 & 3 \\ -5 & 1 \end{pmatrix}$$

$$B = \begin{pmatrix} 4 & k \\ 1 & -1 \end{pmatrix}$$

The determinant of the matrix $A^2 - AB$ is equal to $3k + 28$

Find the value of k .

First find A^2 and AB individually.

Rule for multiplying a 2×2 matrix by a 2×2 matrix:

$$\begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} \begin{pmatrix} a_2 & b_2 \\ c_2 & d_2 \end{pmatrix} = \begin{pmatrix} a_1 a_2 + b_1 c_2 & a_1 b_2 + b_1 d_2 \\ c_1 a_2 + d_1 c_2 & c_1 b_2 + d_1 d_2 \end{pmatrix}$$

$$A^2 = \begin{pmatrix} 2 & 3 \\ -5 & 1 \end{pmatrix} \times \begin{pmatrix} 2 & 3 \\ -5 & 1 \end{pmatrix} = \begin{pmatrix} (4) + (-15) & (6) + (3) \\ (-10) + (-5) & (-15) + (1) \end{pmatrix} \\ = \begin{pmatrix} -11 & 9 \\ -15 & -14 \end{pmatrix}$$

$$AB = \begin{pmatrix} 2 & 3 \\ -5 & 1 \end{pmatrix} \times \begin{pmatrix} 4 & k \\ 1 & -1 \end{pmatrix} = \begin{pmatrix} (8) + (3) & (2k) + (-3) \\ (-10) + (1) & (-5k) + (-1) \end{pmatrix} \\ = \begin{pmatrix} 11 & 2k-3 \\ -9 & -5k-1 \end{pmatrix}$$

Now you can subtract the two:

To subtract a 2×2 matrix from a 2×2 matrix:

$$\begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} - \begin{pmatrix} a_2 & b_2 \\ c_2 & d_2 \end{pmatrix} = \begin{pmatrix} a_1 - a_2 & b_1 - b_2 \\ c_1 - c_2 & d_1 - d_2 \end{pmatrix}$$

$$\begin{pmatrix} -11 & 9 \\ -15 & -14 \end{pmatrix} - \begin{pmatrix} 11 & 2k-3 \\ -9 & -5k-1 \end{pmatrix} = \begin{pmatrix} (-11) - (11) & (9) - (2k-3) \\ (-15) - (-9) & (-14) - (-5k-1) \end{pmatrix} \\ = \begin{pmatrix} -22 & 12-2k \\ -6 & -13+5k \end{pmatrix}$$

$$\text{determinant of } A^2 - AB = -22(-13+5k) - 4(12-2k)$$

$$-22(-13+5k) - 4(12-2k) = 3k + 28$$

$$286 - 110k - 48 + 8k = 3k + 28$$

$$-28 \left(\begin{array}{l} 238 - 102k = 3k + 28 \\ 210 - 102k = 3k \end{array} \right) - 28$$

$$+102k \left(\begin{array}{l} 210 = 105k \\ \div 105 \end{array} \right) \div 105 \quad \begin{array}{l} 2 + 102k \\ \div 105 \end{array}$$

$$k = \frac{210}{105}$$

$$k = 2$$

$$k = 2$$

(Total for Question 26 is 6 marks)



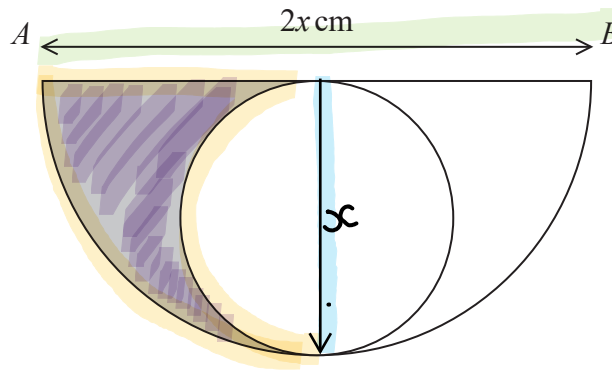


Diagram NOT
accurately drawn

The diagram shows a semicircle, with diameter AB , where $AB = 2x$ cm.

The diagram also shows a circle, which is the circle with the greatest possible radius that can be drawn inside the semicircle.

The perimeter of the shaded region is P cm and the area of the shaded region is A cm².

Given that $P = A$, find an expression for x in terms of π .

The diameter of the circle remains the same at any point.

So the diameter of the small circle must be half of the semi-circle.

Area of a circle: πr^2

$$\begin{aligned}\text{Area of a half of semi-circle} &= \pi \left(\frac{2x}{2}\right)^2 \times \frac{1}{4} \\ &= \pi (x)^2 \times \frac{1}{4} \\ &= \frac{1}{4} \pi x^2\end{aligned}$$

$$\begin{aligned}\text{Area of half of small circle} &= \pi \left(\frac{x}{2}\right)^2 \times \frac{1}{2} \\ &= \frac{x^2}{4} \pi \times \frac{1}{2} \\ &= \frac{1}{8} \pi x^2\end{aligned}$$

$$\begin{aligned}A &= \frac{1}{4} \pi x^2 - \frac{1}{8} \pi x^2 \\ &= \frac{2}{8} \pi x^2 - \frac{1}{8} \pi x^2 \\ &= \frac{1}{8} \pi x^2\end{aligned}$$

Perimeter of a circle: πd

$$\begin{aligned}\text{Perimeter of half of semi-circle} &= \frac{1}{4} \times \pi (2x) + x \\ &= \frac{1}{2} \pi x + x\end{aligned}$$

$$\begin{aligned}\text{Perimeter of half of circle} &= \frac{1}{2} \times \pi (x) \\ &= \frac{1}{2} \pi x\end{aligned}$$

$$\begin{aligned}P &= \frac{1}{2} \pi x + \frac{1}{2} \pi x + x \\ &= \pi x + x\end{aligned}$$

$$P = A$$

$$\begin{aligned}\pi x + x &= \frac{1}{8} \pi x^2 \\ \div x \quad \left(\pi + 1 = \frac{1}{8} \pi x \right) \div x \\ \times 8 \quad \left(8\pi + 8 = \pi x \right) \times 8 \\ \div \pi \quad \left(\frac{8\pi + 8}{\pi} = x \right) \div \pi\end{aligned}$$



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$$x = \frac{8\pi + 8}{\pi}$$

(Total for Question 27 is 6 marks)



P 6 0 2 5 6 A 0 2 1 2 4

- 28 A particle P is moving along a straight line. At time t seconds, the displacement, x metres, of P from a fixed point O on the line is given by

$$x = -3t^3 + 6t^2 + kt + 4 \quad t \geq 0$$

At time t seconds, the velocity of P is v m/s such that $v = 9$ when $t = 2$

- (a) Show that $k = 21$

Here you will have to differentiate displacement to find velocity and then substitute to find k .

Integrate $\left(\begin{array}{c} \text{displacement} \\ \text{velocity} \end{array} \right) \rightarrow$ Differentiate

The general rule for differentiation is bring down the power and subtract 1.

$$x = -3t^3 + 6t^2 + kt + 4$$

$$v = (-3)3t^{3-1} + (2)6t^{2-1} + (1)kt^{1-1} + (0)4t^{0-1}$$

$$v = -9t^2 + 12t + k$$

$$(4) = -9(2)^2 + 12(2) + k$$

$$9 = -36 + 24 + k$$

$$+12 \rightarrow \begin{array}{l} 9 = -12 + k \\ 21 = k \end{array} \rightarrow +12$$

(3)

Particle P comes to instantaneous rest at the point A .

- (b) Using $k = 21$, find the value of t when P is at A .

When at instantaneous rest $v = 0$.

$$-9t^2 + 12t - 21 = 0$$

$$9t^2 - 12t + 21 = 0$$

$$3t^2 - 4t + 7 = 0$$

$$\frac{(3t-7)(t+1)}{3} = 0 \rightarrow 3 \times 7 = 21$$

So what two numbers add to give -4 and multiply to give 21?

-7 and 3

$$(3t-7)(t+1) = 0$$

$$3t-7=0 \quad t+1=0$$

$$3t=7 \quad t=-1$$

$$t = 7/3$$

$\rightarrow$ Time cannot be negative so reject $t = -1$

$$t = 7/3$$

(3)



- (c) Find, to the nearest metre, the distance OA .

Here you can use the equation given for displacement and substitute your value for time.

$$x = -3t^3 + 6t^2 + 21t + 4$$

$$x = -3\left(\frac{7}{5}\right)^3 + 6\left(\frac{7}{5}\right)^2 + 21\left(\frac{7}{5}\right) + 4 \rightarrow \text{Just type into your calculator using brackets!}$$

$$= 48\text{m}$$

.....48.....m
(2)

(Total for Question 28 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS



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