

Please check the examination details below before entering your candidate information			
Candidate surname		Other names	
Pearson Edexcel International GCSE		Centre Number	
		Candidate Number	
Monday 7 January 2019			
Morning (Time: 1 hour 30 minutes)		Paper Reference 4MB1/01R	
Mathematics B Paper 1R			
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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Answer ALL TWENTY EIGHT questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Express 15 centimetres as a percentage of 3 metres.

Since your two values do not share the same metric unit, you first need to convert.

If converting 15cm,

$$1\text{cm} = 0.01\text{m}$$

$$15\text{cm} = 0.15\text{m}$$

$$\uparrow \div 100$$

Then find this as a percentage:

$$\frac{0.15}{3} \times 100 = 5\%$$

If converting 3 m,

$$1\text{m} = 100\text{cm}$$

$$3\text{m} = 300\text{cm}$$

$$\uparrow \times 100$$

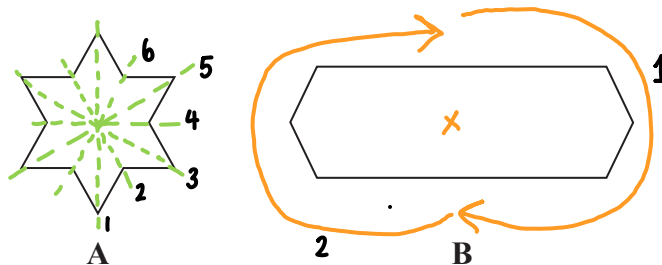
Now find the percentage:

$$\frac{15}{300} \times 100 = 5\%$$

..... 5 %

(Total for Question 1 is 2 marks)

2



The diagram shows shape A and shape B.

Write down,

(a) the number of lines of symmetry of shape A,

A line of symmetry goes through the centre of the shape and cuts it exactly in half.

As such, you can draw lines of symmetry on the shape and count how many there are in 6
total. Shape A has 6 lines of symmetry. (1)

(b) the order of rotational symmetry of shape B.

The order of rotational symmetry is the number of times that a shape looks the same when it is rotated one full turn.

You can rotate shape B by the centre and count the number of times it fits onto 2
itself. This is 2 times. (1)

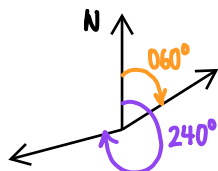
(Total for Question 2 is 2 marks)



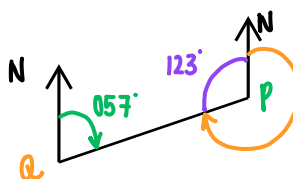
- 3 The bearing of ship P from ship Q is 057°

Find the bearing of ship Q from ship P .

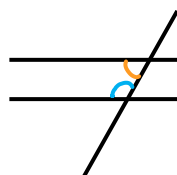
A bearing is an angle measured clockwise from North. It must be written in 3 figures.



You can first draw a diagram to help you.



The bearing of Q from P is the reflex $\angle NPQ$ but you need to find this.



Co-interior angles add to 180° .

First, find the obtuse $\angle NPQ/x$.

$$57^\circ + x = 180^\circ$$

$$x = 123^\circ$$

Next find the bearing:

$$123 + \angle NPQ = 360$$

$$\angle NPQ = 237^\circ$$

237

(Total for Question 3 is 2 marks)

4

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

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

Calculate $3A + 2B$

To multiply a 2×2 matrix by a factor x .

$$x \begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} = \begin{pmatrix} xa_1 & xb_1 \\ xc_1 & xd_1 \end{pmatrix}$$

The first steps in this question would be to multiply A and B by the factors said.

$$3 \begin{pmatrix} 2 & -1 \\ -3 & 5 \end{pmatrix} = \begin{pmatrix} 3(2) & 3(-1) \\ 3(-3) & 3(5) \end{pmatrix} = \begin{pmatrix} 6 & -3 \\ -9 & 15 \end{pmatrix}$$

$$2 \begin{pmatrix} -1 & 2 \\ 3 & -3 \end{pmatrix} = \begin{pmatrix} 2(-1) & 2(2) \\ 2(3) & 2(-3) \end{pmatrix} = \begin{pmatrix} -2 & 4 \\ 6 & -6 \end{pmatrix}$$

Now you can add the two matrices.

To add a 2×2 matrix to a 2×2 matrix:

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

$$\begin{pmatrix} 6 & -3 \\ -9 & 15 \end{pmatrix} + \begin{pmatrix} -2 & 4 \\ 6 & -6 \end{pmatrix} = \begin{pmatrix} 6 + -2 & -3 + 4 \\ -9 + 6 & 15 + -6 \end{pmatrix} = \begin{pmatrix} 4 & 1 \\ 15 & 9 \end{pmatrix}$$

$$\begin{pmatrix} 4 & 1 \\ 15 & 9 \end{pmatrix}$$

(Total for Question 4 is 2 marks)



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

$$2\frac{1}{4} \times 2\frac{2}{3}$$

Give your answer in its simplest form.

First, write the fractions as improper fractions.

$$\begin{aligned} 2\frac{1}{4} &= \frac{2 \times 4}{4} + \frac{1}{4} \\ &= \frac{8}{4} + \frac{1}{4} \\ &= \frac{9}{4} \end{aligned}$$

$$\begin{aligned} 2\frac{2}{3} &= \frac{2 \times 3}{3} + \frac{2}{3} \\ &= \frac{6}{3} + \frac{2}{3} \\ &= \frac{8}{3} \end{aligned}$$

Now you can multiply:

$$\frac{9}{4} \times \frac{8}{3} = 3 \times 2 = 6$$

* Note that it is easier to simplify before multiplying.

6

(Total for Question 5 is 2 marks)

- 6 Given that $y = 7x^2 - \frac{3}{x}$

find $\frac{dy}{dx}$

The notation $\frac{dy}{dx}$ suggest that you will need to differentiate. The general rule for differentiation is to "bring down the power and subtract 1."

But for this question, you will first need to rewrite your equation using rules of indices.

You know that $\frac{1}{x} = x^{-1}$

Therefore

$$7x^2 - \frac{3}{x} = 7x^2 - 3x^{-1}$$

Now you can differentiate:

$$\begin{aligned} \frac{dy}{dx} &= (2)7x^{2-1} - (-1)3x^{-1-1} \\ &= 14x + 3x^{-2} \end{aligned}$$

$$\frac{dy}{dx} = 14x + 3x^{-2}$$

(Total for Question 6 is 2 marks)



7 Here are the first 4 terms of a sequence.



(i) Write down the next 2 terms of the sequence.

Looking at these terms, you can see that to find the next term, you need to divide the previous term by -4 .

$$-64 \div -4 = 16$$

$$16 \div -4 = -2$$

16, -2

(ii) Explain how you found your answer.

You need to divide each term by -4 .

(Total for Question 7 is 3 marks)

8 Ying has 4 black counters and 3 white counters.

There is a number on each counter.

The mean of the numbers on the black counters is 11.5

The mean of the numbers on the white counters is 9

Calculate the mean, to 3 significant figures, of the numbers on all 7 counters.

You can find the mean of all the counters by first finding the total values of all the black counters and white counters separately and then divide the sum of this by the total number of counters.

The general formula for mean is $\text{mean} = \frac{\text{sum of all values}}{\text{number of values}}$

so you can work backwards from this to find the sum of values for black and white counters

$$\text{sum of all values} = \text{mean} \times \text{number of values}$$

$$\text{sum of all number on black} = 11.5 \times 4 = 46$$

$$\text{sum of all values on white} = 9 \times 3 = 27$$

$$\frac{46 + 27}{7} = 10.428... \\ \approx 10.4 (3 \text{ sf})$$

10.4

(Total for Question 8 is 3 marks)



- 9 Find the largest integer value of x such that $17 - 2x \geq 4(x - 5)$
Show clear algebraic working.

You have to rearrange the equation to make x the subject.

$$\begin{array}{lcl}
 17 - 2x & \geq & 4(x - 5) \\
 \text{Expand brackets} & & \\
 17 - 2x & \geq & 4x - 20 \\
 +2x & & +2x \\
 17 & \geq & 6x - 20 \\
 +20 & & +20 \\
 37 & \geq & 6x \\
 \div 6 & & \div 6 \\
 6.16... & \geq & x
 \end{array}$$

An integer is a whole number.

Since $x \leq 6.16...$, the largest integer value that x can take is 6.

6

(Total for Question 9 is 3 marks)

- 10 A regular polygon has n sides.

Each interior angle of the regular polygon is 135° greater than each exterior angle of the polygon.

Find the value of n .

In this question, you need to know two formulas: the formula for the interior angles of a polygon and the formula for the exterior angles of a polygon.

To find the interior angle of a polygon.

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

where n = number of sides

To find the exterior angle of a regular polygon:

$$\frac{360}{n}$$

where n = number of sides

$$\begin{array}{lcl}
 \text{exterior angle} + 135 & = & \text{interior angle} \\
 \frac{360}{n} + 135 & = & \frac{(n-2) \times 180}{n} \\
 \text{Expand brackets} & & \\
 \frac{360}{n} + 135 & = & \frac{180n - 360}{n} \\
 \times n & & \times n \\
 360 + 135n & = & 180n - 360 \\
 -135n & & -135n \\
 360 & = & 45n - 360 \\
 +360 & & +360 \\
 720 & = & 45n \\
 \div 45 & & \div 45 \\
 16 & = & n
 \end{array}$$

$$n = 16$$

(Total for Question 10 is 3 marks)



11 A piece of ribbon 9 metres long is cut into 3 parts in the ratios 3:5:7 by length.

Calculate the length, in metres, of the longest piece.

Since you know that the total length was 9 m, you can find the length of each part by first finding the scale factor.

$$\begin{aligned} 3+5+7 &= 15 \\ \text{scale factor} &= \frac{9}{15} \\ &= \frac{3}{5} \end{aligned}$$

The part with the longest length will be the one with the largest ratio. Here, the largest ratio is 7. You can multiply the ratio by the scale factor to find the length.

$$\begin{aligned} 7 \times \frac{3}{5} &= \frac{21}{5} \\ &= 4.2 \text{ m} \end{aligned}$$

..... 4.2 m

(Total for Question 11 is 3 marks)

12 (a) Write 9.6×10^{-7} as an ordinary number.

Remember that if you have a negative power on 10, you have to move the decimal point to the left by the number of the power. So here you must move it 7 spaces to the left.

0.00000096

..... 0.00000096
(1)

(b) Calculate $\frac{2.4 \times 10^{199}}{9.6 \times 10^{-7}}$

Give your answer in standard form.

Here, you have to divide your constants and power of 10 separately.

① Divide constants

$$2.4 \div 9.6 = 0.25$$

② Divide powers of 10.

Remember rules of indices: $x^a \div x^b = x^{a-b}$

$$\begin{aligned} 10^{199} \div 10^{-7} &= 10^{199-(-7)} \\ &= 10^{206} \end{aligned}$$

..... 2.5×10^{205}
(2)

③ Write your answer in standard form

$$0.25 \times 10^{206} = 2.5 \times 10^{205} \quad \text{moving the decimal 1 to the right so subtract 1 from power}$$

(Total for Question 12 is 3 marks)



13 Without using a calculator and showing all your working, express

$$\sqrt{605} - \sqrt{80}$$

in the form $\sqrt{n}$ where n is an integer.

n will be a common prime factor of 605 and 80. So your first step will be to write 605 and 80 in terms of their factors:

$$\begin{aligned}\sqrt{605} &= \sqrt{5 \times 121} \\ &= 11\sqrt{5}\end{aligned}$$

$$\begin{aligned}\sqrt{80} &= \sqrt{16 \times 5} \\ &= 4\sqrt{5}\end{aligned}$$

Since both numbers have the same surd, you can subtract them.

$$11\sqrt{5} - 4\sqrt{5} = 7\sqrt{5}$$

..... $7\sqrt{5}$

(Total for Question 13 is 3 marks)

14 Solve the equation

$$5x^2 = 7 - 9x$$

Give your solutions to 3 significant figures.

Show your working clearly.

This is a quadratic so you will first have to make the expression equal to 0.

$$\begin{aligned}5x^2 &= 7 - 9x \\ +9x \quad \hookrightarrow \quad -7 \quad \hookrightarrow \quad 5x^2 + 9x - 7 &= 0\end{aligned}$$

Since the question wants the answer to 3 significant figures, you have to use the quadratic formula:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where $a = 5$
 $b = 9$
 $c = -7$

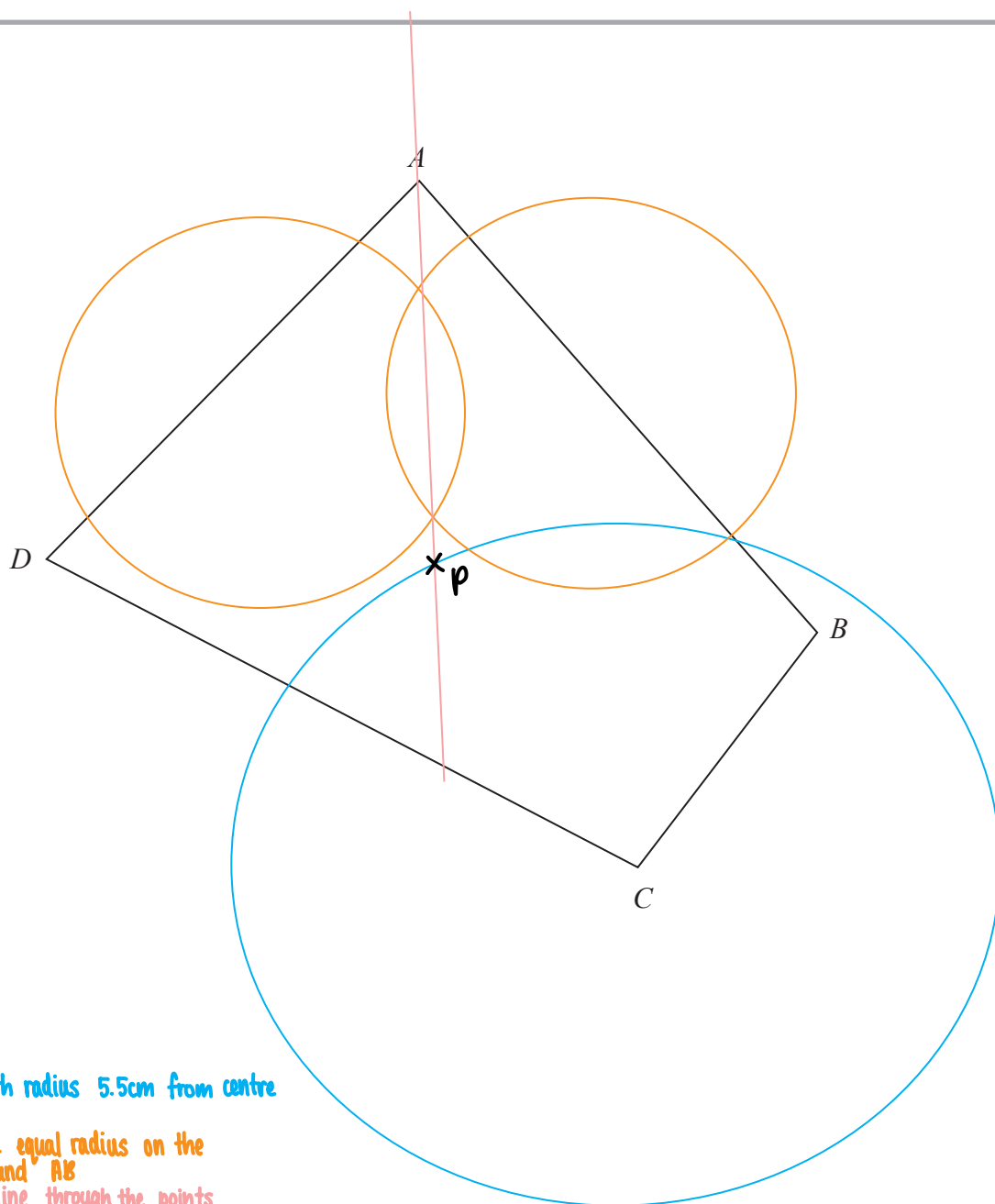
$$\begin{aligned}&\frac{- (9) \pm \sqrt{(9)^2 - 4(5)(-7)}}{2(5)} \\ &= 0.5866... \\ &\approx 0.587 \text{ (3 sf)}\end{aligned}$$

$$\begin{aligned}&\frac{- (9) - \sqrt{(9)^2 - 4(5)(-7)}}{2(5)} \\ &= -2.3866... \\ &\approx -2.39 \text{ (3 sf)}\end{aligned}$$

$$x = 0.587 \quad x = -2.39$$

(Total for Question 14 is 3 marks)





1. Draw an arc with radius 5.5cm from centre C using a compass.
2. Draw two arcs of equal radius on the midpoints of AD and AB.
4. Draw a straight line through the points where the two arcs from part 2 meet. This is your perpendicular bisector of BD.
5. Identify the points where your straight line and arc C meet as P.

The diagram shows quadrilateral $ABCD$.

The point P lies inside the quadrilateral, such that P is 5.5 cm from C **and** equidistant from AD and AB .

Using ruler and compasses only and **showing all your construction lines**, show the point P on the diagram.

(Total for Question 15 is 4 marks)



- 16 t varies inversely as the square of a where $a > 0$
 $t = 14$ when $a = 5$

Calculate the value of a when $t = 224$

In other words, t is INVERSELY PROPORTIONAL to a^2

$$\therefore t \propto \frac{1}{a^2}$$

$$t = \frac{k}{a^2} \quad \text{where } k \text{ is constant.}$$

Your first step is to find k :

$$14 = \frac{k}{(5)^2}$$

$$14 \div (5)^2 = k$$

$$0.56 = k$$

Now you can find a when $t = 224$

$$\begin{array}{l} 224 = \frac{0.56}{a^2} \\ \times a^2 \quad \left(\begin{array}{l} \nearrow 224a^2 = 0.56 \\ \searrow \end{array} \right) \times a^2 \\ \div 224 \quad \left(\begin{array}{l} \nearrow a^2 = \frac{0.56}{224} \\ \searrow \end{array} \right) \div 224 \\ \sqrt{\quad} \quad \left(\begin{array}{l} \nearrow a = \sqrt{\frac{0.56}{224}} \\ \searrow \end{array} \right) \sqrt{\quad} \\ a = 0.05 \end{array}$$

$$a = 0.05$$

(Total for Question 16 is 4 marks)



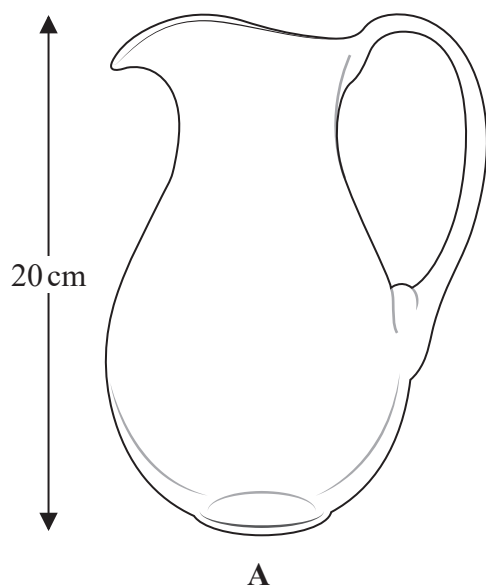
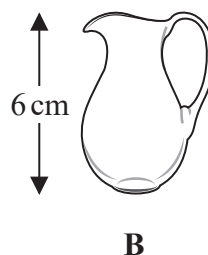


Diagram NOT
accurately drawn



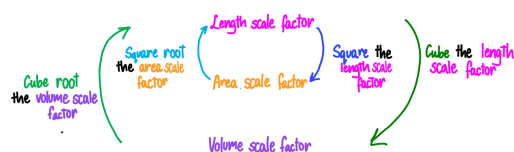
The diagram shows two similar jugs.

The height of jug A is 20 cm and the height of jug B is 6 cm.

Given that

$$\text{volume of jug A} - \text{volume of jug B} = 1459.5 \text{ cm}^3$$

calculate the volume, in cm^3 , of jug B.



Since the jugs are similar, there should a scale factor between the height which you can cube to find a scale factor between the volumes.

$$20 \div 6 = \frac{10}{3} \quad \leftarrow \text{Cube this to find volume scale factor.}$$

$$\left(\frac{10}{3}\right)^3 = \frac{1000}{27}$$

Now you know that the volume of B multiplied by $\frac{1000}{27}$ is the volume of A. You need to write this as an equation.

$$\text{volume of B} \times \frac{1000}{27} = \text{volume of A} \quad (1)$$

$$\text{from question} \rightarrow \text{volume of A} - \text{volume of B} = 1459.5 \text{ cm}^3 \quad (2)$$

You can rewrite these using A and B.

$$B \times \frac{1000}{27} = A$$

$$A - B = 1459.5$$

There are now two simultaneous equation that you can solve.
Substitute $A = B \cdot \frac{1000}{27}$ into equation 2 so you only have one unknown.

$$\left[B \cdot \frac{1000}{27}\right] - B = 1459.5$$

$$\frac{1000}{27} B - 1B = 1459.5$$

$$\frac{973}{27} B = 1459.5$$

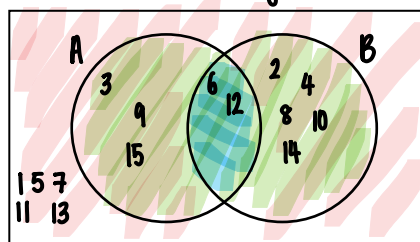
$$B = 40.5 \text{ cm}^3$$

$$\dots\dots\dots 40.5 \dots\dots\dots \text{ cm}^3$$

(Total for Question 17 is 4 marks)



You can draw a Venn Diagram:



18 $\mathcal{E} = \{\text{positive integers from 1 to 15 inclusive}\}$

$A = \{\text{multiples of 3}\}$

$B = \{\text{even numbers}\}$

(a) Find $A \cup B$

$A \cup B$ means A or B.

$$A \cup B = \{3, 9, 15, 6, 12, 2, 8, 4, 10, 11, 13, 7\} \quad (1)$$

(b) (i) Find $A \cap B$

$A \cap B$ means the intersection of A and B.

$$A \cap B = \{6, 12\} \quad (1)$$

(ii) Find $n([A \cap B]')$

$n([A \cap B]')$ means the number of values NOT in the intersection of A and B.

There are 15 numbers in total and 2 in $(A \cap B)$

$$15 - 2 = 13$$

$$n([A \cap B]') = 13 \quad (1)$$

The set C has 8 elements and $B \cap C = \emptyset$ $\emptyset$ means the set is empty

(c) Write down the elements of set C.

Since there are no numbers which are in both B and C, all numbers except the ones in B are in C.

$$C = \{1, 3, 5, 7, 9, 11, 13, 15\} \quad (1)$$

(Total for Question 18 is 4 marks)



19 Solve the simultaneous equations

$$\textcircled{1} \quad 10x + 2y = 17$$

$$\textcircled{2} \quad 15x - 3y = 39$$

There are two ways you can solve these simultaneous equations:

method 1: Elimination

① Make the value of the coefficient of x or y equal
Here you can make both coefficients of y have a value 6.

$$\begin{array}{r} \times 3 \leftarrow 10x + 2y = 17 \\ \hline 30x + 6y = 51 \end{array} \quad \times 3$$

$$\begin{array}{r} \times 2 \leftarrow 15x - 3y = 39 \\ \hline 30x - 6y = 78 \end{array} \quad \times 2$$

② Since the coefficients of y have different signs (+ or -), you need to add them.

$$\begin{array}{r} 30x + 6y = 51 \\ -30x - 6y = 78 \\ \hline 60x = 129 \\ \div 60 \rightarrow x = 2.15 \end{array}$$

③ Now you can find the value of y by substituting your value of x into one of the equations.

$$\begin{array}{r} \text{Expand } 10(2.15) + 2y = 17 \\ \hline 21.5 + 2y = 17 \\ -21.5 \rightarrow 2y = -4.5 \\ \div 2 \rightarrow y = -2.25 \end{array}$$

method 2: substitution

① Rearrange equation ① to make y the subject.

$$\begin{array}{r} 10x + 2y = 17 \\ -10x \rightarrow 2y = 17 - 10x \\ \div 2 \rightarrow y = \frac{17}{2} - 5x \end{array}$$

② Substitute your equation for y into equation ②

$$\begin{array}{r} \text{Expand } 15x - 3\left(\frac{17}{2} - 5x\right) = 39 \\ \hline 15x - \frac{51}{2} + 15x = 39 \\ + \frac{51}{2} \rightarrow 30x = 64.5 \\ \div 30 \rightarrow x = 2.15 \end{array}$$

③ You can find a value for y by substituting your value for x .

$$\begin{array}{r} \text{Expand } 15(2.15) - 3y = 39 \\ \hline 32.25 - 3y = 39 \\ -32.25 \rightarrow -3y = 6.75 \\ \div -3 \rightarrow y = -2.25 \end{array}$$

$$x = 2.15, y = -2.25$$

(Total for Question 19 is 4 marks)

20 The coordinates of point A are $(7, 2)$ and the coordinates of point B are $(-5, y)$.

The modulus of the vector $\vec{AB}$ is 13

Calculate the possible values of y .

The modulus is the magnitude which you can find using Pythagoras's theorem.

To find the modulus, you first need to find the vector $\vec{AB}$.

$$\vec{AB} = \begin{pmatrix} -5 \\ y \end{pmatrix} - \begin{pmatrix} 7 \\ 2 \end{pmatrix} = \begin{pmatrix} -12 \\ y-2 \end{pmatrix}$$

→ From this you can form an equation for magnitude:

$$\text{Pythagoras: } a^2 + b^2 = c^2$$

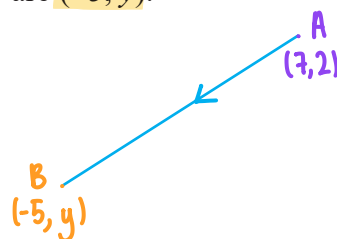
$$\begin{array}{r} |\vec{AB}| = \sqrt{(-12)^2 + (y-2)^2} \\ \sqrt{(-12)^2 + (y-2)^2} = 13 \\ \text{square } \rightarrow (-12)^2 + (y-2)^2 = 169 \end{array}$$

$$\begin{array}{r} 144 + (y-2)^2 = 169 \\ -144 \rightarrow (y-2)^2 = 25 \\ \sqrt{} \rightarrow y-2 = \pm 5 \end{array}$$

$$\begin{array}{r} \text{when } y-2 = 5 \quad y-2 = -5 \\ y = 7 \quad y = -3 \end{array}$$

$$y = 7, -3$$

(Total for Question 20 is 4 marks)



- 21 The straight line joining the points with coordinates $(-a, -22)$ and $(3a, 38)$ has equation $y = mx + a$

Calculate the value of a and the value of m .

- ① Find the gradient

$$y = mx + a$$

gradient ↑

$(3a, 38)$ $m(\text{gradient}) = \frac{\Delta y}{\Delta x}$

$(-a, -22)$

$$m = \frac{38 - (-22)}{3a - (-a)} = \frac{60}{4a} = \frac{15}{a}$$

- ② Substitute your coordinates values into the equation $y = \frac{15}{a}x + a$ to find a .

$$(-22) = \frac{15}{a}(-a) + a$$

$$-22 = -15 + a$$

$$-7 = a$$

- ③ Find $m(\text{gradient})$ by substituting your new value for a .

$$m = \frac{15}{-7}$$

$$= -\frac{15}{7}$$

$$a = -7$$

$$m = -\frac{15}{7}$$

(Total for Question 21 is 4 marks)



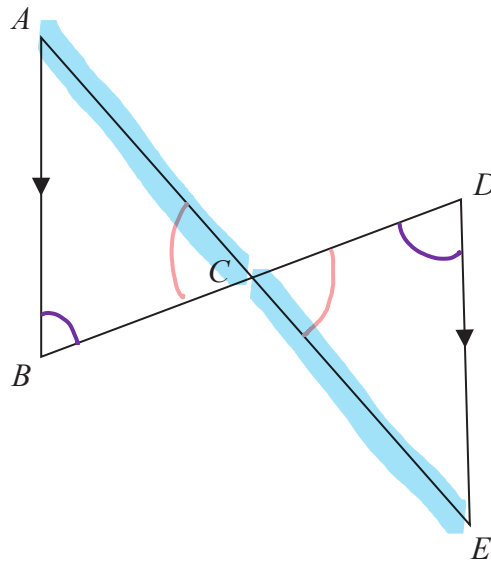


Diagram NOT
accurately drawn

In the diagram ACE and BCD are straight lines such that the point C is the midpoint of BD .

AB is parallel to DE .

Prove that the triangles ABC and EDC are congruent.

There are 4 conditions to prove congruency in triangles:

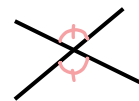
1. Side-Side-Side (SSS) - all sides are equal.
2. Side-Angle-Side - two sides and an angle are equal.
3. Angle-Side-Angle (ASA) - two angles and a side are equal.
4. Right Angle-Hypotenuse-Side (RHS) - Right Angle, hypotenuse and side are equal.

Here, the case for congruency will be ASA.

① $\angle ACB = \angle DCE$

This is because corresponding angles are equal

Corresponding angles
are equal.

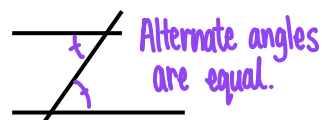


② $AC = CE$

C is the midpoint of AE .

③ $\angle ABC = \angle CDE$

This is because alternate angles are equal.



The triangles ABC and EDC are congruent by ASA.

(Total for Question 22 is 4 marks)

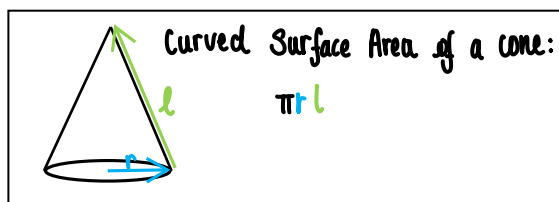
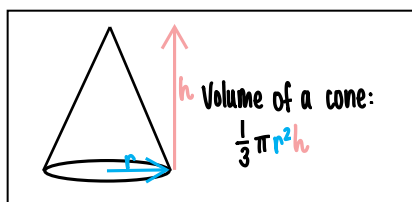


- 23 A right circular cone has a curved surface area of $136\pi \text{ cm}^2$.

The radius of the base of the cone is 8 cm

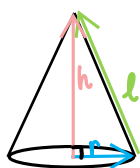
The volume of the cone is $k\pi \text{ cm}^3$

Find the value of k .



We have all elements we need for the volume except the height so we are going to work backwards from surface area to find l and then height.

$$\begin{aligned} \pi r l &= 136\pi \\ \div \pi \quad \pi (8) l &= 136\pi \\ \quad 8l &= 136 \\ \div 8 \quad \hookrightarrow \quad l &= 17 \end{aligned}$$



We now know both length and radius, so we can use Pythagoras's theorem to find height.

$$\begin{aligned} a^2 + b^2 &= c^2 \\ h^2 + r^2 &= l^2 \\ h^2 + 8^2 &= 17^2 \\ -64 \quad \hookrightarrow \quad h^2 + 64 &= 289 \\ \quad h^2 &= 225 \\ \sqrt{\quad} \quad \hookrightarrow \quad h &= 15 \end{aligned}$$

Now, you can find volume:

$$\frac{1}{3} \pi (8)^2 (15) = \underline{320\pi}$$

$$k\pi = 320\pi$$

$$k = 320$$

$$k = \underline{320}$$

(Total for Question 23 is 4 marks)



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24 Solve $3 - \frac{x+1}{2x^2+9x-5} - \frac{2x-1}{x+5} = 1$

Show clear algebraic working.

Your first priority should be to factorise the quadratic

$$2x^2 + 9x - 5 = (2x + 5)(x - 1) \rightarrow \text{Find 2 numbers that add to give 9 and multiply to give -10.}$$

In order to subtract or add fractions, the denominators must be the same. Here you want them to be $(2x-1)(x+5)$ since this is the largest denominator.

$$3 - \frac{x+1}{(x+5)(x-1)} - \frac{2x-1}{x+5} = 1$$

$$\frac{3(2x^2+9x-5)}{2x^2+9x-5} - \frac{x+1}{2x^2+9x-5} - \frac{(2x-1)(2x-1)}{(x+5)(2x-1)} = 1$$

← This is why you need to factorise first since you only need to multiply by a factor $(2x-1)$

$$\frac{(6x^2 + 27x - 15) - (x + 1) - (4x^2 - 2x - 2x + 1)}{2x^2 + 9x - 5} = 1$$

$$\frac{2x^2 + 30x - 17}{2x^2 + 9x - 5} = 1$$

$$\begin{aligned} & \times 2x^2 + 9x - 5 \\ & \quad \swarrow \searrow \\ & \quad 2x^2 + 30x - 17 = 2x^2 + 9x - 5 \\ & \quad \quad \quad \downarrow -2x^2 \\ & \quad \quad 30x - 17 = 9x - 5 \\ & \quad \quad \quad \downarrow -9x \\ & \quad \quad 21x - 17 = -5 \\ & \quad \quad \quad \downarrow +17 \\ & \quad \quad 21x = 12 \\ & \quad \quad \quad \downarrow \div 21 \\ & \quad \quad x = \frac{12}{21} \\ & \quad \quad \quad \downarrow \div 3 \\ & \quad \quad = \frac{4}{7} \end{aligned}$$

$$x = \frac{4}{7}$$

(Total for Question 24 is 4 marks)



25 There are 20 counters in a bag.

There are 7 red counters.

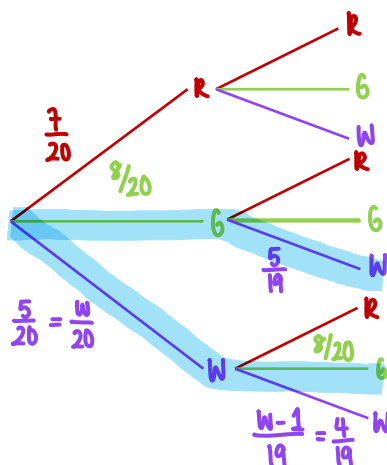
The rest of the counters are green or white.

Bernard takes at random 2 counters from the bag.

The probability that Bernard will take 2 white counters is $\frac{1}{19}$

Calculate the probability that Bernard will take 1 green counter and 1 white counter.

For this question, it is best to draw a probability tree.



By using the idea that the constant 'w' represents the number of white counters, and that we multiply across the branch, you can work backwards to find w.

$$\frac{w}{20} \times \frac{w-1}{19} = \frac{1}{19}$$

$$\frac{w(w-1)}{20 \times 19} = \frac{1}{19}$$

$$\frac{w^2 - w}{380} = \frac{1}{19}$$

$$w^2 - w = 20$$

$(w-5)(w+4) = 0$ ← factorise by finding two numbers that add to give -1 and multiply to give -20.

$$w-5=0 \rightarrow w=5$$

$$w+4=0 \rightarrow w=-4$$

You cannot have a negative number of counters so w is 5.

Now that you know the number of red and white counters you can find the number of green counters.

$$20 - 7 - 5 = 8$$

To find the probability of 1 green and 1 white, you need to add the probability of green then white and white then green.

$$P(G \text{ and } W) = \frac{8}{20} \times \frac{5}{19} = \frac{40}{380}$$

$$P(W \text{ then } G) = \frac{5}{20} \times \frac{8}{19} = \frac{40}{380}$$

$$\frac{40}{380} + \frac{40}{380} = \frac{80}{380}$$

$$\frac{80}{380}$$

(Total for Question 25 is 5 marks)



- 26 The table below gives information about the lengths of time that 50 people have been waiting for a train.

Waiting time (m minutes)	Frequency	Cumulative frequency
$0 < m \leq 5$	4	4
$5 < m \leq 10$	5	9
$10 < m \leq 15$	11	20
$15 < m \leq 20$	8	28 ← 25th
$20 < m \leq 25$	22	50

- (a) Find the modal class.

The modal class is the class with the highest frequency.

$$20 < m \leq 25$$

(1)

- (b) Find the class interval that contains the median waiting time.

The median waiting time will be the waiting time of the middle term. Here the middle term is $\frac{50}{2} = 25^{\text{th}}$ term. You can find in which class interval the 25th term sits using cumulative frequency.

The 25th term sits in the class interval $15 < m \leq 20$.

$$15 < m \leq 20$$

(2)

- (c) Calculate an estimate for the mean waiting time.

The mean for this table would be the sum of (the midpoint of each class interval multiplied by the frequency of that interval) divided by the total frequency.

$$\frac{\sum (\text{midpoint of class interval} \times \text{frequency})}{\text{total frequency}} = \text{mean}$$

$$\frac{(2.5 \times 4) + (7.5 \times 5) + (12.5 \times 11) + (17.5 \times 8) + (22.5 \times 22)}{50} = \frac{10 + 37.5 + 137.5 + 140 + 495}{50}$$

$$= \frac{820}{50}$$

$$= 16.4$$

$$16.4 \text{ minutes}$$

(3)

(Total for Question 26 is 6 marks)



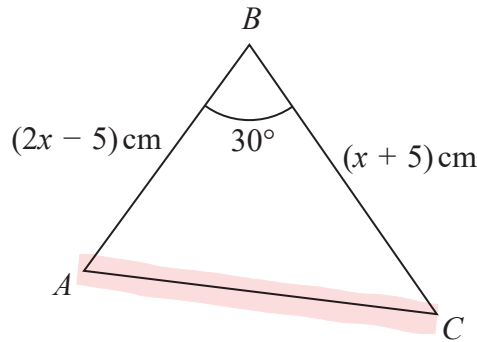


Diagram **NOT**
accurately drawn

The diagram shows $\triangle ABC$ in which

$$AB = (2x - 5) \text{ cm}$$

$$BC = (x + 5) \text{ cm}$$

$$\angle ABC = 30^\circ$$

The area of $\triangle ABC$ is 15.75 cm^2

Calculate the length, in cm to 3 significant figures, of AC .

Here, you need to first find the value of x . You are given the area of the triangle so this suggests that you will need to use the equation for area:

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

where $a = (2x - 5)$

$$b = (x + 5)$$

$$C = 30$$

$$15.75 = \frac{1}{2} \times (2x - 5) \times (x + 5) \times \sin 30$$

$$15.75 = \frac{1}{2} \times [2x^2 + 10x - 5x - 25] \times \sin 30$$

$$15.75 = \frac{1}{2} \times \sin 30 \times [2x^2 + 5x - 25]$$

$$15.75 = \frac{1}{2} \times \frac{1}{2} \times [2x^2 + 5x - 25]$$

$$15.75 = \frac{1}{4} [2x^2 + 5x - 25]$$

$$63 = 2x^2 + 5x - 25$$

$$0 = 2x^2 + 5x - 88$$

$$0 = (2x - 11)(x + 8) \rightarrow \text{Find 2 numbers which add to make 5 and multiply to make } 2 \times -88 = -176$$

$$0 = (2x - 11)(x + 8)$$

$$2x - 11 = 0 \quad x + 8 = 0$$

$$x = \frac{11}{2} \quad x = -8$$

You cannot have negative lengths, so

$$x = \frac{11}{2}$$

$$\curvearrowright \underline{\underline{=}}$$

$$\dots\dots\dots 6.09 \dots\dots\dots \text{ cm}$$

(Total for Question 27 is 6 marks)



You can now use cosine rule to find $\vec{AC}$.

$$a^2 = b^2 + c^2 - 2bc \cos A$$

where $a = AC$

$$b = (2x-5) = (2(\frac{11}{2})-5) = 6$$

$$c = (x+5) = (\frac{11}{2}+5) = \frac{21}{2}$$

$$A = 30^\circ$$

$$AC^2 = (6)^2 + \left(\frac{21}{2}\right)^2 - 2(6)\left(\frac{21}{2}\right)\cos 30$$

$$AC = \sqrt{(6)^2 + \left(\frac{21}{2}\right)^2 - 2(6)\left(\frac{21}{2}\right)\cos 30}$$

$$AC = 6.09...$$

$$\approx 6.09 \text{ (3sf)}$$

28 (a) Factorise fully $15x^3y - 20x^2y^2$

You need to identify the highest common factor between $15x^3y$ and $-20x^2y^2$. This is $5x^2y$.

So you need to take out a factor of $5x^2y$

$$15x^3y - 20x^2y^2 = 5x^2y(3x - 4y)$$

$$\frac{5x^2y(3x - 4y)}{(2)}$$

(b) Simplify fully $\frac{(27x^6)^{2/3}}{18x^3}$

Rules of indices: $(x^a)^b = x^{ab}$ $\frac{x^a}{x^b} = x^{a-b}$

You can first raise the terms in the brackets to $2/3$

$$(27x^6)^{2/3} = (27)^{2/3} \times x^{6 \times 2/3}$$

$$= 9x^4$$

You can now rewrite your expression: $\frac{9x^4}{18x^3} = \frac{9}{18} x^{4-3}$

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

$$\frac{1}{2}x \quad (3)$$

(c) Given that $(x - 2)$ is a factor of $2x^3 + 3x^2 + kx - 6$

find the value of k .

If $(x - 2)$ is a factor, $(x - 2) = 0$

$$x = 2$$

Therefore, the equation will be equal to 0 where your value of x is 2.

$$2(2)^2 + 3(2) + k(2) - 6 = 0$$

$$8 + 6 + 2k - 6 = 0$$

$$8 + 2k = 0$$

$$\begin{array}{l} -8 \quad \left(\begin{array}{l} \div 2 \\ \downarrow \end{array} \right. \left. \begin{array}{l} \downarrow -8 \\ \div 2 \end{array} \right) \\ \quad \quad \quad 2k = -8 \\ \quad \quad \quad k = -4 \end{array}$$

$$k = -4 \quad (2)$$

(Total for Question 28 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS



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