

NAME	FORM CLASS	ACAD CLASS



ST. PATRICK'S SCHOOL PRELIMINARY EXAMINATION 2026

SUBJECT : Mathematics
(4052/01)

DATE : 17 August 2026

LEVEL : Secondary 4EXP/5NA

DURATION : 2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Name, Form Class and Acad Class in the spaces at the top of the page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

The number of marks is given in brackets [] at the end of each question or part question.

If working is needed for any question it must be shown with the answer.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 90 .

The use of an approved scientific calculator is expected, where appropriate.

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.

For Examiner's Use			
Type of Penalties		Question Number	
Presentation	−1		
	−2		
			90

This paper consists of 23 printed pages including this cover page.

Mathematical Formulae*Compound Interest*

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2} r^2 \theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

Answer **all** the questions.

1 Calculate $\sqrt[3]{15.6^2 - \frac{9.4}{0.028}}$.

Answer [1]

2 Simplify.

(a) $2p^4 \times 6p^{-5}$

Answer [1]

(b) $4(3x - 2) - 5$

Answer [1]

3 (a) Express 0.00047 in standard form.

Answer [1]

(b) Express 1 km as a percentage of 0.4 nm, where $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$.
Give your answer in standard form.

Answer % [1]

- 4 The magnetic force, F , between two magnets is inversely proportional to the square of the distance, d , between them.

At a certain distance the force is 0.8 N.

Find the increase in the magnetic force when the distance is halved.

Answer N [2]

- 5 A bag of sand has a mass of x kg and a bag of cement has a mass of y kg.
Two bags of sand have a mass that is 10 kg more than one bag of cement.
A delivery of 4 bags of sand and 3 bags of cement has a total mass of 220 kg.
Find the value of x and y .

Answer $x =$
 $y =$ [3]

- 6 A toy building block is a cuboid measuring 24 mm by 16 mm by 10 mm.
Identical blocks are stacked together to form a cube.
Find the length of the smallest possible cube that can be formed, and the number of blocks needed.

Answer length of cube mm
Number of blocks [3]

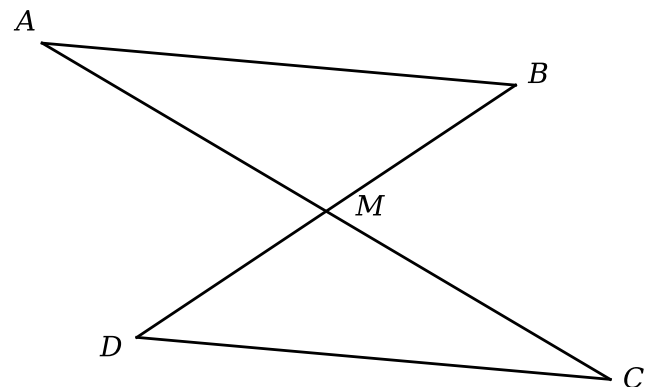
- 7 In Class A, the ratio of boys to girls is 5 : 2.
In Class B, the ratio of boys to girls is 7 : 4.
The two classes have the same number of boys.
Express as a fraction, the total number of girls in both classes.

Answer [3]

- 8 Solve the equation $3x^2 - 7x + 1 = 0$, giving your answers correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

- 9 In the diagram, AC and BD intersect at M .
 M is the midpoint of both AC and BD .
 Show that AB is parallel to CD .



Answer

.....

 [3]

- 10** The table shows the times, t minutes, taken by 40 students to complete a Mathematics quiz.

Time, t (minutes)	Frequency
$30 \leq t < 40$	6
$40 \leq t < 50$	10
$50 \leq t < 60$	16
$60 \leq t < 70$	8

- (a)** Calculate an estimate for

- (i)** the mean time,

Answer min [1]

- (ii)** the standard deviation of the times.

Answer min [1]

- (b)** Each recorded time was 5 minutes less than the actual time, so 5 minutes is added to each time to correct it.

Explain how the mean and standard deviation of the corrected times compare with the values in **(a)**.

.....
 [2]

- 11** Two fair four-sided dice, each with faces numbered 1, 2, 3 and 4, are thrown. The two numbers shown are multiplied to give the score.

In a game, Aisha wins if the score is even and Ben wins if the score is odd.

- (a)** Explain why the game is unfair.

.....
 [1]

- (b)** Aisha claims that she is twice as likely to win as Ben. Determine whether Aisha is correct.

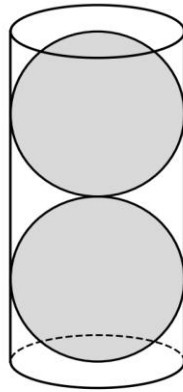
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 [2]

- 12** The area of triangle PQR is 67.67 cm^2 . Given that $QP = 9.8 \text{ cm}$ and $QR = 15 \text{ cm}$, find the possible values of angle PQR .

Answer Angle $PQR = \dots\dots\dots$ or $\dots\dots\dots$ [3]

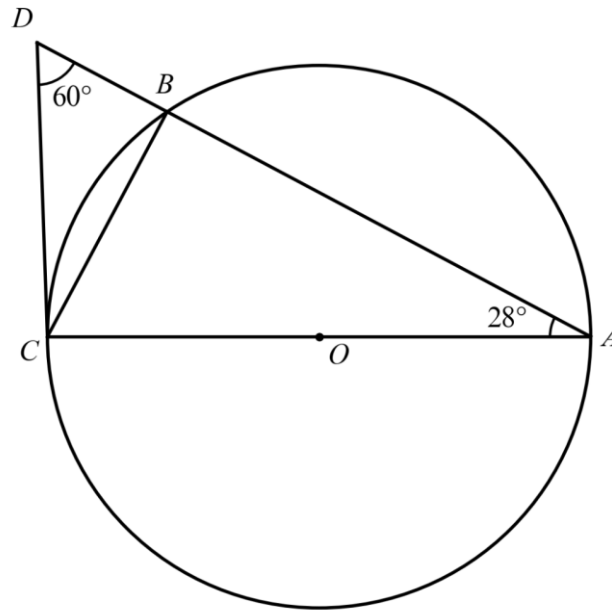
- 13** A closed cylinder fits two identical spheres exactly, as shown. Each sphere touches the curved surface of the cylinder, and the spheres touch each other and the two flat ends.



Find the fraction of the volume of the cylinder that is **not occupied by the spheres**, giving your answer in its simplest form.

Answer [3]

- 14** A, B and C are points on a circle with centre O . AOC and ABD are straight lines, Angle $CAB = 28^\circ$ and Angle $BDC = 60^\circ$.



- (a)** Find angle DCB .
Give a reason for each step of your working.

Answer Angle $DCB = \dots\dots\dots$ [2]

- (b)** Explain why DC is **not** a tangent to the circle.

Answer

$\dots\dots\dots$
 $\dots\dots\dots$ [1]

- 15 The diagram shows the first three figures in a sequence. Each figure is a large square made up of unit squares, with a shaded square block at its centre.

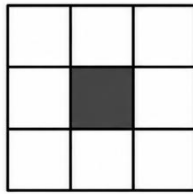


Figure 1

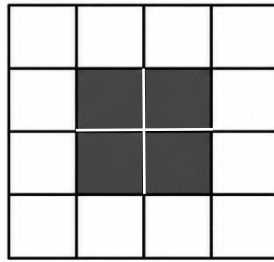


Figure 2

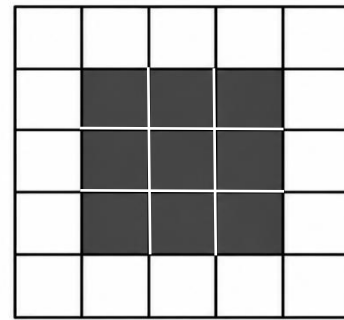


Figure 3

Figure number, n	1	2	3	4
Number of shaded squares	1	4	9	
Number of unshaded squares	8	12	16	

- (a) Complete the table for Figure 4. [1]
- (b) Write down an expression, in terms of n , for the number of unshaded squares in Figure n .

Answer [1]

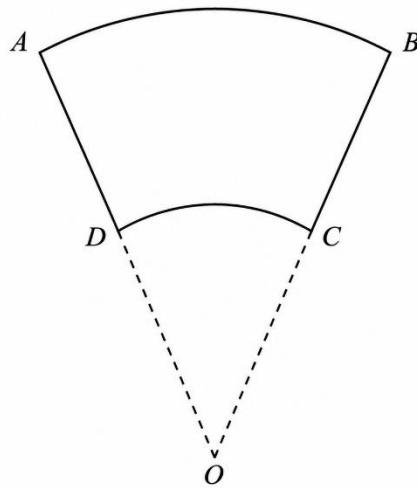
- (c) One figure in the sequence has 96 unshaded squares.
Find the number of **shaded** squares in this figure.

Answer [2]

- 16** The figure shows a region $ABCD$ bounded by two arcs, that share the same center O , and the straight edges AD and BC .

$OA = 2 OD$, angle $DOB = 1.2$ radians, and the perimeter of $ABCD$ is 44.8 cm.

Find the area of the figure $ABCD$.



Answer cm^2 [4]

- 17 (a) Given that $3^k \times 9^3 = \frac{1}{81^k}$, find the value of k .

Answer $k = \dots\dots\dots$ [2]

- (b) Two integers, A and B , can be written as the products of prime factors.

$$A = p \times q^2 \times 7 \quad B = p^{r+1} \times q \times 7$$

The smallest number that is divisible by both A and B is 4725.

Find p , q and r .

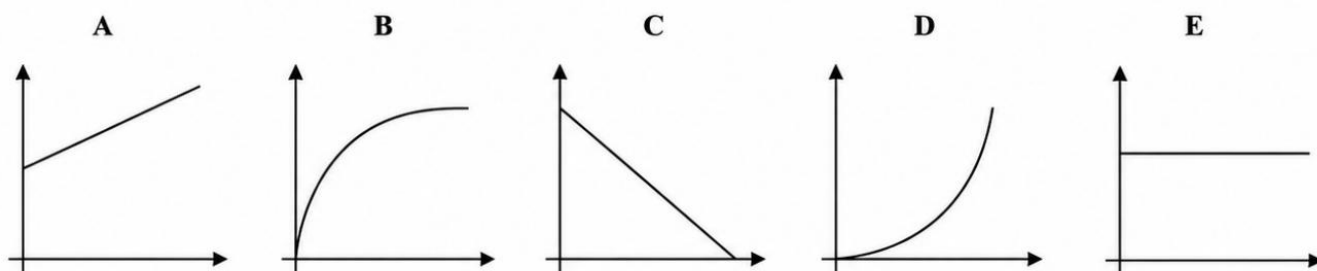
Answer $p = \dots\dots\dots$

$q = \dots\dots\dots$

$r = \dots\dots\dots$

[2]

18 The diagrams below show five different graphs, labelled **A**, **B**, **C**, **D** and **E**.



Match each situation to the graph that best represents it.

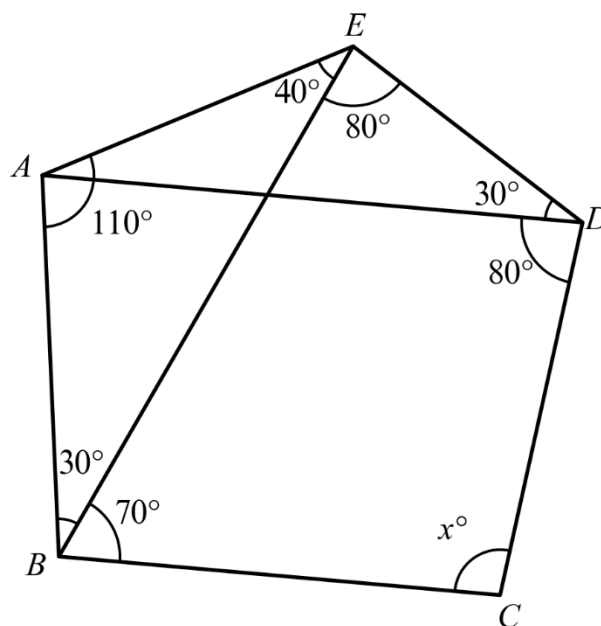
Write the correct letter in each box.

Answer

Situation	Graph
(i) The depth of water in a cylindrical tank as water is drained out at a constant rate. [depth – time graph]	
(ii) The area of a circular oil spill as its radius increases. [area – radius graph]	
(iii) The distance travelled by a car as it decelerates until it comes to a stop. [distance – time graph]	

[3]

- 19 The diagram shows an irregular pentagon $ABCDE$.



- (a) Find the value of x .

Answer [2]

- (b) Show that the points $ABCDE$ lie on the circumference of a circle.
You are expected to state any circle properties used.

Answer

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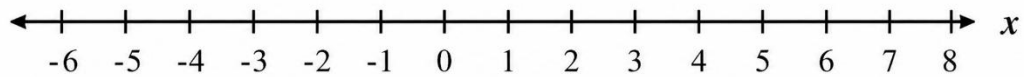
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[3]

- 20 (a)** Solve the inequality $-15 < 3x - 3 \leq 15$.

Answer [2]

- (b)** Represent your solution to part **(a)** on the number line below.



[1]

- (c)** It is given that y is such that $2 \leq y \leq 8$.
If x and y are integers, find the smallest possible value of $y^2 - x^2$.

Answer [1]

- 21** A sculpture of height 5.3 m stands at point A in a park.
 A flower garden, F , is 12.8 m from A on a bearing of 062° .
 The scale drawing below shows the position of A and the direction of North.
Scale: 1 cm represents 2 m

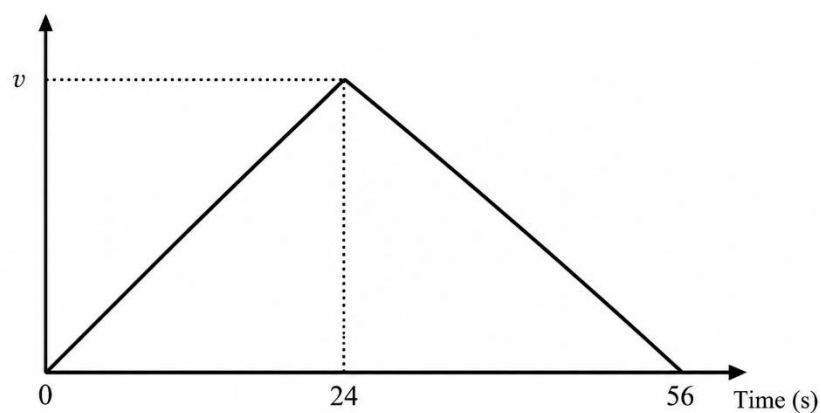


- (a) By construction, locate and mark the position of F . [1]
 (b) A playground, P , is due south of F and 16 m from A .
 By construction, locate and mark the position of P .
 Draw the paths PA and PF . [1]
 (c) Calculate the greatest angle of elevation of the top of the sculpture from the path PF .

Answer [2]

- 22** The speed-time graph shows a car's journey between two sets of traffic lights. The car accelerates uniformly from rest to a maximum speed of v m/s in 24 seconds, then decelerates uniformly to rest at 56 seconds. The car travels 672 m in total.

Speed (m/s)



- (a)** Calculate the maximum speed, v .

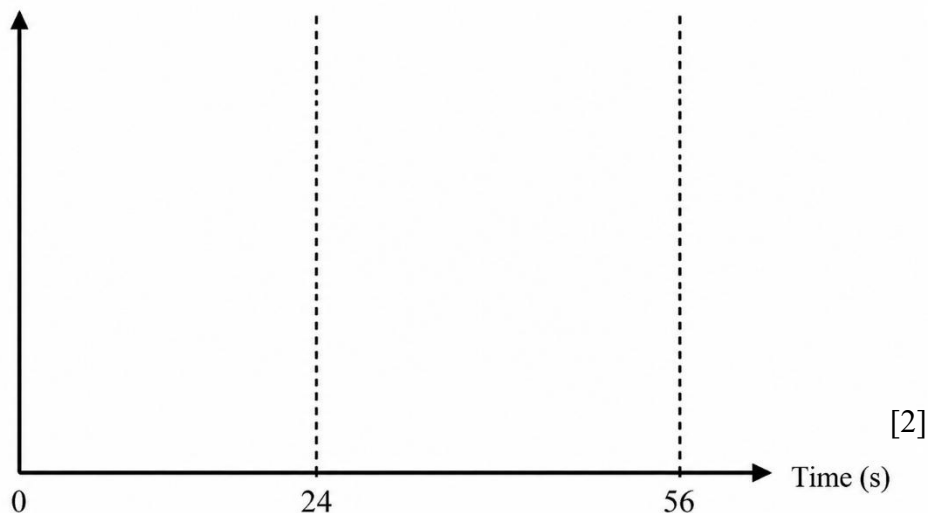
Answer m/s [1]

- (b)** Calculate the deceleration of the car after 24 seconds.

Answer m/s² [1]

- (c)** On the axes below, sketch the distance-time graph for the journey.

Distance (m)



- 23** The point $A(0, 7)$ is translated to the point B by the translation vector $\mathbf{p}$, where

$$\mathbf{p} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$$

- (a)** Find the coordinates of B .

Answer [1]

- (b)** Find $|\mathbf{p}|$.

Answer [2]

- (c)** Find the equation of line AB .

Answer [2]

- 24** $\xi = \{x : x \text{ is an integer, } 1 \leq x \leq 12\}$
 $A = \{x : x \text{ is a multiple of } 3\}$
 $B = \{x : x \text{ is a factor of } 12\}$
 $C = \{x : x \text{ is a prime number greater than } 6\}$

(a) Find $n(A \cup B)'$.

Answer [1]

(b) List the elements of $A' \cap B$.

Answer [1]

(c) State whether the statement “ $9 \in A \cap B'$ ” is true or false, justifying your answer.

Answer
 [1]

(d) An integer is chosen at random from ξ .

Event X : the chosen integer belongs to set B .

Event Y : the chosen integer belongs to set C .

Determine whether events X and Y are mutually exclusive. Give a reason for your answer.

Answer

 [1]

25 Each day, a pump fills the same empty tank with water.

On Monday, the pump takes t minutes to fill the tank.

On Tuesday, the pump runs at a rate of 40 litres per minute and takes 6 minutes longer than on Monday.

On Wednesday, the pump runs at a rate of 60 litres per minute and takes 4 minutes less than on Monday.

- (a)** Write down expressions, in terms of t , for the volume of water in the tank, in litres, on Tuesday and on Wednesday.

Answer Tuesday : litres

Wednesday : litres [1]

- (b)** Hence form an equation in t and solve it to find the time taken on Monday.

Answer minutes [3]

- (c)** Hence find the capacity of the tank.

Answer litres [1]

- 26** A school canteen sells two meal sets, Set A and Set B.

The numbers of meal sets sold on Monday and Tuesday are represented by the matrix

$$\mathbf{Q} = \begin{array}{cc} & \begin{array}{cc} \text{Set A} & \text{Set B} \end{array} \\ \begin{bmatrix} 120 & 80 \\ 150 & 60 \end{bmatrix} & \begin{array}{l} \text{Mon} \\ \text{Tues} \end{array} \end{array}$$

where the rows represent Monday and Tuesday respectively, and the columns represent Set A and Set B respectively.

Set A costs \$4.50 and Set B costs \$6.00.

- (a)** Write down a column matrix $\mathbf{P}$ to represent the prices of Set A and Set B.

Answer $\mathbf{P} =$ [1]

- (b)** Calculate $\mathbf{QP}$.

Answer $\mathbf{QP} =$ [1]

- (c)** Explain what each element of the matrix $\mathbf{QP}$ represents.

Answer
 [1]

- (d) The canteen makes a profit of 30% of the selling price of each Set A sold and 40% of the selling price of each Set B sold.

$\mathbf{R}$ is a diagonal matrix such that the elements of $\mathbf{RP}$ gives the profit made on each Set A and Set B meal sold.

- (i) State the matrix $\mathbf{R}$.

Answer $\mathbf{R} =$ [1]

- (ii) Find the profit made by the canteen for each of the two days, by matrix to matrix multiplication.

Answer Profit for Monday \$

Tuesday \$ [2]

END OF PAPER