DUNMAN SECONDARY SCHOOL

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS/ 5 NORMAL ACADEMIC

MATHEMATICS

Paper 1

4052/01
19 August 2025
2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Calculator Model

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
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 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 or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 90.

Total Marks

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ is in radians

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

Trigonometry

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

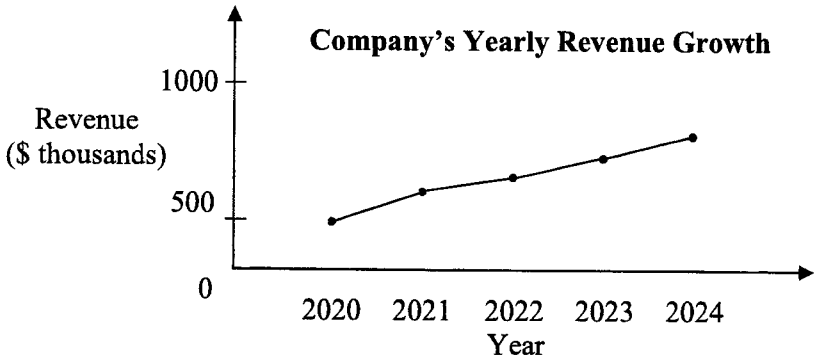
$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

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

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

1 The graph below shows a company's yearly revenue from 2020 to 2024.



(a) State one misleading feature of the graph.

.....

..... [1]

(b) Explain how this feature affects the reader's interpretation of the graph.

.....

..... [1]

---

2 Sammi is travelling back to Singapore from Italy.
She wants to change 830 euros (€) into Singapore dollars ($).

The exchange rate in Italy is €1 = $1.4893.
The exchange rate in Singapore is $1 = €0.6747.

How many more Singapore dollars will she get by changing her money in Italy?

Answer $ ..... [2]

---

3 **(a)** Given that $3\sin x = 1$, find the two possible values for angle x, where $0° \leq x \leq 180°$.

Answer $x =$ ..... or ..... [2]

(b) Convert 26° into radians.

Answer ..... [1]

---

4 300 ml of liquid is poured into bottles A, B and C in the ratio 2 : 8 : 5.
n ml of liquid is spilled from bottle A.
The ratio of the amounts of liquid in A, B and C becomes 7 : 40 : 25.
Find the value of n.

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

---

5 **(a)** Simplify $\left(\frac{27a^{12}}{b^3}\right)^{-\frac{2}{3}}$.

Answer ..... [2]

(b) $13\times9^2-4\times3^4=3^p$

Use the laws of indices to find the value of p.
Show your working.

Answer $p=$ ..... [2]

---

6 The gravitational force F (in newtons) is inversely proportional to the square of the distance r (in metres) between two objects.

John says: "If I tripled the distance between the two objects, the gravitational force they experience will be one-third as strong."

Is he correct? Explain your answer.

Answer

.....

.....

..... [2]

---

7 The bullet train in Japan takes 1.55 hours to travel 341 kilometres from Tokyo to Nagoya.

(a) By rounding these numbers correct to 1 significant figure, find an estimate of the speed of the bullet train. Show the numbers you use.

Answer ..... km/h [1]

(b) Without doing any further calculation, explain why the actual speed is faster than the answer to **part (a)**.

Answer .....

.....

..... [1]

(c) The actual speed of a bullet train is 227 km/h.
Change 227 km/h into metres per second.

Answer ..... m/s [1]

---

8 Factorise completely.

(a) $16a^2b - 8ab^2$

Answer ..... [1]

(b) $3c - 4d + 3cd - 4$

Answer ..... [2]

---

9 A map of a city has a scale of $1 : n$.

The actual area of the city is 728.6 km^2.

The area of the city on the map is 29 cm^2.

Express the value of n in standard form, correct to 1 significant figure.

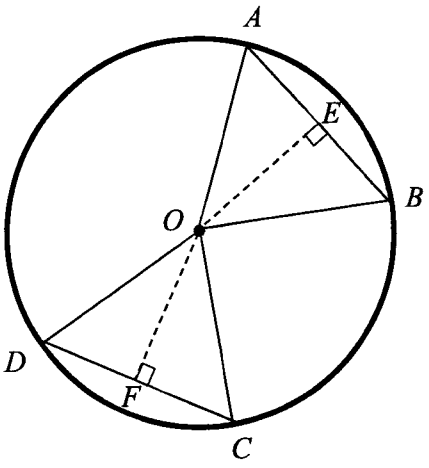
Answer $n =$ ..... [3]

---

10 Express as a single fraction in its simplest form $\frac{5x}{18} - \frac{5x+12}{54} - \frac{2(x-1)}{27}$.

Answer ..... [3]

11



In the diagram, A, B, C and D are points on a circle, centre O.
$OE = OF$.
Prove that triangles OAB and OCD are congruent.
Give a reason for each statement you make.

Answer

[2]

---

12 Simplify $\dfrac{2x^2+7x-15}{16x^4-81}$.

Answer ..... [3]

---

13 **(a)** Express $7-10x+x^2$ in the form $(x+a)^2+b$.

Answer ..... [2]

(b) Write down the equation of the line of symmetry of the graph of $y=7-10x+x^2$.

Answer ..... [1]

---

14 **(a)** $\xi = \{\text{integers } x : 1 \leq x \leq 14\}$
$X = \{\text{perfect square}\}$
$Y = \{\text{prime numbers}\}$

(i) List the elements in Y'.

Answer ..... [1]

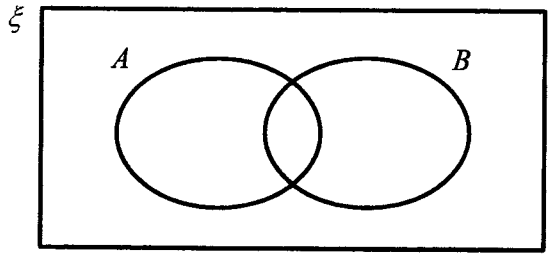
(ii) Explain why $X \cap Y = \phi$.

Answer .....

.....

..... [1]

(b) On the Venn diagram, shade the region which represents $(A' \cap B)'$.

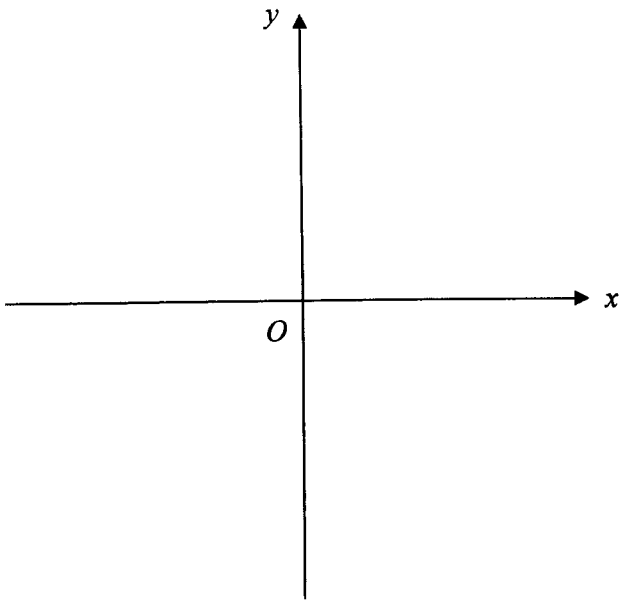


[1]

---

15 Sketch the graph of $y = -(x+2)(x-7)$ on the axes below.

Indicate clearly the points where the graph crosses the x-axis.



[2]

---

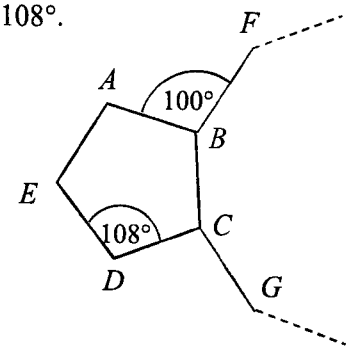
16 A sphere has radius $2r$ cm.
A cone has a radius equal to one-third of the radius of the sphere, and a height of $10h$ cm.
The volume of the sphere is twice the volume of the cone.
Express the ratio $h : r$ in its simplest form.

Answer ..... : ..... [3]

---

17 The diagram shows a regular pentagon, $ABCDE$, and three of the sides, GC, CB and BF, of a second polygon.

Angle $ABF = 100°$ and angle $CDE = 108°$.



Explain why the second polygon is not a regular polygon.

Answer

.....

..... [3]

18 P is the point $(2, -5)$.

$\overrightarrow{QP} = \begin{pmatrix} -4 \\ -3 \end{pmatrix}$.

(a) Find the length of PQ.

Answer ..... [1]

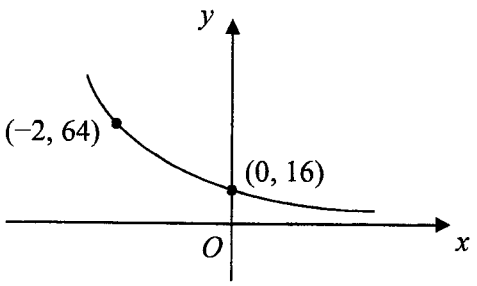
(b) Find the equation of PQ.

Answer ..... [3]

(c) Another point, R, lies between P and Q on the line PQ such that $PQ : PR = 4 : 3$.
Find the coordinates of R.

Answer $R = (\ldots\ldots, \ldots\ldots)$ [2]

19 The sketch shows the graph of $y = ka^x$, where $a > 0$.



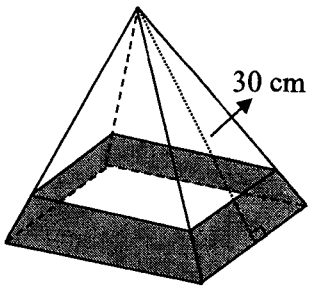
Find the values of k and a.

Answer $k =$ .....

$a =$ ..... [2]

---

20 The diagram shows a rectangular pyramid resting on the ground, with a slant height of 30 cm.
The shaded region on each lateral face represents **one-fifth** of the lateral surface area of the pyramid being coated with paint.
Find the length of the slant height that is coated with paint.



Answer ..... cm [2]

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21 A fridge contains 5 bottles of pineapple juice and 4 bottles of orange juice.
John takes a bottle, selected at random, from the fridge and drinks it.
Peter then takes a bottle, selected at random, from the fridge.

Find, as a fraction in its simplest form, the probability that

(a) Peter chooses orange juice,

Answer ..... [2]

(b) one of them chooses pineapple juice and the other chooses orange juice.

Answer ..... [2]

22 The table below summarises the monthly salary of 100 workers in a company.

Monthly Salary (m thousand dollars)	$4 \leq m < 4.5$	$4.5 \leq m < 5$	$5 \leq m < 5.5$	$5.5 \leq m < 6$	$6 \leq m < 6.5$
Frequency	15	29	12	34	10

(a) Calculate an estimate of the mean monthly salary.

Answer $..... [1]

(b) Calculate an estimate of the standard deviation of the monthly salary.

Answer $..... [1]

(c) A financial crisis occurred and there was a rebalancing of salaries to support some workers. The rebalancing is as follows:

- Workers earning less than $5000 will receive an increment of $300.
- Workers earning between $5000 (inclusive) and $5500 (exclusive) will keep their current salary.
- Workers earning $5500 or more will receive a pay cut of $300.

Explain how this rebalancing affects the mean and the standard deviation of the salaries.

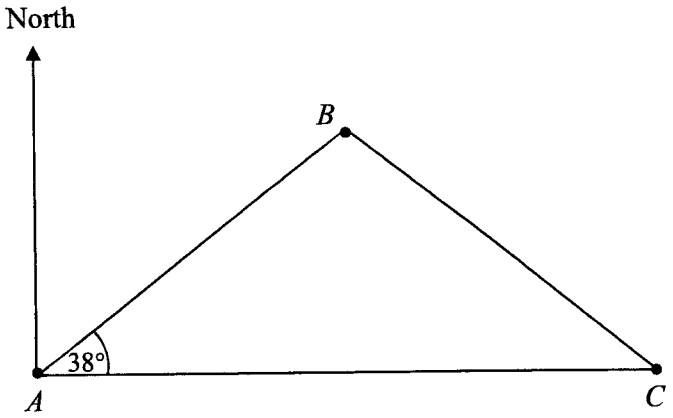
Answer .....

.....

.....

..... [2]

23 The diagram shows the position of an island A at sea level.
Boat B and ship C are on the surface of the sea.
Ship C lies due east of island A. Angle $BAC = 38°$.



(a) Calculate the bearing of A from B.

Answer ..... [2]

(b) On the diagram above, construct a line such that every point on this line is equidistant from the lines AB and AC.
The line intersects BC at P.
Measure the length BP.

Answer $BP =$ ..... cm [2]

24 The equation of line l_1 is $5y = 6x - 2$.

The equation of line l_2 is $2y = 5x - 6$.

(a) Find the coordinates of the point of intersection of line l_1 and line l_2.

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

(b) The equation of another line l_3 is $py = 3x - 1$, where p is a constant.

Explain why it is not possible to find a value of p such that lines l_1 and l_3 do not intersect.

Answer

.....

..... [3]

25 At a school carnival, two different classes sold ice cream to raise funds.
They sold in three different flavours: almond, blueberry and chocolate.
Class A sold 60 almond ice cream, 80 blueberry and 50 chocolate.
Class B sold 50 almond ice cream, 90 blueberry and 70 chocolate.

This information can be represented by the matrix $\mathbf{P} = \begin{pmatrix} 60 & 80 & 50 \\ 50 & 90 & 70 \end{pmatrix}$

(a) The almond ice cream is sold at \$1.20.
The blueberry ice cream is sold at \$1.50.
The chocolate ice cream is sold at \$1.80.
Represent these amounts in a 3×1 column matrix **Q**.

Answer **Q** = [1]

(b) Evaluate the matrix $\mathbf{T} = \mathbf{PQ}$.

Answer **T** = [2]

(c) State what each of the elements of **T** represents.

Answer .....

..... [1]

(d) Class A decides to donate 80% of their amount raise to an elderly home.
Class B decides to donate 90% of their amount to the same elderly home.
Write a matrix **D** such that the product **DT** will give the total amount donated.

Answer **D** = [1]

26 **(a)** The highest common factor (HCF) of two numbers is 18.

The lowest common multiple (LCM) of the two numbers is 216.

Written as a product of its prime factors, $216 = 2^3 \times 3^3$.

Both numbers are greater than 25.

Find the two numbers.

Answer ..... and ..... [2]

(b) Written as a product of its prime factors, $11664 = 2^4 \times 3^6$.

(i) Explain why 11664 is a perfect square.

Answer .....

.....

..... [1]

(ii) The number $11664 \div \frac{6}{m}$ is a perfect cube where m is a prime number.

Find the value of m.

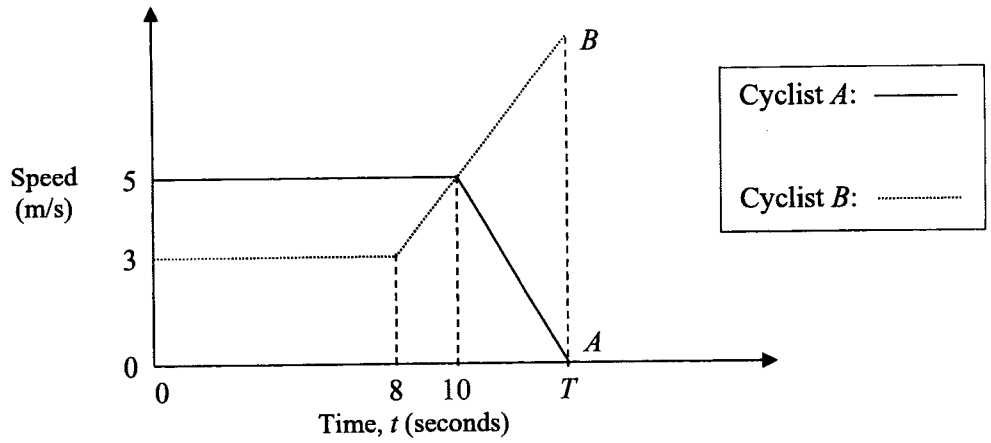
Answer $m =$ ..... [1]

27 The diagram shows the speed-time graph for two cyclists, A and B, travelling along the same track in the same direction.

A travels at a constant speed of 5 m/s for 10 seconds and then decelerates to a stop at T seconds.

B travels at a constant speed of 3 m/s for 8 seconds and then accelerates till T seconds.

When $t = 10$, the speed of B is 5 m/s.



(a) Calculate the acceleration of B after 8 seconds.

Answer ..... m/s^2 [1]

(b) The area beneath each speed-time graph represents the distance travelled by each cyclist.

(i) Find an expression, in terms of T, for the distance travelled by A in the T seconds.

Answer ..... m [1]

(ii) When $t = 0$, both A and B start at the same position.

When $t = T$, both A and B meet again.

Form an equation to represent this information and show that it simplifies to

$$T^2 - 15T + 14 = 0.$$

Answer

[3]

(iii) Solve the equation and find the value of T.

Answer $T =$ ..... [2]

End of Paper

22

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DUNMAN SECONDARY SCHOOL

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

MATHEMATICS
Paper 2

4052/02
26 August 2025
2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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The use of an approved scientific calculator is expected, where appropriate.
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For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

Total Marks

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

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Answer **all** the questions.

1 **(a)** Solve the inequality $2x-1<\frac{5+9x}{2}$.

Answer ..... [2]

(b) It is given that $b=\frac{2\left(n-5p^2\right)}{n-p^2}$.

(i) Find b when $n = 1$ and $p = -2$.

Answer ..... [1]

(ii) Express p in terms of b and n.

Answer $p =$ ..... [3]

(c) Solve the equation $\frac{3x}{2x-1}-\frac{2}{5-x}=7$.

Answer ..... or ..... [5]

2 **(a)** In 2023, the amount of waste recycled in Singapore was 3.553 million tonnes.
The amount of waste disposed in Singapore was 3.3064 million tonnes.

(i) How much more waste (in tonnes) was recycled than disposed in Singapore in 2023?
Write the difference (in tonnes) in standard form, correct to three significant figures.

Answer ..... tonnes [2]

(ii) The amount of waste recycled in Singapore in 2020 was 3.040 million tonnes.
Calculate the percentage increase in the amount of waste recycled from 2020 to 2023.

Answer ..... % [2]

(iii) From 2022 to 2023, the amount of waste recycled in Singapore decreased by 15.2%.
Calculate the amount of waste recycled (in tonnes) in 2022.

Answer ..... tonnes [2]

(b) The cash price of a new car is $120 000.

(i) Jason buys the car on hire purchase.
He pays a deposit of 20% of the cash price.
He then makes 84 monthly payments of $1400.

What is the total amount that Jason pays for the car?

Answer $ ..... [2]

(ii) The original value of the car is its cash price of $120 000.
Each year, the value of the car decreases by 15% of its value at the start of the year.

Calculate the overall percentage decrease in the value of the car compared with its original value after 5 years.

Answer ..... % [2]

3 The daily growth rate, h millimeters per day, of Plant A is related to the number of hours of sunlight it receives each day, t, by the formula $h = \frac{1}{6}t^2(4-t)$.

(a) Complete the table of values for $h = \frac{1}{6}t^2(4-t)$.

Values are given to 2 decimal places where appropriate.

t	0.5	1	1.5	2	2.5	3	3.5	4
h		0.5	0.94	1.33	1.56	1.5	1.02	0

[1]

(b) On the grid opposite, draw the graph of $h = \frac{1}{6}t^2(4-t)$ for $0 \le t \le 4$. [3]

(c) Use your graph to find the maximum number of hours of sunlight Plant A can receive to achieve a daily growth rate of 1 millimetre per day.

Answer ..... hours [1]

(d) **(i)** By drawing a tangent, find the gradient of the curve at (3, 1.5).

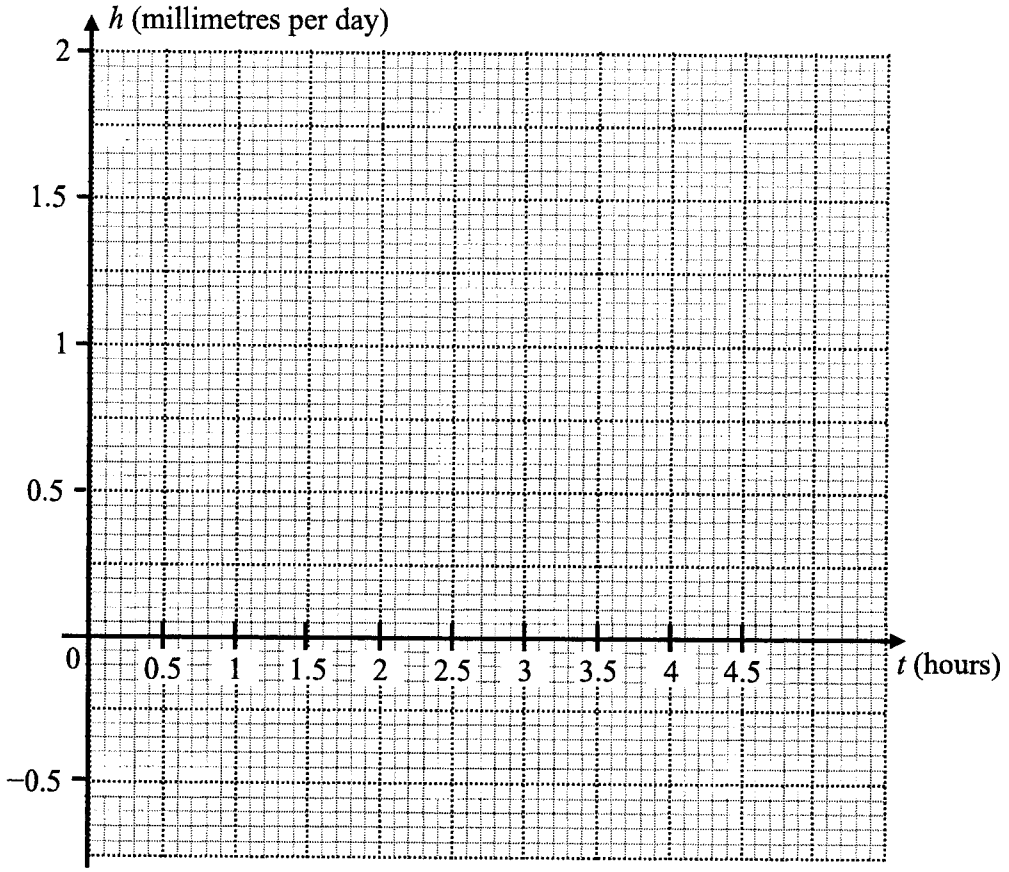
Answer ..... [2]

(ii) What does the gradient in **part (i)** tell us about the effect of additional sunlight on the daily growth rate of plant A at this point? Explain your answer.

Answer .....

.....

..... [1]



The daily growth rate, h millimeters per day, of another Plant B is related to the t hours of sunlight it receives each day by the formula $2h = t$.

(e) **(i)** On the grid above, draw the graph of $2h = t$ for $0 \leq t \leq 4$.

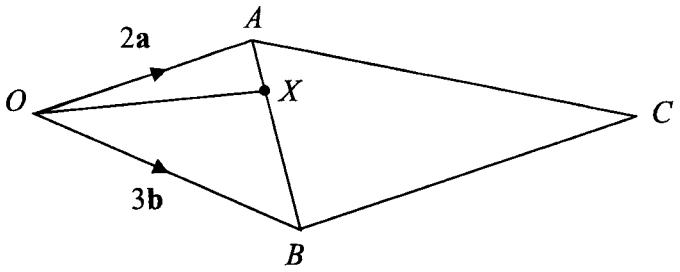
[1]

(ii) Find an equation in the form $t^3 + pt^2 + qt + r = 0$, where p, q and r are constants to be found, such that the solutions represent the number of hours of sunlight when both Plant A and Plant B have the same daily growth rate.

Answer

[2]

4



$OACB$ is a trapezium.

$\overrightarrow{OA} = 2\mathbf{a}$, $\overrightarrow{OB} = 3\mathbf{b}$ and $\overrightarrow{OA} = \frac{2}{3}\overrightarrow{BC}$.

X is the point on AB such that $AX : XB = 1 : 3$.

(a) Express, as simply as possible, in terms of **a** and/or **b**,

(i) $\overrightarrow{AX}$,

Answer ..... [2]

(ii) $\overrightarrow{OX}$.

Answer ..... [1]

(b) Y is the point on BC produced such that $BY = 3OA$.
Find, in terms of **a** and/or **b**, $\overrightarrow{XY}$.

Answer ..... [2]

(c) Explain why O, X and Y lie on a straight line.

Answer .....

.....

..... [2]

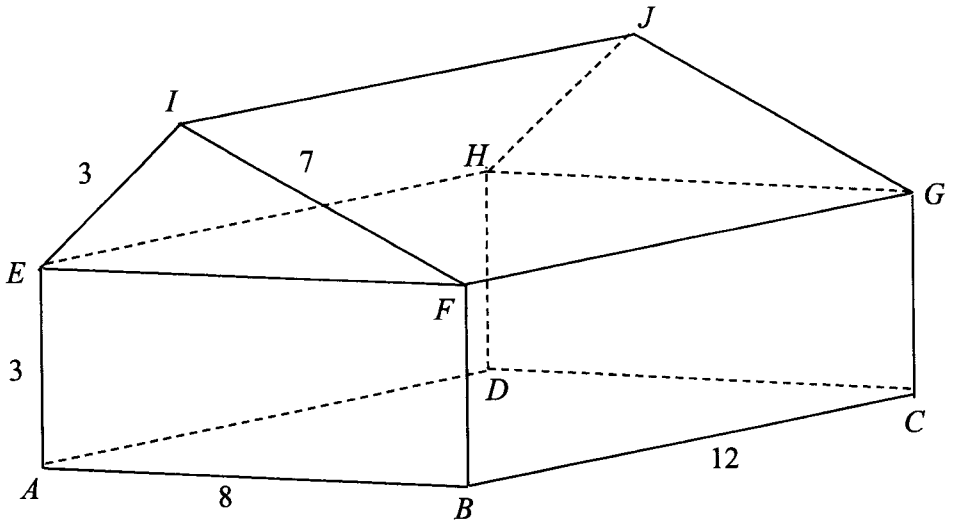
(d) Find the ratio of the area of triangle OBX to the area of quadrilateral $OACB$.

Answer ..... : ..... [2]

(e) W is the point on AB such that triangle OAW is similar to triangle CBW.
Find, in terms of **a** and/or **b**, $\overrightarrow{OW}$.

Answer ..... [2]

5



The diagram shows a solid made of a cuboid *ABCDEFGH* and a triangular prism *EFGHIJ*, resting on level ground.
AB = 8 m, *BC* = 12 m, *AE* = 3 m, *EI* = 3 m and *FI* = 7 m.

(a) Show that angle *EFI* = 21.8°, correct to 1 decimal place.
Answer

[3]

(b) Find the volume of the solid, leaving your answer correct to 2 decimal places.

Answer .....m³ [2]

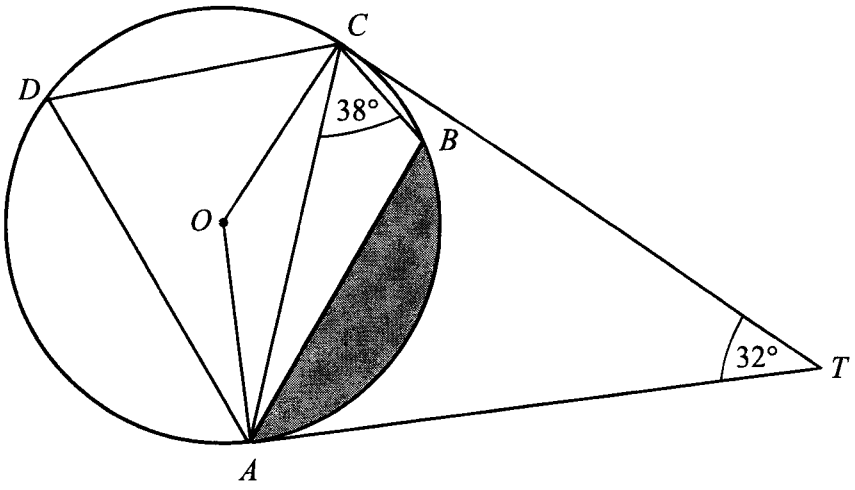
(c) Find the vertical height of I above the ground.

Answer .....m [2]

(d) Find the angle of elevation of J from B.

Answer ..... ° [4]

6



The diagram shows a circle $ABCD$, centre O.
AT and CT are tangents to the circle.
Angle $ATC = 32°$ and angle $ACB = 38°$.

(a) Find angle ADC.
Give a reason for each step of your working.

Answer ..... ° [3]

(b) Determine if OC parallel to AB.
Give a reason for each step of your working.

Answer

[3]

(c) The radius of the circle is 10 cm.

Calculate the area of the shaded region.

Answer ..... cm^2 [4]

7 **(a)** The diagram shows part of a number grid.

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45

A cross outlining five numbers, as shown, can be placed anywhere on the grid.

(i) If n represents the number in the top left corner of the cross, write down an expression, in terms of n, for the number in the bottom right corner of the cross.

Answer ..... [1]

(ii) Show that the difference between the products of the numbers in the opposite corners of the cross is always 36.

Answer

[2]

(iii) Show that the sum of the five numbers in the cross cannot be 1715.

Answer

[3]

(b) The nth term of a sequence is given by $T_n = 2n^2 - n + 3$.

(i) Find the value of T_{10}.

Answer ..... [1]

(ii) The difference, D, between two consecutive terms of the sequence is $T_{n+1} - T_n$. Show that $D = kn + 1$, where k is an integer to be found.

Answer

[2]

(iii) Using the expression from **part (ii)**, explain, without doing any further calculation, how the difference between two consecutive terms of the sequence changes as n increases by 1 each time.

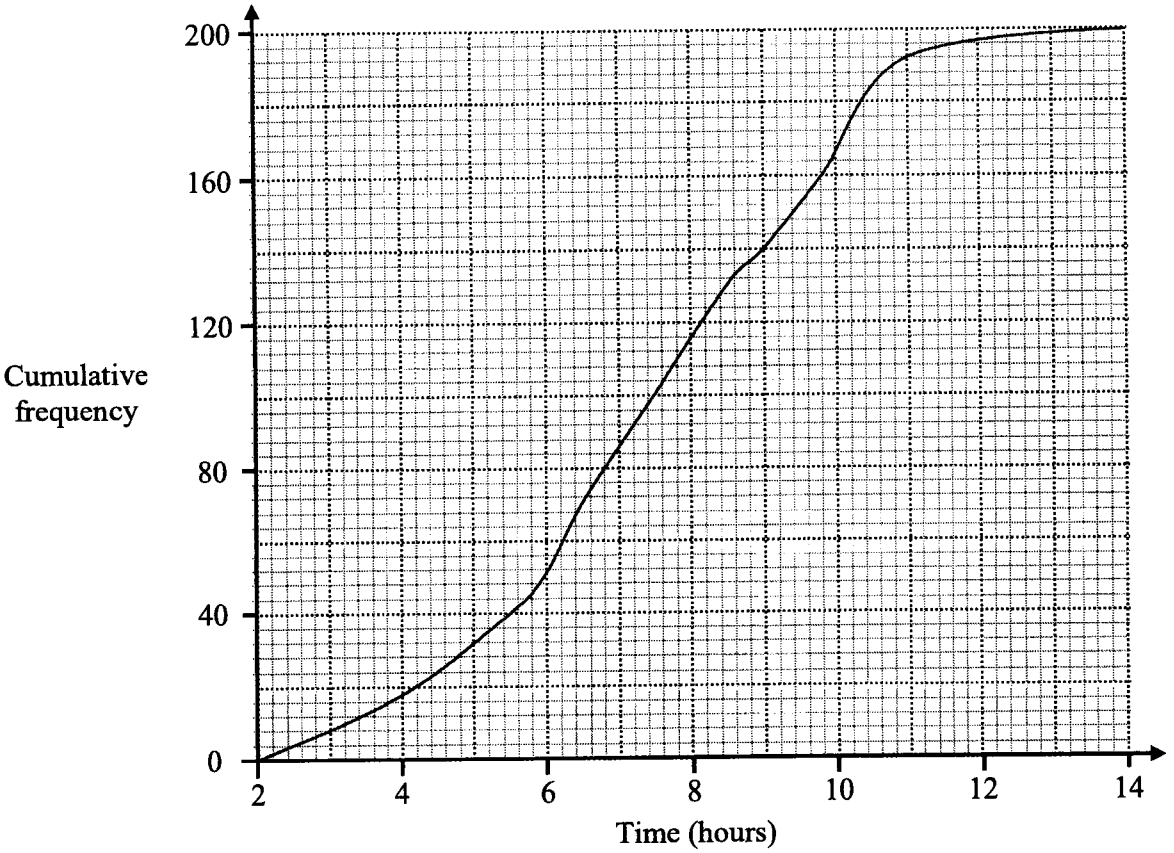
Answer .....

.....

..... [1]

8 A group of 200 teenagers in Singapore were asked how many hours of daily screen time they had, on average, in the last week.

The cumulative frequency curve shows the distribution of the hours.



(a) Use the curve to estimate

(i) the median hours,

Answer ..... hours [1]

(ii) the interquartile range of the number of hours.

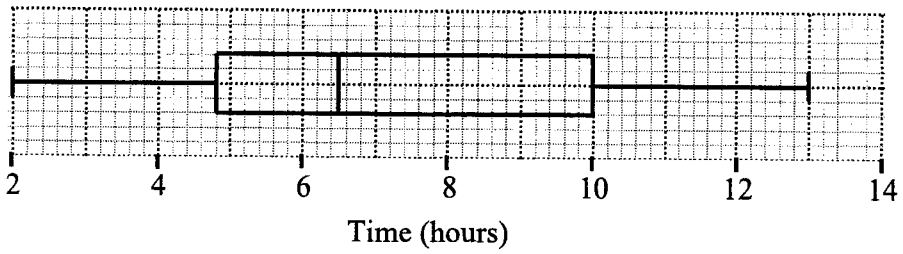
Answer ..... hours [2]

(b) Find the probability that a teenager selected from this group had a daily screen time of at least 5 hours.

Answer ..... [1]

(c) Another group of 200 teenagers in Country X were also asked how many hours of daily screen time they had, on average, in the last week.

The box-and-whisker plot shows the distribution of the hours.



Make two comparisons between the daily screen time of teenagers in Singapore and in Country X.

Answer

1 .....

.....

2 .....

..... [2]

9 Mr Tan is engaging a contractor to install large ceiling fans in the school hall.

The hall is a large rectangular space, 30 metres long, 20 metres wide and 8 metres high.

There are two requirements:

1. **Good air circulation.** The fans together must meet the minimum airflow requirement.
2. **Comfortable cooling environment.** Each fan must produce an air velocity of at least 0.3 m/s.

Formulas related to the requirements are provided by the vendor.

Volume of air moved by fan

- Volume of air moved by fan for 1 full rotation (VFR)
  = circular cross-sectional area of the fan × height of air column
- Volume of air moved by fan per second (VPS)
  = VFR × number of full rotations per minute (RPM) ÷ 60

Minimum airflow requirement

- Minimum airflow requirement (m^3/min) = total volume of school hall (m^3) ÷ 5
- Total airflow generated per minute of fans (m^3/min) = VFR × 70 × number of fans

Air velocity requirement

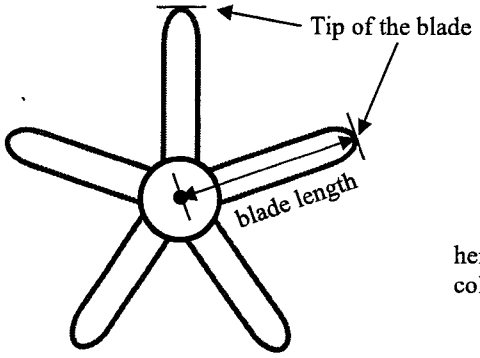
- Air velocity = VPS ÷ circular cross-sectional area of the fan

The vendor also provided the specifications of three fan models.

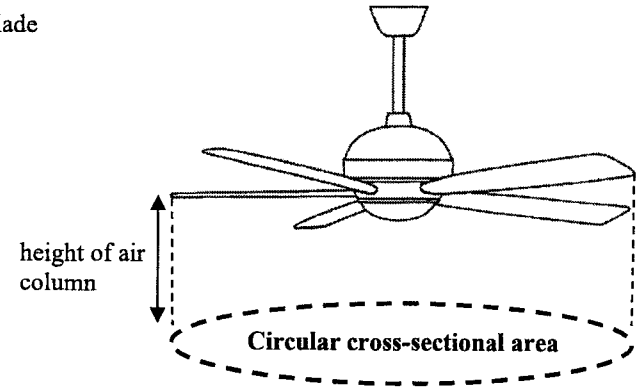
Specifications of Fan Models A, B and C

Type	Blade length (m)	Number of blades	Motor Power (W)	Height of air column (m)	Number of full rotations per minute (RPM)	Weight (kg)
A	2.0	5	75	0.5	60	32.0
B	2.5	5	90	0.5	50	35.0
C	3.0	6	120	0.6	45	38.0

Schematic Diagrams of a Fan



Top-down view



Side view

(a) A Type A fan has 5 blades arranged evenly in a circular layout.
Calculate the arc length between two adjacent blades at the tip of the blades.
Give your answer correct to 1 decimal place.

Answer ..... m [1]

(b) Show that the total volume of air moved per second (VPS) by a Type B fan is 8.18 m^3/s, correct to 3 significant figures.

Answer

[2]

(c) The contractor recommended Mr Tan to install **two Type C fans** in the school hall.

Based on the requirements for good air circulation and comfortable cooling, determine if the recommendation is suitable. Justify your decision.

Answer

.....

..... [7]

END OF PAPER