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TAMPINES SECONDARY SCHOOL

Secondary Four Express / Five Normal Academic
Preliminary Examination 2024

NAME					
CLASS				**REGISTER NUMBER**	

MATHEMATICS **4052/01**

Paper 1 **22 August 2024**

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

For Examiner's Use

Write your name, class and register 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, glue or correction fluid.

Answer **all** the 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 value 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**.

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 = $4\pi r^2$

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

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

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

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

Sector area = $\frac{1}{2}r^2\theta$, where θ 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

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

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

Answer **all** the questions.

1 Find the largest prime number that satisfies the inequality $\frac{3x-8}{2} < 28$.

Answer .....…….…….. [2]

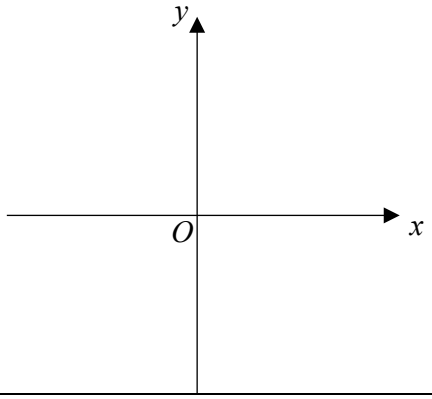
2 Expand and simplify $a-3(a-5b)$.

Answer .....…….…….. [1]

3 Factorise $4x^6 - 100y^2$ completely.

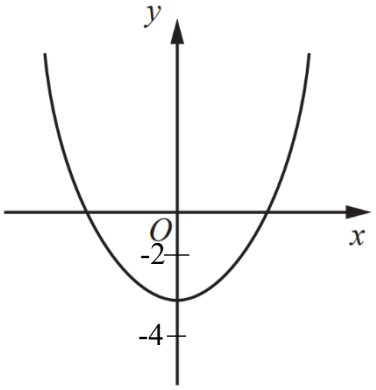
Answer …… [2]

4 **(a)** Sketch the graph of $y = 2(3)^x$, indicating the points of intersection between the axes, if any.



[1]

(b) State a possible equation for the graph shown below.



Answer …… [1]

5 At the end of 2023 there were 27000 rhinos living in the wild.
The number of rhinos is expected to increase exponentially by 3% each year.

Calculate the number of rhinos expected to be living in the wild at the end of 2027.
Give your answer correct to the nearest ten thousand.

Answer ..... [2]

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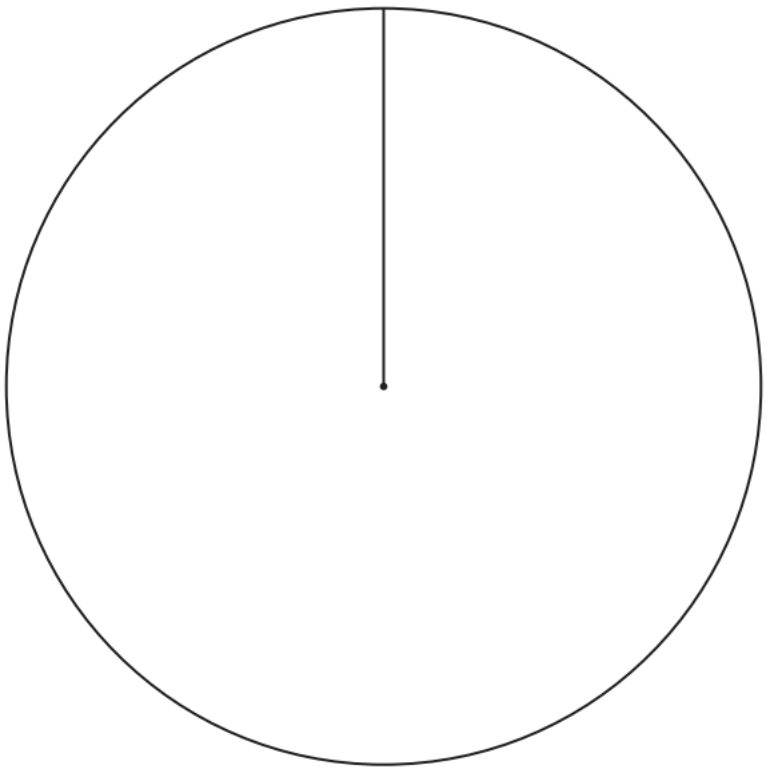
6 The table below shows the favourite language that each of 80 students studies.

Language	Frequency
French	20
Japanese	42
Thai	18

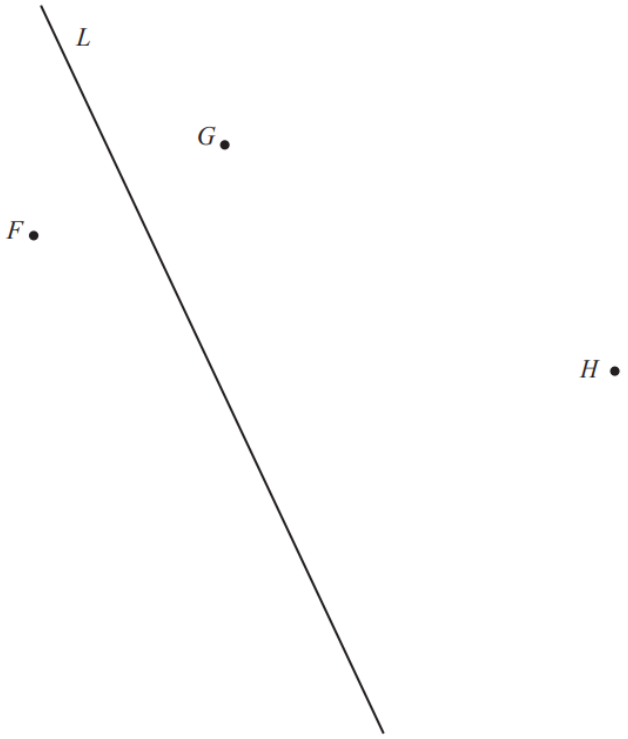
Complete the pie chart to show this information.



[2]

7 **Use a ruler and compasses only** for this question.
You must show all your construction arcs.

Line L is the perpendicular bisector of FG.
Construct a circle that passes through the points F, G and H. [2]



8 **(a)** By using prime factorization, explain why 2420 is not a perfect cube.

Answer ……...

……

…… [2]

(b) When written as a product of its prime factors, the lowest common multiple of two numbers is 2420 and the highest common factor of these two numbers is 110.
Given that **neither of these two numbers is 2420**, find the value of these two numbers.

Answer ……..…….. and ……..…… [2]

9

(a) Simplify $\left(\frac{27x^{15}}{8y^{12}}\right)^{-\frac{1}{3}}$.

Answer …… [2]

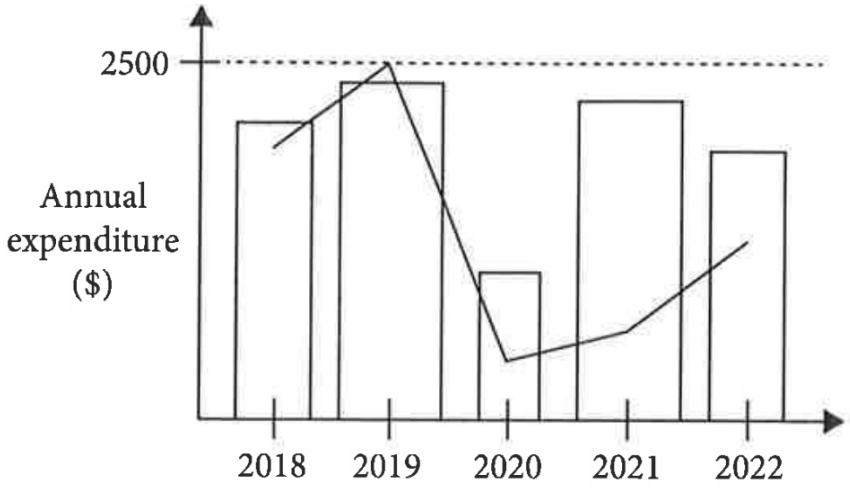
(b) (i) Factorize $4xy-2+y-8x$ completely.

Answer …… [2]

(ii) Hence solve the equation $7^{4xy-2+y-8x}=1$.

Answer $x =$ ……..…… , $y =$ ……..…… [1]

10 Susan draws the diagram below to show her annual expenditure on flight tickets and hotel stays.
The vertical bars represent the amounts spent on hotel stays.
The line graph represents the amount spent on flight tickets.



(a) State one aspect of the graph that may be misleading and how this may lead to a misinterpretation of the annual amount spent on hotel stays.

Answer ……...

……

……

…… [2]

(b) Susan claims that, the years when she spends more on flight tickets corresponds to when she spends more on hotel stays.

Does the chart support her claim?
Justify your answer with reference to the chart.

Answer The chart support / does not support her claim because ……

……

……

…… [1]

11 **(a)** The following shows two sets.

$A = \{4, 8, 12, 16, 20, 24\}$ $B = \{8, 16, 24\}$

Use the following set notations to complete this statement.

$\subset$ $\not\subset$ $\in$ $\notin$ ϕ $\cup$ $\cap$

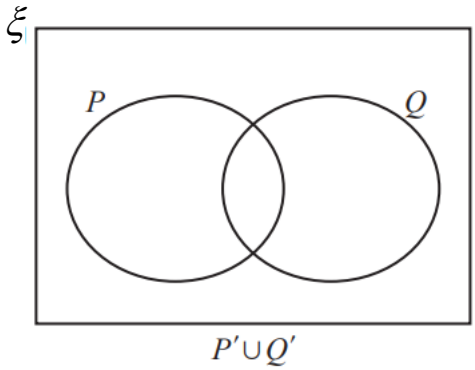
(i) B …….. A

[1]

(ii) 22 …….. A

[1]

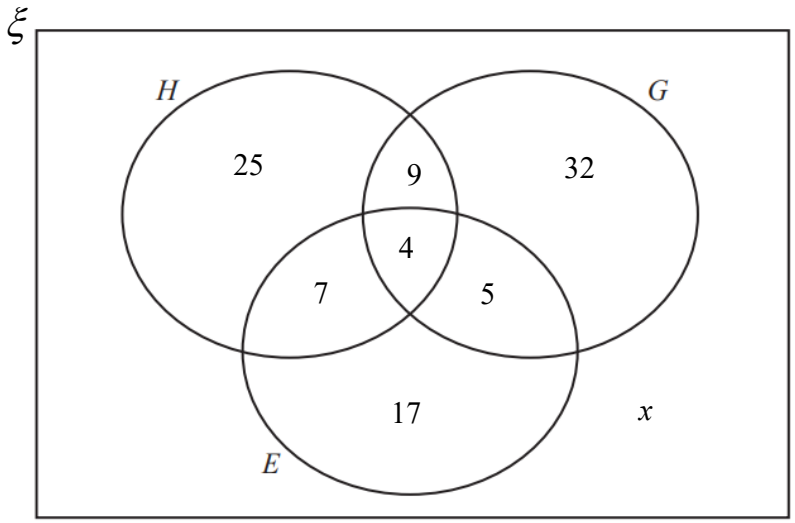
(b) Shade the given set on the Venn diagram below.



$P' \cup Q'$

[1]

(c) There are 120 students in a group.
The Venn diagram below shows the number of students who study History (H), Geography (G) and Economics (E).



(i) Find the value of x and state what this value represents.

Answer $x =$ …… and it represents ……..

……

[1]

(ii) Two of the students who study Economics are chosen at random.

Find, as a fraction in its simplest form, the probability that one of these students also studies Geography but not History and the other student also studies History but not Geography.

Answer ..... [2]

12 Find five positive integers that satisfy all four of the following conditions.

(1) Mode = 5
(2) Median = 5
(3) Mean = 6
(4) Range = 7

Answer ……. , ……. , ……. , ……., ……. [1]

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13 The following shows a list of ingredients for a recipe for making shortbread biscuits.

Ingredients to make **25** biscuits
- 250 grams of flour
- 100 grams of sugar
- 175 grams of butter

(a) Write down the ratio of flour, sugar and butter in its simplest form.

Answer ……..……. : ……..…..….. : ……..…..…. [1]

(b) Raju is making shortbread biscuits for a party using this recipe.
She wants to make as many biscuits as possible.
She has 1.5 kg of flour, 0.5 kg of sugar and 1 kg of butter.
Calculate the maximum number of biscuits Raju can make.

Answer ……..……..…..…....……..…..…. [2]

14 The expression $9-5x+x^2$ can be written in the form $p+(x-2.5)^2$.

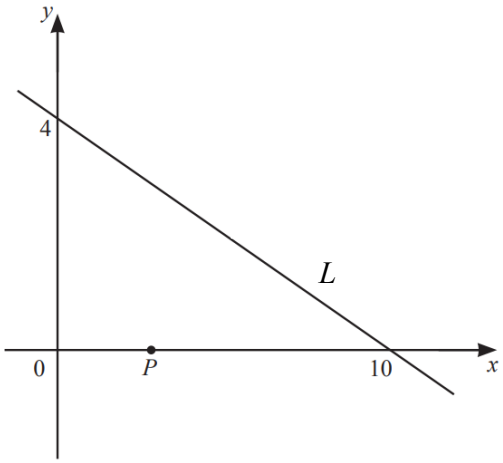
(a) Find the value of p.

Answer $p =$ ..... [1]

(b) Write down the equation of the line of symmetry of the graph $y = 9-5x+x^2$.

Answer ..... [1]

15



The diagram above shows a straight line L. The line cuts the axes at $(10,\ 0)$ and $(0,\ 4)$.

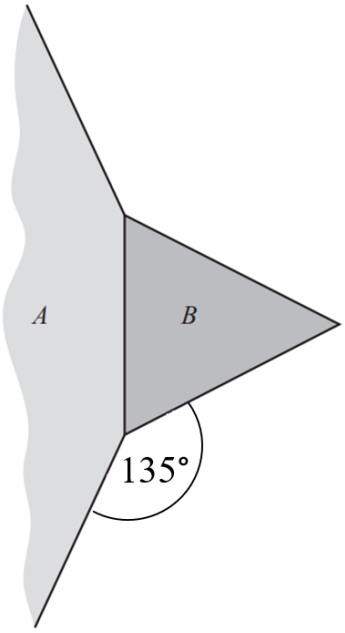
(a) Find the equation of line L.

Answer ..... [2]

(b) The point P has coordinates $(3,\ 0)$. Calculate the shortest distance from P to line L.

Answer ..... [3]

16 The diagram shows part of the regular polygon A joining the equilateral triangle B.
Calculate the number of sides of polygon A.



Answer ……[3]

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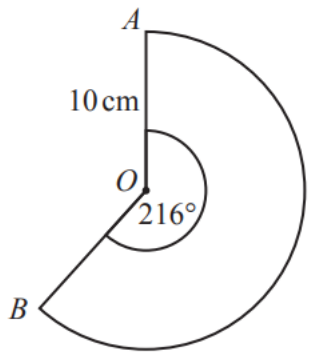
17 P is inversely proportional to the square root of Q.
The **sum** of the values of P when $Q = 9$ and when $Q = 16$ is 21.
Find the value of Q when $P = 100$.

Answer ……[3]

18



AOB is a sector of a circle, centre O. $OA = 10$ cm and the sector angle is 216°.

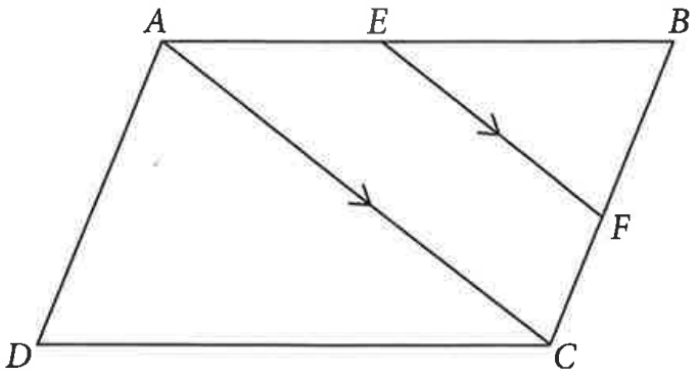
(a) Calculate the perimeter of this sector. Give your answer in terms of π.

Answer ……..…….…..…...cm [2]

(b) A cone is made from this sector by joining OA to OB.
Calculate the volume of the cone.

Answer ……..…….…..…..cm^3 [4]

19 $ABCD$ is a parallelogram. The points E and F lie on AB and BC respectively such that EF is parallel to AC.



(a) Identify two triangles and show that they are congruent. [2]

Answer

(b) Given that $AE = BE$, find the ratio of the area triangle BEF : area of trapezium $ACEF$.

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

20 **(a)** The nth term of a sequence is given by $2n^2 + 4$.

(i) Write down the first 5 terms.

Answer ……. ,……. , ……. , ……. , ……. [1]

(ii) Explain why it is not possible for a term in this sequence to be an odd number.

Answer ……...

……... [1]

(b) The first 5 terms of another sequence are -1 , 5, 15, 29, 47, …

By comparing this sequence with your answer to **(a)**, write down the kth term.

Answer …… [1]

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21 Solve $\frac{4x+5}{x} = 4 + \frac{3}{x+2}$.

Answer $x =$ …… [3]

22 Two teams played 16 basketball matches.
Their scores are shown in the stem-and-leaf diagram.

Team A							Team B				
		1	1	0	0	3	6	6			
8	8	6	2	1	0	4	2	3	3	7	
	5	4	3	3	2	5	0	2	4	6	7
						6	1	6	8	9	
					9	7	3				

Key : 0 | 3 | 6 Means a score of 30 by Team A and a score of 36 by Team B

(a) Find the median score of Team A.

Answer ……..…….…..…..... [1]

(b) Find the interquartile range of the scores of Team B.

Answer ……..…….…..…..... [1]

(c) Use your answers to part **(a)** and **(b)** to make two comments comparing the scores of the two teams.

Answer

1..……....

……...

……...

2..……..

……...

……... [2]

(d) Explain why the mean may not be an appropriate average to use to summarise the scores of Team A.

Answer ……...

……... [1]

23 A bakery makes chicken pies (C), seafood pies (S) and vegetarian pies (V) every day.
The matrix **M** shows the number of pies of each type that are made each day.

$$\mathbf{M} = \begin{matrix} \\ \text{small} \\ \text{large} \end{matrix} \begin{matrix} \begin{matrix} \text{C} & \text{S} & \text{V} \end{matrix} \\ \begin{pmatrix} 80 & 60 & 20 \\ 70 & 40 & 40 \end{pmatrix} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{P} = 7\mathbf{M}$.

Answer ……..…….…..…..... [1]

(b) Each small pie costs \$1.25 to make.
Each large pie costs \$2.50 to make.
By representing these amounts in a 1×2 row matrix **N**, evaluate the matrix $\mathbf{T} = \mathbf{NP}$.

Answer [1]

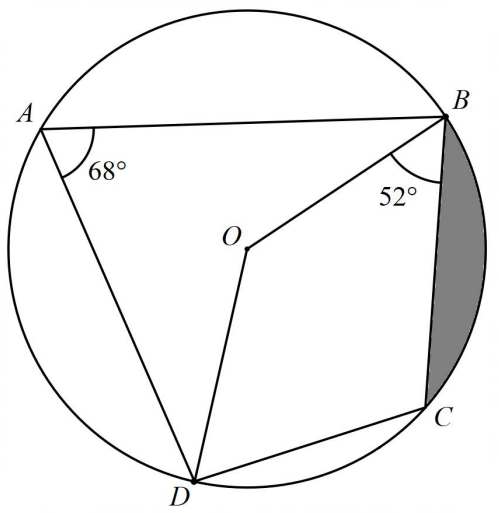
(c) Explain what the third element in matrix **T** represents.

Answer ……... [1]

(d) One week, the bakery sold all the chicken pies and vegetarian pies, and $\frac{3}{5}$ of each size of the seafood pies that were made that week. The unsold pies were given to the staff of the bakery. Given that the bakery made a profit of 150% for each pie that it sells, calculate the total amount of profit that the bakery made that week.

Answer ……..…….…..…..... [2]

24



A, B, C and D are points on the circle, centre O.
Angle $BAD = 68°$ and angle $OBC = 52°$.

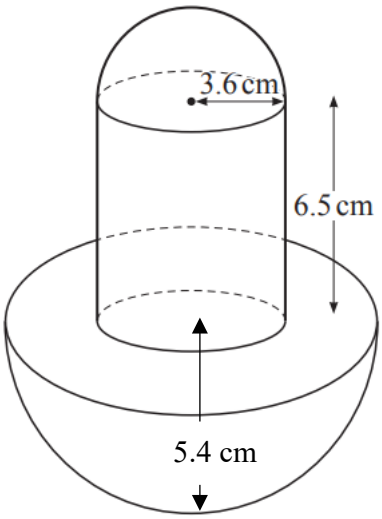
(a) Work out the angle ODC.
Give a reason for each step of your answer.

Answer ……..……..…..…..... [3]

(b) Given that the length of $OB = 5$ cm. Calculate the area of the shaded segment BC.

Answer ……..……..…..…...cm^2 [3]

25

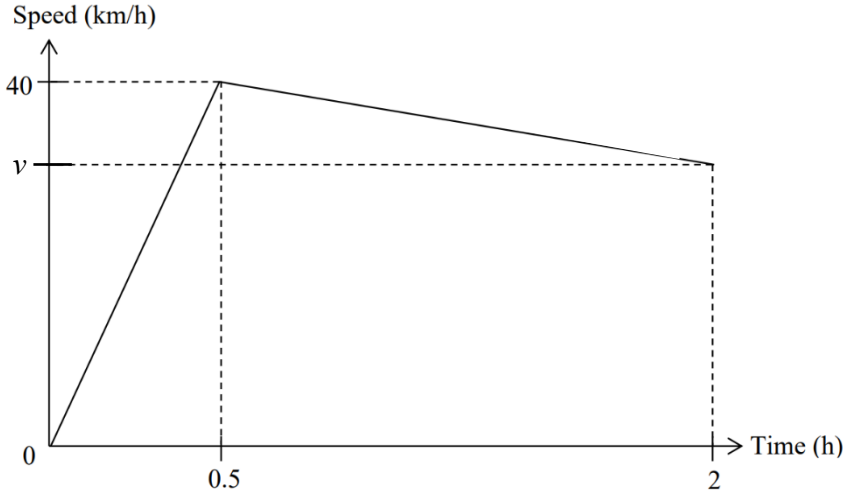


The diagram shows a solid formed by joining two hemispheres and a cylinder.
The radius of the small hemisphere and the radius of the cylinder are both 3.6 cm.
The length from the centre to the bottom of the large hemisphere is 5.4 cm.

Calculate the total surface area of the solid.

Answer ……..……..…..…...cm^2 [5]

26 The diagram shows the speed-time graph for Anne in the first 2 hours of a cycling race.

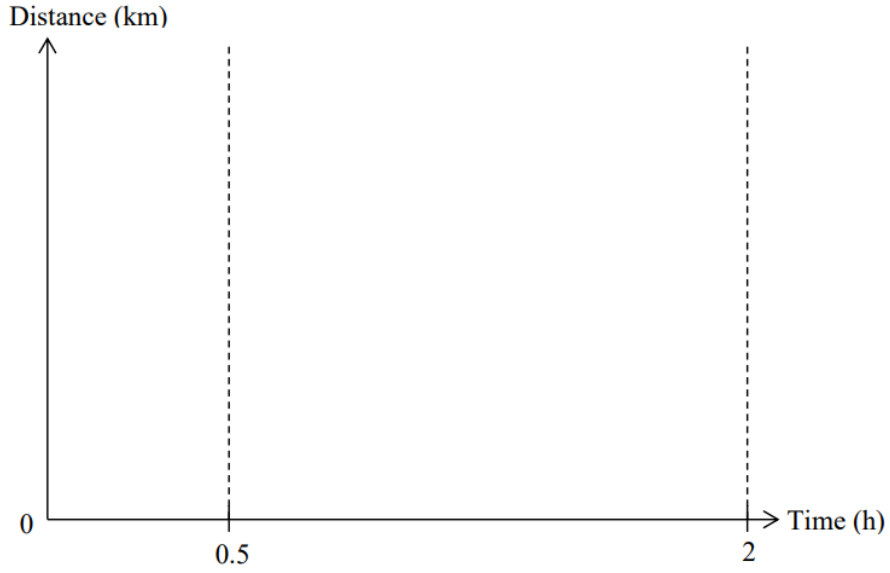


(a) The deceleration of Anne's journey after 0.5 hours is 6 km/h.
Find the value of v.

Answer $v =$ ..... km/h [2]

(b) The area under the speed-time graph represents the distance travelled.
Draw the distance-time graph for the first 2 hours of Anne's journey.

Answer



[2]

End of Paper