Name: .... ( ) Class: ....

ASSUMPTION ENGLISH SCHOOL
END-OF-YEAR EXAMINATION
2024

MATHEMATICS (4052/01)

LEVEL : Sec 3 Express,
Sec 3 Normal (Academic) SBB

DATE : 4 October 2024

CLASSES: Sec 3/1, 3/2, 3/3, 3/5(SBB)

DURATION: 2 Hours

Additional Materials provided: NIL

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a 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 3 significant figures. Give answers in degrees to 1 decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

For Examiner's use:	
Total	/ 80

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 80.

This question paper consists of 17 printed pages, including the cover page.

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

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

Trigonometry

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

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

Answer **all** questions.

1 By rounding off each number to 1 significant figure, estimate the value of $\dfrac{10.9\times\sqrt{3.61}}{1.94}$.

Answer ..... [1]

---

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

Answer ..... [2]

---

3 **(a)** Convert $460°$ into radians.

Answer ..... rad [1]

(b) Given that $\cos x° = k$ and $\cos y° = -k$, and both angles are less than $180°$, express y in terms of x.

Answer ..... [1]

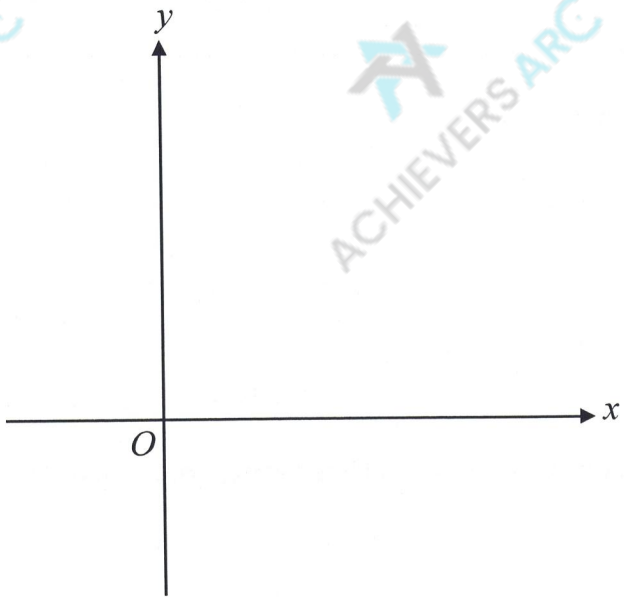
---

4 Find the smallest perfect square that satisfies the inequalities $3x-7<15+x\leq 4x-9$.

Answer ..... [3]

---

5 **(a)** Sketch the curve of $y=(x-2)^2+4$ on the given axes, indicating clearly the y-intercept and the coordinates of the turning point.



[2]

(b) Explain why the equation $(x-2)^2+4=k$ has no solutions for $k<4$.

.....

.....

..... [1]

---

6 **(a)** Simplify $\dfrac{(-2a^2b)^4}{ab^4}$.

Answer ..... [2]

(b) Solve the equation $3^x \times 9^{x-2} = 27$.

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

---

7 Kenny deposits \$5000 for 5 years into Bank **A**. Bank **A** pays a compound interest of 2% every six months.

(a) Kenny calculates that he will have a total amount of $5000\left(1+\dfrac{4}{100}\right)^5$ in the bank after 5 years. Explain why this calculation is incorrect.

.....

..... [1]

(b) Calculate the total interest earned by Kenny after 5 years.

Answer \$..... [3]

---

8 Solve the equation $\frac{3}{x^2-x-6}-\frac{2}{x+2}=1$.

Answer $x=$ ..... or $x=$ ..... [5]

---

9 **(a)** The point $(a, 2a)$ lies on the line with equation $x-2y=36$. Find the value of a.

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

(b) Without solving any equations, explain why the simultaneous equations $y=\frac{1}{2}x-3$ and $x-2y=36$ have no solutions.

.....

.....

..... [2]

---

10 **(a)** Factorise $3ay - y^2 - 6a^2 + 2ay$ completely.

Answer ..... [2]

(b) **(i)** Expand $(x-b)^2$.

Answer ..... [1]

(ii) Hence, or otherwise, factorise $x^2 - 2b + b^2 - 4$ completely.

Answer ..... [2]

11 At the beginning of the year, there are 23 boys and 17 girls in a class.
In this class, 10 boys and 7 girls wear spectacles.

(a) A student is chosen at random from the class.

(i) Ali says that the probability of choosing a girl who wears spectacles is $\frac{7}{17}$.

Explain why this is incorrect.

.....

.....

..... [1]

(ii) Find the probability of choosing a boy who does not wear spectacles.

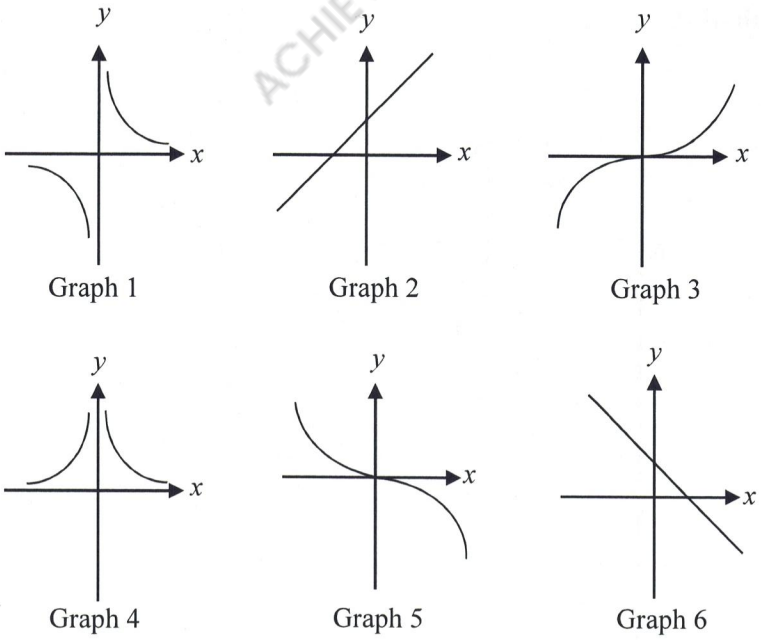
Answer ..... [1]

(b) Later in the year, n boys join the class.

Given that the probability of choosing a girl at random from the class is now $\frac{1}{3}$, find the value of n.

Answer ..... [2]

12



Sketches of some graphs are shown above.
Match the correct graph to each of the following equations.

(a) $y = 2x^3$

Answer Graph ..... [1]

(b) $y = -x + 1$

Answer Graph ..... [1]

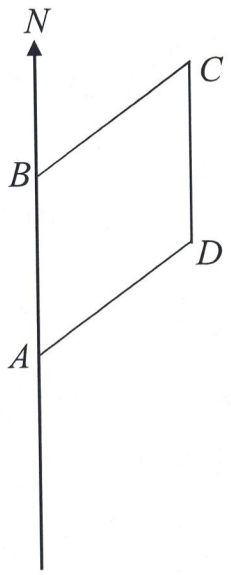
(c) $y = \frac{1}{x}$

Answer Graph ..... [1]

(d) $yx^2 = 1$

Answer Graph ..... [1]

13 A, B, C and D are four points on level ground forming the corners of a rhombus. B is due north of A.



The bearing of C from B is $052°$. Find

(a) the bearing of B from C,

Answer ..... ° [1]

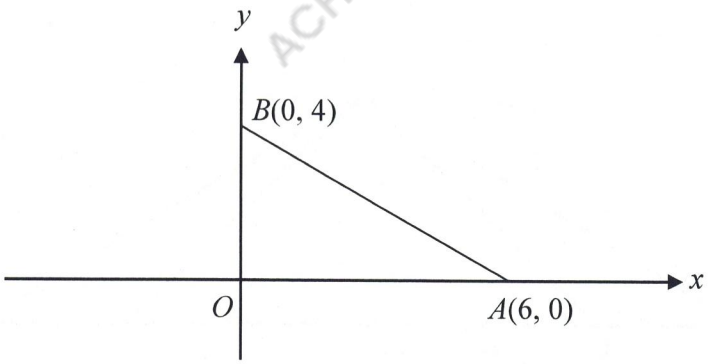
(b) the bearing of D from C,

Answer ..... ° [1]

(c) the bearing of D from B,

Answer ..... ° [2]

14



The diagram shows the points $A(6, 0)$ and $B(0, 4)$.

(a) Find the equation of AB.

Answer ..... [2]

(b) The point C on the x-axis is such that the area of the triangle ABC is 20 units^2.

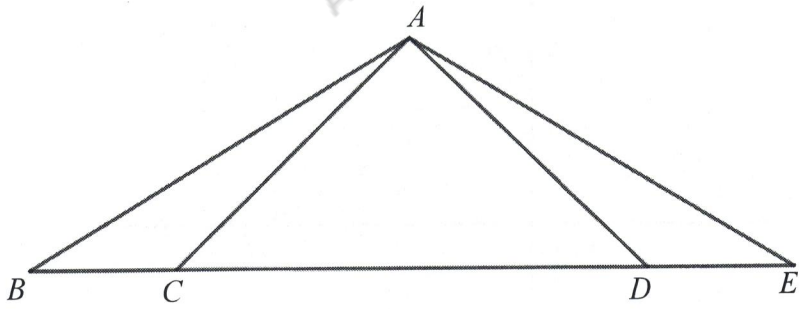
(i) Write down the coordinates of the two possible positions of C.

Answer ..... or ..... [2]

(ii) If the x-coordinate of C is positive, find the shortest distance from C to AB.

Answer ..... [3]

15



In the diagram above, C and D are on the line BE such that angle ABC = angle AED and angle ACB = angle ADE.

(a) Explain why triangle ACD is isosceles.

Answer

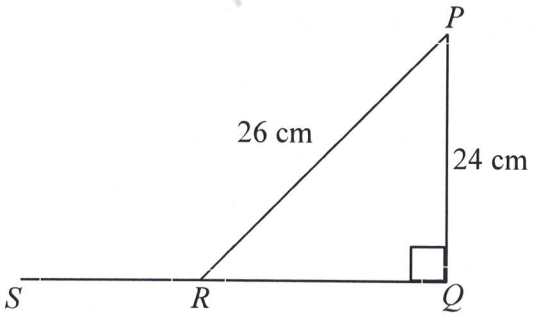
[2]

(b) Show that triangle ABC is congruent to triangle AED.

Answer

[2]

16 PQR is a right-angled triangle with angle $PQR = 90°$.
$PR = 26$ cm, $PQ = 24$ cm, and S lies on QR produced.



Write down, as a fraction in its simplest form, the value of

(a) $\sin \angle PRQ$,

Answer ..... [1]

(b) $\sin \angle PRS$,

Answer ..... [1]

(c) $\cos \angle PRS$,

Answer ..... [1]

(d) $\tan(90° - \angle PRQ)$.

Answer ..... [1]

17 It is given that $k\left(1-\frac{v^2}{c^2}\right)=T$.

(a) Find the value of T when $k=2$ and $v=0.5c$.

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

(b) Rearrange the formula to make c the subject.

Answer ..... [3]

18

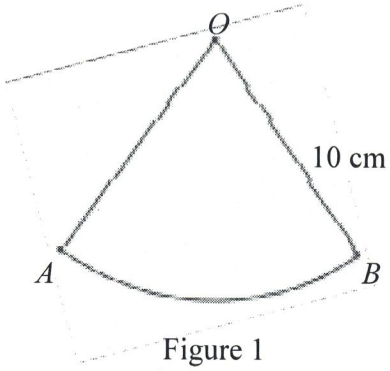


Figure 1

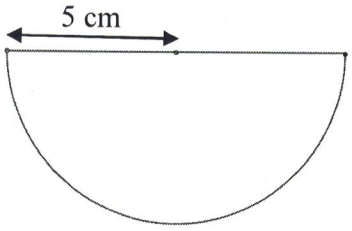


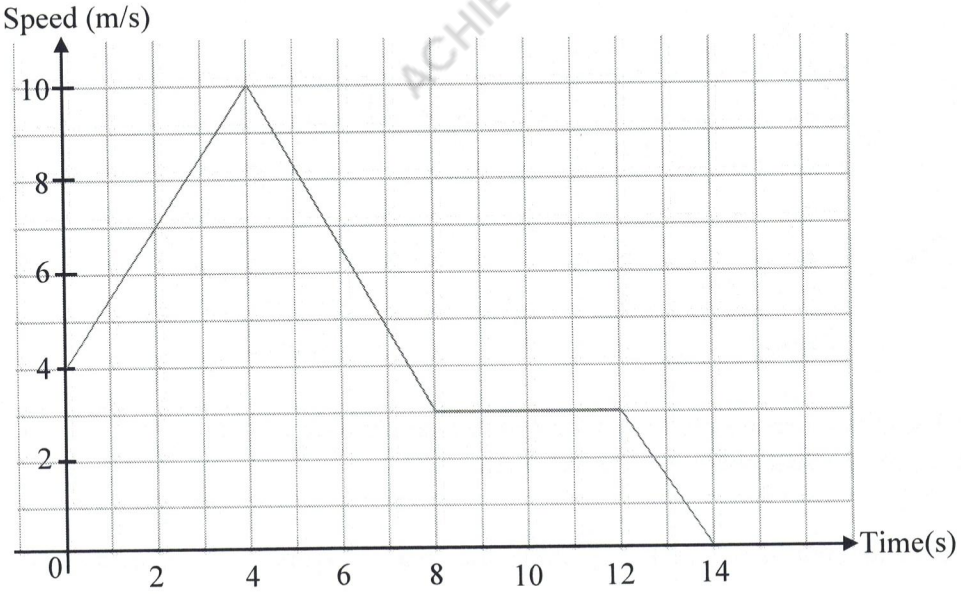
Figure 2

Figure 1 shows a circular arc OAB with centre O and radius 10 cm.
Figure 2 shows a semicircle with radius 5 cm.

Given that the area of Figure 1 is $\frac{2}{3}$ times the area of Figure 2, find the value of angle AOB in degrees.

Answer ..... ° [5]

19 The speed-time graph of an object is shown below.



(a) Find the acceleration of the object in the third second of motion.

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

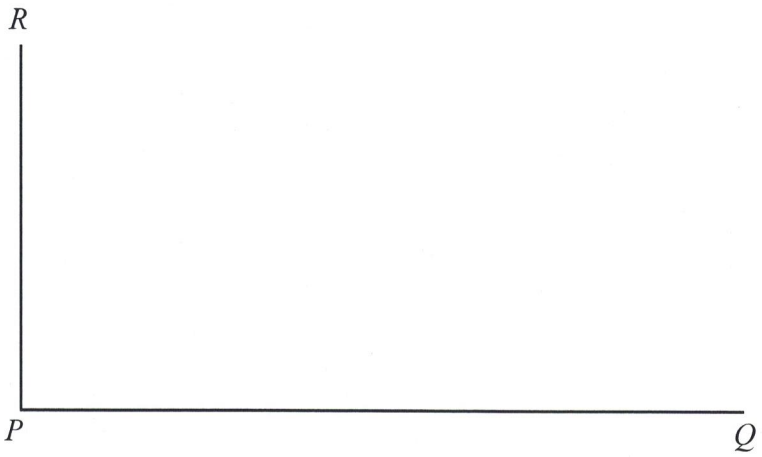
(b) State the range of time for which the object is moving at constant speed.

Answer Between ..... s and ..... s [1]

(c) Given that total distance travelled by the object is the area under the speed-time graph, find the average speed of the object.

Answer .....m/s [3]

20 The drawing below, drawn to scale, shows the position of three towns P, Q and R.



(a) P and Q are 30 km apart. Express the scale of the drawing in the form $1 : n$.

Answer ..... [2]

(b) A tower T is to be erected such that it is (i) equidistant from P and Q, and (ii) closer to P than to R.

By constructing two bisectors on your diagram above, label a possible position of T. [3]

~ End of paper ~

Name: .... (   )   Class: ....

ASSUMPTION ENGLISH SCHOOL
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2024

MATHEMATICS (4052/02)

LEVEL : Sec 3 Express,
Sec 3 Normal (Academic) SBB

DATE : 8 October 2024

CLASSES: Sec 3/1, 3/2, 3/3, 3/5 (SBB)

DURATION: 2 Hours

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[Turn over]

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Mathematical Formulae

Compound interest

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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

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

Trigonometry

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

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

Answer **all** questions.

1 **(a)** In 2024, the expenditure of the Ministry of Education is projected to be \$14 750 million, which is \$672 million higher than that in 2023.

(i) Express 14 750 million in standard form.

Answer ..... [1]

(ii) Calculate the percentage increase in the expenditure from 2023 to 2024.

Answer ..... % [2]

(b) The perimeter of a rectangular field is 300 m. The ratio of the length to the width of the field is 3 : 2. Calculate the area of the field, giving your answer in square kilometres.

Answer ..... km^2 [3]

(c) Anakin rented a car during his holiday in the United Kingdom. He drove a total of 460 km, and the car uses fuel at an average rate of 5.9 litres per 100 km.

He paid a total of £125.60 for car rental and £1.43 per litre of fuel. He paid using his credit card and was charged a fee of 1.6% for the currency conversion.
The exchange rate between Singapore dollars and Pound sterling is $1 = £0.60.

Calculate the total amount, including credit card fee, that Anakin is charged for car rental and fuel. Give your answer in Singapore dollars correct to the nearest cent.

Answer $ ..... [4]

2 **(a)** **(i)** Express $x^2 - 6x + 9.5$ in the form $(x-a)^2 + b$.

Answer ..... [2]

(ii) **Hence**, solve the equation $x^2 - 6x + 9.5 = 6.75$.

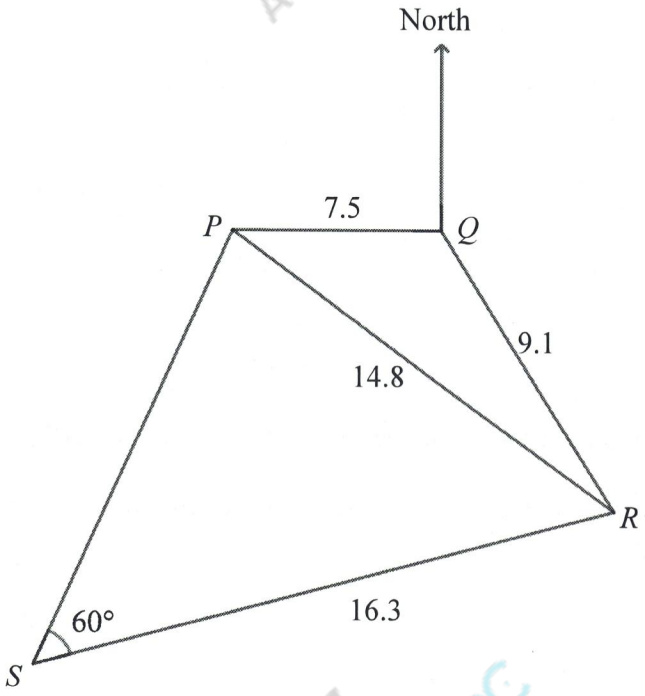
Answer $x =$ ..... or ..... [3]

(b) Simplify $\frac{2a^2b}{5} \div \frac{4a^3}{10b}$

Answer ..... [2]

(c) Simplify $\frac{2 + 5x - 3x^2}{x^2 - 4}$.

Answer ..... [3]



The diagram shows four points P, Q, R and S on level ground. P is due west of Q. $PQ = 7.5$ km, $QR = 9.1$ km, $PR = 14.8$ km, $RS = 16.3$ km, and angle $PSR = 60°$.

(a) Find the bearing of R from Q.

Answer .....° [4]

(b) Show that acute angle $SPR = 72.5°$ correct to 1 decimal place.

Answer [2]

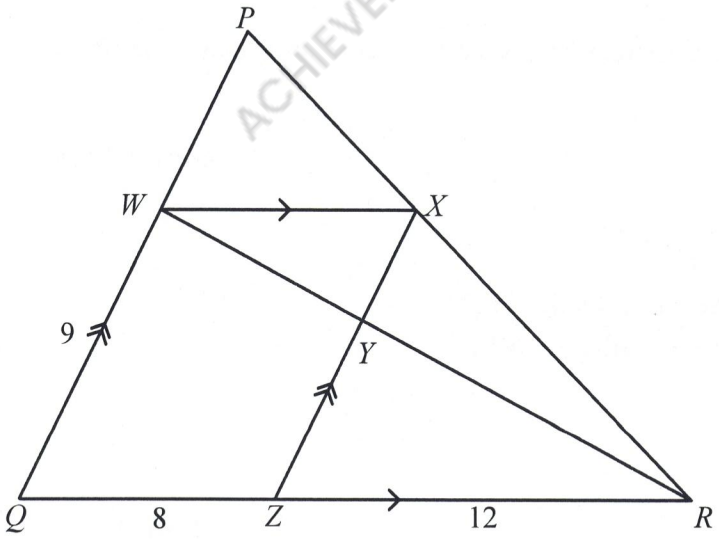
(c) A vertical mountain of height 7000 m is located at R. A car is driving along SP.

(i) Find the shortest distance from the car to the mountain.

Answer ..... km [2]

(ii) Hence, find the greatest angle of elevation of the car from the top of the mountain.

Answer .....° [2]



In the diagram above, PWQ, PXR, WYR, XYZ and QZR are straight lines.
WX is parallel to QR, and PQ is parallel to XZ.
$QZ = 8$ cm, $ZR = 12$ cm and $WQ = 9$ cm.

(a) Explain why $WX = 8$ cm and $ZX = 9$ cm.

.....

..... [1]

(b) Stating your reasons clearly, show that triangle RWQ is similar to triangle RYZ.

Answer

[2]

(c) Stating your reasons clearly, show that triangle RYZ is similar to triangle WYX.

[2]

(d) Other than triangle RYZ, state another triangle that is similar to triangle RWQ.

Answer Triangle ..... [1]

(e) Calculate

(i) $\dfrac{\text{Area of triangle } RWQ}{\text{Area of triangle } WXY}$,

Answer ..... [1]

(ii) $\dfrac{\text{Area of triangle } RYX}{\text{Area of triangle } WXY}$,

Answer ..... [1]

(iii) $\dfrac{\text{Area of triangle } RYX}{\text{Area of triangle } RWQ}$.

Answer ..... [2]

5

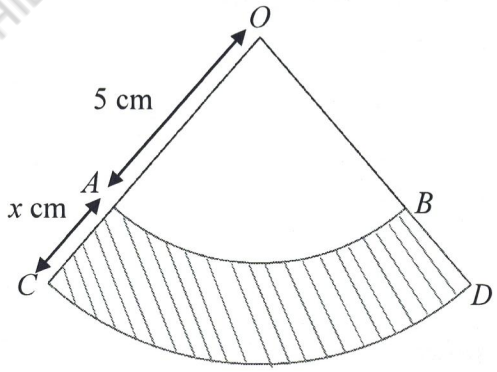


Figure 1

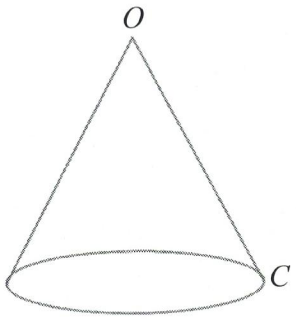


Figure 2

Figure 1 shows two sectors OAB and OCD, both centred at O.
$OA = 5$ cm and $AC = x$ cm.

(a) (i) Given that arc CD is 40% longer than arc AB, show that $x = 2$.

Answer

[2]

(ii) Given that angle $AOB = 1.4$ radians, find the area of the shaded region enclosed by the two arcs, $ACDB$.

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

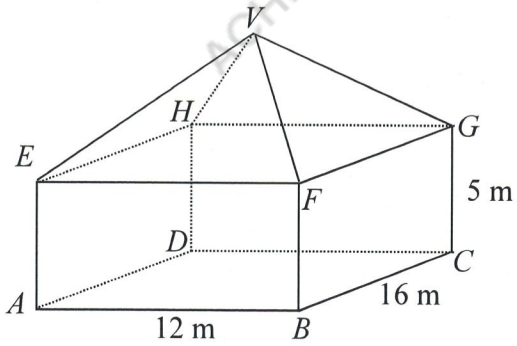
(iii) Find the perimeter of the shaded region enclosed by the two arcs, *ACDB*.

Answer ..... cm [2]

(b) Sector *OCD* in Figure 1 is then folded into a cone as shown in Figure 2.
Find the volume of the cone.

Answer ..... cm^3 [4]

6



The diagram shows a greenhouse made of glass. It consists of a right pyramid, *VEFGH*, attached to a cuboid *ABCDEFGH*.
AB = 12 m, *BC* = 16 m, *GC* = 5 m, and angle *EVF* = 40°.

(a) Show that *VF* = 17.5 m, correct to 3 significant figures.

Answer

[2]

(b) Calculate

(i) angle *BGC*,

Answer ..... ° [1]

(ii) angle *BHC*,

Answer ..... ° [1]

(iii) length of *BH*.

Answer ..... m [2]

(c) Find the total volume of the greenhouse.

Answer ..... m^3 [3]

(d) A scale model of the greenhouse is constructed such that the area of its rectangular base is one-ninth the area of the actual base *ABCD*.
Find the volume of this model.

Answer ..... m^3 [2]

7 The distance between two towns **P** and **Q** is 200 km.
Ellie started driving from **P** at a speed of v km/h for the first 80 km.

(a) Write down an expression in terms of v for the number of hours taken to travel the first 80 km.

Answer ..... [1]

She then increased her speed by 40 km/h and maintained this speed until she reached **Q**.

(b) Write down an expression in terms of v for the number of hours taken to travel the rest of the journey.

Answer ..... [1]

(c) The first part of the journey took 8 minutes more.
Write down an equation in v and show that it reduces to $v^2 + 340v - 24000 = 0$.

Answer

[3]

(d) Find the time taken for Ellie to drive from **P** to **Q**.
Give your answer in hours and minutes.

Answer ..... hours ..... mins [4]

8 Kenny is comparing the total annual running costs of operating a diesel vehicle and a hybrid vehicle to decide which is more cost-effective for his driving needs.

He models the running cost by the following equation:

Total Running Cost Per Year = Fixed Cost + Variable Cost + Wear and Tear Cost

For x km travelled in a year, the total running cost can be calculated as follow:

	Fixed Cost	**Variable Cost**	**Wear and Tear Cost**
Hybrid Vehicle	\$600	\$0.08 per km	Directly proportional to x^2
Diesel Vehicle	\$200	\$0.10 per km	Directly proportional to x^2

(a) For the hybrid vehicle, it is found the total wear and tear cost is \$60 if $x = 2000$. Show that the total running cost per year for the hybrid vehicle, C_h, can be given by the equation $C_h = 600 + 0.08x + 0.000015x^2$.

Answer

[3]

(b) Complete the table of values below for $C_h = 600 + 0.08x + 0.000015x^2$.

x	0	2000	3000	4000	5000	6000	7000	8000
C_h	600	820		1160	1375	1620	1895	

[2]

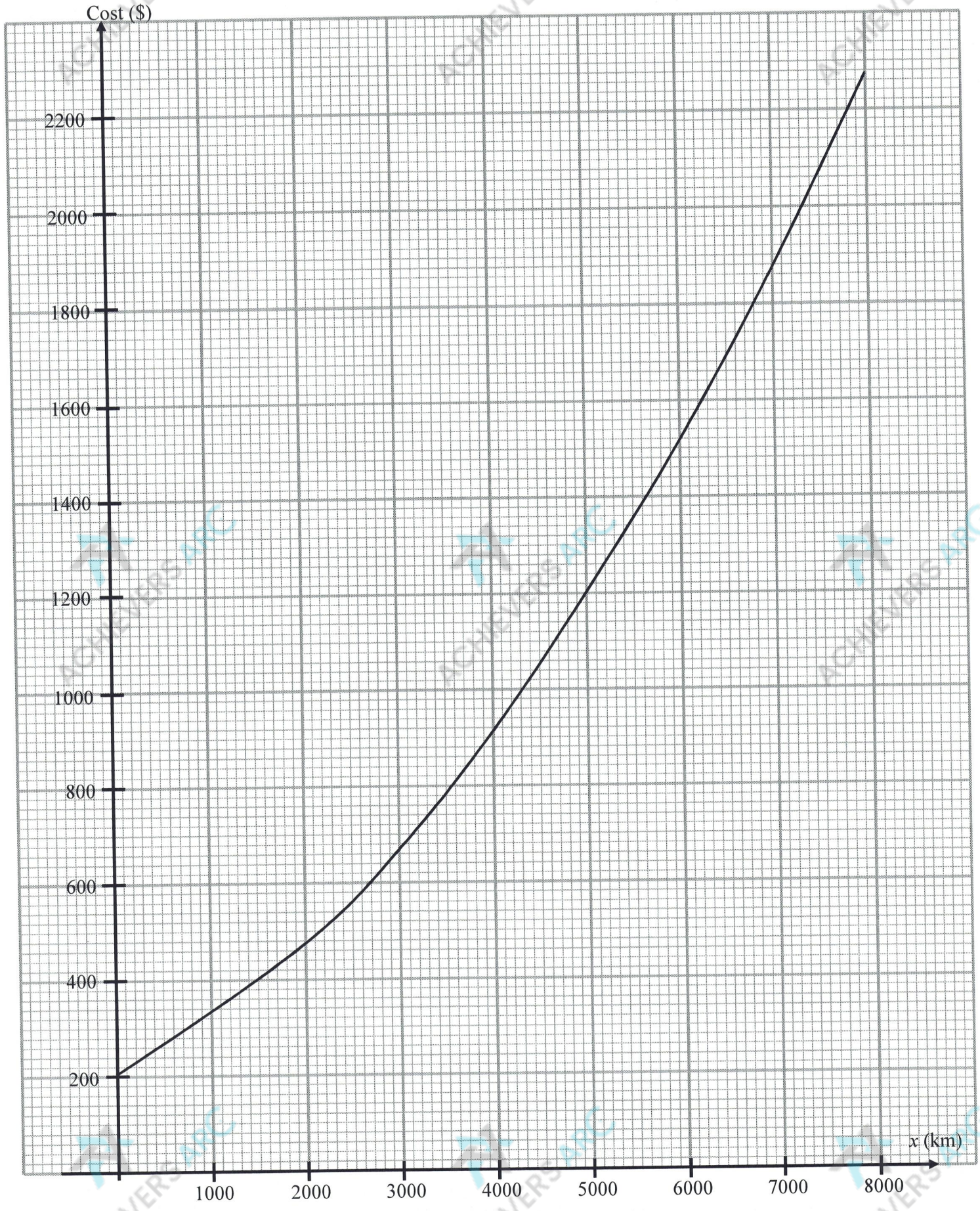
(c) The total running cost for the diesel vehicle, C_d, can also be modelled by a similar equation. The graph of C_d against x is plotted on the axes provided on page 19.

By comparing C_h and C_d, determine which vehicle is more cost-effective for Kenny.

Answer

[5]

(Additional working space for Question 8)


Cost ($)
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
x (km)
1000
2000
3000
4000
5000
6000
7000
8000

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