Name:	Index No.:	Class:

PRESBYTERIAN HIGH SCHOOL

MATHEMATICS **4048/01**
PAPER ONE

20 August 2021 Friday 2 hours

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SECONDARY FOUR EXPRESS/ FIVE NORMAL (ACADEMIC)
PRELIMINARY EXAMINATIONS

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1 The number of people who are fully vaccinated in Singapore is given as 2420800, correct to the nearest hundred.
Write down the minimum number of people who are fully vaccinated.

Answer 2420750 [1]

---

2 **(a)** Express $\left(\sqrt[3]{x}\right)^2$ in index notation.

Answer ..... [1]

(b) Find the integer n such that $2^n = \frac{1}{32}$.

Answer $n =$ ..... [1]

---

3 **(a)** Express 378 as the product of its prime factors.

Answer $2 \times 3^3 \times 7$ [1]

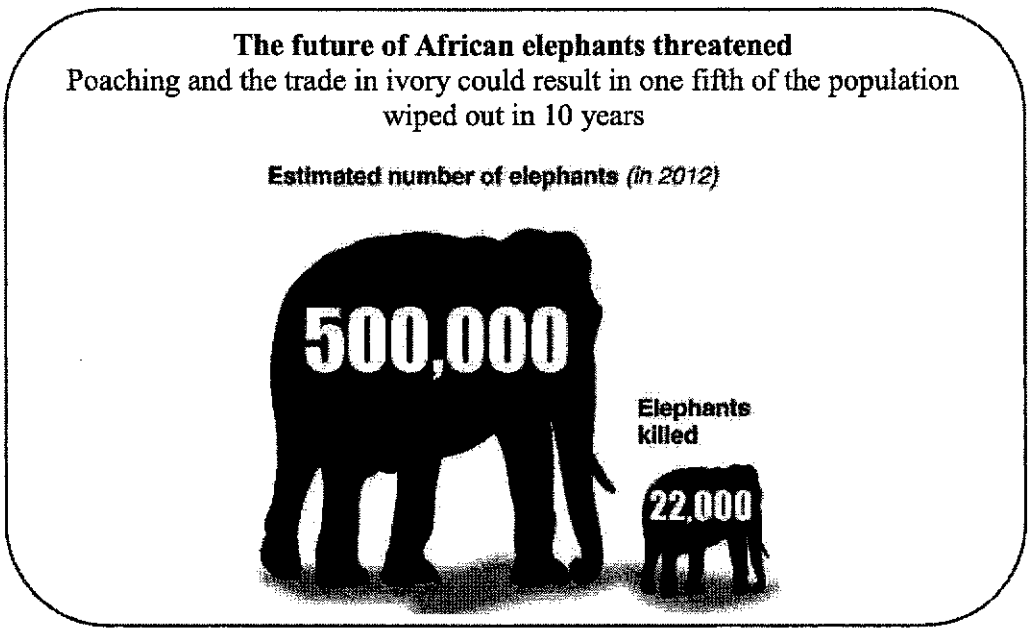
(b) Find the smallest positive integer k such that $378k$ is a perfect cube.

Answer $k =$ ..... [1]

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4 A website shows a poster of the poaching statistics of African elephants.



Adapted from: https://www.allcreaturespod.com/episodes/episode-2-elephant/poaching-stats/

Explain how the poster above may be misleading.

The **sizes of the two elephants** are not in proportion which will mislead readers into thinking that the **number of elephants killed is larger than the actual number.**

or

If 22 000 elephants are killed each year, in 10 years' time, 22 000 x 10 = 220 000 will be killed. But 220 000 is **44% of the population** and not 1/5 as stated in the headline. This will mislead readers into **thinking that only 20% of the population** will be wiped out. [1]

---

5 On 1st January 2018, Mrs Yeo invests $15000 in an account which pays at a rate of compound interest of R% per year. On 1st January 2021, she earned a total interest of $988.45.
Find the value of R.

Answer $R =$ ..... [2]

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6 There were 3 candidates A, B, and C in a school election for the President of Student Council. There were 1120 voters and the votes for the 3 candidates were divided in the ratio of 11 : 7 : 2. Calculate the difference between the highest number and lowest number of votes.

Answer ..... [2]

---

7 There are 12 girls and 9 boys in a group.

(a) Find, in its simplest form, the probability of selecting a boy randomly from the group.

Answer ..... [1]

(b) How many more boys are needed to join the group so that the probability of selecting a boy randomly from the group will be $\frac{4}{5}$?

Answer ..... boys [1]

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8 **(a)** Factorise x^2+5x-6.

Answer ..... [1]

(b) Hence, solve $(p-1)^2+5(p-1)-6=0$.

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

---

9 **(a)** Simplify $2(3x+5)-2(1-2x)$.

Answer $2(5x+4)$ ..... [1]

(b) Given $\frac{2y}{3}-\frac{y-4}{4}\leq 5$, find the largest rational value of y.

Answer ..... [2]

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10 **(a)** 6 men take 10 days to paint an apartment.
Calculate the number of men required to paint the same apartment in 3 days.

Answer ..... [1]

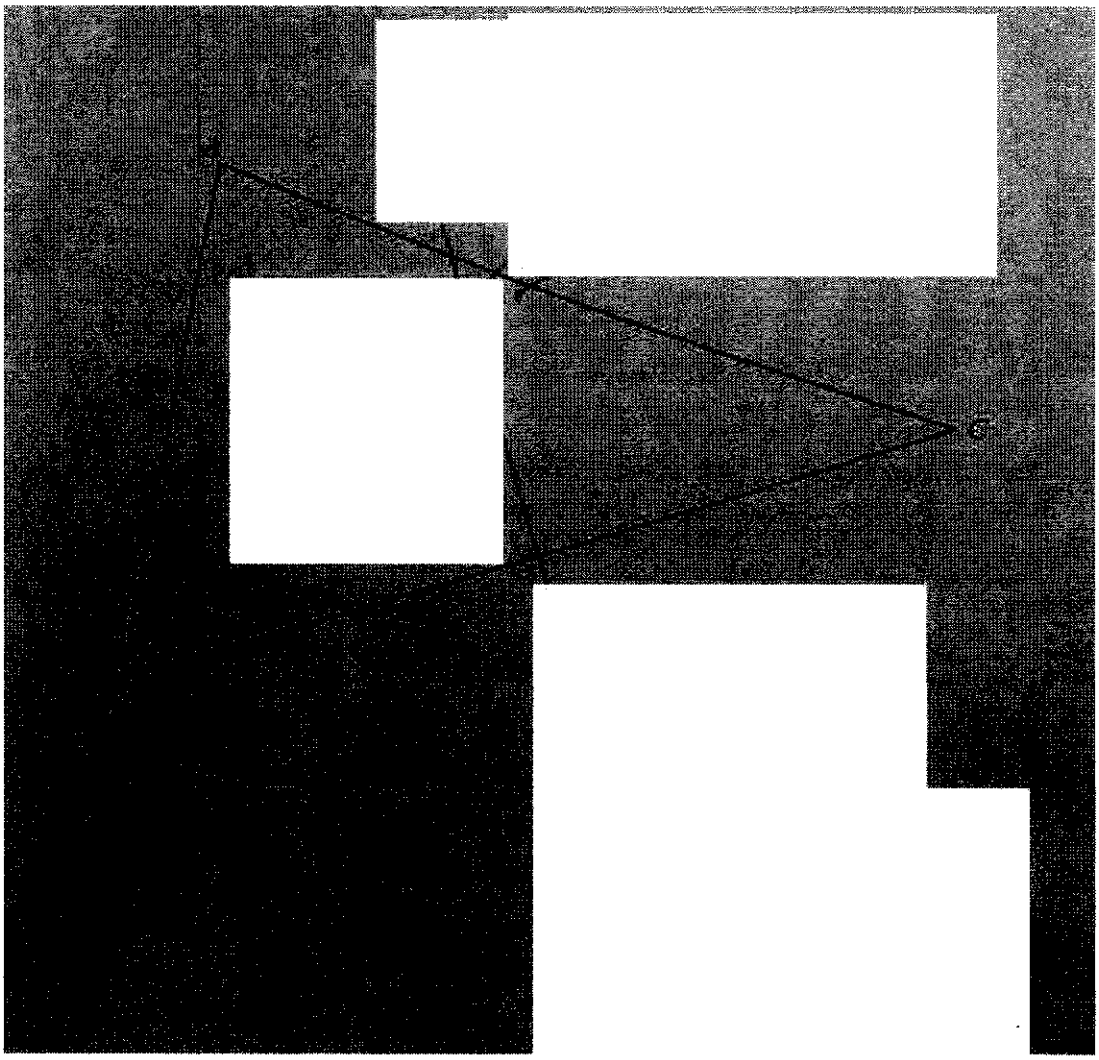
(b) The braking distance, d of a car is directly proportional to the square of its speed, v.
When the speed of the car is increased by 200%, find the percentage increase in its braking distance.

Answer ..... % [2]

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11 The diagram shows a triangle ABC.



On the diagram,

(a) construct the bisector of angle ABC, [1]

(b) construct the perpendicular bisector of BC, [1]

(c) label the point P that is equidistant from B and C, and also equidistant from AB and BC. [1]

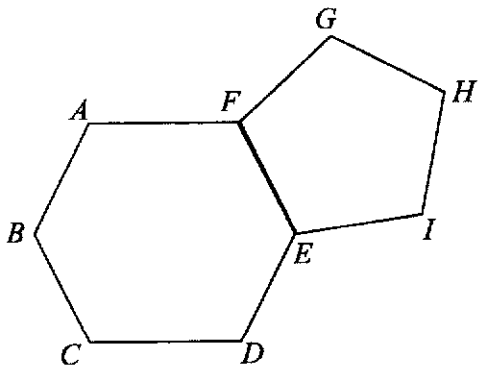
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12 A straight line with equation $2y = kx + h$ passes through the points (–2, 6) and (1, –9). Find the values of k and h.

Answer $k =$ ..... , $h =$ ..... [3]

---

13 The diagram shows a regular hexagon, *ABCDEF* and a regular pentagon, *EFGHI*.



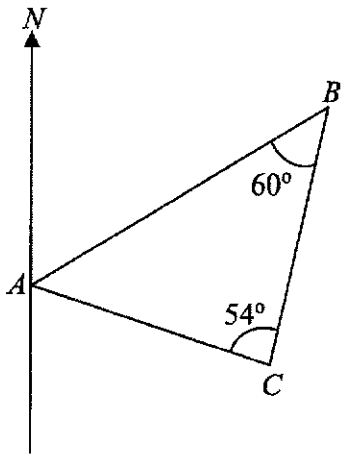
Find $\angle EDI$.

Answer ..... [3]

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14 The diagram shows the positions of points A, B and C.
$\angle ABC = 60°$, $\angle BCA = 54°$ and the bearing of B from A is 078°.



Find the bearing of

(a) C from A,

Answer ..... [1]

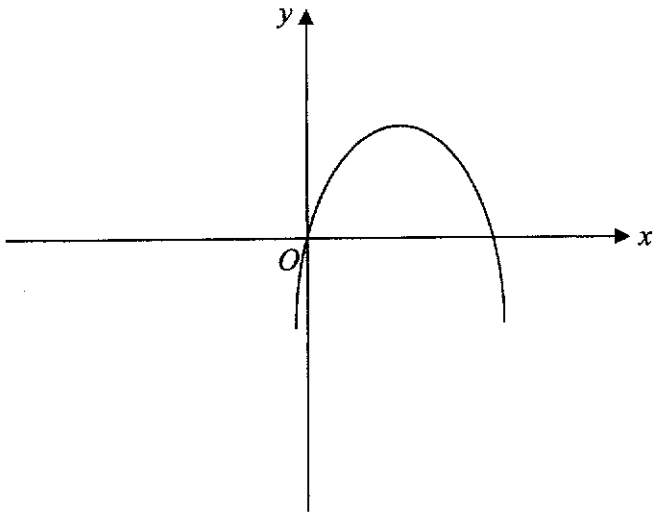
(b) B from C.

Answer ..... [2]

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15 **Sketch** the graph of $y = -(x-2)^2 + 4$ on the axes below.

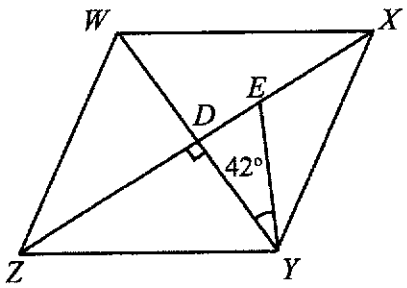
Indicate clearly the coordinates of the points where the graph crosses the axes and the maximum point on the curve.



[3]

---

16 The diagram shows a rhombus $WXYZ$, where the diagonals intersect at D.
$ZDEX$ lies on a straight line. $EY = 4.7$ cm, $XZ = 15$ cm and $\angle DYE = 42°$.



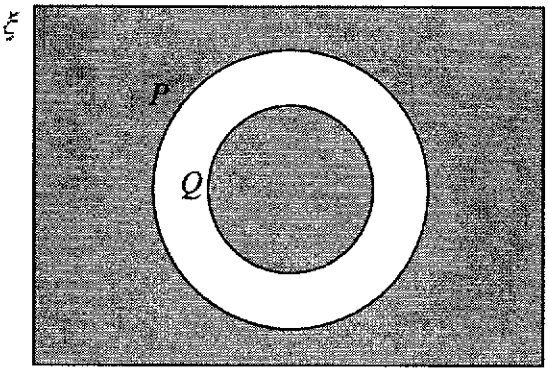
Find the length EX.

Answer ..... [3]

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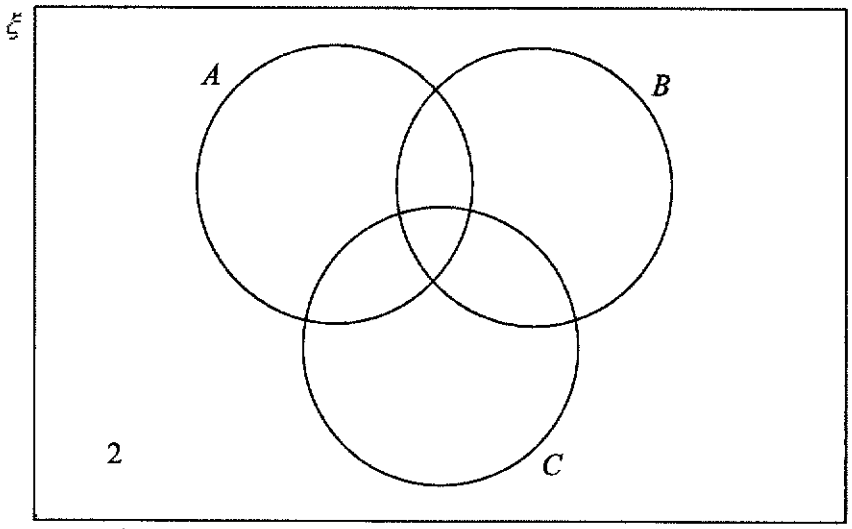
17 **(a)** On the Venn diagram, shade the region which represents $Q \cup P'$.



[1]

(b) $\xi = \{\text{integers } x : 1 \leq x \leq 9\}$

The Venn diagram shows the elements of ξ and three sets A, B and C.



Use one of the symbols below to complete each statement.

$$\varnothing \quad \subset \quad \not\subset \quad \notin \quad \in \quad \xi$$

(i) $\{4, 8\} \subset B$ [1]

(ii) $9 \in C$ [1]

(iii) $B \cap C = \varnothing$ [1]

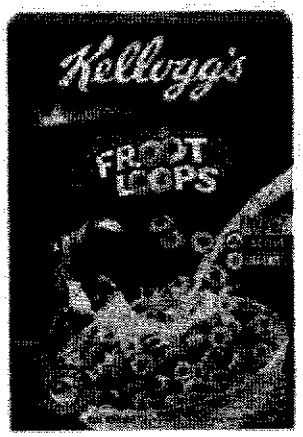
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18 The following diagram shows 2 geometrically similar boxes of cereals of the same brand.

Box *A*
20g
$0.80



Box *B*
160g
$3.40



(a) Show that the cost of the cereal is **not** directly proportional to the quantity of the cereal. Explain with clear calculation.

[1]

(b) Find $\frac{\text{height of Box } A}{\text{height of Box } B}$.

Answer ..... [1]

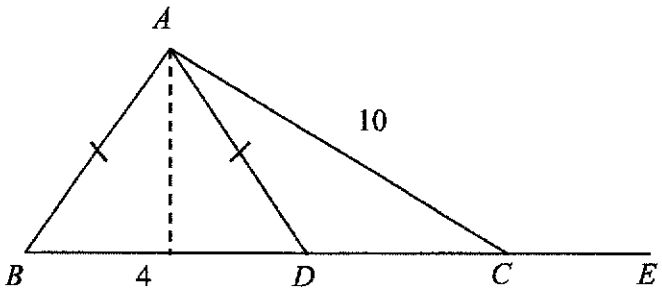
(c) It is given that the surface area of Box *A* is 454 cm^2.
Calculate the surface area of Box *B*.

Answer ..... [2]

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19 In the diagram, $BDCE$ is a straight line. $BD = 4$ cm, $AC = 10$ cm and $AB = AD$.



(a) Given that the area of triangle ABD is 16 cm^2, show that the vertical height of triangle ABD is 8 cm.

[1]

(b) Write down, as a fraction, the value of

(i) $\sin \angle ACE$.

Answer ..... [1]

(ii) $\tan \angle ACD$,

Answer ..... [2]

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20 A map has a scale of 1 : 150 000.

(a) The length of a road on the map is 6.4 cm.
Calculate the actual length, in kilometres, of the road.

Answer ..... [2]

(b) The area of a park is 10.125 km^2.
Calculate, the area, in square centimetres, of the park on the map.

Answer ..... [2]

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21 **(a)** The line l has equation $4x+2y+7=0$.

(i) Find the gradient of line l.

Answer ..... [1]

(ii) Find the coordinates of the point where l cuts the y-axis.

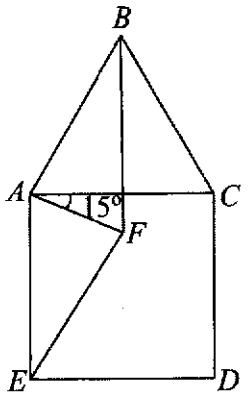
..... [1]

(b) Another line k is parallel to $y=\frac{1}{2}x+5$ and it passes through the point $(8,3)$.
Find the equation of line k.

Answer ..... [2]

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22 In the diagram, ABC is an equilateral triangle, $ACDE$ is a square and angle $FAC = 15°$.



(a) Show that triangle EAF and triangle BAF are congruent.
Give a reason for each statement you make.

[3]

(b) If the line BF bisects angle ABC, prove that triangle FAE is an isosceles triangle.

[2]

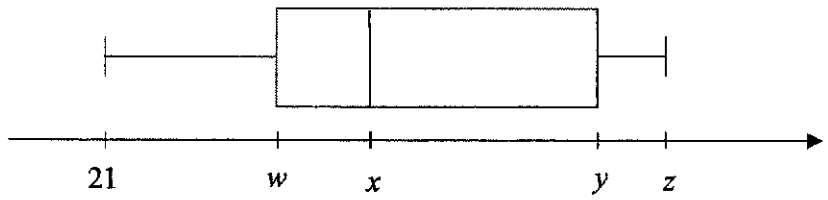
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23 (a) The table shows the scores of 10 students in a Mathematics test.

Test score	Frequency
21	2
49	3
55	1
65	1
80	1
95	2

The test scores are also represented in the box-and-whisker plot below.



Write down the values of w, x, y and z.

Answer $w =$ .....

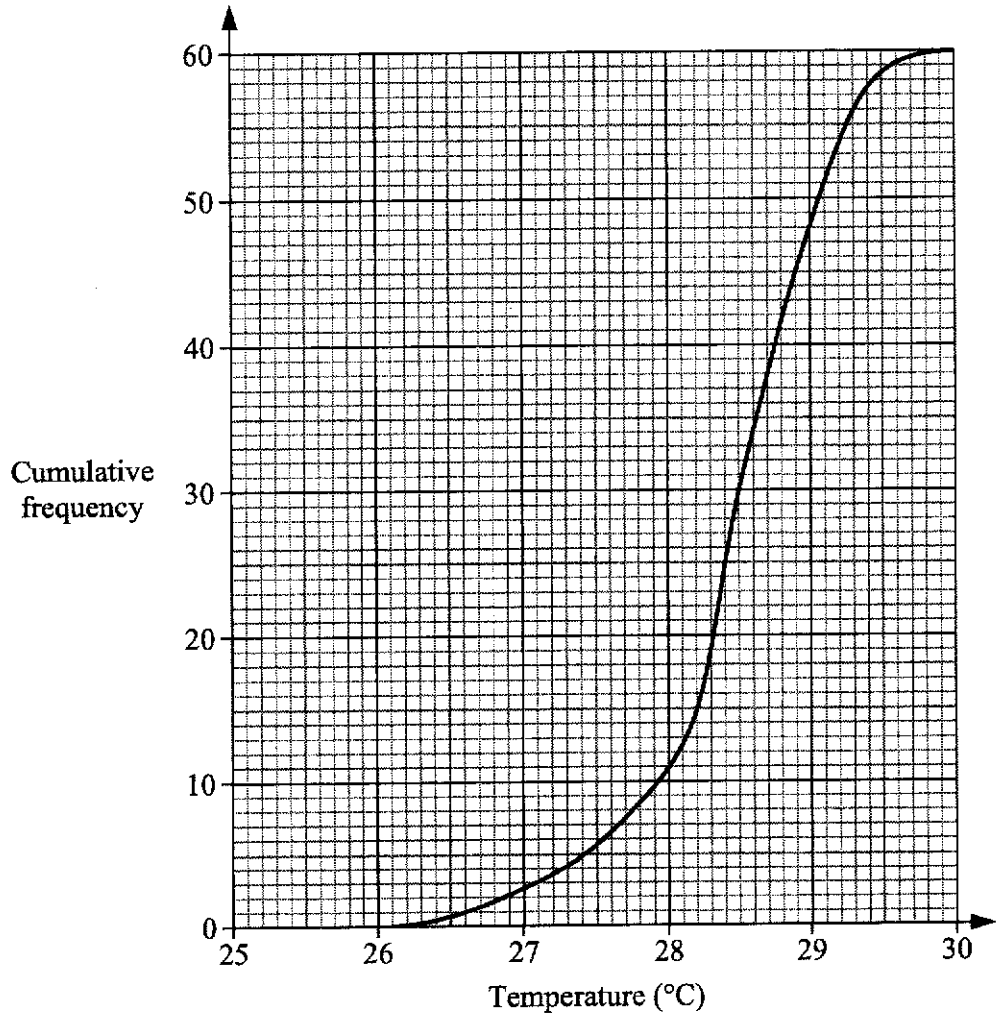
$x =$ .....

$y =$ .....

$z =$ ..... [2]

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(b) The temperature at Ang Mo Kio was recorded every day for 60 days.
The cumulative frequency graph below shows the distribution of the temperatures.



(i) Use the graph to estimate

(a) the number of days that had temperatures above 29°C.

Answer ..... [1]

(b) the interquartile range of the temperatures.

Answer ..... [1]

(ii) The temperature at Jurong was recorded every day for the same period.
The interquartile range of the temperatures at Jurong is 1.5°C.
Explain what this tell us about the temperature at Jurong compared with the temperature at Ang Mo Kio.
[1]

.....

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24 On every weekday, a bakery delivers chicken pies and apple pies to four cafes.
On every weekend, it delivers double the number of chicken pies and apple pies to each of the cafe.

The matrix **E** shows the number of chicken and apple pies delivered to each cafe on each weekday and each weekend

$$\mathbf{E} = \begin{matrix} \text{Chicken pies} & \text{Apple pies} \\ \begin{pmatrix} 38 & 50 \\ 76 & 100 \end{pmatrix} & \begin{matrix} \text{Weekday} \\ \text{Weekend} \end{matrix} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{M} = 4\mathbf{E}$.

Answer $\mathbf{M} =$ ..... [1]

(b) Evaluate the matrix $\mathbf{C} = \begin{pmatrix} 5 & 2 \end{pmatrix}\mathbf{M}$.

Answer $\mathbf{C} =$ ..... [1]

(c) State what the elements of **C** represent.

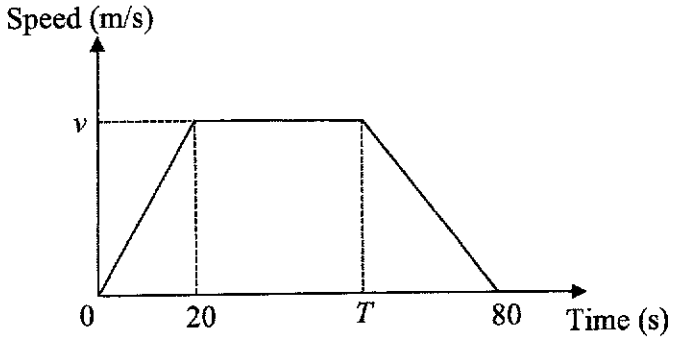
[1]

(d) The price of each chicken pie is \$1.80 and the price of an apple pie is \$1.50.
By matrix multiplication, calculate the total amount of money the bakery collects per week from the sale of the pies to the four cafes.

Answer \$ ..... [2]

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25 The diagram below shows the speed-time graph of a bus journey.
The bus accelerated from rest at 1.25 m/s^2 to a speed of v m/s in 20 seconds, and travelled at this speed until T seconds before it came to a stop at 80 seconds.
The total distance travelled for the whole journey was 1450 m.



(a) Find the values of

(i) v,

Answer ..... [1]

(ii) T.

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

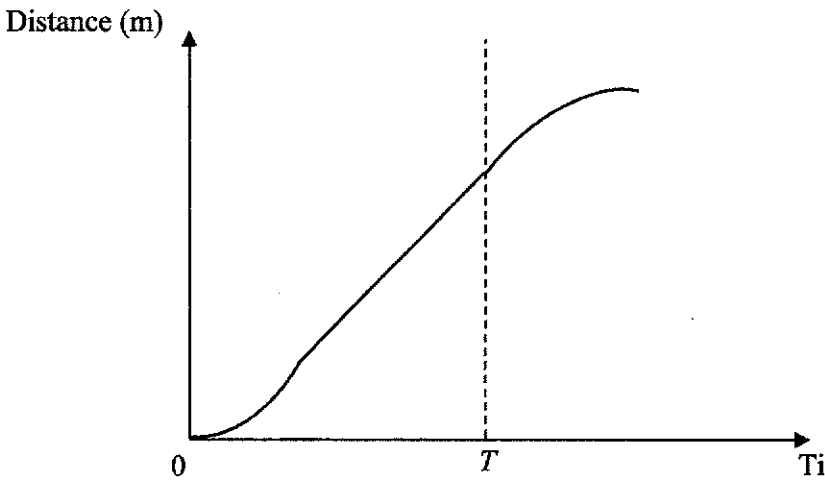
(b) Describe the motion of the bus between 20 seconds and T seconds.

..... [1]

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(c) On the axes below, draw the distance-time graph of the bus journey, marking and stating the distance travelled for each time duration clearly on the vertical axis.



[2]

END OF PAPER

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PRESBYTERIAN HIGH SCHOOL

MATHEMATICS
PAPER TWO

4048/02

19 August 2021 Thursday 2 hours 30 minutes

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SECONDARY FOUR EXPRESS / FIVE NORMAL (ACADEMIC)
PRELIMINARY EXAMINATION

For Examiner's Use												
Qn	1	2	3	4	5	6	7	8	9	10		*Marks Deducted*
Marks												

Category	Accuracy	Units	Symbols	Others
Question				

Total Marks
95

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

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1	(a)	(i)	Express x^2-6x-2 in the form $(x-a)^2+b$ where a and b are constants.
			Answer ..... [2]
		(ii)	Hence, state the minimum value of $y=x^2-6x-2$.
			-11
			Answer ..... [1]
	(b)	(i)	Simplify $\frac{2x^2-18}{3x^2+11x+6}$.
			Answer ..... [3]
		(ii)	Hence, or otherwise, express $1-\frac{2x^2-18}{3x^2+11x+6}$ as a single fraction in its simplest form.
			Answer ..... [2]

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(c) Given that $R^2 = h(\pi p - q)^2$.

(i) Find the value of R when $h = 20$, $p = 10$ and $q = 5$.

Answer ..... [2]

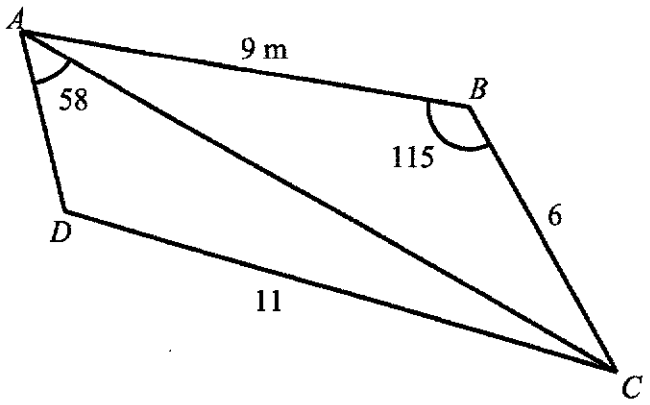
(ii) Express q in terms of h, p and R.

Answer ..... [2]

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2 The diagram shows a field $ABCD$ on horizontal ground.
Angle $ABC = 115°$, Angle $CAD = 58°$, $AB = 9$ m, $BC = 6$ m and $CD = 11$ m.



Calculate

(a) AC,

Answer ..... m [2]

(b) obtuse angle ADC,

Answer ..... ° [3]

(c) the area of triangle ACD,

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

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	(d)	the shortest distance from D to AC.	
		Answer ..... m [2]	

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3	(a)	The approximate mass of the earth is 5.97×10^{24} kg. How many times is the earth heavier than a sumo wrestler who weighs 125 kg? Give your answer in standard form correct to 3 significant figures.	
		Answer ..... [2]	
	(b)	A mobile phone can be bought online at a price of US$350. The same type of mobile phone is sold in Singapore at S$600. A local shop owner decides to sell the same type of mobile phone at a discount such that its price is equivalent to what a buyer pays online. Given that US$1 = S$1.36, calculate the percentage of discount he has to offer.	
		Answer .....% [3]	
	(c)	A train travels for 68 km at an average speed of 51 km/h. It then traveled for another 20 km at an average speed of 40 km/h before reaching its destination. Calculate the average speed for the whole journey.	
		Answer .....km/h [3]	

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	(d)	In the year 2020, there are 250 male employees and 300 female employees in an office. In the year 2019, the number of male employees was 130% of the current male employees. In the year 2019, the number of female employees was 65% of the current female employees. Find the difference in the number of male and female employees in the year 2019 as a percentage of the number of female employees in that year.	
		Answer ..... % [3]	

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4 **Answer the whole of this question on a piece of graph paper.**

The variables x and y are related by the equation $y = x^3 - 3x^2 + 1$.

Some corresponding values of x and y are given in the following table.

x	−2	−1	0	1	2	3	4
y	−19	−3	1	−1	p	1	17

(a) Find the value of p.

Answer p = ... [1]

(b) Using a scale of 2 cm to 1 unit, draw a horizontal x-axis for $-2 \le x \le 4$.
Using a scale of 1 cm to 2 units, draw a vertical y-axis for $-20 \le y \le 20$.
On your axes, plot the points given in the table and join them with a smooth curve.

(c) Use your graph to find the value(s) of x for which

(i) $x^3 - 3x^2 + 1 = 0$,

Answer x = ... [2]

(ii) $x^3 - 3x^2 + 1 = -4x$.

Answer x = ... [1]

(d) By drawing a suitable tangent, find the gradient of the curve at $x = 3$.

Draw a correct tangent line on graph

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		Answer ..... [2]	
	(e)	The line $y = k$, where k is a constant, meets the curve $y = x^3 - 3x^2 + 1$ at two points. Draw this line and hence find a possible value of k.	
		Answer k = ... [2]	

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5 **(a)** Consider the sequence:

$T_1 = 1 = 1$

$T_2 = 1 + 2 = 3$

$T_3 = 1 + 2 + 3 = 6$

$T_4 = 1 + 2 + 3 + 4 = 10$

$T_5 = 1 + 2 + 3 + 4 + 5 = 15$

(i) Write down T_6 of the sequence in the similar form.

Answer ..... [1]

(ii) The nth term of the sequence is given below.

$$T_n = 1 + 2 + 3 + 4 + ... + n = \frac{n(n+1)}{2}$$

Use the formula to find

(a) T_{100} ,

Answer ..... [1]

(b) the value of $3 + 6 + 9 + 12 + ... + 300$.

Answer ..... [2]

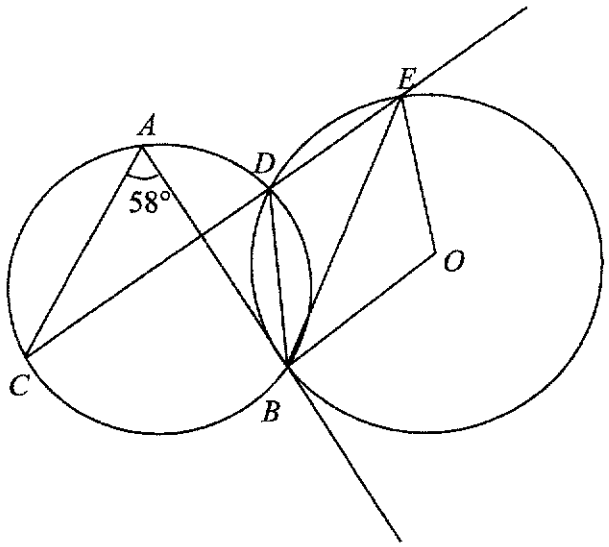
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	(b	Consider the number sequence: 1, 4, 7, 10, 13, 16, …….. **(i)** Write down the *n*th term of the sequence.	
		Answer ……..…….. [1]	
		(ii) Find the 80^{th} term of the sequence.	
		Answer ……..…….. [1]	
		(iii) Write down the smallest and largest four-digit number of the sequence.	
		Answer …… and ……..…….. [2]	

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6 **(a)** In the diagram, AB is a tangent to the circle with centre O, $\angle CAB = 58°$ and CDE is a straight line.



Find, st∠ ating your reasons clearly,

(i) $\angle BDE$,

Answer .....° [2]

(ii) obtuse $\angle BOE$,

Answer .....° [2]

(iii) $\angle EBO$,

Answer .....° [1]

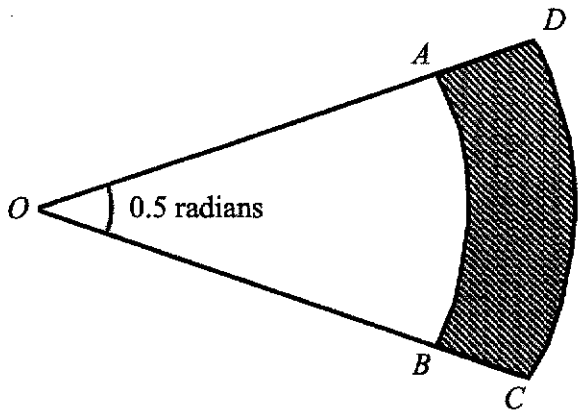
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(iv) $\angle ABE$.

Answer .....° [2]

(b) The figure shows arcs, AB and CD, of two concentric circles with centre at O. Their radii, OB and OC, are x cm and y cm respectively, and $\angle AOB = 0.5$ radians.

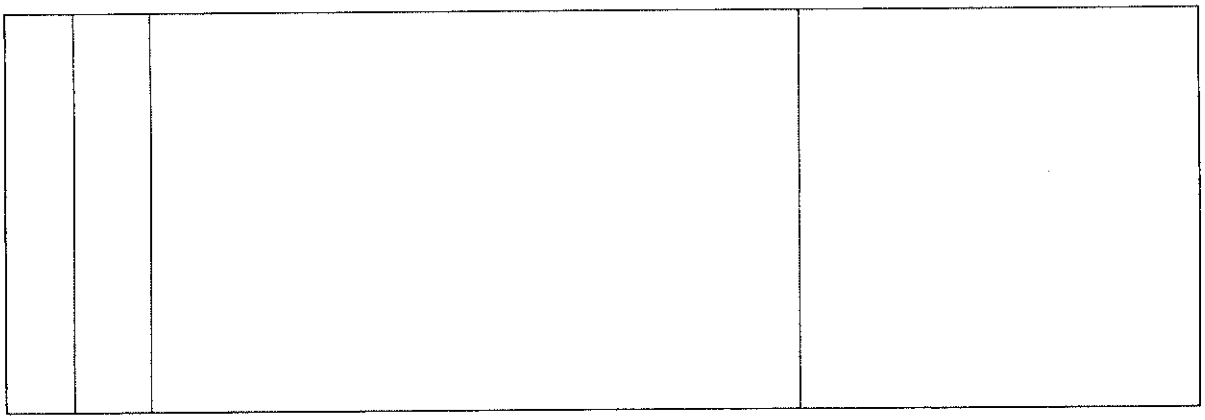


(i) Find the area of the shaded region in terms of x and y.

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

(ii) If the perimeter of the shaded region $ABCD$ is 120 cm, show that $y = \frac{1}{5}(240 + 3x)$.

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7	(a)	The position vector of A is $\begin{pmatrix}3\\4\end{pmatrix}$ and the position vector of B is $\begin{pmatrix}7\\10\end{pmatrix}$.
		(i) Find the column vector $\overrightarrow{AB}$.
		Answer ..... [1]
		(ii) Find $\lvert\overrightarrow{AB}\rvert$.
		Answer ..... [1]
		(iii) Given that $\overrightarrow{AB} = 3\overrightarrow{BC}$, find the coordinates of point C.
		Answer ..... [1]
	(b)	Given $\overrightarrow{PQ} = \begin{pmatrix}2\\1\end{pmatrix}$, $\overrightarrow{PR} = \begin{pmatrix}-1\\-\frac{1}{2}\end{pmatrix}$ and the point Q has coordinates (–2, 4).
		(i) Deduce the gradient of the line PQ and hence, find the equation of the line PQ.

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Answer ..... [1]

(ii) Write down 2 facts about P, Q and R.

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8 A model consists of a solid hemisphere attached to a solid cylinder as shown in diagram1.

The height of the cylinder is 26 cm and the base area is 198 cm^2.

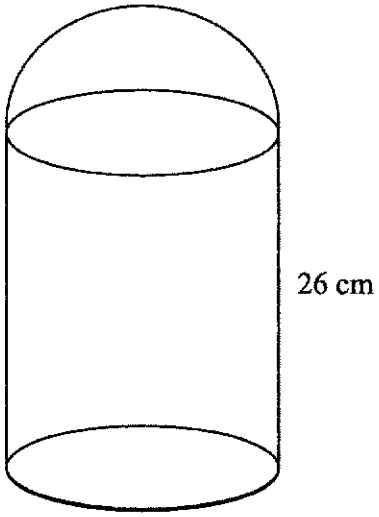


Diagram 1

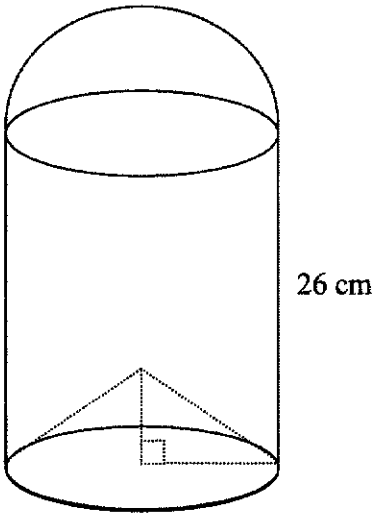


Diagram 2

(a) Calculate, giving your answers to the nearest whole number, the volume of

(i) the cylinder,

Volume of cylinder $= 26 \times 198 = 5148\,cm^3$

Answer ..... [1]

(ii) the hemisphere.

Answer ..... [3]

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	(b)	Part of the cylinder in the shape of a right circular cone is removed as shown in the diagram 2.
		(i) Given that the volume of the cone removed from the model is 630 cm^3, calculate the height of the cone.
		Answer ..... cm [1]
		(ii) Calculate the total surface area of the model as shown in diagram 2, giving the answer to the nearest whole number.
		Answer ..... cm^2 [4]

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9 **(a)** The following stem-and-leaf diagram shows the marks obtained by 20 pupils in a class test that has a total mark of 50.

1	0	2					
2	3	3	4	7	7		
3	2	5	5	5	6	7	9
4	1	6	7	8	8		
5	0						

(i) State the median score.

Answer ..... [1]

(ii) Find the standard deviation.

Answer ..... [3]

(iii) If distinction is awarded to pupils who scored at least 80%, find the percentage of pupils in the class who scored distinction.

Answer ..... % [2]

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(b) Bell has six 10-cent coins and two 50-cent coins. She takes 2 coins at random from her purse, one after the other.

(i) Complete the probability tree diagram shown in the answer space, giving the answers in fraction in the simplest form.

(ii) Find the probability that the total value of the two coins is 60 cents.

Answer ..... [2]

(iii) If a third coin is taken out, calculate the probability that the total amount is 30 cents.

Answer ..... [2]

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10 Peter is shopping for an air conditioner.

(a) Peter writes down the duration he would use the air conditioner in the following table.

Monday to Thursday	6 hours each day
Friday	7 hours 15 minutes
Saturday & Sunday	8 hours each day

Show that the mean length of time that she would use the air conditioner each day is 6 hours 45 minutes.

Answer ..... [2]

Peter is deciding between two models of air conditioner.
Page 25 shows the information that he needs, including the electricity consumptions of the two models.

(b) Based on his usage, Peter estimates that the electricity consumptions in one year will be 1755 kWh for Model S and 1066.5 kWh for Model E.
Show with workings how he come up with these estimates.

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	(c)	The total cost of an air conditioner includes its price, the cost of the electricity it consumes and the cost of servicing it. Electricity costs 25.3 cents per kWh, including GST. Peter would like the air conditioner to be serviced once every 4 months. Based on his usage, which model should he choose if he intends to use the air conditioner for 7 years? Justify your decision with calculations. (You should assume that the costs of electricity and servicing remain the same.)	

END OF PAPER

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Name:	Index No.:	Class:

PRESBYTERIAN HIGH SCHOOL

MATHEMATICS
PAPER ONE

4048/01

20 August 2021 Friday 2 hours

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SECONDARY FOUR EXPRESS/ FIVE NORMAL (ACADEMIC)
PRELIMINARY EXAMINATIONS

SUGGESTED ANSWERS

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1 The number of people who are fully vaccinated in Singapore is given as 2420800, correct to the nearest hundred.
Write down the minimum number of people who are fully vaccinated.

Answer 2420750 [1]

---

2 **(a)** Express $\left(\sqrt[3]{x}\right)^2$ in index notation.

$\left(\sqrt[3]{x}\right)^2 = x^{\frac{2}{3}}$

Answer $x^{\frac{2}{3}}$ [1]

(b) Find the integer n such that $2^n = \frac{1}{32}$.

$2^n = \frac{1}{32}$
$2^n = 2^{-5}$
$n = -5$

Answer $n =$ -5 [1]

---

3 **(a)** Express 378 as the product of its prime factors.

Answer $2 \times 3^3 \times 7$ [1]

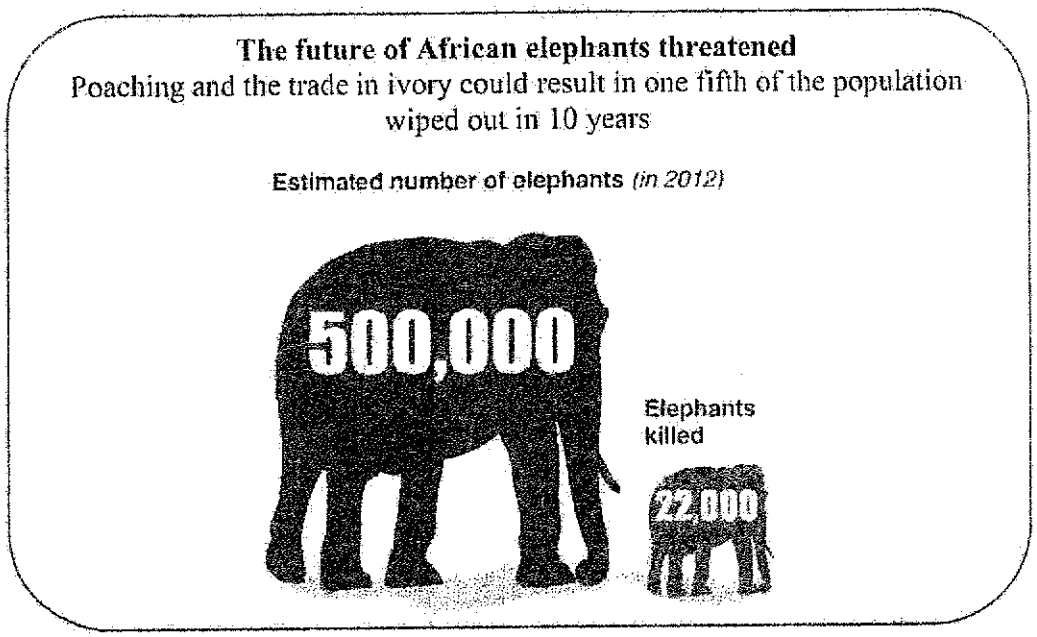
(b) Find the smallest positive integer k such that $378k$ is a perfect cube.

$k = 2^2 \times 7^2 = 196$

Answer $k =$ 196 [1]

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4 A website shows a poster of the poaching statistics of African elephants.



Adapted from: https://www.allcreaturespod.com/episodes/episode-2-elephant/poaching-stats/

Explain how the poster above may be misleading.

The **sizes of the two elephants** are not in proportion which will mislead readers into thinking that the **number of elephants killed is larger than the actual number.**

or

If 22 000 elephants are killed each year, in 10 years' time, 22 000 x 10 = 220 000 will be killed. But 220 000 is **44% of the population** and not 1/5 as stated in the headline. This will mislead readers into **thinking that only 20% of the population** will be wiped out. [1]

---

5 On 1st January 2018, Mrs Yeo invests $15000 in an account which pays at a rate of compound interest of R% per year. On 1st January 2021, she earned a total interest of $988.45.
Find the value of R.

$$15000+988.45=15000\left(1+\frac{R}{100}\right)^3$$

$$R=100\left(\sqrt[3]{\frac{15988.45}{15000}}-1\right)$$

$$=2.14999$$

$$=2.15$$

Answer $R=$ 2.15 [2]

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6 There were 3 candidates A, B, and C in a school election for the President of Student Council. There were 1120 voters and the votes for the 3 candidates were divided in the ratio of 11 : 7 : 2. Calculate the difference between the highest number and lowest number of votes.

$$\text{highest number of votes} = \frac{11}{20} \times 1120$$
$$= 616$$
$$\text{lowest number of votes} = \frac{2}{20} \times 1120$$
$$= 112$$
$$\text{difference} = 616 - 112$$
$$= 504$$

Answer 504 votes [2]

---

7 There are 12 girls and 9 boys in a group.

(a) Find, in its simplest form, the probability of selecting a boy randomly from the group.

$$\frac{9}{12+9} = \frac{3}{7}$$

Answer $\frac{3}{7}$ [1]

(b) How many more boys are needed to join the group so that the probability of selecting a boy randomly from the group will be $\frac{4}{5}$?

Let the number of boys be b.

$$\frac{9+b}{21+b} = \frac{4}{5}$$
$$84 + 4b = 45 + 5b$$
$$b = 39$$

Answer 39 boys [1]

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8 **(a)** Factorise x^2+5x-6.

Answer $(x+6)(x-1)$ [1]

(b) Hence, solve $(p-1)^2+5(p-1)-6=0$.

$(p-1+6)=0$ or $(p-1-1)=0$

$p=-5$ $\qquad$ $p=2$

Answer $p=$ -5 or 2 [2]

---

9 **(a)** Simplify $2(3x+5)-2(1-2x)$.

$2(3x+5)-2(1-2x)$

$=6x+10-2+4x$

$=10x+8$

$=2(5x+4)$

Answer $2(5x+4)$ [1]

(b) Given $\frac{2y}{3}-\frac{y-4}{4}\leq 5$, find the largest rational value of y.

$\frac{2y}{3}-\frac{y-4}{4}\leq 5$

$\frac{8y-3y+12}{12}\leq 5$

$5y+12\leq 60$

$y\leq 9\frac{3}{5}$

Answer $9\frac{3}{5}$ [2]

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10 **(a)** 6 men take 10 days to paint an apartment.
Calculate the number of men required to paint the same apartment in 3 days.

1 man takes $6 \times 10 = 60$ days
No of men required = $60 \div 3 = 20$

Answer 20 men [1]

(b) The braking distance, d of a car is directly proportional to the square of its speed, v.
When the speed of the car is increased by 200%, find the percentage increase in its braking distance.

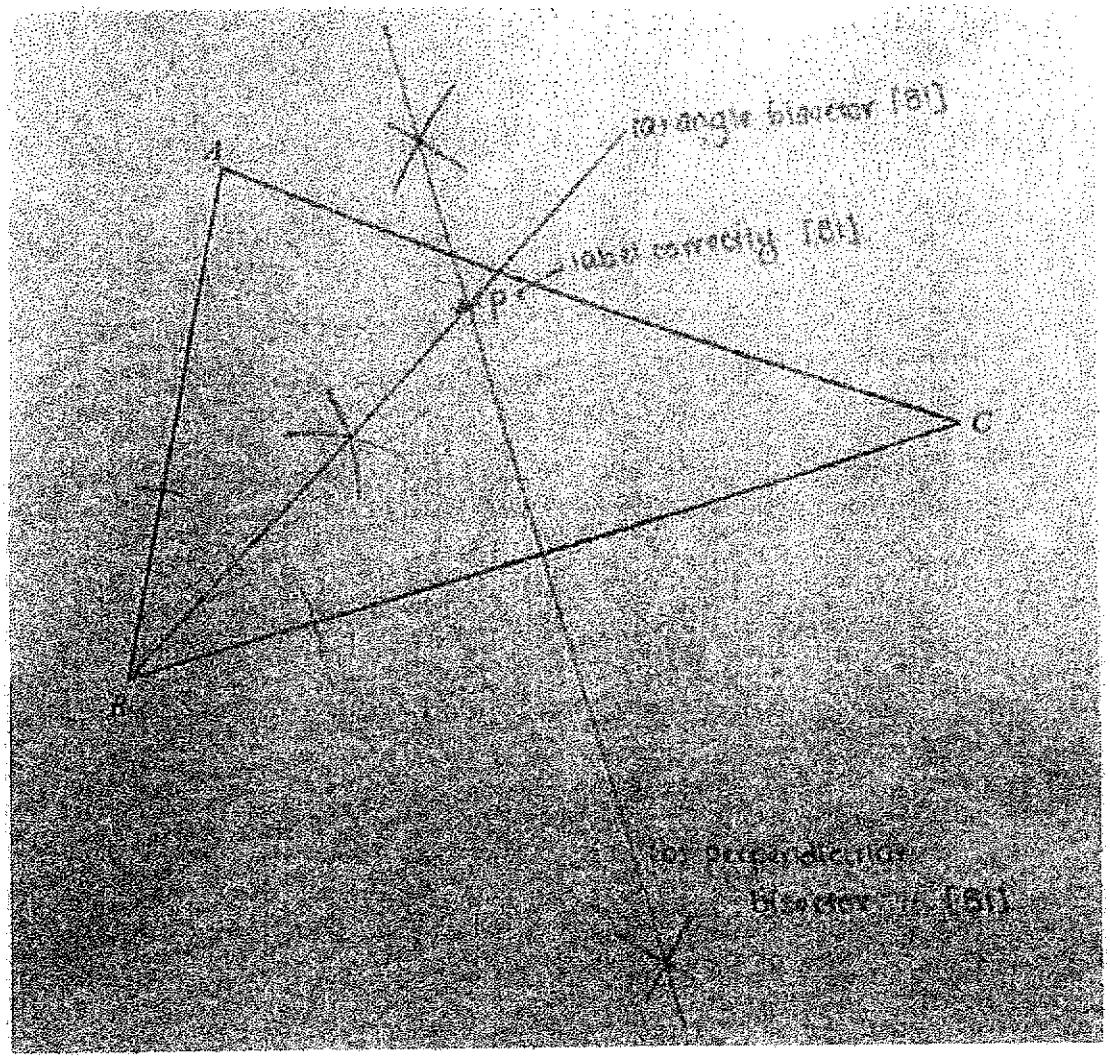
$d = kv^2$
When v increased by 200%, $d = k(3v)^2$
$= k(9v^2)$

$$\% \text{ increase} = \frac{9v^2 - v^2}{v^2} \times 100\%$$
$$= 800\%$$

Answer 800 % [2]

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11 The diagram shows a triangle ABC.



On the diagram,

(a) construct the bisector of angle ABC, [1]

(b) construct the perpendicular bisector of BC, [1]

(c) label the point P that is equidistant from B and C, and also equidistant from AB and BC. [1]

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12 A straight line with equation $2y = kx + h$ passes through the points (–2, 6) and (1, –9). Find the values of k and h.

$12 = -2k + h \quad -(1)$

$-18 = k + h \quad -(2)$

(1)– (2):

$30 = -3k$

$k = -10$

Subs $k = -10$ into eqn (2)

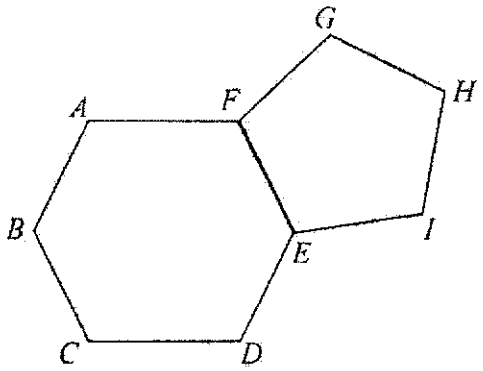
$-18 = -10 + h$

$h = -8$

Answer $k =$ –10 , $h =$ –8 [3]

---

13 The diagram shows a regular hexagon, *ABCDEF* and a regular pentagon, *EFGHI*.



Find $\angle EDI$.

$$\text{one int } \angle \text{ of hexagon} = \frac{(6-2)180}{6} = 120°$$

$$\text{one int } \angle \text{ of pentagon} = \frac{(5-2)180}{5} = 108°$$

$$\angle DEI = 360° - 120° - 108°$$

$$= 132°$$

$$\angle DEI = \frac{180° - 132°}{2}$$

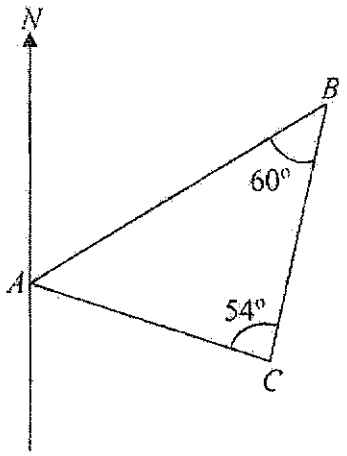
$$= 24°$$

Answer 24° [3]

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14 The diagram shows the positions of points A, B and C.
$\angle ABC = 60°$, $\angle BCA = 54°$ and the bearing of B from A is 078°.



Find the bearing of

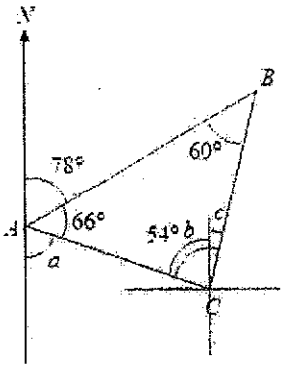
(a) C from A.

$\angle BAC = 180° - 60° - 54°$
$= 66°$
bearing $= 78° + 66°$
$= 144°$

Answer 144° [1]

(b) B from C.

$\angle a = 180° - 78° - 66°$ (adj $\angle$ on a st line)
$= 36°$
$\angle b = 36°$ (alt $\angle$)
$\angle c = 54° - 36°$
$= 18°$



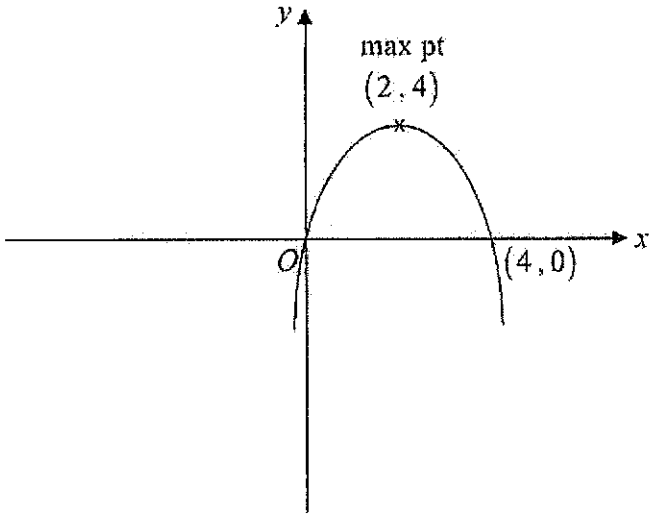
Answer 018° [2]

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15 **Sketch** the graph of $y=-(x-2)^2+4$ on the axes below.

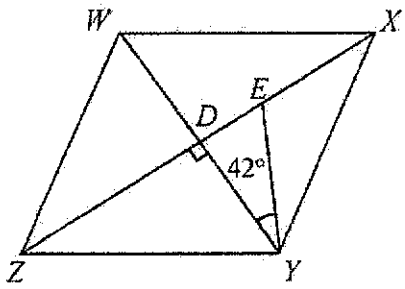
Indicate clearly the coordinates of the points where the graph crosses the axes and the maximum point on the curve.



[3]

---

16 The diagram shows a rhombus $WXYZ$, where the diagonals intersect at D.
$ZDEX$ lies on a straight line. $EY = 4.7$ cm, $XZ = 15$ cm and $\angle DYE = 42°$.



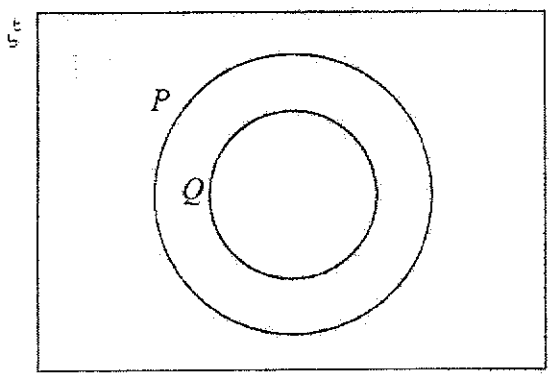
Find the length EX.

$$\sin 42° = \frac{DE}{4.7}$$
$$DE = 4.7 \sin 42°$$
$$= 3.1449 \text{ cm}$$
$$EX = 7.5 - 3.1449$$

Answer 4.36 cm [3]

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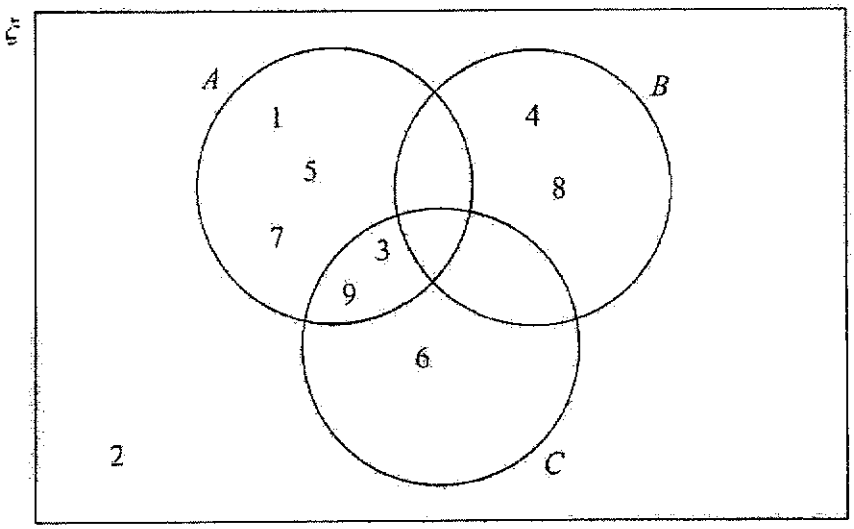
17 **(a)** On the Venn diagram, shade the region which represents $Q \cup P'$.



[1]

(b) $\xi = \{\text{integers } x : 1 \leq x \leq 9\}$

The Venn diagram shows the elements of ξ and three sets A, B and C.



Use one of the symbols below to complete each statement.

$\varnothing \quad \subset \quad \not\subset \quad \notin \quad \in \quad \xi$

(i) $\{4, 8\} \subset B$ [1]

(ii) $9 \in C$ [1]

(iii) $B \cap C = \varnothing$ [1]

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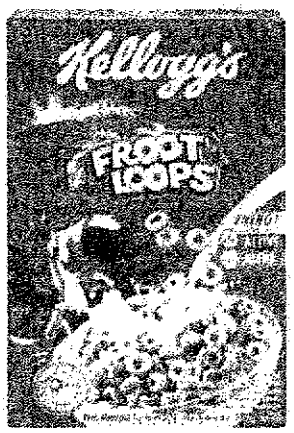
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18 The following diagram shows 2 geometrically similar boxes of cereals of the same brand.

Box *A*
20g
$0.80



Box *B*
160g
$3.40



(a) Show that the cost of the cereal is **not** directly proportional to the quantity of the cereal. Explain with clear calculation.

Answer

$$\text{Cost of per gram for Box } A = \frac{0.80}{20} = \$0.04$$

$$\text{Cost of per gram for Box } B = \frac{3.40}{160} = \$0.02125$$

Since **cost per gram is not a constant**, the cost of the cereal is **not directly proportional** to the quantity of the cereal. [1]

(b) Find $\dfrac{\text{height of Box } A}{\text{height of Box } B}$.

$$\frac{\text{height of Box } A}{\text{height of Box } B} = \sqrt[3]{\frac{20}{160}}$$

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

Answer $\dfrac{1}{2}$ [1]

(c) It is given that the surface area of Box *A* is 454 cm^2.
Calculate the surface area of Box *B*.

$$\left(\frac{1}{2}\right)^2 = \frac{454}{\text{surface area of Box } B}$$

$$\text{surface area of Box } B = 2^2 \times 454$$

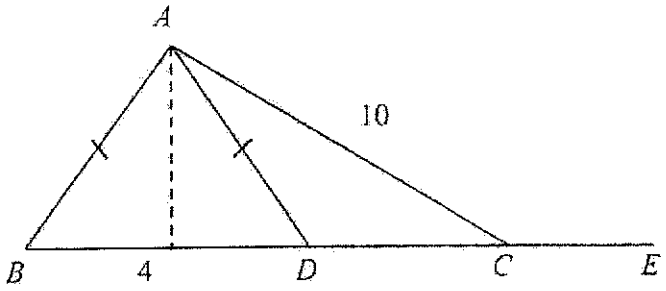
$$= 1816$$

Answer 1816 cm^2 [2]

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19 In the diagram, $BDCE$ is a straight line. $BD = 4$ cm, $AC = 10$ cm and $AB = AD$.



(a) Given that the area of triangle ABD is 16 cm^2, show that the vertical height of triangle ABD is 8 cm.

Answer

$$\frac{1}{2} \times 4 \times h = 16$$

$h = 8$ (shown) [1]

(b) Write down, as a fraction, the value of

(i) $\sin \angle ACE$.

$$\sin \angle ACE = \frac{8}{10} = \frac{4}{5}$$

Answer $\frac{4}{5}$ [1]

(ii) $\tan \angle ACD$,

$$MC = \sqrt{10^2 - 8^2} = 6$$

$$\tan \angle ACD = \frac{8}{6} = \frac{4}{3}$$

Answer $\frac{4}{3}$ [2]

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20 A map has a scale of 1 : 150 000.

(a) The length of a road on the map is 6.4 cm.
Calculate the actual length, in kilometres, of the road.

$$\text{length} = 6.4 \times 150000$$
$$= 960000 \text{ cm}$$
$$= 9.6 \text{ km}$$

Answer 9.6 km [2]

(b) The area of a park is 10.125 km^2.
Calculate, the area, in square centimetres, of the park on the map.

$$\text{area scale is } (1 \text{ cm})^2 : (1.5 \text{ km})^2$$
$$\text{area on map} = \frac{10.125}{2.25}$$
$$= 4.5 \text{ cm}^2$$

Answer 4.5 cm^2 [2]

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21 (a) The line l has equation $4x+2y+7=0$.

(i) Find the gradient of line l.

$$4x+2y+7=0$$
$$2y=-4x-7$$
$$y=-2x-\frac{7}{2}$$

Answer -2 [1]

(ii) Find the coordinates of the point where l cuts the y-axis.

$\left(0,-\frac{7}{2}\right)$ [1]

(b) Another line k is parallel to $y=\frac{1}{2}x+5$ and it passes through the point $(8,3)$.

Find the equation of line k.

$y=\frac{1}{2}x+5 \quad \Rightarrow m=\frac{1}{2}$

subs $(8,3)$ into $y=\frac{1}{2}x+c$

$3=\frac{1}{2}(8)+c$

$c=-1$

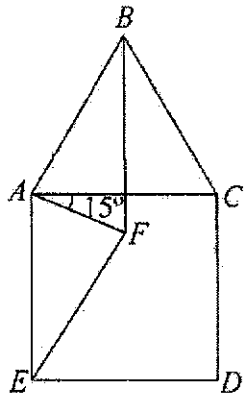
$y=\frac{1}{2}x-1$

Answer $y=\frac{1}{2}x-1$ [2]

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22 In the diagram, ABC is an equilateral triangle, $ACDE$ is a square and angle $FAC = 15°$.



(a) Show that triangle EAF and triangle BAF are congruent.
Give a reason for each statement you make.

Answer

Since triangle ABC is equilateral, $AC = AB$ and $\angle CAB = 60°$
Since $ACDE$ is a square, $AE = AC$ and $\angle EAC = 90°$
$\therefore AE = AB$
$\angle BAF = 60° + 15° = 75°$
$\angle EAF = 90° - 15° = 75°$
$\therefore \angle BAF = \angle EAF$
FA is a common side.
$\therefore$ Triangles EAF and CAF are congruent (SAS) [3]

(b) If the line BF bisects angle ABC, prove that triangle FAE is an isosceles triangle.

Answer

$\angle ABF = \angle FBC = 30°$ (BF bisects $\angle ABF$)
$\angle AEF = \angle ABF = 30°$ (corr $\angle$s of congruent $\triangle$)
$\angle EFA = 180° - 30° - 75°$
$= 75°$
$= \angle EAF$
Since $\angle EFA = \angle EAF$, triangle FAE is an isosceles triangle.

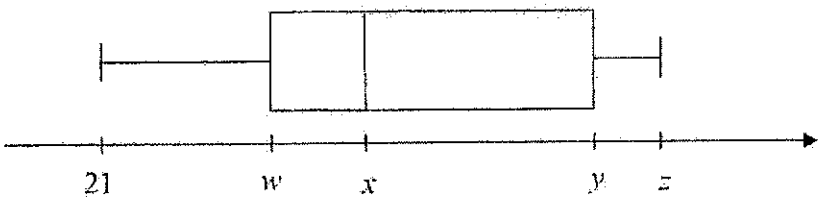
[2]

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23 (a) The table shows the scores of 10 students in a Mathematics test.

Test score	Frequency
21	2
49	3
55	1
65	1
80	1
95	2

The test scores are also represented in the box-and-whisker plot below.



Write down the values of w, x, y and z.

Answer $w =$ 49

$x =$ 52

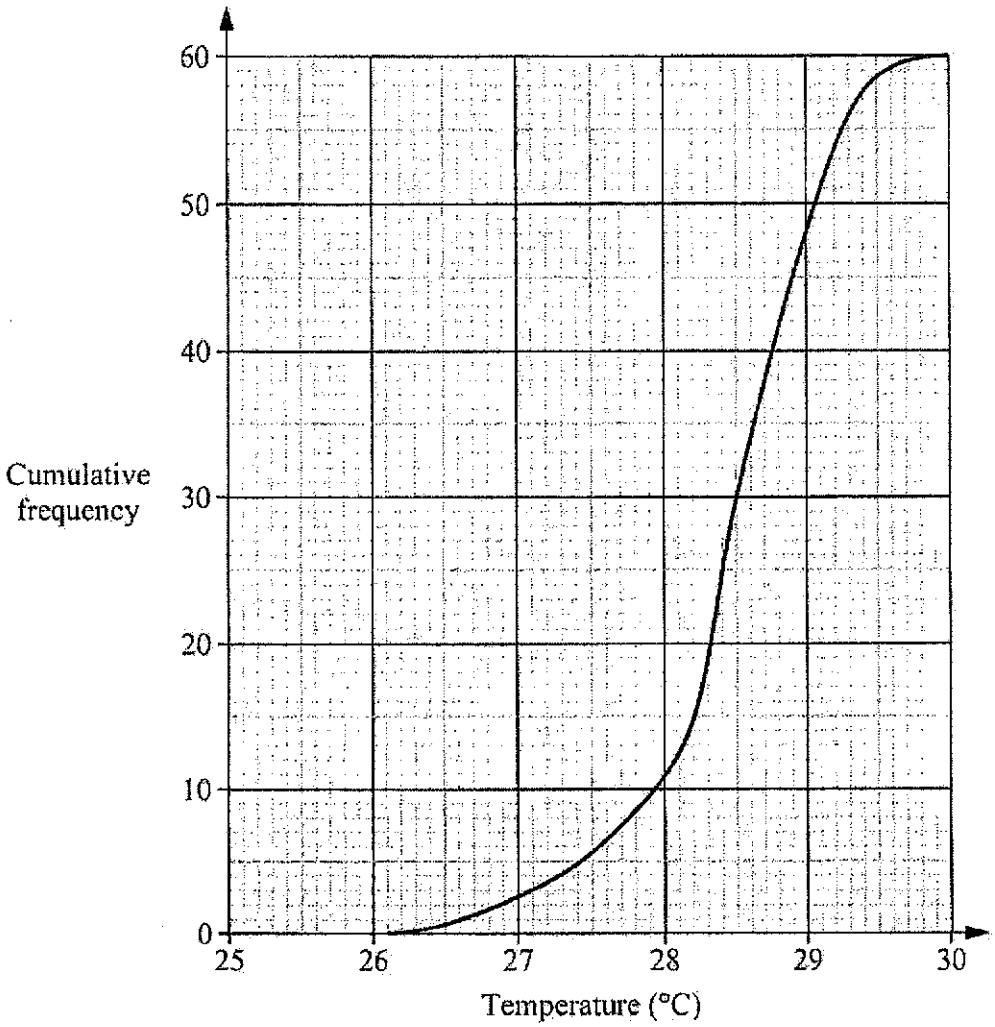
$y =$ 80

$z =$ 95 [2]

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(b) The temperature at Ang Mo Kio was recorded every day for 60 days.
The cumulative frequency graph below shows the distribution of the temperatures.



(i) Use the graph to estimate

(a) the number of days that had temperatures above 29°C.
$60 - 48 = 12$

Answer 12 days [1]

(b) the interquartile range of the temperatures.
Q3 = 28.9, Q1 = 28.2

Answer 0.7 °C [1]

(ii) The temperature at Jurong was recorded every day for the same period.
The interquartile range of the temperatures at Jurong is 1.5°C.
Explain what this tell us about the temperature at Jurong compared with the temperature at Ang Mo Kio.

The temperatures at Jurong have a **larger spread** than the temperatures at Ang Mo Kio. [1]

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24 On every weekday, a bakery delivers chicken pies and apple pies to four cafes.
On every weekend, it delivers double the number of chicken pies and apple pies to each of the cafe.
The matrix **E** shows the number of chicken and apple pies delivered to each cafe on each weekday and each weekend

$$\mathbf{E} = \begin{matrix} \text{Chicken pies} & \text{Apple pies} \\ \end{matrix} \begin{pmatrix} 38 & 50 \\ 76 & 100 \end{pmatrix} \begin{matrix} \text{Weekday} \\ \text{Weekend} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{M} = 4\mathbf{E}$.

$$\mathbf{M} = 4\begin{pmatrix} 38 & 50 \\ 76 & 100 \end{pmatrix} = \begin{pmatrix} 152 & 200 \\ 304 & 400 \end{pmatrix}$$

Answer $\mathbf{M} =$ $\begin{pmatrix} 152 & 200 \\ 304 & 400 \end{pmatrix}$ [1]

(b) Evaluate the matrix $\mathbf{C} = (5 \quad 2)\mathbf{M}$.

$$\mathbf{C} = (5 \quad 2)\begin{pmatrix} 152 & 200 \\ 304 & 400 \end{pmatrix} = (1368 \quad 1800)$$

Answer $\mathbf{C} =$ $(1368 \quad 1800)$ [1]

(c) State what the elements of **C** represent.

The bakery delivers 1368 chicken pies and 1800 apple pies to the four cafes **per week respectively.** [1]

(d) The price of each chicken pie is \$1.80 and the price of an apple pie is \$1.50.
By matrix multiplication, calculate the total amount of money the bakery collects per week from the sale of the pies to the four cafes.

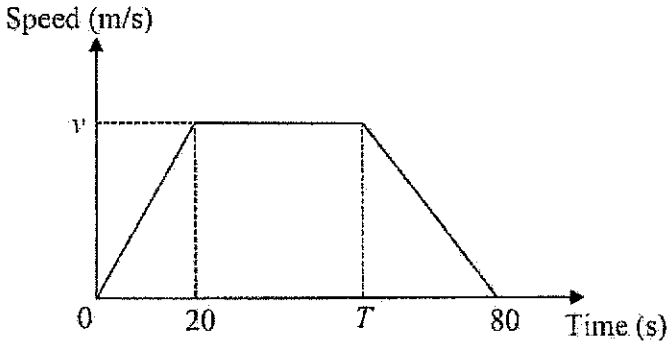
$$\text{total amount of money} = (1368 \quad 1800)\begin{pmatrix} 1.80 \\ 1.50 \end{pmatrix}$$
$$= (5162.40)$$

Answer \$ 5162.40 [2]

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25 The diagram below shows the speed-time graph of a bus journey.
The bus accelerated from rest at 1.25 m/s^2 to a speed of v m/s in 20 seconds, and travelled at this speed until T seconds before it came to a stop at 80 seconds.
The total distance travelled for the whole journey was 1450 m.



(a) Find the values of

(i) v,

$$\frac{v}{20} = 1.25$$
$$v = 25$$

Answer $v =$ 25 [1]

(ii) T.

$$\frac{1}{2}(80+T-20)(25) = 1450 \quad \text{[M1]}$$
$$(60+T)(25) = 2900$$
$$60+T = 116$$
$$T = 56$$

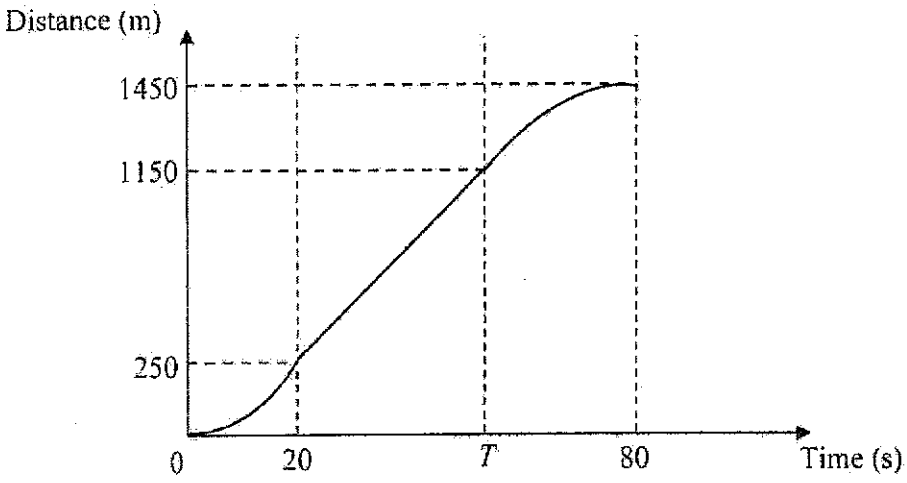
Answer $T =$ 56 [2]

(b) Describe the motion of the bus between 20 seconds and T seconds.

The bus is travelling at a **constant speed of 25 m/s.** [1]

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(c) On the axes below, draw the distance-time graph of the bus journey, marking and stating the distance travelled for each time duration clearly on the vertical axis.



[2]

END OF PAPER

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PRESBYTERIAN HIGH SCHOOL

MATHEMATICS
PAPER TWO

4048/02

19 August 2021 Thursday 2 hours 30 minutes

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SECONDARY FOUR EXPRESS / FIVE NORMAL (ACADEMIC)
PRELIMINARY EXAMINATION

SUGGESTED ANSWERS

For Examiner's Use												
Qn	1	2	3	4	5	6	7	8	9	10		*Marks Deducted*
Marks												

Category	Accuracy	Units	Symbols	Others
Question				

Total Marks
95

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

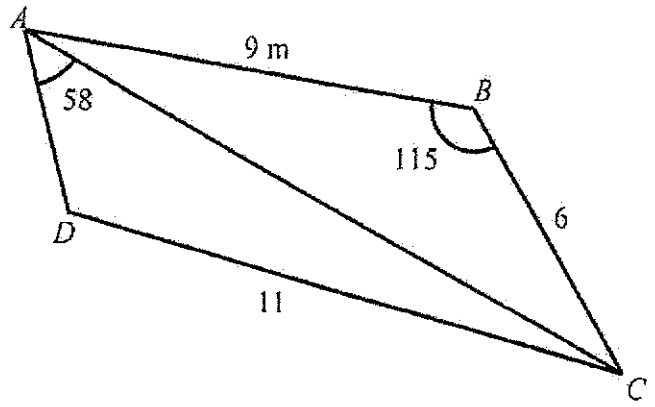
$$\text{Mean} = \frac{\sum fx}{\sum f}$$

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

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2 The diagram shows a field $ABCD$ on horizontal ground.
Angle $ABC = 115°$, Angle $CAD = 58°$, $AB = 9$ m, $BC = 6$ m and $CD = 11$ m.



Calculate

(a) AC,

$(AC)^2 = 9^2 + 6^2 - 2(9)(6)\cos 150°$
$= 162.64277$
$AC = 12.753 \approx 12.8\,m$

Answer ..... m [2]

(b) obtuse angle ADC,

$\frac{\sin \angle ADC}{12.753} = \frac{\sin 58°}{11}$
$\sin \angle ADC = 0.983196$
Obtuse $\angle ADC = 180° - 79.48°$
$\approx 100.5°$

Answer ..... ° [3]

(c) the area of triangle ACD,

$\angle ACD = 180° - 58° - 100.52° = 21.48°$
Area of $\Delta ACD = \frac{1}{2}(11)(12.573)\sin 21.48°$
$= 25.68 \approx 25.7 m^2$

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

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	(d)	the shortest distance from D to AC.	
		Let the shortest distance be h. Area of $\Delta ACD = 25.68$ $\frac{1}{2}(12.573)h = 25.68$ $h = 4.027 \approx 4.03m$	
			Answer ..... m [2]

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3	(a)	The approximate mass of the earth is 5.97×10^{24} kg. How many times is the earth heavier than a sumo wrestler who weighs 125 kg? Give your answer in standard form correct to 3 significant figures.	
		$\frac{5.97\times10^{24}}{125} = 4.776\times10^{22} \approx 4.78\times10^{22}$	
		Answer ..... [2]	
	(b)	A mobile phone can be bought online at a price of US$350. The same type of mobile phone is sold in Singapore at S$600. A local shop owner decides to sell the same type of mobile phone at a discount such that its price is equivalent to what a buyer pays online. Given that US$1 = S$1.36, calculate the percentage of discount he has to offer.	
		Price online $= 350\times1.36 = S\$476$ $\%\ \text{discount} = \frac{600-476}{600}\times100$ $= 20.667 \approx 20.7$ *or* $20\frac{2}{3}$	
		Answer .....% [3]	
	(c)	A train travels for 68 km at an average speed of 51 km/h. It then traveled for another 20 km at an average speed of 40 km/h before reaching its destination. Calculate the average speed for the whole journey.	
		Time taken for 68 km $= \frac{68}{51} = 1\frac{1}{3}\ h$ Time taken for 20 km $= \frac{20}{40} = \frac{1}{2}\ h$ Average speed $= \frac{68+20}{1\frac{1}{3}+\frac{1}{2}} = 48\ km/h$	
		Answer .....km/h [3]	

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	(d)	In the year 2020, there are 250 male employees and 300 female employees in an office. In the year 2019, the number of male employees was 130% of the current male employees. In the year 2019, the number of female employees was 65% of the current female employees. Find the difference in the number of male and female employees in the year 2019 as a percentage of the number of female employees in that year.	
		Number of male $= 250 \times \frac{130}{100} = 325$ Number of female $= 300 \times \frac{65}{100} = 195$ % difference $= \frac{325 - 195}{195} \times 100$ $= \frac{130}{195} \times 100 = 66.7$ *or* $66\frac{2}{3}$	
			Answer ..... % [3]

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4 **Answer the whole of this question on a piece of graph paper.**

The variables x and y are related by the equation $y = x^3 - 3x^2 + 1$.

Some corresponding values of x and y are given in the following table.

x	−2	−1	0	1	2	3	4
y	−19	−3	1	−1	p	1	17

(a) Find the value of p.

$p = -3$

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

(b) Using a scale of 2 cm to 1 unit, draw a horizontal x-axis for $-2 \le x \le 4$.
Using a scale of 1 cm to 2 units, draw a vertical y-axis for $-20 \le y \le 20$.
On your axes, plot the points given in the table and join them with a smooth curve.

(c) Use your graph to find the value(s) of x for which

(i) $x^3 - 3x^2 + 1 = 0$,

From the graph, $x = -0.55, 0.7, 2.9$

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

(ii) $x^3 - 3x^2 + 1 = -4x$.

From the graph, $x = -0.22$

Answer $x =$ ..... [1]

(d) By drawing a suitable tangent, find the gradient of the curve at $x = 3$.

Draw a correct tangent line on graph

Gradient $= \dfrac{16-(-8.4)}{4.6-2} \approx 9.38$

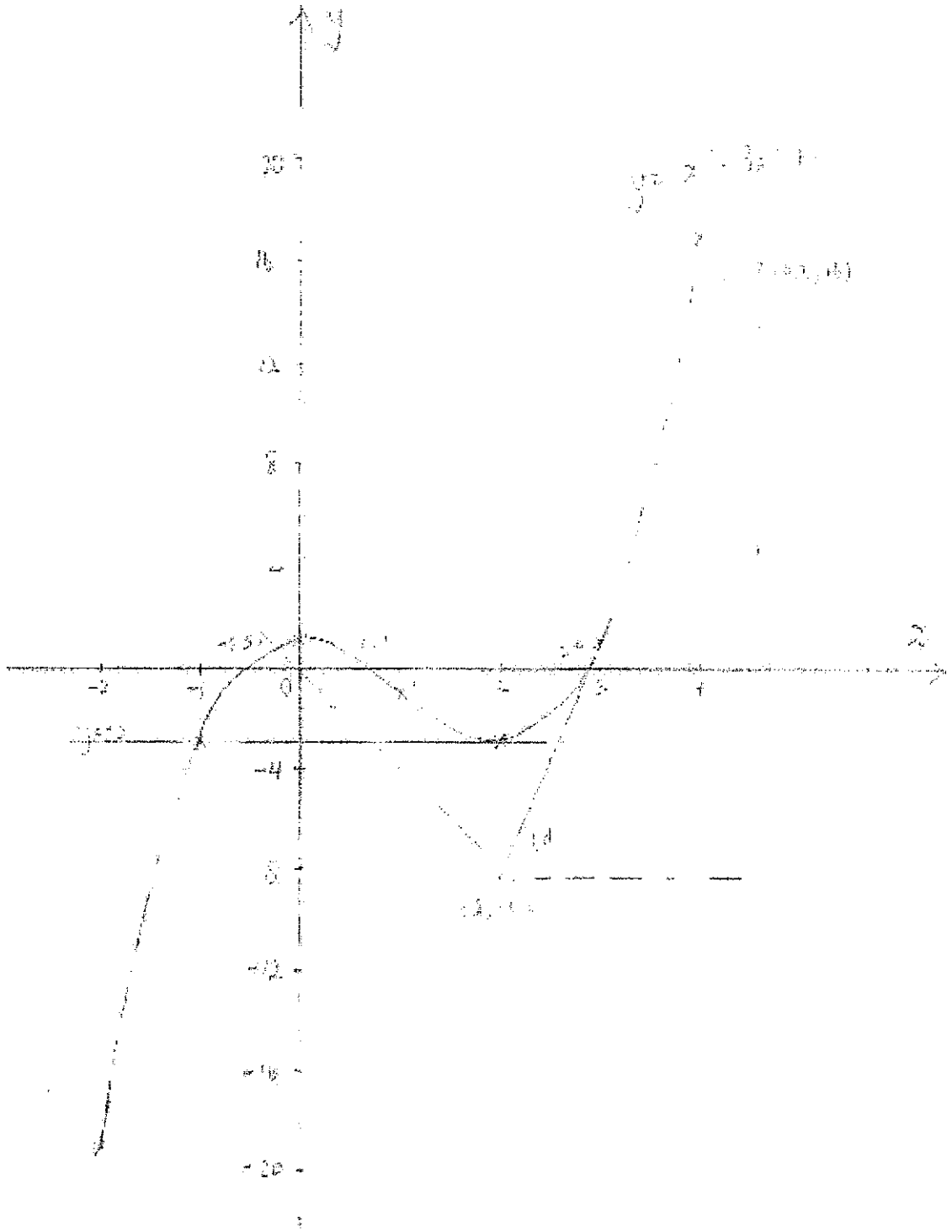
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		Answer ..... [2]	
	(e)	The line $y = k$, where k is a constant, meets the curve $y = x^3 - 3x^2 + 1$ at two points. Draw this line and hence find a possible value of k.	
		Draw the line $y = 1$ *or* $y = -3$ Possible value of $k = 1$ Possible value of $k = -3$	
		Answer k = ... [2]	

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Q4



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5 **(a)** Consider the sequence:

$T_1 = 1 = 1$

$T_2 = 1 + 2 = 3$

$T_3 = 1 + 2 + 3 = 6$

$T_4 = 1 + 2 + 3 + 4 = 10$

$T_5 = 1 + 2 + 3 + 4 + 5 = 15$

(i) Write down T_6 of the sequence in the similar form.

$T_6 = 1 + 2 + 3 + 4 + 5 + 6 = 21$

Answer ..... [1]

(ii) The nth term of the sequence is given below.

$$T_n = 1 + 2 + 3 + 4 + \ldots\ldots + n = \frac{n(n+1)}{2}$$

Use the formula to find

(a) T_{100} ,

$$T_{100} = \frac{100(101)}{2}$$
$$= 5050$$

Answer ..... [1]

(b) the value of $3 + 6 + 9 + 12 + \ldots\ldots + 300$.

$3(1 + 2 + 3 + 4 + \ldots\ldots + 100)$
$= 3(5050) = 15150$

Answer ..... [2]

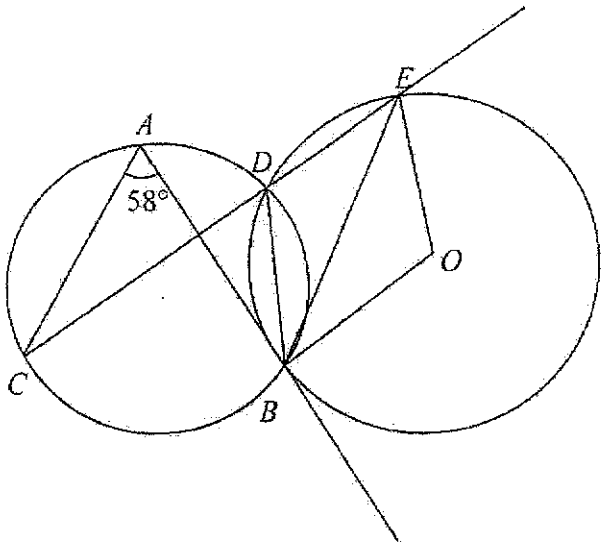
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	(b	Consider the number sequence: 1, 4, 7, 10, 13, 16, ...	
		(i) Write down the nth term of the sequence.	
		$T_n = 3n - 2$	
		Answer ..... [1]	
		(ii) Find the 80^{th} term of the sequence.	
		$T_{80} = 3(80) - 2 = 238$	
		Answer ..... [1]	
		(iii) Write down the smallest and largest four-digit number of the sequence.	
		Smallest = 1000 Largest = 9997	
		Answer ..... and ..... [2]	

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6 **(a)** In the diagram, AB is a tangent to the circle with centre O, $\angle CAB = 58°$ and CDE is a straight line.



Find, stating your reasons clearly,

(i) $\angle BDE$,

$\angle CDB = \angle CAB = 58°$ ($\angle s$ in the same segment)

$\angle BDE = 180° - 58° = 122°$

Answer .....° [2]

(ii) obtuse $\angle BOE$,

Reflex $\angle BOE = 122° \times 2 = 244°$
($\angle$ at centre = $2\angle$ at circumference)

Obtuse $\angle BOE = 360° - 244° = 116°$

Answer .....° [2]

(iii) $\angle EBO$,

$$\angle EBO = \frac{180° - 116°}{32°} = 32°$$

Answer .....° [1]

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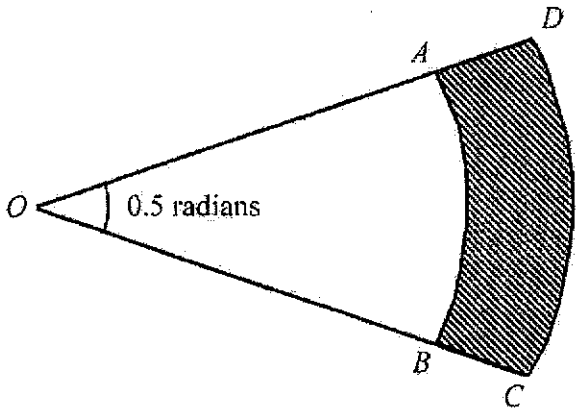
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(iv) $\angle ABE$.

$\angle ABO = 90°$ (radius $\perp$ tangent)
$\angle ABE = 90° - 32° = 58°$

Answer .....° [2]

(b) The figure shows arcs, AB and CD, of two concentric circles with centre at O. Their radii, OB and OC, are x cm and y cm respectively, and $\angle AOB = 0.5$ radians.



(i) Find the area of the shaded region in terms of x and y.

Area of shaded region
$= \frac{1}{2}y^2(0.5) - \frac{1}{2}x^2(0.5)$
$= \frac{1}{4}(y^2 - x^2)$ *or* $\frac{1}{4}(y-x)(y+x)$
or $0.25(y^2 - x^2)$

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

(ii) If the perimeter of the shaded region $ABCD$ is 120 cm, show that $y = \frac{1}{5}(240 + 3x)$.

$AB = 0.5x$
$DC = 0.5y$

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		Perimeter of $ABCD = 120$ $0.5x + 0.5y + 2(y - x) = 120$ $\frac{1}{2}x + \frac{1}{2}y + 2y - 2x = 120$ $\frac{5}{2}y = \frac{3}{2}x + 120$ $y = \frac{1}{5}(240 + 3x)$	

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7	(a)	The position vector of A is $\begin{pmatrix}3\\4\end{pmatrix}$ and the position vector of B is $\begin{pmatrix}7\\10\end{pmatrix}$.	
		(i) Find the column vector $\overrightarrow{AB}$.	
		$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = \begin{pmatrix}7\\10\end{pmatrix} - \begin{pmatrix}3\\4\end{pmatrix} = \begin{pmatrix}4\\6\end{pmatrix}$	
		Answer ..... [1]	
		(ii) Find $\lvert\overrightarrow{AB}\rvert$.	
		$\lvert\overrightarrow{AB}\rvert = \sqrt{4^2+6^2} = 7.21$ *units*	
		Answer ..... [1]	
		(iii) Given that $\overrightarrow{AB} = 3\overrightarrow{BC}$, find the coordinates of point C.	
		$\overrightarrow{BC} = \frac{1}{3}\overrightarrow{AB} = \begin{pmatrix}\frac{4}{3}\\2\end{pmatrix}$ $\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC} = \begin{pmatrix}7\\10\end{pmatrix} + \begin{pmatrix}\frac{4}{3}\\2\end{pmatrix} = \begin{pmatrix}8\frac{1}{3}\\12\end{pmatrix}$ Coordinates of C is $\left(8\frac{1}{3},\ 12\right)$	
		Answer ..... [1]	
	(b)	Given $\overrightarrow{PQ} = \begin{pmatrix}2\\1\end{pmatrix}$, $\overrightarrow{PR} = \begin{pmatrix}-1\\-\frac{1}{2}\end{pmatrix}$ and the point Q has coordinates (–2, 4).	
		(i) Deduce the gradient of the line PQ and hence, find the equation of the line PQ.	
		Gradient of $PQ = \frac{1}{2}$	

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$y = \frac{1}{2}x + c$

$4 = \frac{1}{2}(-2) + c$

$c = 5$

Therefore the equation of line PQ is $y = \frac{1}{2}x + 5$

Answer ..... [1]

(ii) Write down 2 facts about P, Q and R.

$\overrightarrow{PQ} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ $\overrightarrow{PR} = \begin{pmatrix} -1 \\ -\frac{1}{2} \end{pmatrix} = -\frac{1}{2}\begin{pmatrix} 2 \\ 1 \end{pmatrix}$

P, Q and R lie on the same straight line.

$\frac{PR}{PQ} = \frac{1}{2}$

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8 A model consists of a solid hemisphere attached to a solid cylinder as shown in diagram 1.

The height of the cylinder is 26 cm and the base area is 198 cm^2.

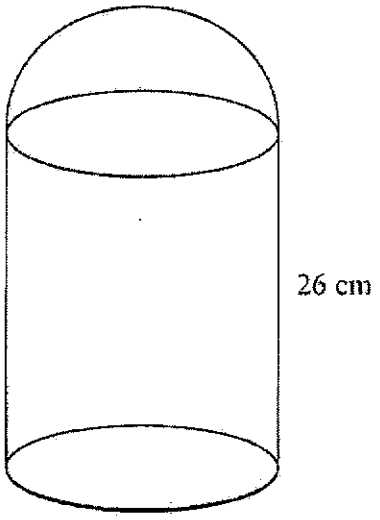


Diagram 1

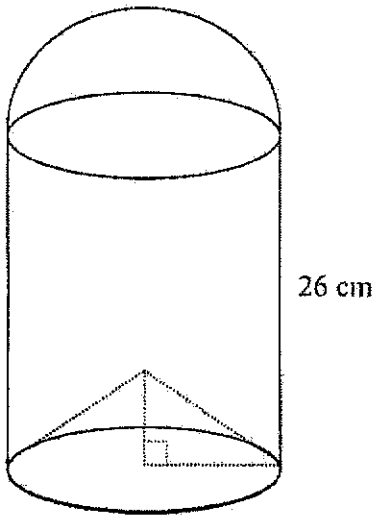


Diagram 2

(a) Calculate, giving your answers to the nearest whole number, the volume of

(i) the cylinder,

Volume of cylinder $= 26 \times 198 = 5148 cm^3$

Answer ..... [1]

(ii) the hemisphere.

Let the radius be r cm

$\pi r^2 = 198$

$r = \sqrt{\frac{198}{\pi}} = 7.93885$

Volume of hemisphere $= \frac{2}{3}\pi(7.93885)^2$

$= 1047.93 \approx 1048 cm^3$

Answer ..... [3]

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(b) Part of the cylinder in the shape of a right circular cone is removed as shown in the diagram 2.

(i) Given that the volume of the cone removed from the model is 630 cm^3, calculate the height of the cone.

$$\frac{1}{3}\pi r^2 h = 630$$

$$\frac{1}{3}(198)h = 630$$

$$h = 9.545 \approx 9.55\,cm$$

Answer ..... cm [1]

(ii) Calculate the total surface area of the model as shown in diagram 2, giving the answer to the nearest whole number.

Curved surface area of cone

$$= \pi rl = \pi(7.939)\left[\sqrt{7.939^2 + 9.545^2}\right] = 309.65$$

Surface area of cylinder

$$= 2\pi r(26) = 2\pi(7.939)(26) = 1296.94$$

Surface area of hemisphere

$$= 2\pi r^2 = 2\pi(7.939)^2 = 396.01$$

Total surface area of model

$$= 2002.6 \approx 2003\,cm^2$$

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

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9 **(a)** The following stem-and-leaf diagram shows the marks obtained by 20 pupils in a class test that has a total mark of 50.

1	0	2					
2	3	3	4	7	7		
3	2	5	5	5	6	7	9
4	1	6	7	8	8		
5	0						

(i) State the median score.

The median score is 35

Answer ..... [1]

(ii) Find the standard deviation.

$\sum fx^2 = 25335$

$\sum fx = 675$

$$\text{Standard deviation} = \sqrt{\frac{25335}{20} - \left(\frac{675}{20}\right)^2}$$

$$= \sqrt{1266.75 - 33.75^2} \approx 11.3$$

Answer ..... [3]

(iii) If distinction is awarded to pupils who scored at least 80%, find the percentage of pupils in the class who scored distinction.

80% is 40 marks.

Percentage who scored distinction

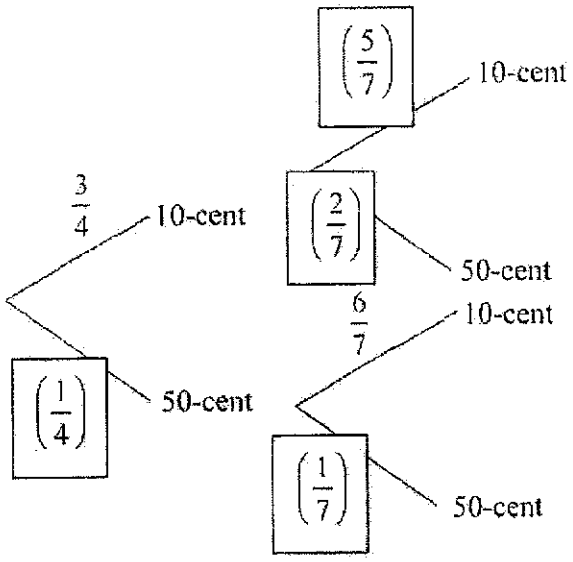
$$= \frac{6}{20} \times 100\% = 30\%$$

Answer ..... % [2]

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(b) Bell has six 10-cent coins and two 50-cent coins. She takes 2 coins at random from her purse, one after the other.

(i) Complete the probability tree diagram shown in the answer space, giving the answers in fraction in the simplest form.



(ii) Find the probability that the total value of the two coins is 60 cents.

P(total value of 2 coins is 60 cents)

$$= \left(\frac{3}{4} \times \frac{2}{7}\right) + \left(\frac{1}{4} \times \frac{6}{7}\right)$$

$$= \frac{3}{14} + \frac{3}{14} \quad = \frac{3}{7}$$

Answer ..... [2]

(iii) If a third coin is taken out, calculate the probability that the total amount is 30 cents.

P(total amount is 30 cents when third coin is taken)

$$= \frac{3}{4} \times \frac{5}{7} \times \frac{2}{3}$$

$$= \frac{5}{14}$$

Answer ..... [2]

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10 Peter is shopping for an air conditioner.

(a) Peter writes down the duration he would use the air conditioner in the following table.

Monday to Thursday	6 hours each day
Friday	7 hours 15 minutes
Saturday & Sunday	8 hours each day

Show that the mean length of time that she would use the air conditioner each day is 6 hours 45 minutes.

Mean length of time

$$= \frac{(6\times 4) + 7\frac{1}{4} + (8\times 2)}{7}$$

$$= 6.75\ h$$

$$= 6h45\,\text{min}$$

Answer ..... [2]

Peter is deciding between two models of air conditioner.
Page 25 shows the information that he needs, including the electricity consumptions of the two models.

(b) Based on his usage, Peter estimates that the electricity consumptions in one year will be 1755 kWh for Model S and 1066.5 kWh for Model E.
Show with workings how he come up with these estimates.

Model S

Electricity consumption $= \frac{6.75}{8} \times 2080 = 1755\,kWh$

Model E

Electricity consumption $= \frac{6.75}{8} \times 1264 = 1066.5\,kWh$

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	(c)	The total cost of an air conditioner includes its price, the cost of the electricity it consumes and the cost of servicing it. Electricity costs 25.3 cents per kWh, including GST. Peter would like the air conditioner to be serviced once every 4 months. Based on his usage, which model should he choose if he intends to use the air conditioner for 7 years? Justify your decision with calculations. (You should assume that the costs of electricity and servicing remain the same.)	
		<u>Model S (7 years)</u> Total cost of electricity $= 1755 \times \frac{25.3}{100} \times 7 = \$3108.11$ Total cost of servicing $= 35 \times 3 \times 1.07 \times 0.6 \times 7 = \$471.87$ Total cost for Model S $= 3108.11 + 471.87 + 650$ $= \$4229.98$ <u>Model E (7 years)</u> Total cost of electricity $= 1066.5 \times \frac{25.3}{100} \times 7 = \$1888.77$ Total cost of servicing $= 35 \times 3 \times 1.07 \times 7 = \$786.45$ Total cost for Model S $= 1888.77 + 786.45 + 1300$ $= \$3975.22$ <u>Conclusion</u> Since Model S cost more than Model E ($4229.98 vs $3975.22) over a period of 7 years, Peter should choose Model E.	

END OF PAPER

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