BUKIT VIEW SECONDARY SCHOOL

Secondary Four Express/Five Normal (Academic)
Preliminary Examination 2024

CANDIDATE NAME

CLASS

REGISTER NUMBER

Mathematics **4052/01**

Paper 1

19 August 2024

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class in the spaces provided on top of this cover page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 90.

Marks
/90

Setter: Mrs Irni Prasad Parents' Signature: ____________

This question paper consists of **20** printed pages.

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer all the questions.

1. Evaluate $\dfrac{4.5^3}{\sqrt{23.4}\times 8.17}$, leaving your answer correct to 4 significant figures.

Answer ……..…….. [1]

---

2. Express the ratio $1\dfrac{2}{3}$ kg : 450 g : 300 g in its simplest form.

Answer …… : ..……. : …… [2]

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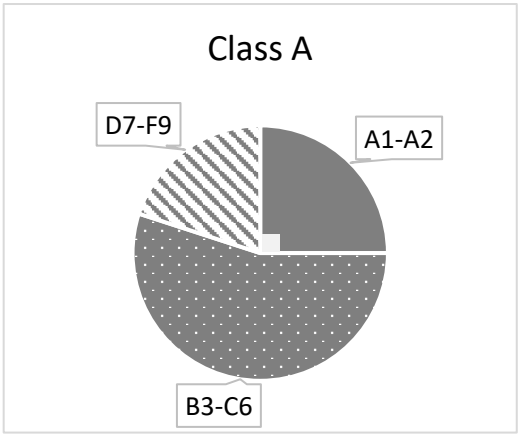
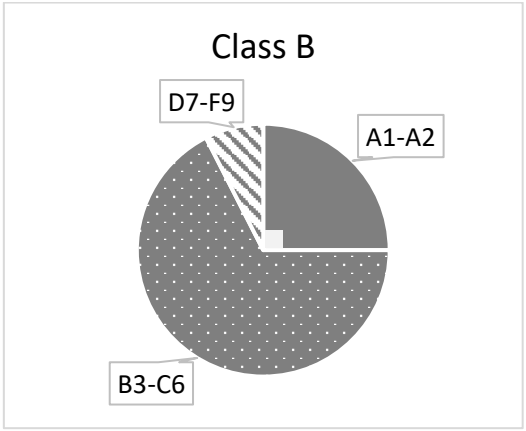
3. The Mathematics grades of students in Class A and Class B are summarised on accurate pie charts shown below.





For each statement, state whether you agree or disagree and explain your reason.

Statement	Agree / Disagree	Reason
(a) More students in Class A failed Mathematics compared to Class B.		
(b) The percentage of students who achieved A1-A2 are the same for both classes.		

[2]

4. A regular polygon has n sides. The size of each interior angle is 5 times the size of each exterior angle.

(a) Calculate the value of each exterior angle.

Answer ……..……..° [1]

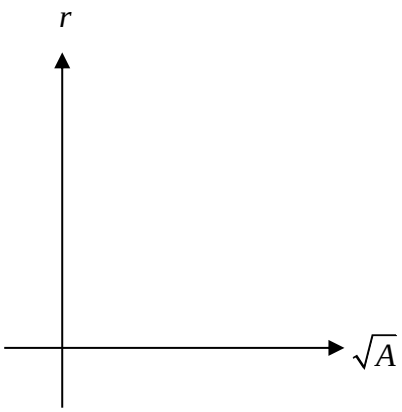
(b) State the value of n.

Answer n = ……..……. [1]

---

5. The radius, r, of an object is directly proportional to the square root of its surface area, A.

(i) Sketch the relationship between r and $\sqrt{A}$ on the space below.



[1]

(ii) The surface area of the object is 1.21 cm^2 when the radius is 0.44 cm.

Find the surface area of the object when the radius is 1.2 cm.

Answer …….…….. cm^2 [2]

---

6. **(a)** Expand and simplify $(4x-1)^2+2$.

Answer ……..…….. [1]

(b) Hence, or otherwise, explain if $(4x-1)^2+2$ is always odd, given that x is an integer.

Answer : ……

……...

……..…… [2]

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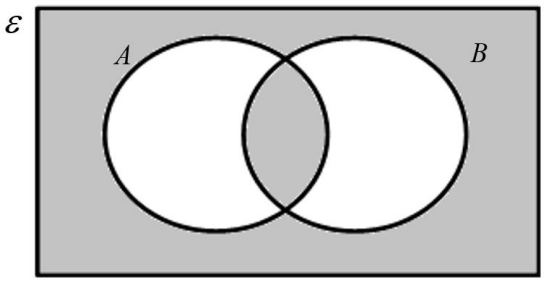
7. **(a)** Write down the set represented by the shaded region.



Answer ……..……. [1]

(b) It is given that $\xi = \{ x : x$ is an integer$\}$, $A = \{x : x \leq 9\}$ and $B = \{2, 4, 6, 8\}$.

State and explain whether the following mathematical statements are **true** or **false**.

(i) $B \subset A$.

This is …….. because …….

……..…….. [1]

(ii) $B \in A$.

This is …….. because …….

……..…….. [1]

8. Express $\frac{2}{d+3e} - \frac{d-15e}{d^2-9e^2}$ as a single fraction in its simplest form.

Answer …….…….. [3]

---

9. A plan of a garden is drawn to a scale 1 : 20.

(a) Calculate the length of the line on the plan, in cm, which represents 13 m long.

Answer …….…….. cm [1]

(b) The actual area of a pond in the garden is p m^2.

Show, with clear working, that the area of the pond represented on the map is $25p$ cm^2.

[2]

---

10. x is 35% of y.
$2x + 45 = y$.

Find the value of x and of y.

Answer x = …… , y = …… [3]

---

11. The difference between simple interest and compound interest for a period of 3 years at 5% per annum is \$366.

Find the principal amount.

Answer \$…….…….. [3]

---

12. The following data shows the masses of 11 parcels in kg.

1.8	2.1	2.4	2.5	2.6	3.2	3.3	3.5	3.8	4.0	4.9

(a) Calculate the mean mass.

Answer ……..…… kg [1]

(b) Find the median mass.

Answer ……..…… kg [1]

(c) Two parcels (the 2.4 kg and the 4.9kg) were removed from the delivery van.
Explain why the median mass remains unchanged.

Answer ……...…….

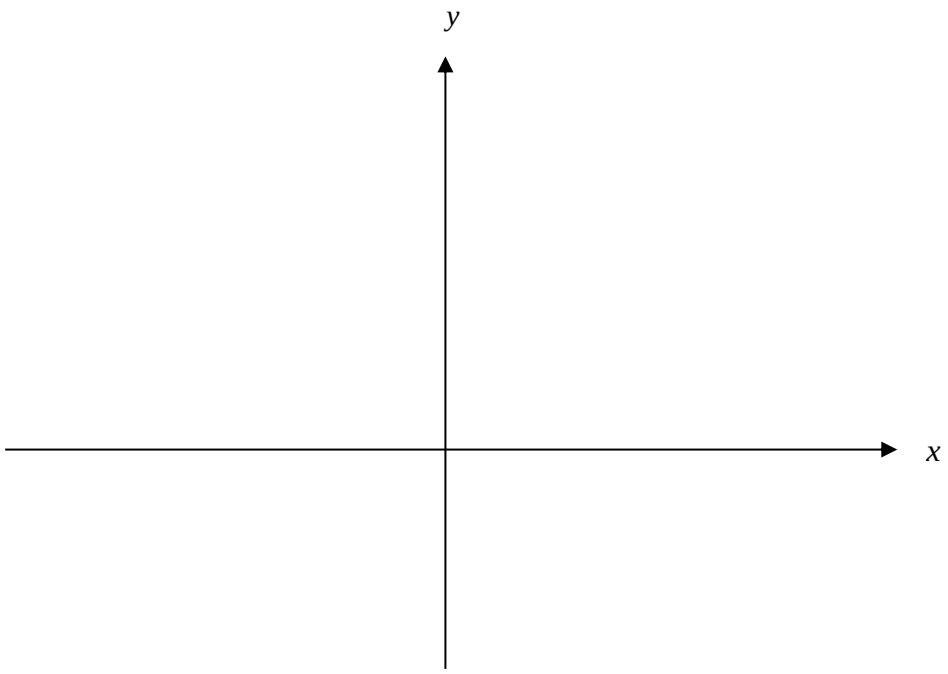
…….

…… [1]

13. (a) By **completing the square**, find the coordinates of the turning point of the curve $y = x^2 + 4x + 7$.

Answer (…… , ……..…) [2]

(b) Hence, sketch the graph of $y = x^2 + 4x + 7$ in the space below, showing your y-intercept and turning point clearly.



[2]

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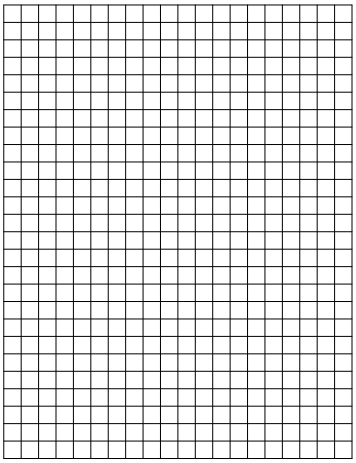
14. On the grid, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

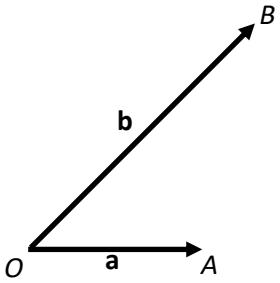
(a) Mark clearly on the grid in the answer space,

(i) the point ***C*** such that $\overrightarrow{OC} = 2\mathbf{b} + \mathbf{a}$

(ii) the point ***D*** such that $\overrightarrow{OD} = \frac{1}{2}\mathbf{b} - 3\mathbf{a}$.

Answer





[2]

(b) Find $\overrightarrow{CD}$ in terms of **a** and **b**.

Answer $\overrightarrow{CD}$ = …….. [2]

---

15. Simplify $\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}}$, leaving your answer in positive index.

Answer ……..…….. [3]

---

16. Danny wants to purchase ingredients from Malaysia.

He needs to pay the Malaysia supplier MYR 2000 for the ingredients.
The transportation fees for the ingredients is MYR 60.
For importing goods into Singapore, a 9% Goods and Services Tax (GST) is payable on the cost of goods and transportation.

The exchange rate between Singapore dollars ($) and Malaysian Ringgit (MYR) is $1 = MYR 3.46.

Calculate the amount of money, in Singapore dollars, that Danny has to pay to import the ingredients.

Answer $…….. [3]

---

17. When written as a product of its prime factors,

$$X = 2^n \times a^b .$$

The cube root of X is 14.

(a) Find the values of n, a, and b.

Answer n = …… , a = ……. , b = ……..… [2]

(b) Find the largest possible number that will divide X and 756 exactly.

Answer …….. [2]

---

18. On a certain day, Barry took the bus to school.
The bus travels at an average speed of 12.5 m/s

(a) Convert 12.5m/s to km/h.

Answer ……..…….. km/h [1]

(b) Jeff and Barry travel the **same distance** to school.
Jeff walked at an average speed of 5 km/h and took 20 minutes longer than Barry.
Find the distance each of them travelled to school.

Answer ……..…….. km [2]

---

19. A straight line meets the curve $y = x^2 - 2x - 3$ at two points A (–3, k) and B (4, 5).

(i) Show that $k = 12$.

Answer :

[1]

(ii) Find the equation of the straight line.

Answer …….…….. [2]

(iii) Find the length of the line segment AB.

Answer ……..…… units [1]

---

20. In a sequence, the same number is subtracted each time to obtain the next term.

The first four terms of the sequence are as follows:

$$54 \quad x \quad y \quad 33$$

(a) Find the value of x and y.

Answer $x =$ ……, $y =$…….. [1]

(b) Write down an expression for the nth term of this sequence.

Answer …….. [1]

(c) Which term in the sequence will give the first negative number?

Answer ……..… term [1]

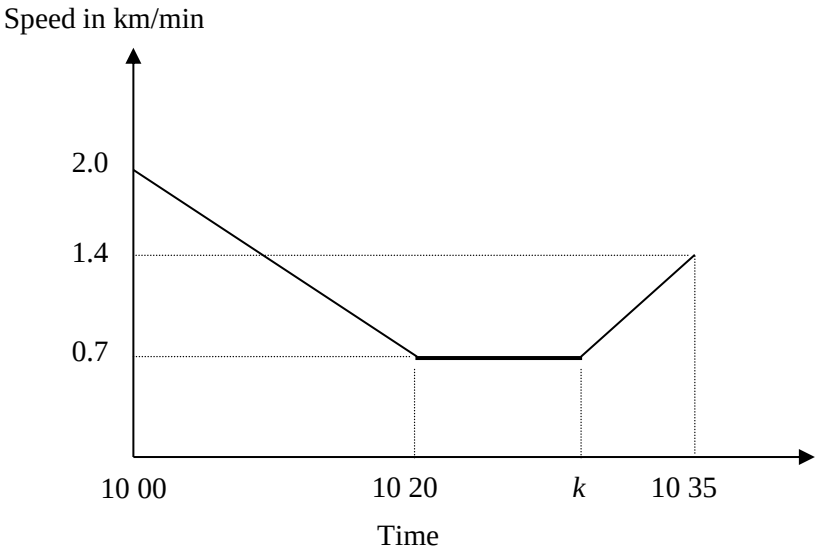
(d) Explain why -260 is **not** a term of this sequence.

Answer ……..…….

…….…….

…… [1]

21. The diagram shows the speed-time graph of a van. The van decelerates uniformly until it reaches 0.7 km/min. It then continues at this constant speed before accelerating its speed uniformly at 0.1 km/min^2.



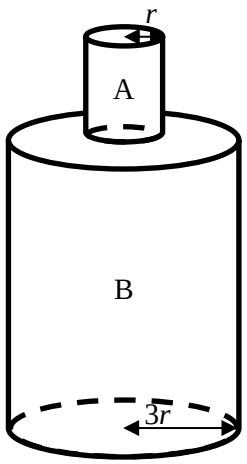
(a) Find the speed of the van at 10 05.

Answer …… km/min [2]

(b) Find time at *k*.

Answer k = ……..…… [2]

22.



The shape of a closed container can be modelled by stacking a smaller cylinder, *A*, on top of a larger cylinder, *B*. Cylinder *A* and Cylinder *B* are geometrically similar.
The radii of Cylinder *A* and Cylinder *B* are *r* cm and 3*r* cm respectively.

(a) It takes 98 seconds to fill the container to the brim.
Calculate the time taken to fill Cylinder *B*.

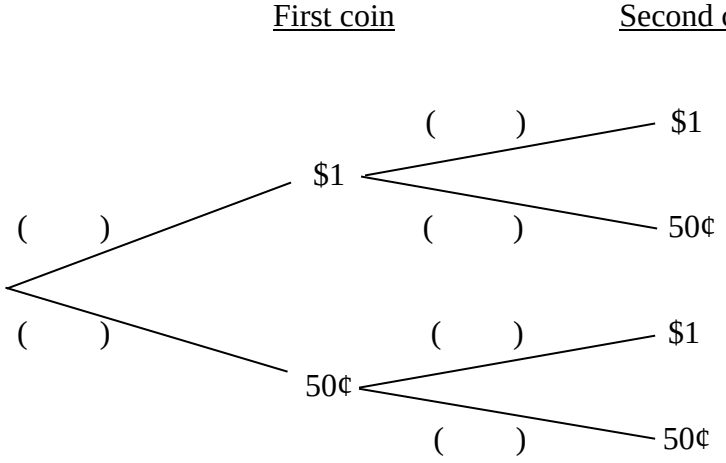
Answer ……..…….…… s [2]

(b) Given that the height of cylinder *A* is *h* cm, find an expression for the total surface area of the container in terms of *r*, *h* and π.

Answer ……..…… cm^2 [3]

23. Mdm Chng has six \$1 coins and eight 50 cents coins in her purse.
She takes the coins out of her purse, at random, one after the other, without replacement.

The probability tree diagram below shows the possible outcomes and their probabilities.



(i) Complete the probability tree diagram.

[2]

(ii) Find the probability that the total value of the two coins taken out is \$1.50.

Answer …… [2]

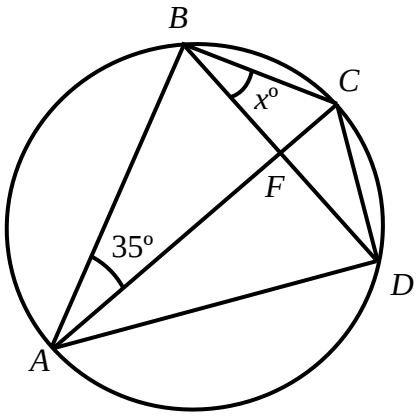
(iii) Mdm Chng took a third coin out.

Find the probability that the total sum of the three coins taken out is \$2.

Answer …… [2]

24. In the diagram, *A, B, C, D,* are points on a circle.

AC and *BD* intersect at *F*. Angle $CBF = x°$ and angle $BAC = 35°$.



(a) Find, in terms of *x*, angle *BCD*. Give reason(s) clearly.

Answer ……..……° [2]

(b) Given that angle *ADB* = 55°, show that *AC* is a diameter of the circle.

Answer :

[2]

25. In **Shop *P***, a tub of ice cream cost \$18.70, a carton of milk cost \$8.60 and a box of chocolates cost \$10.
In **Shop *G***, a tub of ice cream cost \$17.50, a carton of milk cost \$7.40 and a box of chocolates cost \$13.

The items are exactly the same in both shops.

The information above can be represented by the Matrix $\mathbf{A} = \begin{pmatrix} 18.7 & 17.5 \\ 8.6 & 7.4 \\ 10 & 13 \end{pmatrix}$.

(a) Tina would like to buy 5 tubs of ice cream, 3 cartons of milk and 1 box of chocolates. Mike would like to buy 3 tubs of ice cream, 4 cartons of milk and x boxes of chocolates.

Represent this information in a 2×3 matrix **B**.

Answer $\mathbf{B} = \begin{pmatrix} & & \\ & & \end{pmatrix}$ [1]

(b) Find, in terms of x, the matrix $\mathbf{C} = \mathbf{BA}$.

Answer $\mathbf{C} = \begin{pmatrix} & \\ & \\ & \end{pmatrix}$ [2]

(c) State what the elements in matrix **C** represents.

Answer ……

……[1]

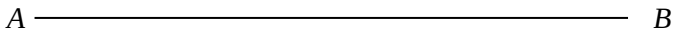
(d) Determine if it is possible for Mike to spend the same amount regardless of which shop he buys the items from. Justify your answer with calculations.

Answer ……

……[2]

26. In the diagram below, the line segment *AB* has been drawn.

(a) Construct a triangle ABC such that $BC = 9$ cm and $AC = 5.5$ cm. [1]



(b) Measure $\angle CAB$.

Answer ……..……° [1]

(c) Construct the perpendicular bisector of *AB*. [1]

(d) Construct the angle bisector of $\angle ABC$. [1]

(e) *S* is a point on *BC* such that *AS* is the shortest distance from *A* to *BC*.
Measure the line segment *AS*.

Answer ……..…… cm [1]

End of Paper

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Mathematics **4052/02**

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

Area of 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

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

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

Answer all the questions.

1. **(a)** Factorise completely $x^2 - 4x - xy + 4y$.

Answer …… [2]

(b) Given that $4^{-\frac{1}{2}} = 8^{\frac{1}{4}} \div 2^{x+1}$, find the exact value of *x*.

Answer x = …… [3]

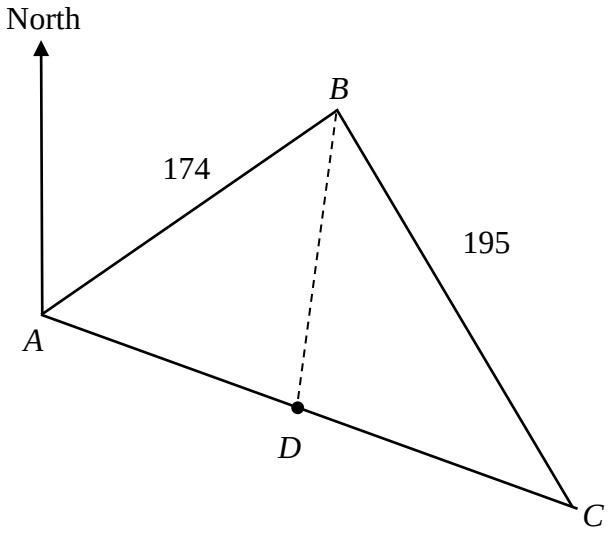
(c) Given that $k = \dfrac{2h+1}{3h-1}$, express *h* in terms of *k*.

Answer h = …… [2]

(d) Solve $\dfrac{2x}{3} < \dfrac{2x+1}{2} \leq \dfrac{3x+7}{4}$.

Answer …… [3]

2. The diagram shows three points, *A*, *B* and *C* on the ground.
AB = 174 m and *BC* = 195 m.
The bearing of *A* from *B* is 238°. The bearing of *C* from *A* is 108°.
A point *D* lies on the path *AC* such that it is equidistant to *A* and to *B*



(a) Show that angle *BAC* = 50°.

Answer :

[3]

(b) Find the angle *BCA*.

Answer ……..° [2]

(c) Find the area of triangle *ABC*.

Answer …… m^2 [3]

(d) Find distance from *C* to *D*.

Answer …… m [4]

---

3. The variables x and y are connected by the equation $y = \frac{x^3}{2} - 4x + 3$.

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

x	−3.5	−3	−2	−1	0	1	2	2 .5	3
y	−4.4	1.5	p	6.5	3	−0.5	−1	0.8	4.5

(a) Find the value of p.

Answer p = ... [1]

(b) On the graph paper found in the next page, draw the graph of $y = \frac{x^3}{2} - 4x + 3$ for $-3.5 \le x \le 3$. [3]

(c) By drawing a tangent, find the gradient of the curve at x = 2.5.

Answer ..... [2]

(d) (i) On the same axes, draw the line $y = -x - 1$ for $-3.5 \le x \le 3$.

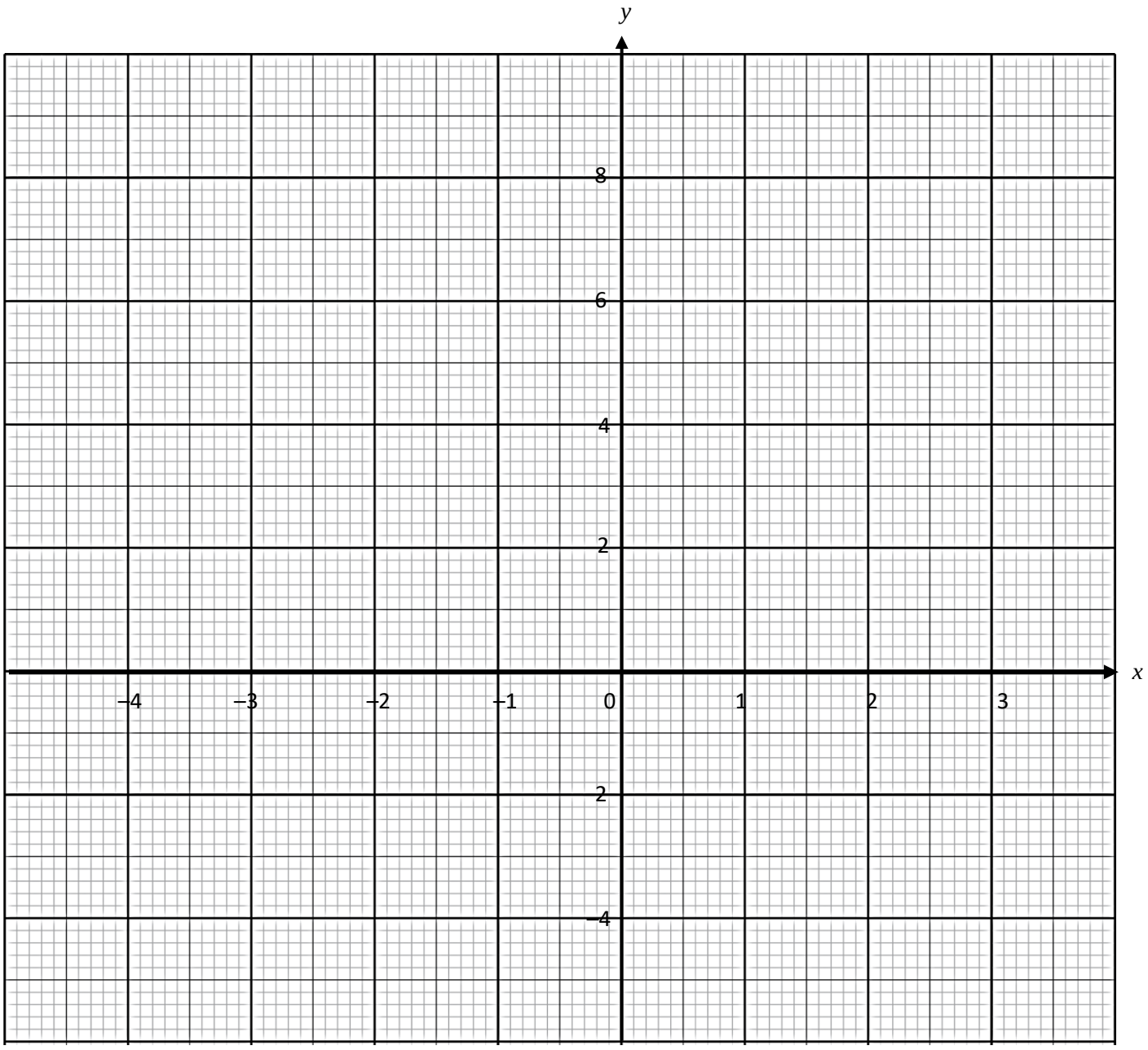
Answer [on graph] [1]

(ii) Write down the x-coordinate of the point where this line intersects the curve.

Answer x = ... [1]

(e) State the minimum value of $y = \frac{x^3}{2} - 4x + 3$ for $0 \le x \le 3$.

Answer ..... [1]



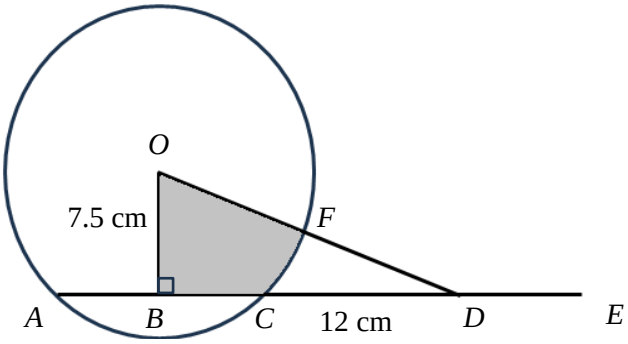
(f) The equation $\frac{x^3}{2} - 4x + 5 = 0$ has only one solution.

Explain how this can be seen from your graph.

Answer :

[2]

4. The diagram shows a circle with centre O.
$ABCDE$ is a straight line. $AC = CD$ and line OD meets the circle at F.
It is given that $OB = 7.5$ cm, $CD = 12$ cm and $\angle OBD = 90°$.



(a) Find the length of OD.

Answer …… cm [1]

(b) Without the use of a calculator, find the value of $\cos \angle ODE$ in its simplest form.

Answer …… [1]

(c) Show that angle COD is approximately 0.501 rad.

Answer :

[3]

(d) Find the perimeter of shaded region.

Answer ……. cm [3]

---

5. A lead technician working with his trainee, can repair a machine in 4.2 hours together. If each of them worked alone, the lead technician would take x hours, while the trainee will need 3.5 hours more.

(a) If each of them worked alone, find in terms of x,

(i) the fraction of work done by the lead technician in one hour,

Answer ..... [1]

(ii) the fraction of work done by the trainee in one hour.

Answer ..... [1]

(b) Form an equation and show that it reduces to $10x^2 - 49x - 147 = 0$.

[3]

(c) Solve $10x^2 - 49x - 147 = 0$.

Answer x = ……. or x = ……. [3]

(d) Hence, find the number of hours needed to repair the machine by **two trainees**.

Answer ……. h [1]

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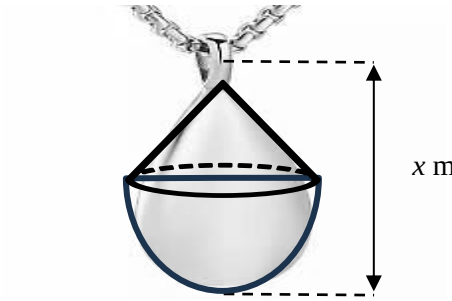
6. A gold pendant is made by joining a hemisphere and a cone.



(a) The radius of the hemisphere is 6 mm.
The volume of the pendant is 0.2π cm^3.

Find x, the height of the pendant in mm.

Answer $x =$……..… [4]

(b) The mass of the pendant is 1.8π grams.

The gold pendant is priced at $101.60 per gram.

(i) Mrs Tan bought it at a discount and paid $528.60.

Calculate the percentage discount given, correct to the nearest whole number.

Answer ……..…..…… % [3]

(ii) A week later, the shop removed the discount offer.
Mr Pang bought the pendant. He also bought a gold chain priced at $810.

He paid a downpayment of $200 and paid the balance with a fixed interest rate of 5.3% per annum for a period of 4 months.

Calculate the amount of each monthly instalment, correct to the nearest 10 cents.

Answer $ ……..…..…… [4]

---

7. A class of 40 Secondary Four students were asked how much time they have spent on social media in the last week.

The results are shown in the table.

Time spent (x hours)	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$
Frequency	p	6	12	q	3

The lower quartile of the time spent on social media was 20 hours.

(i) Show that $p = 4$.

[2]

(ii) Hence state the value of q.

Answer $q =$ …… [1]

(iii) Estimate the mean number of hours spent by the students.

Answer …… [2]

(iv) Estimate the standard deviation.

Answer …… [1]

A class of 40 Secondary Three students were asked how much time (in hours) they have spent on social media in the last week.

The results are summarised in the table.

Mean	15.8
Standard Deviation	10.9

(v) Make two comparisons between the number of hours spent on social media by the Secondary Three students and by the Secondary Four students. Use the data to support your answers.

Answer

……

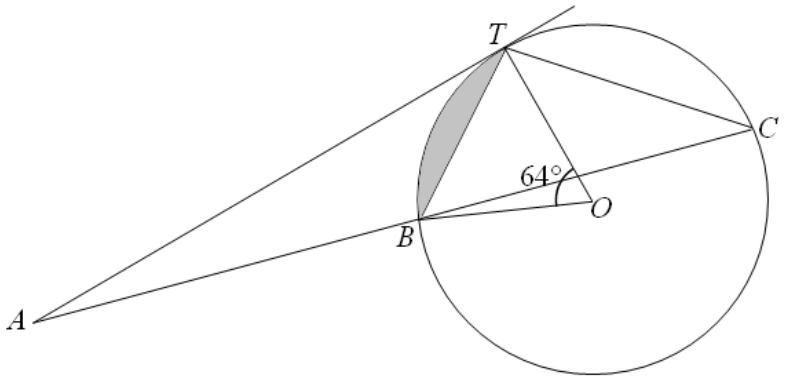
……

……

……

…… [2]

8.



In the diagram, AT is a tangent to the circle, centre O.

A line through A meets the circle at B and C.

It is given that angle $TOB = 64°$.

(a) Find each of the following angles, stating your reason(s) clearly.

(i) $\angle BCT =$ …….. °.

Reason : ……. [1]

(ii) $\angle BTO =$ …….. °.

Reason : ……. [1]

(b) Hence or otherwise, show that triangle ATB and triangle ACT are similar.

Answer :

[3]

(c) Given that $AB = 4.5$ cm and $BC = 3.5$ cm, find the length of AT.

Answer …… cm [2]

(d) Find the value of $\frac{\text{Area } \Delta ABT}{\text{Area } \Delta BCT}$.

Answer …… [1]

(e) Given that the radius of the circle is 1.8 cm, find the area of the shaded segment.

Answer …… cm^2 [3]

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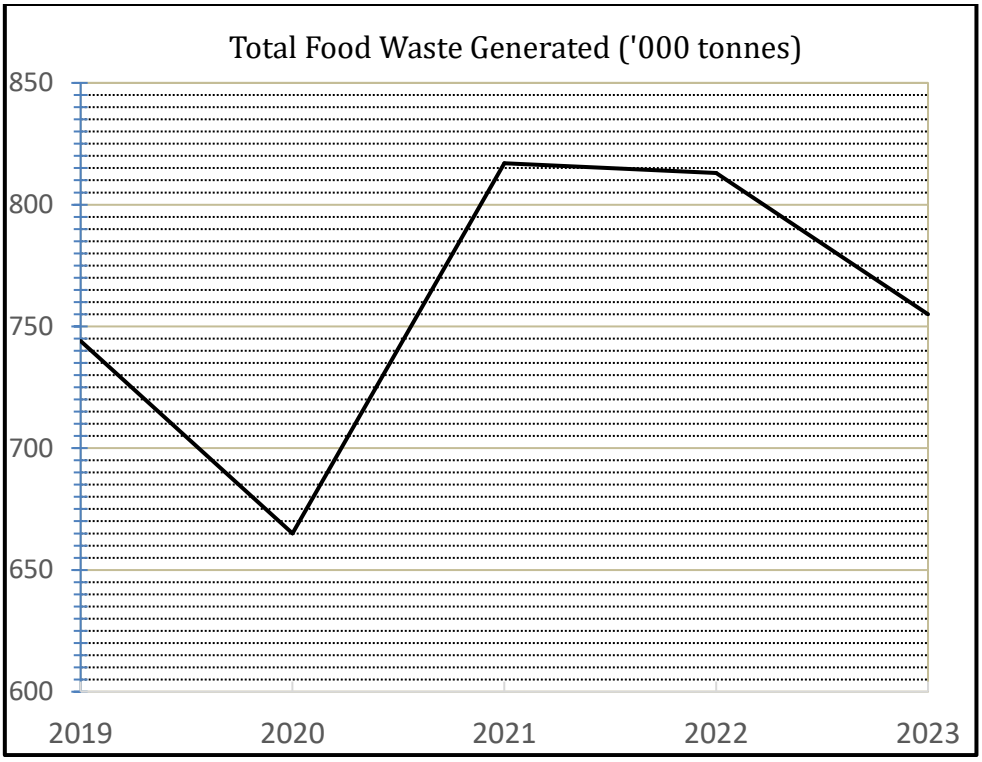
9. To achieve **Singapore's Zero Waste Masterplan goal**, the government aims to reduce food waste by 30% by 2030.

The annual waste and recycling statistics from the National Environment Agency shows the amount of food waste generated (in 1000 tonnes) in Singapore from 2019 to 2023.



[Source: NEA Website on Waste Statistics]

Year	Estimated Singapore Population
2022	5.64 million
2023	5.9 million

The National Environment Agency (NEA) reported that in **2022**, Singapore generated 813 000 tonnes of food waste annually.

[1 Tonne = 1000 kg]

(a) Express 813 000 tonnes in kg, in standard form.

Answer : ……..…… kg [1]

(b) Calculate the average mass, in kg, of food waste **per person**, **per day**, in **2022**.

Answer : …… kg [2]

Mrs Kim's household is made up of **5 persons** altogether.

The table below shows the estimated average mass of food wastage (in kg) for the three meals in her household in 2022.

Breakfast	Lunch	Dinner
0.25	0.9	1.25

(c) Calculate the average mass, in kg, of food waste per person in Mrs Kim's household, per day, in 2022.

Answer : …… kg [1]

According to NEA, **a household of 5 persons** can reduce food waste in these 4 ways.

Ways to reduce food waste	**Estimated food waste reduction**
Composting	4.9 kg per week
Utilising leftovers	175 g per day
Keeping track of expiry dates	0.8 kg per week
Proper storage	2.4 kg per month

In 2023, Mrs Kim encouraged her family to reduce their food waste by implementing the methods listed above. However, Mrs Kim's household does not have a food composting machine.

(d) Determine if Mrs Kim's household managed to reduce their food waste more effectively than the national average mass. Provide your reasoning and calculations clearly.

Working:

Answer : ……..

…… [6]

End of Paper

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S4E/5N EM Prelim 2024 Paper 1 Marking Scheme

Answer all the questions.

1. Evaluate $\dfrac{4.5^3}{\sqrt{23.4}\times 8.17}$, leaving your answer correct to 4 significant figures.

Answer ……**2.306** ----- B1 …… [1]

---

2. Express the ratio $1\frac{2}{3}$ kg : 450 g : 300 g in its simplest form.

$\frac{5000}{3}$ g : 450 g : 300 g ----- M1 (convert first number to g)

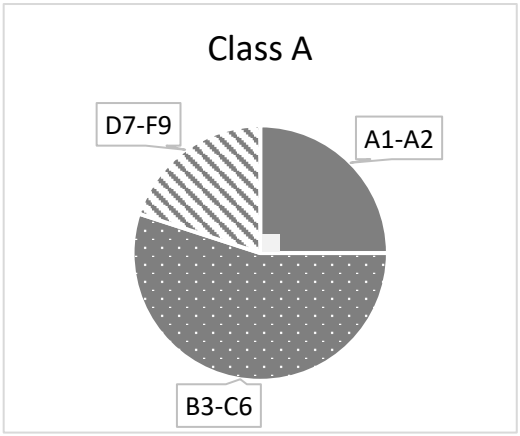
5000 : 1350 : 900

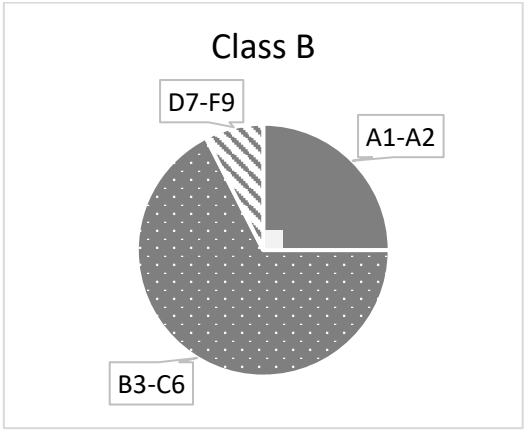
100 : 27 : 18 -------- **A1 (**

Answer …… : …… : …… [2]

---

3. The Mathematics grades of students in Class A and Class B are summarised on accurate pie charts shown below.





For each statement, state whether you agree or disagree and explain your reason.

Statement	Agree / Disagree	Reason
(a) More students in Class A failed Mathematics compared to Class B.	**Disagree**	**We do not know the total number of students in each class.** ----- **B1**
(b) The percentage of students who achieved A1-A2 are the same for both classes.	**Agree**	**The proportion/percentage is $\frac{90}{360}=\frac{1}{4}$ for A1-A2 for both classes.** ----- **B1**

[2]

4. A regular polygon has n sides. The size of each interior angle is 5 times the size of each exterior angle.

(a) Calculate the value of each exterior angle.

$5x + x = 180$
$\boldsymbol{x = 30}$ ------- B1

Answer ……..° [1]

(b) State the value of n.

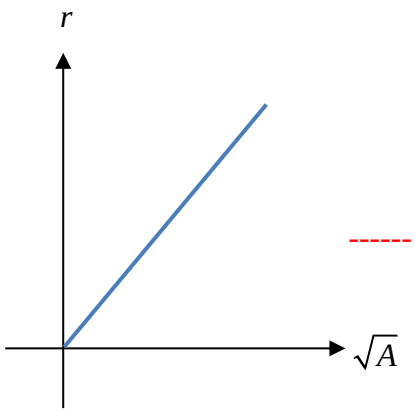
$n = \frac{360}{30} = \mathbf{12}$ ------- B1

Answer n = ……. [1]

---

5. The radius, r, of an object is directly proportional to the square root of its surface area, A.

(i) Sketch the relationship between r and A on the space below.



------ B1

[1]

(ii) The surface area of the object is 1.21 cm^2 when the radius is 0.44 cm.

Find the surface area of the object when the radius is 1.2 cm.

$r = k\sqrt{A}$
$0.44 = k\sqrt{1.21}$ ------- M1
$k = 0.4$

$r = 0.4\sqrt{A}$
$1.2 = 0.4\sqrt{A}$
$3 = \sqrt{A}$
$A = 9\,cm^2$ ------- **A1**

Answer …….. cm^2 [2]

---

6. **(a)** Expand and simplify $(4x-1)^2+2$.

$(4x-1)^2+2 = 16x^2-8x+1+2$

$= 16x^2-8x+3$ --- B1

Answer …….. [1]

(b) Hence, or otherwise, explain if $(4x-1)^2+2$ is always odd, given that x is an integer.

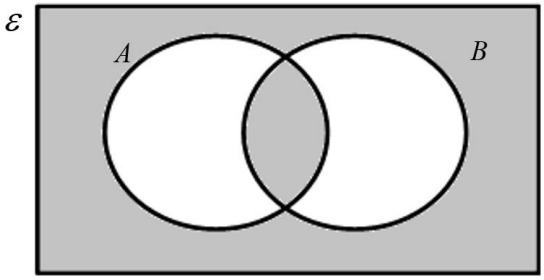
Answer : **16 and 18 are even numbers**. Hence, $16x^2-8x$ will be an even number. ------ B1

Adding an **odd number to an even number gives an odd number**.

Therefore adding 3 to $16x^2-8x$ will always be odd. ------ B1 [2]

---

7. **(a)** Write down the set represented by the shaded region.



Answer $(A\cap B)\cup(A\cup B)'$ --- B1 [1]

(b) It is given that $\xi = \{ x : x \text{ is an integer}\}$, $A = \{x : x \le 9\}$ and B {2, 4, 6, 8}.

State and explain whether the following mathematical statements are **true** or **false**.

(i) $B \subset A$.

This is **True** because **all the elements in B are in A** and B ≠ A --- B1

…….. [1]

(ii) $B \in A$.

This is **False** because B is a set, not an element --- B1

…….. [1]

8. Express $\frac{2}{d+3e}-\frac{d-15e}{d^2-9e^2}$ as a single fraction in its simplest form

$\frac{2}{d+3e}-\frac{d-15e}{d^2-9e^2}$

$= \frac{2}{d+3e}-\frac{d-15e}{(d+3e)(d-3e)}$ ---- M1 (factorise denominator)

$= \frac{2(d-3e)-(d-15e)}{(d+3e)(d-3e)}$ ---- M1 (single fraction or better)

$= \frac{2d-6e-d+15e}{(d+3e)(d-3e)}$

$= \frac{d+9e}{(d+3e)(d-3e)}$ ----- A1 (accept $\frac{d+9e}{d^2-9e^2}$)

Answer …….…….. [3]

---

9. A plan of a garden is drawn to a scale 1 : 20.

(a) Calculate the length of the line on the plan which represents 13 m long.

1 cm : 20 cm
1 cm : 0.2 m
? : 13 m

$\frac{13}{0.2}$ = **65 cm** ------ B1

Answer …….…….. cm [1]

(b) The actual area of a pond in the garden is p m^2.

Show, with clear working, that the area of the pond represented on the map is $25p$ cm^2.

1 cm : 20 cm
1 cm : 0.2 m
1 cm^2 : 0.04 m^2 ------- M1
? : p m^2

$\frac{p}{0.04} = p \div \frac{4}{100}$
$= p \times \frac{100}{4}$
$= 25p$ } A1 (show all steps)

[2]

---

10. x is 35% of y.
$2x + 45 = y$.

Find the value of x and of y.

$x = 0.35y$ – – – – – [1]
$2x + 45 = y$ ---------- [2]

Sub [1] into [2] :

$2(0.35y) + 45 = y$ ------ M1
$0.7\,y + 45 = y$
$0.3\,y = 45$
$\boldsymbol{y = 150}$ ------ A1

And $\boldsymbol{x = 52.5}$ ------ A1

Answer x = …… , y = …… [3]

---

11. The difference between simple interest and compound interest for a period of 3 years at 5% per annum is $366.

Find the principal amount.

Interest (compound int) – Simple interest = 366

$$\left[P\left(1+\frac{5}{100}\right)^3 - P\right] - \frac{P\times 5\times 3}{100} = 366$$ ------ M1 (compound interest application correct)

------ M1 (difference is compound interest – simple interest)

$[1.57625P - P] - 0.15 = 366$
$0.007625P = 366$
$P = \mathbf{48000}$ ------ A1

Answer $……. [3]

---

12. The following data shows the masses of 11 parcels in kg.

1.8	2.1	2.4	2.5	2.6	3.2	3.3	3.5	3.8	4.0	4.9

(a) Calculate the mean mass.

$$\frac{2.6+3.2+2.4+3.3+1.8+4.0+4.9+3.5+3.8+2.5+2.1}{11} = \mathbf{3.1}$$ ----- B1

Answer ……..…… kg [1]

(b) Find the median mass.

Rearrange

1.8 2.1 2.4 2.5 2.6 **3.2** 3.3 3.5 3.8 4.0 4.9 ----- B1

Answer ……..…… kg [1]

(c) Two parcels (the 2.4 kg and the 4.9kg) were removed from the delivery van.

Explain why the median mass remains unchanged.

Answer ……...…….

The 2 weights falls on the left and right of the median value, keeping the median weight unchanged in the middle. ----- B1 [1]

13. (a) By **completing the square**, find the coordinates of the turning point of the curve $y = x^2 + 4x + 7$.

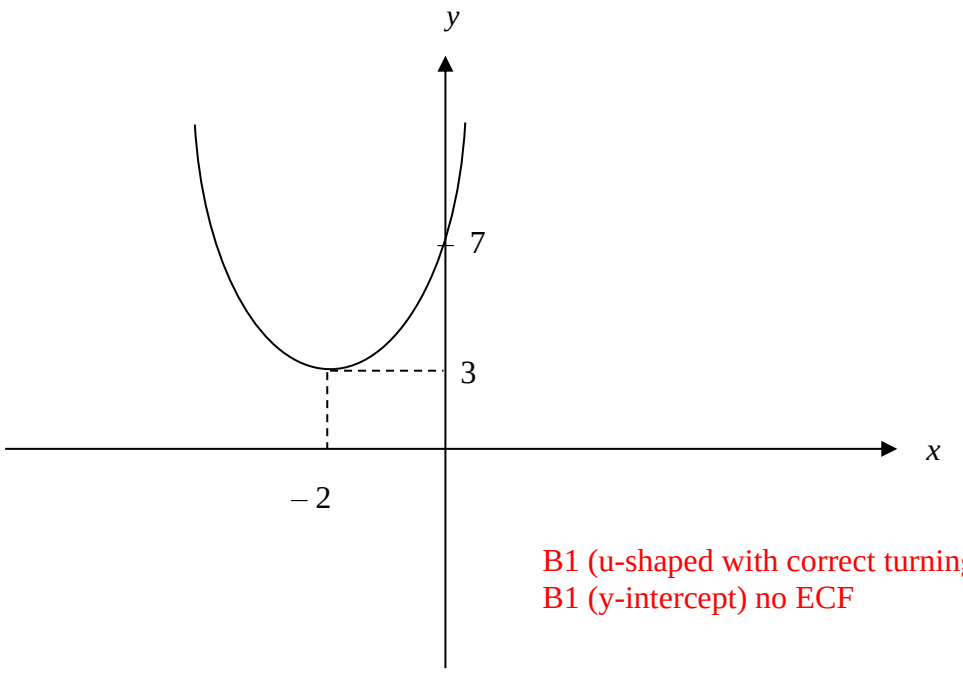
$x^2 + 4x + 7 = (x+2)^2 - 4 + 7$

$= (x+2)^2 + 3$ ----- M1 (this must be evident)

Turning point is **(– 2, 3)** ----- A1

Answer (…… , ……..) [2]

(b) Hence, sketch the graph of $y = x^2 + 4x + 7$ in the space below, showing your y-intercept and turning point clearly.



B1 (u-shaped with correct turning point)
B1 (y-intercept) no ECF

[2]

---

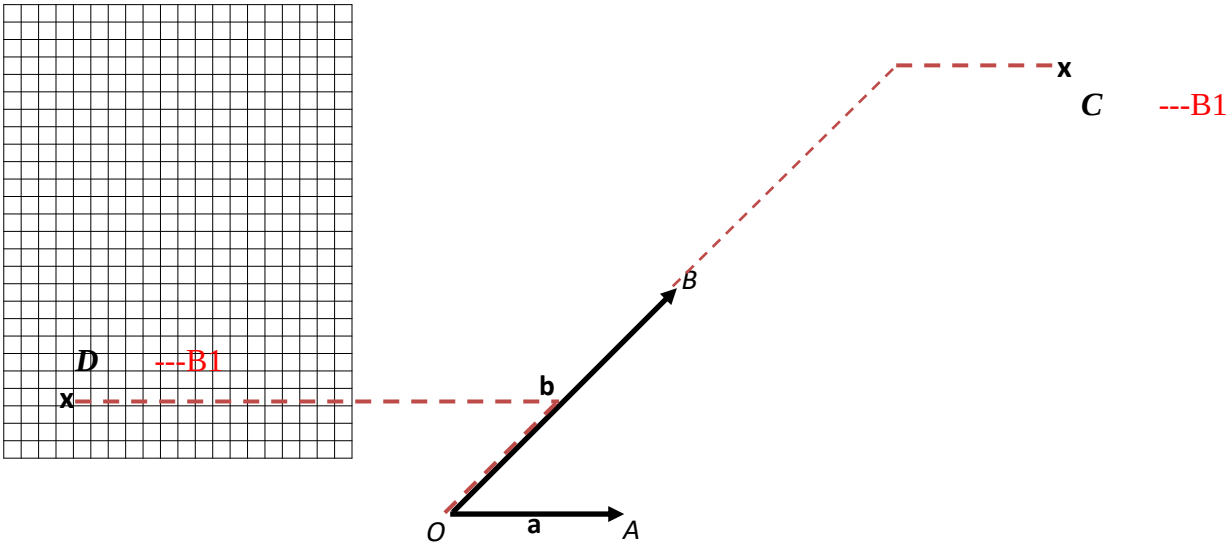
14. On the grid, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Mark clearly on the grid in the answer space,

(i) the point ***C*** such that $\overrightarrow{OC} = 2\mathbf{b} + \mathbf{a}$

(ii) the point ***D*** such that $\overrightarrow{OD} = \frac{1}{2}\mathbf{b} - 3\mathbf{a}$.

Answer



[2]

(b) Find $\overrightarrow{CD}$ in terms of **a** and **b**.

$\overrightarrow{CD} = \overrightarrow{CO} + \overrightarrow{OD}$

$= -2\mathbf{b} - \mathbf{a} + \frac{1}{2}\mathbf{b} - 3\mathbf{a}$ ----- M1

$= -4\mathbf{a} - \frac{3}{2}\mathbf{b}$ ----- A1

Answer $\overrightarrow{CD}$ = …….. [2]

---

15. Simplify $\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}}$, leaving your answer in positive index.

$\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}} = \left(\frac{9p^4}{q^2}\right)^{-\frac{3}{2}}$ ---- M1

$= \left(\frac{q^2}{9p^4}\right)^{\frac{3}{2}}$ ---- M1

$= \frac{q^3}{27p^6}$ ---- A1

(or B1 for each term)

$\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}} = \frac{9^{-\frac{3}{2}}p^{-\frac{9}{2}}q^3}{p^{\frac{3}{2}}}$ ---- M1

$= \frac{1}{27}p^{-6}q^3$ ---- M1

$= \frac{q^3}{27p^6}$ ---- A1

Answer …….…….. [3]

---

16. Danny wants to purchase ingredients from Malaysia.

He needs to pay the Malaysia supplier MYR 2000 for the ingredients.
The transportation fees for the ingredients is MYR 60.
For importing goods into Singapore, a 9% Goods and Services Tax (GST) is payable on the cost of goods and transportation.

The exchange rate between Singapore dollars ($) and Malaysian Ringgit (MYR) is $1 = MYR 3.46.

Calculate the amount of money, in Singapore dollars, that Danny has to pay to import the ingredients.

MYR : $
3.46 : 1
2060 : $\frac{2060}{3.46}$ ---- M1
= 595.3757

With GST = $\frac{109}{100} \times 595.3757$ ---- M1 (*their* value)
= $648.959

= **$648.96** ---- A1

Answer $…….. [3]

---

17. When written as a product of its prime factors,

$$X = 2^n \times a^b .$$

The cube root of X is 14.

(a) Find the values of n, a, and b.

$\sqrt[3]{X} = 14$

$X = 14^3$

$= 2^3 \times 7^3$ $\quad n = \mathbf{3}$ --- B1 , $\quad a = \mathbf{7}$, $b = \mathbf{3}$ ---- B1

Answer $n =$ …… , $a =$ …… , $b =$ …….. [2]

(b) Using the answer in **(a)**, find the largest possible number that will divide X and 756 exactly.

$X = 2^3 \times 7^3$

$756 = 2^2 \times 3^3 \times 7$ ---- M1

HCF $= 2^2 \times 7 = \mathbf{28}$ ------- **A1 / B2**

Answer …….. [2]

---

18. On a certain day, Barry took the bus to school.
The bus travels at an average speed of 12.5 m/s

(a) Convert 12.5m/s to km/h.

$$\frac{12.5m}{1s} = \frac{0.0125km}{\frac{1}{3600}h}$$ $= \mathbf{45}$ km/h ------ B1

Answer ……..…….. km/h [1]

(b) Jeff and Barry travel the **same distance** to school.
Jeff walked at an average speed of 5 km/h and took 20 minutes longer than Barry.
Find the distance each of them travelled to school.

Let d be distance each travel to school.

$\frac{d}{5} = \frac{d}{45} + \frac{20}{60}$ ------ M1 (or equivalent)

$\frac{9d}{45} - \frac{d}{45} = \frac{1}{3}$

$\frac{8d}{45} = \frac{1}{3}$

$24d = 45$

d = **1.875** km ------ A1

Answer ……..…….. km [2]

---

19. A straight line meets the curve $y = x^2 - 2x - 3$ at two points A (–3, k) and B (4, 5).

By finding the value of k,

(i) Show that $k = 12$.

Answer :

Sub A (–3, k) into equation
$k = (-3)^2 - 2(-3) - 3$ ---- B1 (substituting)
$= 12$

(ii) Find the equation of the straight line.

Gradient = $\dfrac{12-5}{-3-4}$ ---- M1
$= -1$

$y = -x + c$
$5 = -4 + c$
$c = 9$

$y = -x + 9$ ------ A1

Answer …….. [2]

(iii) Find the length of the line segment AB.

Length of AB = $\sqrt{(12-5)^2 + (-3-4)^2}$
$= \sqrt{98}$
$= 9.89949$

$=$ **9.90 units** (3 s.f) ------ B1 (or more accurate approximation)

Answer …… units [1]

---

20. In a sequence, the same number is subtracted each time to obtain the next term.
The first four terms of the sequence are as follows:

54 x y 33

(a) Find the value of x and y.

$\frac{54-33}{3}=7$
x = **47** , y = **40** ---- B1 (both correct)

Answer x = ……, y =…….. [1]

(b) Write down an expression for the nth term of this sequence.

61 – 7*n* ---- B1

Answer …….. [1]

(c) Which term in the sequence will give the first negative number?

$61-7n<0$
$7n>61$
$n>8\frac{5}{7}$

9th term ---- B1 (accept 9 or ninth)

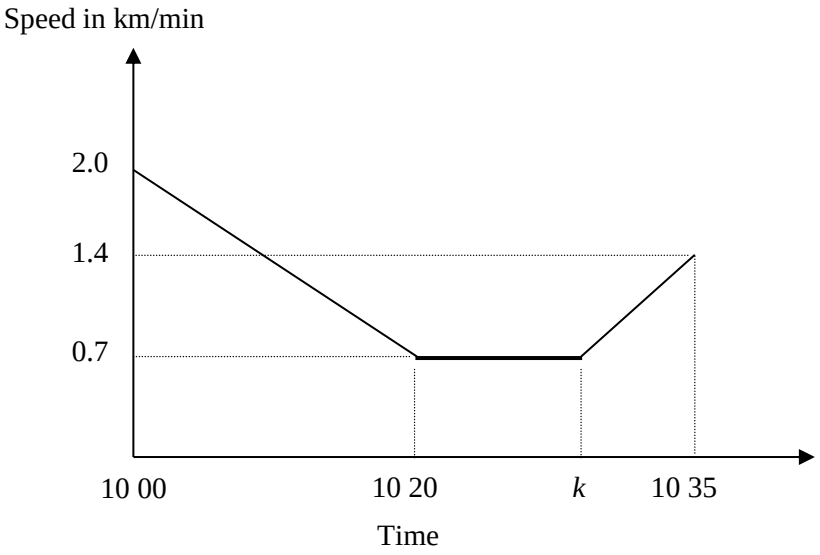
Answer ……..… term [1]

(d) Explain why -260 is **not** a term of this sequence.

$61-7n=-260$
$7n=321$
$n=45\frac{6}{7}$

Answer ……
Since n is not a positive integer/ whole number,
– 260 is no a term in this sequence. ----- B1 (with working)
……
…… [1]

21. The diagram shows the speed-time graph of a van. The van decelerates uniformly until it reaches 0.7 km/min. It then continues at this constant speed for k minutes before accelerating its speed uniformly at 0.1 km/min^2.



(a) Find the speed of the van at 10 05.

$acceleration = \frac{2-0.7}{20} = 0.065$ km/m^2 ----- M1

Speed at 1005 = 2 – (5× 0.065)

= **1.675** km/min ----- A1 (accept $1\frac{27}{40}$)

Answer …… km/min [2]

(b) Find the value of k.

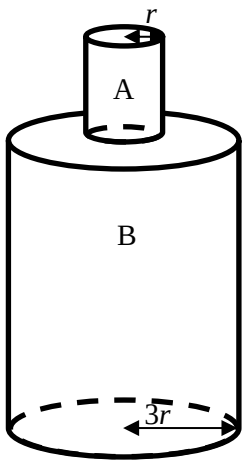
$\frac{1.4-0.7}{T} = 0.1$ ----- M1

T = 7 min

k = 1035 h – 7 min = 1028 h ----- A1

Answer k = ……..…… [2]

22.



The shape of a closed container can be modelled by stacking a smaller cylinder, *A*, on top of a larger cylinder, *B*. Cylinder *A* and Cylinder *B* are geometrically similar.
The radii of Cylinder *A* and Cylinder *B* are *r* cm and 3*r* cm respectively.

(a) It takes 98 seconds to fill the container to the brim.
Calculate the time taken to fill Cylinder *B*.

$\frac{r_A}{r_B} = \frac{1}{3}$

$\frac{V_A}{V_B} = \left(\frac{1}{3}\right)^3 = \frac{1}{27}$ ----- M1

Time taken to fill Cylinder $B = \frac{98}{28} \times 27$

= 94.5 sec ----- A1

Answer ……..…… s [2]

(b) Given that the height of cylinder *A* is *h* cm, find an expression for the total surface area of the container in terms of *r*, *h* and π.

2 circles + curved surface A + curved surface B

$= 2\pi(3r)^2 + 2\pi rh + 2\pi(3r)(3h)$ ------ M2 (M1 for any 2 correct)

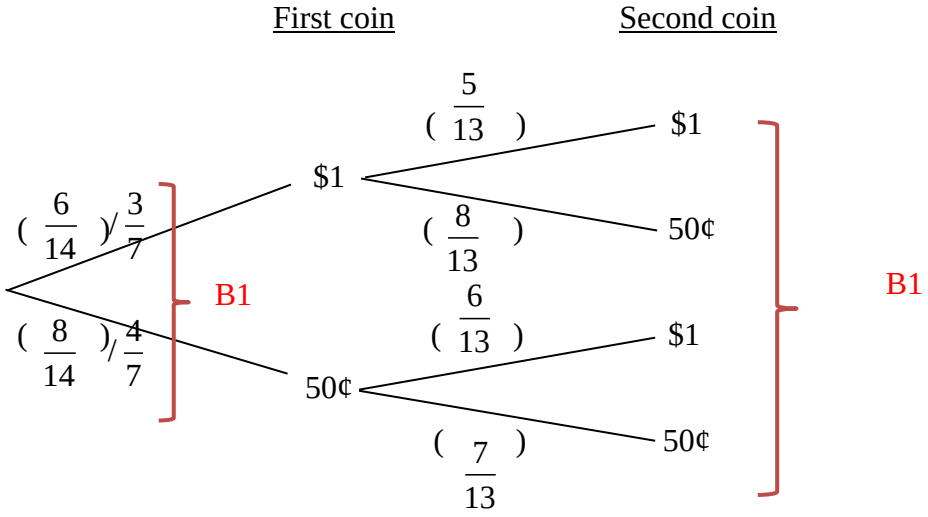
$= 18\pi r^2 + 2\pi rh + 18\pi rh$

$= 18\pi r^2 + 20\pi rh$ ------ A1

Answer ……..…… cm^2 [3]

23. Mdm Chng has six $1 coins and eight 50 cents coins in her purse.
She takes the coins out of her purse, at random, one after the other, without replacement.

The probability tree diagram below shows the possible outcomes and their probabilities.



(i) Complete the probability tree diagram.

[2]

(ii) Find the probability that the total value of the two coins taken out is $1.50

P ($1and 50 cents or 50 cents and $1)

$= \left(\frac{6}{14}\times\frac{8}{13}\right)+\left(\frac{8}{14}\times\frac{6}{13}\right)$ ------ M1

$= \frac{48}{91}$ ------ A1

Answer …… [2]

(iii) Mdm Chng took a third coin out.

Find the probability that the total sum of the three coins taken out is $2.

P ($1and 50 cents and 50 cents or 50 cents and $1 and 50 cents or 50 cents and 5- cents and $1)

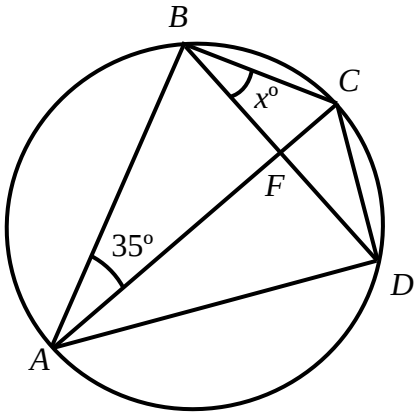
$= \left(\frac{6}{14}\times\frac{8}{13}\times\frac{7}{12}\right)\times 3$ ------ M1

$= \frac{6}{13}$ ------ A1

Answer …… [2]

24. In the diagram, *A*, *B*, *C*, *D*, are points on a circle.

AC and *BD* intersect at *F*. Angle $CBF = x°$ and angle $BAC = 35°$.



(a) Find, in terms of *x*, angle *BCD*. Give reason(s) clearly.

Angle *CAD* = *x* (angles in same segment) ------- M1 (with reason)

Angle *BCD* = 180 – (35 + *x*) (angles in opp segment)

= **145 – *x*** ------ A1 (with reason above)

Answer ……..……° [2]

(b) Given that angle *ADB* = 55°, show that *AC* is a diameter of the circle.

Answer :

Angle *BCA* = Angle *ADB* (angles in same segment)
= 55°
Angle *ACD* = 145 – *x* – 55
= 90° – *x*

Angle *ADC* = 180 – *x* – (90 – *x*) --- M1 (accept without reason)
= 90°

Since Angle *ADC* = 90°, *AC* is a diameter of the circle (**rt angle in a semicircle**) --- A1

[2]

25. In **Shop *P***, a tub of ice cream cost \$18.70, a carton of milk cost \$8.60 and a box of chocolates cost \$10.
In **Shop *G***, a tub of ice cream cost \$17.50, a carton of milk cost \$7.40 and a box of chocolates cost \$13.

The items are exactly the same in both shops.

The information above can be represented by the Matrix **A** = $\begin{pmatrix} 18.7 & 17.5 \\ 8.6 & 7.4 \\ 10 & 13 \end{pmatrix}$.

(a) Tina buys 5 tubs of ice cream, 3 cartons of milk and 1 box of chocolates.
Mike buys 3 tubs of ice cream, 4 cartons of milk and x boxes of chocolates.

Represent this information in a 2 × 3 matrix **B**.

Answer **B** = $\begin{pmatrix} 5 & 3 & 1 \\ 3 & 4 & x \end{pmatrix}$ ---- B1[1]

(b) Find, in terms of x, the matrix **C** = **BA**.

$\begin{pmatrix} 5 & 3 & 1 \\ 3 & 4 & x \end{pmatrix}\begin{pmatrix} 18.7 & 17.5 \\ 8.6 & 7.4 \\ 10 & 13 \end{pmatrix} = \begin{pmatrix} 129.3 & 122.7 \\ 90.5+10x & 82.1+13x \end{pmatrix}$ ----- B2/1/0

Answer **C** = $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(c) State what the elements in matrix **C** represents.

Answer The total amount Tina and Mike has to pay for items from Shop P and Shop G respectively. **---- B1**

……[1]

(d) Determine if it is possible for Mike to spend the same amount regardless of which shop he buys the items from. Justify your answer with calculations.

$90.5+10x = 82.1+13x$ ------ M1 (their expressions from (b)

$8.4 = 3x$

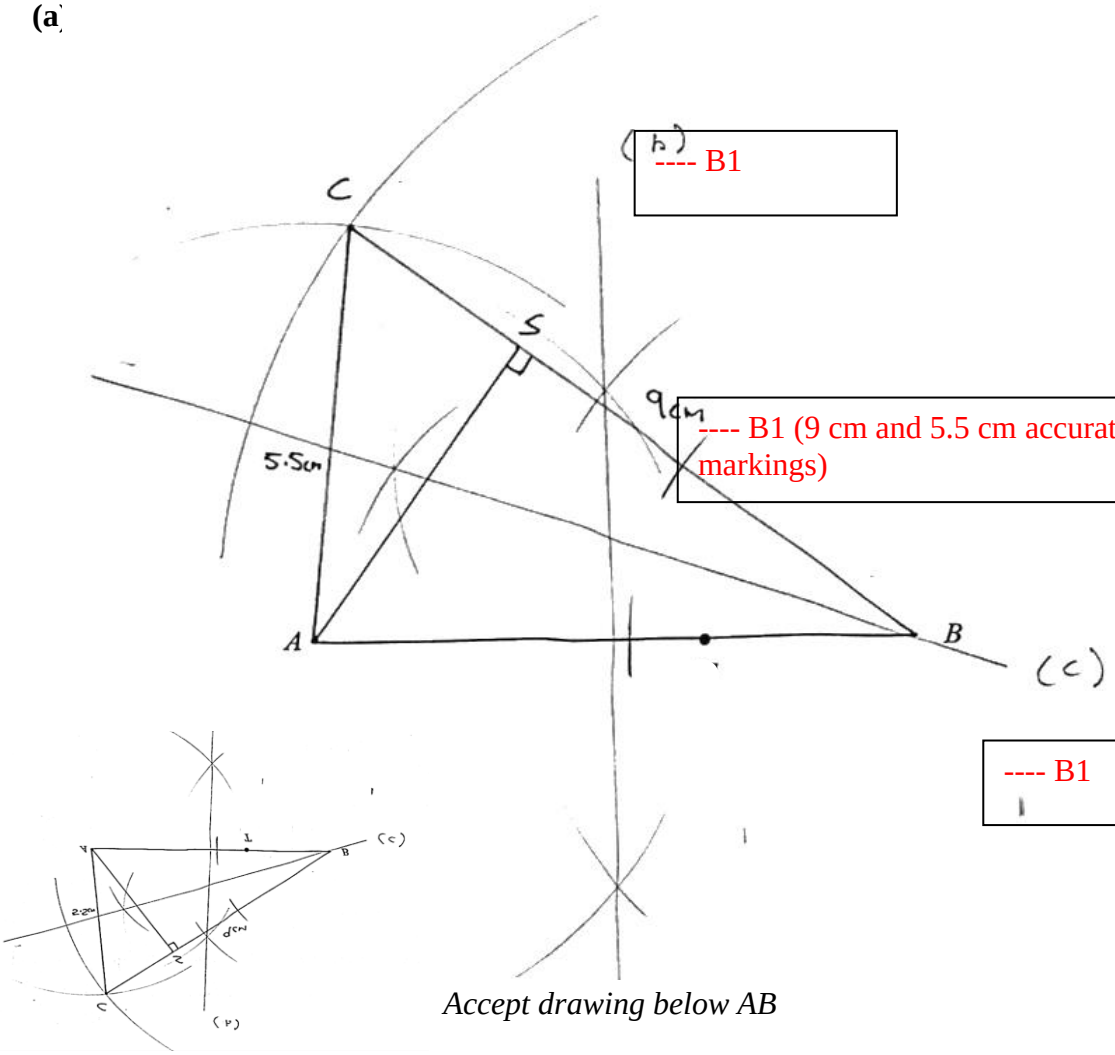
$x =$ **2.8**

Since x is not a whole number, it is not possible. ------ A1

Answer x = …… [2]

26. In the diagram below, the line *AB* has been drawn. T is a point on the line *AB*.

(a)]



---- B1

---- B1 (9 cm and 5.5 cm accurate with markings)

---- B1

Accept drawing below AB

(b) Measure $\angle CAB$.

Answer ..... **83** ---- B1 (+/- 1)° [1]

(c) Construct the perpendicular bisector of *AB*. [1]

(d) Construct the angle bisector of $\angle ABC$. [1]

(e) *S* is a point on *BC* such that *AS* is the shortest distance from *A* to *BC*.
Measure the line segment *AS*.

Answer **4.7 cm** ---- B1 (+/- 0.1) ..... cm [1]

End of Paper

S4E/5N EM Prelim 2024 Paper 2 Marking Scheme

Answer all the questions.

1. **(a)** Factorise completely $x^2-4x-xy+4y$.

$x^2-4x-xy+4y$
$= x(x-4)-y(x-4)$ ------ M1 (1st level)
$= (x-y)(x-4)$ ------ A1

Answer …… [2]

(b) Given that $4^{-\frac{1}{2}}=8^{\frac{1}{4}}\div 2^{x+1}$, find the exact value of x.

$4^{-\frac{1}{2}}=8^{\frac{1}{4}}\div 2^{x+1}$
$2^{2(-\frac{1}{2})}=2^{3(\frac{1}{4})}\div 2^{x+1}$ ------ M1 (base 2 for at least one term)
$2^{-1}=2^{\frac{3}{4}-(x+1)}$
$\therefore -1=\frac{3}{4}-x-1$ ------ M1 (compare power, no ECF)
$x=\frac{3}{4}$ ------ A1

Answer x = …… [3]

(c) Given that $k=\frac{2h+1}{3h-1}$, express h in terms of k.

$k=\frac{2h+1}{3h-1}$
$k(3h-1)=2h+1$
$3kh-k=2h+1$ ------ M1 (linear and expand correctly)
$3kh-2h=k+1$
$h(3k-2)=k+1$
$h=\frac{k+1}{3k-2}$ ------ A1 accept $h=\frac{-k-1}{-3k+2}$

Answer h = …… [2]

(d) Solve $\frac{2x}{3}<\frac{2x+1}{2}\le\frac{3x+7}{4}$.

$\frac{2x}{3}<\frac{2x+1}{2}$ and $\frac{2x+1}{2}\le\frac{3x+7}{4}$

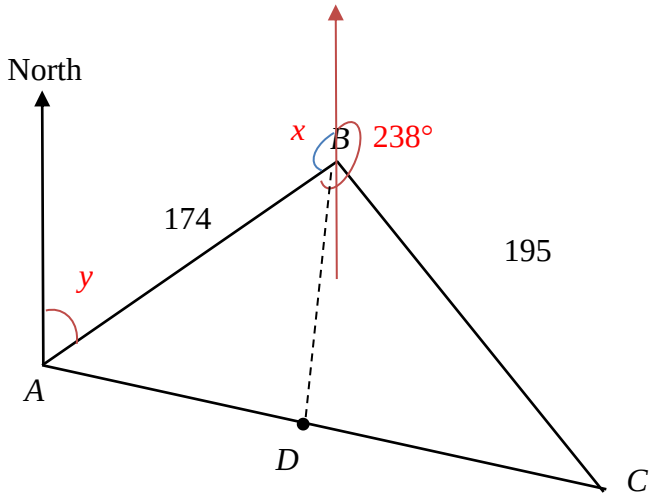
$4x<6x+3$ ------- M1 (linear)
$-2x<3$
$x>-\frac{3}{2}$

$8x+4\le 6x+14$ ------- M1 (linear)
$2x\le 10$
$x\le 5$

$\therefore\ -\frac{3}{2}<x\le 5$ ------- A1

Answer …… [3]

2. The diagram shows three points, *A*, *B* and *C* on the ground.
AB = 174 m and *BC* = 195 m.
The bearing of *A* from *B* is 238°.The bearing of *C* from *A* is 108°.
A point *D* lies on the path *AC* such that it is equidistant to *A* and to *B*



(a) Show that angle *BAC* = 50°.

$\angle x = 360 - 238$ (angles at a point) ---------- M1 (with reason)
= 122°

$\angle y$ = 180 – 122 (int angles) ---------- M1 (with reason)
= 58°

$\angle BAC = 108 - 58$ ---------- A1 (shown)
= 50°

(MUST **label** angles clearly to be awarded full marks)

[3]

(b) Find the angle *BCA*.

$\frac{\sin BCA}{174} = \frac{\sin 50}{195}$ ---------- M1

$\angle BCA = \sin^{-1}(0.683547)$
= 43.12147
= **43.1°** ---------- A1

Answer ……..° [2]

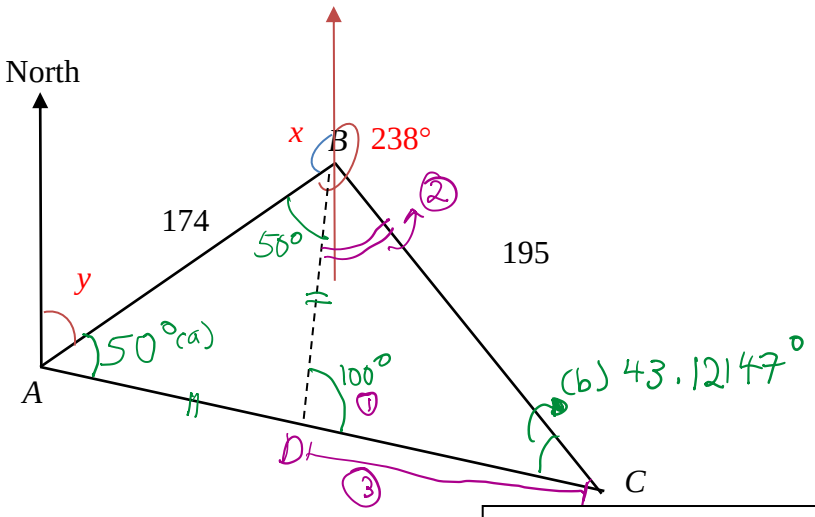
(c) Find the area of triangle *ABC*.

$\angle ABC = 180 - 43.12147 - 50$ ---------- M1
$= 86.87853°$

Area of triangle $= \frac{1}{2} \times 174 \times 195 \times \sin 86.87853$ ---------- M1 (using 'their' $\angle ABC$)
$= 16939.82$
$=$ **16900 m²** ---------- A1 (or any accurate higher approximation)

Answer …… m² [3]

(d) Find distance from *C* to *D*.



Since *AD* = *BD*, *ABD* is isosceles triangle.

$\angle BDC = 50 + 50$ (ext $\angle$ of Δ) ---------- M1
$= 100°$

$\angle DBC = 180 - 100 - 43.12147$ ---------- M1
$=$ **36.87853°**

Using sine rule
$\frac{CD}{\sin 36.87853} = \frac{195}{\sin 100°}$ ---------- M1 (using their $\angle D$
$CD = 118.8287782$
$=$ **119 m** (3 sf) ---------- A1 (accept more accurate approximations)

or 180 – 50 – 50 – 43.12147 = 36.87853
gets 2 marks

Alternative

Using cosine rule AC= -- M2

AD = M1

CD = AC – AD ---- A1

Answer …… m [4]

---

3. The variables x and y are connected by the equation $y = \frac{x^3}{2} - 4x + 3$.

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

x	–3.5	–3	–2	–1	0	1	2	2.5	3
y	–4.4	1.5	p	6.5	3	–0.5	–1	0.8	4.5

(a) Find the value of p.

$p = 7$ ------- B1

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

(b) On the graph paper found in the next page, draw the graph of $y = \frac{x^3}{2} - 4x + 3$ for $-3.5 \le x \le 3$. [3]

Points – 2 M smooth curve 1 M

(c) By drawing a tangent, find the gradient of the curve at $x = 2.5$.

Tangent line --- M1

Gradient = 5.4 ------- A1 (accept 4.9 to 5.8)

Answer ..... [2]

(d) (i) On the same axes, draw the line $y = -x - 1$ for $-3.5 \le x \le 3$.

Answer [on graph] [1]

(ii) Write down the x-coordinate of the point where this line intersects the curve.

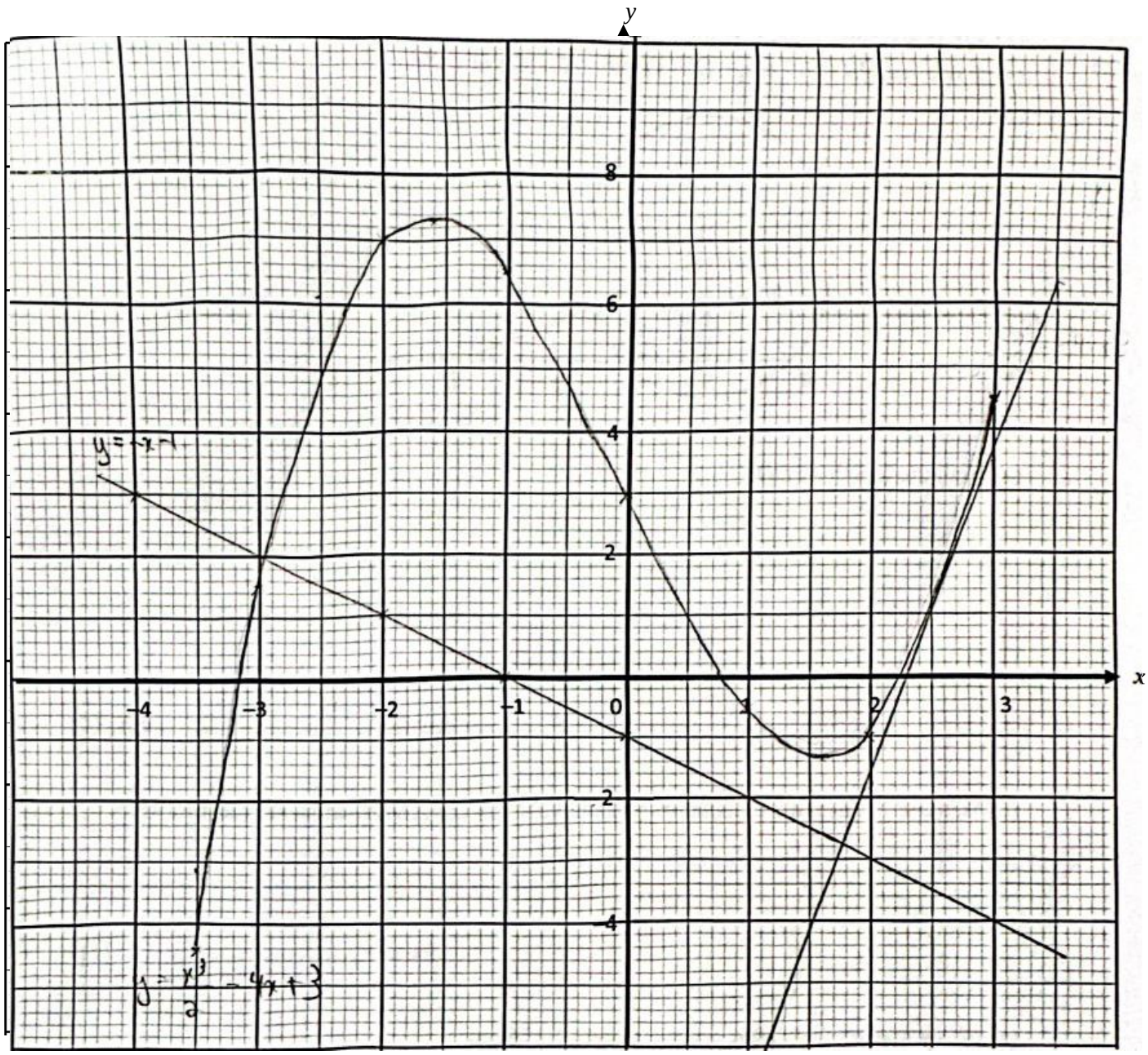
–2.9 ------- B1 (accept –2.95 to –2.8)

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

(e) State the minimum value of $y = \frac{x^3}{2} - 4x + 3$ for $0 \le x \le 3$.

–1.35 ------- B1 (accept –1.5 to –1.2)

Answer ..... [1]



(f) The equation $\frac{x^3}{2} - 4x + 5 = 0$ has only one solution.

Explain how this can be seen from your graph.

Answer :

$\frac{x^3}{2} - 4x + 5 = 0$

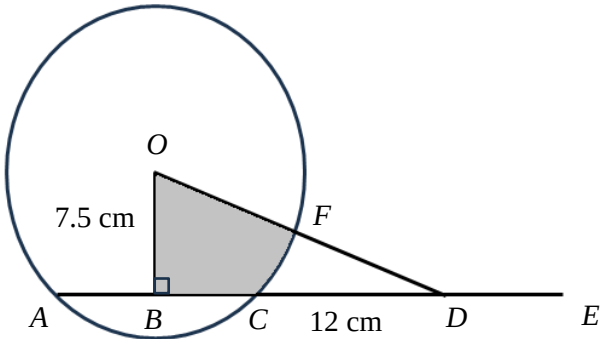
$\frac{x^3}{2} - 4x + 5 - 2 = 0 - 2$

$\frac{x^3}{2} - 4x + 3 = -2$ ------ M1

By **drawing the line $y = -2$, there is one point of intersection**. ------ A1 (no need to draw, but must mention y = -2)

[2]

4. The diagram shows a circle with centre O.
$ABCDE$ is a straight line. $AC = CD$ and line OD meets the circle at F.
It is given that $OB = 7.5$ cm, $CD = 12$ cm and $\angle OBD = 90°$.



(a) Find the length of OD.

$OD^2 = 7.5^2 + 18^2$
OD = 19.5 cm ---------- B1

Answer …… cm [1]

(b) Without the use of a calculator, find the value of $\cos \angle ODE$ in its simplest form.

$\cos \angle ODE = -\frac{18}{19.5} = -\frac{12}{13}$ ---------- B1

Answer …… [1]

(c) Show that angle COD is approximately 0.501 rad.

Answer :

$\tan \angle BOD = \frac{18}{7.5}$ ---------- M1
= 1.176005
= 1.176 rad
$\tan \angle BOC = \frac{6}{7.5}$ ---------- M1
= 0.67474 rad

$\angle COD = 1.176005 - 0.67474$
= 0.501264
= 0.501 rad ---------- A1

[3]

(d) Find the perimeter of shaded region.

Radius OC = $\sqrt{7.5^2 + 6^2}$ = 9.60468 cm ---------- M1

Length arc *CE* = 9.60468 × 0.501264 ---------- M1 (using '*their*' radius)
= 4.81448 cm

Perimeter = 7.5 + 6 + 9.60458 + 4.81448
= 27.919
= 27.9 cm ---------- A1

Answer ..... cm [3]

---

5. A lead technician working with his trainee, can repair a machine together.
If each of them worked alone, the lead technician would take x hours, while the trainee will need 3.5 hours more.

(a) Find in terms of x,

(i) the fraction of work done by the lead technician in one hour,

$\frac{1}{x}$ ------- B1

Answer ..... [1]

(ii) the fraction of work done by the trainee in one hour.

$\frac{1}{x+3.5}$ ------- B1

Answer ..... [1]

(b) In one hour, both the lead technician and his trainee will complete $\frac{5}{21}$ of the repairs for the machine.
Form an equation and show that it reduces to $10x^2 - 49x - 147 = 0$.

$\frac{1}{x} + \frac{1}{x+3.5} = \frac{5}{21}$ ------- M1 accept $\frac{1}{x} + \frac{1}{x+3.5} = \frac{1}{4.2}$

Or $\frac{42}{x} + \frac{42}{x+3.5} = 1$

$\frac{x+3.5+x}{x^2+3.5x} = \frac{5}{21}$ ------- M1 (single fraction from their first equ of same difficulty level)

$42x + 73.5 = 5x^2 + 17.5x$

$0 = 5x^2 - 24.5x - 73.5$ ------- A1

$10x^2 - 49x - 147 = 0$

[3]

(c) Solve $10x^2 - 49x - 147 = 0$.

$(10x + 21)(x - 7) = 0$ ------- M1 (must write '=0')

$x = -2.1$ or $x = 7$ ---------- A2

or

$x = \dfrac{-(-49) \pm \sqrt{(-49)^2 - 4(10)(-147)}}{2(10)}$ ---- M1 (must write 'x=')

$x = \dfrac{49 \pm \sqrt{8281}}{20}$

$x = -2.1$ or $x = 7$ ---------- A2

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

(d) Hence, find the number of hours needed to repair the machine by **two trainees**.

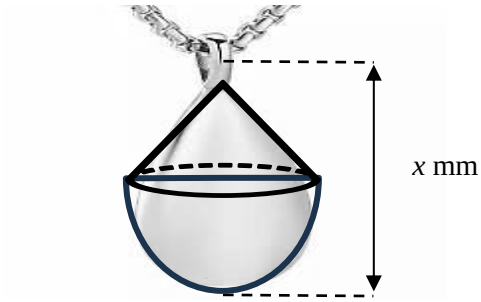
One trainee need $7 + 3.5$ = 10.5 hours

Two trainees will need **5.25** hours ------- B1

Answer ..... h [1]

---

6. A gold pendant is made by joining a hemisphere and a cone.



(a) The radius of the hemisphere is 6 mm.
The volume of the pendant is 0.2π cm^3.

Find x, the height of the pendant in mm.

$\frac{2}{3}\pi(0.6^3)+\frac{1}{3}\pi(0.6^2)\left(\frac{x}{10}-0.6\right)=0.2\pi$ ------ M1 conversion to '0.6 cm'

------ M1 (cone application **and/or** hemisphere)

$0.144\pi+0.12\pi\left(\frac{x}{10}-0.6\right)=0.2\pi$

$0.12\pi\left(\frac{x}{10}-0.6\right)=0.056\pi$ -------- M1 (accept $0.37699\left(\frac{x}{10}-0.6\right)=0.175929$) or better

$\frac{x}{10}-0.6=\frac{7}{15}$ or M1 $h=\frac{7}{15}$

$x=10\frac{2}{3}$ mm ------ A1 (accept 10.7/ 10.67)

Answer x =……..…. [4]

(b) The mass of the pendant is 1.8π grams.

The gold pendant is priced at $101.60 per gram.

(i) Mrs Tan bought is at a discount and paid $528.60.

Calculate the percentage discount given, correct to the nearest whole number.

Price of gold pendant = $101.60 × 1.8π
= $574.53 ------ M1

% discount = $\frac{574.53-528.60}{574.53}\times 100$ ------ M1
= 7.995
= **8%** (nearest whole number) ------ A1

Answer …… % [3]

(ii) A week later, the shop removed the discount offer.
Mr Pang bought the pendant along with the gold chain priced at $810.
He paid a downpayment of $200 and paid the balance with a fixed interest rate of 5.3% per annum for a period of 4 months.

Calculate the amount of each monthly instalment, correct to the nearest 10 cents.

Total = $574.53 + 810 = $1384.5344

Balance = $1384.5344 – 200
= $1184.5344 ------ M1 (no ecf)

Interest = $\frac{1184.5344\times 5.3\times \frac{4}{12}}{100}$ ------ M1 (SI application, no ecf)
= $20.92677

Monthly installment = $\frac{1184.5344+20.92677}{4}$ ------ M1 ('their' balance + interest divide by 4)
= $301.365
= **$301.40** (nearest 10 cent) ------ A1

Answer $ ……..…… [4]

---

7. A class of 40 Secondary Four students were asked how much time they have spent on social media in the last week.

The results are shown in the table.

Time spent (x hours)	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$
Frequency	p	6	12	q	3

The lower quartile of the time spent on social media was 20 hours.

(i) Show that $p = 4$.

Since **lower quartile** = 20 hours,

¼ of 40 = 10 students spent 20 hours of less ------ M1 (must show in some form for full 2 marks)

P = 10 – 6 ------ A1/B1 only if 10 – 6 is seen
= 4

[2]

(ii) Hence state the value of q.

q = 40 – 4 – 6 – 12 – 3 = **15** ------- B1

Answer q = ... [1]

(iii) Estimate the mean number of hours spent by the students.

Mean = $\dfrac{(4\times5)+(6\times15)+(12\times25)+(15\times35)+(3\times45)}{40}$ ------- M1 (or sum below)

$= \dfrac{1070}{40}$

= **26.75** ---- A1/B1

Answer ..... [2]

(iv) Estimate the standard deviation.

10.9287
=10.9 ------- B1

Answer ..... [1]

A class of 40 Secondary Three students were asked how much time (in hours) they have spent on social media in the last week.

The results are summarised in the table.

Mean	15.8
Standard Deviation	10.9

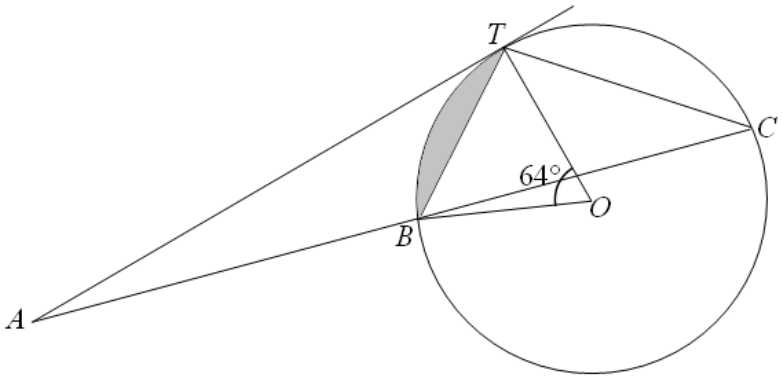
(i) Make two comparisons between the number of hours spent on social media by the Secondary Three students and by the Secondary Four students. Use the data to support your answers.

Answer

The Sec 4 students have a **higher mean time** spent on social media, this indicates that the **Sec 4 students generally spend more time of social media** compared to Sec 3 students. ------- B1 (must use mean for comparison)

Both cohorts have the **same standard deviation**, this means their time spent is **equally spread out/equal(same) consistency**. ------- B1 [2]

8.



In the diagram, AT is a tangent to the circle, centre O.

A line through A meets the circle at B and C.

It is given that angle $TOB = 64°$.

(a) Find each of the following angles, stating your reason(s) clearly.

(i) $\angle BCT =$ 32° …….. °.

Reason : Angle at centre is twice angle at circumference ----- B1 (accept abbreviations)
…….. [1]

(ii) $\angle BTO =$ 58° …….. °.

Reason : Base angle <u>isosceles triangle</u> ----- B1 (accept abbreviations)
…….. [1]

(b) Hence or otherwise, show that triangle ATB and triangle ACT are similar.

Answer :

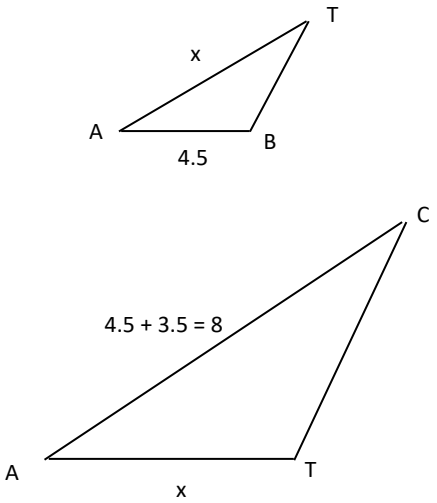
$\angle ATB = 90 - 58$ (tan ⊥ rad) ----- M1 (accept only with reason)
$= 32°$
$= \angle TCB$

$\angle TAC$ is common/shared angle. ----- M1

$\therefore$ triangle ATB and triangle ACT are similar (AA similarity test) ----- A1
(give A1 if 1st M1 had no reason)

[3]

(c) Given that $AB = 4.5$ cm and $BC = 3.5$ cm, find the length of AT.



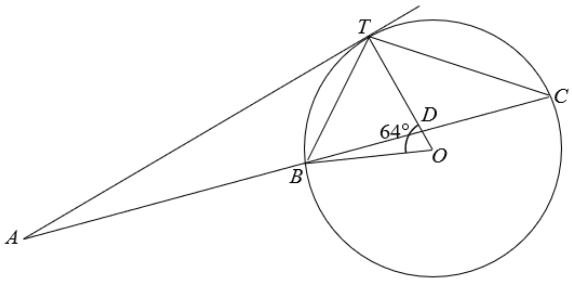
$\frac{x}{8} = \frac{4.5}{x}$ ------ M1

$x^2 = 36$

$x = 6$ cm ------ A1

Answer …… cm [2]

(d) Find the value of $\frac{\text{Area } \Delta BCT}{\text{Area } \Delta ABT}$.



$\frac{\text{Area } \Delta BCT}{\text{Area } \Delta ABT} = \frac{9}{7}$ ------ B1

Answer …… [1]

(e) Given that the radius of the circle is 1.8 cm, find the area of the shaded segment

$\text{Area} = \left(\frac{64}{360} \times \pi \times 1.8^2\right) - \left(\frac{1}{2} \times 1.8 \times 1.8 \times \sin 64\right)$ ------- M1, M1

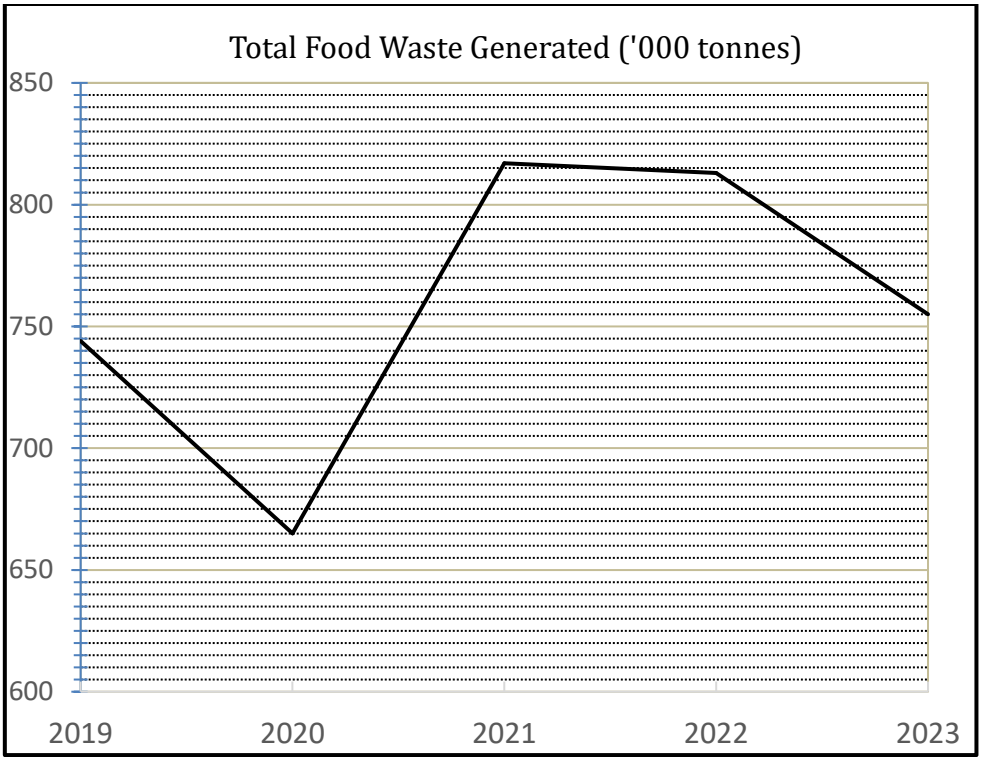
= 0.354 cm² ------- A1

Answer …… cm² [3]

---

9. To achieve **Singapore's Zero Waste Masterplan goal**, the government aims to reduce food waste by 30% by 2030.

The annual waste and recycling statistics from the National Environment Agency shows the amount of food waste generated (in 1000 tonnes) in Singapore from 2019 to 2023.



[Source: NEA Website on Waste Statistics]

Year	Estimated Singapore Population
2022	5.64 million
2023	5.9 million

The National Environment Agency (NEA) reported that in **2022**, Singapore generated 813 000 tonnes of food waste annually.

[1 Tonne = 1000 kg]

(a) Express 813,000 tonnes in kg, in standard form.

8.13×10^{8} ------- B1

Answer : …… kg [1]

(b) Calculate the average mass, in kg, of food waste per person, per day, in **2022**.

$\frac{8.13\times10^{8}}{5.64\times10^{6}} \div 365$ ------- M1 (using 'their' (a))

= **0.395 kg** (3 sf) ------- A1

Answer : …… kg [2]

Mrs Kim's household is made up of **5 persons** altogether.

The table below shows the estimated average mass of food wastage (in kg) for the three meals in her household in 2022.

Breakfast	Lunch	Dinner
0.25	0.9	1.25

(c) Calculate the average mass, in kg, of food waste per person in Mrs Kim's household, per day, in 2022.

(0.25+0.9+1.25) ÷5 = **0.48 kg** ------- B1

Answer : …… kg [1]

According to NEA, a household of 5 persons can reduce food waste in these 4 ways.

Ways to reduce food waste	**Estimated food waste reduction**
Composting	4.9 kg per week
Utilising leftovers	175 g per day
Keeping track of expiry dates	0.8 kg per week
Proper storage	2.4 kg per month

In 2023, Mrs. Kim encouraged her family to reduce their food waste by implementing the methods listed above. However, Mrs. Kim's household does not have a food composting

(d) Determine if Mrs. Kim's household managed to reduce their food waste more effectively than the national average mass. Provide your reasoning and calculations.

Compare Yearly

National food waste per person per **year** in 2023

$= \frac{755000000}{5900000}$ ------ M1

= 127.9661 kg

National food waste reduction per person from 2022 to 2023

$= \left(\frac{8.13\times10^{8}}{5.64\times10^{6}}\right) - 126.9661$ ------ M1

$= 144.1489 - 126.9661$

= **16.1828 kg**

Per day calculations (in kg) --- M1 (at least **2** calculations)

Leftovers = 0.175 × 365 = 63.875 kg
Expiry = 0.8 × 52 = 41.6 kg (0.8×4×12=7.86kg)
Storage = 2.4 × 12 = 28.8 kg

Each person waste (household has 5 person)

$= \frac{63.875 + 41.6 + 28.8}{5}$ ---- M1 (add all 3 parts,÷ 5 people)

= **26.855 kg / 26.215 kg**

> **16.1828 kg** ------ M1 (comparison*)

Mrs Kim managed to reduce food waste <u>more effectively</u> than the national average mass.
--- A1 (follow through from their comparisions)

*Percentage comparison will be
15.625% > 11.24% ------ M1 (comparison)

Compare % reduction

Food waste per person per day in 2023

$= \frac{755000000}{5900000} \div 365$ ------ M1

= 0.350592 kg

Percentage of food reduction from 2022 to 2023

$= \frac{0.395 - 0.350592}{0.395} \times 100$ ------ M1

$= \frac{0.044408}{0.395} \times 100$

= **11.24 %**

Per day calculations (in kg) --- M1 (at least **2** calculations)

Leftovers = 175 g = 0.175 kg

Expiry $= \frac{0.8}{7}$ = 0.114285 kg

Storage $= \frac{2.4}{4} \div 7 = \frac{3}{35}$ kg

Each person waste reduced (household has 5 person)

$= \frac{0.175 + 0.114285 + \frac{3}{35}}{5}$ ---- M1 (add all 3 parts,÷ 5 people)

= 0.075 kg

% savings $= \frac{0.075}{0.48} \times 100$

= **15.625%** ------ M1

> 11.24%

Mrs Kim managed to reduce food waste <u>more effectively</u> than the national average mass.

--- A1 (follow through from their comparisions)

Compare absolute value

Food waste per person per day in 2023

$= \frac{755000000}{5900000} \div 365$ ------ M1

= 0.350592 kg

Percentage of food reduction from 2022 to 2023

= 0.395 – 0.350592 x 5 ------ M1

= **0.044408 kg**

← same M1

Each person waste reduced (household has 5 person)

$= \frac{0.175 + 0.114285 + \frac{3}{35}}{5}$ ------- M1

= 0.075 kg ------- M1

> 0.044408 kg

Mrs Kim managed to reduce food waste <u>more effectively</u> than the national average mass.

--- A1 (follow through from their comparisions)

[6]

Per person

	Per day	Per Week	Per Month	Per Year
Kim	0.075	0.51644	2.2379	26.855
National	0.055	0.3112	1.348	16.1828

Per 5 persons

	Per day	Per Week	Per Month	Per Year
Kim	0.375	2.582	11.19	134.275
National	0.22	1.561	6.742	80.914

End of Paper