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BROADRICK SECONDARY SCHOOL

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2023

MATHEMATICS

Paper 2

4052/02

Aug 2023

Candidates answer on the Question Paper.

2 hours 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Write the question number attempted in the left column in the box provided.

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 .

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.

For Examiner's Use		
Error In	Question Number	Marks Deducted
Rounding-off		
Reasoning		
Presentation		

For Candidate's Use	For Examiner's Use
Question Number	Marks Obtained
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total Marks	/90

This document consists of **19** printed pages.

[Turn Over

Mathematical Formulae*Compound interest*

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

Mensuration

$$\text{Curved Surface area of a cone} = \pi r l$$

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

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

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

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

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

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

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 (a) Expand and simplify $3 - (2x + 1)(x - 4)$.

Answer [2]

- (b) Express as a single fraction in its simplest form $\frac{1}{x+2} + \frac{2x-3}{2x^2+x-6}$.

Answer [2]

- (c) (i) Express $x^2 - 8x + 25$ in the form $(x - a)^2 + b$.

Answer [1]

- (ii) Hence explain why $x^2 - 8x + 25$ is always positive for any value of x .

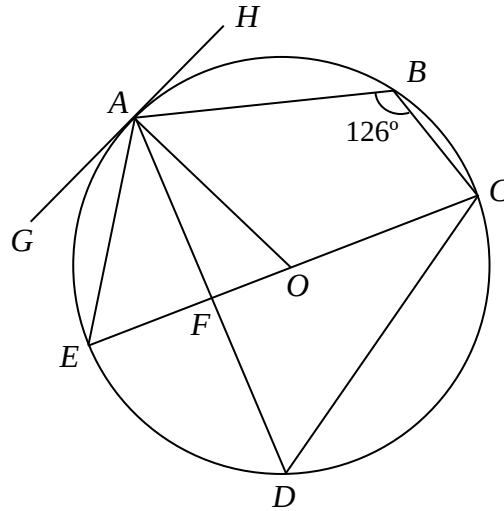
Answer

.....

.....

..... [1]

- 2 In the figure, A, B, C, D and E are on the circle, with centre O .
 GAH is a tangent to the circle.
 The chord AD intersects the diameter COE at F .
 Angle $ABC = 126^\circ$.



- (a) Stating your reasons clearly, find angle EAG .

Answer $^\circ$ [4]

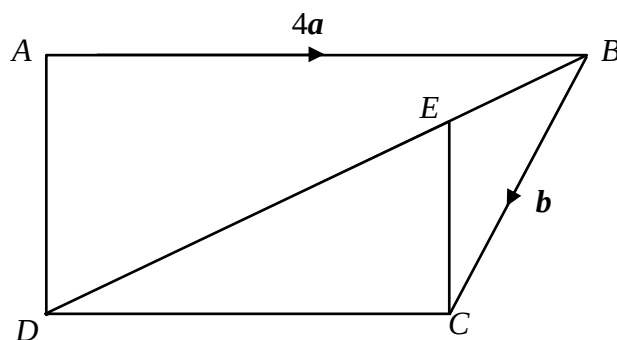
- (b) Prove that triangle EAF and triangle DCF are similar.

Answer

[2]

- 3 In the diagram, AB is parallel to DC and $\overrightarrow{AB} = \frac{4}{3}\overrightarrow{DC}$.

E is a point on DB such that $4\overrightarrow{DE} = 3\overrightarrow{DB}$.



- (a) Given that $\overrightarrow{AB} = 4\mathbf{a}$ and $\overrightarrow{BC} = \mathbf{b}$, find

(i) $\overrightarrow{DB}$,

Answer [1]

(ii) $\overrightarrow{EC}$.

Answer [2]

- (b) Show that EC is parallel to AD .

Answer

.....

.....

.....

..... [2]

(c) Giving your answer as a fraction in its lowest terms, find the value of

(i) $\frac{\text{Area of } \triangle BCE}{\text{Area of } \triangle DCE},$

Answer [1]

(i) $\frac{\text{Area of } \triangle CBD}{\text{Area of } ABCD}.$

Answer [1]

4 In January 2022, the price of a premium grade of petrol in Singapore was x dollars per litre.

(a) Write down an expression, in terms of x , for the number of litres of petrol that could be bought with \$100 in January 2022.

Answer litres [1]

In June 2022, the price of the same premium grade petrol increased by 64 cents per litre.

(b) Write down an expression, in terms of x , for the number of litres of petrol that could be bought with \$100 in June 2022.

Answer litres [1]

With the increase in price, 4.6 litres lesser of the premium grade petrol can be bought with \$100 in June 2022 as compared with January 2022.

(c) Form an equation in x and show that it reduces to $575x^2 + 368x - 8000 = 0$.

Answer

[3]

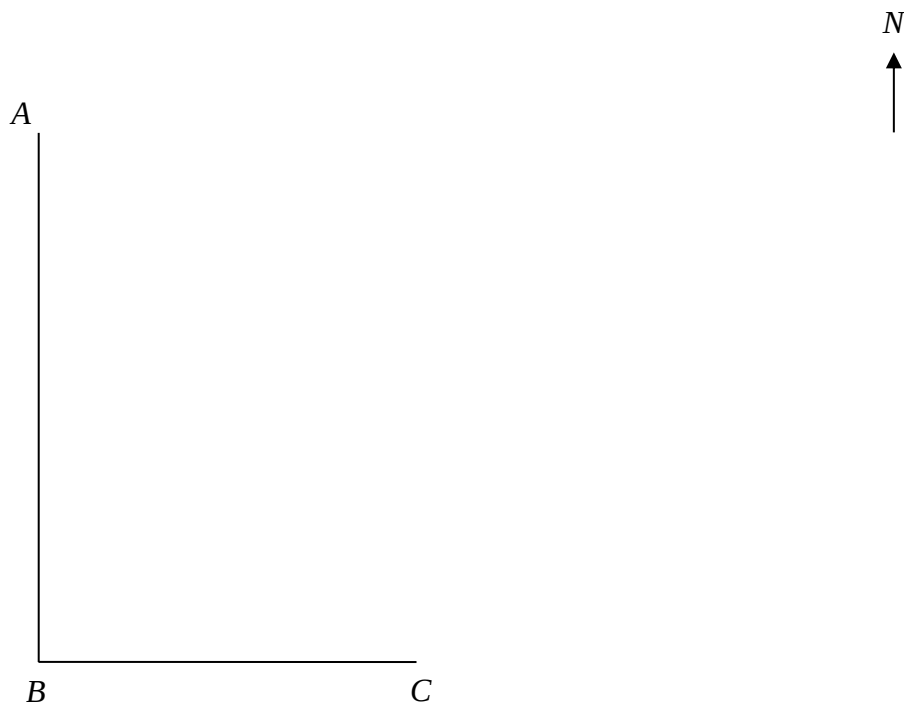
- (d) On a particular day in June 2022, Jason estimated and said that \$80 is more than enough to buy 20 litres of the premium grade petrol.
Justify if he is correct.
Show your workings clearly.

Answer

[5]

- 5 A developer bought a land in the shape of a quadrilateral $ABCD$, $AB = 70$ m, $BC = 50$ m, $\hat{ABC} = 90^\circ$, $AD = 80$ m and $CD = 65$ m.

- (a) Using a scale of 1 cm to represent 10 metres, construct an accurate scale drawing of the plan of the land. Sides AB and BC are drawn in the answer space below.



[2]

- (b) Write down the bearings of D from B , given that B is due south of A .

Answer ° [1]

- (c) The developer intends to plant a tree on the land.
The tree, T is on a bearing of 010° from B and on a bearing of 130° from A .
Find and label the position of tree T . [1]

- (d) Construct
(i) the perpendicular bisector AB , [1]
(ii) the angle bisector of angle BCD . [1]

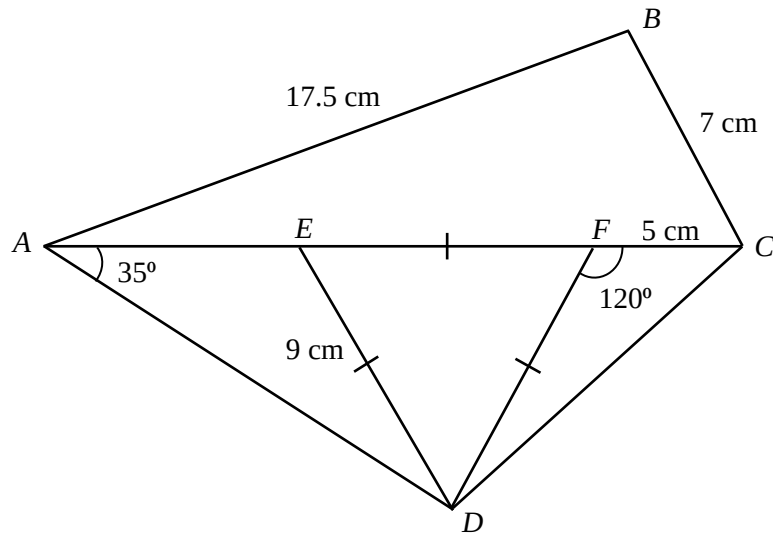
- (e) The two lines in (d) intersect at a flagpole, F .
How far is the **actual** distance of the flag pole from point C ?

Answer m [1]

- (f) Calculate the angle of elevation of the flag pole, 9 m tall, from point C .

Answer ° [2]

- 6 In the diagram, A, B, C, D, E and F are points on a horizontal plane, where $AB = 17.5$ cm, $BC = 7$ cm, $FC = 5$ cm, $ED = EF = FD = 9$ cm, $\hat{DFC} = 120^\circ$ and $\hat{EAD} = 35^\circ$. $AEFC$ is a straight line.



Find

- (a) the length of AE ,

Answer cm [3]

- (b) angle ABC ,

Answer $^\circ$ [3]

(c) the area of triangle ABC .

Answer cm^2 [2]

- 7 A Christmas ornament is made by joining together a hemisphere of radius 5 cm and a cone with a base radius of 5 cm as shown in Diagram 1.

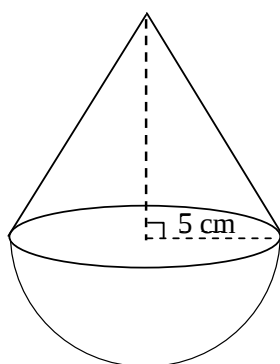


Diagram 1

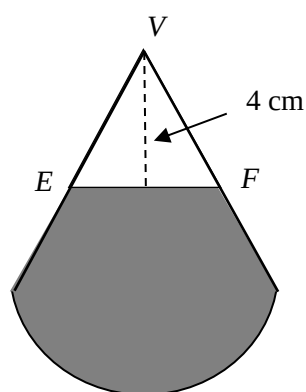


Diagram 2

- (a) Given that the volume of the cone is equal to $\frac{3}{4}$ of the volume of the hemisphere, show that the height of the cone is 7.5 cm.

Answer

[3]

Diagram 2 shows the vertical cross-section of the Christmas ornament through the vertex V , of the cone that is partly filled with coloured sand through a fine hole at the top. The surface level of the sand is represented by EF which is 4 cm directly below V .

- (b)** Find the volume of sand in the container.

Answer cm^3 [5]

- (c)** The company which produces this Christmas ornament made a larger geometrically similar ornament for outdoor display. James claims that since the radius of the cone in the larger ornament is 20 cm, the amount of paint needed to paint the outer surface of the larger ornament will be 4 times that of the original ornament. Justify if his claim is correct.

Answer

[2]

- 8 The table below shows some values of x and the corresponding values of y where $y = \frac{x^3}{2} - x + 1$.

x	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y	-1	0.81	a	1.44	1	0.56	0.5	1.19	3

- (a) Find the value of a .

Answer $a = \dots\dots\dots$ [1]

- (b) Draw the graph of $y = \frac{x^3}{2} - x + 1$ for $-2 \leq x \leq 2$ **on the graph grid on the next page.** [3]

- (c) Write down the coordinates of the turning points.

Answer $(\dots\dots\dots, \dots\dots\dots)$ [1]

$(\dots\dots\dots, \dots\dots\dots)$ [1]

- (d) Using your graph, explain why $\frac{x^3}{2} - x - 1 = 0$ has only one solution.

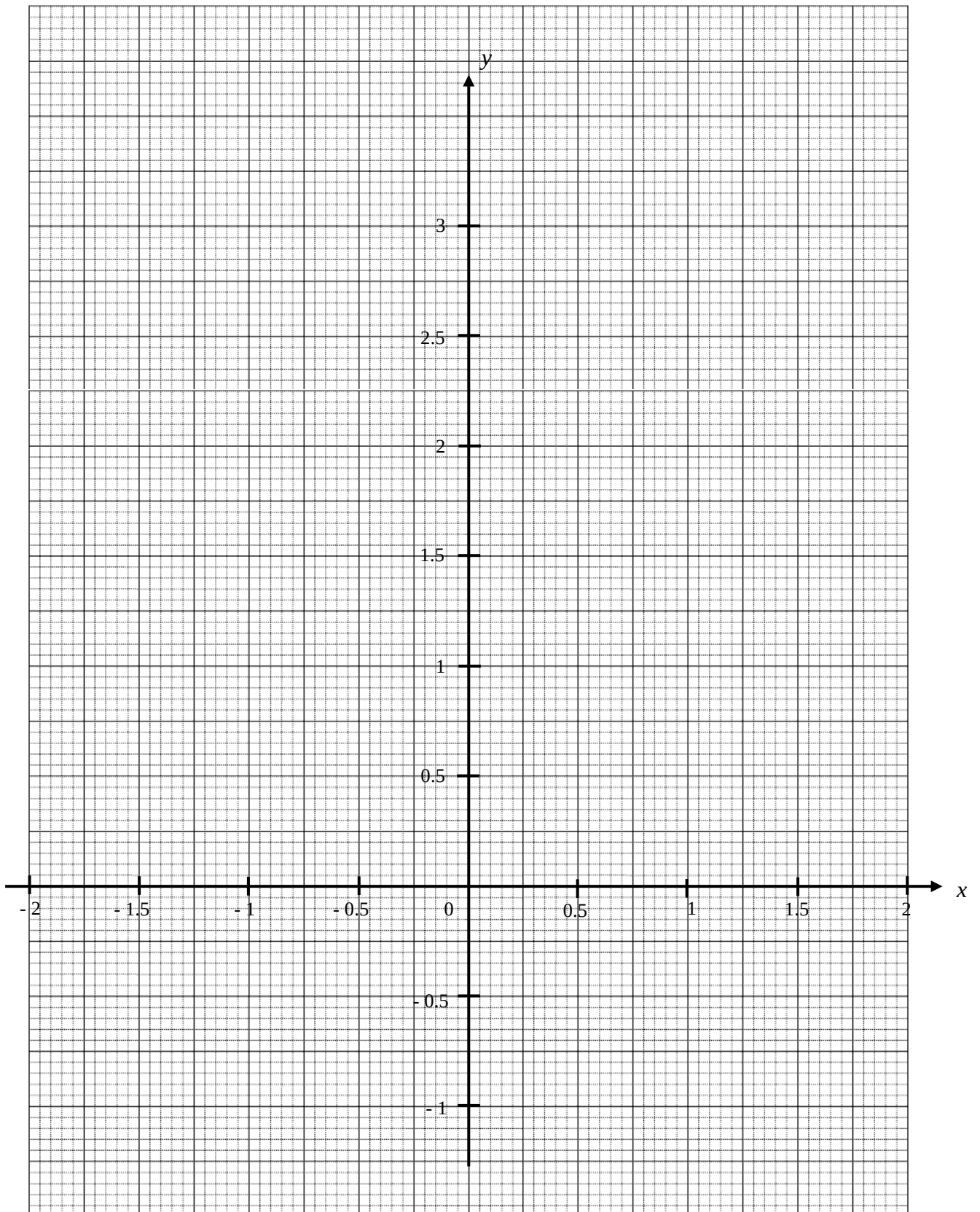
Answer $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$ [2]

- (e) (i) On the same axes, draw the graph of $2y + x = 2$. [2]

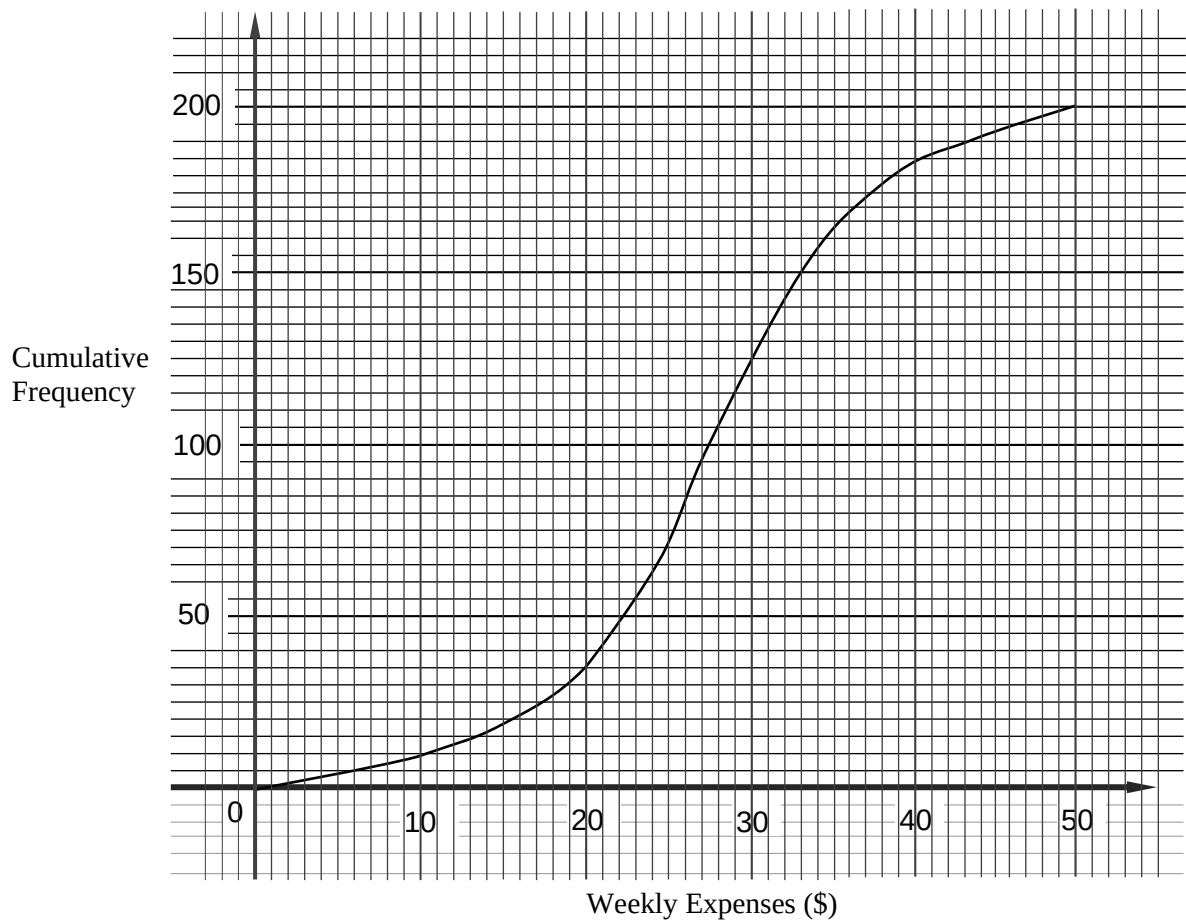
- (ii) Show that the x coordinates of the points of intersection of line and the curve give the solutions to the equation $x^3 - x = 0$.

Answer

[3]



- 9 (a) The weekly expenses by 200 students in Dakota Secondary are represented by the cumulative frequency curve below.



Using the graph, find

- (i) the median weekly expenses,

Answer \$ [1]

- (ii) the interquartile range.

Answer \$ [2]

- (iii) The expenses of the same group of students were recorded on another week. Each student spends \$5 more this time to purchase Student's Handbook. Explain if there any impact on the interquartile range compared with the first.

Answer

..... [1]

- (b) Every morning, Mrs Toh drives her son to school.

The probability of her son being late for school is $\frac{1}{5}$ if she uses Route A.

- (i) If Mrs Toh takes Route A for 2 consecutive days, draw a tree diagram to show the possible outcomes.

Answer

[2]

- (ii) Find the probability that her son will arrive late for school on at least one of the two days.

Answer [2]

Mrs Toh can also use Route B to send her son to school.

The probability of her son being late for school is $\frac{1}{4}$ if she uses Route B.

- (iii) Assuming she sets off at the same time regardless of the route chosen and that she is **equally likely** to take either route, find the probability that on any given day her son will be late for school.

Answer [2]

- 10 Michelle is the president of Broadrick Secondary School's Student Council. She is tasked to plan for the graduation dinner at the end of the year.

Planning Guidelines for Graduation Dinner

- There should be minimal of 9 different dishes, including 1 main dish, 1 meat, 1 fish, 1 prawn, 1 vegetable, 1 finger food, 1 pastry, 1 dessert and 1 beverage.
- The school hall must be well-decorated, have at least 5 air coolers and a photo booth.
- Organising costs should be as low as possible to minimise the cost that each student needs to pay to attend the dinner.

The menu selection from the selected caterer is provided below.

Ace Catering Services (Halal Certified)

- Buffet comes complete with food warmers, fully dressed table setups and full set of disposable cutleries and serviettes.

- Prices shown are not inclusive of 2% handling fee and 8% GST.

- Choose at least 9 items in the menu, including a beverage.

- Minimal 80 pax.

Promotion!

Get 5% off total price when you choose a 10th item in the Fruits/Salad category!

Main

Item	Per Pax
Yang Chow Fried Rice	\$1.00
Signature Mee Goreng	\$1.00
Thai Pineapple Fried Rice	\$1.50

Meat

Item	Per Pax
Sea Cucumber Duck	\$4.50
Black Pepper Beef	\$3.50
Signature Curry Chicken with Potatoes	\$2.50
Lemon Chicken	\$2.80

Seafood

Item	Per Pax
Sweet and Sour Fish	\$2.80
Nonya Sauce Fish Fillet	\$3.00
Scallop on Shell with Chilli Crab Sauce	\$4.00
Baked Mussel with Herb and Garlic	\$3.00
Golden Butter Prawn	\$4.00
Oat Cereal Prawn	\$4.00

Vegetables

Item	Per Pax
Kai Lan with Mushroom and Wolfberry	\$1.80
Stir Fry Cauliflower and Broccoli	\$1.80

Finger Food

Item	Per Pax
Golden Sotong Ball	\$2.00
Fried Samosa	\$1.80
Sambal Fish Ball	\$1.80

Pastry

Item	Per Pax
Mini Assorted Cream Puff	\$1.50
Mini Chocolate Brownie	\$1.50
Mini Oreo Cheesecake	\$1.80

Dessert

Item	Per Pax
Chef's Special Chendol	\$1.50
Grass Jelly with Longan	\$1.20
Hot Bo Bo Cha Cha	\$1.20

Fruits/Salad

Item	Per Pax
Tropical Fruits Platter	\$1.50
Thai Style Green Mango Salad	\$1.80

Beverage

Item	Per Pax
Homemade Barley	\$1.00
Refreshing Tropical Punch	\$0.50
Ice Lemon Tea	\$0.50

Other costs:

Table Rental* (excluding 8% GST)		Air Cooler Rental (excluding 8% GST)	
Item	Per unit	Item / Quantity	Per unit
6-pax round table with skirting	\$20	1 – 2 medium units	\$120
10-pax round table with skirting	\$25	3 – 4 medium units	\$100
Chair Rental** (excluding 8% GST)		5 – 6 medium units	\$90
Item / Quantity	Per unit	7 or more medium units	\$80
50 or less PVC Chairs	\$3.50	Party Decoration Packages (inclusive of 8% GST)	
Between 51 – 100 PVC Chairs	\$3.20	Package Type	Cost
Between 101 – 150 PVC Chairs	\$2.80	<u>Standard</u>	\$1500
Between 151 – 200 PVC Chairs	\$2.40	- Includes streamers, buntings, balloons and flora deco	
201 or more PVC Chairs	\$2.20	<u>Premium</u>	\$2500
*Delivery charge of \$50 applies for 5 tables or less.		- Includes streamers, buntings, balloons and flora deco	
**Delivery charge of \$50 applies for 30 chairs or less.		- Addition setup of Photo booth	

- (a) Michelle needs to rent tables and chairs for the graduation dinner. If the expected number of students attending the graduation dinner is 181, calculate the total **lowest** possible cost of rental (excluding 8% GST) to seat all the students at the dinner.

Answer [2]

- (b)** Ace Catering is offering a 5% discount to customers who choose the 10th item in the Fruits/Salad category.
Calculate if this promotion price will be higher or lower as compared to choosing 9 items, including a beverage at original price.

Answer

Hence, the promotion price isby \$...... [3]

- (c)** Michelle was told that the attendance for the graduation dinner may increase between 10 to 15 percent.
Taking into consideration the additional numbers, planning guidelines as well as the GST charges, she suggested each student to pay \$39.
Determine if Michelle's decision to get each student to pay \$39 is enough for the costs incurred to be covered fully.
Show your workings clearly.

Answer

(continue 10c next page)

(continue 10c in this page)

[6]

End of Paper