

Name: \_\_\_\_\_ ( ) Class: \_\_\_\_\_

**KRANJI SECONDARY SCHOOL**  
**Preliminary Examination**  
**Secondary 4 Express / 5 Normal Academic**

**MATHEMATICS**  
**Paper 2**

**4048/02**



Friday

**26 August 2022**

2 hours 30 mins

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**READ THESE INSTRUCTIONS FIRST:**

**Do not open this question paper until you are told to do so.**

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

Write in dark blue or black pen.

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

Do not use staples, paper clips, 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 your answers in degrees to one decimal place.

For  $\pi$ , use either your calculator value or 3.142, unless the question requires the answer in terms of  $\pi$ .

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is **100**.

Question	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
<b>Total</b>	

**Setter:** Ms Madeleine Chew

This question paper consists of **30** printed pages, including the cover page.

[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) Brandon plans to invest \$5000 in a bank.  
The bank pays 4% per annum interest compounded monthly.  
Calculate the total amount at the end of 3 years, correcting your answer to the nearest dollar.

Answer \$ ..... [1]

- (b) In 2021, Alice was paid a basic salary of \$82 500, which is an increase of 7% from her basic salary in 2020.  
Calculate her basic salary in 2020, correcting your answer to the nearest cent.

Answer \$ ..... [2]

- (c) Rearrange the formula  $7mb = 3b + 2m$  to make  $b$  the subject.

Answer  $b =$  ..... [2]

- (d) Using factorisation, solve the equation  $21x^2 = 2 - 11x$ .

*Answer*  $x = \dots\dots\dots$  or  $\dots\dots\dots$  [2]

---

- 2 Nurul bought some jars of cookies for \$500. She paid \$ $n$  for each jar of cookies.

- (a) Write down an expression, in terms of  $n$ , for the number of jars of cookies she bought.

*Answer*  $\dots\dots\dots$  [1]

Nurul found that 2 jars of cookies were spoilt and could not be sold.  
Nurul sold each remaining jar of cookies for \$3 more than she paid for it.

- (b) Write down an expression, in terms of  $n$ , for the total sum of money she received from the sale of the jars of cookies.

*Answer*  $\dots\dots\dots$  [1]

- (c) Given that she made a profit of \$92 from the sale of the jars of cookies, form an equation in  $n$  and show that it reduces to  $n^2 + 49n - 750 = 0$ .

*Answer*

- (d) Solve  $n^2 + 49n - 750 = 0$ , giving your solutions correct to 3 decimal places.

*Answer*  $n = \dots\dots\dots$  or  $\dots\dots\dots$  [3]

- (e) Explain why one of the solutions in part (d) need to be rejected.

*Answer*  $\dots\dots\dots$

$\dots\dots\dots$  [2]

- (f) Hence, find the selling price of each jar of cookies sold by Nurul, giving your solution correct to the nearest dollar.

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

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- 3 The tickets for a musical is divided into 4 categories. Table 1 shows the price of a ticket for each category.

**Table 1**

Category 1	Category 2	Category 3	Category 4
\$218	\$138	\$66	\$40

Table 2 shows the number of tickets sold for the afternoon and evening show on a particular Saturday.

**Table 2**

	Category 1	Category 2	Category 3	Category 4
Afternoon Show	35	120	75	16
Evening Show	60	93	112	27

- (a) Represent the information in Table 1 by a column matrix **P**.

$$\text{Answer } \mathbf{P} = \begin{pmatrix} & & & \end{pmatrix} \quad [1]$$

- (b) There was an early bird discount in the first week of ticket sale:
- 25% for Category 1 and Category 2
  - 15% for Categories 3 and Category 4

By multiplying matrix **P** with a suitable matrix, find the matrix whose elements represent the cost of each category of ticket during the first week of ticket sale.

$$\text{Answer } \begin{pmatrix} & & & \end{pmatrix} \quad [2]$$

- (c) Represent the information in Table 2 by a  $2 \times 4$  matrix  $\mathbf{T}$ .

$$\text{Answer } \mathbf{T} = \begin{pmatrix} & & & \\ & & & \end{pmatrix} \quad [1]$$

- (d) Evaluate the matrix  $\mathbf{S} = \mathbf{TP}$ .

$$\text{Answer } \mathbf{S} = \begin{pmatrix} & & & \\ & & & \end{pmatrix} \quad [2]$$

- (e) Explain what each element in matrix  $\mathbf{S}$  represent.

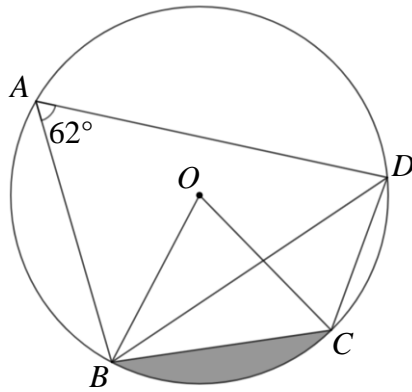
*Answer* .....

.....

.....

[1]

- 4 In the diagram, the points  $A$ ,  $B$ ,  $C$  and  $D$  lie on a circle, centre  $O$ . It is given that angle  $BAD = 62^\circ$  and  $OC$  bisects angle  $BCD$ .



- (a) Find, giving reasons for each answer,

- (i) angle  $BCD$ ,

Answer ..... [1]

- (ii) angle  $BOC$ ,

Answer ..... [2]

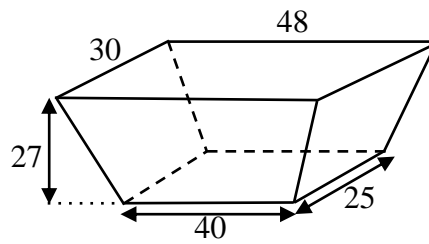


- (b) Given that the radius of the circle is 6 cm, find the shaded area.

*Answer* .....  $\text{cm}^2$  [3]

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- 5 A shopping basket can be modelled by a frustum of an inverted pyramid as shown below.



The solid frustum is obtained by removing the top portion of an inverted right rectangular pyramid.

The flat rectangular base of the frustum has length 40 cm and width 25 cm.

The remaining vertical height is 27 cm.

The flat rectangular top of the frustum is 48 cm by 30 cm.

- (a) Calculate the exact total surface area of the solid frustum.

Answer .....  $\text{cm}^2$  [3]

- (b) (i) Show that the height of the original inverted right rectangular pyramid is 162 cm.

*Answer*

[2]

- (ii) Calculate the exact volume of the solid frustum.

*Answer* ..... cm<sup>3</sup> [2]

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**6**  $A$  is the point  $(-2, 8)$  and  $B$  is the point  $(x, -4)$ .

**(a)** Given that the gradient of line  $AB$  is  $-1.5$ , find the value of  $x$ .

*Answer*  $x = \dots\dots\dots$  [2]

**(b)** Find the length of  $AB$ .

*Answer*  $\dots\dots\dots$  units [2]

The equation of line  $CD$  is  $6y + 9x = 5$ .

**(c)** The point  $(4b, -b)$  lies on the line  $CD$ . Find the value of  $b$ .

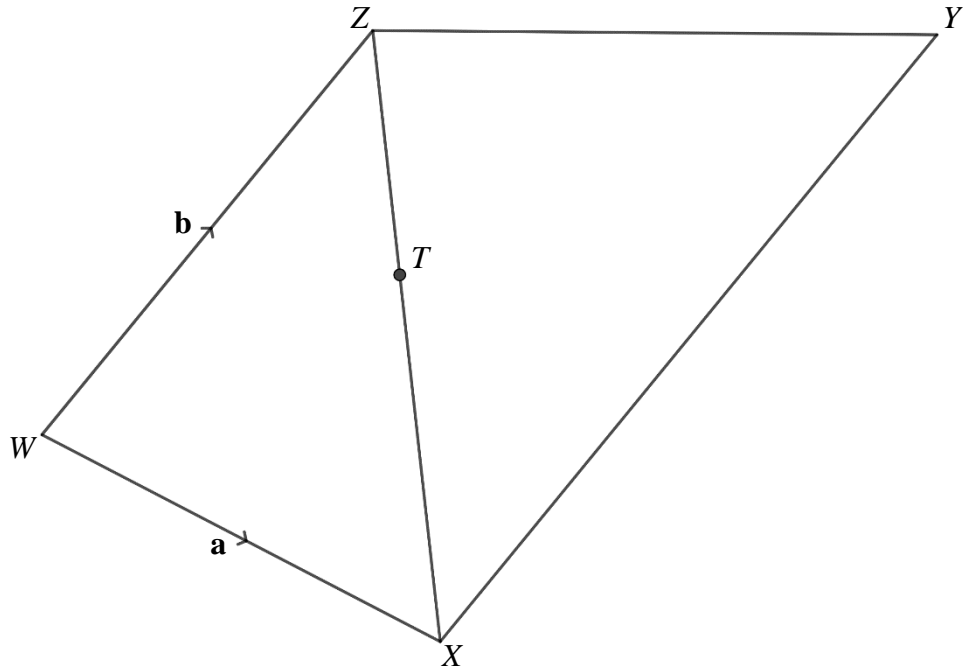
*Answer*  $b = \dots\dots\dots$  [1]

- (d) Explain why line  $CD$  does not intersect line  $AB$ .

*Answer*

- 7 In the diagram,  $WXYZ$  is a quadrilateral such that  $\overrightarrow{WX} = \mathbf{a}$ ,  $\overrightarrow{WZ} = \mathbf{b}$  and  $\overrightarrow{WZ} = \frac{2}{3} \overrightarrow{XY}$ .

$T$  is a point on  $XZ$  such that  $5\overrightarrow{TX} = 3\overrightarrow{ZX}$ .



- (a) What is the special name given to the quadrilateral  $WXYZ$ ?

Answer ..... [1]

- (b) Express, as simply as possible, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ ,

(i)  $\overrightarrow{ZX}$ ,

Answer  $\overrightarrow{ZX} = \dots\dots\dots$  [1]

(ii)  $\overrightarrow{WY}$ ,

Answer  $\overrightarrow{WY} = \dots\dots\dots$  [1]

(iii)  $\overrightarrow{WT}$ .

Answer  $\overrightarrow{WT} = \dots\dots\dots$  [2]

(c) Explain why points  $W$ ,  $T$  and  $Y$  lie on a straight line.

Answer  $\dots\dots\dots$

$\dots\dots\dots$  [2]

(d) Find

(i)  $\frac{\text{Area of triangle } WZT}{\text{Area of triangle } YXT}$ ,

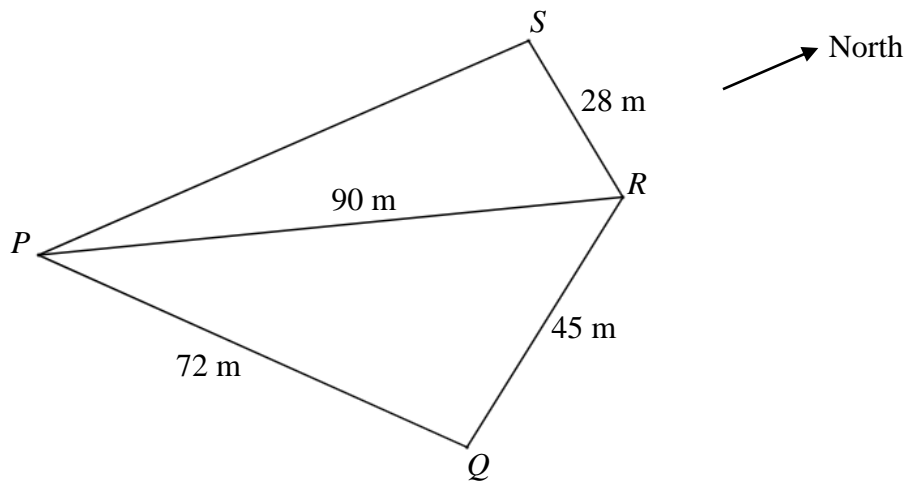
Answer  $\dots\dots\dots$  [1]

(ii)  $\frac{\text{Area of triangle } YZT}{\text{Area of triangle } YXT}$ .

Answer  $\dots\dots\dots$  [1]

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- 8 The diagram shows a park  $PQRS$  and a path  $PR$ .  
 $S$  is due north of  $P$  and the bearing of  $R$  from  $P$  is  $018^\circ$ .  
 It is also given that  $PQ = 72$  m,  $QR = 45$  m,  $RS = 28$  m and  $PR = 90$  m.



(a) Calculate

- (i) obtuse angle  $PSR$ ,

Answer ..... [3]

- (ii) the bearing of  $P$  from  $R$ ,

Answer ..... [1]



- (b) Show that angle  $PQR$  is  $97.903^\circ$ , correct to three decimal places.

*Answer*

[2]

- (c) Find

- (i) the area of triangle  $PQR$ ,

*Answer* .....  $\text{m}^2$  [2]

- (ii) and hence calculate the shortest distance from  $Q$  to  $PR$ .

*Answer* .....  $\text{m}$  [2]

- (d) A lamp post stands vertically at point  $Q$ .  
The greatest angle of elevation of the top of the lamp post when viewed from a point along  $PR$  is  $8^\circ$ . Calculate the height of the lamp post.

*Answer* .....  $\text{m}$  [2]

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- 9 The variables  $x$  and  $y$  are connected by the equation

$$y = \frac{x}{4}(8 - 6x + x^2).$$

Some corresponding values of  $x$  and  $y$ , correct to 2 decimal places, are given in the table below.

$x$	-1	0	0.5	1	1.5	2	2.5	3	4	5
$y$	-3.75	0	$h$	0.75	0.47	0	-0.47	-0.75	0	3.75

- (a) Calculate the value of  $h$ .

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

- (b) On the grid opposite, using a scale of 2 cm to represent 1 unit, draw a horizontal  $x$ -axis for  $-1 \leq x \leq 5$ .  
Using a scale of 2 cm to represent 1 unit, draw a vertical  $y$ -axis for  $-4 \leq y \leq 4$ .  
On your axes, plot the points given in the table and join them with a smooth curve.

[3]

- (c) Use your graph to find the solution to the equation  $x^3 - 6x^2 + 8x = 12$  for  $-1 \leq x \leq 5$ .

Answer  $x = \dots\dots\dots$  [2]

- (d) (i) Line  $L$  has gradient  $-0.5$  and passes through the point  $(3, 1)$ .  
Draw line  $L$  on the same axes for  $-1 \leq x \leq 5$ .

[2]

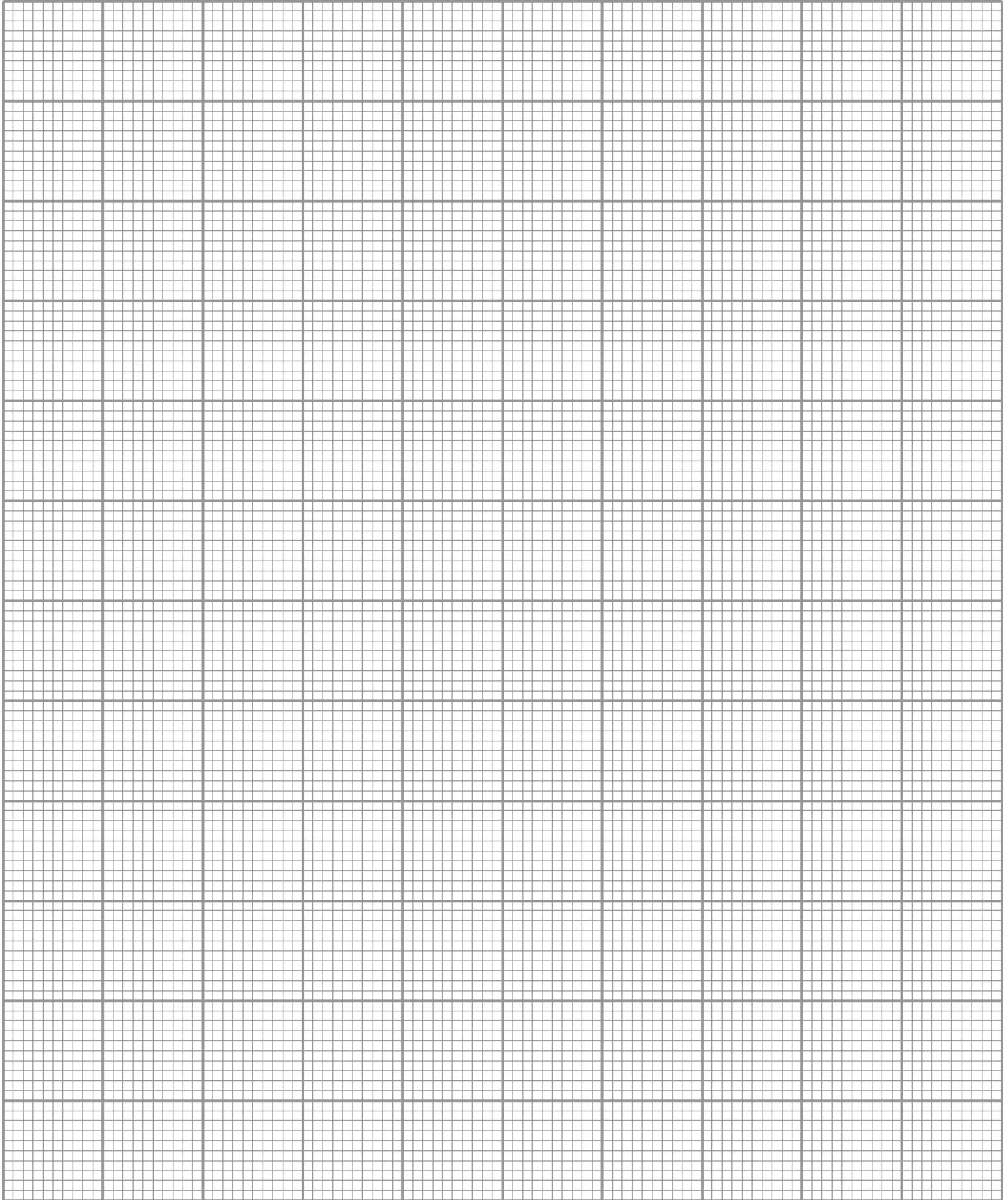
- (ii) Write down the  $x$ -coordinate of the point where the two graphs intersect.

[1]

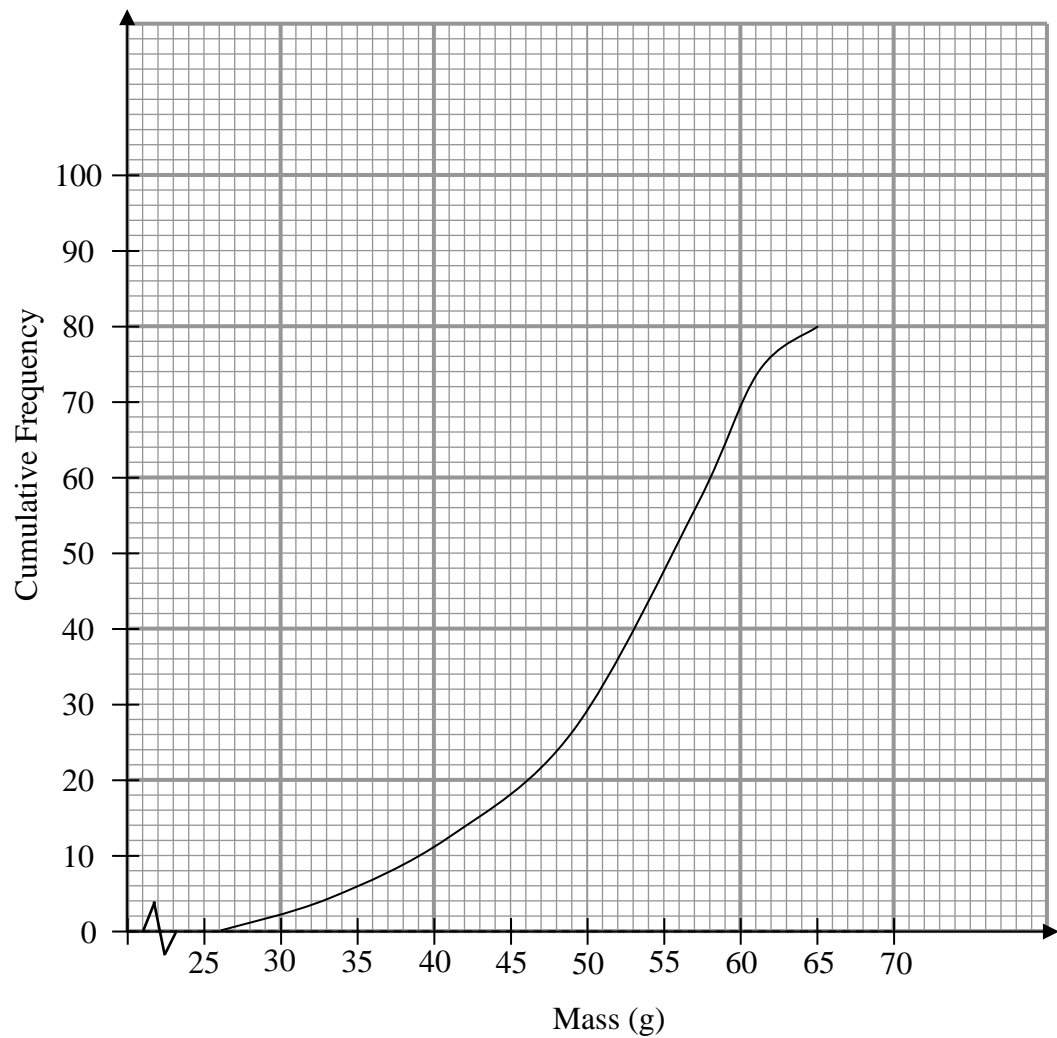
Answer  $x = \dots\dots\dots$

- (iii) This value of  $x$  is a solution of a cubic equation. Write down the cubic equation in the form  $x^3 + Ax^2 + Bx + C = 0$ , where  $A$ ,  $B$  and  $C$  are integers.

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



- 10** The masses of 80 eggs collected at Farm A are recorded.  
The cumulative frequency curve below shows the distribution of their masses.



**(a)** Use the curve to estimate

**(i)** the median mass,

Answer ..... g [1]

**(ii)** the 30<sup>th</sup> percentile,

Answer ..... g [1]

**(iii)** the interquartile range.

Answer ..... g [2]

- (b) Eggs whose masses are more than 60 g are considered grade A eggs.  
Find the number of grade A eggs.

Answer ..... eggs [1]

- (c) The distribution of the masses of the eggs can be represented by the grouped frequency table below.

Mass ( $x$ g)	$25 < x \leq 35$	$35 < x \leq 45$	$45 < x \leq 55$	$55 < x \leq 65$
Frequency	6	$n$	30	32

- (i) Show that the value of  $n$  is 12.

Answer .....

..... [1]

- (ii) A worker in Farm A select two eggs at random, one after another, without replacement.  
Find the probability that both eggs are more than 45g.  
Give your answer as a decimal correct to four significant figures.

Answer ..... [2]

- (iii) Calculate the mean and standard deviation.

Answer Mean = ..... g

Standard Deviation = ..... g [2]

- (d) The masses of eggs at Farm B are also measured and recorded. Information relating to the masses of eggs at Farm B are given below.

Mean = 53g  
Standard Deviation = 9g

Make two comparisons between the masses of eggs at Farm A and Farm B.

1.....  
.....  
.....

2.....  
.....  
.....

[2]

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- 11** Daily Value (DV) are the recommended amounts of nutrients to consume or not to exceed each day based on a 2000 calorie diet, the energy needs of an average adult.

The following table shows the recommended upper and lower limits for the nutrients listed, based on a 2000 calorie daily diet.

<b>Nutrient</b>	<b>DV</b>	<b>%DV</b>	<b>Recommended limits</b>
Saturated Fat	20g	=100% DV	Less than
Sodium	2,300mg	=100% DV	Less than
Dietary Fiber	28g	=100% DV	At least
Added Sugars	50g	=100% DV	Less than
Vitamin D	20mcg	=100% DV	At least
Calcium	1,300mg	=100% DV	At least
Iron	18mg	=100% DV	At least
Potassium	4,700mg	=100% DV	At least
<ul style="list-style-type: none"> <li>• Upper limit means it is recommended that you eat "less than" the amount of nutrient listed per day.</li> <li>• Lower limit means it is recommended that you eat "at least" this amount of nutrient on most days.</li> </ul>			
<p><u>Units of Measure Key:</u></p> <ul style="list-style-type: none"> <li>• g = grams</li> <li>• mg = milligrams (<math>1\text{mg} = 1 \times 10^{-3}\text{g}</math>)</li> <li>• mcg = micrograms (<math>1\text{mcg} = 1 \times 10^{-6}\text{g}</math>)</li> </ul>			

It is advisable to often choose foods that are:

- Higher in %DV for Dietary Fiber, Vitamin D, Calcium, Iron, and Potassium
- Lower in %DV for Saturated Fat, Sodium, and Added Sugars

Source: <https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label>

The nutrition facts on a package of wholemeal bread is given as follows:

<b>Nutrition Facts</b>	
<b>Serving size 2 slices (60g)</b>	
<b>Amount per serving</b>	
<b>Calories</b>	<b>145</b>
<b>% Daily Value*</b>	
<b>Total Fat</b> 1.4g	<b>2%</b>
Saturated Fat 0.7g	<b>4%</b>
Trans Fat 0g	
<b>Cholesterol</b> 0mg	<b>0%</b>
<b>Sodium</b> 206.4mg	<b>9%</b>
<b>Potassium</b> 0mg	<b>0%</b>
<b>Total Carbohydrate</b> 28.8g	<b>10%</b>
Dietary Fiber 3.6g	<b>13%</b>
Sugars 0g	
<b>Protein</b> 7.4g	<b>15%</b>
Vitamin A	0%
Vitamin C	0%
Calcium	8%
Iron	15%
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice	

The % Daily Value are rounded off to the nearest whole number.

The net weight of the package of wholemeal bread is 420g.

(a) Calculate the total calories in a package of wholemeal bread.

Answer ..... calories [1]



- (b) The recommended daily calorie intake of a male teenager is 2800 calories.

Show that the % Daily Value of dietary fiber per serving of bread for a male teenager, rounded to the nearest whole number, is 9%.

*Answer*

[3]

- (c) Generally, the recommended daily calorie intake for adults are:

- female adult: 2000 calories
- male adult: 2500 calories

The basic requirement of a daily meal plan is to meet the daily calorie intake and the recommended limits of the daily values based on the calorie intake.

- (i) Complete the following table of the recommended limits for the nutrients listed, for a male adult.

*Answer*

Nutrient	DV for male adult	Recommended Limits
Saturated fat (g)		Less than
Dietary fiber (g)		At least
Sodium (mg)		Less than

[1]

Johan is a male adult. On a particular day, this is his meal plan:

<u><b>Breakfast</b></u>	<u><b>Lunch</b></u>	<u><b>Dinner</b></u>
<ul style="list-style-type: none"> <li>• 2 slices of wholemeal bread</li> <li>• 2 servings of peanut spread (all natural)</li> <li>• 1 hard boiled egg (large)</li> </ul>	<ul style="list-style-type: none"> <li>• 1 turkey ham sandwich</li> <li>• 1 avocado</li> </ul>	<ul style="list-style-type: none"> <li>• 1 package of chicken and mushroom soup (ready meal)</li> <li>• 1 avocado</li> </ul>

Refer to **Table 1 on the next page** for some of the nutrition facts of the food items in his meal plan.

- (ii) Does Johan's meal plan on this particular day meet the basic daily meal plan requirements?

Justify your decision with clear calculations.

*Answer*

	<b>Avocado</b>	<b>Chicken and mushroom soup (ready meal)</b>	<b>Hard boiled egg (large)</b>	<b>Peanut spread (all natural)</b>	<b>Turkey Ham Sandwich</b>
Amount per serving	1 avocado (100g)	250g	1 egg	20g	1 sandwich (219g)
Serving per package	-	2	-	12	-
<b><u>Nutrition Facts (per serving)</u></b>					
Energy (calories)	320	213.3	78	486	270
Saturated fat (g)	4.2	3	2	1.3	1
Dietary fiber (g)	13.4	3	0	1.6	4
Sodium (mg)	14	718.8	62	51	800

**Table 1**

Answers for checking:

Qn	Solution
1(a)	\$5636
1(b)	\$77102.80
1(c)	$b = \frac{2m}{7m-3}$
1(d)	$x = \frac{1}{7}$ or $x = -\frac{2}{3}$
2(a)	$\left(\frac{500}{n}\right)$ jars of cookies
2(b)	$\$ \left( \frac{500}{n} - 2 \right) (n+3)$ or $\$ \left( 500 + \frac{1500}{n} - 2n - 6 \right)$
2(d)	$n = 12.246$ (3dp) or $n = -61.246$
2(e)	$n = -61.246$ needs to be rejected because n represents cost and <b>cost cannot be negative</b>
2(f)	\$15
3(a)	$\begin{pmatrix} 218 \\ 138 \\ 66 \\ 40 \end{pmatrix}$
3(b)	$\begin{pmatrix} 163.5 \\ 103.5 \\ 56.1 \\ 34 \end{pmatrix}$
3(c)	$\begin{pmatrix} 35 & 120 & 75 & 16 \\ 60 & 93 & 112 & 27 \end{pmatrix}$
3(d)	$\begin{pmatrix} 29780 \\ 34386 \end{pmatrix}$
3(e)	29780, 34386 represent the amount collected from the sales of tickets for the afternoon show and evening show <b>respectively</b> . <b>OR</b> 29780, 34386 represent the amount collected from the sales of tickets for <b>each</b> show. <b>OR</b> 29780 represents the amount collected from the sales of tickets for the afternoon show. 34386 represents the amount collected from the sales of tickets for the evening show.
4(a)(i)	$118^\circ$
4(a)(ii)	$62^\circ$
4(b)	$3.58\text{cm}^2$
5(a)	$6330\text{cm}^2$
5(b)(ii)	$32760\text{cm}^3$
6(a)	$x = 6$

6(b)	14.4 units												
6(c)	$b = \frac{1}{6}$												
7(a)	Trapezium												
7(b)(i)	$\mathbf{a} - \mathbf{b}$												
7(b)(ii)	$\mathbf{a} + \frac{3}{2}\mathbf{b}$												
7(b)(iii)	$\overrightarrow{WT} = \frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$ OR $\frac{1}{5}(2\mathbf{a} + 3\mathbf{b})$ OR $\frac{2}{5}(\mathbf{a} + \frac{3}{2}\mathbf{b})$												
7(d)(i)	$\frac{4}{9}$												
7(d)(ii)	$\frac{2}{3}$												
8(a)(i)	96.7°												
8(a)(ii)	198°												
8(b)	97.903°												
8(c)(i)	1600m <sup>2</sup>												
8(c)(ii)	35.7m												
8(d)	5.01m												
9(a)	$h = 0.66$												
9(d)(ii)	$x = 4.15$												
9(d)(iii)	$x^3 - 6x^2 + 10x - 10 = 0$												
10(a)(i)	53g												
10(a)(ii)	48g												
10(a)(iii)	12g												
10(b)	11												
10(c)(ii)	0.5984												
10(c)(iii)													
10(d)	1. The eggs at Farm B are heavier because the mean of the massess of eggs at Farm B, 53g, is more than that of Farm A, 51 g.  2. The masses of the eggs at Farm B are more consistent because the standard deviation of the massess of eggs at Farm B, 9g, is less than that of Farm A, 9.17g.												
11(a)	1015 calories												
11(c)(i)	<table><tr><th>Nutrient</th><th>DV for male adult</th><th>Recommended Limits</th></tr><tr><td>Saturated fat (g)</td><td>25</td><td>Less than</td></tr><tr><td>Dietary fiber (g)</td><td>35</td><td>At least</td></tr><tr><td>Sodium (mg)</td><td>2875</td><td>Less than</td></tr></table>	Nutrient	DV for male adult	Recommended Limits	Saturated fat (g)	25	Less than	Dietary fiber (g)	35	At least	Sodium (mg)	2875	Less than
	Nutrient	DV for male adult	Recommended Limits										
	Saturated fat (g)	25	Less than										
	Dietary fiber (g)	35	At least										
Sodium (mg)	2875	Less than											
11(c)(ii)	<p><b>Johan's meal plan</b> 2 slices of wholemeal bread + 2 servings of peanut spread + 1 hard boiled egg + 1 turkey ham sandwich + 1 package chicken and mushroom soup + 2 avocado</p> <p><b>Johan's meal plan (based on servings)</b></p>												

1 serving of wholemeal bread + 2 servings of peanut spread + 1 serving of hard boiled egg + 1 serving turkey ham sandwich  
+ 2 servings chicken and mushroom soup + 2 avocado

Total calories and nutrients for Johan's meal plans:

Energy (calories)	$145 + 2(486) + 78 + 270 + 2(213.3) + 2(320)$ $= 2531.6$
Saturated fat (g)	$0.7 + 2(1.3) + 2 + 1 + 2(3) + 2(4.2)$ $= 20.7$
Dietary fiber (g)	$3.6 + 2(1.6) + 0 + 4 + 2(3) + 2(13.4)$ $= 43.6$
Sodium (mg)	$206.4 + 2(51) + 62 + 800 + 2(718.8) + 2(14)$ $= 2636$

Johan's meal plan on this particular day **meet the basic daily meal plan requirements** because

- the **total calorie intake**, 2531.6 calories is **more than the recommended minimum calorie intake**, 2500 calories.
- the **saturated fat**, 20.7g, is **less than the recommended limit**, 25g
- the **total dietary fiber**, 43.8g, is **more than the recommended limit**, 35g
- the **total sodium**, 2636g, is **less than the recommended limit** for sodium, 2875g