O

TAMPINES SECONDARY SCHOOL

Secondary Four Express / Five Normal Academic
PRELIMINARY EXAMINATION 2024

NAME					
CLASS				**REGISTER NUMBER**	

MATHEMATICS **4052/02**

Paper 2 **23 August 2024**

2 hours 15 minutes

Candidates answer on the Question Paper.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	**Total**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces at the top of this 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, glue or correction fluid.

Answer **all** the 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 of 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 number of marks for this paper is **90**.

This document consists of **22** printed pages and **2** blank pages.

[Turn over

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ is in radians

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

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

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

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1 **(a)** Simplify $\frac{6(a+1)^3}{7b} \div \frac{9(a+1)}{28b}$.

Answer ..... [2]

(b) $x = a + \frac{bv^2}{k}$

(i) Find x when $a = 2$, $b = 3$, $v = -4$ and $k = 5$.

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

(ii) Rearrange the formula to make v the subject.

Answer $v =$ ..... [3]

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(c) Solve the simultaneous equations.

$4x + 7y = -23$
$6x - 2y = 3$

You must show your working.

Answer $x =$ .....

$y =$ ..... [3]

(d) Write as a single fraction in its simplest form $\dfrac{x^2}{(x+y)(x-3y)} - \dfrac{x-y}{x-3y}$.

Answer ..... [2]

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2 **(a)** Faiz invested \$25 000 in an account which paid simple interest.
At the end of 9 months, the value of the investment was \$26 500.
Calculate the interest rate per annum of the investment.

Answer ..... % [2]

(b) Jane exchanged 500 Singapore dollars (\$) into Thai baht (THB) when the exchange rate was \$1 = 26.77 THB. She travelled to Thailand and spent 10 600 THD.
On her return to Singapore, she exchanged the remaining Thai baht into dollars with the exchange rate \$1 = 26.88 THB.

Calculate the amount she received in dollars. Correct your answer to the nearest cent.

Answer \$..... [2]

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(c) The cash price of a furniture set was \$2700. Kim bought the set under a hire purchase scheme: 15% deposit and monthly instalments of \$68 for 36 months.

Calculate the amount of interest paid as a percentage of the cash price.

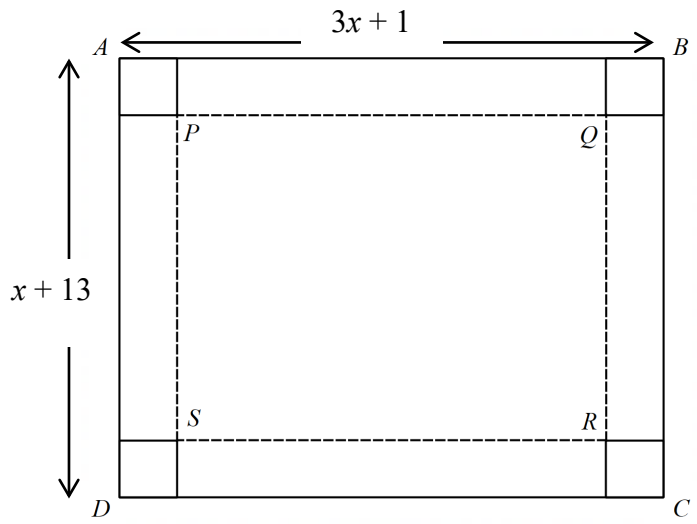
Answer ..... % [3]

(d) By selling an item at 25% discount off the marked price, a shopkeeper still makes 10% profit on his cost. If the cost price is \$180, calculate the marked price of the item.

Answer \$ ..... [3]

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3



The diagram shows a rectangular cardboard $ABCD$ with $AB = (3x+1)$ cm and $AD = (x+13)$ cm. A square of side 3 cm is cut from each corner. The remaining cardboard is then folded along the dotted lines to form an open rectangular box with base $PQRS$ and height 3 cm. The volume of the tray is 930 cm^3.

(a) Form an equation, in terms of x, to represent this information and show that it simplifies to $3x^2 + 16x - 345 = 0$.

[4]

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(b) Solve the equation $3x^2 + 16x - 345 = 0$.
Give your solutions correct to two decimal places.

Answer x = …… or x = …… [3]

(c) Find the length of the diagonal SQ.

Answer …… cm [3]

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4 **(a)** A is the point (3, 7) and B is the point (13, – 8).

(i) Find $\left|\overrightarrow{AB}\right|$.

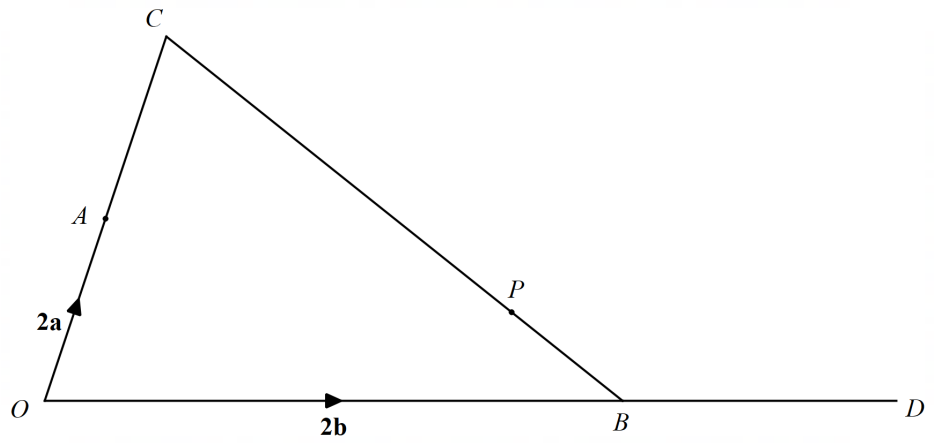
Answer ..... [2]

(ii) Given that $\overrightarrow{BA} = 2\overrightarrow{AP}$, find the coordinates of P.

Answer (..... , ...) [2]

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(b)



In triangle *OCB*, *A* is the midpoint of *OC* and *P* is the point on *CB* such that $CP = \frac{3}{4}CB$. The line *OB* produced to *D* such that *OB = 2 BD*. $\overrightarrow{OA} = 2\,\mathbf{a}$ and $\overrightarrow{OB} = 2\,\mathbf{b}$.

(i) Express $\overrightarrow{CP}$ in terms of **a** and **b**, as simply as possible.

Answer …… [2]

(ii) Express $\overrightarrow{AP}$ in terms of **a** and **b**, as simply as possible.

[1]

Answer ……

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(iii) Show that A, P and D lie on the same straight line.

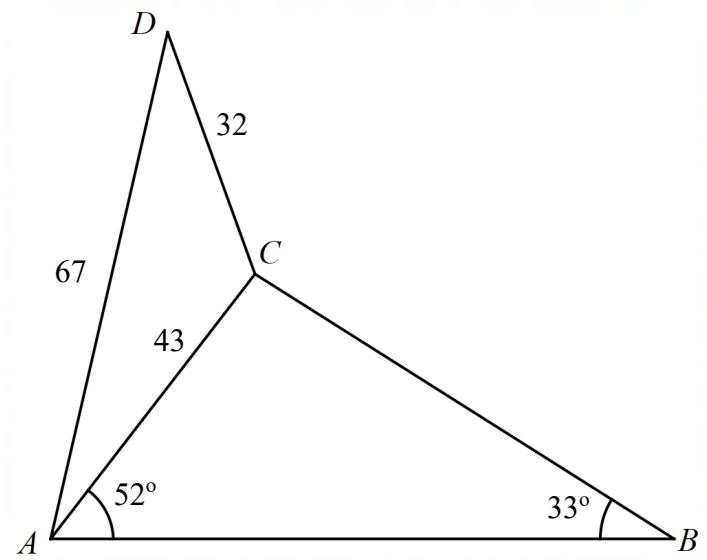
Answer ..... [3]

(iv) Find $\dfrac{\text{Area of } \Delta OCB}{\text{Area of } \Delta CPD}$.

Answer ..... [1]

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5



A, B, C and D are four points on level ground, with B due east of A.
$AC = 43$ m, $CD = 32$ m, $AD = 67$ m, angle $CAB = 52°$ and angle $ABC = 33°$.

(a) Calculate the bearing of B from C.

Answer ..... [2]

(b) Calculate AB.

Answer ..... *m* [2]

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(c) Calculate angle CDA.

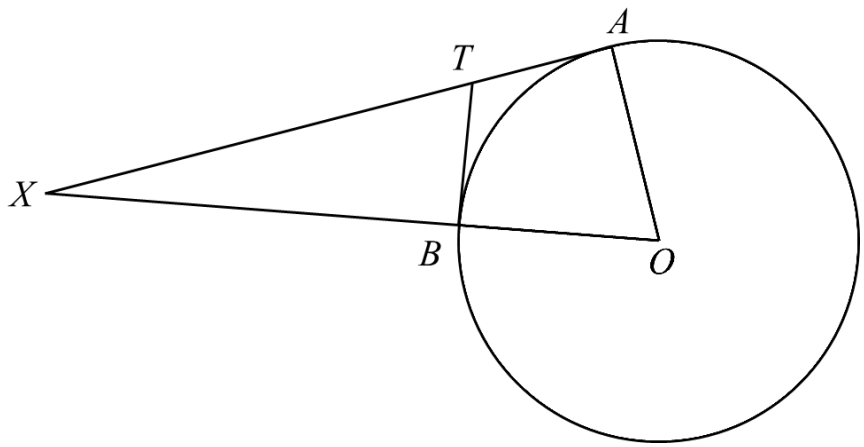
Answer ..... [3]

(d) A drone hovers 60 m vertically above D.
Find the angle of depression of A from the drone.

Answer ..... [2]

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6



The diagram shows a circle with centre O. TA and TB are tangents to the circle at A and B respectively. AT produced meets OB produced at X.

(a) Show that triangle OAX is similar to triangle TBX.
Give a reason for each statement you make.

[2]

(b) $XB = 12$ cm and $TX = 13$ cm.
(i) Find OA.

Answer ..... cm [3]

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(b) (ii) Calculate, as a fraction in its simplest form, the numerical value of the ratio

$$\frac{\text{area of triangle } TBX}{\text{area of quadrilateral } OATB}.$$

Answer …… [2]

(iii) Calculate the reflex angle AOB in radians.

Answer …… [3]

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7 **(a)** Complete the table of values for $y = 10 - x - \frac{16}{x}$.

x	1	2	3	4	5	6	7	8	9
y	-7	0	1.7		1.8	1.3	0.7	0	-0.8

[1]

(b) On the grid opposite, draw the graph of $y = 10 - x - \frac{16}{x}$ for $1 \le x \le 9$. [3]

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

Answer ..... [2]

(d) Use your graph to solve $9 - x - \frac{16}{x} = 0$.

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

(e) The straight line $y = mx - 1$ intersects the curve $y = 10 - x - \frac{16}{x}$ at two points.

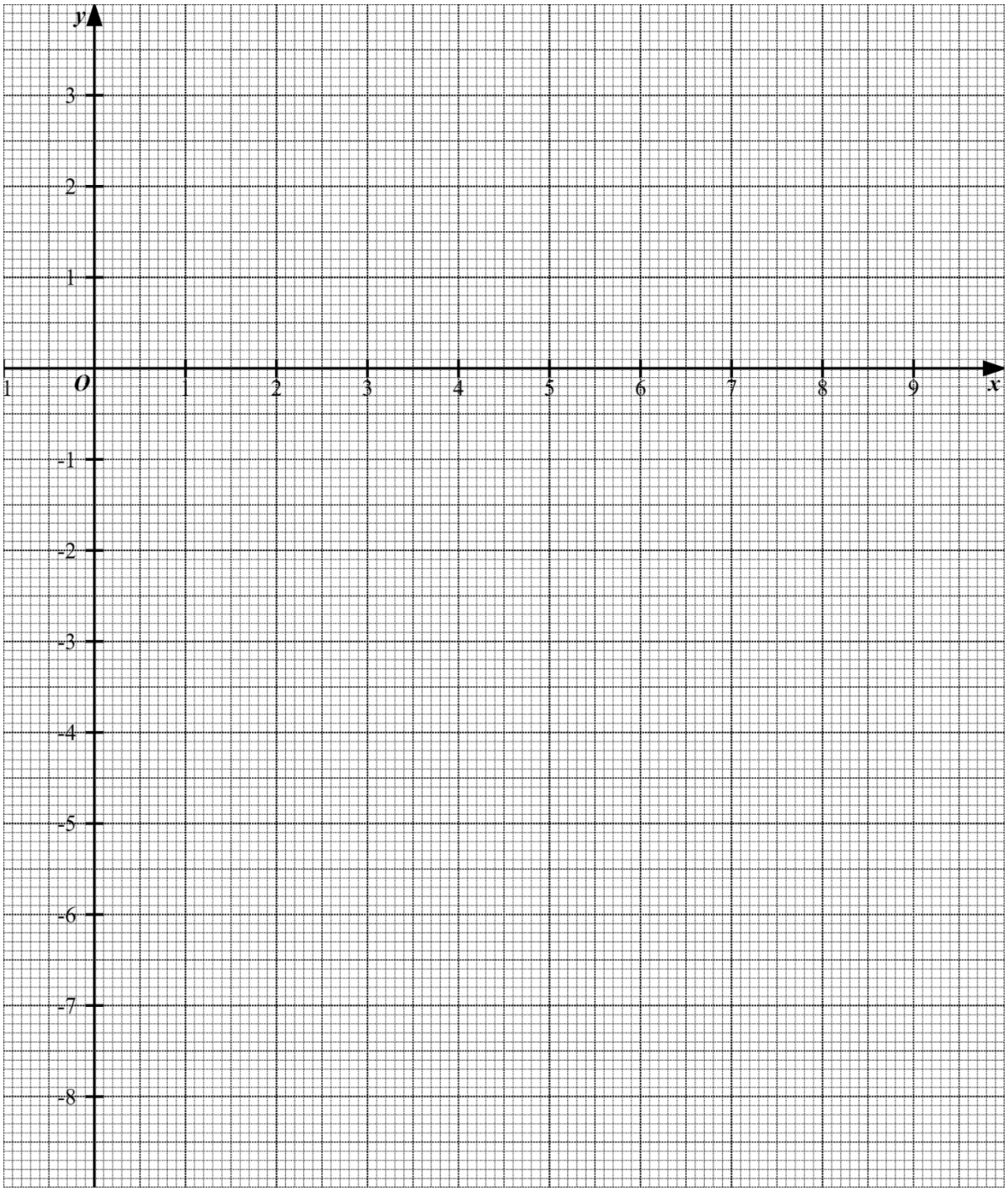
(i) Write down and simplify the equation, in terms of m, in the form $Ax^2 + Bx + 16 = 0$, which is satisfied by the values of x at the points of intersection.

Answer ..... [2]

(ii) If the values of y at the points of intersection are greater than or equal to zero, find the least value of m.

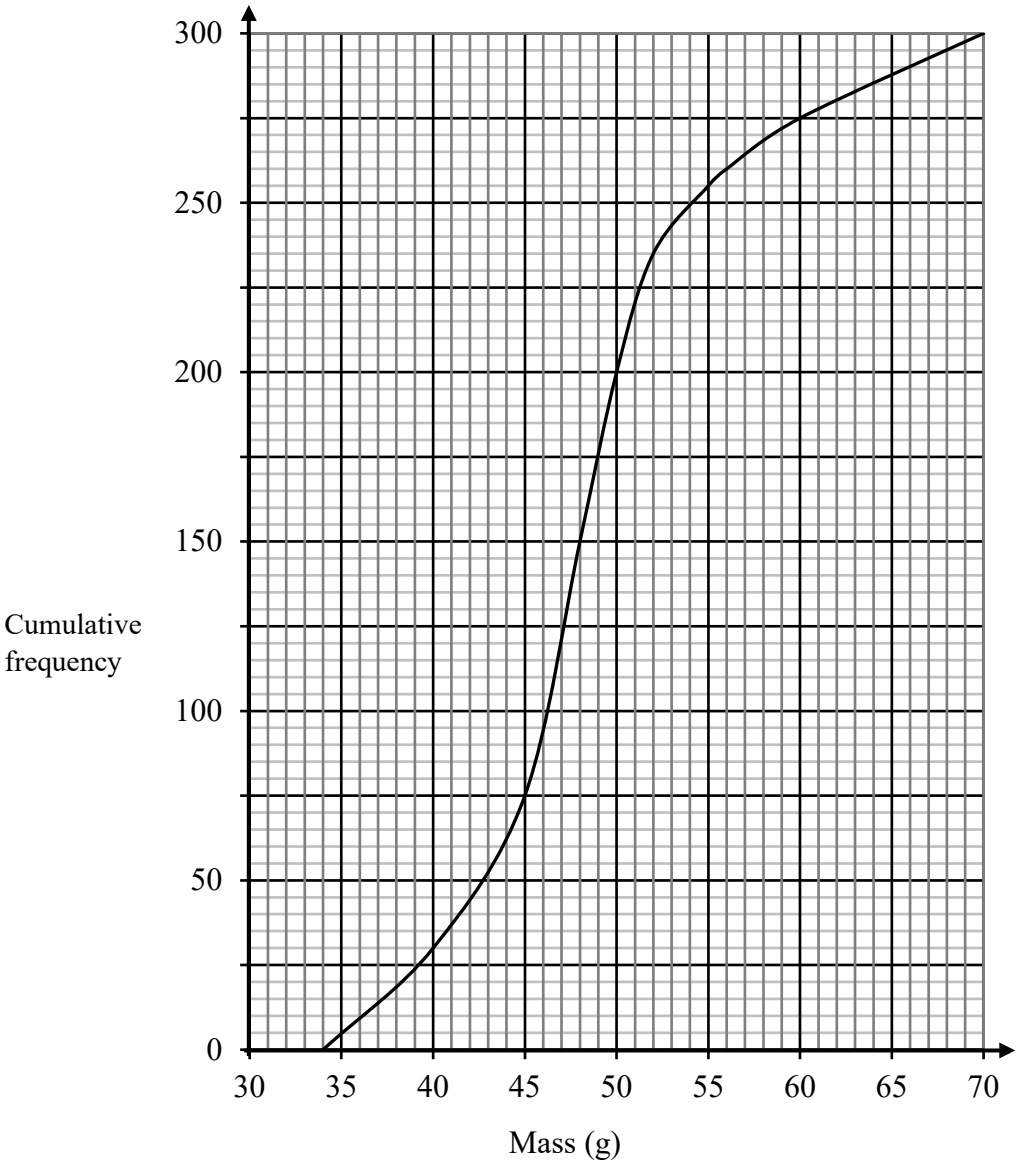
Answer $m =$ ..... [1]

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8 The masses, in grams, of a batch of 300 eggs are recorded.
The cumulative frequency curve shows the distribution of the masses.



(a) Use the curve to find

(i) the median mass of the eggs,

Answer …… *g* [1]

(ii) the interquartile range,

Answer …… *g* [2]

(iii) the 10^{th} percentile.

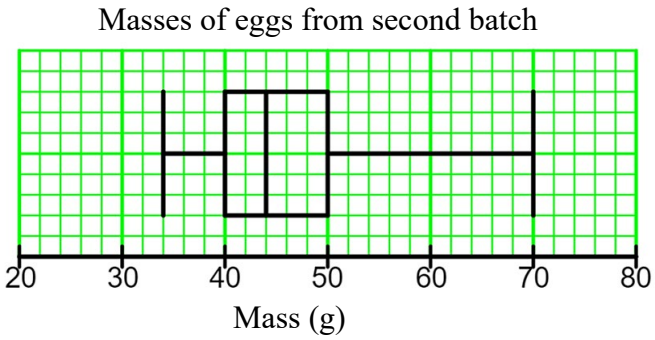
Answer …… *g* [1]

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(b) An egg is classified as 'Medium' if its mass is greater than or equal to 50 g but less than 56 g. Two eggs are chosen at random.
Calculate the probability that both are 'Medium' eggs.

Answer …… [2]

(c) The masses, in grams, of a **second** batch of 300 eggs are recorded and are represented by the box-and-whisker diagram below.



(i) Which batch of the eggs has more consistent mass?
Justify your answer using appropriate figures.

…….

……. [1]

(ii) The right whisker is longer than the left whisker.
Explain what this tells us about the distribution of the data set.

……

…… [1]

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[Turn over for Question 9]

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9 The table shows the utility charges for Chen's family in July 2024.
It includes the charges for utilities such as electricity (in kilowatt-hours), gas (in kilowatt-hours), water (in cubic metres) and refuse removal. The charges for electricity, gas and water are dependent on their usage while refuse removal is a fixed amount.

	Usage	Rate ($)	Amount ($)	Total ($)
Electricity Services	289 kWh	***p***	86.09	86.09
Gas Services	11 kWh	0.2312	2.54	2.54
Water Services	8.5 Cu M	1.2900	10.97	
Waterborne Tax	8.5 Cu M	1.0000	8.50	
Water Conservation Tax	$10.97	50 %	5.49	24.96
Refuse Removal	1 Qty	9.00	9.00	9.00
Subtotal			122.59	122.59
GST	$122.59	9%	***r***	***r***
Current Charges: (inclusive of GST)				***s***

(a) Calculate the values of *p, r* and *s*.

Answer p = ...

r = ...

s = ... [3]

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(b) Chen considers installing an air-conditioner in his home at the beginning of August. He finds the following information from the National Environmental Agency (NEA) website on energy-efficient appliances and online electrical store.

Model of air-conditioner	Energy-efficient label*	Annual Energy Cost ($) **	
		For 6-hour usage/day	For 7-hour usage/day
A	√ √ √	792	923
B	√ √ √ √	616	717
C	√ √ √ √	789	894
D	√ √ √ √ √	552	643
E	√ √ √ √ √	594	688

* *more ticks (√) indicate more energy-efficient*

*** Annual Energy Cost is based on current rate in utility charge, excluding GST*

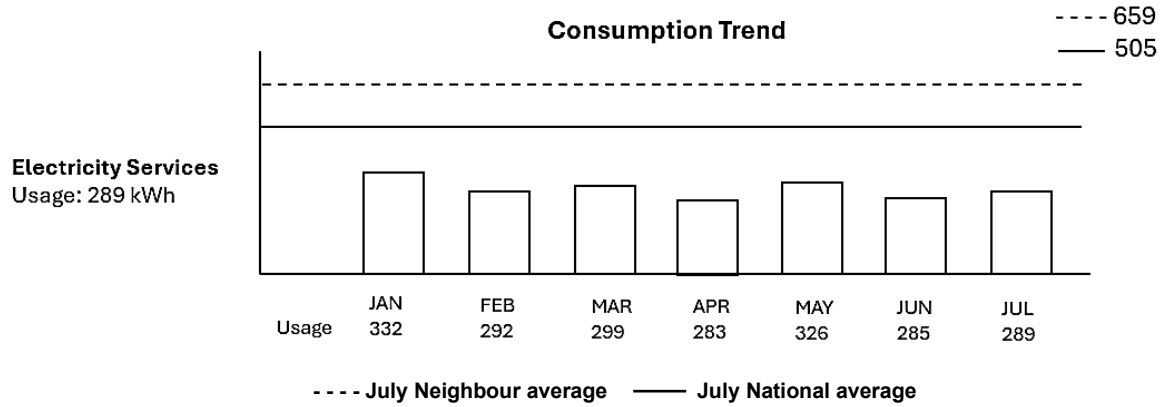
Example: If air-conditioner model A is used for 6 hours daily, the annual energy cost is $792.

Tips on Buying Energy-Efficient Air-Conditioner

- Choose an energy efficient air-conditioner with more ticks on the energy label.
- Choose models with lower Life Cycle Costs (LCC).
  LCC = Purchase Price + Annual Energy Cost × 7

Model of air-conditioner	A	B	C	D	E
Purchase Price $ (excluding GST)	1690	2749	1989	3499	3305

The chart shows Chen's electricity consumption trend:



Chen considers buying an air-conditioner with at least 4-ticks label, with low LCC and intends to use it for 6 hours each day. He expects an increase in electricity consumption in August, **in addition** to the 289 kWh recorded in July. However, he wants to keep his August total electricity consumption to be below July National average.

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Assuming the costs for gas, water services and refuse removal charge remain unchanged, suggest the model of air-conditioner he should opt for and estimate the August utility charge. Justify any decision you make and show your calculations clearly.

……

…… [7]

End of Paper

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