O

JURONGVILLE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
Secondary 4 Express

STUDENT NAME			
CLASS		INDEX NUMBER	

MATHEMATICS

4052/02

Paper 2

02 AUGUST 2024

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces 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, highlighters, glue or correction fluid.
DO NOT WRITE ON ANY BARCODES.

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

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 total marks for this paper is 90.

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.

DO NOT OPEN THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

For Examiner's Use
90

Mathematical Formulae

Compound interest

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

Mensuration

Curved Surface area of a cone = πrl

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

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

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

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

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

1 **(a)** Simplify $\frac{28xy^3}{5h} \div \frac{7x^2y}{30k^3}$.

Answer ……..…… [2]

(b) Given that $2^y = 4^{1011} + 4^{1011} + 4^{1011} + 4^{1011}$, find the value of y.

Answer y = ……..…… [3]

(c) It is given that $c = \dfrac{x^2 - a}{x^2 + b}$.

(i) Find the value of c when $a = -1$, $b = 5$ and $x = -3$.

Answer $c =$ ……. [1]

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

Answer ……. [2]

(d) **(i)** Solve the equation $\frac{3}{1-z}-\frac{1}{z-1}=2$.

Answer $z =$……. [2]

(ii) **Hence,** find the value of a when $\frac{3}{1-2a}-\frac{1}{2a-1}=2$.

Answer $a =$ ……. [1]

2 **(a)** Elly played a computer game 500 times and won 370 of these games.
She then won the next x games and lost none.
She has now won 75% of the games that she has played.

Find the value x.

Answer $x =$ ……..…… [2]

(b) Grade *A* coffee costs \$48 per kilogram.
Grade *B* coffee costs \$32 per kilogram.

Alen mixes Grade *A* coffee with Grade *B* coffee in the ratio 3 : 2 to obtain a mixture.
He then sells the mixture at \$45 per kilogram.

Calculate the percentage gain on the cost price.

Answer ……..…… % [3]

(c) Raju has a hard disk with a memory space of 2.4 terabytes.
(1 terabyte = 10^{12} bytes)

(i) 2.4×10^{12} can be written as k billion.

Find the value of k.

Answer k = …… [1]

(ii) If the size of a one-minute video is 50 megabytes, how many 2-hour full length movie videos can be stored in Raju's hard disk?
(1 megabyte = 10^6 bytes)

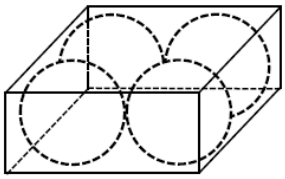
Answer …… movies [1]

(d) A car is selling at $13 500.
Ms Tan bought it at a hire purchase price, with a deposit of $500 and monthly instalment of $243.75 for 5 years at a flat rate of r% per year.

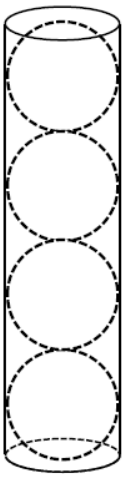
Calculate the interest rate, r.

Answer …… [3]

3



Package *A*



Package *B*

The diagrams show two ways of packing four identical spherical balls.
The radius of each ball is 3 cm.

Package *A* is a closed cuboid with a square base.
Each ball touches the top, bottom and the two sides of the cuboid.
Each ball also touches two other balls.

Package *B* is a closed cylinder.
Each ball touches the side of the cylinder.
Two balls touch the ends of cylinder while the two inner balls touch two other balls.

For both packages, the material used is of negligible thickness.

(a) Write down the dimensions of the cuboid.

Answer Length = …… cm

Breadth = …… cm

Height = …… cm [1]

(b) Calculate the total volume of the four balls.

Answer …… cm^3 [2]

(c) Jasmine claims that the volume of empty space in package *A* is more than that in package *B*.

Do you agree with her?
Show your working clearly.

Answer

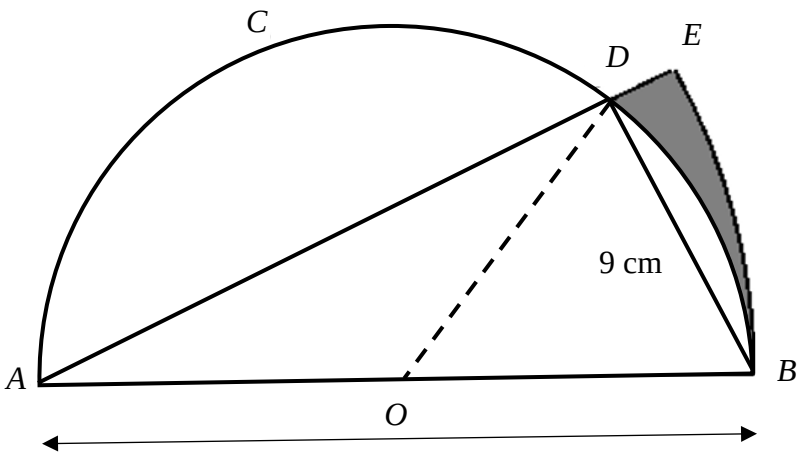
[3]

(d) Jasmine intends to wrap Package *B* with wrapping paper.
She estimates that the amount of wrapping paper she needs will be at least 20% more than the total external surface area of the package.

Calculate the minimum amount of wrapping paper required.
Give your answer to the nearest square centimetres.

Answer ……..… cm^2 [3]

4 In the diagram, *ACDB* is a semicircle with diameter 15 cm and centre *O*.
ABE is a sector with centre *A*.
BD is 9 cm.



(a) Prove that angle *BAD* = 0.6435 radians, correct to 4 decimal places.
Give a reason for each statement you make.

Answer

[2]

(b) Calculate arc length *BE*.

Answer ……..… cm [1]

(c) Calculate angle *AOD*, giving your answer in radians.

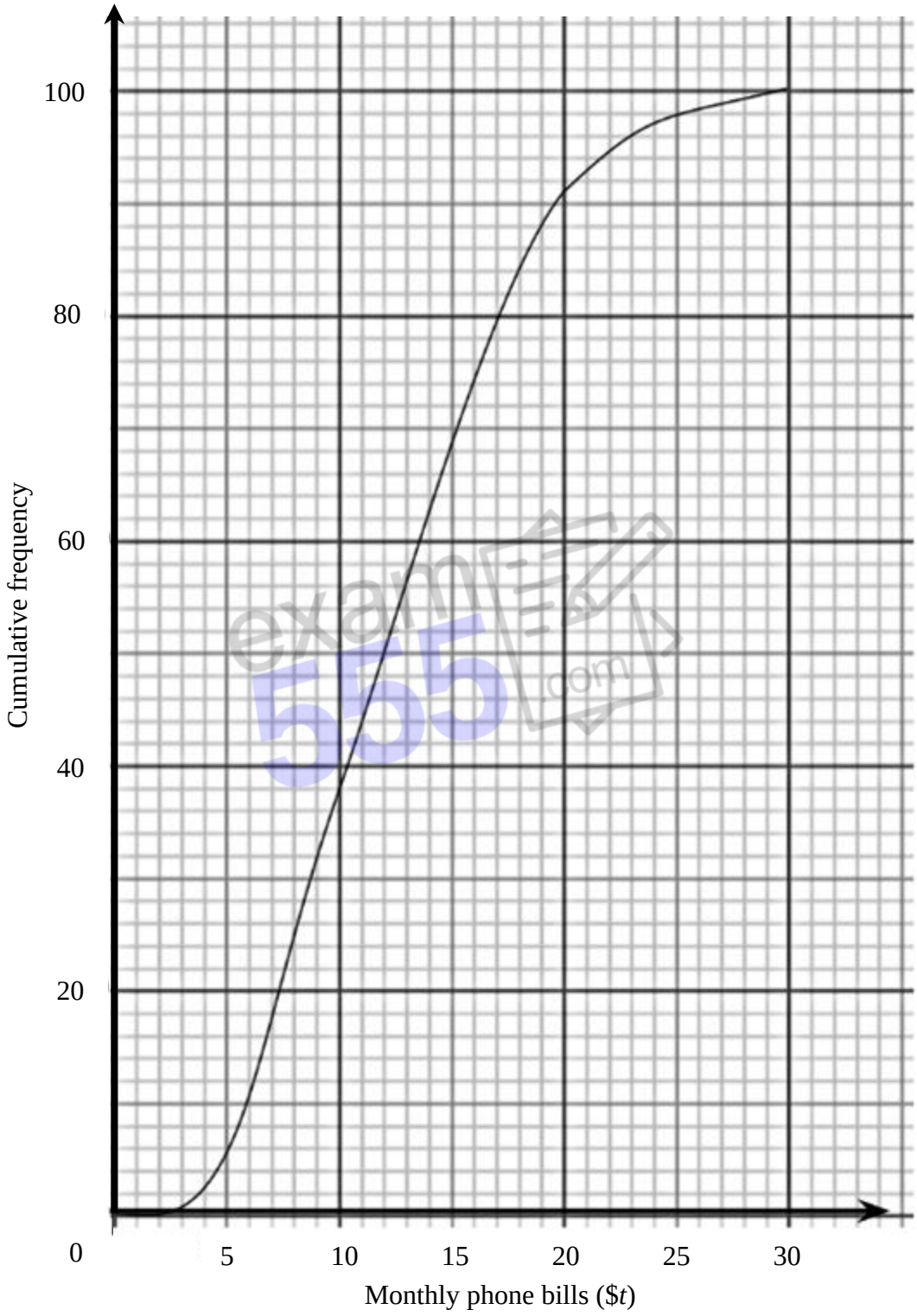
Answer ……..… rad [2]

(d) Calculate the area of the shaded region *BDE*.
Show your working clearly.

Answer ……..… cm^2 [5]

5 **(a)** A Residents' Committee (RC) records the monthly phone bills of 100 families in Jurong North District.

The distribution of the monthly phone bills is represented by a cumulative frequency curve below.



(i) Complete the following grouped frequency table for the monthly phone bills, $\$t$, of Jurong North District.

.

Monthly phone bills ($\$t$)	Frequency
$0 < t \leq 10$	38
$10 < t \leq 20$	
$20 < t \leq 30$	9

[1]

(ii) Calculate an estimate of the mean.

Answer $ ……..…. [1]

(iii) **C**alculate an estimate of the standard deviation.

Answer $ ……..…. [1]

(iv) Find the interquartile range of the distribution.

Is there any difference between using standard deviation and interquartile range to estimate the spread of the monthly phone bills in Jurong North district?

Explain.

Answer The interquartile range is ……

……

……

…… [2]

(v) It is recorded that another district, known as Clementine district, has a median monthly phone bill of $17.

The Chairman of the RC in Clementine district claims that his residents spend less on average monthly phone bills as compared to residents in Jurong North district.

Explain if his claim is justified.

Answer ……

……

……

…… [1]

(b) In a community event, cash vouchers are given as lucky draw prizes to the selected 100 families in Jurong North district.

The table below shows the information about the number of families with senior citizens in Jurong North district.

Each family has at most one senior citizen who belongs to either the Pioneer or Merdeka generation.

	Number of families with senior citizens	
	Pioneer Generation	**Merdeka Generation**
Stay alone	30	25
Stay with dependents	5	6

(i) One family is selected at random from Jurong North District.

Find the probability that this family has no senior citizen.

Answer ……..…… [1]

(ii) Two families are selected at random from Jurong North District.

Find the probability that both families have senior citizens who belong to the Merdeka Generation.

Answer ……..…… [2]

(iii) Both families have senior citizens who belong to the Pioneer Generation, but one of them stay alone.

Answer ……..…… [2]

6 **(a)** Complete the table of value for $y = \frac{24}{x} + x - 9$.

Give your answer correct to one decimal place.

x	2	2.3	2.6	3	4	5	6	7	8
y	5	3.7	2.8	2	1	0.8	1		2

[1]

(b) On the grid opposite, draw the graph of $y = \frac{24}{x} + x - 9$, for $2 \le x \le 8$. [3]

(c) Use your graph to find the range of values of x for which $\frac{24}{x} + x \le 10\frac{1}{2}$.

Answer ……..…… [1]

(d) On the same grid, draw a tangent and find the gradient of the curve at (4, 1).

Answer ……..…… [2]

(e) **(i)** On the same grid, draw the graph of $y = \frac{1}{2}x + 1$ for $2 \le x \le 8$.

Answer ……..…… [2]

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

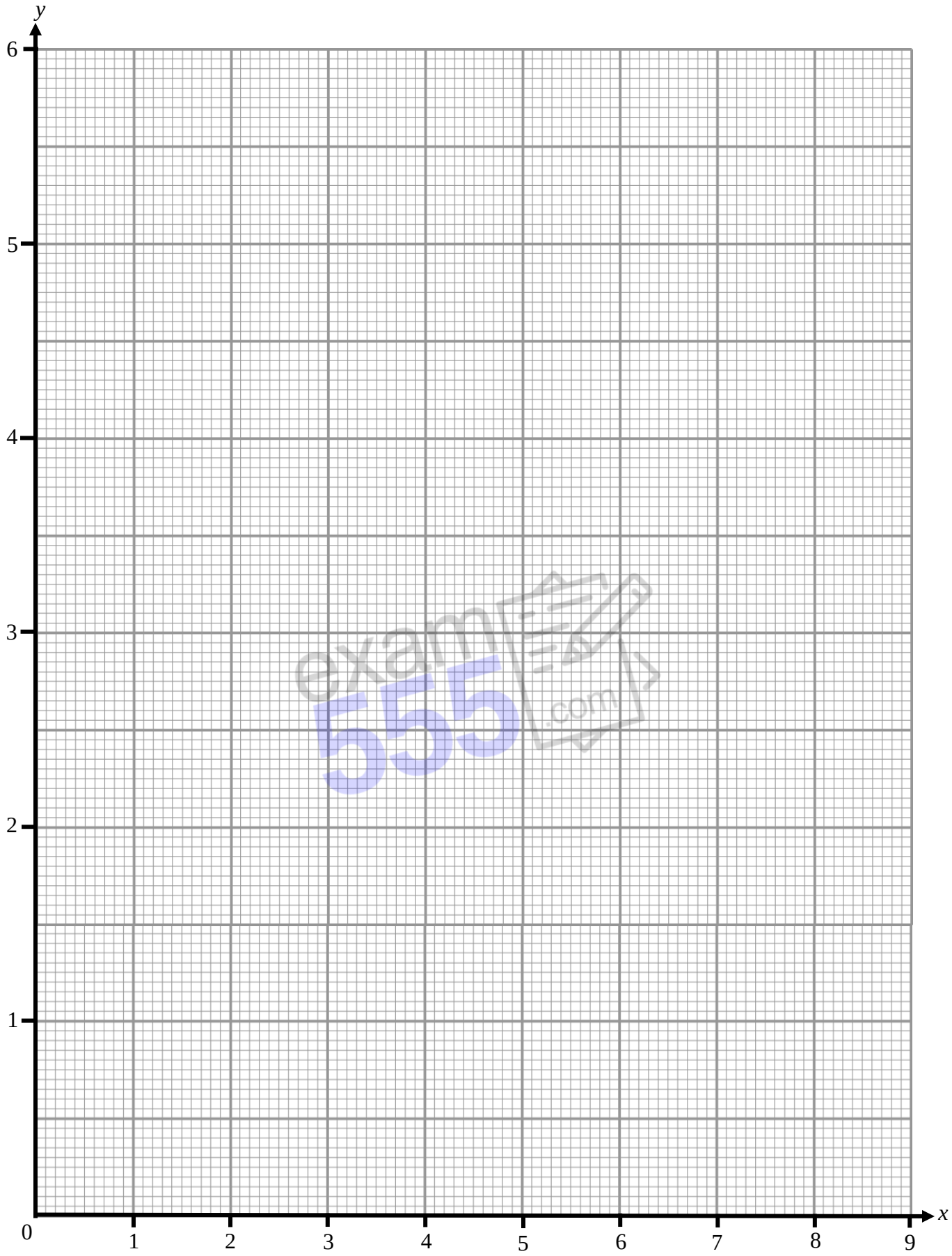
Answer x = ……..…… [1]

(iii) This value of x has a solution of the equation $Ax^2 + Bx + 48 = 0$.

Find the value of A and the value B.

Answer A = ……..……

B = ……..…… [2]



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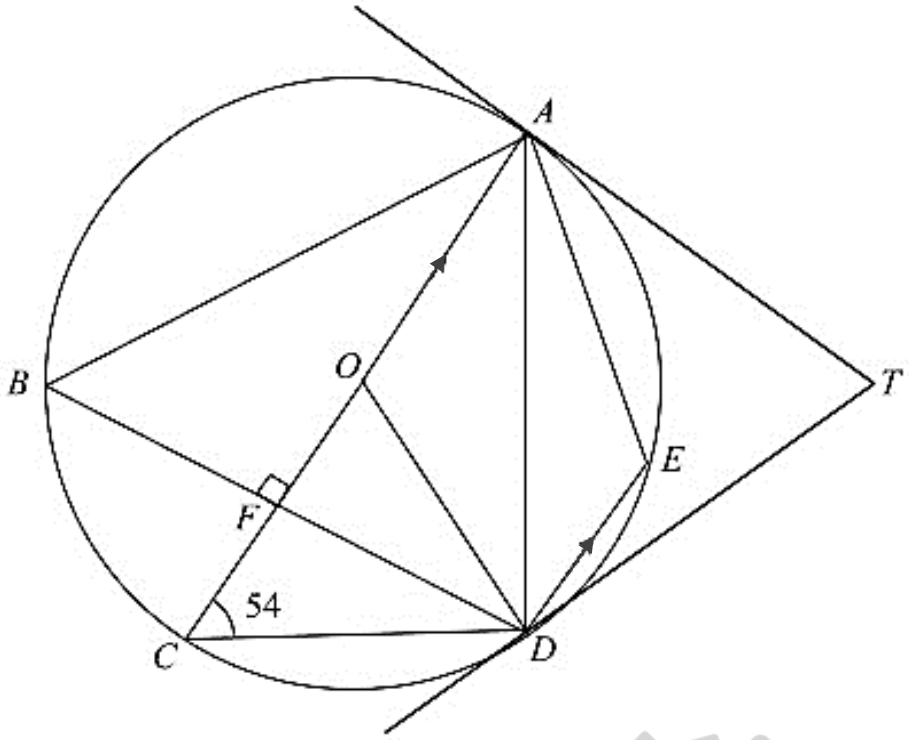


In the diagram, O is the centre of the circle $ABCDE$. DE is parallel to CA, TA and TD are tangents to the circle at A and D respectively.
AC is perpendicular to BD and $\angle ACD = 54°$.

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

Answer

[2]

(b) By stating your reasons clearly, find

(i) angle *CAD*,

Answer ……..… ° [1]

(ii) angle *AOD*,

Answer ……..… ° [1]

(iii) angle *CAE*,

Answer ……..… ° [2]

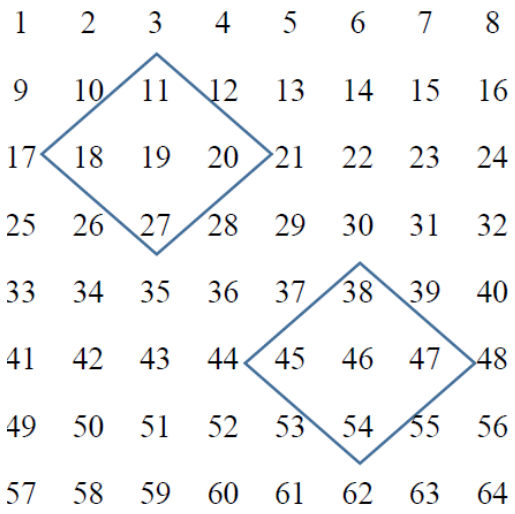
(iv) angle *BAT*,

Answer ……..… ° [1]

(v) angle *ATD*.

Answer ……..… ° [1]

8 (a)



The numbers 1 to 64 are arranged in a grid as shown.
A rhombus is placed in various positions on the grids to enclose five of the numbers.
Two possible positions of the rhombus are shown above.

(i) A rhombus is placed such that the number at the centre is 19.

Find the sum of the five numbers in the rhombus.

Answer …… [1]

(ii) It is given that the number in the centre of one rhombus is y.

Find and simplify an expression, in terms of y, for the sum of five numbers.

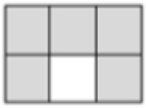
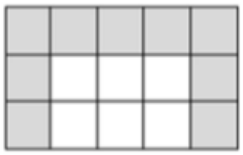
Answer …… [2]

(iii) It is given that the sum of the five numbers in another rhombus is 145.

Find the number at the top of this rhombus.

Answer ……..…… [1]

(b) The table below shows a flooring consisting of square tiles measuring 1 m^2 each. Each day similar tiles are added to the previous pattern.

			
Number of days	Day 1	Day 2	Day 3
Area added (m^2)	1	5	9
Length, l (m)	1	3	5
Breadth, b (m)	1	2	3

(i) Find an expression, in terms of n, for the area added on Day n.

Answer ……..…… [1]

(ii) Find the area added on Day 20.

Answer ……..…… m^2 [1]

(iii) Explain why the area added is always odd.

Answer ……

……

…… [1]

(iv) Find an expression for the **total area** of the flooring in the form of $an^2 + bn$, on Day *n*.

Answer …… [2]

(v) Determine if a **total area** of 780 m^2 of flooring can be completed in 3 weeks.

Answer ……

……

…… [2]

[Turn over for Question 9]

9 The Open Electricity Market is an initiative by the Energy Market Authority (EMA) of Singapore that allows households to enjoy more choices and flexibility when buying electricity.

Mr Simon and his family live in a bungalow.
Their average monthly electricity consumption is 2000 kWh.
Mr Simon will be using his OABC credit card to pay for his monthly electricity bill.
He would also like to receive a paper bill each month instead of an electronic one.
As Mr Simon will be migrating to London, he intends to terminate his electricity supply at the end of 8 months, on 30 August 2024.

Based on the above information, Mr Simon has identified three retailers that he can choose from for his electricity supply from 1 January 2024 to 30 August 2024.
The minimum contract period is 1 year.

List of Electricity Retailer

	Alpha Switch	**Best Electric**	**Chew Watt**
a) Base Price	20% **off** regulated tariff, with GST (see table below)	23.80 cents/kWh	23.35 cents/kWh
b) Sign-up Incentives	One-time $200 Cash rebate and 3% monthly rebates for OABC credit card holder	Nil	One-time $150 Cash rebate
c) Early Termination Charge (E.T.C) (if minimum contract period is not met)	Nil	E.T.C. = $A \times B \times C \times 15\%$ A = Average monthly electricity consumption B = Base Price C = Number of months remaining or part thereof	E.T.C. = Termination Rate × remaining months Termination Rate per month: Terrace - $30 Semi-D - $45 Bungalow - $60
d) Cost of Paper Bill	$0.60 per bill	$1.14 per bill	$0.75 per bill

Estimate of Quarterly Household Regulated Tariffs in 2024

	Without GST (cents/kWh) per month	With GST (cents/kWh) per month
January 2024 – March 2024	29.89	
April 2024 – June 2024	29.79	
July 2024 – September 2024	29.88	

(a) In 2024, GST will be chargeable at 9%.
Complete the table above. [1]

(b) Suggest the cheapest retailer for Mr Simon's electricity bill for the period of 1 January 2024 to 30 August 2024.
Justify your decision and show your method clearly.

The suggested retailer is ……

…… [7]

~ End of paper ~