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| <b>Name:</b> | <b>Register No.:</b> | <b>Class:</b> |
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**SECONDARY FOUR  
PRELIMINARY EXAMINATION 2025**

**MATHEMATICS  
Paper 2**

**4052/02  
26 August 2025  
2 hours 15 minutes**

Candidates answer on the Question Paper.

**READ THESE INSTRUCTIONS FIRST**

Write your name, register number and class 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.

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 of the 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  $\pi$ , use either your calculator value or 3.142.

***For Examiner's Use***

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----------|---|---|---|---|---|---|---|---|---|----|
| Marks    |   |   |   |   |   |   |   |   |   |    |

| Table of Penalties |    | Question No. | 90 |
|--------------------|----|--------------|----|
| Presentation       | –1 |              |    |
| Accuracy/ Units    | –1 |              |    |

## ***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*

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

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

- 1 (a) Solve the inequality  $2 - x < \frac{3x + 4}{2} < 5x - 3$ .

Answer \_\_\_\_\_ [3]

- (b) It is given that  $F = \frac{m(7a - 2x^2)}{3a}$ , where  $m \neq 0$  and  $a \neq 0$ .

- (i) Find, in terms of  $a$ , the value of  $F$  when  $x = -a$  and  $m = 3$ .

Answer  $F =$  \_\_\_\_\_ [1]

- (ii) Express  $x$  in terms of  $F$ ,  $a$  and  $m$ .

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

(c) Solve the equation  $\frac{x+2}{x+5} + \frac{3x}{x-2} = 7$  .

*Answer*  $x =$  \_\_\_\_\_ or \_\_\_\_\_ [4]

- 2** A company conducted a survey in a girl's school and found that a user's likelihood of logging into a particular app each day depends on whether she logged in the previous day.

If the user logs in on a particular day, the probability that she logs in again the following day is 0.7.

If the user does not log in on a particular day, the probability that she continues not logging in the next day is 0.8.

It is given that Emily logs in on Monday.

- (a)** Find the probability that Emily logs in on Tuesday, Wednesday and Thursday.

*Answer* \_\_\_\_\_ [2]

- (b)** Find the probability that Emily does not log in on Wednesday.

*Answer* \_\_\_\_\_ [2]

- (c)** Each time the user logs in, she will earn 10 reward points.  
If the user does not log in, no reward points will be given.

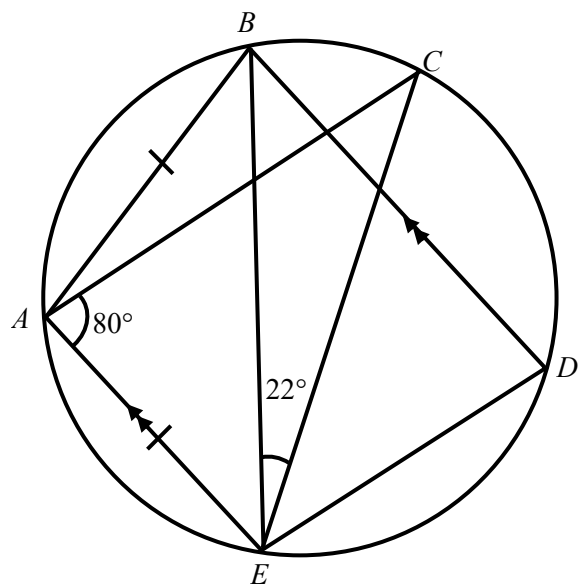
- (i)** Find the probability that Emily earns exactly 20 points by Wednesday.

*Answer* \_\_\_\_\_ [2]

- (ii)** Find the probability that Emily earns more than 10 points by Wednesday.

*Answer* \_\_\_\_\_ [2]

- 3  $A, B, C, D$  and  $E$  are points on a circle.  
 $AE = AB$ ,  $AE$  is parallel to  $BD$ , angle  $BEC = 22^\circ$  and angle  $EAC = 80^\circ$ .



- (a) Find angle  $AEB$ .

Answer Angle  $AEB =$  \_\_\_\_\_ [2]

- (b) Find angle  $DEC$ .

Answer Angle  $DEC =$  \_\_\_\_\_ [3]

(c) Angle  $AFE = 78^\circ$ .

Determine the position of point  $F$ .

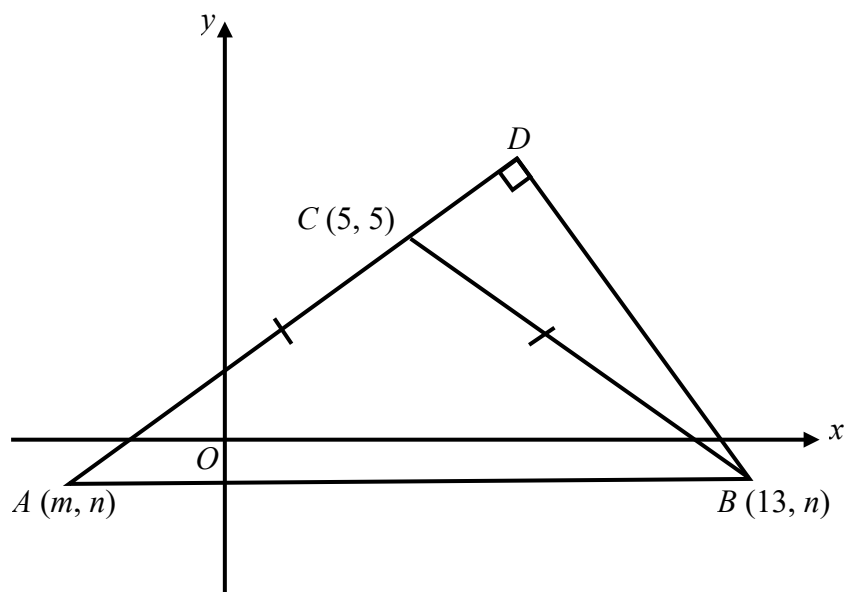
Justify your answer.

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[2]

- 4 In the diagram, the perpendicular from  $B$  to  $AC$  meets  $AC$  produced at  $D$ .  
It is given that  $AC = BC$  and the gradient of  $BC$  is  $-\frac{3}{4}$ .



- (a) Find the equation of line  $BC$ .

Answer \_\_\_\_\_ [2]

- (b) Find the value of  $n$ .

Answer  $n =$  \_\_\_\_\_ [1]

(c) Show that  $m = -3$ .

..... [1]

(d) Find the area of triangle  $ABC$ .

*Answer* ..... units<sup>2</sup> [2]

(e) Hence, find the length of  $BD$ .

*Answer* ..... units [3]

- 5**  $A$ ,  $B$  and  $C$  are points on the horizontal ground.  
 $B$  is at a bearing of  $290^\circ$  and 800 m away from  $A$ .  
 $C$  is due north of  $A$  and at a bearing of  $60^\circ$  from  $B$ .

**(a)** Find  $BC$ .

*Answer* \_\_\_\_\_ m [2]

**(b)** Show that  $AC$  is approximately 707.64 m.

*Answer*

[2]

$CT$  is a vertical tower at  $C$ .

When Betty is at  $A$ , the angle of elevation of the top of the tower,  $T$ , is  $20^\circ$ .

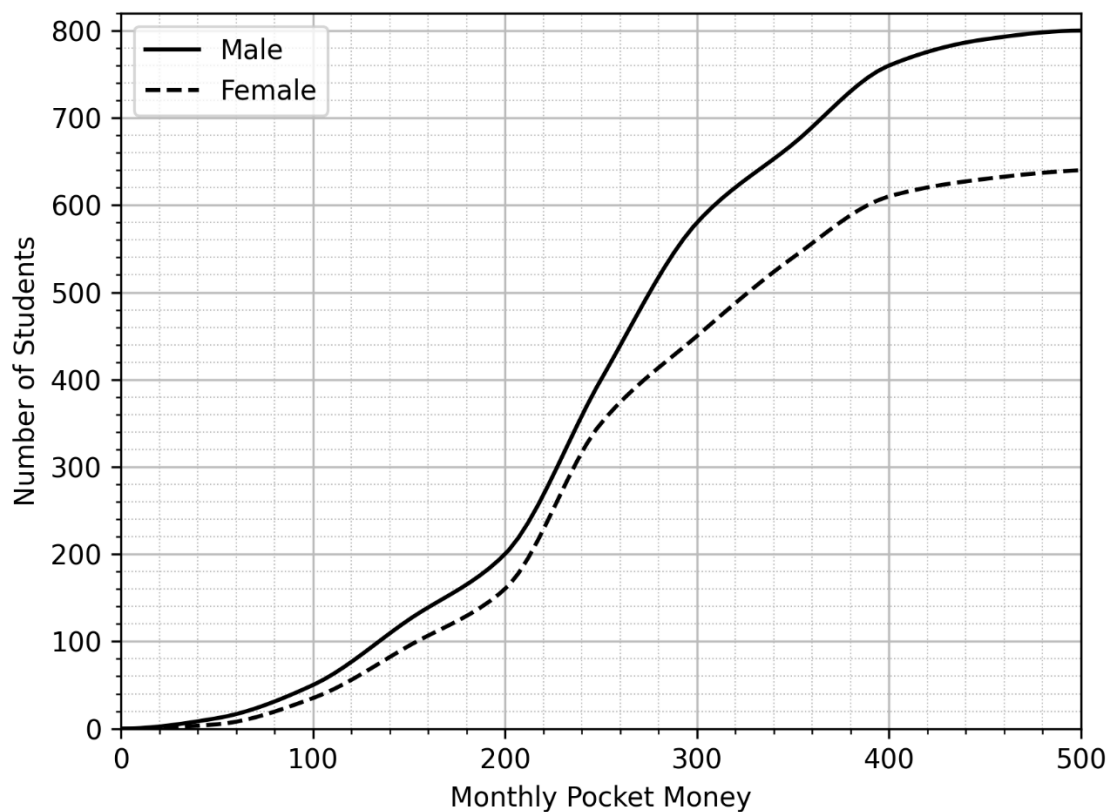
(c) Find  $CT$ .

*Answer* \_\_\_\_\_ m [2]

(d) Find the largest angle of elevation of  $T$  as Betty walks from  $A$  to  $B$ .

*Answer* \_\_\_\_\_ [3]

- 6 A secondary school conducted a survey on the amount of pocket money male and female students received each month. The cumulative frequency curves below represent the distributions of the amounts received by each group.



- (a) Use the curve to estimate  
(i) the median monthly pocket money the male students received,

Answer \$ \_\_\_\_\_ [1]

- (ii) the interquartile range of the monthly pocket money the male students received.

Answer \$ \_\_\_\_\_ [2]

- (b) Find the number of students who received more than \$300 of pocket money each month.

*Answer* \_\_\_\_\_ [2]

- (c) Amy said, “In this survey, the percentage of male students who received above \$300 of pocket money each month is higher than the percentage of female students who received above \$300 of pocket money each month.”  
Do you agree with this statement?  
Justify your answer.

*Answer*

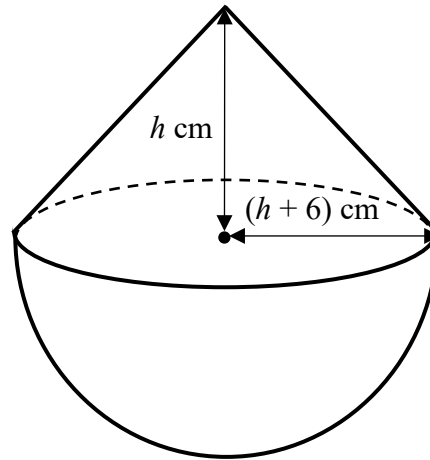
[2]

- (d) The school realised that there is a mistake in the data.  
One of the male student’s monthly pocket money should be \$300 instead of \$250.  
How does this affect the accuracy of the interquartile range of the male students’ monthly pocket money?

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----- [1]

- 7 The figure shows a solid consisting of a right circular cone and a hemisphere. The height and the base radius of the circular cone are  $h$  cm and  $(h + 6)$  cm respectively. The volume of the hemisphere is three times the volume of the cone.



- (a) Show that  $h = 12$ .

*Answer*

[3]

- (b) Find the total surface area of the solid giving your answer correct to the nearest  $\text{cm}^2$ .

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

- (c) Cathy buys a tin of paint that can cover a surface area of  $0.5 \text{ m}^2$ .  
She cuts the solid into 2 identical parts and plans to paint all surfaces of the two parts with the can of paint.  
Does she have enough paint?  
Explain your answer.

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[3]

- 8** A cuboid has a square base of sides  $x$  cm.  
Its height is  $h$  cm and its volume is  $150 \text{ cm}^3$ .

- (a)** Show that the total surface area of the cuboid,  $A = 2x^2 + \frac{600}{x}$ .

*Answer*

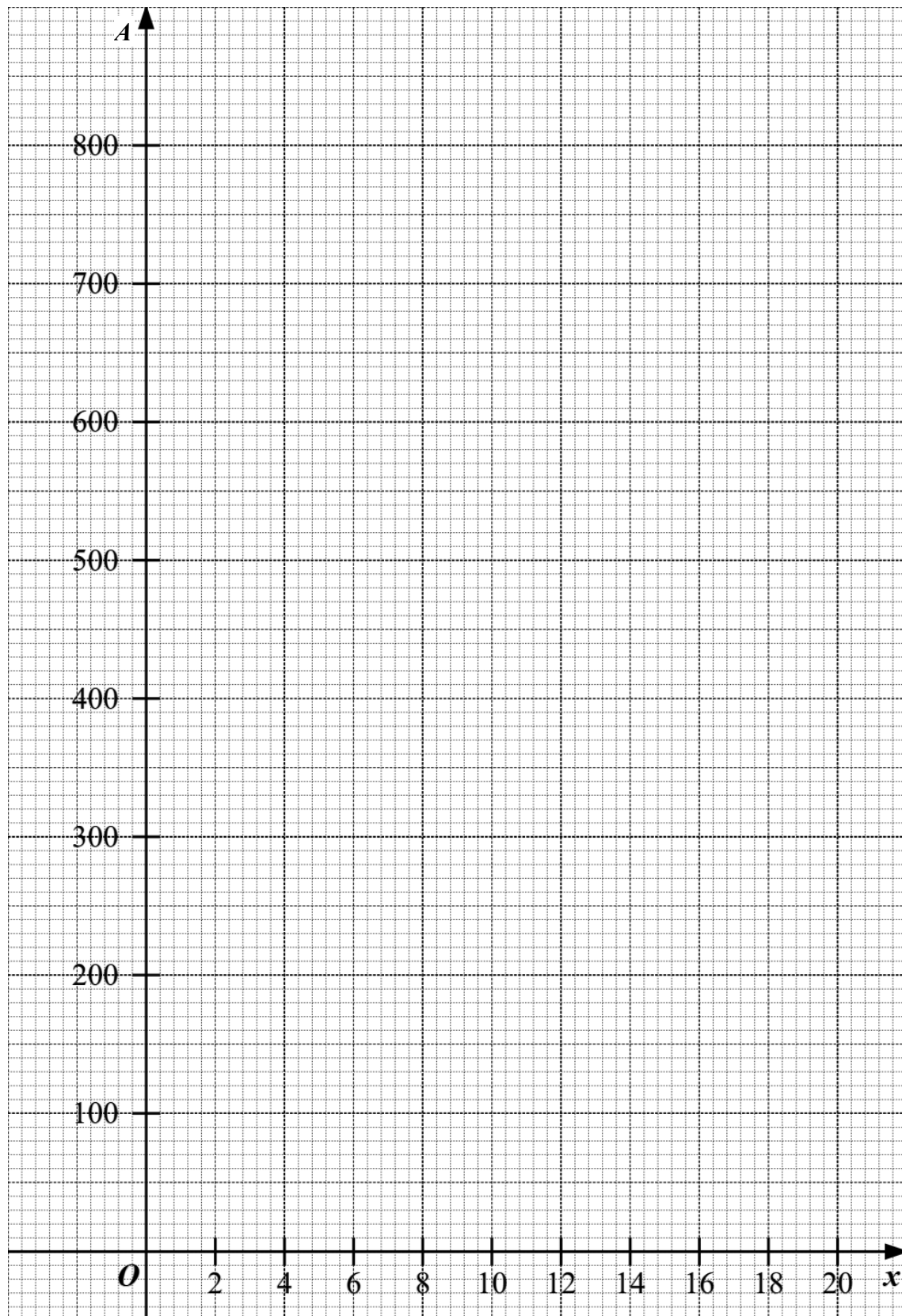
[2]

- (b)** Complete the table of values for  $A = 2x^2 + \frac{600}{x}$ .

| $x$ | 2   | 4   | 6   | 8   | 10  | 12  | 14 | 16  | 18  | 20  |
|-----|-----|-----|-----|-----|-----|-----|----|-----|-----|-----|
| $A$ | 308 | 182 | 172 | 203 | 260 | 338 |    | 550 | 681 | 830 |

[1]

- (c) On the grid, draw the graph of  $A = 2x^2 + \frac{600}{x}$  for  $2 \leq x \leq 20$ .



- (d) Can the total surface area of the cuboid be  $150 \text{ cm}^2$ ?  
Explain your answer.

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----- [1]

- (e) A manufacturer designs cuboid packaging boxes with square bases. The total surface area must not exceed the material cost limit which is given by  $A = 25x + 150$ .

- (i) On the same grid, draw the straight line  $A = 25x + 150$  for  $2 \leq x \leq 20$ .

*Answer* [1]

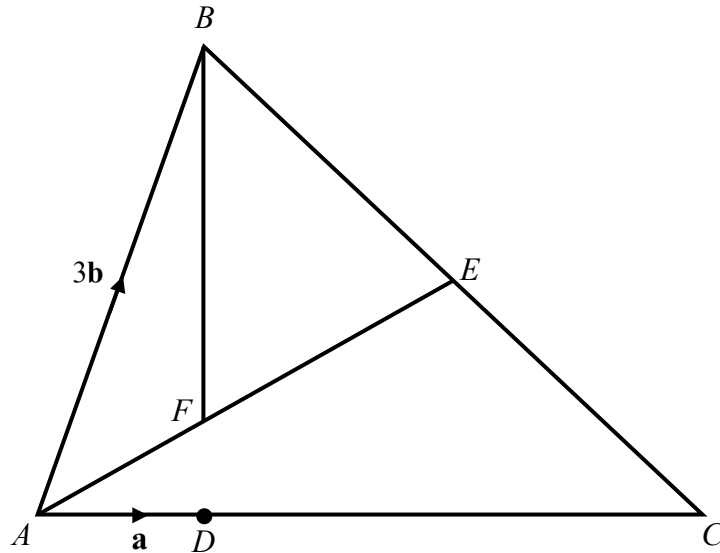
- (ii) Use the graph to find the possible lengths of the sides of the cuboid where the material cost is maximised.

*Answer*  $x = \text{----- cm}$  or  $\text{----- cm}$  [2]

- 9 In the diagram,  $\overrightarrow{AD} = \mathbf{a}$ ,  $\overrightarrow{AB} = 3\mathbf{b}$  and  $AD = \frac{1}{4}AC$ .

$E$  is the midpoint of  $BC$ .

$F$  is a point on  $AE$  such that  $AF = \frac{2}{3}FE$ .



- (a) Express and simplify your answers in terms of  $\mathbf{a}$  and  $\mathbf{b}$ ,

(i)  $\overrightarrow{BC}$ ,

Answer  $\overrightarrow{BC} =$  \_\_\_\_\_ [1]

(ii)  $\overrightarrow{AF}$ ,

*Answer*  $\overrightarrow{AF} = \underline{\hspace{2cm}}$  [2]

(iii)  $\overrightarrow{BF}$ .

*Answer*  $\overrightarrow{BF} = \underline{\hspace{2cm}}$  [1]

(b) Explain if  $BF$  produced will meet  $AC$  at  $D$ .

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----- [3]

(c) Find the value of

(i)  $\frac{\text{area of } \triangle ABF}{\text{area of } \triangle ABE},$

*Answer* \_\_\_\_\_ [1]

(ii)  $\frac{\text{area of } \triangle BEF}{\text{area of } \triangle ABC}.$

*Answer* \_\_\_\_\_ [2]

- 10** A secondary school is planning a major upgrade by setting up a solar panel system. The goal is to choose the system that offers the best financial value over its entire lifespan. The school is evaluating two solar panel providers, SolarSmart and EcoSun.

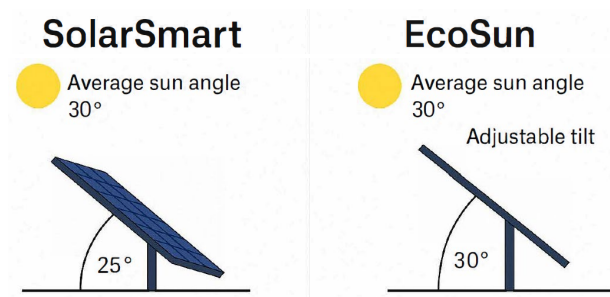
School's current electricity usage:

- School uses an average of 17 000 kilowatt hours (kWh) of electricity per year.
- The cost of electricity is \$0.30 per kWh.

Information on the solar panel providers:

| Company    | Number of Panels | Type of Panel     | Total Installation Cost | Annual Maintenance Cost |
|------------|------------------|-------------------|-------------------------|-------------------------|
| SolarSmart | 50               | Fixed tilt at 25° | \$66 000                | \$340                   |
| EcoSun     | 45               | Adjustable tilt   | \$64 000                | \$360                   |

- Each panel's wattage is 320 Watts (W) at 100% efficiency.
- The average sun angle at the school's location is 30°.
- For every 1° difference between the panel tilt and the sun angle, the panel's efficiency drops by 1%.
- Both solar panel systems are guaranteed to last for 25 years.



Additional information:

- Singapore gets an average of 4.2 hours of peak sunlight per day.
- Solar panel output in daily watt hours = solar panel wattage × peak sunlight hours × 75%.
- The school can sell any extra energy it does not use back to the grid for \$0.20 per kWh.

- (a) Calculate, in watt hours, the daily power output per panel for SolarSmart.

*Answer* \_\_\_\_\_ Wh [2]

- (b) Find the total daily power output from each company, leaving your answer in kilowatt hours (kWh).

*Answer* Daily output for SolarSmart = \_\_\_\_\_ kWh

Daily output for EcoSun = \_\_\_\_\_ kWh [2]

- (c) Recommend which company the school should choose.  
Justify your decision and show your calculations clearly.

..... [5]

- (d) State one assumption made in your calculation in (c).

*Answer*

..... [1]

**END OF PAPER**