| Name: | Register No.: | Class: |
|---|---|---|
| | | |

# CRESCENT GIRLS' SCHOOL
# SECONDARY FOUR
# PRELIMINARY EXAMINATION

**MATHEMATICS**
**Paper 1**

**4052/01**
**21 August 2025**
**2 hours 15 mins**

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 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Marks | | | | | | | | | | | | |
| Question | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Marks | | | | | | | | | | | | |

| Table of Penalties | | Qn. No. | | |
|---|---|---|---|---|
| *Presentation* | –1 | | | |
| *Accuracy/ Units* | –1 | | Parent's/ Guardian's Signature | 90 |

**This question paper consists of 19 printed pages.**

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## *Mathematical Formulae*

*Compound Interest*

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

*Mensuration*

$$\text{Curved surface area of a cone} = \pi rl$$

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

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

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

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

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

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

*Trigonometry*

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

*Statistics*

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

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



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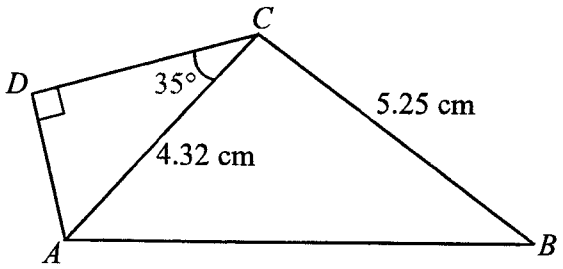
Answer **all** the questions.

**1** Alex puts aside \$8000 in an investment fund which offers compounded interest quarterly at an interest rate of 2% per annum.
Calculate the total value of his investment at the end of 3.5 years.

*Answer* \$ ..... [2]

---

**2** In the quadrilateral $ABCD$, $BC = 5.25$ cm, $AC = 4.32$ cm.
Angle $ADC = 90°$. Angle $ACD = 35°$.




**(a)** Calculate $AD$.

*Answer* ..... cm [1]

**(b)** Given that the area of triangle $ABC = 3.18$ cm$^2$, find the obtuse angle $ACB$.

*Answer* ..... [2]

---



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3 The density of gold is 19.32 g/cm$^3$.
The mass of a gold bracelet is 37.51 g.

**(a)** By rounding these numbers correct to 2 significant figures, find an estimate of the volume of the gold bracelet.
Show the numbers you use.

*Answer* ..... cm$^3$ [2]

**(b)** Without doing any further calculation, explain why the actual volume of the gold bracelet is less than the answer to **part (a)**.

.....

.....

..... [1]

---

4 A box contains 10 blue water bottles, 7 green water bottles and 5 red water bottles.

**(a)** Two water bottles are drawn from the box.
In the first draw, a water bottle is randomly drawn from the box with no replacement.
What is the probability that a green bottle will be drawn on the second draw?

*Answer* ..... [2]

**(b)** How many red water bottles should be added into the bag such that the probability of drawing a red water bottle on the first draw is $\frac{2}{3}$?

*Answer* ..... [2]

---



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

*Answer* ..... [3]

---

**6** Five positive integers have a mean of 18, a median of 14 and a mode of 33.
Given that the two smallest integers are prime numbers, find the five numbers.

*Answer* ....., ....., ....., ....., ..... [2]

---



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7 In 2023, the revenue of a company was 12% more than in 2022.
In 2024, it was 30% less than in 2023.

**(a)** Given that $p$ represents the revenue of the company in 2022, express the revenue in 2023 in terms of $p$.

*Answer* ..... [1]

**(b)** Ben said that in 2024, the revenue of the company was 33.6% less than in 2022.
Do you agree?
You must show your calculations.

.....

.....

..... [2]

---

**8** **(a)** Solve $\frac{3}{1-x}-\frac{2}{3x-1}=0$.

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

**(b)** Simplify $\frac{4x^2-25}{6x^2-13x-5}$.

*Answer* ..... [2]

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**9** The ratio of exterior angle : interior angle of a regular polygon is 1 : 9.
Calculate

**(a)** the number of sides of the polygon,

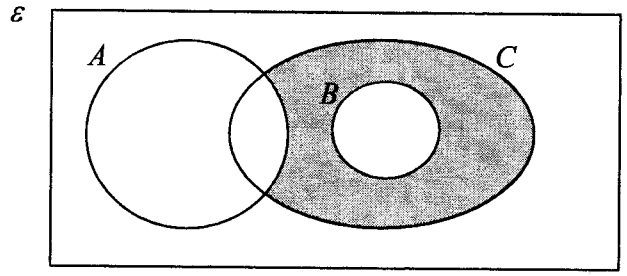
*Answer* ..... [2]

**(b)** the sum of the interior angles of the polygon.

*Answer* ..... [1]

---

**10** **(a)** Write down the set represented by the following shaded region.




*Answer* ..... [1]

**(b)** Given that $\varepsilon = \{x : x \text{ is an integer}, 1 \leq x < 13\}$, and its subsets $A$, $B$ and $C$ are

$A = \{x : x \text{ is a factor of } 16\}$

$B = \{x : x \text{ is a prime number}\}$

$C = \{x : 9 - x \geq 1\}$

**(i)** List the elements in the set $A \cap B$.

*Answer* ..... [1]

**(ii)** Find $n(B' \cup C)$.

*Answer* ..... [1]

**(iii)** Explain clearly if $A \subset C$.

.....

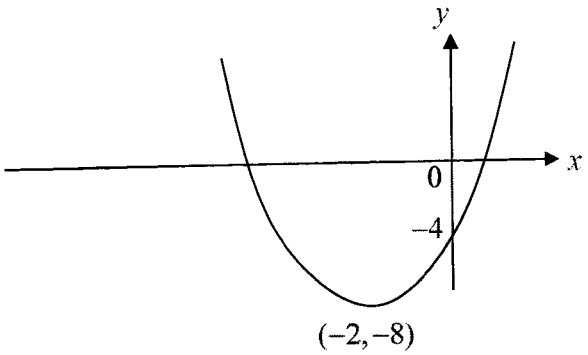
..... [1]

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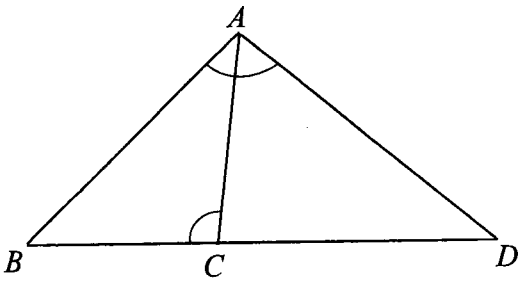
**11** The figure below shows a graph with $y$-intercept $-4$.
It has a minimum point $(-2, -8)$.
Find the equation of the graph in the form $y = x^2 + ax + b$, where $a$ and $b$ are integers.




*Answer* $y =$ ..... [2]

---

**12**




In the diagram, angle $ACB$ = angle $DAB$.

**(a)** Show that the triangles $ABC$ and $DBA$ are similar.

*Answer*

[2]

**(b)** Given that $AB = 5.2$ cm and $BC = 3.4$ cm, find the length of $CD$.

*Answer* ..... cm [2]

---



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**13 (a)**



The diagram shows two geometrically similar bowls.
The larger bowl has a base area of 64 $cm^2$.
The smaller bowl has a base area of 12.25 $cm^2$.

**(i)** The height of the smaller bowl is 7 cm.
Calculate the height of the bigger bowl.

*Answer* ..... cm [2]

**(ii)** A hawker stall uses the two types of bowls to serve porridge to customers.
The price of the same type of porridge served using the large bowl is eight times as much as the small bowl.
Which size gives a better value for money? Explain your answer.

.....
.....
..... [2]

**(b)** The illumination, $I$ units, of a bulb is inversely proportional to the square of the distance, $d$ metres.
The distance from a particular bulb is increased by 25% of its original distance.
Calculate the percentage reduction in the illumination of the bulb.

*Answer* ..... % [2]



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**14** Simplify $\left(\frac{x^4}{100}\right)^{\frac{1}{2}} \div \left(64x^3\right)^{-\frac{2}{3}}$.

*Answer* ..... [2]

---

**15** A map is drawn to a scale of 1: 25 000.

**(a)** This scale can be expressed as 1 centimetre represents $n$ kilometres.
Find $n$.

*Answer* $n =$ ..... [1]

**(b)** The distance between two points on the map is 41.5 centimetres.
Find the actual distance, in kilometres, between the two points.

*Answer* ..... km [1]

**(c)** A farm has an area of 51.2 square centimetres on this map.
Find the area of the farm, in square centimetres, on a second map which is drawn to a scale of 1 : 80 000.

*Answer* ..... $cm^2$ [2]

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**16** **(a)** Expand and simplify $(3x-5p)^2$.

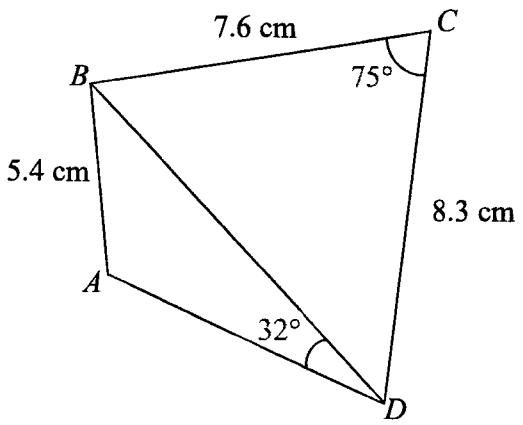
*Answer* ..... [1]

**(b)** Given that $(3x-5p)^2 = 9x^2 - 90x + 225$, find $p$.

*Answer* $p =$ ..... [1]

---

**17** The diagram shows a quadrilateral $ABCD$.
$AB = 5.4$ cm, $BC = 7.6$ cm, $CD = 8.3$ cm, angle $BCD = 75°$ and angle $ADB = 32°$.




**(a)** Find $BD$.

*Answer* ..... cm [3]

**(b)** Find angle $BAD$.

*Answer* ..... [2]

---



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**18** **(a)** **(i)** Write 3150 as a product of its prime factors.

*Answer* ..... [1]

**(ii)** The highest common factor (HCF) of two numbers is 21.
The lower common multiple (LCM) of the two numbers is 3150.
Both numbers are greater than 70. Find the two numbers

*Answer* ..... and ..... [2]

**(b)** **(i)** Use prime factors to explain why $14 \times 56$ is a perfect square.

.....
..... [1]

**(ii)** $p$ and $q$ are both prime numbers.
Find the values of $p$ and $q$ so that $14 \times 56 \div \frac{p}{q}$ is a perfect cube.

*Answer* $p =$ ..... , $q =$ ..... [2]



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**19** **(a)** Factorise completely $49x^2-(x+3)^2$.

*Answer* ..... [2]

**(b)** One solution of the equation $6x^2+kx-14=0$, where $k$ is an integer, is $x=\frac{2}{3}$.

Find

**(i)** the value of $k$,

*Answer* $k=$ ..... [1]

**(ii)** the other solution to the equation.

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



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**20** A bicycle rental station charges by hour for the rental of its bicycles.
On a particular week, the normal bicycles, children bicycles, and family bicycles were rented for 210 hours, 40 hours and $x$ hours respectively on Saturday.
On Sunday, the normal bicycles, children bicycles, and family bicycles were rented for 325 hours, 65 hours and 32 hours, respectively.

**(a)** Represent the above information in a $2\times3$ matrix **P**.

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

**(b)** The charges for one hour's rental is \$12 for normal bicycle, \$8 for children bicycle and \$40 for family bicycle.

Find, in terms of $x$, the matrix $\mathbf{Q} = \mathbf{P}\begin{pmatrix} 12 \\ 8 \\ 40 \end{pmatrix}$.

*Answer* $\mathbf{Q} = \begin{pmatrix} \\ \end{pmatrix}$ [1]

**(c)** Explain what each element in **Q** represents.

.....
..... [1]

**(d)** The revenue from rental of family bicycles on that Saturday is equivalent to the revenue from the rental of children bicycles on that Sunday.
Calculate the value of $x$.

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



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**(e)** In the following week, a special event was held near the bicycle rental station.
The rental revenue increased by 25% and 50% compared to the previous Saturday and Sunday respectively.
Using your answer in **(d)** and matrix multiplication only, calculate the revenue on Saturday and Sunday, respectively.

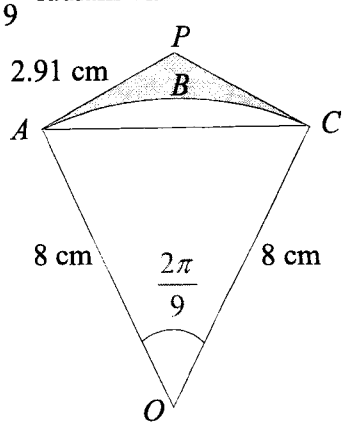
*Answer* $ ..... on Saturday and $ ..... on Sunday [2]



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**21** $ABC$ is an arc of a circle, centre $O$ and radius 8 cm.

The tangents at $A$ and $C$ meet at $P$. Angle $AOC$ is $\frac{2\pi}{9}$ radians and $AP = 2.91$ cm.




**(a)** Show that angle $APC = \frac{7\pi}{9}$ radians.

(Give reasons for each step of your working.)

*Answer*

[2]

**(b)** Find the area of the shaded region.

*Answer* ..... ..... $cm^2$ [3]



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**22** Construct triangle $ABC$ where $AB = 5.8$ cm, $BC = 7$ cm and $AC = 9.5$ cm.
Line $AB$ has been drawn.

*Answer*

$A$ ——————————— $B$

[1]

**(a)** On the same diagram, construct

**(i)** the perpendicular bisector of $AB$, [1]

**(ii)** the angle bisector of angle $CAB$. [1]

**(b)** Mark clearly a possible point which lies inside the triangle, equidistant from $A$ and $B$, and is nearer to $AC$ than $AB$. Label this point $X$. [1]



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**23** The figure below shows a series of patterns consisting of dots and lines.
Figure 1 has 4 dots and 7 lines.

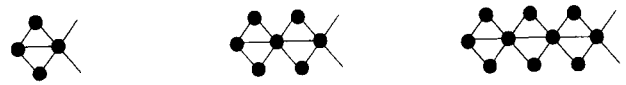


Figure 1 Figure 2 Figure 3

**(a)** Which figure has 19 dots?

*Answer* Figure ..... [1]

**(b)** Let $L$ denotes the number of lines.
Write down a formula for $L$ in terms of $n$, in Figure $n$.

*Answer* $L_n$ = ..... [1]

**(c)** Is there a figure with 83 lines?
Explain your reasoning.

.....

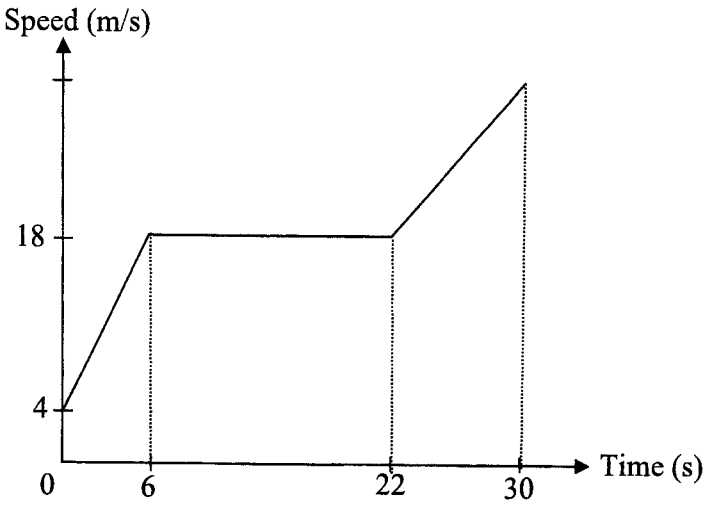
.....

..... [1]



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**24** The diagram shows a speed time graph of an object during a period of 30 seconds.




**(a)** Calculate the acceleration of the object when $t = 4$.

*Answer* ..... $m/s^2$ [1]

**(b)** Calculate the distance travelled in the first 15 seconds.

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

**(c)** Given that the acceleration of the object after $t = 22$ is 1.5 $m/s^2$, calculate the speed of the object when $t = 30$.

*Answer* ..... m/s [2]



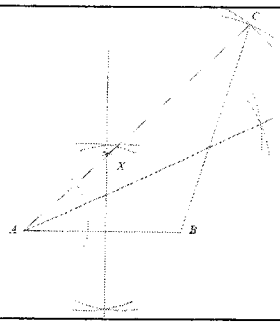
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Answer Key

| | | | |
|---|---|---|---|
| 1 | \$8578.57 | 14 | $1.6x^4$ |
| 2(a) | 2.48 cm | 15(a) | 0.25 |
| 2(b) | $163.7°$ | 15(b) | 10.375 km |
| 3(a) | $2.0\ \text{cm}^3$ | 15(c) | $5\ \text{cm}^2$ |
| 3(b) | Volume is found by dividing a larger mass by a smaller density. The actual volume is less than the estimated volume | 16(a) | $9x^2-30px+25p^2$ |
| 4(a) | $\frac{7}{22}$ | 16(b) | 3 |
| 4(b) | 29 | 17(a) | 9.70 cm |
| 5 | $\frac{-1-4x}{(2x+1)(x-2)}$ | 17(b) | $107.9°$ |
| 6 | 3, 7, 14, 33, 33 | 18(ai) | $2\times3^2\times5^2\times7$ |
| 7(a) | $1.12p$ | 18(aii) | 126 and 525 |
| 7(b) | I do not agree as there is only a drop of 21.6% in revenue between 2024 and 2022 instead of 33.6% | 18(bi) | The indices/powers of the prime factors are even integers. Therefore, $14\times56$ is a perfect square |
| 8(a) | $\frac{5}{11}$ | 18(bii) | $p=2,\ q=7$ |
| 8(b) | $\frac{(2x+5)}{(3x+1)}$ | 19(a) | $3(8x+3)(2x-1)$ |
| 9(a) | 20 | 19(bi) | 17 |
| 9(b) | $3240°$ | 19(bii) | $-\frac{7}{2}$ |
| 10(a) | $A'\cap(B'\cap C)$ or $(A\cup B)'\cap C$ | 20(a) | $\begin{pmatrix}210 & 40 & x\\ 325 & 65 & 32\end{pmatrix}$ |
| 10(bi) | $\{2\}$ | 20(b) | $\begin{pmatrix}2840+40x\\ 5700\end{pmatrix}$ |
| 10(bii) | 11 | 20(c) | The elements represent the revenue of the bicycle rental station on Saturday and Sunday respectively on that particular week |
| 10(biii) | All elements in Set A are elements in Set C, $A\neq C$. Therefore $A\subset C$ | 20(d) | 13 |
| 11 | $x^2+4x-4$ | 20(e) | \$4200 and \$8550 |
| 12(a) | $\angle ABC=\angle DBA$ (common ang<br>$\angle ACB=\angle DAB$ (given)<br>Therefore $\Delta ABC$ is similar to | 21(b) | $0.951\ \text{cm}^2$ |



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| | | | |
|---|---|---|---|
| 12(b) | 4.55 cm | 22 |  |
| 13 (ai) | 16 cm | 23(a) | Figure 6 |
| 13(aii) | As the volume of the large bowl is more than 8 times the volume of the small bowl, the larger bowl gives better value for money. | 23(b) | $L_n = 5n + 2$ |
| 13(b) | 36% | 23(c) | Since $n$ is not a positive integer, there is no figure with 83 lines. |
| | | 24(a) | $2\frac{1}{3}$ m/s$^2$ |
| | | 24(b) | 228 m |
| | | 24(c) | 30 |



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**CRESCENT GIRLS' SCHOOL**
**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.
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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. | | |
|---|---|---|---|---|
| Presentation | –1 | | | |
| Accuracy/ Units | –1 | | Parent's / Guardian's Signature | 90 |

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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 = $\pi rl$

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 $\theta$ is in radians

Sector area $= \frac{1}{2}r^2\theta$, where $\theta$ 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)** 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]



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

*Answer* $x =$ ..... or ..... [4]



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**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]

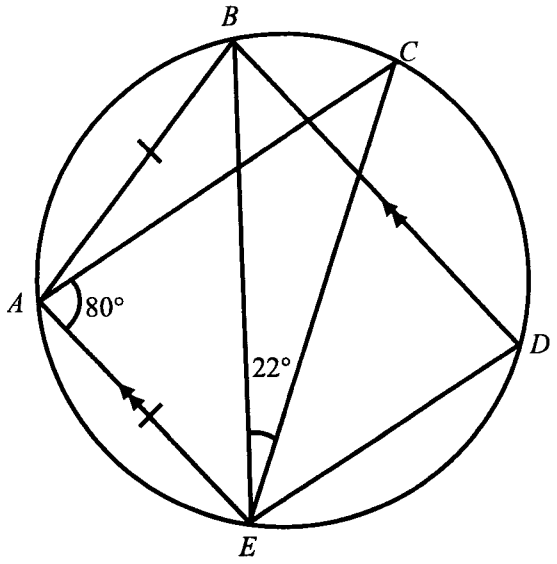
**(ii)** Find the probability that Emily earns more than 10 points by Wednesday.

*Answer* ..... [2]



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




**(a)** Find angle $AEB$.

*Answer* Angle $AEB$ = ..... [2]

**(b)** Find angle $DEC$.

*Answer* Angle $DEC$ = ..... [3]



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**(c)** Angle $AFE = 78°$.

Determine the position of point $F$.

Justify your answer.

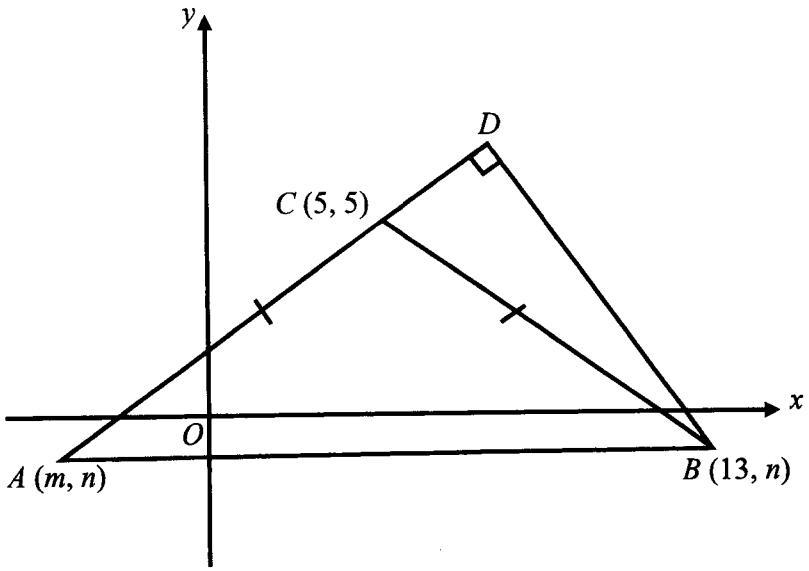
[2]



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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]



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

_____ [1]

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

*Answer* ..... units$^2$ [2]

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

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



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

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

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

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

*Answer*

[2]



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$CT$ is a vertical tower at $C$.
When Betty is at $A$, the angle of elevation of the top of the tower, $T$, is 20°.

**(c)** Find $CT$.

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

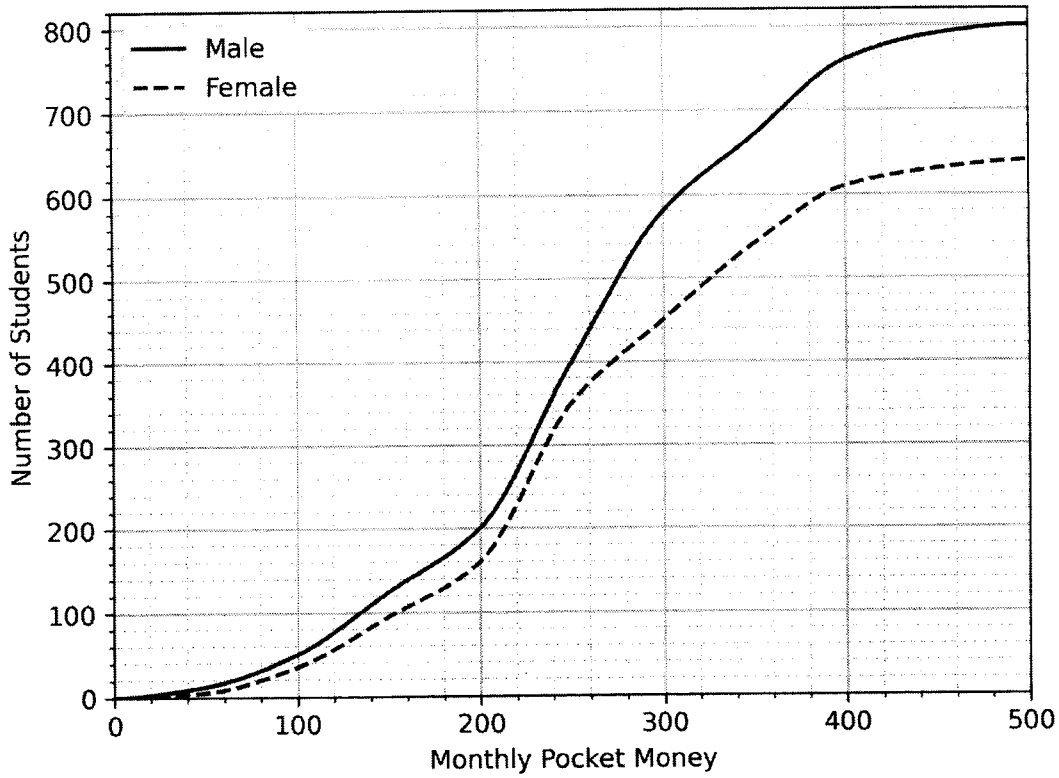
**(d)** Find the largest angle of elevation of $T$ as Betty walks from $A$ to $B$.

*Answer* ..... [3]



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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]



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**(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?

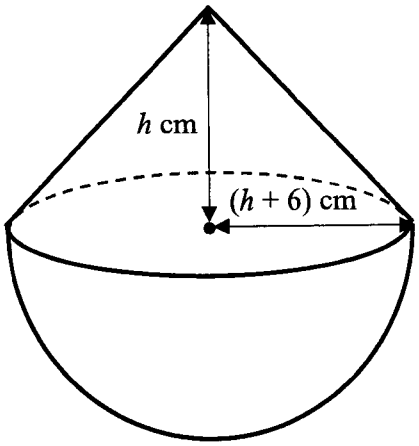
_____

_____ [1]



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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 $cm^2$.

*Answer* ..... $cm^2$ [3]



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**(c)** Cathy buys a tin of paint that can cover a surface area of 0.5 $m^2$.
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.

---

---

[3]



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

**(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 $A = 2x^2 + \frac{600}{x}$.

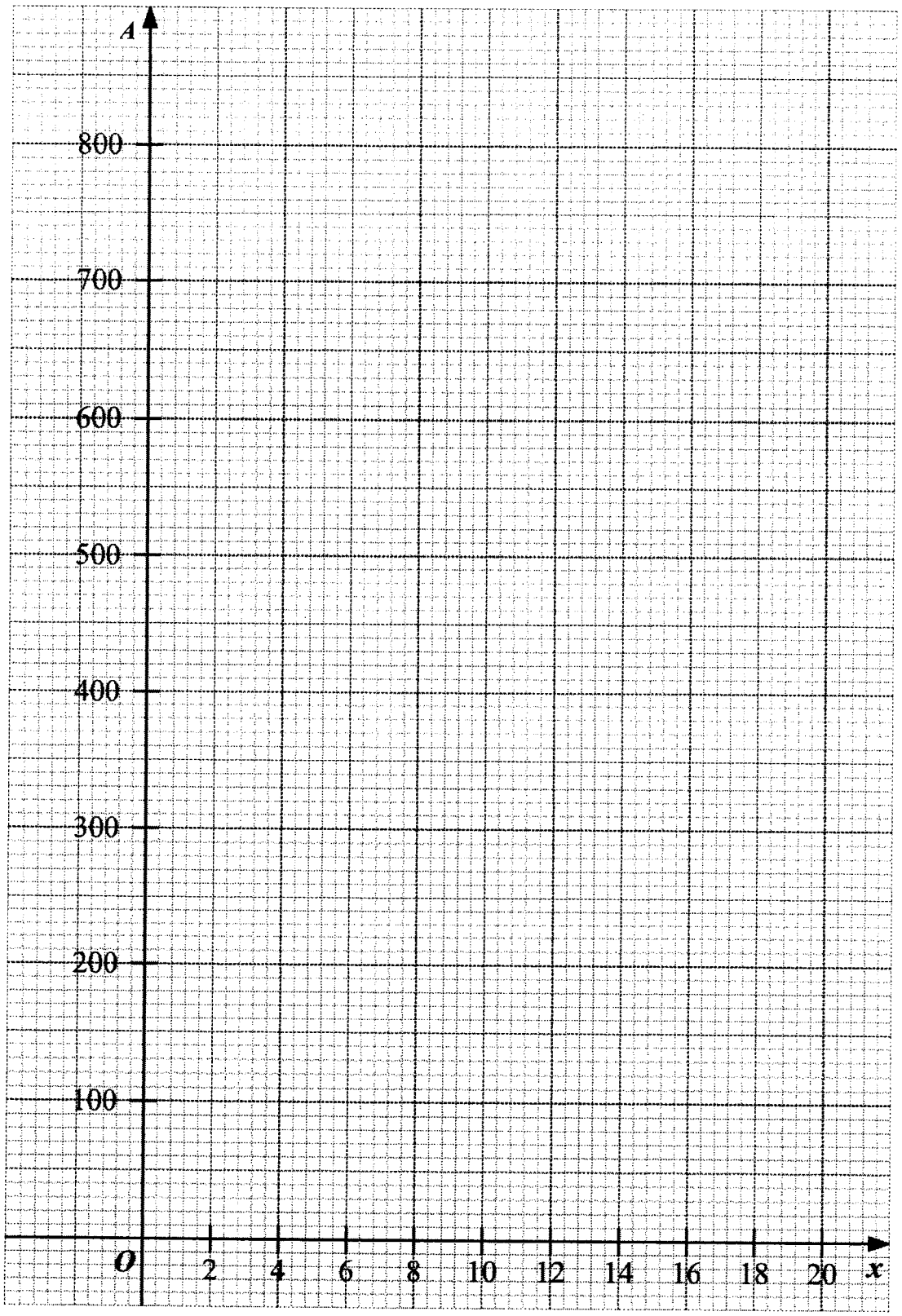
| $x$ | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| $A$ | 308 | 182 | 172 | 203 | 260 | 338 | | 550 | 681 | 830 |

[1]



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




[3]



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**(d)** Can the total surface area of the cuboid be 150 $cm^2$?
Explain your answer.

_____

_____ [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* $x =$ ..... cm or ..... cm [2]

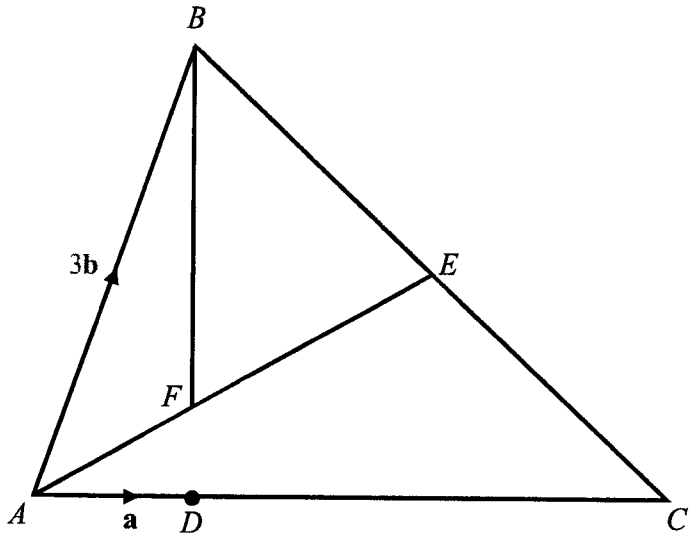


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**9** In the diagram, $\overrightarrow{AD} = \mathbf{a}$, $\overrightarrow{AB} = 3\mathbf{b}$ and $AD = \frac{1}{4}AC$.

$E$ 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 **a** and **b**,

**(i)** $\overrightarrow{BC}$,

*Answer* $\overrightarrow{BC} =$ ..... [1]



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(ii) $\overrightarrow{AF}$,

*Answer* $\overrightarrow{AF}$ = ..... [2]

(iii) $\overrightarrow{BF}$.

*Answer* $\overrightarrow{BF}$ = ..... [1]



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

[3]

**(c)** Find the value of

**(i)** $\dfrac{\text{area of } \Delta ABF}{\text{area of } \Delta ABE}$,

*Answer* ..... [1]

**(ii)** $\dfrac{\text{area of } \Delta BEF}{\text{area of } \Delta ABC}$.

*Answer* ..... [2]



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**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.

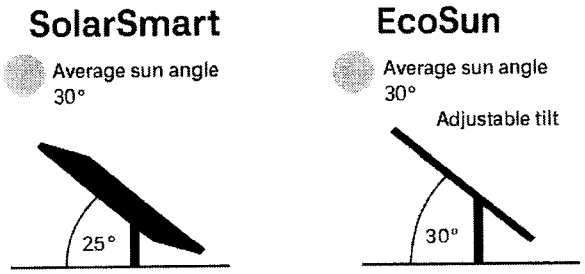
School's current electricity usage:

- 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.



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**(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]



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**(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**



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**Answer Key**

1(a) $x > \frac{10}{7}$

(bi) $F = 7 - 2a$

(bii) $x = \pm\sqrt{\frac{7am - 3aF}{2m}}$

(c) 3.80 or −5.80

2(a) 0.343

(b) 0.45

(c) 0.27

(d) 0.76

3(a) 39°

(b) 41°

(c) Point $F$ lies on the centre of the circle.

4(a) $y = -\frac{3}{4}x + \frac{35}{4}$

(b) $n = -1$

(d) 48 units$^2$

(e) 9.6 units

5(a) 868 m

(c) 258 m

(d) 21.2°

6(ai) $250

(ii) $110

(b) 410

(c) I do not agree with the statement.

(d) This does not affect the interquartile range.

7(b) 3259 cm$^2$

(c) She has enough paint.

8(b) 435

(d) Total surface area of the cuboid cannot be 150 cm$^2$.

(eii) 3 or 16

9(ai) $4\mathbf{a} - 3\mathbf{b}$

(ii) $\frac{4}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$

(iii) $\frac{4}{5}\mathbf{a} - \frac{12}{5}\mathbf{b}$

(b) BF produced will meet AC at D.

(ci) $\frac{2}{5}$

(ii) $\frac{3}{10}$

10(a) 957.6Wh

(b) Daily power output for SolarSmart = 47.88kWh

Daily power output for EcoSun = 45.36kWh

(c) SolarSmart

(d) Solar panel generates the same amount of energy every day. / 365 days in a year. / No degradation in panel performance over time / Electricity prices does not change. / Peak sunlight hours remain constant over 25 years… etc.



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