

2026 4e5n Math Prelim Paper 2 Marking Scheme

- 1 (a) Find all the prime numbers that satisfy the inequality $-3 < \frac{x-1}{6} \leq \frac{1}{2}$.

$$-3 < \frac{x-1}{6} \leq \frac{1}{2}$$

$$-18 < x-1, \quad x-1 \leq 3$$

$$-17 < x, \quad x \leq 4$$

$$-17 < x \leq 4$$

$$\text{Answer : } 2, 3 \quad [\text{A1}]$$

Answer [3]

- (b) Simplify $\frac{6xy^4}{5z^5} \div \frac{9x^3z}{20y^3}$

$$\begin{aligned} & \frac{6xy^4}{5z^5} \div \frac{9x^3z}{20y^3} \\ &= \frac{6xy^4}{5z^5} \times \frac{20y^3}{9x^3z} \\ &= \frac{8y^7}{3x^2z^6} \end{aligned}$$

Answer [2]

- (c) Simplify $\left(\frac{\sqrt[4]{r^{12}}}{27s^9} \right)^{\frac{1}{3}}$

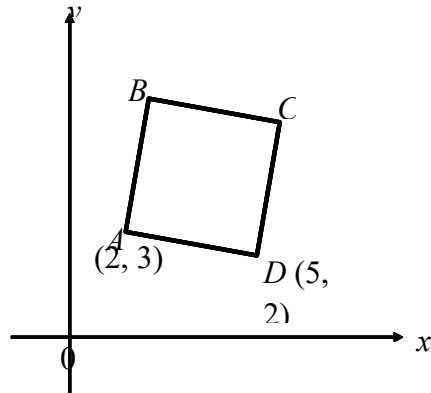
$$\begin{aligned} & \left(\frac{\sqrt[4]{r^{12}}}{27s^9} \right)^{\frac{1}{3}} \\ &= \left(\frac{27s^9}{r^3} \right)^{\frac{1}{3}} \\ &= \frac{3s^3}{r} \end{aligned}$$

Answer [2]

(d) Write as a single fraction in its simplest form $\frac{7}{25x^2-4} - \frac{3}{2-5x} + 1$.

$$\begin{aligned}
 & \frac{7}{25x^2-4} - \frac{3}{2-5x} + 1 \\
 &= \frac{7}{(5x-2)(5x+2)} + \frac{3}{(5x-2)} + \frac{25x^2-4}{25x^2-4} \\
 &= \frac{7+3(5x+2)+25x^2-4}{(5x-2)(5x+2)} \\
 &= \frac{7+15x+6+25x^2-4}{(5x-2)(5x+2)} \\
 &= \frac{25x^2+15x+9}{(5x-2)(5x+2)}
 \end{aligned}$$

2



(a) In the diagram, $ABCD$ is a square. The coordinates of A and D are $(2, 3)$ and $(5, 2)$ respectively. Find the area of square $ABCD$.

$$\text{Length of } AD = \sqrt{(5-2)^2 + (2-3)^2}$$

$$= \sqrt{10}$$

Area of square $ABCD$

$$= \sqrt{10} \times \sqrt{10}$$

$$= 10 \text{ units}^2$$

Answerunits² [3]

- (b) The points $M(0, 2k)$, $N(1, k)$ and $P(5, -6)$ lie on the same straight line.
 (i) Show that the value k is 2.

Answer

Gradient of MN = gradient of MP

$$\frac{2k+6}{0-5} = \frac{2k-k}{0-1}$$

$$\frac{2k+6}{-5} = \frac{k}{-1}$$

$$2k+6 = 5k$$

$$3k = 6$$

$$k=2$$

[2]

- (ii) Find the equation of MN .

Gradient of MN = -2

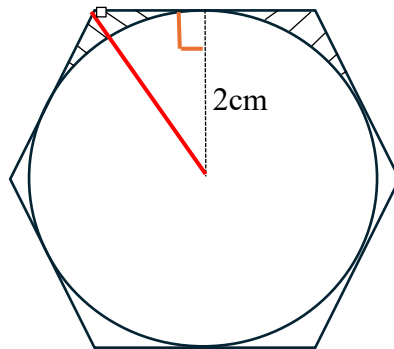
$$y = -2x + c$$

$$c = 2k = 4$$

$$y = -2x + 4$$

Answer [2]

3 (a) The diagram below shows a circle of radius 2 cm inscribed in a regular hexagon.



(i) Show that the length of one side of the hexagon is 2.31cm

Answer

Looking at the triangle drawn –

$$\begin{aligned}\tan 30^\circ &= \frac{x}{2} \\ x &= 2 \tan 30^\circ = 1.155 \text{ cm} \\ \therefore \text{Length of each side} &= 1.155 \times 2 = 2.31 \text{ cm}\end{aligned}$$

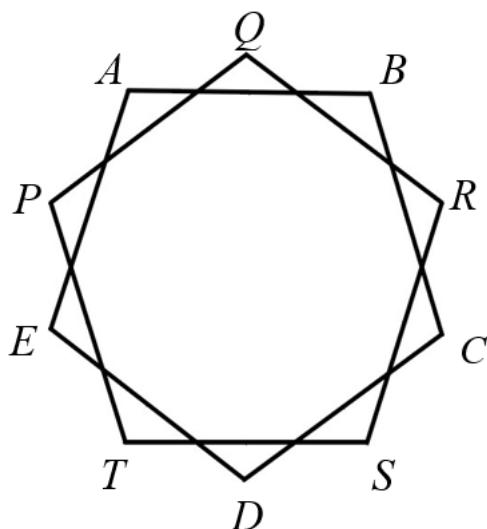
[2]

(ii) Find the area of the shaded region.

$$\begin{aligned}\text{Shaded area} &= 2(\text{Area of } \Delta - \text{Area of sector}) \\ &= 2\left(\frac{1}{2} \times 2 \times 2.31 - \frac{60}{360} \times \pi \times 2^2\right) \\ &= 0.431 \text{ cm}^2\end{aligned}$$

Answercm² [3]

- (b) Two regular pentagons $ABCDE$ and $PQRST$ are joined together to form the shape shown below.



Find angle AEC .

$AECB$ is a quadrilateral.

$$\begin{aligned}\angle EAB = \angle ABC &= \frac{(5-2) \times 180}{5} \\ &= 108^\circ\end{aligned}$$

$$\angle AEC = \angle ECB$$

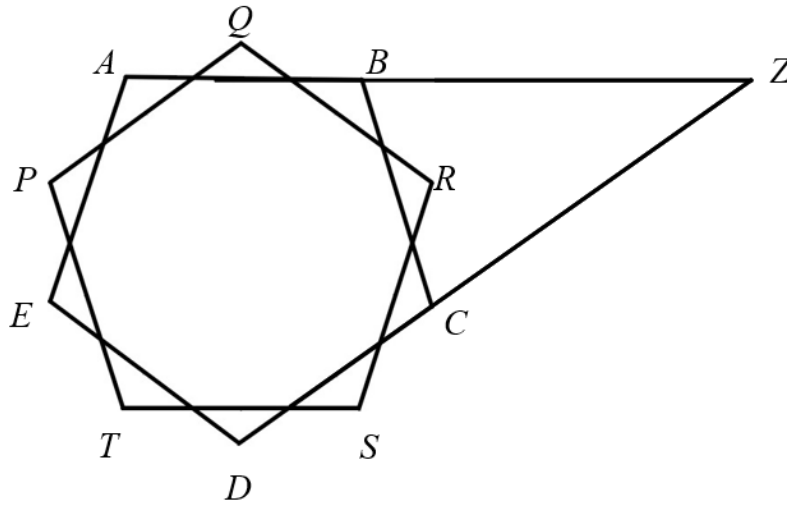
$$2\angle AEC = 360^\circ - 2(108^\circ)$$

$$2\angle AEC = 144^\circ$$

$$\therefore \angle AEC = 72^\circ$$

Answer $^\circ$ [3]

- (c) The sides CD and AB are produced to meet at Z . Show that triangle BZC is an isosceles triangle.



Answer

$$\angle ABC = 108^\circ$$

$$\angle CBZ = 180^\circ - 108^\circ = 72^\circ$$

$$\angle BCZ = 180^\circ - 108^\circ = 72^\circ$$

Since $\angle CBZ = \angle BCZ$, triangle BZC is an isosceles triangle.

- 4 The table below shows the distribution of three types of apartments in three blocks of an Executive Condominium.

	3-room	4-room	5-room
Block 1	25	20	60
Block 2	35	45	30
Block 3	30	50	10

This information can be represented by the matrix $\mathbf{A} = \begin{pmatrix} 25 & 20 & 60 \\ 35 & 45 & 30 \\ 30 & 50 & 10 \end{pmatrix}$.

The areas of the 3-room, 4-room and 5-room apartments are 75 m², 95 m² and 120 m² respectively.

- (i) Represent the areas of the apartments in a 3×1 column matrix $\mathbf{C}$.

$$\text{Answer } \mathbf{C} = \begin{pmatrix} 75 \\ 95 \\ 120 \end{pmatrix}$$

- (ii) Evaluate the matrix $\mathbf{M} = \mathbf{AC}$

$$\mathbf{AC} = \begin{pmatrix} 25 & 20 & 60 \\ 35 & 45 & 30 \\ 30 & 50 & 10 \end{pmatrix} \begin{pmatrix} 75 \\ 95 \\ 120 \end{pmatrix}$$

$$\mathbf{AC} = \begin{pmatrix} 10975 \\ 10500 \\ 8200 \end{pmatrix}$$

$$\text{Answer } \mathbf{M} = [1]$$

- (iii) State what the elements of **M** represent.

Answer

The elements in AB represent the total floor areas of the apartments in blocks 1, 2 and 3 respectively.

- (iv) Estate management fees are charged based on the floor area of the apartments in the three blocks per quarter. The estate management fee rates is $\$15/\text{m}^2$ per quarter. Find the total amount of estate management fee collected in a year for the Executive Condominium.

$$\begin{aligned} &\text{Total amount collected in a year} \\ &= 4 \times 15 \times (10975 + 10500 + 8200) \\ &= \$1780500 \end{aligned}$$

Answer \$..... [3]

- (v) The total estate management fee collected in one year for the Executive Condominium is used in the following areas.

Areas	Amount
Day-to-day operating expenses	25% of the total amount collected
Cleaning	$\frac{1}{5}$ of the total amount collected
Security guards	\$2350 per month for each security guard. The estate has 2 security guards.
Landscaping	\$50 000 per year
Electricity for common areas	\$120 000 per year

The remaining amount is transferred to the **sinking fund**, which is used for future major repairs and replacement of shared facilities.
Calculate the amount transferred to the sinking fund.

Day-to-day operating expenses = $25\% \times 1\,780\,500 = \$445\,125$

Cleaning = $\frac{1}{5} \times 1\,780\,500 = \$356\,100$

Security guards : Annual cost = $2 \times 2350 \times 12 = \$56\,400$

[M2 for finding either day to day operating expenses, cleaning or security guards]

Landscaping = \$50 000

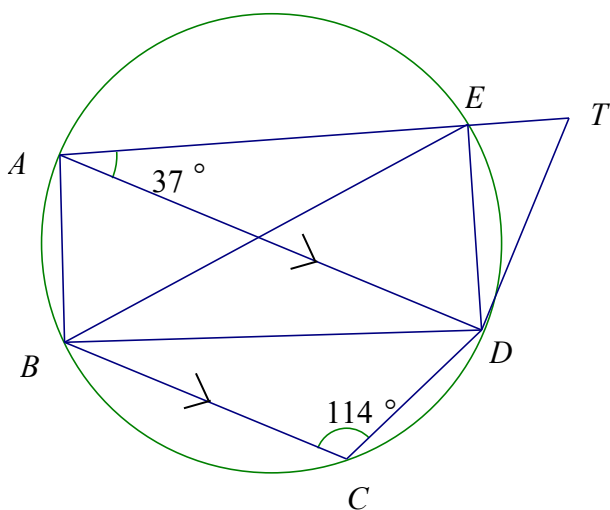
Electricity for common areas: Annual cost= \$120 000

Total expenditure= $\$445\,125 + \$356\,100 + \$56\,400 + \$50\,000 + \$120\,000 = \$102\,7625$

Amount transferred to the sinking fund

$1\,780\,500 - 102\,7625$ [M1] = $\$752\,875$ [A1]

5



The points A, B, C, D and E lie on the circle. AD is the diameter of the circle, DT is a tangent to the circle, AET is a straight line and AD is parallel to BC . Angle $BCD = 114^\circ$ and angle $DAE = 37^\circ$.

(a) Find angle EBC .

Give a reason for each step of your working.

$$\angle AED = 90^\circ \text{ [right angle triangle in semi-circle]}$$

$$\angle EBA = 180^\circ - 37^\circ - 90^\circ$$

$$= 53^\circ \text{ [angles sum of a triangle]}$$

$$\angle DAB = 180^\circ - 114^\circ$$

$$= 66^\circ \text{ [angles in opposite segment]}$$

$$\angle EBC = 180^\circ - 66^\circ - 53^\circ$$

$$= 61^\circ \text{ [interior angles]}$$

(b) Emily claims that quadrilateral $AEDB$ is a parallelogram.

Do you agree with her claim?

Give a reason for each step of your working.

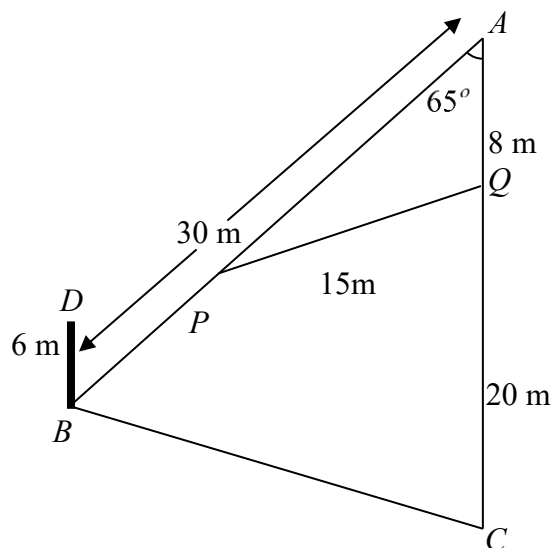
$$\angle EAB = 37^\circ + 66^\circ$$

$$= 103^\circ$$

$$\angle EAB + \angle AED \neq 180^\circ$$

By interior angles, AB is not parallel to ED , so quadrilateral $AEDB$ is not a parallelogram. [A1]

6



A landscape architect is designing a new park as shown in the diagram above. The straight road AC runs due north-south. Point B is an existing entrance to the park. Point P is a proposed rest area on path AB . Point Q is a water point on road AC .

Given that $AQ = 8$ m, $QC = 20$ m, $AB = 30$ m, $PQ = 15$ m and angle $PAQ = 65^\circ$.

(a) Calculate bearing of B from A .

$$\begin{aligned}\text{Bearing of } B \text{ from } A &= 180^\circ + 65^\circ \\ &= 245^\circ\end{aligned}$$

Answer $^\circ$ [1]

(b) Find the length of the footpath BC .

Using Cosine Rule,

$$BC^2 = 30^2 + 28^2 - 2(30)(28)\cos 65^\circ$$

$$BC = 31.2\text{m}$$

Answerm [2]

- (c) The shortest footpath from P to road AC is to be constructed. Find the length of the shortest footpath.

Using Sine rule,

$$\frac{\sin \angle APQ}{8} = \frac{\sin 65^\circ}{15}$$

$$\angle APQ = 28.9^\circ$$

$$(iii) \quad \text{Area of } \triangle APQ = \frac{1}{2}(8)(15)\sin 86.1^\circ$$

$$\approx 59.9m^2$$

- (iv) Let the shortest distance be x m.

$$\frac{1}{2}(x)(8) = 59.9$$

$$x = 15.0m$$

Answerm [4]

- (d) A lamp post BD , 6 m tall, is to be installed vertically at point B .

Calculate the angle of elevation of the top of the lamp post, D , from point C .

Let the angle of elevation be θ .

$$\tan \theta = \frac{6}{31.2}$$

$$\theta = 10.9^\circ$$

Answer° [2]

7. The map below shows the driving distances from Singapore to different parts of Malaysia.



Adapted from <https://www.tourradar.com/t/218274>

Jonathan drove from Singapore to Kuala Lumpur and then returned from Kuala Lumpur to Singapore during the June holidays. Some details of his average speed are shown below.

Journey	Average Speed
Singapore to Kuala Lumpur	x km/h
Kuala Lumpur to Singapore	10 km/h more than the journey from Singapore to Kuala Lumpur

- (a) Write down, in terms of x , the time taken for the journey from Singapore to Kuala Lumpur.

$$\frac{360}{x}$$

- (b) Given that the difference in time taken for the two journeys was 24 minutes, form an equation in x and show that it reduces to $x^2 + 10x - 9000 = 0$.

Answer

$$\frac{360}{x} - \frac{360}{x+10} = \frac{24}{60}$$

$$360(x+10) - 360x = \frac{2}{5}x(x+10)$$

$$3600 \div \frac{2}{5} = x^2 + 10x$$

$$x^2 + 10x - 9000 = 0$$

- (c) Solve the equation $x^2 + 10x - 9000 = 0$ and find the average speed for the journey from Singapore to Kuala Lumpur.

$$x^2 + 10x - 9000 = 0$$

$$(x - 90)(x + 100) = 0$$

$$x = 90 \text{ or } x = -100 \text{ (rej)}$$

Speed is 90km/h

- (d) Jonathan set off at 9:45pm on Tuesday for his return journey from Kuala Lumpur to Singapore. Find the day and time he reached home, give your answer correct to the nearest minute.

Time taken

$$= \frac{360}{100}$$

$$= 3\text{h } 36\text{minutes}$$

Answer Jonathan reached home on **Wednesday** and the time is **1.09am or 0109**

- (e) The speed limit and penalties for speeding on Singapore expressways are shown below.

SINGAPORE EXPRESSWAY SPEED LIMIT & SPEEDING PENALTIES

SPEED LIMITS ON EXPRESSWAYS



90 km/h

Most expressways

- PIE
- KPE
- AYE
- SLE
- TPE
- ECP



80 km/h

Certain stretches with higher risk

- Tunnels
- Sharp bends
- Roadworks
- Other hazardous sections

 Always adhere to the speed limit on the electronic signboards and road signs as it may vary along the expressway.

 Any speed above the posted limit is an offence. There is **no official speed allowance**.

SPEEDING PENALTIES (EFFECTIVE 1 JAN 2026)

EXCEEDING SPEED LIMIT BY	DEMERIT POINTS	FINE / ACTION (LIGHT VEHICLE)
Up to 20 km/h	6 points	\$200
> 20 – 30 km/h	8 points	\$300
> 30 – 40 km/h	12 points	\$400
> 40 – 50 km/h	18 points	Court Prosecution
> 50 km/h	24 points	Court Prosecution and possible licence suspension / disqualification

IMPORTANT NOTES

- Demerit points are accumulated within 12 months.
- Accumulating 24 demerit points within 12 months will result in licence suspension.
- Demerit points will be reduced after 12 months from the date of the offence, provided no further demerit points are incurred.

Jonathan claims that he did not exceed the speed limit during his return journey. Do you agree with Jonathan's claim? Justify your answer using the information provided. State the fine and the number of demerit points, if any, that Jonathan would receive.

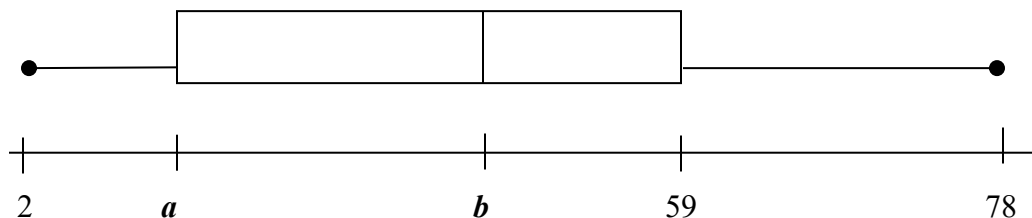
Answer

I disagree; Jonathan is 10km to 20km off the speed limit. He will be fine \$200 and received 6 demerit points.

8 (a) The ages of 15 people are recorded below.

46 2 8 6 41 47 59 43 59 65 78 55 39 48 60

A box-and-whisker diagram is drawn to represent the data.



(i) Find the values of a and b .

Answer $a = 39$ and $b = 47$

(ii) Calculate

(a) the mean of the ages.

Answer 43.7

(b) the standard deviation of the ages.

Answer 21.6

(b) Explain why the mean may not be an appropriate average for this data set.
State a more appropriate measure of average.

The mean is **not appropriate** because there are **extreme values (outliers)** such as **2** and **78**, which pull the mean away from the centre of the data.

Median

9. The first few lines of a number sequence are:

$$1^2 + 0^2 = 1$$

$$2^2 + 1^2 = 5$$

$$3^2 + 2^2 = 13$$

$$4^2 + 3^2 = 25$$

(a) Write down the 10th line.

$$10^2 + 9^2 = 181$$

Answer [1]

(b) Write down in the simplest form, the n th line, in terms of n .

$$n^2 + (n-1)^2 = n^2 + n^2 - 2n + 1$$

$$= 2n^2 - 2n + 1$$

Need to simplify the expression

Answer[2]

(c) One of the lines in the sequence is

$$x^2 + y^2 = 2521.$$

Find the values of x and y .

$$2n^2 - 2n + 1 = 2521$$

$$2n^2 - 2n - 2520 = 0$$

$$n^2 - n - 1260 = 0$$

$$(n-36)(n+35) = 0$$

$$n = 36 \text{ or } n = -35 \text{ (rejected)}$$

$$x = 36, y = 35$$

Answer $x = \dots\dots\dots$, $y = \dots\dots\dots$ [4]

10. The Singapore Government aims to increase the use of Electric Vehicles (EVs) to reduce carbon emissions. One way of encouraging EV ownership is by installing more public charging stations across the island.

The table below shows the approximate number of public EV charging stations at the end of each year.

Years after 2020, x	1	2	3	4	5
Number of charging stations, y	2200	2600	3100	3700	4500

- (a) On the grid provided, plot the points given in the table and join them to form a smooth curve. [2]

- All points correctly plotted (allow one minor plotting error)
- Smooth curve through the trend

- (b) Four students suggest different mathematical models for the graph.

Student	Model
A	$y = ax + b$
B	$y = ax^2 + b$
C	$y = a\sqrt{x} + b$
D	$y = ab^x$

State which student's model best represents the graph.
Give one reason for your choice.

Answer

Student D

Reason:

The graph increases at an increasing rate and becomes progressively steeper.

Or any suitable reason.

- (c) In 2030, the Land Transport Authority announces a target of 13 000 charging stations. Based on your model, comment on whether this target is likely to be achieved. You are required to show all mathematical calculations clearly and state any assumptions you have made.

Points used	To find a and value of a	To find b and value of b
(1,2200) & (2,2600)	1861.5	1.1818
(1,2200) & (3,3100)	1853.3	1.1871
(1,2200) & (4,3700)	1850.0	1.1892
(1,2200) & (5,4500)	1839.6	1.1959
(2,2600) & (3,3100)	1828.9	1.1923
(2,2600) & (4,3700)	1827.0	1.1929
(2,2600) & (5,4500)	1803.6	1.2006
(3,3100) & (4,3700)	1823.2	1.1935
(3,3100) & (5,4500)	1772.5	1.2048
(4,3700) & (5,4500)	1691.1	1.2162

Overall range

- a :

$$1691 \leq a \leq 1862$$

- b :

$$1.182 \leq b \leq 1.216$$

If using (1, 2200) and (2, 2600)

$$2200 = ab \text{ ---- [1]}$$

$$2600 = ab^2 \text{ --- [2]}$$

$$(2) \div (1)$$

Sub in values to form 2 pairs of equations

$$b = 1.18$$

$$\text{sub } b = 1.18 \text{ into [1]}$$

$$a = 2200 \div 1.1818$$

$$= 1861.56$$

Using each pair of estimated values of a and b , we calculate the predicted number of charging stations in **2030** ($x = 10$) using

$y = ab^{10}$. find the predicted amount of EV charging in 2030

Points used	a	b	Predicted y in 2030
(1,2200) & (2,2600)	1861.5	1.1818	9 892
(1,2200) & (3,3100)	1853.3	1.1871	10 300
(1,2200) & (4,3700)	1850.0	1.1892	10 450
(1,2200) & (5,4500)	1839.6	1.1959	10 950
(2,2600) & (3,3100)	1828.9	1.1923	10 630
(2,2600) & (4,3700)	1827.0	1.1929	10 690
(2,2600) & (5,4500)	1803.6	1.2006	11 200
(3,3100) & (4,3700)	1823.2	1.1935	10 770
(3,3100) & (5,4500)	1772.5	1.2048	11 410
(4,3700) & (5,4500)	1691.1	1.2162	11 973

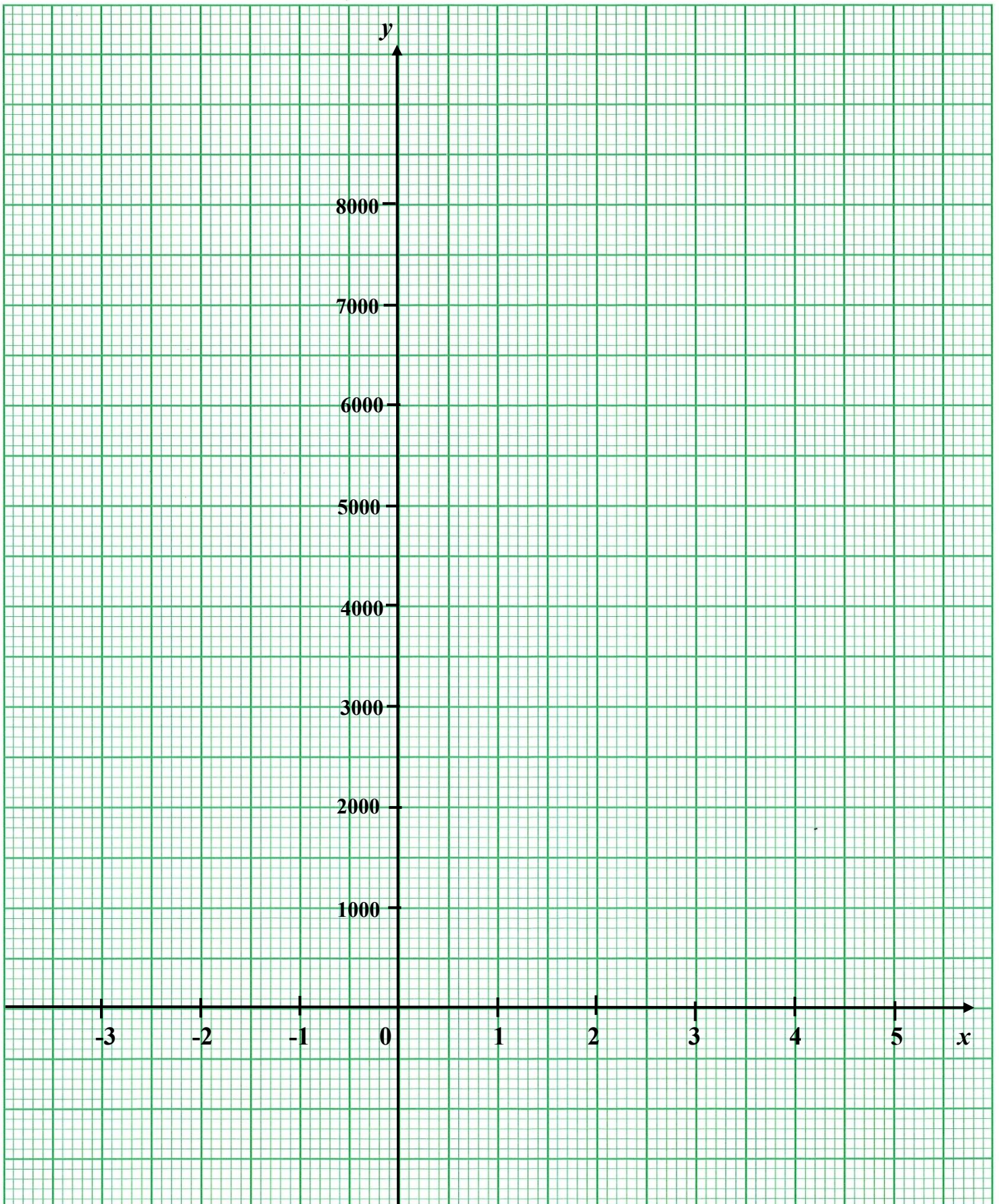
Conclusion

All reasonable models predict **fewer than 12 000** charging stations by 2030.

- **Lowest prediction:** about **9 920**
- **Highest prediction:** about **11 990**

The model predicts that the target of 13 000 charging stations is unlikely to be achieved by 2030.

Answer for 10a



Answer for 10a

