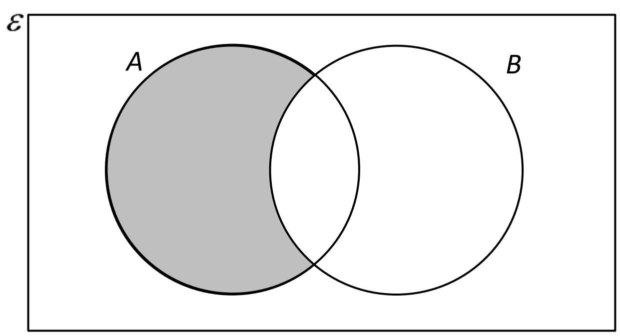
2024 4E5N EM Prelim P1 Mark Scheme

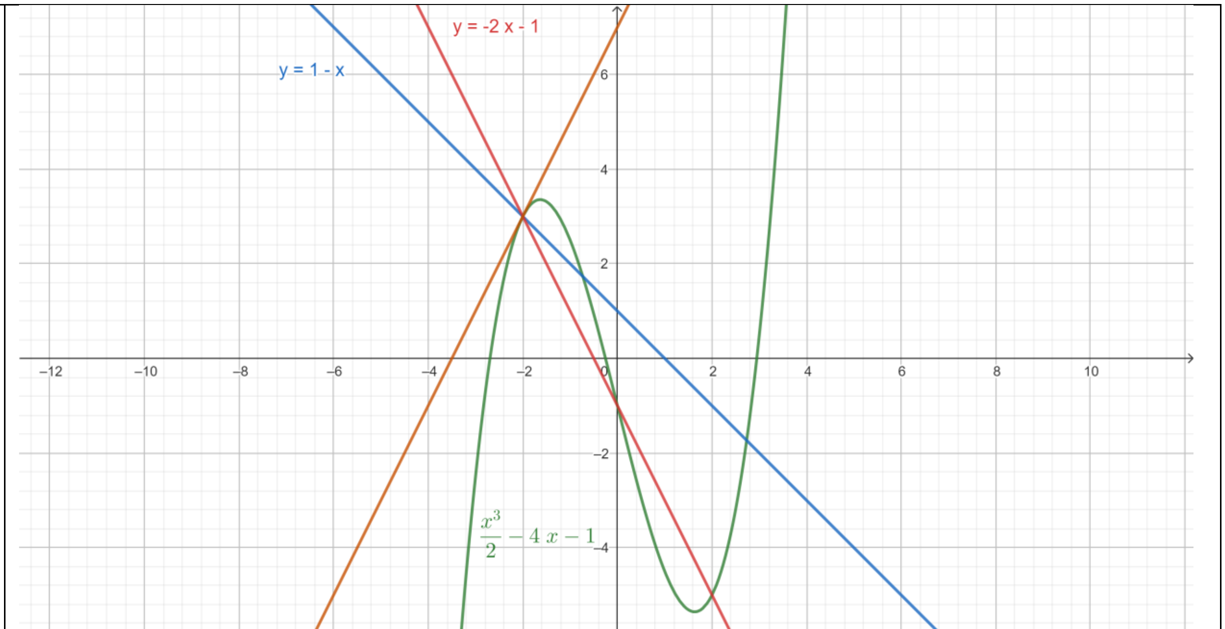
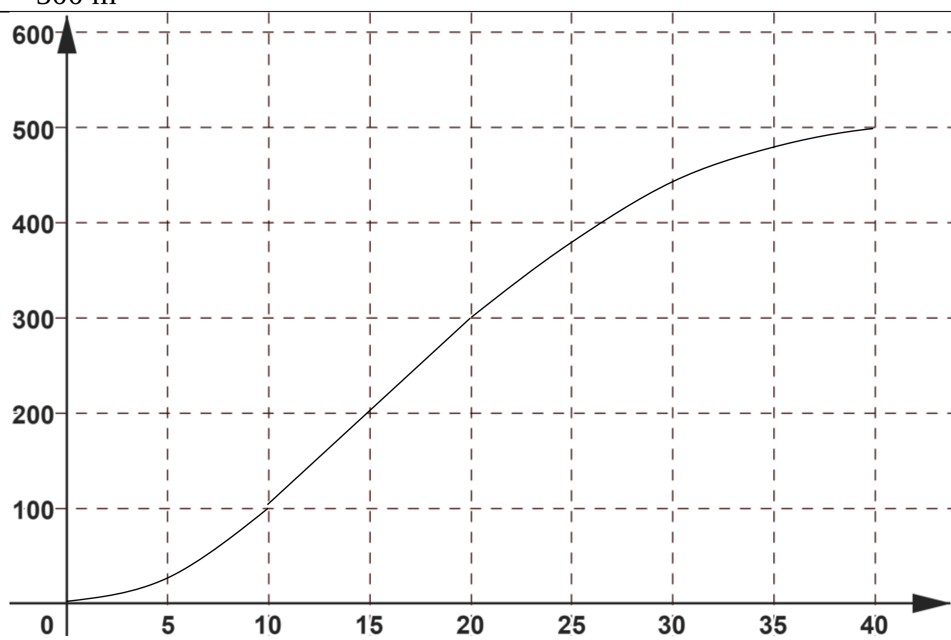
1	$PQ^2 + PQ^2 = 15^2$ $2PQ^2 = 225$ $PQ = 10.6$ cm	**M1** **A1**
2a	$\frac{3}{5}$	**B1**
2b	New total = 3×5 = 15 Yellow balls left $= 15 - 8 - 5 = 2$ $x = 7 - 2 = 5$	**B1**
3	2020 population = $\frac{100}{104} \times 5920000$ = 5690000 (nearest ten thousand)	**M1** **A1**
4	$\frac{2x}{3} - \frac{3(x-2)}{4}$ $= \frac{8x - 9(x-2)}{12}$ $= \frac{8x - 9x + 18}{12}$ $= \frac{18 - x}{12}$	**M1** – Common denominator A1
5	$\left(\frac{x^3}{27y^6}\right)^{\frac{4}{3}} = \frac{x^4}{81y^8}$	**B1** - numerator **B1** - denominator
6	$24 = 2^3 \times 3$ $20 = 2^2 \times 5$ $15 = 3 \times 5$ LCM $= 2^3 \times 3 \times 5$ Smallest length = 120 cm	**M1** **A1**
7a	9	**B1**
7b	Angle = $\frac{3}{18} \times 360 = 60$	**B1**
8a	$1.90 \times 10^{27} \div 5.97 \times 10^{24} = 3.18 \times 10^2$	**B1**
8b	Jupiter density = $1.90 \times 10^{27} \div 1.43 \times 10^{24}$ =1328.6713 kg/m^3 Earth density = $5.97 \times 10^{24} \div 1.08 \times 10^{21}$ = 5527.7778 kg/m^3 Earth has a higher density	**M1** **A1**

9	$P\left(1+\frac{4}{100}\right)^3 = 89989.12$ $P = 89989.12 \div \left(1+\frac{4}{100}\right)^3$ = \$80000	**M1** **M1** **A1**
10a	196.5 g	**B1**
10b	$197.5 \div 24.5$ = 8.06 g	**M1** **A1**
11a	7 and 8	**B1**
11b	Mean $= \frac{4+5+6+3(7)+3(8)+10}{10}$ = 7	**B1**
11c	Yes. The mean mark for the whole class, 7.5, was higher than the mean mark for the girls. Thus the **mean mark for the boys would have to be higher than 7.5**, which is better than the girls marks. Accept use of actual calculation of mean mark for boys to justify.	**B1**
12a	$a^4 - b^2 = \left(a^2 + b\right)\left(a^2 - b\right)$	**B1**
12b	$8xy - 1 - 4x + 2y$ $= 8xy - 4x + 2y - 1$ $= 4x\left(2y-1\right) + 2y - 1$ $= \left(2y-1\right)\left(4x+1\right)$	**M1** **A1**
13a		**B1**
13bi	{12, 42, 72}	**B1**
13bii	0	**B1**
14a	Exterior angle = 180 – 140 = 40 Number of sides $= 360 \div 40$ = 9 Or $\left(n-2\right) \times 180 = 140n$ $180n - 360 = 140n$ $40n = 360$ $n = 9$	**M1** **A1** **M1** **A1**

14b	Exterior angle of octagon $= 360 \div 8 = 45$ Exterior angle of equilateral triangle $= 180 - 60 = 120$ $x = 120 + 45 = 165$	**M1** **A1**
15a	Accept 3 700 000 to 3 900 000	**B1**
15b	The total waste generated in the 2020s have decreased compared to the 2010s as the waste generated are lower on average.	**B1**
15c	Yes. The amount of **waste disposed of remains generally constant** over the last decade but the **waste recycled was generally lesser in the 2020s**, thus there is a decline in percentage of waste recycled in the 2020s.	**B1** **B1**
16a	angle *ACB* = angle *ADC* (given) angle *BAC* = angle *CAD* (common angle) Since all corresponding angles of the triangle are equal, triangles *ABC* and *ACD are similar*	**M1** **A1**
16b	$\frac{AB}{AC} = \frac{AC}{AD}$ $\frac{6.5}{AC} = \frac{AC}{6.5+5.5}$ $AC^2 = 78$ $AC = 8.83\text{ cm}$	**M1** **A1**
17a	$(a+2b)(a-2b) - a^2$ $= a^2 - 4b^2 - a^2$ $= -4b^2$	**M1** – correct expansion A1
17b	$12\,349 \times 12\,341 - 12\,345^2$ $(12\,345 + 2(2)) \times (12\,345 - 2(2)) - 12\,345^2$ $= -4(2)^2$ $= -16$	**M1** **A1**
18a	No. of days $= \frac{15}{5} \times 8 = 24$	**B1**
18b	$T = k\sqrt{l}$ % increase $= \frac{k\sqrt{1.5l} - k\sqrt{l}}{k\sqrt{l}} \times 100$ $= \frac{k\sqrt{l}\left(\sqrt{1.5} - 1\right)}{k\sqrt{l}} \times 100$ =22.5%	**M1** **A1**
19a	4 cm : 1 km 4 cm : 100 000 cm 1 : 25 000	**B1**

19b	$40 \div 4 = 10$ km	**B1**
19c	4 cm : 1 km 16 cm^2 : 1 km^2 $4.5 \times 16 = 72$ cm^2	 **M1** **A1**
20a	$62^2 = 56^2 + 73^2 - 2(56)(73)\cos\angle BAC$ $\angle BAC = 55.5845$ Bearing $= 180 - 55.5845$ = 124.4	**M2** **A1** **A1**
20b	Area of triangle ABC $= \frac{1}{2}(56)(73)\sin 55.5845$ = 1686.2195 =1690 km^2	 **M1** **A1**
21a	$56 = 2^3 \times 7$ $126 = 2 \times 3^2 \times 7$ $56 \times 126 = 2^4 \times 3^2 \times 7^2$ Since the powers of all prime factors are even, 56×126 is a perfect square.	**M1** **M1** **A1**
21b	$2 \times 7 = 14$	**B1**
21c	$k = 2^2 \times 3 \times 7^2$ = 588	**M1** **A1**
22a	$9x^2 + 6x - 8 = 0$ $(3x-2)(3x+4) = 0$ $x = \frac{2}{3}$ or $x = -\frac{4}{3}$	 **M1** **A2**
22b	$9(y-1)^2 + 6y - 14 = 0$ $9(y-1)^2 + 6(y-1) + 6 - 14 = 0$ $9(y-1)^2 + 6(y-1) - 8 = 0$ From (a) , $y - 1 = \frac{2}{3}$ or $y - 1 = -\frac{4}{3}$ $y = 1\frac{2}{3}$ or $y = -\frac{1}{3}$	 **M1** **A1**
23a	**B** = $\begin{bmatrix} 30 & 60 \\ 35 & 55 \end{bmatrix}$	**B1**
23b	**C** = $5\begin{bmatrix} 20 & 40 \\ 30 & 30 \end{bmatrix} + 2\begin{bmatrix} 30 & 60 \\ 35 & 55 \end{bmatrix}$	

	$= \begin{bmatrix} 160 & 320 \\ 220 & 260 \end{bmatrix}$	**B1**
23c	Elements of **C** represent the total number people from each of the categories of adults and children, admitted to the theatre in the morning and afternoon respectively over one week.	**B1**
23di	**D** = $\begin{bmatrix} 160 & 320 \\ 220 & 260 \end{bmatrix}\begin{bmatrix} 25 \\ 12 \end{bmatrix} = \begin{bmatrix} 7840 \\ 8620 \end{bmatrix}$	**B1**
23dii	**E** = $\frac{1}{7}\begin{bmatrix} 1 & 1 \end{bmatrix}\begin{bmatrix} 7840 \\ 8620 \end{bmatrix} = \begin{bmatrix} 2351\frac{3}{7} \end{bmatrix}$	**B1**
23diii	**E** represents the average amount of money collected per day from admissions over one week.	**B1**
24a	$\frac{x^3}{2} - 4x - 1 = 1 - x$ $\frac{x^3}{2} - 3x - 2 = 0$ $x^3 - 6x - 4 = 0$	**B1**
24b	Draw tangent Gradient = 2	**M1** **A1**
24ci	$x^3 - 4x = 0$ $\frac{x^3}{2} - 2x = 0$ $\frac{x^3}{2} - 4x - 1 = -2x - 1$ Equation of line: $y = -2x - 1$	**B1**

<table>
<tr><td>24cii</td><td colspan="2">
</td></tr>
<tr><td>24cii</td><td>Draw $y = -2x - 1$
$x = -2, 0, 2$</td><td>M1
A1</td></tr>
<tr><td>25a</td><td>16 m/s</td><td>B1</td></tr>
<tr><td>25b</td><td>2 m/s^2</td><td>B1</td></tr>
<tr><td>25c</td><td>Distance = area under graph
= 100 + 200 + 200
= 500 m</td><td>
M1
A1</td></tr>
<tr><td>25d</td><td>
</td><td>B1 for straight section correct
B1 for curved section correct</td></tr>
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