



**TANJONG KATONG GIRLS' SCHOOL  
PRELIMINARY EXAMINATION  
SECONDARY FOUR EXPRESS**

CANDIDATE  
NAME

SOLUTION

CLASS

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INDEX  
NUMBER

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**MATHEMATICS**

**4052/01**

Paper 1

**21 August 2025**

**2 hours 15 minutes**

Candidates answer on the Question Paper

**READ THESE INSTRUCTIONS FIRST**

Write your index number and name 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.  
**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 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**

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Qn		Solution
1	(a)	$\left(\frac{\sqrt[3]{a}}{3b^2}\right)^4 = \frac{a^{\frac{4}{3}}}{3^4(b^2)^4} = \frac{a^{\frac{4}{3}}}{81b^8}$
	(b)	$10 \times 3^6 - 2 \times 9^3 = 8 \times 3^k$ $10 \times 3^6 - 2 \times 3^6 = 8 \times 3^k$ $8 \times 3^6 = 8 \times 3^k$ $3^6 = 3^k$ $k = 6$

Qn		Solution
2	(a)	2.4 radians $= 2.4 \times \frac{180^\circ}{\pi}$ $= 137.5^\circ \text{ (1 d.p.)}$
	(b)	$\text{Area of } \triangle XYZ = \frac{1}{2} \times YX \times YZ \times \sin \angle XYZ$ $63 = \frac{1}{2} \times 12 \times 15 \times \sin \angle XYZ$ $\sin \angle XYZ = 0.7$ $\angle XYZ = 44.427^\circ \text{ or } 180^\circ - 44.427^\circ$ $= 44.4^\circ \text{ or } 135.6^\circ \text{ (1 d.p.)}$ <p>If <math>\angle XYZ = 44.4^\circ</math> and <math>\angle XYZ</math> is the largest angle,  then sum of <math>\angle</math>s in <math>\triangle XYZ &lt; 44.4^\circ \times 3 = 133.2^\circ &lt; 180^\circ</math>.  This contradicts <math>\angle</math> sum of <math>\triangle = 180^\circ</math>. <math>\therefore \angle XYZ \neq 44.4^\circ</math>.</p> <p>Answer: <math>135.6^\circ</math></p>

Qn	Solution
3	$(x + 96 \times 0.8) \times 1.1 \times 1.09 = 257.55$
	$x = 138$ (nearest whole number)

Qn	Solution
4 (a)	$\sqrt[6]{x} = a \times b^2 \times c^3$ where $a, b$ and $c$ are different prime numbers. $\sqrt[6]{x} = a \times b^2 \times c^3$ where $a, b$ and $c$ are different prime numbers. $x = (a \times b^2 \times c^3)^6$ $= [(a \times b^2 \times c^3)^3]^2$ $= [(a \times b^2 \times c^3)^2]^3$ Or $\sqrt{x} = (a \times b^2 \times c^3)^3$ and $\sqrt[3]{x} = (a \times b^2 \times c^3)^2$
	Yes, I agree. Since $x = [(a \times b^2 \times c^3)^3]^2 = [(a \times b^2 \times c^3)^2]^3$ or $\sqrt{x} = (a \times b^2 \times c^3)^3$ and $\sqrt[3]{x} = (a \times b^2 \times c^3)^2$ where $(a \times b^2 \times c^3)^3$ and $(a \times b^2 \times c^3)^2$ are integers, $x$ is a perfect square of $(a \times b^2 \times c^3)^3$ and a perfect cube of $(a \times b^2 \times c^3)^2$ . Alternatively: Yes, I agree. Since $x = a^6 \times b^{12} \times c^{18}$ , all the indices (powers) of the prime factors of $x$ are multiples of 2 and 3 (or multiples of 6), $x$ is both a perfect square and a perfect cube.

4 (b)	(i)	Given $y = 2^7 \times 5^{11} \times 13^{21}$ , $w = y \div m$ and $w$ is a perfect cube $\text{Biggest } w = \frac{2^7 \times 5^{11} \times 13^{21}}{\text{smallest } m} = 2^6 \times 5^9 \times 13^{21}$ $\text{Smallest } m = 2 \times 5^2$
	(ii)	$\text{LCM} = 2^8 \times 5^{11} \times 13^{21}$ $\text{HCF} = 2^7 \times 5^9$ $y = 2^7 \times 5^{11} \times 13^{21}$ $z = 2^7 \times 5^{10}$ $\text{Smallest } v = 2^8 \times 5^9$

Qn		Solution
5	(a)	The first year's interest is more than 2% of \$8000 because interest calculated every quarter is based on the new principal which includes interest accumulated so the principal increases every quarter.
	(b)	Interest = $8000\left(1 + \frac{0.5}{100}\right)^8 - 8000$ $= \$325.66$ (2 d.p.)

Qn		Solution
6		$x^2 - 20x - a$ $= (x-10)^2 - 10^2 - a$ $= (x+b)^2 - 125$ $\therefore b = -10, -10^2 - a = -125$ $a = 25$

Qn		Solution
7		<p>Let the initial amount of water be <math>x \text{ cm}^3</math>.  Then the initial amount of pebbles will be <math>0.1x \text{ cm}^3</math>.</p> $\frac{0.1x + 3600}{x} = \frac{1}{4} \quad \text{or } 15\% \times x = 3600$ $0.4x + 14400 = x \quad x = \frac{3600}{0.15}$ $x = 24000 \quad = 24000$ <p>Capacity of tank</p> $= \frac{2.5}{1.5} (24000 + 0.1 \times 24000) \text{ or } 24000 \times 1.1 + \frac{24000 \times 1.1}{1.5}$ $= 44000$ <p>Alternatively:</p>

	Pebbles	Water	Tank
+3600	0.1x	x	$\frac{250\%}{150\%} \times 1.1x = \frac{11}{6}x$
	0.25x	x	

$\therefore 0.25x - 0.1x = 3600$   
 $x = 24000$   
 $\frac{11}{6}x = \frac{11}{6} \times 24000$   
 $= 44000$

8	(a)	(i)	$118 - 32 = 86$ teenagers
		(ii)	$150 - 118 = 32$ teenagers
		(iii)	39 marbles
	(b)	75 teenagers' estimate is < 51 marbles  Do not accept median is 51 or 50 <sup>th</sup> percentile is 51 or half the number of teens estimate 51 marbles.	
	(c)	(i)	54 students' estimate < 47 marbles. $\frac{54}{150} \times 100\% = 36\%$  36 <sup>th</sup> percentile = 47, $p = 36$
		(ii)	$\frac{54}{150} \times \frac{53}{149} = \frac{477}{3725}$ or 0.128 (3 s.f.)

Qn		Solution
9	(a)	(i) Jane should go to <u>XYZ</u> Money Changer because for every USD, she can get <u>0.01</u> more SGD than changing her money at <u>ABC</u> Money Changer.
		(ii) USD 1 = SGD 1.27 Jane will receive $200 \times \text{SGD } 1.27 = \text{SGD } 254.00$
	(b)	(i) Jane should go to <u>ABC</u> Money Changer because for every 1 CNY will pay <u>0.002</u> less SGD than changing her money at <u>XYZ</u> Money Changer.
		(ii) CNY 1 = SGD 0.18 $\Rightarrow$ SGD 1 = CNY $\frac{1}{0.18}$  Jane will receive CNY $\frac{550}{0.18} = \text{CNY } 3055.56$

Qn		Solution
10	(a)	$\frac{x}{2(3-2x)} - \frac{3}{2x-5}$ $= \frac{x(2x-5) - 3 \times 2(3-2x)}{2(3-2x)(2x-5)}$
		$= \frac{2x^2 - 5x - 18 + 12x}{2(3-2x)(2x-5)}$ $= \frac{2x^2 + 7x - 18}{2(3-2x)(2x-5)}$
	(b)	$\frac{4x-6}{16x^4-81}$ $= \frac{4x-6}{(4x^2-9)(4x^2+9)}$ $= \frac{2(2x-3)}{(2x-3)(2x+3)(4x^2+9)}$ $= \frac{2}{(2x+3)(4x^2+9)}$

	(c)	$15ac - 6bc + 30ad - 12bd$
		$= 3c(5a - 2b) + 6d(5a - 2b)$
		$= (3c + 6d)(5a - 2b)$
		$= 3(c + 2d)(5a - 2b)$

Qn	Solution
11	$2y - 3x = 10$ $y = \frac{3}{2}x + 5$ Gradient = $\frac{3}{2}$ $\frac{9 - b}{-4 - a} = \frac{3}{2}$
	$18 - 2b = -12 - 3a$ $3a = -12 - 18 + 2b$ $a = \frac{2}{3}b - 10$

Qn	Solution
12 (a)	median mass of potatoes $= \frac{(101 + 103)}{2} = 102 \text{ grams}$
(b)	$20 = Q_3 - Q_1$ $Q_3 = 20 + Q_1$ $Q_3 = 20 + 89$ $= 109$
	$109 = \frac{108 + y}{2}$ $y = 110$ $x = 0$

Qn	Solution
13	$(3x-2)^2 - 6(1-x)(x+1) - 1$ $= 9x^2 - 12x + 4 - 6(1-x^2) - 1$ $= 15x^2 - 12x - 3$ $= 3(5x^2 - 4x - 1)$ $= 3(5x+1)(x-1)$
	<p style="text-align: center;"><math>5x+1 &gt; 0</math> and <math>x-1 \geq 0</math>.</p> <p>For all natural numbers <math>x</math>, <math>\therefore (5x+1)(x-1)</math> are non-negative integers.</p> <p>This implies <math>(3x-2)^2 - 6(1-x)(x+1) - 1 = 3(5x+1)(x-1)</math> is a non-negative multiple of 3.</p>

Qn	Solution
14	<p>The title that eggs are sold at more than 50% discount is misleading.</p> <p>The discount today is actually</p> $= \frac{3.20 - 2.15}{3.20} \times 100\%$ $= 32.8\% \text{ (3 s.f.)}$ <p>which is <math>&lt; 50\%</math>.</p> <p>Alternatively,</p> <p>Price after 50% discount of \$3.20 should be \$1.60 but <math>\\$2.15 &gt; \\$1.60</math>. The discount is less than 50%.</p> <p>A possible mistake made by students is that students may think that the picture of Year 2025 is misleading. However, since the picture only increases in length but not in breadth compare to Year 2020, the size of the picture is proportional to the price and there is nothing misleading about the pictures.</p>

Take note:

If the picture of Year 2025 shows an increase in both length and breadth as shown below, then there will be an alternative answer as shown below.

**Eggs at more than 50% discount. Today only!**

\$2.15 for 10

\$

Year 2020  
Today only!

\$3.20 for 10

\$

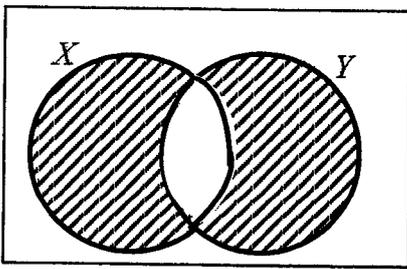
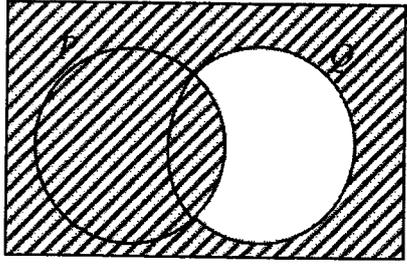
Year 2025

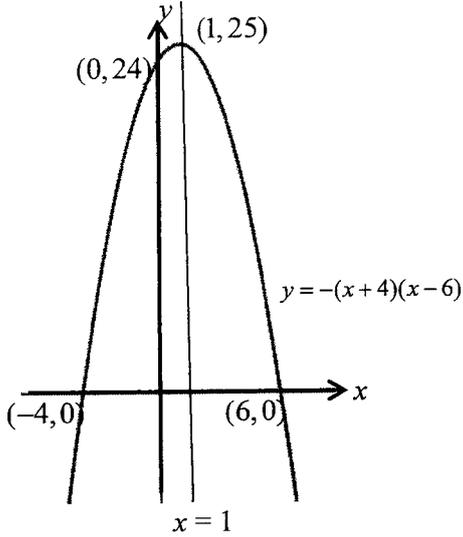


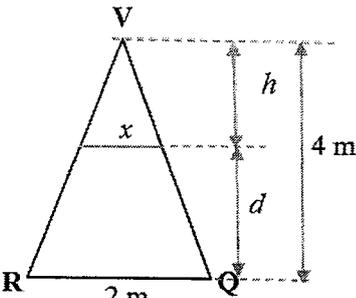
Comparing the pictures representing the prices in 2020 and 2025, the picture of 2025 increases in both length and breadth which is an exaggeration of the price increase.

The price in 2025 is  $\frac{3.20}{2.15} \approx 1.5$  times of 2020 but the area/size of the picture is

$1.5^2 = 2.25 > 2$  times of 2020.

	Qn	Solution
15	(a)	$(X \cap Y)' \cup (X' \cap Y)$ 
	(b)	  $P \cup Q'$ Accept: $P \cup (P \cup Q)'$

Qn	Solution
16	 <p data-bbox="316 846 810 1003">Eqn of line of symmetry <math>x = 1</math>. Coordinates of the turning point <math>(1, 25)</math>, <math>x</math>-intercepts <math>(-4, 0)</math>, <math>(6, 0)</math> and <math>y</math>-intercept <math>(0, 24)</math>.</p>

Qn	Solution
17 (a)	 <p style="text-align: center;">Diagram B</p> <p>Show that <math>d = 4 - 2x</math>.</p> $\frac{h}{x} = \frac{4}{2}$ $\frac{4-d}{x} = \frac{4}{2}$ $4-d = 2x$ $d = 4 - 2x \text{ (shown)}$
(b)	$\frac{V_{\text{empty}}}{V_{\text{container}}} = \left(\frac{h}{4}\right)^3$ $\frac{1}{4} = \left(\frac{h}{4}\right)^3$
	$h = 4 \times \sqrt[3]{\frac{1}{4}}$
	$d = 4 - h$ $= 4 - 4 \times \sqrt[3]{\frac{1}{4}}$ $= 1.48 \text{ (3 s.f.)}$

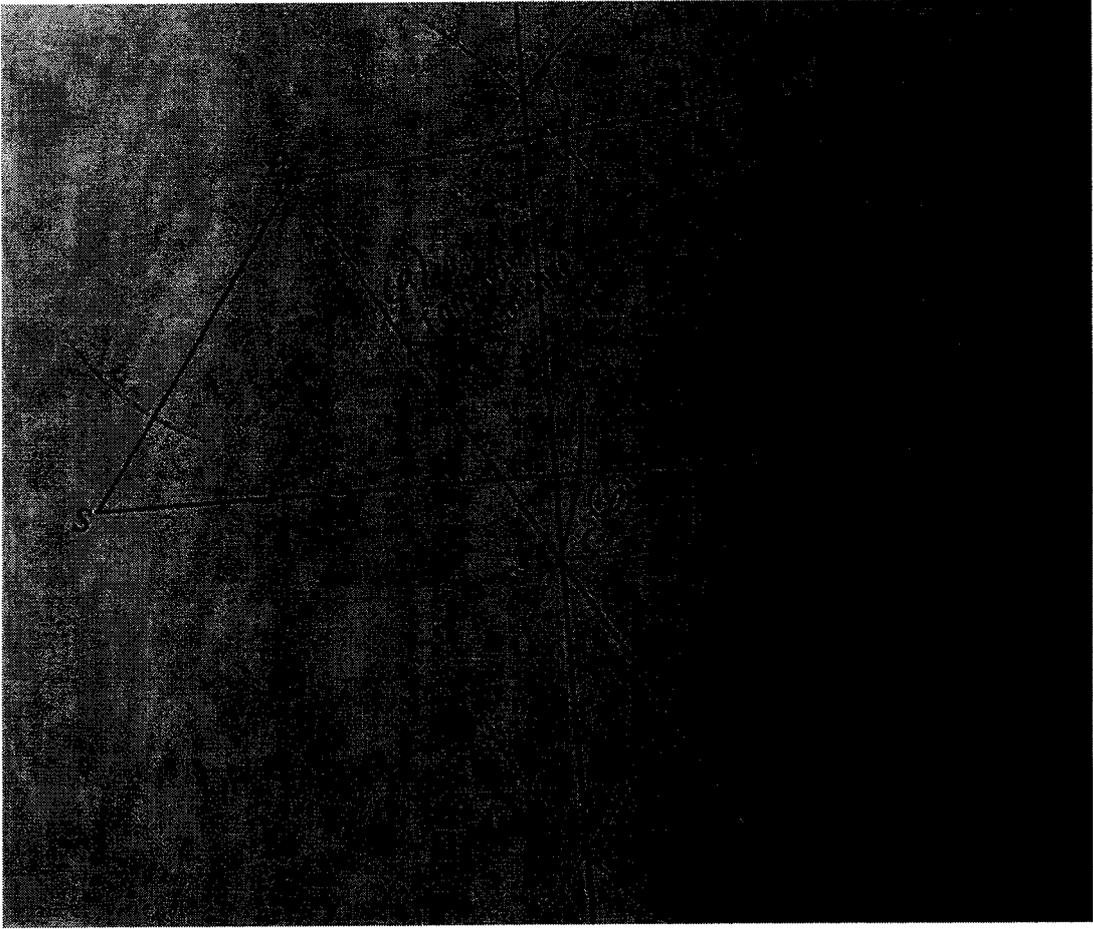
17	(b)	<p>Alternative:</p> <p>Vol. of big pyramid</p> $= \frac{1}{3} \times 2^2 \times 4$ $= \frac{16}{3}$ <hr/> <p>Vol. of empty space = <math>\frac{1}{3} \times x^2 \times h</math></p> $= \frac{1}{3} \times x^2 \times (4 - d)$ $= \frac{1}{3} \times x^2 \times [4 - (4 - 2x)]$ $= \frac{2}{3} x^3$ <hr/> <p>Vol. of empty space = <math>\frac{1}{4} \times</math> Vol. of big pyramid</p> $\frac{2}{3} x^3 = \frac{1}{4} \times \frac{16}{3}$ $x^3 = 2$ $x = \sqrt[3]{2}$ $d = 4 - 2 \times \sqrt[3]{2}$ $= 1.48 \text{ (3 s.f.)}$
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Qn	Solution
18 (a)	$C = \begin{pmatrix} 280 \\ 320 \end{pmatrix}$
(b)	$  \begin{aligned}  P &= 12SC \\  &= 12 \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 280 \\ 320 \end{pmatrix} \\  &= 12 \begin{pmatrix} 3280 \\ 1760 \end{pmatrix} \\  &= \begin{pmatrix} 39360 \\ 21120 \end{pmatrix}  \end{aligned}  $
(c)	$N = \begin{pmatrix} 1.1 & 0 \\ 0 & 1.2 \end{pmatrix}$
(d)	$  \begin{aligned}  Q &= (1 \ 1)SM \\  &= (1 \ 1) \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 1.1 & 0 \\ 0 & 1.2 \end{pmatrix} \begin{pmatrix} 280 \\ 320 \end{pmatrix} \\  &= (1 \ 1) \begin{pmatrix} 6 & 5 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 308 \\ 384 \end{pmatrix} \\  &= (1 \ 1) \begin{pmatrix} 3768 \\ 2000 \end{pmatrix} \\  &= (5768)  \end{aligned}  $
(e)	<p>The elements of <b>Q</b> represent the <u>total monthly lesson fees collected</u> by Mr Asahi <u>after the fee increase</u>.</p>

Qn	Solution
19 (a)	$\angle CBD = \angle CDB$ $= \frac{180^\circ - 108^\circ}{2} \text{ (base } \angle\text{s of isosceles } \Delta)$ $= 36^\circ$ $\text{ext. } \angle = \frac{360^\circ}{n} = 36^\circ$ $n = 10$
(b)	<p>Interior <math>\angle = 180^\circ - 36^\circ</math> (adj. <math>\angle</math>s on a straight line)  <math>= 144^\circ</math></p> <p>Alternative method:</p> <p>Interior <math>\angle = \frac{(10-2) \times 180^\circ}{10}</math>  <math>= 144^\circ</math></p>

Qn	Solution
20 (a)	<p>Bearing of <math>F</math> from <math>Z</math>  <math>= 180^\circ + 061.8^\circ</math> (alternate angles)  <math>= 241.8^\circ</math></p>
(b)(i)	<p><math>LF &lt; LZ</math>  <math>\Rightarrow \angle LZF &lt; \angle LFZ</math>  <math>\Rightarrow \angle LZF &lt; 61.8^\circ &lt; 90^\circ</math></p> <p><math>\therefore \angle LZF</math> is an acute angle</p>
(b)(ii)	<p><math>\frac{\sin \angle LZF}{35} = \frac{\sin 61.8^\circ}{60}</math></p> <p><math>\sin \angle LZF = \frac{\sin 61.8^\circ}{60} \times 35 = 0.51409</math> (5 s.f.)</p> <p><math>\angle LZF = 30.937^\circ</math></p> <p><math>\angle NLZ = 30.937^\circ + 61.8^\circ</math> (exterior <math>\angle</math>)  <math>= 92.737^\circ</math>  Bearing of <math>Z</math> from <math>L = 092.7^\circ</math> (1 d.p.)</p> <p>Alternative presentation:</p> <p>Bearing of <math>Z</math> from <math>L = 030.937^\circ + 061.8^\circ</math> (alternate <math>\angle</math>s)  <math>= 092.737^\circ</math>  <math>= 092.7^\circ</math> (1 d.p.)</p>

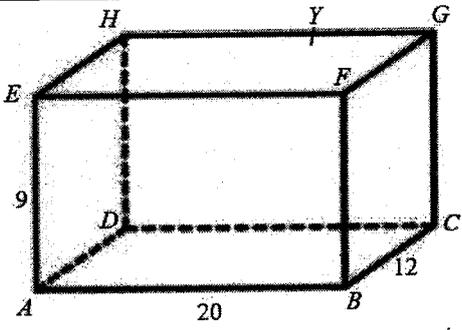
(c)	$\angle FLZ = 180^\circ - 61.8^\circ - 30.937^\circ \text{ (}\angle \text{ sum of } \Delta\text{)}$ $= 87.263^\circ$ $FZ = \sqrt{35^2 + 60^2 - 2(35)(60)\cos 87.263^\circ}$ $= 68.003$ $= 68.0 \text{ m (3 s.f.)}$ <p>Alternative,</p> $\frac{FZ}{\sin 87.263^\circ} = \frac{60}{\sin 61.8^\circ}$ $FZ = \frac{60}{\sin 61.8^\circ} \times \sin 87.263^\circ$ $= 68.003$ $= 68.0 \text{ m (3 s.f.)}$
(d)	<p>Let the shortest distance from <math>L</math> to <math>FZ</math> be <math>x</math>.</p> $\sin 61.8^\circ = \frac{x}{35}$ $x = 35 \sin 61.8^\circ$ $= 30.8456\dots$ $= 30.8 \text{ m (3 s.f.)}$ <p>Alternative,</p> $\frac{1}{2} \times 68.003 \times x = \frac{1}{2} \times 35 \times 60 \sin 87.263^\circ$ $x = 30.846$ $= 30.8 \text{ m (3 s.f.)}$

Qn	Solution
21	

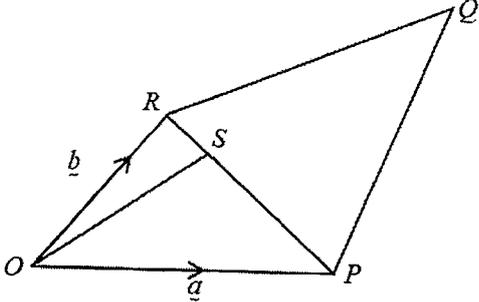
Qn		Solution				
22	(a)	$x$	$\frac{1}{4}$	1	4	9
		$y$	12	6	3	2
		$xy^2$	$\frac{1}{4} \times 12^2$ = 36	$1 \times 6^2$ = 36	$4 \times 3^2$ = 36	$9 \times 2^2$ = 36
Since $xy^2 = 36$ for all pairs of values of $x$ and $y$ , $x$ and $y^2$ are inversely proportional.						
22	(b)	$xy^2 = 36$				
		Let the original $x$ and $y$ be $x_0$ and $y_0$ . Let the new $x$ and $y$ be $x_1$ and $y_1$ .				
		When $y$ is increased by 150%, $y_1 = 2.5y_0$ .				
		$x_1(2.5y_0)^2 = x_0y_0^2$				
		$x_1 = 0.16x_0$				
		Percentage reduction in $x$				
		$= \frac{x_0 - 0.16x_0}{x_0} \times 100\%$				
		$= 84\%$				

Qn		Solution	
23	(a)(i)	8, 5, 2, -1	
		nth term = $8 + (n-1)(-3) = 11 - 3n$	
	(a)(ii)	Comparing the two sequences:	
		8, 5, 2, -1 +1 +4 +9 +16  9, 9, 11, 15  nth term = $11 - 3n + n^2$	
	(b)	$S_n = \frac{n}{2}(7n-3)$	
		$T_1 = S_1 = \frac{1}{2}(7-3) = 2$	
		$T_1 + T_2 = S_2 = \frac{2}{2}(7 \times 2 - 3) = 11$	
		$T_2 = S_2 - S_1 = 11 - 2 = 9$	
		Common difference = $T_2 - T_1 = 9 - 2 = 7$	
		$T_n = 2 + (n-1)7$	
		$= 7n - 5$	

	<p>Alternatively,</p> $S_n = \frac{n}{2}(7n-3) = \frac{1}{2}(7n^2 - 3n)$ $S_{n-1} = \frac{n-1}{2}[7(n-1)-3]$ $= \frac{n-1}{2}(7n-10)$ $= \frac{1}{2}(7n^2 - 17n + 10)$ $T_n = S_n - S_{n-1}$ $= \frac{1}{2}(7n^2 - 3n) - \frac{1}{2}(7n^2 - 17n + 10)$ $= \frac{1}{2}(14n - 10)$ $= 7n - 5$
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Qn	Solution
24 (a)	 <p> <math>GY = \frac{2}{5} \times 20 = 8 \text{ m}</math> </p> <p>By Pythagoras Theorem,</p> $AH = BG = \sqrt{BC^2 + GC^2} = \sqrt{12^2 + 9^2} = 15 \text{ m}$ $BY = \sqrt{GY^2 + BG^2} = \sqrt{8^2 + 15^2} = 17 \text{ m}$
	$\cos \angle AYB = \frac{AY^2 + BY^2 - AB^2}{2(AY)(BY)}$ <p>Given <math>AY = \sqrt{369} \text{ m}</math>,</p> $= \frac{(\sqrt{369})^2 + 17^2 - 20^2}{2(\sqrt{369})(17)}$
	$\cos \angle AYB = 0.39503 \text{ (5 s.f.)}$ $\angle AYB = 66.732^\circ$ $= 66.7^\circ \text{ (1 d.p.)}$

	(b)	<p>Let <math>X</math> be the point directly below <math>Y</math>.          Let <math>Z</math> be the point on <math>AB</math> where <math>AZ:ZB = 3:2</math>.</p> <p>Let the largest angle of depression of <math>AB</math> from <math>Y</math> be <math>\theta</math>.</p> <p><math>\theta = \angle YZX</math> (alternate angles)</p> $\tan \angle YZX = \frac{9}{12}$
		<p><math>\angle YZX = 36.9^\circ</math> (1 d.p.)  <math>\therefore</math> largest angle of depression of <math>AB</math> from <math>Y = 36.9^\circ</math>.</p>

Qn		Solution
25	(a)	 $\begin{aligned} \overline{RP} &= \overline{OP} - \overline{OR} \\ &= \underline{a} - \underline{b} \\ \overline{OS} &= \overline{OR} + \overline{RS} \\ &= \underline{b} + \frac{1}{4}(\underline{a} - \underline{b}) \\ &= \frac{1}{4}\underline{a} + \frac{3}{4}\underline{b} \\ &= \frac{1}{4}(\underline{a} + 3\underline{b}) \end{aligned}$

$$\begin{aligned}
 \overline{OQ} &= \overline{OR} + \overline{RQ} \\
 &= \underline{b} + \frac{2}{3}\underline{a} + \underline{b} \quad \because \text{given } \overline{RQ} = \frac{2}{3}\underline{a} + \underline{b} \\
 &= \frac{2}{3}\underline{a} + 2\underline{b} \\
 &= \frac{2}{3}(\underline{a} + 3\underline{b}) \\
 &= \frac{2}{3} \times 4 \times \frac{1}{4}(\underline{a} + 3\underline{b}) \\
 &= \frac{8}{3}\overline{OS}
 \end{aligned}$$

Since  $\overline{OQ} = \frac{8}{3}\overline{OS}$ ,  $OQ$  is parallel to  $OS$  and  $O$  is a common point. Thus,  $O$ ,  $S$  and  $Q$  form a straight line.

(b) Since  $XS$  is parallel to  $QP$ , let  $\overline{XS} = m\overline{QP}$ ,  $\overline{OX} = n\underline{a}$ .

$$\begin{aligned}
 \overline{XS} &= m\overline{QP} \\
 \overline{XO} + \overline{OS} &= m(\overline{QO} + \overline{OP}) \\
 -n\underline{a} + \frac{1}{4}\underline{a} + \frac{3}{4}\underline{b} &= m\left(-\frac{2}{3}\underline{a} - 2\underline{b} + \underline{a}\right) \\
 \left(-n + \frac{1}{4}\right)\underline{a} + \frac{3}{4}\underline{b} &= m\left(\frac{1}{3}\underline{a} - 2\underline{b}\right) \\
 \left(-n + \frac{1}{4}\right)\underline{a} + \frac{3}{4}\underline{b} &= \frac{m}{3}\underline{a} - 2m\underline{b}
 \end{aligned}$$

Since  $\underline{a}$  and  $\underline{b}$  are not parallel,

$$\begin{aligned}
 -n + \frac{1}{4} &= \frac{m}{3} \quad \text{and} \quad \frac{3}{4} = -2m \\
 \therefore m &= -\frac{3}{8} \quad \text{and} \quad n = \frac{1}{4} - \frac{m}{3} = \frac{1}{4} - \left(-\frac{3}{8}\right) \div 3 = \frac{3}{8}
 \end{aligned}$$

$$\begin{aligned}
 \overline{XS} &= -\frac{3}{8}\left(\frac{1}{3}\underline{a} - 2\underline{b}\right) \\
 &= -\frac{1}{8}\underline{a} + \frac{3}{4}\underline{b}
 \end{aligned}$$

**Method 2:**

Since triangle OSX is similar to triangle OQP, ratio of OS : OQ = 3 : 8  
Ratio of XS : PQ = 3 : 8

$$\begin{aligned}\overline{XS} &= \frac{3}{8} \left( 2\cancel{b} - \frac{1}{3}\cancel{a} \right) \\ &= \frac{3}{4}\cancel{b} - \frac{1}{8}\cancel{a}\end{aligned}$$



## 2025 TKGS PRELIM MATH P2 Solution

Qn	Solution			
1	(ai)	$50818 \times 10^9 Wh = 5.0818 \times 10^4$ $= 5.0818 \times 10^4 GWh$ $= 5.1 \times 10^4 GWh$		
	(a)	<table border="1"> <tr> <td data-bbox="331 725 405 1218">(ii)</td> <td data-bbox="405 725 1362 1218"> <math display="block">\frac{16.5}{100} \times 53715 = 8862.975</math> <math display="block">= 8900 GWh (2 s.f)</math> </td> </tr> </table>	(ii)	$\frac{16.5}{100} \times 53715 = 8862.975$ $= 8900 GWh (2 s.f)$
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Qn		Solution
2	(a)	$2(5-4x) = 3x-1$ $10-8x = 3x-1$ $-8x-3x = -1-10$ $-11x = -11$ $x = 1$
Qn		Solution
2	(b)	$\frac{x+12}{3} \geq -3(x-3) \text{ and } 5x-3 < 7$
		$\frac{x+12}{3} \geq -3(x-3) \qquad 5x-3 < 7$
		$x+12 \geq -3x+9 \qquad 5x < 10$
		$4x \geq -3 \qquad x < 2$
		$x \geq -\frac{3}{4}$
		$-\frac{3}{4} \leq x < 2$
	(c)	(i)
		$d = \frac{1}{2} [(-2)^2(5) - 7(-2)^2]$
		$= \frac{1}{2} [20 - 28]$
		$= -4$
	(ii)	$2d = b^2c - 7b^2$ $2d = b^2(c-7)$

	$b^2 = \frac{2d}{c-7}$ $b = +\sqrt{\frac{2d}{c-7}} \quad \text{or} \quad b = -\sqrt{\frac{-2d}{7-c}}$
(d)	$\frac{x}{2x-1} - 3 = \frac{4}{x}$ $\frac{x-3(2x-1)}{2x-1} = \frac{4}{x}$ $\frac{x-6x+3}{2x-1} = \frac{4}{x}$ $\frac{-5x+3}{2x-1} = \frac{4}{x}$ $x(-5x+3) = 4(2x-1)$ $-5x^2+3x = 8x-4$ $5x^2+5x-4 = 0$ $x = \frac{-5 \pm \sqrt{5^2 - 4(5)(-4)}}{2(5)}$ $x = 0.52 \quad \text{or} \quad -1.52$

Qn	Solution
3	<p data-bbox="252 248 292 282">(a)</p> <p data-bbox="331 248 533 282">Volume of cone</p> $\begin{aligned} &= \frac{1}{3} \pi (6x)^2 y \\ &= \frac{1}{3} \pi (36x^2) y \\ &= 12\pi x^2 y \end{aligned}$ <p data-bbox="331 510 612 544">Volume of hemisphere</p> $\begin{aligned} &= \frac{1}{2} \times \frac{4}{3} \pi (6x)^3 \\ &= \frac{2}{3} \pi (216x^3) \\ &= 144\pi x^3 \end{aligned}$ $V_{\text{cone}} = 2 \times V_{\text{hemisphere}}$ $12\pi x^2 y = 2 \times 144\pi x^3$ $12\pi x^2 y = 288\pi x^3$ $y = \frac{288\pi x^3}{12\pi x^2}$ $y = 24x$

(b)

$$l_{\text{cone}} = \sqrt{(6x)^2 + y^2}$$

$$= \sqrt{(6x)^2 + (24x)^2}$$

$$= 6x\sqrt{17}$$

Curved surface area of cone

$$= \pi r l$$

$$= \pi (6x) 6x\sqrt{17}$$

$$= 36\pi\sqrt{17}x^2$$

Curved surface area of hemisphere

$$= \frac{1}{2} \times 4\pi r^2$$

$$= 2\pi(6x)^2$$

$$= 72\pi x^2$$

Total surface area =  $36\pi\sqrt{17}x^2 + 72\pi x^2$

$$36\pi\sqrt{17}x^2 + 72\pi x^2 = 600$$

$$x^2 = \frac{600}{\pi(36\sqrt{17} + 72)} = 0.86642$$

$$x = 0.93082 \quad (x > 0)$$

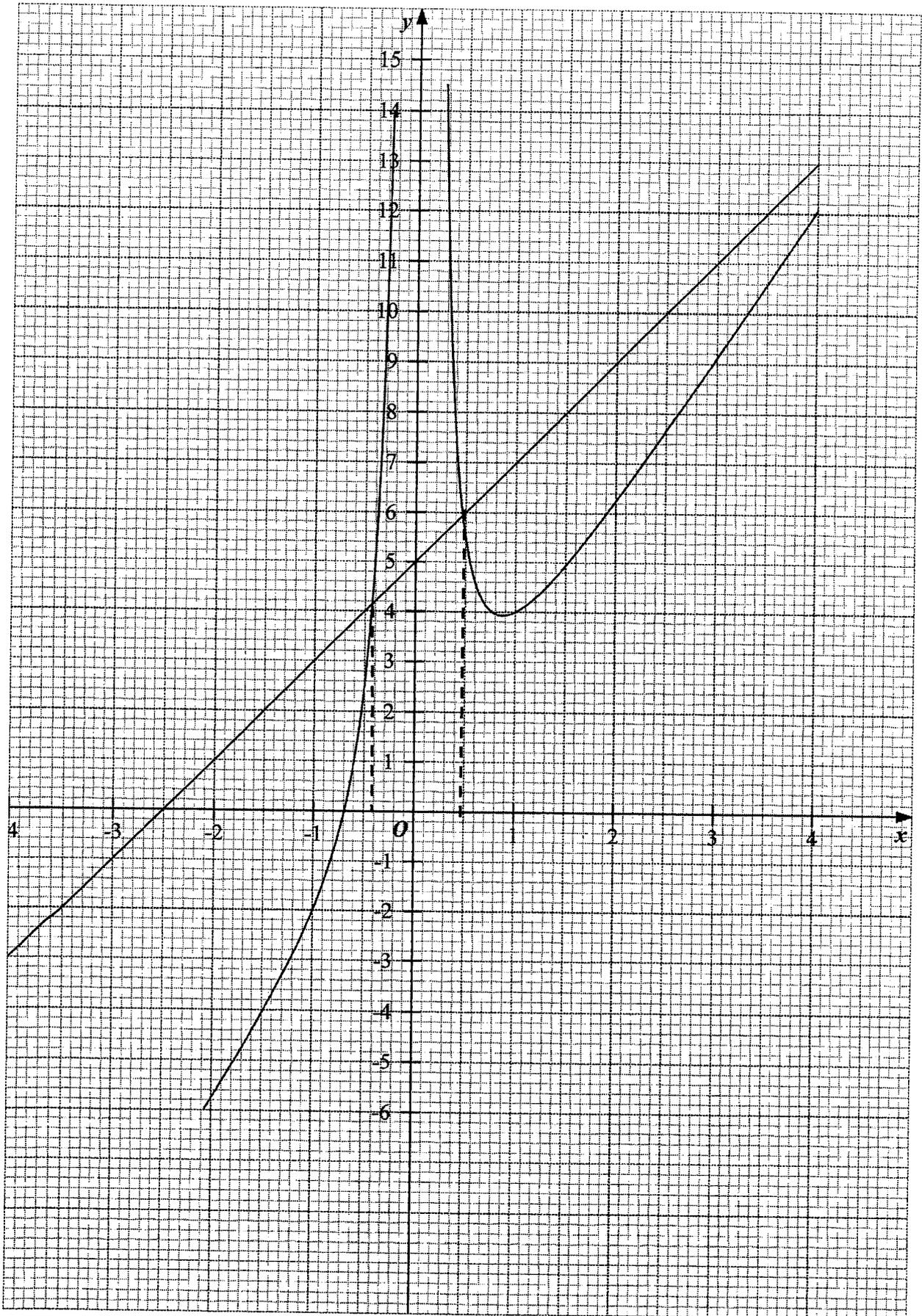
$$H = 24x + 6x = 30x$$

when  $x = 0.93082$

$$H = 30(0.93082) = 27.9 \text{ cm (3 s.f.)}$$

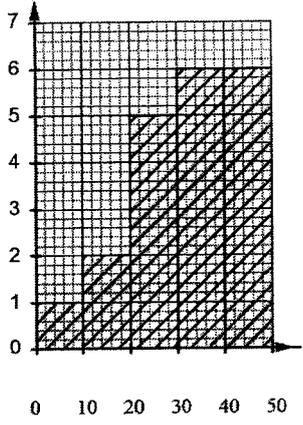
Qn		Solution				
4	(a)	<table border="1"><tr><td><math>x</math></td><td>3</td></tr><tr><td><math>y</math></td><td>9.1</td></tr></table>	$x$	3	$y$	9.1
$x$	3					
$y$	9.1					
	(b)	Graph plotting ( refer to next page )				
	(c)	Straight line plot ( refer to next page )				

	<b>(cii)</b>	$x = -0.4 \pm 0.05$ or $0.5 \pm 0.05$
	<b>(ciii)</b>	$\frac{1}{x^2} + 3x = 5 + 2x$ $1 + 3x^3 = 5x^2 + 2x^3$ $x^3 - 5x^2 + 1 = 0$ $A = 1 \quad B = -5$



Qn		Solution
5	(a)	$\angle OBE = \frac{180^\circ - 114^\circ}{2} \text{ (base angle of isos triangle)}$ $= 33^\circ$ $\angle DBE = 38^\circ + 33^\circ$ $= 71^\circ$ $\angle DFE = 180^\circ - 71^\circ \text{ (angles in opp seg)}$ $= 109^\circ$ $\angle FED = 180^\circ - 109^\circ - 25^\circ \text{ (angle sum of triangle)}$ $= 46^\circ$
	(b) (i)	$\cos \angle BCE = \frac{11}{14} \text{ (}\angle CBA = 90^\circ \text{, right angle in semcircle)}$ $\angle CBD = \cos^{-1}\left(\frac{11}{14}\right)$ $= 0.66695$ $= 0.667 \text{ rad}$
	(b) (ii)	<p>Area of shaded region <math>ABD =</math></p> $\frac{1}{2}(11)(14) \sin(0.66695) - \frac{1}{2}11^2(0.66695)$ $= 7.2811$ $= 7.28$

Qn		Solution
6	(a)	(i) $(-7+5, -2+4) = (-2, 2)$
		(ii) Grad of AC = $\frac{-4-2}{1-(-2)} = -2$ $y = -2x + c$ $x = 1, y = -4$ $-4 = -2 + c$ $c = -2$ $y = -2x - 2$
	(b)	(i) $m = -\frac{1}{2}(-2) + 6 = 7$
		(ii) Length: $\sqrt{(-2-10)^2 + (7-1)^2} = 13.416$ $\approx 13.4$
	(iii) At $(q, 5)$ , $30 + pq = 16$ ----- (1) $5 = -\frac{1}{2}q + 6$ ----- (2) $q = 2$ $p = \frac{-14}{2}$ $= -7$	

Qn		Solution
7	(a)	(i) 
		(ii) Estimated mean $= \frac{1 \times 5 + 2 \times 15 + 5 \times 25 + 6 \times 35 + 6 \times 45}{20}$ $= 32$
		(iii) Using calculator , S.D $\approx 11.446$ $= 11.4$
	(b)	In the histogram, the mean and standard deviations are calculated based on the mid-value of each interval. The mid-value is an estimate of the actual value. Hence, there is a difference in value from the table.

	(c)	(i)	$P(\text{Green}) = \frac{30-5-9}{30}$ $= \frac{8}{15}$
		(ii)	$P(\text{same color}) = P(R, R) + P(G, G) + P(B, B)$ $= \frac{5}{30} \times \frac{4}{29} + \frac{16}{30} \times \frac{15}{29} + \frac{9}{30} \times \frac{8}{29}$ $= \frac{166}{435}$
		(iii)	$P(\text{different}) = 1 - P(\text{both same color})$ $= 1 - \left( \frac{5}{30} \times \frac{5}{30} + \frac{9}{30} \times \frac{9}{30} + \frac{16}{30} \times \frac{16}{30} \right)$ $= 1 - \frac{181}{450}$ $= \frac{269}{450}$

Qn		Solution							
8	(a)	(i)	<table border="1"> <tr> <td>Pattern Number</td> <td><math>n</math></td> </tr> <tr> <td>Number of grey squares</td> <td><math>2n+1</math></td> </tr> <tr> <td>Number of white squares</td> <td><math>n^2</math></td> </tr> </table>	Pattern Number	$n$	Number of grey squares	$2n+1$	Number of white squares	$n^2$
			Pattern Number	$n$					
			Number of grey squares	$2n+1$					
		Number of white squares	$n^2$						
(ii)	$n^2 = 1381$ $n = 37.2$ There is no sequence with 1381 white squares as $n = 37.2$ is not an integer or 1381 is not a perfect square number.								
(iii)	$n^2 - (2n+1) = n^2 - 2n + \left(\frac{2}{2}\right)^2 - \left(\frac{2}{2}\right)^2 - 1$ $= (n-1)^2 - 2$								
(iv)	$n \geq 3$ $n-1 \geq 2$ $(n-1)^2 \geq 4$ $(n-1)^2 - 2 \geq 2$ $\therefore (n-1)^2 - 2 > 0$  Since $(n-1)^2 - 2 = n^2 - (2n+1)$ ,  $n^2 - (2n+1) > 0$ $n^2 > 2n+1$  Therefore, the number of white tiles is greater than the number of grey tiles for $n \geq 3$								

Qn	Solution
(b)	<p>Let <math>x</math> be the cash price of the car</p> $\text{Interest} = \frac{\left(\frac{3}{4}x\right)(3.78)(7)}{100}$ $\frac{3}{4}x + \frac{\left(\frac{3}{4}x\right)(3.78)(7)}{100} = 1850 \times 7 \times 12$ $0.94845x = 155400$ $x = \frac{155400}{0.94845}$ $= \$163846.2755$ $\approx \$163846 \text{ (nearest dollar)}$

Qn	Solution																
9	(a)	$6 \times 3 = 18kWh$															
	(b)	$\begin{aligned} \text{Total hours} &= (8 \times 45 + 7 \times 60 \times 4) \times 50 \\ &= 102000 \text{ hours} \end{aligned}$															
	(c)	<table border="1" data-bbox="331 696 997 1088"> <thead> <tr> <th></th> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>Cost of air con</td> <td><math>60 \times 1288</math> = \$77280</td> <td><math>60 \times 840</math> = \$50400</td> </tr> <tr> <td>Cost of electricity</td> <td><math>\frac{30.65}{100} \times 102000 \times 3 \times 4</math> = \$375156</td> <td><math>\frac{30.65}{100} \times 102000 \times 3.2 \times 4</math> = \$400166.40</td> </tr> <tr> <td>Cost of maintenance in first 4 years</td> <td><math>2 \times 2100</math> = \$4200</td> <td><math>2 \times 4 \times 1000</math> = \$8000</td> </tr> <tr> <td>Total cost for 4 years</td> <td><math>77280 + 375156 + 4200</math> = \$456636</td> <td><math>50400 + 400166.40 + 8000</math> = \$458566.40</td> </tr> </tbody> </table> <p data-bbox="331 1128 986 1193">Assumption: Tax tariff rate remains unchanged in the first 4 years.</p> <p data-bbox="331 1227 1214 1263">The air conditioners do not require additional repairs in the first 4 years</p> <p data-bbox="331 1469 1359 1541">Model A will have a lower cost after the first 4 years of usage by <b>\$1930.40</b> compared to model B</p>		A	B	Cost of air con	$60 \times 1288$ = \$77280	$60 \times 840$ = \$50400	Cost of electricity	$\frac{30.65}{100} \times 102000 \times 3 \times 4$ = \$375156	$\frac{30.65}{100} \times 102000 \times 3.2 \times 4$ = \$400166.40	Cost of maintenance in first 4 years	$2 \times 2100$ = \$4200	$2 \times 4 \times 1000$ = \$8000	Total cost for 4 years	$77280 + 375156 + 4200$ = \$456636	$50400 + 400166.40 + 8000$ = \$458566.40
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