DUNMAN SECONDARY SCHOOL

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS/ 5 NORMAL ACADEMIC

MATHEMATICS **4052/02**

Paper 2

2 hours 15 minutes

Solutions

Question	Answer
1(a)	$2x-1<\frac{5+9x}{2}$ $4x-2<5+9x$ $-7<5x$ $x>-\frac{7}{5}$ or $x>-1.4$
1(b)(i)	$b=\frac{2\left(n-5p^2\right)}{n-p^2}$ $b=12\frac{2}{3}$
1(b)(ii)	$b=\frac{2\left(n-5p^2\right)}{n-p^2}$ $b\left(n-p^2\right)=2\left(n-5p^2\right)$ $bn-bp^2=2n-10p^2$ $10p^2-bp^2=2n-bn$ $p^2\left(10-b\right)=2n-bn$ $p^2=\frac{2n-bn}{10-b}$ $p=\pm\sqrt{\frac{2n-bn}{10-b}}$
1(c)	$\frac{3x}{2x-1}-\frac{2}{5-x}=7$ $\frac{3x\left(5-x\right)-2\left(2x-1\right)}{\left(2x-1\right)\left(5-x\right)}=7$ $15x-3x^2-4x+2=7\left(10x-2x^2-5+x\right)$ $-3x^2+11x+2-77x+14x^2+35=0$ $11x^2-66x+37=0$ $x=\frac{-\left(-66\right)\pm\sqrt{\left(-66\right)^2-4\left(11\right)\left(37\right)}}{2\left(11\right)}$ $=\frac{66\pm\sqrt{2728}}{22}$ $=5.37$ (3 s.f.) or 0.626 (3 s.f.)

Question	Answer
2(a)(i)	Difference = (3.553 – 3.3064) million tonnes $= 0.2466 \times 10^6$ $= 2.47 \times 10^5$ tonnes
2(a)(ii)	percentage increase $= \frac{3.553 - 3.040}{3.040} \times 100\%$ $= 16.875\%$ $= 16.9\%$ (3 s.f.)
2(a)(iii)	amount of waste in 2022 $= 3.553 \times 10^6 \div 84.8 \times 100$ $= 4.19 \times 10^6$ (3 s.f.)
2(b)(i)	deposit = $20\% \times 120000 = 24000$ total monthly payment = $84 \times 1400 = 117600$ total amount = $24000 + 117600 = 141600$
2(b)(ii)	value of car 5 years later = $120000 \times 0.85^5 = 53244.6375$ percentage decrease $= \frac{120000 - 53244.6375}{120000} \times 100\%$ $= 55.6\%$ (3 s.f.)

Question	Answer
3(a)	$h = 0.15$
3(b)	
3(c)	3.5 hours
3(d)(i)	Gradient = -0.5 (± 0.1)
3(d)(ii)	Since gradient is negative, the daily growth rate decreases with additional sunlight.
3(e)(i)	Straight line passing through (0, 0) and (4, 2)
3(e)(ii)	$\frac{1}{6}t^2(4-t) = \frac{t}{2}$ $4t^2 - t^3 = 3t$ $t^3 - 4t^2 + 3t = 0$

Question	Answer
4(a)(i)	$\overrightarrow{AB} = -2\mathbf{a} + 3\mathbf{b}$ $\overrightarrow{AX} = \frac{1}{4}(-2\mathbf{a} + 3\mathbf{b})$ $= -\frac{1}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}$

4(a)(ii)	$\overrightarrow{OX} = 2\mathbf{a} - \frac{1}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}$ $= \frac{3}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}$
4(b)	$\overrightarrow{BY} = 3(2\mathbf{a}) = 6\mathbf{a}$ $\overrightarrow{XY} = \overrightarrow{XB} + \overrightarrow{BY}$ $= \frac{3}{4}(-2\mathbf{a} + 3\mathbf{b}) + 6\mathbf{a}$ $= \frac{9}{2}\mathbf{a} + \frac{9}{4}\mathbf{b}$
4(c)	$\overrightarrow{OX} = \frac{1}{3}\overrightarrow{XY}$ Since OX is parallel to XY, and X is a common point, O, X and Y lie on a straight line.
4(d)	$\frac{\text{Area of triangle } OBX}{\text{Area of triangle } OAB} = \frac{BX}{AB} = \frac{3}{4}$ $\frac{\text{Area of triangle } OAB}{\text{Area of triangle } ABC} = \frac{OA}{BC} = \frac{2}{3} = \frac{4}{6}$ $\frac{\text{Area of triangle } OBX}{\text{Area of triangle } OABC} = \frac{3}{4+6} = \frac{3}{10}$
4(e)	$\overrightarrow{OC} = 3\mathbf{a} + 3\mathbf{b}$ $\overrightarrow{OW} = \frac{2}{5}(3\mathbf{a} + 3\mathbf{b})$ $= \frac{6}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$

Question	Answer
5(a)	$3^2 = 8^2 + 7^2 - 2(8)(7)\cos\angle EFI$ $\cos\angle EFI = \dfrac{8^2 + 7^2 - 3^2}{2(8)(7)}$ $= \dfrac{13}{14}$ $\angle EFI = \cos^{-1}\left(\dfrac{13}{14}\right) = 21.7867... = 21.8°$
5(b)	vol of prism $= \left(8\times 3 + \dfrac{1}{2}\times 7\times 8\times \sin 21.7867°\right)\times 12$ $= 412.70717..$ $= 412.71\text{m}^3$
5(c)	height $= 3 + 7\sin 21.8°$ $= 5.5995...$ $= 5.60$ m (3 s.f.)
5(d)	Let X be the point vertically below J. $CX = 7\cos 21.8° = 6.4994...$ $BX = \sqrt{12^2 + 6.4994^2} = 13.647...$ $\tan\angle JBX = \dfrac{5.5995}{13.647}$ $\angle JBX = \tan^{-1}\left(\dfrac{5.5995}{13.647}\right)$ $= 22.3°$ (1 d.p.)

Question	Answer
6(a)	$\angle OCT = 90°$ (tangent $\perp$ radius) $\angle AOC = 360° - 90° - 90° - 32°$ ($\angle$ sum of quadrilateral) $=148°$ $\angle ADC = 148° \div 2$ ($\angle$at centre = 2$\angle$at circumference) $= 74°$
6(b)	$\angle CBA = 180° - 74°$ ($\angle s$ in opposite segment) $=106°$ $\angle OCA = \dfrac{180° - 148°}{2}$ (base $\angle s$ of isosceles triangle) $=16°$ $\angle OCB = 16° + 38°$ (base $\angle s$ of isosceles triangle) $= 54°$ $\angle OCB + \angle CBA = 106° + 54°$ $= 160° \neq 180°$ Therefore, by converse of interior angles, OC is not parallel to AB.
6(c)	$\angle AOB = 38° \times 2$ ($\angle$at centre = 2$\angle$at circumference) $= 76°$ Area of sector $= \dfrac{76}{360} \times \pi\left(10^2\right) = \dfrac{190}{9}\pi$ Area of triangle $= \dfrac{1}{2}(10)(10)\sin 76° = 48.5147...$ Area of shaded region $= \dfrac{190}{9}\pi - 48.5147 = 17.8 \text{ cm}^2$ (3 s.f.)

Question	Answer
7(a)(i)	$n + 20$
7(a)(ii)	Product of top left and bottom right = $n(n+20) = n^2 + 20n$ Product of top right and bottom left = $(n+2)(n+18) = n^2 + 20n + 36$ Difference = $(n^2 + 20n + 36) - (n^2 + 20n) = 36$
7(a)(iii)	Sum = $n + (n+2) + (n+10) + (n+18) + (n+20) = 5n + 50$ Let $5n + 50 = 1715 \Rightarrow n = 333$ If n = 333, the cross will be 333 … 335 … 343 … 351 … 353 However, 333 = 9 × 37, the first number will be in the last column of the number grid, therefore, the sum cannot be 1715.
7(b)(i)	$T_{10} = 2(10)^2 - 10 + 3 = 193$
7(b)(ii)	$T_{n+1} = 2(n+1)^2 - (n+1) + 3$ $= 2(n^2 + 2n + 1) - n - 1 + 3$ $= 2n^2 + 3n + 4$ $D = 2n^2 + 3n + 4 - (2n^2 - n + 3)$ $= 4n + 1$
7(b)(iii)	Since D is a linear expression in n and the coefficient of n is 4, it means that the difference increases by 4 each time n increases by 1.

Question	Answer
8(a)(i)	7.5 hours (±0.1)
8(a)(ii)	Q1 = 6, Q3 = 9.4 IQR = 9.4 – 6 = 3.4 (±0.1)
8(b)	32 students spent 5 hours or less. 168 students spent at least 5 hours. Probability = $\frac{168}{200} = \frac{21}{25} = 0.84$
8(c)	In general, teenagers in Country X spent less daily screen time with median of 6.5 hours compared to Singapore's median of 7.5 hours. The amount of daily screen time spent by teenagers in Country X has a larger spread with an IQR of 5.2 hours as compared to that of Singapore with IQR of 3.4 hours.

Question	Answer
9(a)	Arc length = $2\pi(2)\times\frac{1}{5} = \frac{4}{5}\pi = 2.513... = 2.5$ m (1 d.p.)
9(b)	Volume of air = $\pi(2.5)^2 \times 0.5 \times 50 \div 60 = 8.1812... = 8.18$ (3 s.f.)
9(c)	<u>For air circulation</u> Minimum airflow requirement $= 30 \times 20 \times 8 \div 5 = 960$ m^3 / min VFR = $\pi(3)^2 \times 0.6 = 5.4\pi = 16.9646...$ Total airflow per minute of fans = $\text{VFR} \times 70 \times 2 = 756\pi = 2375.044...$ Therefore, $2375.044... > 960$, **minimum airflow requirement is met**. <u>For comfortable cooling environment</u> VPS = $5.4\pi \times 45 \div 60 = 4.05\pi$ Air velocity = $4.05\pi \div \pi(3)^2 = 0.45$ m/s > 0.3 m/s Therefore, **comfortable cooling environment is met.** Hence, the **recommendation is suitable.**