DUNMAN SECONDARY SCHOOL

CANDIDATE NAME

CLASS

INDEX NUMBER

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS/ 5 NORMAL ACADEMIC

MATHEMATICS **4052/01**

Paper 1

2 hours 15 minutes

Solutions

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Qn	Answer
1(a)	Inconsistent y-axis scale
1(b)	The revenue growth appears to be more than doubled from 2020 compared to 2024 when in actual fact only increased from about \$500 000 to \$800 000.

Qn	Answer
2	In Italy, $830 \times 1.4893 = \$1236.119$ In Singapore, $830 \div 0.6747 = \$1230.176375$ Difference = \$5.94

Qn	Answer
3(a)	$\sin x = \frac{1}{3}$ $x = 19.47122...$ or $160.5287...$ $= 19.5°$ or $160.5°$ (1 d.p.)
3(b)	$26° = 0.45378... = 0.454$ (3 s.f.)

Qn	Answer
4	Amount of liquid in bottles B and C $= 300 \div 15 \times 13 = 260$ ml Amount of liquid in bottle A = 40 ml Amount of liquid left in bottle A $= 260 \div 65 \times 7 = 28$ ml $n = 40 - 28 = 12$ **OR** 2 : 8 : 5 is equivalent to 10 : 40 : 25 75 units rep. 300 ml 1 unit rep. 4 ml $n = 4 \times (10 - 7) = 12$

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Qn	Answer
5(a)	$\left(\frac{27a^{12}}{b^3}\right)^{-\frac{2}{3}}$ $=\left(\frac{b^3}{27a^{12}}\right)^{\frac{2}{3}}$ $=\frac{b^2}{9a^8}$
5(b)	$13\times9^2-4\times3^4=3^p$ $13\times3^4-4\times3^4=3^p$ $3^4(13-4)=3^p$ $3^4\times3^2=3^p$ $p=6$

Qn	Answer
6	$F=\frac{k}{r^2}$ $F_1=\frac{k}{(3r)^2}=\frac{k}{9r^2}=\frac{1}{9}\left(\frac{k}{r^2}\right)=\frac{1}{9}F$ He is not correct since the force should be $\frac{1}{9}$ instead.

Qn	Answer
7(a)	300 km ÷ 2hour = 150 km/h
7(b)	Since distance is rounded down and time is rounded up, this speed will be lower than the actual speed.
7(c)	227 km/h $=227\times1000\div3600$ $=63.1$ m/s

Qn	Answer
8(a)	$16a^2b-8ab^2$ $=8ab(2a-b)$
8(b)	$3c-4d+3cd-4$ $=3c(1+d)-4(1+d)$ $=(3c-4)(1+d)$

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Qn	Answer
9	$29\ \text{cm}^2 : 728.6\ \text{km}^2$ $\sqrt{29}\ \text{cm} : \sqrt{728.6}\ \text{km}$ $5.3852\ \text{cm} : 26.993\ \text{km}$ (5 s.f.) $1\ \text{cm} : 5.0124\ \text{km}$ (5 s.f.) $1 : 501244$ $1 : 5\times10^5$ $n = 5\times10^5$

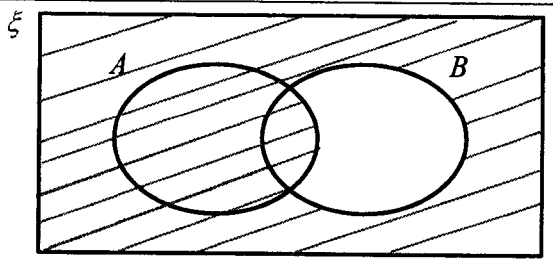
Qn	Answer
10	$\frac{5x}{18} - \frac{5x+12}{54} - \frac{2(x-1)}{27}$ $= \frac{15x-5x-12-4(x-1)}{54}$ $= \frac{10x-12-4x+4}{54}$ $= \frac{6x-8}{54}$ $= \frac{3x-4}{27}$

Qn	Answer
11	$OD = OB$ (radius of circle) $OC = OA$ (radius of circle) $CD = AB$ (equal chords) Therefore, triangles OAB and OCD are congruent by SSS congruency test.

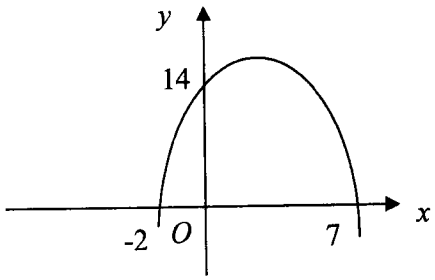
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Qn	Answer
12	$\dfrac{2x^2+7x-15}{16x^4-81}$ $=\dfrac{(2x-3)(x+5)}{(4x^2)^2-9^2}$ $=\dfrac{(2x-3)(x+5)}{(4x^2-9)(4x^2+9)}$ $=\dfrac{(2x-3)(x+5)}{(2x-3)(2x+3)(4x^2+9)}$ $=\dfrac{x+5}{(2x+3)(4x^2+9)}$

Question	Answer
13(a)	$7-10x+x^2$ $=x^2-10x+7$ $=(x-5)^2-5^2+7$ $=(x-5)^2-18$
13(b)	$x=5$

Question	Answer
14(a)(i)	1, 4, 6, 8, 9, 10, 12, 14
14(a)(ii)	Since perfect squares have more than 2 factors, they will never be prime numbers. Hence, $X \cap Y = \phi$
14(b)	

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Question	Answer
15	

Question	Answer
16	$\frac{4}{3}\pi(2r)^3 = 2\times\frac{1}{3}\pi\left(\frac{2}{3}r\right)^2\times 10h$ $\frac{32\pi r^3}{3} = \frac{80\pi r^2 h}{27}$ $32r\times 27 = 3\times 80h$ $864r = 240h$ $\frac{h}{r} = \frac{864}{240}$ $h:r = 18:5$

Question	Answer
17	angle $ABC = 108°$ angle $FBC = 360° - 108° - 100°$ ($\measuredangle s$ at a point) $= 152°$ exterior angle $= 180° - 152° = 28°$ for regular polygon $= \frac{360°}{28°}$ $= 12.85...$ not whole number For a regular polygon, they have equal angles. Hence, $360°$ is not divisible by $28°$, the second polygon is not regular.

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Question	Answer
18(a)	$\sqrt{(-4)^2+(-3)^2}=5$
18(b)	gradient $=\frac{-3}{-4}=\frac{3}{4}$ Equation: $y=\frac{3}{4}x+c$ $-5=\frac{3}{4}(2)+c$ $c=-\frac{13}{2}$ $y=\frac{3}{4}x-\frac{13}{2}$ or $-6\frac{1}{2}$ or -6.5
18(c)	x-coordinates $=2+\frac{3}{4}(4)=5$ y-coordinates $=-5+\frac{3}{4}(3)=-2\frac{3}{4}$ $R=(5, -2.75)$

Question	Answer
19	$16=ka^0 \Rightarrow k=16$ $64=16a^{-2}$ $a^2=\frac{1}{4}$ $a=\frac{1}{2}$ (rej. -ve)

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Question	Answer
20	$\frac{A_1}{A_2}=\left(\frac{l_1}{l_2}\right)^2$ $\frac{4}{5}=\left(\frac{l_1}{30}\right)^2$ $\sqrt{\frac{4}{5}}=\frac{l_1}{30}$ $l_1=30\times\sqrt{\frac{4}{5}}=26.832$ cm (5 s.f.) length $=30-26.832=3.17$ (3 s.f.)

Question	Answer
21(a)	Probability $=\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{3}{8}=\frac{4}{9}$
21(b)	Probability $=\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{5}{8}=\frac{5}{9}$

Question	Answer
22(a)	mean $=\frac{15\times4.25+29\times4.75+12\times5.25+34\times5.75+10\times6.25}{100}$ $=5.225$ mean = \$5225
22(b)	Standard deviation = \$637.87 or \$638
22(c)	Mean remains unchanged, standard deviation becomes smaller

Question	Answer
23(a)	Angle NAB = 52° Angle $N_1BA = 180° - 52° = 128°$ (interior angles, NA // N_1B) Bearing of A from B $= 360° - 128° = 232°$
23(b)	BP = 2.1 cm

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Question	Answer
24(a)	$5y=6x-2 \times 2$: $10y=12x-4$ -- (1) $2y=5x-6 \times 5$: $10y=25x-30$ -- (2) (2) – (1): $13x-26=0$ $x=2, y=2$ $\therefore (2, 2)$
24(b)	For $py=3x-1$ not to intersect with $5y=6x-2$, **they must be parallel.** $y=\frac{3}{p}x-\frac{1}{p}$ $\frac{3}{p}=\frac{6}{5} \Rightarrow p=\frac{5}{2}$ $l_3: y=\frac{6}{5}x-\frac{2}{5}$ Since line l_1 and l_3 have the same equation, they will intersect. Therefore, it is not possible to find a value of p that the lines will not intersect.

Question	Answer
25(a)	$\mathbf{Q}=\begin{pmatrix}1.20\\1.50\\1.80\end{pmatrix}$
25(b)	$\mathbf{T=PQ}$ $=\begin{pmatrix}60 & 80 & 50\\50 & 90 & 70\end{pmatrix}\begin{pmatrix}1.20\\1.50\\1.80\end{pmatrix}$ $=\begin{pmatrix}72+120+90\\60+135+126\end{pmatrix}$ $=\begin{pmatrix}282\\321\end{pmatrix}$
25(c)	282 and 321 represents the total revenue by Class A and class B respectively.
25(d)	$\mathbf{D}=\begin{pmatrix}0.8 & 0.9\end{pmatrix}$

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Question	Answer
26(a)	$2\times3^3=54$ and $2^3\times3^2=72$
26(b)(i)	All prime factors have even indices/powers Or $2^4\times3^6=\left(2^2\times3^3\right)^2$ and therefore, a perfect square
26(b)(ii)	$11664\div\frac{6}{m}$ $=2^4\times3^6\div\frac{6}{m}$ $=2^4\times3^6\times\frac{m}{6}$ $=2^3\times3^5\times m$ $m=3$

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Question	Answer
27(a)	acceleration $= \frac{5-3}{10-8} = 1$ m/s^2
27(b)(i)	Distance $= \frac{1}{2}(T+10)\times 5 = 25+2.5T$ OR Distance $= 5\times 10+\frac{1}{2}\times 5\times(T-10) = 25+2.5T$
27(b)(ii)	Acceleration after 8 seconds = 1 m/s^2 Let speed of B at $T=s$ m/s $\frac{s-3}{T-8}=1$ $s=T-5$ Distance travelled by B $=3\times 8+\frac{1}{2}(3+s)(T-8)$ $=24+\frac{1}{2}(3+T-5)(T-8)$ $=24+\frac{1}{2}(T-2)(T-8)$ When A and B meet, $24+\frac{1}{2}(T-2)(T-8)=25+2.5T$ $\frac{1}{2}(T-2)(T-8)=2.5T+1$ $T^2-10T+16=5T+2$ $T^2-15T+14=0$ (shown)
27(b)(iii)	$(T-14)(T-1)=0$ $T=14$ or $T=1$ (rej.)

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MATHEMATICS **4052/02**

Paper 2

2 hours 15 minutes

Solutions

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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)	$\frac{3x}{2x-1}-\frac{2}{5-x}=7$ $\frac{3x(5-x)-2(2x-1)}{(2x-1)(5-x)}=7$ $15x-3x^2-4x+2=7\left(10x-2x^2-5+x\right)$ $-3x^2+11x+2-77x+14x^2+35=0$ $11x^2-66x+37=0$ $x=\frac{-(-66)\pm\sqrt{(-66)^2-4(11)(37)}}{2(11)}$ $=\frac{66\pm\sqrt{2728}}{22}$ $=5.37$ (3 s.f.) or 0.626 (3 s.f.)

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

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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)	$\overrightarrow{OC} = 3\mathbf{a} + 3\mathbf{b}$ $\overrightarrow{OW} = \frac{2}{5}(3\mathbf{a} + 3\mathbf{b})$ $= \frac{6}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$

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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.)

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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 $= \dfrac{76}{360} \times \pi(10^2) = \dfrac{190}{9}\pi$ Area of triangle $= \dfrac{1}{2}(10)(10)\sin 76° = 48.5147...$ Area of shaded region $= \dfrac{190}{9}\pi - 48.5147 = 17.8$ cm^2 (3 s.f.)

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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, $333 = 9 \times 37$, 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.

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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 $= 30\times20\times8\div5 = 960$ m^3 / min VFR = $\pi(3)^2 \times 0.6 = 5.4\pi = 16.9646...$ Total airflow per minute of fans = 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.**

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