

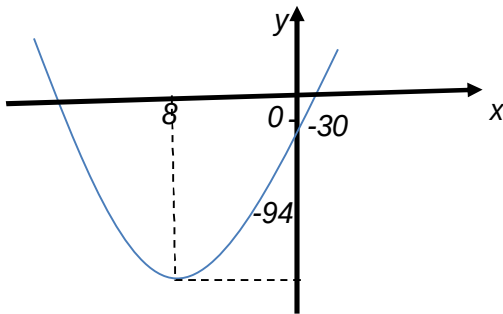
Fairfield Methodist School (Secondary)
 Secondary 4 Express / 5 Normal (Academic)
 Marking Scheme
 Preliminary Examinations 2023

Qn No.	Workings	Description	Mark Allocation	AO
1(a)	$540 = 2^2 \times 3^3 \times 5$		B1	AO1
1(b)	$m = 2$ $n = 5$		B1	AO1
2(a)	901.16		B1	AO1
2(b)	9.0116×10^2 or 9.01×10^2 (3 s.f.)		B1	AO1
3(a)	37		B1	AO1
3(b)	$9 + 4n$		B1	AO1
3(c)	Let $318 = 9 + 4n$ $4n = 309$ $n = 77 \frac{1}{4}$ Since n is not a positive integer, 318 is not a term of the sequence.		B1	AO3
4(a)	$72 + 2x + 75 + 69 + x = 360$ $3x + 216 = 360$ $3x = 144$ $x = 48$		B1	AO2
4(b)	No. of adults $= \frac{75}{360} \times 240$ $= 50$		B1	AO1
5	$\frac{2}{5}$ y-intercept = $5(\frac{2}{5}) = 2$ Gradient of line graph $= -\frac{\text{vert}}{\text{horizontal}}$ $= -\frac{2}{\frac{2}{5}}$ $= -5$ Equation of line is $y = -5x + 2$		M1 M1 A1	AO2

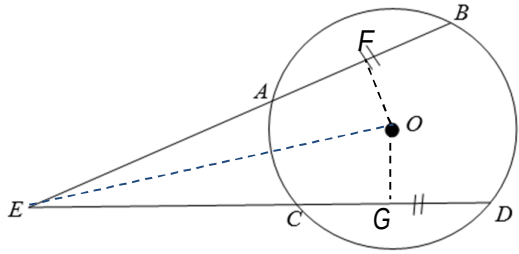
Qn No.	Workings	Description	Mark Allocation	AO
6	Distance travelled by fuel in 24 mins $= 2 \times 24 \times 60 = 2880\text{m}$ Capacity of fuel tank $= 2880 \times \pi \left(\frac{8/2}{100} \right)^2$ $= 14.476$ $= 14.5\text{m}^3 (3sf)$ $= 145000\text{l} (3sf)$		M1 M1 A1	AO2
7a	$(81x^4)^{-\frac{3}{4}}$ $= \frac{1}{81^{\frac{3}{4}}} (x)^{-3}$ $= \frac{1}{(3^4)^{\frac{3}{4}}} \times \frac{1}{x^3}$ $= \frac{1}{3^3} \times \frac{1}{x^3}$ $= \frac{1}{27x^3}$	Apply $(a^m)^n = a^{mn}$	M1 A1	AO1
7b	$32^{\frac{1}{5}} \times 2^x = 8^{\frac{1}{4}}$ $(2^5)^{\frac{1}{5}} \times 2^x = (2^3)^{\frac{1}{4}}$ $2 \times 2^x = 2^{\frac{3}{4}}$ $2^{1+x} = 2^{\frac{3}{4}}$ $1+x = \frac{3}{4}$ $x = \frac{3}{4} - 1$ $= -\frac{1}{4}$	Apply $(a^m)^n = a^{mn}$	M1 A1	AO1
8(a)(i)	{3, 6, 9, 12, 15, 18, 21}	No { } will result to no marks awarded	B1	AO1
8(a)(ii)	{4, 8, 10, 14, 16, 20, 22}		B1	AO1
8(b)(i)	$A' \cap (B \cap C) = \emptyset$ $5 \in A' \cap C$	B1 for each correct answer	B1 B1	AO1

Qn No.	Workings	Description	Mark Allocation	AO
8(b)(ii)	$n[B' \cap (A \cup C)] = 5$		B1	AO1
9	$\frac{4m^2 - 20mn + 16n^2}{3m - 12n}$ $= \frac{4(m^2 - 5mn + 4n^2)}{3(m - 4n)}$ $= \frac{4(m - 4n)(m - n)}{3(m - 4n)}$ $= \frac{4(m - n)}{3}$	M1 for factorising out either common factor correctly M1 for factorising $m^2 - 5mn + 4n^2$ correctly	M1 M1 A1	AO1
10	Let Ching's and Lex's original savings be $\\$3u$ and $\\$5u$ respectively. $\frac{3u - 60}{5u - 60} = \frac{4}{7}$ $7(3u - 60) = 4(5u - 60)$ $21u - 420 = 20u - 240$ $21u - 20u = 420 - 240$ $u = 180$ $\therefore$ Total amount of money now $= 180(3 + 5) - 2(60)$ $= \$1320$	M1 for converting to linear equation correctly M1 for expanding either side correctly M1 for simplifying either algebraic terms or constants correctly	M1 M1 M1 A1	AO2
11a	$\cos x = -\cos 65^\circ$ $x = 180^\circ - 65^\circ = 115^\circ$		B1	AO1
11b	Area of $\triangle PQR = \frac{1}{2}(PQ)(PR)\sin \angle QPR$ $15 = \frac{1}{2}(10)(6)\sin \angle QPR$ $15 = 30\sin \angle QPR$ $\sin \angle QPR = \frac{15}{30}$ $\angle QPR = \sin^{-1}\left(\frac{15}{30}\right)$ $= 30^\circ \text{ or } 150^\circ$		M1 M1 A1 for both ans	AO1
12a	A^2 $= \begin{pmatrix} 4 & 6 \\ 0 & -2 \end{pmatrix} \begin{pmatrix} 4 & 6 \\ 0 & -2 \end{pmatrix}$			AO1

Qn No.	Workings	Description	Mark Allocation	AO
	$= \begin{pmatrix} 16 & 12 \\ 0 & 4 \end{pmatrix}$		B1	
12b	A = 2B $\begin{pmatrix} 4 & 6 \\ 0 & -2 \end{pmatrix} = 2 \begin{pmatrix} 2 & k \\ 0 & -1 \end{pmatrix}$ $\begin{pmatrix} 4 & 6 \\ 0 & -2 \end{pmatrix} = \begin{pmatrix} 4 & 2k \\ 0 & -2 \end{pmatrix}$ $2k = 6$ $k = 3$		B1	AO1
13a	$S = \begin{pmatrix} 34000 & 20100 \\ 14500 & 30000 \end{pmatrix}$		B1	AO1
13b	$(1 \ 1) \begin{pmatrix} 34000 & 20100 \\ 14500 & 30000 \end{pmatrix}$ $= (48500 \ 50100)$		B1	AO1
13c	The total/combined sales in 2021 and 2022 (or for the 2 years) for IMic and Lenovo Laptops respectively	- Keywords: Total/Combined , respectively, 2021 and 2022 or past 2 years	B1	AO2
14a	<i>Angle x</i> $= 180^\circ - 112^\circ$ (int. angles, AB // CD) $= 68^\circ$	Deduct 1 mark – wrong or missing reasons	B1	AO1
14b	<i>Angle z</i> $= 85^\circ$ (corr. angles, AB // CD) <i>Angle y</i> $= 180^\circ - 85^\circ$ (adj. on a str. line) $= 95^\circ$		M1 A1-	AO1
15a	$y = x^2 + 3$		B1	AO1
15b	$y = x^3 + 3$		B1	AO1
15c	$y = 3^x + 3$		B1	AO1
15d	$y = 3x^{-2}$		B1	AO1
16a	Refer to last page			AO1
16b	Refer to last page			AO1
16c	Refer to last page			AO2

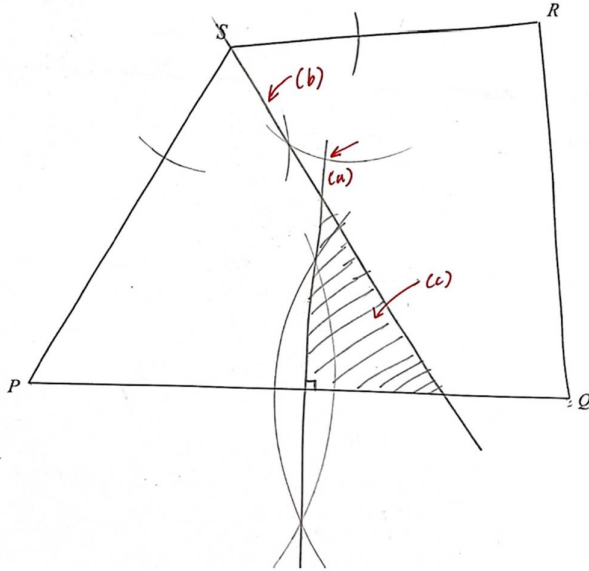
Qn No.	Workings	Description	Mark Allocation	AO
17(a)	$3ax + 16by - 12ay - 4bx$ $= 3ax - 12ay - 4bx + 16by$ $= 3a(x - 4y) - 4b(x - 4y)$ $= (3a - 4b)(x - 4y)$ or $(4b - 3a)(4y - x)$	M1 for factorising any 2 terms correctly	M1 A1	AO1
17(b)	$3mn - 243mn^5$ $= 3mn(1 - 81n^4)$ $= 3mn(1 + 9n^2)(1 - 9n^2)$ $= 3mn(1 + 9n^2)(1 + 3n)(1 - 3n)$	M1 for factorising out $3mn$ M1 for applying difference of squares to $1 - 81n^4$	M1 M1 A1	AO1
18a	$x^2 + 16x - 30$ $= x^2 + 16x + (\frac{16}{2})^2 - (\frac{16}{2})^2 - 30$ $= (x + 8)^2 - 94$		B1	AO1
18b	$x^2 + 16x - 30 = 0$ $(x + 8)^2 - 94 = 0$ $(x + 8)^2 = 94$ $x + 8 = \pm\sqrt{94}$ $x = \sqrt{94} - 8$ or $-\sqrt{94} - 8$ $x = 1.70(2d.p.)$ or $-17.70(2d.p.)$		M1 A1 for both ans	AO1
18c	 Turning Point = (-8, -94) When $x = 0$, $y = (0 + 8)^2 - 94 = -30$	Correct Shape Correct y-intercept and turning point	C1 P1	AO1

Qn No.	Workings	Description	Mark Allocation	AO
19a	Size of 1 int angle from octagon $= \frac{(8-2) \times 180^\circ}{8} = 135^\circ$ Size of 1 int angle from Hexagon $= \frac{(6-2) \times 180^\circ}{6} = 120^\circ$ $\angle a = 360^\circ - 135^\circ - 120^\circ$ (sum of $\angle$s at a pt.) $= 105^\circ$		M1 M1 A1	AO1
19b	$\frac{(n-2) \times 180^\circ}{n} = 105^\circ$ $n - 2 = \frac{105^\circ n}{180^\circ}$ $n - \frac{105^\circ n}{180^\circ} = 2$ $0.41667n = 2$ $n = 4.8$ Since n is not a positive integer, that polygon does not exist.		M1 M1 A1	AO3
20a	% of student with revision > 12 hours $= \frac{10+12}{41} \times 100\% = 53.7\% (3s.f.)$		B1	AO1
20b	Median position = 21st position Median = 12 h – 16hr or $12 \text{ hr} \leq \text{time} \leq 16 \text{ hr}$		B1	AO1
20ci	Est Mean $= \frac{5(2) + 6(6) + 8(10) + 10(14) + 12(18)}{41}$ = 11.756h = 11.8h		B1	AO1
20cii	Std Deviation = 5.4495h = 5.45 h		B1	AO1

Qn No.	Workings	Description	Mark Allocation	AO
21a	 Since $AB=CD$, $OF = OE$(equal chords) ---- S $AF = FB = CG = GD$ ($\perp$ bisector of chord) $\angle AFO = \angle CGO = 90^\circ$ ----- R EO is shared side of $\triangle OFE$ and $\triangle OGE$ ----H By RHS Congruency Test, $\triangle OFE \cong \triangle OGE$ As $EF = CE$, $EA = EF - AF$ $EC = EG - CG$ Since $EF = CE$ and $AF = CG$, $EA = EC$ (proven)		M2 for all Evidences M1 for 2 evidences M1 for RHS Test AG1	AO3
21a	Alternative Solution: $EA \times EB = EC \times ED$ (Intersecting Secant Theorem) $EA(EA + AB) = EC(EC + CD)$ $\frac{EA}{EC} = \frac{EA + AB}{EC + CD}$ $\frac{EA}{EC} = \frac{EA + AB}{EC + AB}$, given that $CD = AB$ $\therefore EA = EC$ (proven)	State the theorem	M1 M1 M1 AG1	

Qn No.	Workings	Description	Mark Allocation	AO
21b	$\angle BEO = \angle DEO = \frac{30^\circ}{2} \text{ (OE is } \angle \text{bisector of } \angle BED)$ $= 15^\circ$ $AF = \frac{40}{2} = 20\text{cm}$ $\tan \angle OEF = \frac{OF}{EF} = \frac{15}{EF}$ $\tan 15^\circ = \frac{15}{EF}$ $EF = \frac{15}{\tan 15^\circ} = 55.981\text{cm}$ $AE = EF - 20$ $= 55.981 - 20$ $= 36.0\text{cm (3 s.f)}$		M1 M1 A1	AO2
21b	Alternative solution: $\angle EBD = \frac{180^\circ - 30^\circ}{2}$ $= 75^\circ \text{ (base } \angle \text{s of an isos. } \Delta, EB=ED)$ $\angle ABO = \cos^{-1} \left(\frac{40^2 + 25^2 - 25^2}{2(40)(25)} \right)$ $= 36.870^\circ (5sf)$ $\angle OBD = 75^\circ - 36.870^\circ = 38.13^\circ$ $BD = \frac{25}{\sin 38.13^\circ} \times \sin(180^\circ - (38.13^\circ \times 2))$ $= 39.331\text{cm}(3sf)$ $EB = \frac{39.331^\circ}{\sin 30^\circ} \times \sin 75^\circ$ $= 75.982\text{cm}(3sf)$ $AE = 75.982 - 40$ $= 36.0\text{cm}(3sf)$		M1 M1 A1	
22	Perimeter of major sector = 3 × Perimeter of minor sector $x(2\pi - \theta) + 2x = 3(x\theta + 2x)$ $2x\pi - x\theta + 2x = 3x\theta + 6x$ $x(2\pi - \theta + 2) = x(3\theta + 6)$ $4\theta = 2\pi - 6 + 2$ $4\theta = 2\pi - 4$ $\theta = \frac{\pi - 2}{2} = 0.571\text{radians}(3dp)$		M1 for each correct perimeter M1 for making θ as the subject A1	AO2

[illegible]

Qn No.	Workings	Description	Mark Allocation	AO
			correct distance	
16		Minus 1 mark for missing construction lines, incomplete perpendicular bisector.	B1 for part (a), (b) and (c) respectively	