

Northbrooks Secondary School
4E5N Preliminary Examinations 2026
Mathematics Paper 2
Mark Scheme

1a	$\frac{2}{x+2} = \frac{1}{3x-4}$ $2(3x-4) = 1(x+2)$ $6x-8 = x+2$ $5x = 10$ $x = 2$	M1 – Cross multiply / common denominator A1
1b	$3x^2 - 48y^2$ $= 3(x^2 - 16y^2)$ $= 3(x+4y)(x-4y)$	M1 – Factor 3 seen A1
1c	$\frac{3^{85} \times 3^{15}}{3^{15} + 3^{15} + 3^{15}}$ $= \frac{3^{100}}{3^{16}}$ $= 3^{100-16}$ $= 3^{84}$	M1 – $\frac{3^{100}}{3^{16}}$ shown A1
1d	Elimination / Substitution Method $3x - 2y = 2 \quad (1)$ $7x + 3y = 43 \quad (2)$ From (1) $\times 3$: $9x - 6y = 6$ From (2) $\times 2$: $14x + 6y = 86$ $9x + 14x = 86 + 6$ $23x = 92$ $x = 4$ $y = 5$	M1 For elimination – making coefficient the same and either + or – correctly For substitution – making x or y the subject correctly A1 A1

1e	$\frac{y^2}{(x+y)(x-3y)} - \frac{x-y}{3y-x}$ $= \frac{y^2}{(x+y)(x-3y)} + \frac{x-y}{x-3y}$ $= \frac{y^2 + (x-y)(x+y)}{(x+y)(x-3y)}$ $= \frac{y^2 + x^2 - y^2}{(x+y)(x-3y)}$ $= \frac{x^2}{(x+y)(x-3y)}$	M1 – Factorise -ve $3y - x = -(x - 3y)$ M1 – attempt common denominator and correct expansion of numerator A1
2a	$QR^2 = PQ^2 + PR^2 - 2(PQ)(PR)\cos \angle RPQ$ $= 2^2 + 3^2 - 2(2)(3)\cos 60^\circ$ $= 7 \text{ (ratio)}$ Hence $PR^2 : RQ^2 = 3^2 : 7$ $= 9 : 7 \text{ (shown)}$	M1 – Apply correct Cosine rule M1 – Calculate to find ratio of QR^2 A1
2bi	$\cos \angle ADE = \frac{5^2 + 9^2 - 12^2}{2 \times 5 \times 9}$ $= -\frac{19}{45}$ $\angle ADE = 114.975^\circ$ $\angle DAB = 180 - 114.975$ $\angle DAB = 65.0^\circ \text{ (1 d.p)}$	M1 – Apply correct Cosine rule M1 – Find angle ADE correctly A1
2bii	Area of $ABCD$ $= 2 \times \left(\frac{1}{2} \times 5 \times 13 \times \sin 65.025^\circ \right)$ $= 58.9 \text{ cm}^2 \text{ (3 s.f)}$	M1 – Area ADB A1

2c	Vol of cylinder = $\pi(8)^2(14)$ Vol of cone = $\frac{1}{3}\pi(8)^2(14)$ Vol of remaining solid = $\frac{2}{3}\pi(8)^2(14)$ $\frac{2}{3}\pi(8)^2(14) = 7 \times \frac{4}{3}\pi(r)^3$ $r^3 = 64$ $r = 4$	M1 Find volume of remaining solid M1 – Form equation A1
3ai	48 g	B1
3aii	51.5 – 45 = 6.5 g	M1 (for LQ or UQ) A1
3aiii	40 g	B1
3b	260 – 200 = 60 $\frac{60}{300} \times \frac{59}{299} = \frac{59}{1495}$ or 0.0395 260 – 195 = 65 $\frac{65}{300} \times \frac{64}{299} = \frac{16}{345}$	M1 – Identify 60 cookies A1
3c	Second batch Median = 44 g IQR = 50 – 40 = 10 g - Batch 1 cookies are heavier than Batch 2 cookies, as the median mass is higher (48 g > 44 g). - Batch 1 cookies are also more consistent than Batch 2 cookies, as the interquartile range is smaller (6 g < 10 g).	B1 B1
4a	3174.20 ÷ 1.18 = \$2690	M1 – 1.18 or 118% A1
4b	<u>First Map</u> Map : Actual (Comparing Length) 1 : 50 000 1 cm : 0.5 km	

	Map : Actual (Comparing Area) $(1 \text{ cm})^2 : (0.5 \text{ km})^2$ $1 \text{ cm}^2 : 0.25 \text{ km}^2$ $16 \text{ cm}^2 : 4 \text{ km}^2$ <u>Second Map</u> Map : Actual (Comparing Area) $25 \text{ cm}^2 : 4 \text{ km}^2$ Map : Actual (Comparing Length) $\sqrt{25 \text{ cm}^2} : \sqrt{4 \text{ km}^2}$ $5 \text{ cm} : 2 \text{ km}$ $1 \text{ cm} : 0.4 \text{ km}$ $1 \text{ cm} : 40\,000 \text{ cm}$ $1 : 40\,000$	M1 – Finding area ratio M1 – Finding actual area of building M1 – Converting area scale to linear scale A1
4c	Dance : Music $4 : 7$ Music : Art $3 : 5$ Dance : Music : Art $12 : 21 : 35$ Let the number of students in Dance, Music & Art be $12x$, $21x$ and $35x$. $\frac{1}{5}(35x) + 12x = 95$ $19x = 95$ $x = 5$ Alternatively, Dance : Music : Art $12 + 7 : 21 : 35 - 7$ $19 : 21 : 28$ $68x = 340$	M1 – Find ratio of all three activities M1 – Equation formed to find one unit A1
4di	$\begin{pmatrix} 0.9 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0.8 \end{pmatrix}$	B1

4dii	$\mathbf{T} = \begin{pmatrix} 0.9 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0.8 \end{pmatrix} \begin{pmatrix} 50 \\ 40 \\ 75 \end{pmatrix}$ $\mathbf{T} = \begin{pmatrix} 45 \\ 40 \\ 60 \end{pmatrix}$	B1
4diii	The <u>discounted price</u> of Apple Pie, Nutella Pie and Strawberry Pie <u>respectively</u> .	B1
4div	$\begin{pmatrix} 13 & 15 & 18 \\ 10 & 20 & 22 \end{pmatrix} \begin{pmatrix} 45 \\ 40 \\ 60 \end{pmatrix} = \begin{pmatrix} 2265 \\ 2570 \end{pmatrix}$ $(1 \quad 1) \begin{pmatrix} 2265 \\ 2570 \end{pmatrix} = (4835)$ Total amount = \$4835	M1 – from their (ii) M1 A1
5ai	Angle $ABE = \text{Angle } ADC$ (given) Angle $BAE = \text{Angle } DAC$ (common angle) By AA similarity, triangles ABE and ADC are similar.	B1 – Need 2 correct statement A1
5aii	$\frac{AC}{AD} = \frac{AE}{AB}$ $\frac{AC}{12} = \frac{8}{6}$ $AC = 16 \text{ cm}$ $BC = 10 \text{ cm}$	M1 – Correct similarity ratio A1
5aiii	Area ratio of triangles ABE and $ADC = 1 : 4$ Area ratio of quadrilateral $BCDE$ and $ADC = 3 : 4$	B1
5b	Each int $\angle$ of $A = \frac{(5-2) \times 180}{5} = 108^\circ$ Each int $\angle$ of $C = 360^\circ - 108^\circ - 90^\circ = 162^\circ$	M1 – Find int angle of pentagon M1 – Find int angle of C (FT)

	Solve by int angle / ext angle $\frac{(n-2) \times 180^\circ}{n} = 162^\circ$ $n = 20$	M1 – Equation formed (FT) A1
6a	-0.3	B1 – Exact, do not award -0.25
6b		B3 Or B2FT for 8 points plotted correctly Or B1FT for 6 or 7 points plotted correctly Tolerance $\pm 0.5\text{mm}$ (half a small grid) for plotting points and drawing curve through points
6c	-2.25 ± 0.5	B1
6d	$\frac{x^3}{4} - 3x = k$ $\frac{x^3}{4} - 3x + 2 = k + 2$ $y = k + 2 \text{ (From graph, } y = 6 \text{ or } -2)$ $k = 4 \text{ or } -4$	B1, B1

7d	full-time woman = $\frac{2}{7} \times 28$ $= 8$ $P(\text{PT man, PT man}) = \frac{2}{27}$ Let m represent the number of part-time men. $\frac{m}{28} \times \frac{m-1}{27} = \frac{2}{27}$ $\frac{m(m-1)}{756} = \frac{2}{27}$ $m(m-1) = 56$ $m = 8$ or $m = -7$ (rej) $\therefore \text{FT man} = 28 - 6 - 8 - 8$ $= 6$ <table border="1"> <thead> <tr> <th></th><th>Part-time employees</th><th>Full-time employees</th></tr> </thead> <tbody> <tr> <th>Women</th><td>6</td><td>8</td></tr> <tr> <th>Men</th><td>8</td><td>6</td></tr> </tbody> </table>		Part-time employees	Full-time employees	Women	6	8	Men	8	6	B1 M1 – Equation form using probability given M1 – Find m A1 FT – from their value of m
	Part-time employees	Full-time employees									
Women	6	8									
Men	8	6									
8a	$\sqrt{(k-7)^2 + (-6-(-1))^2} = 13$ $k^2 - 14k + 49 + 25 = 169$ $k^2 - 14k - 95 = 0$ $(k-19)(k+5) = 0$ $k = 19$ or -5 Since $k < 0$, $k = -5$	M1 – Equation formed using length A1									
8b	Area of triangle $= \frac{1}{2} \times (8+6) \times (7+5)$ $= 84 \text{ units}^2$	M1 A1									

8c	$\text{Gradient } PQ = \frac{8 - (-1)}{-5 - 7} = -\frac{3}{4} \text{ (or } -0.75)$ $8 = -\frac{3}{4}(-5) + c$ $c = \frac{17}{4} \text{ (or } 4.25)$ $y = -\frac{3}{4}x + \frac{17}{4}$	M1 – gradient of PQ M1 – find y-intercept based on <i>their m</i> A1
----	--	--

PRWC

9a	$4300\left(1 + \frac{3}{100}\right)^5$ $= 4984.878$ $\approx \$5000 \text{ (shown)}$	B1
9b	$100\,000 - 5(5000)$ $= \$75\,000$ Accept more accurate value (to 2 d.p): $100\,000 - 5(4984.878)$ $= \$75\,075.607$ $\approx \$75\,075.61$	B1
9c	To find the maximum loan amount, we consider the most expensive possible scenario, <u>1598cc petrol car</u> Category A, Max COE Price $\approx$ \$120 000 Total cost price $120\,000 + 120\,000$ $= \\$240\,000$ <u>208kW electric car</u> Category B, Max COE Price $\approx$ \$130 000 – 140 000 Total cost price $130\,000 + 130\,000 - 30\,000$ $= \\$230\,000$ For <u>208kW electric car</u>, downpayment required for 60% bank loan $40\% \times 230\,000$ $= \\$92\,000$ Downpayment $>$ \$75 000 (unable to afford) For <u>1598cc petrol car</u>, downpayment required for 70% bank loan $30\% \times 240\,000$ $= \\$72\,000$ Downpayment $<$ \$75 000 (able to afford)	

	Hence, Daniel will purchase <u>1598cc petrol car.</u> $70\% \times 240\,000$ $= \$168\,000$ $I = \frac{168\,000 \times 2.48 \times 7}{100}$ $= \$29164.80$ $= 29\,164.80 + 240\,000$ $= \$269\,164.80$
	Marks 1- Find total cost price of 1598cc 1- Find total cost price of EV208kW 1- Find downpayment required for 1598cc (allow FT from <i>their</i> cost price) 1- Find downpayment required for EV208kW (allow FT from <i>their</i> cost price) 1- Conclude that Daniel can afford chosen car downpayment < <i>answer in (b)</i> 1- Find interest from bank loan (allow FT from <i>their</i> cost price) 1- Final amount paid (allow FT of Interest + <i>their</i> cost price)