

AS PURE PAPER MARK SCHEME- MATHSFLEX TUTORING

Q1

Let $u = \sqrt{x}$ $6x + \sqrt{x} - 15 = 0 \Rightarrow 6u^2 + u - 15 = 0$ $\Rightarrow (3u + 5)(2u - 3) = 0$	M1 A1
Attempts $\sqrt{x} = \frac{3}{2}, -\frac{5}{3} \Rightarrow x = \dots$	M1
$x = \frac{9}{4}$ only	A1cso

Q2

Sets up the proof by exploring when $n = 2k$ or $n = 2k + 1$ eg $(2k)^2 + 3(2k) = \dots k^2 + \dots k$ or $(2k + 1)^2 + 3(2k + 1) = \dots k^2 + \dots k$	M1
eg $4k^2 + 6k$ or $4k^2 + 10k + 4$ and shows or gives a reason why the expression is even	A1
Explores when $n = 2k$ and $n = 2k + 1$ eg $(2k)^2 + 3(2k) = \dots k^2 + \dots k$ and $(2k + 1)^2 + 3(2k + 1) = \dots k^2 + \dots k$	dM1
eg $4k^2 + 6k$ and $4k^2 + 10k + 4$ and shows or gives a reason why both of the expressions are even hence $n^2 + 3n$ is even for all $n \in \mathbb{N}$	A1

Q3

$\frac{x}{\sin 30^\circ} = \frac{x + 2}{\sin 120^\circ}$	M1
$x \sin 120^\circ - x \sin 30^\circ = 2 \sin 30^\circ$	dM1
$x = 2.73$ from correct working	A1
$AB^2 = 1.73^2 + 4.73^2 - 2 \times 1.73 \times 4.73 \times \cos 150^\circ$ $\Rightarrow AB = \dots$	M1
$AB = \text{awrt } 6.29 \text{ (cm)}$	A1

Q4

$2p$	B1
$\log_a 135 = \log_a (5 \times 27) = \log_a 5 + \log_a 27$	M1
$\log_a 125^{\frac{1}{3}} + \log_a 27 = \frac{1}{3}q + p$	A1
$\log_a 375 \times \log_a 5.4 = (\log_a 125 + \log_a 3) \times (\log_a 27 - \log_a 5)$	M1
$\left(q + \frac{1}{3}p\right) \times \left(p - \frac{1}{3}q\right)$	A1

Q5

Uses or implies that $V = ad + b$	B1
Uses both $50 = 50a + b$ and $15 = 225a + b$ to get either a or b	M1
Uses both $50 = 50a + b$ and $15 = 225a + b$ to get either a and b	dM1
$\Rightarrow V = -\frac{1}{5}d + 60$	A1
States either that the initial volume was 60 (litres) or that the distance travelled was 300 (km)	B1ft
Attempts to find both answers by solving $0 = -\frac{1}{5}d + 60$ and $0 = 300 - 5V$	M1
States both that the initial volume was 60 (litres) and that the distance travelled was 300 (km)	A1
States, eg, "Good model" as 320km is close to 300km	B1ft

Q6

Deduces the line has gradient "-2" and point (8, 5) eg $y - 5 = -2(x - 8)$	M1
$y = -2x + 21$	A1
Solves $y = -2x + 21$ and $y = \frac{1}{2}x$ simultaneously	M1
$P = \left(\frac{42}{5}, \frac{21}{5}\right)$ oe	A1
Length $PN = \sqrt{\left(\frac{42}{5} - 8\right)^2 + \left(\frac{21}{5} - 5\right)^2} = \sqrt{\frac{4}{5}}$	M1
Equation of C is $(x - 8)^2 + (y - 5)^2 = \frac{4}{5}$ oe	A1
Attempts to find where $y = \frac{1}{2}x + k$ meets C using vectors. eg $\begin{pmatrix} \frac{42}{5} \\ \frac{21}{5} \end{pmatrix} + 2 \times \begin{pmatrix} -\frac{2}{5} \\ \frac{4}{5} \end{pmatrix}$	M1
Substitutes their $\left(\frac{38}{5}, \frac{29}{5}\right)$ in $y = \frac{1}{2}x + k$ to find k	M1
$k = 2$	A1

Q7

States or uses $\tan x = \frac{\sin x}{\cos x}$	B1
$3\sin x = 4\cos^2 x \Rightarrow 3\sin x = 4(1 - \sin^2 x)$	M1
$4\sin^2 x + 3\sin x - 4 = 0$ from correct working	A1
Attempts to solve $4\sin^2 x + 3\sin x - 4 = 0 \Rightarrow \sin x = \dots$	M1
$\sin x = \frac{-3 \pm \sqrt{73}}{8}$	A1
Takes $\sin^{-1}$ leading to at least one answer in the range	dM1
$x = \text{awrt } 43.9^\circ$ and $x = \text{awrt } 136.1^\circ$ only	A1
$20 \times "2" = 40$ following through on their "2"	B1ft
Explains either "mathematically" by stating $4 \times 5 \times$ their number in the range 0 to 360° or "in words" eg stating $4 \times "2"$ values every 360° and 5 lots of 360°	B1ft

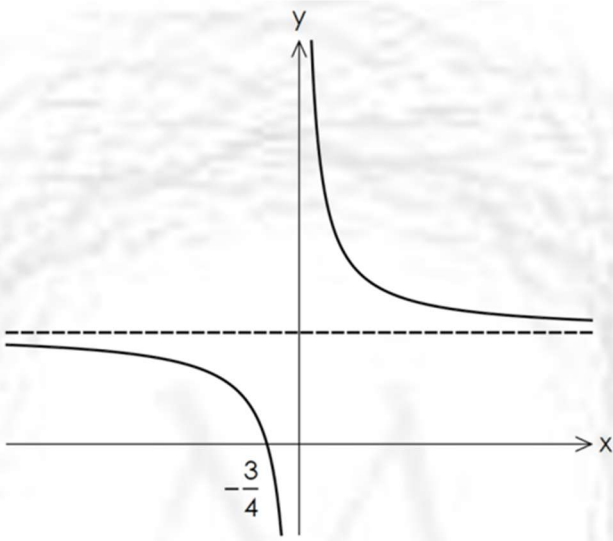
Q8

4^6 or 4096 as the constant term	B1
$\left(4 - \frac{3x}{2}\right)^6 = \dots + {}^6C_1(4)^5\left(-\frac{3x}{2}\right) + {}^6C_2(4)^4\left(-\frac{3x}{2}\right)^2 + {}^6C_3(4)^3\left(-\frac{3x}{2}\right)^3 + \dots$ $= \dots + 6 \times (4)^5\left(-\frac{3x}{2}\right) + 15 \times (4)^4\left(-\frac{3x}{2}\right)^2 + 20 \times (4)^3\left(-\frac{3x}{2}\right)^3 + \dots$	M1 A1
$= 4096 - 9216x + 8640x^2 - 4320x^3 + \dots$	A1
Coefficient of x^2 is $\frac{1}{3} \times 8640 + \left(-\frac{4}{3}\right) \times (-4320)$	M1
$= 8640$	A1

Q9

Finds critical values: $x^2 - 2x < 15 \Rightarrow x^2 - 2x - 15 < 0 \Rightarrow 5, -3$	M1
Chooses inside region for their values: $-3 < x < 5$	M1
Presents solutions in set notation $\{x : -3 < x < 5\}$	A1

Q10

2ai		M1 A1
2aii	Asymptotes: $y = 4, x = 0$	B1
2b	eg $\frac{3}{x} + 4 = 3x^2 + 7x - 3 \Rightarrow 3 + 4x = 3x^3 + 7x^2 - 3x$	M1
	$3x^3 + 7x^2 - 7x - 3 = 0$ from correct working	A1
2c	$\begin{array}{r} x^2 + 2x \pm \dots \\ \text{eg } 3x + 1 \overline{) 3x^3 + 7x^2 - 7x - 3} \end{array}$	M1
	$x^2 + 2x - 3 = 0$	A1
	$(3x + 1)(x + 3)(x - 1) = 0 \Rightarrow x = \dots$	dM1
	$x = -3, x = 1$	A1cso

Q11

$\overrightarrow{QR} = \overrightarrow{PR} - \overrightarrow{PQ} = 14\mathbf{i} - 17\mathbf{j} - (4\mathbf{i} + 8\mathbf{j})$	M1
$= 10\mathbf{i} - 25\mathbf{j}$	A1
$ \overrightarrow{QR} = \sqrt{10^2 + (-25)^2}$	M1
$= 5\sqrt{29}$	A1ft
$\overrightarrow{PS} = \overrightarrow{PQ} + \frac{2}{5}\overrightarrow{QR} = 4\mathbf{i} + 8\mathbf{j} + \frac{2}{5}(10\mathbf{i} - 25\mathbf{j})$	M1
$= 8\mathbf{i} - 2\mathbf{j}$	A1

Q12

States or uses the upper limit $\sqrt{3}$	B1
$\int 9x^2 + 4 \, dx = 3x^3 + 4x$	M1 A1
Full method of finding the area of R eg $31\sqrt{3} - [3x^3 + 4x]_0^{\sqrt{3}} = \dots$ eg $[27x - 3x^3]_0^{\sqrt{3}} = \dots$	M1
$\Rightarrow \text{Area } R = 18\sqrt{3}$	A1

Q13

Attempts to find the value of $\frac{dy}{dx}$ at $x = 2$	M1
$\frac{dy}{dx} = 6x \Rightarrow$ gradient at P is 12	A1
Gradient PQ $= \frac{3(2+h)^2 - 5 - 7}{2+h-2}$ oe	B1
$= \frac{3(2+h)^2 - 12}{2+h-2} = \frac{12h + 3h^2}{h}$	M1
$= 12 + 3h$	A1
Explains that as $h \rightarrow 0$, $12 + 3h \rightarrow 12$ and states that the gradient of the chord tends to the gradient of (the tangent to) the curve	B1

Q14

$g(3) = 2 \times 3^3 + 3 \times 3^2 - 17 \times 3 - 30$	M1
$g(3) = 0 \Rightarrow (x-3)$ is a factor, hence $g(x)$ is divisible by $(x-3)$	A1
$2x^3 + 3x^2 - 17x - 30 = (x-3)(2x^2 \dots x \pm 6)$	M1
$= (x-3)(2x^2 + 13x + 6)$ $(2x^2 + 9x + 10)$	A1
Attempts to factorise quadratic factor	dM1
$g(x) = (x-3)(2x+1)(x+6)$ $(x+2)(2x+5)$	A1

Q15

Temperature = 76°C	B1
$16 + 60e^{-\frac{t}{8}} = 45 \Rightarrow 60e^{-\frac{t}{8}} = 29$	M1
$t = -8\ln\left(\frac{29}{60}\right)$	dM1
$t = 5.8$	A1
States a suitable reason - As $t \rightarrow \infty$, $\theta \rightarrow 16$ from above - The minimum temperature is 16°C	B1
$A + B = 87$ or $A + Be^{-1} = 45$	M1
$A + B = 87$ and $A + Be^{-1} = 45$	A1
Full method to find at least a value for A	dM1
Deduces $\mu = \frac{45e - 87}{e - 1}$ or accept $\mu = \text{awrt } 20.6$	A1

Q16

$\log_{10} V = 0.064t + 2.486$ $\Rightarrow V = 10^{0.064t + 2.486}$ $\Rightarrow V = 10^{0.064t} \times 10^{2.486}$	$V = ab^t$ $\Rightarrow \log_{10} V = \log_{10} a + \log_{10} b^t$ $\Rightarrow \log_{10} V = \log_{10} a + t\log_{10} b$	B1
States either $a = 10^{2.486}$ or $b = 10^{0.064}$	States either $\log_{10} a = 2.486$ or $\log_{10} b = 0.064$	M1
$a = 306$ or $b = 1.16$	$a = 306$ or $b = 1.16$	A1
Either $V = 306 \times 1.16^t$ or imply by $a = 306, b = 1.16$		A1
The value of ab is the (total) number of views of the advert 1 day after it went live		B1
Substitutes $t = 25$ in either equation and finds V eg $V = 306 \times 1.16^{25}$		M1
awrt 13000		A1