

2026 Additional Mathematics Prelim Marking Scheme

1	$\tan A = \frac{\sqrt{5}}{2}$ $\cot A = \frac{1}{\tan A}$ $= \frac{2}{\sqrt{5}}$ $= \frac{2}{5}\sqrt{5}$	M1 M1 A1
2(a)	$\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$ $= \frac{3 \tan B - \tan B}{1 + 3 \tan^2 B}$ $= \frac{2 \tan B}{1 + 3 \tan^2 B}$ $= \frac{2 \sin B}{\cos B} \div \left(1 + \frac{3 \sin^2 B}{\cos^2 B} \right)$ $= \frac{2 \sin B}{\cos B} \times \frac{\cos^2 B}{\cos^2 B + 3 \sin^2 B}$ $= \frac{2 \sin B \cos B}{1 - \sin^2 B + 3 \sin^2 B}$ $= \frac{\sin 2B}{1 + 2 \sin^2 B}$	M1 (sub in tan B) M1 (change tan to $\frac{\sin}{\cos}$) M1 (use trigo identity) A1
2(b)(i)	$\cos 2x = \sqrt{3} \cos x - 1$ $2 \cos^2 x - 1 = \sqrt{3} \cos x - 1$ $2 \cos^2 x - \sqrt{3} \cos x = 0$ $\cos x(2 \cos x - \sqrt{3}) = 0$ $\cos x = 0 \quad \text{or} \quad \cos x = \frac{\sqrt{3}}{2}$ $x = \frac{\pi}{2}, \frac{3\pi}{2} \quad \quad \quad x = \frac{\pi}{6}, \frac{11\pi}{6}$	M1 (use double angle formulae) M1 (factorise) A1 A1
2(b)(ii)	$\frac{x}{2} = \frac{\pi}{2}, \frac{\pi}{6}$ $x = \pi, \frac{\pi}{3}$	B1
3(a)	$\frac{dv}{dt} = p - 24t$ At max. speed, $a = 0$ when $t = 2$, $p - 24(2) = 0$ $p - 48 = 0$ $p = 48$	M1 M1

	$v = 48t - 12t^2$ max speed = $48(2) - 12(2)^2 = 48\text{cm/s}$	A1
3(b)	At instantaneous rest, $v = 0$, $48t - 12t^2 = 0$ $12t(4 - t) = 0$ $t = 0$ or $t = 4$ The person changes direction, moves in the opposite direction at $t = 4$. So the total distance travelled by the person in the interval $t = 0$ to $t = 7$ is not obtained by finding the value of s when $t = 7$.	M1 B1
3(c)	$s = \int (48t - 12t^2) dt$ $= \frac{48t^2}{2} - \frac{12t^3}{3} + c$ $= 24t^2 - 4t^3 + c$ When $t = 0, s = 0, \therefore c = 0$. $\therefore s = 24t^2 - 4t^3$ When $t = 4$, $s = 24(4)^2 - 4(4)^3$ $= 128 \text{ cm}$ When $t = 7$, $s = 24(7)^2 - 4(7)^3$ $= -196 \text{ cm}$ Total distance travelled = $128 + 128 + 196$ $= 452 \text{ cm}$	M1 (obtain equation) M1 M1 A1
4(a)	$x^2 + y^2 - 4x + 8y - 16 = 0$ $(x - 2)^2 - 2^2 + (y + 4)^2 - 4^2 - 16 = 0$ $(x - 2)^2 + (y + 4)^2 = 6^2$ $\therefore C(2, -4) \text{ and } r = 6$	M1 A1 A1
4(b)	New centre is $(2, 10)$ Equation is $(x - 2)^2 + (y - 10)^2 = 36$ Distance between the 2 centres = 14 units Sum of 2 radius = 12 units Since distance between the 2 centre of circle is more than the sum of 2 radius, the 2 circles did not touch each other.	M1 A1 M1 A1

5(a)	$d = av^3 + bv^2$ $\frac{d}{v^2} = av + b$ Plot $\frac{d}{v^2}$ against v. Gradient = a Vertical-intercept = b	M1 A1 A1 (for a) A1 (for b)
5(b)(i)		B1 (all points plotted) B1 (straight line drawn) B1 (axis labelled)
5(b)(ii)	$V = V_o e^{kt}$ $\ln V = \ln V_o e^{kt}$ $= \ln V_o + \ln e^{kt}$ $= \ln V_o + kt \ln e$ $= kt + \ln V_o$ Vertical-axis intercept = $\ln V_o = 9.39$ $V_o = e^{9.39}$ $= 11968.09933$ $\approx 12000 \text{ (to 3 s.f.)}$ Gradient, $k = \frac{9.59 - 9.41}{8 - 0.8}$ $= 0.025 \quad [\text{Accept } \pm 0.0025]$	M1 A1 M1 A1
5(b)(iii)	It refers to the value of the watch on 1 st January 2016. (Accept initial value of the watch.)	B1

5(b)(iv)	When $t = 7$, $\ln V = 9.57$ $V = 14328.42$ ≈ 14300	M1 for their line at $t = 7$ A1
6(a)	$y = p^2 + 2 - px + x^2$ $b^2 - 4ac = (-p)^2 - 4(1)(p^2 + 2)$ $= -3p^2 - 8$ For all real values of p, $p^2 \geq 0$ $-3p^2 \leq 0$ $-3p^2 - 8 \leq -8$ Since discriminant < 0 No real roots	M1 M1 M1 A1
6(b)	$(k+3)x^2 + x - 1 = (k+1)x - 2$ $(k+3)x^2 - kx + 1 = 0$ $(-k)^2 - 4(k+3)(1) > 0$ $k^2 - 4k - 12 > 0$ $(k+2)(k-6) > 0$ $k < -2 \quad \text{and} \quad k > 6$ Since $k+3 > 0$ $k > -3$ $\therefore -3 < k < -2 \quad \text{and} \quad k > 6$	M1 M1 M1 A1
7(a)	$3(x-y)^3 + 24x^3$ $= 3[(x-y)^3 + 8x^3]$ $= 3[(x-y) + 2x][(x-y)^2 - (x-y)(2x) + (2x)^2]$ $= 3(3x-y)(3x^2 + y^2)$	M1 M1 A1
7(b)(i)	$f\left(\frac{1}{2}\right) = 0$ $4\left(\frac{1}{2}\right)^3 + a\left(\frac{1}{2}\right)^2 + b\left(\frac{1}{2}\right) + 3 = 0$ $\frac{1}{4}a + \frac{1}{2}b = -3\frac{1}{2}$ $a + 2b = -14$ $f(-1) = 18$ $4(-1)^3 + a(-1)^2 + b(-1) + 3 = 18$ $a - b = 19$ $a = 19 + b$ $19 + b + 2b = -14$ $b = -11, a = 8$	M1 M1 M1 M1 (substitution) A1 (for both answer)

7(b)(ii)	$f(x) = (2x-1)(2x^2+5x-3)$ [Long division or observation] $= (2x-1)(2x-1)(x+3) = 0$ $x = \frac{1}{2}$ or $x = -3$	M1 M1 A1
8(a)	$\frac{d}{dx} \left(\frac{1}{6} \tan^3 2x \right)$ $= \frac{1}{2} (\tan^2 2x) (\sec^2 2x) (2)$ $= \tan^2 2x \sec^2 2x$ $= (\sec^2 2x - 1)(\sec^2 2x)$ $= \sec^4 2x - \sec^2 2x$	M1 – differentiate trigo M1 A1 (use of identity)
8(b)	$\frac{d^2 y}{dx^2} = 9 \cos 3x - 5 \sin x$ $\frac{dy}{dx} = \int 9 \cos 3x - 5 \sin x \, dx$ $= 9 \left(\sin 3x \right) \left(\frac{1}{3} \right) + 5 \cos x + c$ $= 3 \sin 3x + 5 \cos x + c$ $x = \frac{3\pi}{2}, \frac{dy}{dx} = 8$ $3 + c = 8$ $c = 5$ $\frac{dy}{dx} = 3 \sin 3x + 5 \cos x + 5$ $y = \int 3 \sin 3x + 5 \cos x + 5 \, dx$ $= -3 \left(\frac{1}{3} \right) \cos 3x + 5 \sin x + 5x + d$ $= -\cos 3x + 5 \sin x + 5x + d$ When $x = \frac{3\pi}{2}, y = \frac{15\pi}{2},$ $\frac{15\pi}{2} = -\cos 3\left(\frac{3\pi}{2}\right) + 5 \sin\left(\frac{3\pi}{2}\right) + 5\left(\frac{3\pi}{2}\right) + d$ $d = 5$ $y = -\cos 3x + 5 \sin x + 5x + 5$	M1 (integrate either trigo correctly) M1 (attempt to sub in the 2 values) M1 for $c = 5$ M1 M1 (attempt to sub in x and y) A1

9(a)	$\log_9(25-10x)-\log_9 5=\log_3(1-x)$ $\log_9 \frac{25-10x}{5}=\log_3(1-x)$ $\frac{\log_3(5-2x)}{\log_3 3^2}=\log_3(1-x)$ $\log_3(5-2x)=\log_3(1-x)^2$ $5-2x=(1-x)^2$ $x^2-4=0$ $x=2$ (reject) $x=-2$	M1 M1 (Change of base) M1 (removing log) A1												
9(b)	$2e^{2x+1}=e^{x+1}+15$ $2e^{2x}e^1=e^xe^1+15e$ $2e^{2x}=e^x+15$ <i>Let</i> $y=e^x$ $2y^2-y-15=0$ $(2y+5)(y-3)=0$ $y=-\frac{5}{2}$ <i>or</i> $y=3$ <i>(reject)</i> $e^x=3$ $x=\ln 3$	M1 M1 M1 A1												
10(a)	$\int_2^k 3(2x-3)^{\frac{1}{2}} dx=26$ $\left[\frac{3(2x-3)^{\frac{3}{2}}}{\left(\frac{3}{2}\right)(2)}\right]_2^k=26$ $\left[(2x-3)^{\frac{3}{2}}\right]_2^k=26$ $(2k-3)^{\frac{3}{2}}-(4-3)^{\frac{3}{2}}=26$ $(2k-3)^{\frac{3}{2}}=27$ $2k-3=9$ $k=6$	M1 (integrate correctly) M1 (sub in values) A1												
10(b)(i)	$\frac{dy}{dx}=-3(x-2)^2=0$ $x=2$ <table><tr><td></td><td>$x<2$</td><td>$x=2$</td><td>$x>2$</td></tr><tr><td>$\frac{dy}{dx}$</td><td>Negative</td><td>0</td><td>Negative</td></tr><tr><td>slope</td><td></td><td></td><td></td></tr></table> It is a point of inflexion.		$x<2$	$x=2$	$x>2$	$\frac{dy}{dx}$	Negative	0	Negative	slope				M1 A1 M1 A1
	$x<2$	$x=2$	$x>2$											
$\frac{dy}{dx}$	Negative	0	Negative											
slope														

10(b)(ii)	$\frac{dy}{dx} = -3(1-2)^2 = -3$ gradient of normal = $\frac{1}{3}$ $y = \frac{1}{3}x + c$ $0 = \frac{1}{3}(18) + c$ $c = -6$ $y = \frac{1}{3}x - 6$	M1 M1 M1 (sub in 18 and 0) A1
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