2026 Sec 4 Additional Math WA2 Mark Scheme

S/No.	Answer	Success Criteria	
1(a)	$\dfrac{\mathrm{d}}{\mathrm{d}x}\left[\sin(x^2)+\cos^3 x+\tan x\right]$ $=2x\cos(x^2)-3\cos^2 x\sin x+\sec^2 x$	I can use the product rule to find the derivative. I can find the derivative of trigonometric functions.	
		Content	L
		Complexity	M
		Context	L
		Response Strategy	Routine
		Assessment Objective	AO1

S/No.	Answer	Success Criteria	
1(b)	$\displaystyle\int \frac{2x^5-3\sqrt{x}}{x^2}\,\mathrm{d}x$ $\displaystyle=\int 2x^3-3x^{-\frac{3}{2}}\,\mathrm{d}x$ $\displaystyle=\frac{2x^4}{4}-\frac{3x^{-\frac{1}{2}}}{-\frac{1}{2}}+c$ $\displaystyle=\frac{x^4}{2}+\frac{6}{\sqrt{x}}+c$ Or $\dfrac{x^4}{2}+6x^{-\frac{1}{2}}+c$	I can integrate power functions.	
		Content	L
		Complexity	M
		Context	L
		Response Strategy	Routine
		Assessment Objective	AO1

S/No.	Answer	Success Criteria	
2(a)	$y = \ln\dfrac{x-2}{3x^2+4}$ $= \ln(x-2) - \ln(3x^2+4)$ $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{1}{x-2} - \dfrac{6x}{3x^2+4}$ When $x = 4$, $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{1}{4-2} - \dfrac{6(4)}{3(4)^2+4}$ $= \dfrac{1}{26}$	I can simplify the expression using the quotient law of logarithm. I can find the derivative of ln functions.	
		Content	L
		Complexity	M
		Context	L
		Response Strategy	Routine
		Assessment Objective	AO1

S/No.	Answer	Success Criteria	
2(b)	$\dfrac{\mathrm{d}y}{\mathrm{d}t} = \dfrac{\mathrm{d}y}{\mathrm{d}x} \times \dfrac{\mathrm{d}x}{\mathrm{d}t}$ $-5 = \dfrac{1}{26} \times \dfrac{\mathrm{d}x}{\mathrm{d}t}$ $\dfrac{\mathrm{d}x}{\mathrm{d}t} = -5 \times 26$ $= -130$ units/s Rate of change of x is -130 units/s.	I can simplify the expression using the quotient law of logarithm. I can find the derivative of ln functions.	
		Content	L
		Complexity	M
		Context	L
		Response Strategy	Routine
		Assessment Objective	AO1

<table>
<tr><th>S/No.</th><th>Answer</th><th colspan="2">Success Criteria</th></tr>
<tr><td rowspan="6">3</td><td rowspan="6">$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{-e^{-x}(x^2+1)-e^{-x}(2x)}{(x^2+1)^2}$
$=\frac{-e^{-x}(x^2+1+2x)}{(x^2+1)^2}$
$=\frac{-e^{-x}(x+1)^2}{(x^2+1)^2}$

Since $(x^2+1)^2>0$, $-e^{-x}<0$ (or $\mathrm{e}^{-x}>0$)

and $(x+1)^2>0$, $x\neq-1$.

$\frac{-e^{-x}(x+1)^2}{(x^2+1)^2}<0$, hence y is a decreasing function for all values of x.</td><td colspan="2">I can find the derivate of exponential functions.
I can use quotient rule to find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

I can conclude that $(x^2+1)^2\geq 0$, $-e^{-x}<0$ and $(x-1)^2>0, x\neq-1$.</td></tr>
<tr><td>Content</td><td>L</td></tr>
<tr><td>Complexity</td><td>M</td></tr>
<tr><td>Context</td><td>M</td></tr>
<tr><td>Response Strategy</td><td>Routine</td></tr>
<tr><td>Assessment Objective</td><td>AO3</td></tr>
</table>

S/No.	Answer	Success Criteria	
4(a)	$y = ax + \frac{b}{x} - 1$ $\frac{dy}{dx} = a - \frac{b}{x^2}$ $x + 2y = 10$ $y = -\frac{1}{2}x + 5$ Gradient of normal $= -\frac{1}{2}$ Gradient of tangent $= 2$ When $x = 1$, $\frac{dy}{dx} = 2$ $a - \frac{b}{1^2} = 2$ $a - b = 2$...........(1) When $x = 1$, $y = 3$ $y = ax + \frac{b}{x} - 1$ $3 = a + b - 1$ $a + b = 4$.................(2) (2) - (1), $2b = 2$ $b = 1$ Sub in (2) $a + 1 = 4$ $a = 3$	I can find $\frac{dy}{dx}$. I can form an equation with the value of x and $\frac{dy}{dx}$. I can form an equation with the coordinates of the point the curve passes through. I can solve the equations simultaneously to find the values of the unknown.	
		Content	L
		Complexity	M
		Context	M
		Response Strategy	Routine
		Assessment Objective	AO2

<table>
<tr>
<td rowspan="6">4(b)</td>
<td rowspan="6">
Equation of normal:
$y-3=-\frac{1}{2}(x-1)$
$y=-\frac{1}{2}x+\frac{7}{2}$

$\frac{1}{x}+3x-1=-\frac{1}{2}x+\frac{7}{2}$
$2+6x^2-2x=-x^2+7x$
$7x^2-9x+2=0$
$(7x-2)(x-1)=0$
$x=\frac{2}{7}$ or $x=1$ (given)

Sub in equation of normal:

$y=-\frac{1}{2}(\frac{2}{7})+\frac{7}{2}$
$y=\frac{47}{14}$

The coordinates are $\left(\frac{2}{7},\frac{47}{14}\right)$
</td>
<td colspan="2">
I can find $\frac{dy}{dx}$.
I can form an equation with the value of x and $\frac{dy}{dx}$.
I can form an equation with the coordinates of the point the curve passes through.

I can solve the equations simultaneously to find the values of the unknown.
</td>
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<tr><td>Content</td><td>L</td></tr>
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<tr><td rowspan="6">5(a)</td><td rowspan="6">$64 = 2x + 8r + 2x + \frac{1}{2}[2\pi(4r)]$
$64 = 4x + 8r + 4\pi r$
$x = 16 - 2r - \pi r$</td><td colspan="2">I can form an equation by equating the perimeter of the figure to the length of the wire.

I can find the area of the rectangle and the semi-circle.</td></tr>
<tr><td>Content</td><td>L</td></tr>
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<tr><td rowspan="6">5(b)</td><td rowspan="6">$A = \frac{1}{2}\pi\left(4r\right)^2 + 2x\left(8r\right)$
$= \frac{1}{2}\pi\left(16r^2\right) + 16xr$
$= 8\pi r^2 + 16r\left(16 - 2r - \pi r\right)$
$= 8\pi r^2 + 256r - 32r^2 - 16\pi r^2$
$= 256r - 32r^2 - 8\pi r^2$</td><td colspan="2">I can form an equation by equating the perimeter of the figure to the length of the wire.

I can find the area of the rectangle and the semi-circle.</td></tr>
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<tr><td>Complexity</td><td>L</td></tr>
<tr><td>Context</td><td>M</td></tr>
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<tr><td rowspan="6">5(c)</td><td rowspan="6">$\frac{\mathrm{d}A}{\mathrm{d}r} = 256 - 64r - 16\pi r$
For stationary value, $\frac{\mathrm{d}A}{\mathrm{d}r} = 0$
$256 - 64r - 16\pi r = 0$
$64r + 16\pi r = 256$
$r\left(64 + 16\pi\right) = 256$
$r = \frac{256}{64 + 16\pi}$
$r = \frac{16}{4 + \pi}$
$r = 2.24$ (2 d.p.)

$\frac{\mathrm{d}^2 A}{\mathrm{d}r^2} = -64 - 16\pi \qquad (< 0)$

This value of x gives a maximum value for the area of the diagram.</td><td colspan="2">I can find $\frac{\mathrm{d}A}{\mathrm{d}r}$.
I can find the value of r for which $\frac{\mathrm{d}A}{\mathrm{d}r} = 0$.
I can find the stationary value of A.
I can show this value is a maximum value using the first or second derivative test.</td></tr>
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