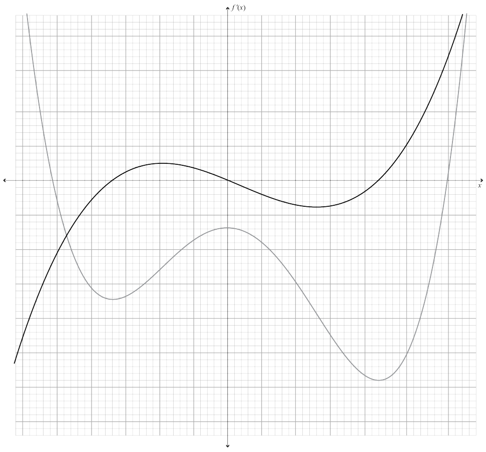
Assessment Schedule – 2025

Mathematics and Statistics: Apply calculus methods in solving problems (91262)

Evidence

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	$f'(x) = 6x^2 - 6x + \frac{1}{2}$ $f'\left(-\frac{1}{2}\right) = 6\left(-\frac{1}{2}\right)^2 - 6\left(-\frac{1}{2}\right) + \frac{1}{2}$ $f'\left(-\frac{1}{2}\right) = 5$	• Correct derivative. AND Correct value of $f'\left(-\frac{1}{2}\right)$.		
(b)	$f(2) = 5\frac{1}{3}$ or $\frac{16}{3}$ $f'(x) = -x^2 + 4x - 3$ $f'(2) = 1$ $y - 5\frac{1}{3} = 1(x - 2)$ $y = 3 + 3\frac{1}{3}$	• Correct derivative. AND Correct value of $f'(2)$.	• Equation of tangent correct in either form.	
(c)	$f(x) = \frac{2}{3}x^3 + x^2 - 24x + c$ $f'(x) = 2x^2 + 2x - 24 = 0$ $x = 3$ or $x = -4$ When $f(3) = -46$ $\frac{2}{3}(3)^3 + (3)^2 - 24(3) + c = -46$ $c = -1$ $f(x) = \frac{2}{3}x^3 + x^2 - 24x - 1$ $x = 3$ is the value of the local minimum, with evidence.	• Function correctly anti-differentiated including $+c$.	• Full function correct.	• Justify why $x = 3$ is the minimum. Correct justification for being a minimum – from either second derivative, inspection or from shape of function which is a labelled diagram
(d)	The *Helena*: $v(t) = 5$ $s(t) = 5t + c$ $s(0) = 5t + c = 200$, $c = 200$ $5(t) = 5t + 200$ Small boat: $a(t) = 0.5$ $v(t) = 0.5t + c$, $v(0) = 0.5t + c$, $c = 0$ $v(t) = 0.5t$ $s(t) = 0.25t^2 + c$, $s(0) = 0.25t^2 + c$, $c = 0$ $s(t) = 0.25t^2$ $0.25t^2 - 5t - 200 = 0$ OR $t = 40$ s or -20 s (impossible) $s(40) = 400$ m – the boat catches up to the *Helena* 400 m from the dock.	• One equation for distance found for one of the boats. OR Velocity of small boat found. Including working for $c = 0$ or $c = 200$.	• Both equations found for distance from dock for both boats. Including $c = 0$ and $c = 200$.	• Equation set equal and solved to find $t = 40$ s and substituted in to either equation to find the boat catches up to the *Helena* 400 m from dock.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No appropriate evidence.	Evidence of correct calculus.	1u	2u	3u+	1r	2r+	1t	2t

Q		Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)		• 2 of 3 correct: - cubic shape - positive - roots correct.	• 3 of 3 correct: - cubic shape - positive - roots correct.	
(b)	$f'(x) = 2x^3 - 6x^2 + 2x + 4$ $f(x) = \frac{x^4}{2} - 2x^3 + x^2 + 4x + c$ $f(2) = 5, c = 1$ $f(x) = \frac{x^4}{2} - 2x^3 + x^2 + 4x + 1$	• Correct anti-differentiation including $+c$.	• Full function correct.	
(c)(i) (ii)	$C(t) = \frac{t^3}{150} - 1.4t^2 + 80t + 240$ $C'(t) = \frac{t^2}{50} - 2.8t + 80$ $C'(60) = -16$ $C'(t) = \frac{t^2}{50} - 2.8t + 80 = 0$ $t = 40$ or $t = 100$ minutes $C''(t) = \frac{t}{25} - 2.8$ $C''(40) = -1.2, \therefore$ max $C''(100) = 1.2, \therefore$ min Therefore minimum (when caffeine at lowest concentration, right before having another coffee) – coffee given 100 minutes after arriving.	• Found $C'(t)$ and substituted for get $C'(60) = -16$. OR Correct derivative found and set to zero.	• The two stationary points found.	• A good argument using shape of the graph, the second derivative or shape of gradient function graph as to why it is around 100 minutes (or equivalent).

(d)(i) (ii)	$f(x) = ax^3 + bx^2 + ax + 2$ $f(1) = a(1)^3 + b(1)^2 + a(1) + 2 = 0$ $2a + b = -2$ $f'(x) = 3ax^2 + 2bx + a$ $f'(-1) = 3a(-1)^2 + 2b(-1) + a = 0$ $4a - 2b = 0$ Solving simultaneously: $a = -\frac{1}{2}$, and $b = -1$ $f'(x) = \frac{-3x^2}{2} - 2x - \frac{1}{2} = 0$ $x = -\frac{1}{3}$ or -1 $f''(x) = -3x - 2$ $f''\left(-\frac{1}{3}\right) = -3\left(-\frac{1}{3}\right) - 2 = -1 < 0$ Therefore at $x = -\frac{1}{3}$, there is a **local maxium.**	• $4a - 2b = 0$ found.	AND $x = -\frac{1}{3}$ found as the other stationary point.	• Correct justification for being a maximum – from either second derivative, inspection or from shape of function, with a labelled diagram.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No appropriate evidence.	Evidence of correct calculus.	1u	2u	3u+	1r	2r+	1t	2t

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (a)	$f'(x) = 4x - 7 = 3$ $4x = 10$ $x = 2.5$ $x = 2.5, y = -25$	• Correct derivative and coordinate found.		
(b)	$A = 2x^2$ $2x^2 = 98$ $x = 7$ cm (x cannot be – 7) $A' = 4x$ $A' = 4(7) = 28\text{ cm}^2/\text{cm}$	• Correct equation for area set up and $A'(x)$ found.	• Correct $A'(7)$. No units required.	
(c)	$SA = 4x^2 + 4xy = 4.32$ $y = \frac{4.32 - 4x^2}{4x}$ $V = 2x^2y$ $V = 2x^2\left(\frac{4.32 - 4x^2}{4x}\right)$ $V = 2.16x - 2x^3$ $V'(x) = 2.16 - 6x^2 = 0$ $x = 0.6$ m or -0.6 (reject as $-$ ve) $V(0.6) = 2.16(0.6) - 2(0.6)^3$ $V(0.6) = 0.864\text{ m}^3$ $V''(x) = -12x$ $V''(0.6) = -7.2 < 0$ Therefore maximum.	• $V'(x)$ found correctly.	• $V'(x)$ set to zero and solved.	• Correct volume found and proved it's a maximum.
(d)	$f(x) = \frac{x^4}{4} + \frac{k-3}{3}x^3 - \frac{3kx^2}{2} + k$ $f'(x) = x^3 + (k-3)x^2 - 3kx$ $f'(x) = x(x-3)(x+k) = 0$ $x = 0, 3,$ and $-k$ Due to positive quartic function, $-k$ would be the left most minimum (coupled with a sketch). Regions where $f'(x) < 0$: $x < -k$ and $0 < x < 3$	• Correct derivative.	• Derivative set to zero and solutions found.	• Regions found correctly with a suitable argument. I.e. Use of the second derivative, or shape.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No appropriate evidence.	Evidence of correct calculus.	1u	2u	3u+	1r	2r+	1t	2t

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0–7	8–13	14–19	20–24