Assessment Schedule – 2021

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

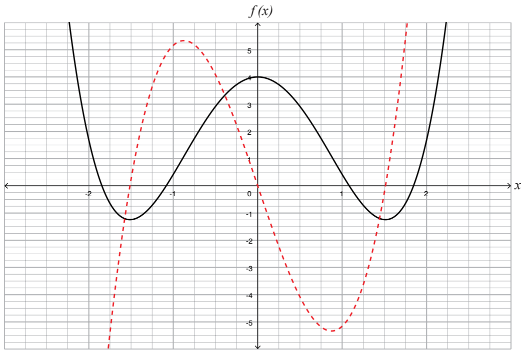
Evidence

Q ONE	Expected coverage	Achievement (u)	Merit (r)	Excellence (t)
(a)	$f'(x) = 12x^2 - 4x - 7$ $f'(3) = 12(3)^2 - 4(3) - 7$ $f'(3) = 89$	Derivative found and gradient evaluated.		
(b)	$f'(x) = \frac{3x^2}{2} + \frac{1}{2}$ $f'(2) = \frac{3(2)^2}{2} + \frac{1}{2}$ $f'(2) = 6.5$ $f(x) = \frac{x^3}{2} + \frac{x}{2}$ $f(2) = \frac{(2)^3}{2} + \frac{(2)}{2}$ $f(2) = 5$ Tangent at point (2,5) with a slope of 6.5 $(y - y_1) = m(x - x_1)$ $(y - 5) = 6.5(x - 2)$ $y = 6.5x - 8$	Correct derivative.	Correct equation of the tangent.	
(c)(i)	$V(t) = 3520$ $3520 = -11(t)^2 + 528t$ $0 = -11(t)^2 + 528t - 3520$ $t = 8, 40$ $V'(t) = -22t + 528$ $V'(8) = -22(8) + 528$ $V'(8) = 352$ $V'(40) = -22(40) + 528$ $V'(40) = -352$	Expression found for $\frac{dV}{dt}$.	Rates of change found.	
(c)(ii)	$V'(t) = -22t + 258$ $V' = 0$ $0 = -22t + 528$ $t = 24$ $V(24) = -11(24) + 528(24)$ $V(24) = 6336$	Derivative found and set to 0.	Max daily viewers found.	

(c)(iii)	$V' = 4.8t^2 - 260t + 2900$ $0 = 4.8t^2 - 260t + 2900$ $t = 15.71$ or 38.46 $t = 15.71$, $V = 19\,678$ $t = 38.46$, $V = 10\,264$ (or 10 263) Once this curve reaches $V = 10\,000$, it never again falls below 10 000 Increasing when: $t < 15.71$ and $t > 38.46$ Decreasing when: $15.71 < t < 38.46$	t values of turning points found.	Coordinates of minimum point found.	Coordinates of both turning points found, statement regarding monetisation. T1: Excellence criteria satisfied with one aspect missing. T2: Justification from: Graph of function or gradient function, gradient on each side of the points, second derivative or substitution in to the function.

Evidence Statement

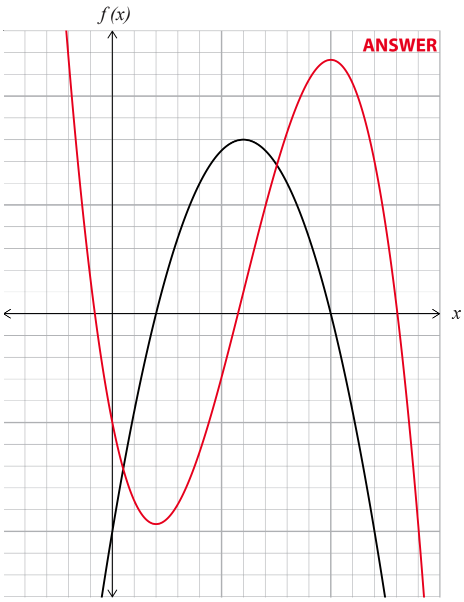
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at one question.	1 of u	2 of u	3 of u	1 of r	2 of r	T1	T2

Q TWO	Expected coverage	Achievement (u)	Merit (r)	Excellence (t)
(a)	 Red curve is solution, x-intercepts are at –1.5,0 and 1.5	Correct shape and orientation of curve OR correct x-intercepts.	Correct shape and orientation of curve AND correct x-intercepts.	
(b)	$f'(x) = 3 + 2cx - 6x^2$ $3 + 2c(2) - 6(2)^2 = -5$ $4c = 16$ $c = 4$	Derivative found and equated to –5.	c evaluated.	
(c)(i)	$a(t) = -9.8$ $v(t) = -9.8t + C$ If $t = 0$ then $v(0) = 2.8$ $v(t) = -9.8t + 2.8$ $v(1) = -9.8(1) + 2.8$ $v(1) = -7 \text{ m s}^{-1}$	Anti-differentiated including constant of integration.	Velocity found.	

(c)(ii)	$v(1) = -9.8(1) + 2.8$ $v(1) = -22.68 \text{ m s}^{-1}$ $-22.68 = -9.8t + 2.8$ $t = \frac{-22.68 - 2.8}{-9.8}$ $t = 2.6$ seconds $h(t) = -\frac{9.8}{2}t^2 + 2.8t + C$ When $t = 2.6$ seconds $h(t) = 0$ (at the water) $0 = -\frac{9.8}{2}(2.6)^2 + 2.8(2.6) + C$ $C = 25.844$ m or 25.84 m (2 d.p.) The cliff is 25.84 m above the water. $v(t) = -9.8t + 2.8$ Top of the jump $v(t) = 0$ $0 = -9.8t + 2.8$ $t = \frac{2.8}{9.8}$ $t = 0.2857$ seconds (4 d.p.) $t = 0.29$ seconds (2 d.p.) $h(t) = -\frac{9.8}{2}t^2 + 2.8t + 25.84$ $h(0.29) = -\frac{9.8}{2}(0.29)^2 + 2.8(0.29) + 25.84$ $h(0.29) = 26.24$ (2 d.p.) Maximum height above water = 26.24 m	Anti-differentiated to find $h(t)$ with unknown constant of integration OR velocity equation set to 0.	Time of impact found OR time of max height.	T1: Correct answer with some IMS T2: Correct answer with clear correct statements.

Evidence Statement

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at one question.	1 of u	2 of u	3 of u	1 of r	2 of r	T1	T2

Q THREE	Expected coverage	Achievement (u)	Merit (r)	Excellence (t)
(a)	$f(x) = \frac{6x^3}{3} + \frac{5x^2}{2} - x + c$ $f(1) = 2.5$ implies that $c = -1$ $f(2) = 2(-2)^3 + \frac{5(-2)^2}{2} - (-2) - 1$ $f(2) = 23$ Point is (2,23)	Anti-differentiation correct apart from constant term.	Co-ordinates correct.	
(b)	$s(t) = 0.1t^3 + t$ $s(3) = 5.7$ (m)	Correct distance.		
(c)	Red curve. Accept any intercepts with axes.  	Negative cubic shape. OR Positive cubic shape with correct turning points.	Negative cubic shape and turning points correctly located.	

(d)(i)	A = Area of Triangle + Area of Rectangle $A_T = \frac{(9-y)(2x)}{2} + 2xy$ $A_T = \frac{(9-(-x^2+9))(2x)}{2} + 2x(-x^2+9)$ $A_T = -x^3 + 18x$ $A_T' = -3x^2 + 18$ At max, $A_T' = 0$ $x^2 = \frac{18}{3}$ $x = \sqrt{6}$ $y = -(\sqrt{6})^2 + 9$ $y = 3$ so the height of the wall is 3 ($A_T = 12\sqrt{6}$ or 29.39) Possible justifications of the maximum: • $A''(\sqrt{6}) = -14.7 < 0$ • $A'(2) = +6$, $A'(3) = -9$, so slope changes from positive to negative. • $A(2) = 28$, $A(3) = 27$, both lower than the maximum. • Graph of $A(x)$ is a negative cubic, so the right-hand turning point is the maximum. • Graph of $A'(x)$ is a concave-down parabola, so the right-hand root has gradient going positive to negative.	Their area expression differentiated consistently.	Values for x and / or y found.	Height of wall clearly stated AND Justification from: Graph of function, or gradient function, gradient on each side of the points, second derivative or substitution in to the function.

(d)(ii)	A = Area of Triangle + Area of Rectangle $A_T = \frac{(d-y)(2x)}{2} + 2xy$ $A_T = \frac{(d-(-kx^2+d))(2x)}{2} + 2x(-kx^2+d)$ $A_T = -kx^3 + 2dx$ $A_T' = -3kx^2 + 2d$ At max, $A_T' = 0$ $x^2 = \frac{2d}{3k}$ $x = \sqrt{\frac{2d}{3k}}$ $y = -k\left(\sqrt{\frac{2d}{3k}}\right)^2 + d$ $y = \frac{-2d}{3} + d$ $y = \frac{d}{3}$ $A_{Triangle} = \frac{(d-y)(2x)}{2}$ $A_{Triangle} = \frac{\left(d-\left(\frac{d}{3}\right)\right)\left(2\sqrt{\frac{2d}{3k}}\right)}{2}$ $A_{Triangle} = \frac{2d}{3}\sqrt{\frac{2d}{3k}}$ $A_{Rectangle} = 2xy$ $A_{Rectangle} = 2\left(\sqrt{\frac{2d}{3k}}\right)\left(\frac{d}{3}\right)$ $A_{Rectangle} = \frac{2d}{3}\sqrt{\frac{2d}{3k}}$ $A_{Rectangle} = A_{Triangle}$	Relationship formed and correctly differentiated.	Values for x or y found.	Area for triangle and rectangle found separately and shown to be equal.

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at one question.	1 of u	2 of u	3 of u	1 of r	2 of r	1 of t	2 of t

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 19	20 – 24