Core 1 Differentiation Answers

7(a)(i)	$\frac{dV}{dt} = 2t^5 - 8t^3 + 6t$	M1 A1 A1	 3	One term correct unsimplified Further term correct unsimplified All correct unsimplified (no + c etc)
(ii)	$\frac{d^2V}{dt^2} = 10t^4 - 24t^2 + 6$	M1 A1	 2	One term FT correct unsimplified **CSO**. All correct simplified
(b)	Substitute $t = 2$ into their $\frac{dV}{dt}$	M1		
	$(= 64 - 64 + 12) = 12$	A1	2	**CSO**. Rate of change of volume is $12\text{m}^3\ \text{s}^{-1}$
(c)(i)	$t = 1 \Rightarrow \frac{dV}{dt} = 2 - 8 + 6$	M1		Or putting their $\frac{dV}{dt} = 0$
	$= 0 \Rightarrow$ Stationary value	A1	2	**CSO**. Shown to = 0 **AND** statement (If solving equation must obtain $t = 1$)
(ii)	$t = 1 \Rightarrow \frac{d^2V}{dt^2} = -8$	M1		Sub $t = 1$ into their second derivative or equivalent full test.
	Maximum value	A1√	2	Ft if their test implies minimum
	Total		**11**	

3(a)	$\frac{dy}{dx} = -10x^4$	M1 A1	 2	kx^4 condone extra term Correct derivative unsimplified
(b)	When $x = 1$, gradient $= -10$	B1√		FT their gradient when $x = 1$
	Tangent is	M1		Attempt at y & tangent (**not** normal)
	$y - 5 = -10(x - 1)$ *or* $y + 10x = 15$ etc	A1	3	CSO Any correct form
(c)	When $x = -2$ $\frac{dy}{dx} = -160$ (or < 0)	B1√		Value of their $\frac{dy}{dx}$ when $x = -2$
	($\frac{dy}{dx} < 0$ hence) y is **decreasing**	E1√	2	ft Increasing if their $\frac{dy}{dx} > 0$
	Total		**7**	

5(a)(i)	$\frac{dy}{dx} = 3x^2 - 20x + 28$	M1 A1 A1	 3	One term correct Another term correct All correct (no + c etc)
(ii)	Their $\frac{dy}{dx} = 0$ for stationary point	M1		Or realising condition for stationary pt
	$(x - 2)(3x - 14) = 0$	m1		Attempt to solve using formula/ factorise
	$\Rightarrow x = 2$	A1		Award M1, A1 for verification that
	or $x = \frac{14}{3}$	A1	4	$x = 2 \Rightarrow \frac{dy}{dx} = 0$ then may earn m1 later

---

5(a)(i)	$2x^2 + 2xh + 4xh \quad (= 54)$	M1		Attempt at surface area (one slip)
	$\Rightarrow x^2 + 3xh = 27$	A1	2	**AG CSO**
(ii)	$h = \dfrac{27 - x^2}{3x}$ or $h = \dfrac{9}{x} - \dfrac{x}{3}$ etc	B1	1	Any correct form
(iii)	$V = 2x^2h \quad = 18x - \dfrac{2x^3}{3}$	B1	1	**AG** (watch fudging) condone omission of brackets
(b)(i)	$\dfrac{dV}{dx} = 18 - 2x^2$	M1		One term correct "their" V
		A1	2	All correct unsimplified $18 - 6x^2/3$
(ii)	Sub $x = 3$ into their $\dfrac{dV}{dx}$	M1		Or attempt to solve their $\dfrac{dV}{dx} = 0$
	Shown to equal 0 plus **statement** that this implies a stationary point if verifying	A1	2	**CSO** Condone $x = \pm 3$ or $x = 3$ if solving
(c)	$\dfrac{d^2V}{dx^2} = -4x$ $(= -12)$	B1√		**FT** their $\dfrac{dV}{dx}$
	$\dfrac{d^2V}{dx^2} < 0$ at stationary point $\Rightarrow$ maximum	E1√	2	**FT** their second derivative conclusion If "their" $\dfrac{d^2y}{dx^2} > 0 \Rightarrow$ minimum etc
	Total		**10**	

4(a)(i)	$t^3 - 52t + 96$	M1		one term correct
		A1		another term correct
		A1	3	all correct (no + c etc)
(ii)	$3t^2 - 52$	M1		ft one term correct
		A1√	2	ft all "correct"
(b)	$\dfrac{dy}{dt} = 8 - 104 + 96$	M1		substitute $t = 2$ into their $\dfrac{dy}{dt}$
	$= 0 \Rightarrow$ stationary value	A1		CSO; shown = 0 + statement
	Substitute $t = 2$ into $\dfrac{d^2y}{dt^2}$ $(= -40)$	M1		any appropriate test, e.g. $y'(1)$ and $y'(3)$
	$\dfrac{d^2y}{dt^2} < 0 \Rightarrow$ max value	A1	4	all values (if stated) must be correct
(c)	Substitute $t = 1$ into their $\dfrac{dy}{dt}$	M1		must be their $\dfrac{dy}{dt}$ NOT $\dfrac{d^2y}{dt^2}$
	Rate of change $= 45 \left(\text{cm s}^{-1}\right)$	A1√	2	ft their $y'(1)$

(d)	Substitute $t = 3$ into their $\frac{dy}{dt}$ $(27 - 156 + 96 = -33 < 0)$	M1		interpreting their value of $\frac{dy}{dt}$
	$\Rightarrow$ decreasing when $t = 3$	E1√	2	allow increasing if their $\frac{dy}{dt} > 0$
	Total		**13**	