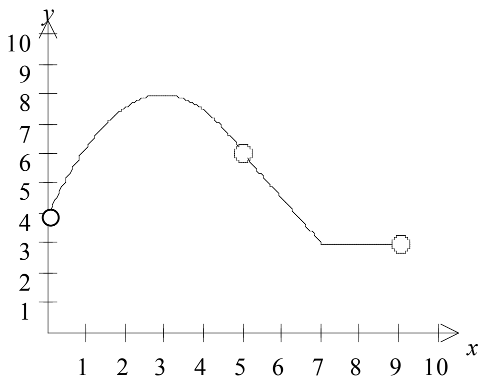
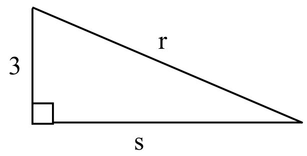
Assessment Schedule – 2006

Calculus: Differentiate functions and use derivatives to solve problems (90635)

Evidence Statement

	Achievement Criteria	Q.	Evidence	Code	Judgement	Sufficiency
Achievement	Differentiate functions and use derivatives to solve problems.	1a	$\frac{dy}{dx} = 5(x^2 - 3x)^4(2x - 3)$	A1	Or equivalent.	*Achievement:* **Four** of code A including at least **one** of code A1 and **one** of code A2.
		1b	$\frac{dy}{dx} = -5\text{cosec}^2 2x.2$ $= -10\text{cosec}^2 2x$	A1	Or equivalent.	
		1c	$\frac{dy}{dx} = \frac{(x+3)\cos x - \sin x}{(x+3)^2}$	A1	Or equivalent.	
		2	$\frac{dN}{dt} = 5e^{0.5t} + \frac{24}{2t+7}$ When $t = 7$, $\frac{dN}{dt} = 167$ mice / month.	A1 or A2	Must show $\frac{dN}{dt}$ Accept any rounding. Units not required.	
		3	$\frac{dP}{dx} = \frac{500\ 000}{x^2} - \frac{1}{25}$ $\frac{dP}{dx} = 0 \quad \Rightarrow \quad x = 3\ 536$ rpm or $2\ 500\sqrt{2}$	A1 or A2	Must show $\frac{dP}{dx}$ Accept any rounding. Units not required.	

	Achievement Criteria	Q	Evidence	Code	Judgement	Sufficiency
Achievement with Merit	Demonstrate knowledge of advanced concepts and techniques of differentiation and solve differentiation problems.	4	$f(x) = 3x^2 + x + 5$ $f(x+h) = 3(x+h)^2 + (x+h) + 5$ $= 3x^2 + 6xh + 3h^2 + x + h + 5$ $f'(x) = \lim_{h \to 0} \frac{6xh + 3h^2 + h}{h}$ $= \lim_{h \to 0} (6x + 3h + 1)$ $= 6x + 1$	A1 M1	Must show $\lim_{h\to 0}$ at least once. Must use first principles formula to arrive at $f'(x)$	*Merit:* Achievement **plus** **three** of code M including at least **one** of code M1 and **one** of code M2 **or** **two** of code M1 and **two** of code M2.
		5	One possible solution  	A1 M1	Meets **4** of these **5** criteria. 1. Discontinuous at $x = 5$ and continuous for $0 < x < 5$ and $5 < x < 9$. 2. Concave down for $0 < x < 5$ 3. Zero gradient at (3,8) 4. Hole at (5,6) 5. Cusp at (7,3) Accept graph which extends for $x \le 0$, $x \ge 9$.	

	Achievement Criteria	Q.	Evidence	Code	Judgement	Sufficiency
Achievement with Merit	Demonstrate knowledge of advanced concepts and techniques of differentiation and solve differentiation problems.	6	$x = 6\cos t$ $y = 4\sin t$ Point of contact $\left(3\sqrt{3}, 2\right)$ or (5.196,2) Parametric: $\frac{dy}{dx} = \frac{4\cos t}{-6\sin t}$ Implicit: $\frac{dy}{dx} = -\frac{4x}{9y}$ Gradient of tangent: $\frac{-2\sqrt{3}}{3}$ Equation of tangent: $\frac{y-2}{x-3\sqrt{3}} = \frac{-2\sqrt{3}}{3}$ When $x = 0$ $y = 8$	A1 M1 or A2 M2	Must show $\frac{dy}{dx}$. Or equivalent.	*Merit:* Achievement **plus** **three** of code M including at least **one** of code M1 and **one** of code M2 **or** **two** of code M1 and **two** of code M2.
		7	 $\frac{dr}{dt} = 8$ $s = \sqrt{r^2 - 9}$ $\frac{ds}{dr} = \frac{r}{\sqrt{r^2 - 9}}$ $\frac{ds}{dt} = \frac{ds}{dr} . \frac{dr}{dt}$ $\frac{ds}{dt} = \frac{8r}{\sqrt{r^2 - 9}}$ When $r = 12$, $\frac{ds}{dt} = \frac{96}{\sqrt{135}}$ $\frac{ds}{dt} = 8.26 \text{ m min}^{-1}$	A1 or A2 M2	Correct $\frac{ds}{dr}$ A1 or A2 available for further evidence Units not required. Or equivalent. Accept –8.26	

	Achievement Criteria	Q.	Evidence	Code	Judgement	Sufficiency
Achievement with Excellence	Solve more complex differentiation problem(s).	8	$\frac{dV}{dt} = \frac{90}{20}$ $= 4.5 \text{ cm}^3 \text{ s}^{-1}$ $S = 4\pi r^2$ $\frac{dS}{dr} = 8\pi r$ $V = \frac{4}{3}\pi r^3$ $\frac{dV}{dr} = 4\pi r^2$ $\frac{dS}{dt} = \frac{dV}{dt}\frac{dS}{dr}\frac{dr}{dV}$ $= 4.5 \,.\, 8\pi r \,.\, \frac{1}{4\pi r^2}$ $= \frac{9}{r}$ $\frac{4}{3}\pi r^3 = 1500 \text{ cm}^3$ $r = 7.10 \text{ cm}$ $\frac{dS}{dt} = \frac{9}{7.10}$ $= 1.27 \text{ cm}^2 \text{ s}^{-1}$	A M E	Must see $\frac{dS}{dr}$ and $\frac{dV}{dr}$ Must see $\frac{dS}{dt}$ Units not required. Or equivalent.	*Excellence:* **Two** of code M1 and **two** of code M2 and **one** of code E.

Judgement Statement

Calculus: Differentiate functions and use derivatives to solve problems (90635)

Achievement	Achievement with Merit	Achievement with Excellence
Differentiate functions and use derivatives to solve problems.	Demonstrate knowledge of advanced concepts and techniques of differentiation and solve differentiation problems. Achievement *plus*	Solve more complex differentiation problem(s).
$4 \times$ A including at least $1 \times$ A1 and $1 \times$ A2	$3 \times$ M including at least $1 \times$ M1 and $1 \times$ M2 **OR** $2 \times$ M1 and $2 \times$ M2	$2 \times$ M1 and $2 \times$ M2 plus $1 \times$ E