C3 Parametric Differentiation Answers

Specimen

4.	*(a)*	$3y^2\frac{dy}{dx} - 2x^2y\frac{dy}{dx} - 2xy^2 = 2x + 3$	B1 $\left(3y^2\frac{dy}{dx}\right)$
			M1 $\left(-2x^2y\frac{dy}{dx} \pm 2xy^2\right)$
			A1
		$\therefore \quad \frac{dy}{dx} = \frac{2x+3+2xy^2}{3y^2 - 2x^2y}$	A1 (all correct)
	(b)	$\frac{dy}{dx} = \frac{2t}{3t^2} = \frac{2}{3t}$	M1 $\left(\frac{dy}{dx} = \frac{dy}{dt} / \frac{dx}{dt}\right)$
			A1
		$\therefore \frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}}$	M1 (correct formula)
		$= -\frac{\frac{2}{3t^2}}{3t^2} = -\frac{2}{9t^4}$	A1, A1 (convincing)

2005 Summer

4.	(a)	$2x + 2x\frac{dy}{dx} + 2y + 6y\frac{dy}{dx} = 0$	B1 $(2x\frac{dy}{dx} + 2y)$
			B1 $(6y\frac{dy}{dx})$
		$\frac{dy}{dx} = -\frac{x+y}{x+3y}$ (o.e)	B1 (all correct)
	(b)	$\frac{dy}{dx} = \frac{6t}{8t^3} = \frac{3}{4t^2}$	M1 $\left(\frac{\dot{y}}{\dot{x}}\right)$ A1 (correct)
		$\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \Big/ \frac{dx}{dt} = \frac{-3/2t^3}{8t^3}$	M1 (correct formula)
		$= -\frac{3}{16t^6}$	A1 (F.T one slip in $\frac{dy}{dx}$)
			[7]

2006 Winter

3. *(a)* $4y^3\dfrac{dy}{dx}+x^3\dfrac{dy}{dx}+3x^2y=2x+4$ — B1 ($4y^3\dfrac{dy}{dx}$)

B1 ($x^3\dfrac{dy}{dx}+3x^2y$)

B1 ($2x+4$)

$4\dfrac{dy}{dx}+8\dfrac{dy}{dx}+12=8$

$\dfrac{dy}{dx}=-\dfrac{4}{12}$ (o.e.) — B1 (C.A.O.)

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(b) (i) $\dfrac{dy}{dx}=\dfrac{12t^3}{6t^2}$ (o.e.) — M1 A1

(ii) $\dfrac{d^2y}{dx^2}=\dfrac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}}=\dfrac{2}{6t^2}$ (o.e.) — M1 (use of correct formula)

A1 (F.T. one slip)

8

2006 Summer

3. *(a)* $\dfrac{dy}{dx}=\dfrac{2\cos 2t}{-\sin t}$ — M1 (attempt to use $\dfrac{dy}{dx}=\dfrac{\dot{y}}{\dot{x}}$),

B1 ($-\sin t$)

B1 ($k\cos 2t$, $k = 1, 2, -2, \frac{1}{2}$)

A1 $\left(\dfrac{2\cos 2t}{-\sin t}, \text{C.A.O.}\right)$

(b) $4x^3+2x^2\dfrac{dy}{dx}+4xy+2y\dfrac{dy}{dx}=0$ — B1 ($2x^2+4xy$)

B1 ($2y\dfrac{dy}{dx}$)

B1 ($4x^3$, 0)

$\dfrac{dy}{dx}=\dfrac{(4x^3+4xy)}{2x^2+2y}$ — B1 (C.A.O.)

8

2007 Winter

6. *(a)* $3x^2 + x^2\frac{dy}{dx} + 2xy + 4y^3\frac{dy}{dx} = 0$ — B1 ($x^2\frac{dy}{dx} + 2xy$)

B1 ($4y^3\frac{dy}{dx}$)

$\frac{dy}{dx} = -\frac{3x^2 + 2xy}{x^2 + 4y^3}$ — B1 (all correct, for final result C.A.O.)

(b) (i) $\frac{dy}{dx} = \frac{dy}{dt}\Big/\frac{dx}{dt} = \frac{2t}{3t^2}\left(= \frac{2}{3t}\right)$ — M1 ($\frac{dy}{dx} = \frac{\dot{y}}{\dot{x}}$)

A1 (one differentiation)
A1 (other differentiation)

$\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}} = \frac{\frac{-2}{3t^2}}{3t^2}$ — M1 (correct formula)

A1 (correct differentiation)
F.T. one slip for differentiation of equivalent difficulty)

$= -\frac{2}{9t^4}$ — (o.e.) A1 (C.A.O.)

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2007 Summer

3. *(a)* (i) $\frac{dy}{dx} = \frac{5t^4 + 20t^2}{10t}$ — M1 (attempt to use $\frac{dy}{dx} = \dot{y}/\dot{x}$)

A1 A1

(ii) $\frac{5t^4 + 20t^2}{10t} = 1$ — M1 (use of equation and attempt to simplify)

$\frac{t^3 + 4t}{2} = 1$

$t^3 + 4t - 2 = 0$ — A1 (convincing)

2008 Winter

3. *(a)* $\frac{dy}{dx} = \frac{2e^{2t}}{4t^3}$

M1 ($\dot{y} = ke^{2t}$, k = 1 or 2 or $2e^{2t} + 5$)

A1 ($2e^{2t}$)

M1 $\left(\frac{dy}{dx} = \frac{\dot{y}}{\dot{x}}\right)$, A1 (all correct C.A.O.)

(b) $4x^3 + \cos y \frac{dy}{dx} + 2xy^3 + 3x^2y^2\frac{dy}{dx} = 0$

B1 (cos $y\frac{dy}{dx}$)

B1 ($2xy^3 + 3x^2\frac{dy}{dx}$)

$\frac{dy}{dx} = -\frac{4x^3 + 2xy^3}{\cos y + 3x^2y^2}$

B1 $\left(\text{F.T } \frac{d}{dy}(\sin y) = -\cos y\frac{dy}{dx}\right)$

(7)

2008 Summer

4. *(a)* $\frac{dy}{dt} = 2e^{2t}$

M1 (ke^{2t}, $k = \frac{1}{2}$, 1, 2)

A1 ($k = 2$)

$\frac{dy}{dt} = \frac{1}{t}$

B1

$\frac{dy}{dx} = 2te^{2t}$ (o.e.)

A1 (C.A.O)

(b) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = 2te^{2t} + 4te^{2t}$

M1 ($f(t)\,e^{2t} + 2t\,g(t)$)

A1 ($f(t) = 2$, $g(t) = 2e^{2t}$)

$\frac{d^2y}{dx^2} = 2te^{2t}(1 + 2t)$ (o.e.)

M1 (use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div \frac{dx}{dt}$)

A1 (F. T candidates $\frac{d}{dt}\left(\frac{dy}{dx}\right)$)

2009 Winter

3.	(a)	$2x + 3x\frac{dy}{dx} + 3y + 4y\frac{dy}{dx} - 2 = 0$	B1 $\left(3x\frac{dy}{dx} + 3y\right)$ (o.e)
		$2 + 3\frac{dy}{dx} + 6 + 8\frac{dy}{dx} - 2 = 0$	B1 $\left(4y\frac{dy}{dx}\right)$ (o.e)
			B1 (correct diff^n of $x^2, -2x$ and 13)
		$\frac{dy}{dx} = -\frac{6}{11}$	B1 (F.T. one slip)
	(b)	$\frac{dy}{dx} = \frac{8e^{2t} + 3e^t}{2e^t}$	M1
			B1 (numerator $ke^{2t} + 3e^t, \; k = 4, 8$)
			B1 ($k = 8$)
			B1 (denominator)
		$\frac{8e^{2t} + 3e^t}{2e^t} = 6$	M1
		$8e^t = 9$	M1
		$t = \ln\left(\frac{9}{8}\right) \approx 0.118$	A1 (C.A.O)
			(11)

2009 Summer

3.	*(a)*	$3x^2 + 2y\frac{dy}{dx} + \tan 2y + 2x\sec^2 2y\frac{dy}{dx} = 0$	$\left(2y\frac{dy}{dx}\right)$ B1
			$\left(\tan 2y + k\sec^2 2y\frac{dy}{dx}; \quad k = 1, 2\right)$ B1
			$(k = 2)$ B1
		$\frac{dy}{dx} = -\frac{3x^2 + \tan 2y}{2y + 2x\sec^2 2y}$	(All correct. F.T. for last B1 if first two Bs gained) B1

(b) (i) $\dfrac{dy}{dt} = \dfrac{(3+2t)(4)-(1+4t)(2)}{(3+2t)^2}$ $\left(\dfrac{(3+2t)f(t)-(1+4t)g(t)}{(3+2t)^2}\right)$ M1

$[f(t)=4,\ g(t)=2]$ A1

(*Give additional mark for simplification here, see last* A1 *of part* (ii))

(ii) $\dfrac{dy}{dx} = \dfrac{\frac{dy}{dt}}{\frac{dx}{dt}}$ (attempt to use $\dfrac{dy}{dx} = \dfrac{\dot{y}}{\dot{x}}$) M1

$= \dfrac{(3+2t)(4)-(1+4t)(2)}{(3+2t)^2} \cdot \dfrac{1}{(3+2t)}$ A1

$= \dfrac{10}{(3+2t)^3}$ (*This may have been given in* (i).) A1

(Penalise faulty simplification on last line)

2010 Winter

3. (*a*) $\dfrac{d(y^3)}{dx} = 3y^2\dfrac{dy}{dx}$ B1

$\dfrac{d(2x^3y)}{dx} = 2x^3\dfrac{dy}{dx} + 6x^2y$ B1

$\dfrac{d(3x^2+4x-3)}{dx} = 6x + 4$ B1

$x = 2, y = 1 \Rightarrow \dfrac{dy}{dx} = -\dfrac{8}{19}$ (c.a.o.) B1

(*b*) (i) $\dfrac{dx}{dt} = 6t$, $\dfrac{dy}{dt} = 12t^2 + 6t^5$ (all three terms correct) B2

(one term correct) B1

Use of $\dfrac{dy}{dx} = \dfrac{dy}{dt} \div \dfrac{dx}{dt}$ M1

$\dfrac{dy}{dx} = 2t + t^4$ (c.a.o.) A1

(ii) $\dfrac{d}{dt}\left[\dfrac{dy}{dx}\right] = 2 + 4t^3$ (f.t. candidate's expression for $\dfrac{dy}{dx}$) B1

Use of $\dfrac{d^2y}{dx^2} = \dfrac{d}{dt}\left[\dfrac{dy}{dx}\right] \div \dfrac{dx}{dt}$ M1

$\dfrac{d^2y}{dx^2} = \dfrac{1 + 2t^3}{3t}$ (c.a.o.) A1

2010 Summer

3. (*a*)

$\frac{d(y^4)}{dx} = 4y^3 \frac{dy}{dx}$ B1

$\frac{d(4x^2y)}{dx} = 4x^2 \frac{dy}{dx} + 8xy$ B1

$\frac{d(3x^3 - 5x)}{dx} = 9x^2 - 5$ B1

$\frac{dy}{dx} = \frac{9x^2 - 5 - 8xy}{4y^3 + 4x^2}$ (c.a.o.) B1

(*b*)

$\frac{dx}{dt} = 4 - 2 \sin 2t,$ B1

$\frac{dy}{dt} = 3 \cos 3t$ B1

Use of $\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$ M1

Substituting $\frac{\pi}{12}$ for t in expression for $\frac{dy}{dx}$ m1

$\frac{dy}{dx} = \frac{1}{\sqrt{2}}$ A1

2011 Winter

3. (*a*)

$\frac{d(2y^2)}{dx} = 4y \frac{dy}{dx}$ B1

$\frac{d(3x^2y)}{dx} = 3x^2\frac{dy}{dx} + 6xy$ B1

$\frac{d(x^4)}{dx} = 4x^3, \ \frac{d(15)}{dx} = 0$ B1

$\frac{dy}{dx} = \frac{4x^3 + 6xy}{4y - 3x^2}$ (c.a.o.) B1 (*b*) (i) Differentiating $\ln t$ and $t^3 - 7t$ with respect to t, at least one correct — M1

candidate's x-derivative $= \frac{1}{t}$,

candidate's y-derivative $= 3t^2 - 7$ — (both values) A1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ — M1

$\frac{dy}{dx} = 3t^3 - 7t$ — (c.a.o.) A1

(ii) $\frac{d}{dt}\left[\frac{dy}{dx}\right] = 9t^2 - 7$ — (f.t. candidate's expression for $\frac{dy}{dx}$) B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left[\frac{dy}{dx}\right] \div$ candidate's x-derivative — M1

$\frac{d^2y}{dx^2} = 9t^3 - 7t$ — (f.t. one slip) A1

When $t = \frac{1}{3}$, $\frac{d^2y}{dx^2} = -2$ — (c.a.o.) A1

2011 Summer

3. (*a*) $\frac{d}{dx}(2x^3) = 6x^2$, $\frac{d}{dx}(2x) = 2$, $\frac{d}{dx}(25) = 0$ — B1

$\frac{d}{dx}(x^2 \cos y) = x^2(-\sin y)\frac{dy}{dx} + 2x(\cos y)$ — B1

$\frac{d}{dx}(y^4) = 4y^3\frac{dy}{dx}$ — B1

$\frac{dy}{dx} = \frac{6x^2 + 2x\cos y + 2}{x^2 \sin y - 4y^3}$ — (c.a.o.) B1

(*b*) (i) candidate's x-derivative $= 3t^2$

candidate's y-derivative $= 4t + 20t^3$

(one term correct B1, all three terms correct B2)

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ — M1

$\frac{dy}{dx} = \frac{4 + 20t^2}{3t}$ — (c.a.o.) A1

(ii) $\frac{dy}{dx} = 5 \Rightarrow 20t^2 - 15t + 4 = 0$

(f.t. candidate's expression for $\frac{dy}{dx}$ from (i)) B1

Considering $b^2 - 4ac$ for candidate's quadratic — M1

$b^2 - 4ac = 225 - 320 < 0$ and hence no such real value of t exists

(f.t. candidate's quadratic) A1

2012 Winter

3. (*a*)

$\frac{d}{dx}(x^3) = 3x^2$ $\quad\quad$ $\frac{d}{dx}(-3x - 2) = -3$ B1

$\frac{d}{dx}(-4x^2y) = -4x^2\frac{dy}{dx} - 8xy$ B1

$\frac{d}{dx}(2y^3) = 6y^2\frac{dy}{dx}$ B1

$x = 3, y = 1 \Rightarrow \frac{dy}{dx} = \frac{6}{42} = \frac{1}{7}$ (c.a.o.) B1

(*b*) (i) Differentiating sin *at* and cos *at* with respect to *t*, at least one correct M1

candidate's *x*-derivative = *a* cos *at*,

candidate's *y*-derivative = – *a* sin *at* (both values) A1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ M1

$\frac{dy}{dx} = -\tan at$ (c.a.o.) A1

(ii) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = -a\sec^2 at$ (f.t. candidate's expression for $\frac{dy}{dx}$) B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div$ candidate's *x*-derivative M1

$\frac{d^2y}{dx^2} = -\sec^3 at$ (c.a.o.) A1

2012 Summer

3. (*a*)

$\frac{d}{dx}(x^3) = 3x^2$ $\quad\quad$ $\frac{d}{dx}(-3x - 2) = -3$ B1

$\frac{d}{dx}(-4x^2y) = -4x^2\frac{dy}{dx} - 8xy$ B1

$\frac{d}{dx}(2y^3) = 6y^2\frac{dy}{dx}$ B1

$x = 3, y = 1 \Rightarrow \frac{dy}{dx} = \frac{6}{42} = \frac{1}{7}$ (c.a.o.) B1 (*b*) (i) Differentiating sin *at* and cos *at* with respect to *t*, at least one correct — M1

candidate's *x*-derivative = $a \cos at$,
candidate's *y*-derivative = $-a \sin at$ (both values) — A1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ — M1

$\frac{dy}{dx} = -\tan at$ (c.a.o.) — A1

(ii) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = -a \sec^2 at$ (f.t. candidate's expression for $\frac{dy}{dx}$) — B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div$ candidate's *x*-derivative — M1

$\frac{d^2y}{dx^2} = -\sec^3 at$ (c.a.o.) — A1

2013 Winter

3. (*a*) $\frac{d(2y^3)}{dx} = 6y^2\frac{dy}{dx}$ — B1

$\frac{d(5x^4y)}{dx} = 5x^4\frac{dy}{dx} + 20x^3y$ — B1

$\frac{d(x^3)}{dx} = 3x^2$, $\frac{d(7)}{dx} = 0$ — B1

$\frac{dy}{dx} = \frac{20x^3y + 3x^2}{6y^2 - 5x^4}$ (o.e.) (c.a.o.) B1

(*b*) (i) candidate's *x*-derivative = $3t^2$ — B1

candidate's *y*-derivative = $4t^3 + 35t^4$ — B1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ — M1

$\frac{dy}{dx} = \frac{4t^3 + 35t^4}{3t^2}$ (c.a.o.) A1

(ii) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = \frac{4 + 70t}{3}$ (o.e.) — B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div \frac{dx}{dt}$

(f.t. candidate's expression for $\frac{dy}{dx}$) — M1

$\frac{d^2y}{dx^2} = \frac{4 + 70t}{9t^2}$ (o.e.) — A1

(iii) An attempt to solve $t^3 - 5 = 3$ and substitution of answer in candidate's expression for $\frac{d^2y}{dx^2}$ — M1

$\frac{d^2y}{dx^2} = 4$ (c.a.o.) A1

2013 Summer

3. (*a*) Use of product formula yielding $x^3 \times 2y \times \frac{dy}{dx} + 3x^2 \times y^2$ B1 B1

$\frac{dy}{dx} = -\frac{3x^2y^2}{2x^3y}$ (c.a.o.) B1

(*b*) (i) Putting candidate's expression for $\frac{dy}{dx} = 3$ and an attempt to simplify M1

$-\frac{3a^2b^2}{2a^3b} = 3 \Rightarrow b = -2a$ (convincing) A1

(ii) Substituting a for x and $-2a$ for y in the equation for C M1

$a = 2,\ b = -4$ A1

2014 Winter

4. (*a*) $\frac{dx}{dt} = 6t^2$ B1

(*b*) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = 2 + 12t^2$ B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div \frac{dx}{dt}$ M1

$\frac{d^2y}{dx^2} = \frac{2 + 12t^2}{6t^2}$ (c.a.o.) A1

$\frac{d^2y}{dx^2} = 2 \Rightarrow 2 + 12t^2 = 12t^2\ (\Rightarrow 2 = 0) \Rightarrow$ no such t exists E1

(*c*) Use of $\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dx}{dt}$ M1

$\frac{dy}{dt} = 12t^3 + 24t^5$ (f.t. candidate's expression for $\frac{dx}{dt}$) A1

Use of a valid method of integration to find y m1

$y = 3t^4 + 4t^6\ (+ c)$ (f.t. one error in candidate's $\frac{dy}{dt}$) A1

$y = 3t^4 + 4t^6 + 3$ (c.a.o.) A1

2014 Summer

3. (*a*)

$\frac{d(y^4)}{dx} = 4y^3\frac{dy}{dx}$ B1

$\frac{d(8xy^2)}{dx} = (8x)(2y)\frac{dy}{dx} + 8y^2$ B1

$\frac{d(2x^2)}{dx} = 4x$, $\frac{d(9)}{dx} = 0$ B1

$\frac{dy}{dx} = \frac{x - 2y^2}{y^3 + 4xy}$ (convincing) (c.a.o.) B1

(*b*)

$\frac{dy}{dx} = 0 \Rightarrow x = 2y^2$ B1

Substitute $2y^2$ for x in equation of C M1

$9y^4 + 9 = 0$ (o.e.) (c.a.o.) A1

$9y^4 + 9 > 0$ for any real y (o.e.) and thus no such point exists A1

2015

4. (*a*)

candidate's x-derivative $= \frac{1}{1 + t^2}$ B1

candidate's y-derivative $= \frac{1}{t}$ B1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ M1

$\frac{dy}{dx} = \frac{1 + t^2}{t}$ A1

(*b*)

$\frac{d}{dt}\left(\frac{dy}{dx}\right) = -t^{-2} + 1$ (o.e.) B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div$ candidate's x-derivative M1

$\frac{d^2y}{dx^2} = (-t^{-2} + 1)(1 + t^2)$ (o.e.) (f.t. one slip) A1

$\frac{d^2y}{dx^2} = 0 \Rightarrow t = 1$ (c.a.o.) A1

$\frac{d^2y}{dx^2} = 0 \Rightarrow x = \frac{\pi}{4}$ (f.t. candidate's derived value for t) A1

2016

4. (*a*) candidate's x-derivative = 12 cos 3t B1

candidate's y-derivative = – 6 sin 3t B1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ M1

$\frac{dy}{dx} = -\frac{1}{2}\tan 3t$ (c.a.o.) A1

(*b*) (i) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = -\frac{3}{2}\sec^2 3t$ (f.t. $\frac{dy}{dx} = k\tan 3t$ or $k\frac{\sin 3t}{\cos 3t}$ only) B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div$ candidate's x-derivative M1

$\frac{d^2y}{dx^2} = -\frac{1}{8}\sec^3 3t$ or $\frac{-1}{8\cos^3 3t}$ (c.a.o.) A1

(ii) $\frac{d^2y}{dx^2} = -\frac{1}{y^3}$ (f.t. $\frac{d^2y}{dx^2} = m\sec^3 3t$ or $\frac{m}{\cos^3 3t}$ only) B1

2017

3. (*a*) $\frac{d}{dx}(2y^3) = 6y^2\frac{dy}{dx}$ B1

$\frac{d}{dx}(-3x^2y) = -3x^2\frac{dy}{dx} - 6xy$ B1

$\frac{d}{dx}(x^4) = 4x^3$, $\frac{d}{dx}(-4x) = -4$, $\frac{d}{dx}(7) = 0$ B1

$\frac{dy}{dx} = \frac{4 - 4x^3 + 6xy}{6y^2 - 3x^2}$ (o.e.) (c.a.o.) B1

(*b*) (i) candidate's x-derivative = 7 + 4t B1

candidate's y-derivative = $\frac{(7+4t)r - (4+3t)m}{(7+4t)^2}$,

where r, m are integers M1

candidate's y-derivative = $\frac{(7+4t)3 - (4+3t)4}{(7+4t)^2}$ A1

$\frac{dy}{dx} = \frac{\text{candidate's } y\text{-derivative}}{\text{candidate's } x\text{-derivative}}$ M1

$\frac{dy}{dx} = \frac{5}{(7+4t)^3}$ (c.a.o.) A1

(ii) $\frac{d}{dt}\left(\frac{dy}{dx}\right) = \frac{-3\times 5\times 4}{(7+4t)^4}$ (o.e.)

(f.t. candidate's expression of correct given form for $\frac{dy}{dx}$) B1

Use of $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \div \frac{dx}{dt}$

(f.t. candidate's expression for $\frac{d}{dt}\left(\frac{dy}{dx}\right)$) M1

$\frac{d^2y}{dx^2} = \frac{-60}{(7+4t)^5}$ (c.a.o.) A1