Differentiation From First Principles Exam Questions MS (From OCR MEI 4752 unless otherwise stated)

Q1, (Jun 2009, Q12)

i	6.1	2	M1 for $\frac{(3.1^2-7)-(3^2-7)}{3.1-3}$ o.e.	2
ii	$\frac{((3+h)^2-7)-(3^2-7)}{h}$	M1	s.o.i.	
	numerator = $6h + h^2$	M1		
	$6 + h$	A1		3
iii	as h tends to 0,	M1		
	grad. tends to 6 o.e. f.t.from "6"+h	A1		2
iv	$y - 2 =$ "6" $(x - 3)$ o.e.	M1		
	$y = 6x - 16$	A1	6 may be obtained from $\frac{dy}{dx}$	2
v	At P, $x = 16/6$ o.e. or ft	M1		
	At Q, $x = \sqrt{7}$	M1		
	0.021 cao	A1		3

Q2, (Jan 2007, Q5)

(i) −0.93, -0.930, -0.9297…	2	M1 for grad = (1 – their y_B)/(2 − 2.1) if M0, SC1 for 0.93	
(ii) answer strictly between 1.91 and 2 or 2 and 2.1	B1	don't allow 1.9 recurring	
(iii) $y' = -8/x^3$, gradient = −1	M1A1		5

Q3, (Jun 2010, Q10)

(i)	$\frac{dy}{dx} = 4x^3$	**M1**	
	when $x = 2$, $\frac{dy}{dx} = 32$ s.o.i.	**A1**	i.s.w.
	when $x = 2$, $y = 16$ s.o.i.	**B1**	
	$y = 32x - 48$ c.a.o.	**A1**	
(ii)	34.481	**2**	**M1** for $\frac{2.1^4 - 2^4}{0.1}$
(iii) (*A*)	$16 + 32h + 24h^2 + 8h^3 + h^4$ c.a.o.	**3**	**B2** for 4 terms correct **B1** for 3 terms correct
(iii) (*B*)	$32 + 24h + 8h^2 + h^3$ or ft	**2**	**B1** if one error
(iii) (*C*)	as $h \to 0$, result $\to$ their 32 from (iii) (B)	**1**	
	gradient of tangent is limit of gradient of chord	**1**	

Q4, (OCR H230/02, Sample Question Paper, Q7)

$f(x+h) = x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$	M1	1.1	Attempt at expansion with product of powers of x and h summing to 4 and some attempt at coefficients, not necessarily correct
$\frac{f(x+h) - f(x)}{h} = \frac{4x^3h + 6x^2h^2 + 4xh^3 + h^4}{h}$	M1	1.1	Attempt $\frac{f(x+h) - f(x)}{h}$ Allow at most two errors
$= 4x^3 + 6x^2h + 4xh^2 + h^3$	A1	1.1	All terms correct
As $h \to 0$ all the terms in h tend to zero. Therefore $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = 4x^3$	A1	2.4	Accept some indication that as h tends to 0, the terms involving h vanish and leave $4x^3$
	E1	2.1	Award for good use of language, and of limit and function notation
	[5]		

Q5, (Jun 2016, Q10)

(i)	$\frac{(5.1^2 - 10.2) - (5^2 - 10)}{5.1 - 5}$ oe	M1	condone omission of brackets
	8.1	A1	
		[2]	

(ii)	$\dfrac{(5+h)^2-2(5+h)-\text{ their }15}{h}$ oe	M1	condone omission of brackets
	$25 + 10h + h^2 - 10 - 2h$ oe seen	M1	allow one sign error
	numerator is $8h + h^2$	A1	
	$8 + h$ isw	A1 [4]	
(iii)	$h \to 0$	M1	may be embedded; allow eg "tends to 0"
	their 8	A1 [2]	**FT** their $k + h$ from part (ii)
(iv)	$y = 8x - 25$ isw	B1	or $y - 15 = 8(x - 5)$ isw or $y = 8x + c$ and $c = -25$ stated isw
	non-zero numerical value for x-intercept on their straight line found	M1	
	[$x =$] 3.125 oe	A1	may be embedded in calculation for area
	$\dfrac{1}{2} \times$ their non-zero y-intercept $\times$ their $\dfrac{25}{8}$	M1	condone arithmetic slips in finding values of intercepts
	$\dfrac{625}{16}$ or $39\frac{1}{16}$ or 39.0625 isw	A1 [5]	accept rounded to 1 dp or better for **A1**; but **A0** if **final** answer negative

Q6, (OCR 4721, Jun 2016, Q8)

(i)	$y_1 = 50,\ y_2 = 2(5+h)^2$ $\dfrac{(50+20h+2h^2)-50}{(5+h)-5}$ $20 + 2h$	B1 M1 A1 [3]	Finds y coordinates at 5 and $5 + h$ Correct method to find gradient of a line segment; at least 3/4 values correct Fully correct working to give answer **AG**
(ii)	e.g. "As h tends to zero, the gradient will be 20"	B1 [1]	Indicates understanding of limit **See Appendix 2 for examples**
(iii)	Gradient of normal $= -\dfrac{1}{20}$ $y - 50 = -\dfrac{1}{20}(x-5),\ x = 0$ $50\frac{1}{4}$	B1 M1 A1 [3]	 Gradient of line must be numerical negative reciprocal of their gradient at A through their A Correct coordinate in any form e.g. $\dfrac{201}{4}, \dfrac{1005}{20}$

Q7, (Edexcel 8MA0/01, Sample Assessment 1, Q6)

Considers $\dfrac{3(x+h)^2-3x^2}{h}$	B1	2.1
Expands $3(x+h)^2 = 3x^2 + 6xh + 3h^2$	M1	1.1b
So gradient $=\dfrac{6xh+3h^2}{h}=6x+3h$ or $\dfrac{6x\delta x+3(\delta x)^2}{\delta x}=6x+3\delta x$	A1	1.1b
States as $h\to 0$, gradient $\to 6x$ so in the limit derivative $=6x$ *	A1*	2.5

(4 marks)