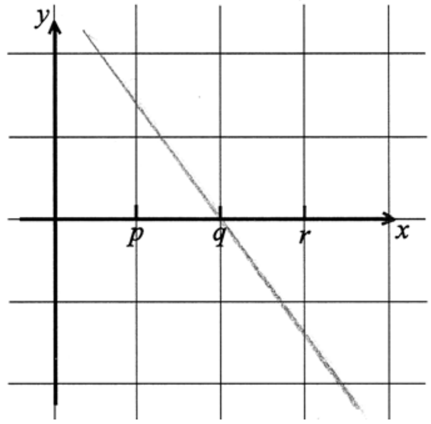
Differentiation 3   ANSWERS

1) (a)



A1A1 *N2*

Note:	Award ***A1*** for negative gradient throughout, ***A1*** for x-intercept of q. It need not be linear.

(b)

		x-coordinate
(i)	Maximum point on f	r
(ii)	Inflexion point on f	q

A1 *N1*
A1 *N1*

(c) **METHOD 1**

Second derivative is zero, second derivative changes sign. ***R1R1*** ***N2***

METHOD 2

There is a maximum on the graph of the first derivative. ***R2*** ***N2***

[6 marks]

2) **QUESTION 2**

(a) $f'(x) = -\sin 2x \times 2 \ (= -2\sin 2x)$ ***A1A1*** ***N2***

Note: Award ***A1*** for 2, ***A1*** for $-\sin 2x$.

(b) $g'(x) = 3 \times \frac{1}{3x-5} \left(= \frac{3}{3x-5} \right)$ ***A1A1*** ***N2***

Note: Award ***A1*** for 3, ***A1*** for $\frac{1}{3x-5}$.

(c) evidence of using product rule ***(M1)***

$h'(x) = (\cos 2x)\left(\frac{3}{3x-5} \right) + \ln(3x-5)(-2\sin 2x)$ ***A1*** ***N2***

[6 marks]

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3)

(a) $\pi \quad (=3.14)$ (accept $(\pi, 0)$, $(3.14, 0)$) ***A1*** ***N1***

[1 mark]

(b) (i) For using the product rule ***(M1)***

$f'(x) = e^x \cos x + e^x \sin x \quad = e^x(\cos x + \sin x)$ ***A1A1*** ***N3***

(ii) At B, $f'(x) = 0$ ***A1*** ***N1***

[4 marks]

(c) $f''(x) = e^x \cos x - e^x \sin x + e^x \sin x + e^x \cos x$ ***A1A1***

$= 2e^x \cos x$ ***AG*** ***N0***

[2 marks]

(d) (i) At A, $f''(x) = 0$ ***A1*** ***N1***

(ii) Evidence of setting up **their** equation (may be seen in part (d)(i)) ***A1***

e.g. $2e^x \cos x = 0$, $\cos x = 0$

$x = \frac{\pi}{2} \; (=1.57)$, $\quad y = e^{\frac{\pi}{2}} \; (=4.81)$ ***A1A1***

Coordinates are $\left(\frac{\pi}{2}, e^{\frac{\pi}{2}}\right)$ $(1.57, 4.81)$ ***N2***

[4 marks]

4)

(a) $f'(x) = 3ax^2 - 12x$ ***A1A1*** ***N2***

Note: Award ***A1*** for each correct term.

[2 marks]

(b) setting **their** derivative equal to 3 (seen anywhere) ***A1***

e.g. $f'(x) = 3$

attempt to substitute $x = 1$ into $f'(x)$ ***(M1)***

e.g. $3a(1)^2 - 12(1)$

correct substitution into $f'(x)$ ***(A1)***

e.g. $3a - 12$, $3a = 15$

$a = 5$ ***A1*** ***N2***

[4 marks]

Total [6 marks]

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5)

(a) attempt to expand *(M1)*

$(x+h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$ ***A1*** ***N2***

[2 marks]

(b) evidence of substituting $x+h$ *(M1)*

correct substitution ***A1***

$e.g.\ \ f'(x) = \lim_{h \to 0} \frac{(x+h)^3 - 4(x+h) + 1 - (x^3 - 4x + 1)}{h}$

simplifying ***A1***

$e.g.\ \ \frac{(x^3 + 3x^2h + 3xh^2 + h^3 - 4x - 4h + 1 - x^3 + 4x - 1)}{h}$

factoring out h ***A1***

$e.g.\ \ \frac{h(3x^2 + 3xh + h^2 - 4)}{h}$

$f'(x) = 3x^2 - 4$ ***AG*** ***N0***

[4 marks]

(c) $f'(1) = -1$ *(A1)*

setting up an appropriate equation ***M1***

$e.g.\ \ 3x^2 - 4 = -1$

at Q, $x = -1$, $y = 4$ $\left(\text{Q is } (-1, 4)\right)$ ***A1A1*** ***N3***

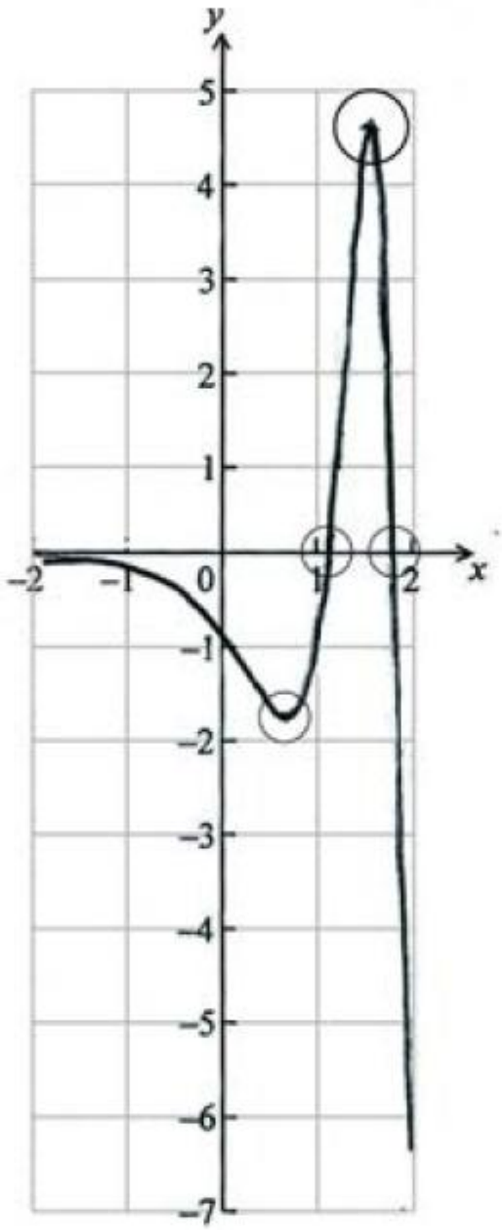
[4 marks]

6)

(a) $f'(x) = -e^{x}\sin(e^{x})$ ***A1A1*** ***N2***

[2 marks]

(b)



A1A1A1A1 ***N4***

Note:	Award ***A1*** for shape that must have the correct domain (from -2 to $+2$) and correct range (from -6 to 4), ***A1*** for minimum in circle, ***A1*** for maximum in circle and ***A1*** for intercepts in circles.

[4 marks]
Total [6 marks]