SL DIFFERENTIATION ANSWERS 2014

Non Calculator

1) N12/5/MATME/SP1/ENG/TZ0/XX/M

(a) **METHOD 1**

evidence of choosing quotient rule *(M1)*

e.g. $\frac{u'v - uv'}{v^2}$

evidence of correct differentiation (must be seen in quotient rule) *(A1)(A1)*

e.g. $\frac{\mathrm{d}}{\mathrm{d}x}(6x) = 6$, $\frac{\mathrm{d}}{\mathrm{d}x}(x+1) = 1$

correct substitution into quotient rule ***A1***

e.g $\frac{(x+1)6 - 6x}{(x+1)^2}$, $\frac{6x + 6 - 6x}{(x+1)^2}$

$f'(x) = \frac{6}{(x+1)^2}$ ***A1*** ***N4***

[5 marks]

METHOD 2

evidence of choosing product rule *(M1)*

e.g. $6x(x+1)^{-1}$, $uv' + vu'$

evidence of correct differentiation (must be seen in product rule) *(A1)(A1)*

e.g. $\frac{\mathrm{d}}{\mathrm{d}x}(6x) = 6$, $\frac{\mathrm{d}}{\mathrm{d}x}(x+1)^{-1} = -1(x+1)^{-2} \times 1$

correct working ***A1***

e.g. $6x \times -(x+1)^{-2} + (x+1)^{-1} \times 6$, $\frac{-6x + 6(x+1)}{(x+1)^2}$

$f'(x) = \frac{6}{(x+1)^2}$ ***A1*** ***N4***

[5 marks]

continued …

1b) (b) **METHOD 1**

evidence of choosing chain rule *(M1)*

e.g. formula, $\dfrac{1}{\left(\dfrac{6x}{x+1}\right)} \times \left(\dfrac{6x}{x+1}\right)'$

correct reciprocal of $\dfrac{1}{\left(\dfrac{6x}{x+1}\right)}$ is $\dfrac{x+1}{6x}$ (seen anywhere) ***A1***

correct substitution into chain rule ***A1***

e.g. $\dfrac{1}{\left(\dfrac{6x}{x+1}\right)} \times \dfrac{6}{(x+1)^2}$, $\left(\dfrac{6}{(x+1)^2}\right)\left(\dfrac{x+1}{6x}\right)$

working that clearly leads to the answer ***A1***

e.g. $\left(\dfrac{6}{(x+1)}\right)\left(\dfrac{1}{6x}\right)$, $\left(\dfrac{1}{(x+1)^2}\right)\left(\dfrac{x+1}{x}\right)$, $\dfrac{6(x+1)}{6x(x+1)^2}$

$g'(x) = \dfrac{1}{x(x+1)}$ ***AG*** ***N0***

[4 marks]

METHOD 2

attempt to subtract logs *(M1)*

e.g. $\ln a - \ln b$, $\ln 6x - \ln(x+1)$

correct derivatives (must be seen in correct expression) ***A1A1***

e.g. $\dfrac{6}{6x} - \dfrac{1}{x+1}, \dfrac{1}{x} - \dfrac{1}{x+1}$

working that clearly leads to the answer ***A1***

e.g. $\dfrac{x+1-x}{x(x+1)}, \dfrac{6x+6-6x}{6x(x+1)}, \dfrac{6(x+1-x)}{6x(x+1)}$

$g'(x) = \dfrac{1}{x(x+1)}$ ***AG*** ***N0***

[4 marks]

continued …

2)

(a) evidence of choosing product rule *(M1)*

eg $uv' + vu'$

correct derivatives (must be seen in the product rule) $\cos x$, $2x$ *(A1)(A1)*

$f'(x) = x^2 \cos x + 2x \sin x$ ***A1*** ***N4***

[4 marks]

3)

10. (a) substitute 0 into f *(M1)*
eg $\ln(0+1)$, $\ln 1$

$f(0) = 0$ ***A1*** ***N2***
[2 marks]

(b) $f'(x) = \frac{1}{x^4+1} \times 4x^3$ (seen anywhere) ***A1A1***

Note: Award ***A1*** for $\frac{1}{x^4+1}$ and ***A1*** for $4x^3$.

recognizing f increasing where $f'(x) > 0$ (seen anywhere) ***R1***
eg $f'(x) > 0$, diagram of signs

attempt to solve $f'(x) > 0$ *(M1)*
eg $4x^3 = 0$, $x^3 > 0$

f increasing for $x > 0$ (accept $x \geq 0$) ***A1*** ***N1***
[5 marks]

(c) (i) substituting $x = 1$ into f'' *(A1)*
eg $\frac{4(3-1)}{(1+1)^2}$, $\frac{4 \times 2}{4}$

$f''(1) = 2$ ***A1*** ***N2***

(ii) valid interpretation of point of inflexion (seen anywhere) ***R1***
eg no change of sign in $f''(x)$, no change in concavity,
f' increasing both sides of zero

attempt to find $f''(x)$ for $x < 0$ *(M1)*
eg $f''(-1)$, $\frac{4(-1)^2\left(3-(-1)^4\right)}{\left((-1)^4+1\right)^2}$, diagram of signs

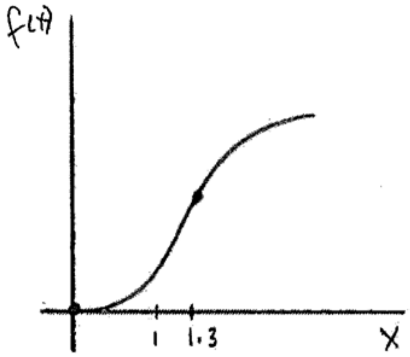
correct working leading to positive value ***A1***
eg $f''(-1) = 2$, discussing signs of numerator **and** denominator

there is no point of inflexion at $x = 0$ ***AG*** ***N0***
[5 marks]

continued …

3d) *Question 10 continued*

(d)



A1A1A1 ***N3***

Notes:	Award ***A1*** for shape concave up left of POI and concave down right of POI. Only if this ***A1*** is awarded, then award the following: ***A1*** for curve through $(0, 0)$, ***A1*** for increasing throughout. Sketch need not be drawn to scale. Only essential features need to be clear.

[3 marks]

Total [15 marks]

4)

Function	Derivative diagram
f_1	(d)
f_2	(e)
f_3	(b)
f_4	(a)

(AG)
(A2)
(A2)
(A2)

M02/520/S(1)M+

(C6)
[6 marks]

10. (a) correct derivatives **applied** in quotient rule *(A1)A1A1*

$1, \ -4x+5$

> **Note:** Award *(A1)* for 1, *A1* for $-4x$ and *A1* for 5, **only** if it is clear candidates are using the quotient rule.

correct substitution into quotient rule *A1*

e.g. $\dfrac{1\times(-2x^2+5x-2)-x(-4x+5)}{(-2x^2+5x-2)^2}, \ \dfrac{-2x^2+5x-2-x.-4x+5}{(-2x^2+5x-2)^2}$

correct working *(A1)*

e.g. $\dfrac{-2x^2+5x-2-(-4x^2+5x)}{(-2x^2+5x-2)^2}$

expression clearly leading to the answer *A1*

e.g. $\dfrac{-2x^2+5x-2+4x^2-5x}{(-2x^2+5x-2)^2}$

$f'(x)=\dfrac{2x^2-2}{(-2x^2+5x-2)^2}$ *AG* *N0*

[6 marks]

(b) evidence of attempting to solve $f'(x)=0$ *(M1)*

e.g. $2x^2-2=0$

evidence of correct working *A1*

e.g. $x^2=1, \ \dfrac{\pm\sqrt{16}}{4}, \ 2(x-1)(x+1)$

correct solution to quadratic *(A1)*

e.g. $x=\pm1$

correct *x*-coordinate $x=-1$ $\left(\text{may be seen in coordinate form } \left(-1, \dfrac{1}{9}\right)\right)$ *A1* *N2*

attempt to substitute -1 into f (do not accept any other value) *(M1)*

e.g. $f(-1)=\dfrac{-1}{-2\times(-1)^2+5\times(-1)-2}$

correct working *A1*

e.g. $\dfrac{-1}{-2-5-2}$

correct *y*-coordinate $y=\dfrac{1}{9}$ $\left(\text{may be seen in coordinate form } \left(-1, \dfrac{1}{9}\right)\right)$ *A1* *N2*

[7 marks]