IB MATHS AA HL · UNIT 5

Rules of Differentiation: exam practice

10 questions · 32 marks · worked solutions and markschemes

Name _____ Date _____ Score / 32

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/hlaa/rules-of-differentiation-exam-practice

1. **3 marks · Paper 1 style · no calculator**

Differentiate $f(x) = 4x^3 - \frac{2}{x} + 5\sqrt{x}$.

Find $f'(x)$. **[3]**

2. **2 marks · Paper 1 style · no calculator**

Differentiate $y = (3x^2 - 1)^5$.

Find $\frac{dy}{dx}$. **[2]**

3. **2 marks · Paper 1 style · no calculator**

Differentiate $y = e^{\cos 2x}$.

Find $\frac{dy}{dx}$. **[2]**

4. **3 marks · Paper 1 style · no calculator**

Differentiate $y = x^2 \sin 3x$.

Find $\frac{dy}{dx}$. **[3]**

5. **3 marks · Paper 1 style · no calculator**

Differentiate $y = \frac{\ln x}{x^2}$.

Find $\frac{dy}{dx}$. **[3]**

6. **3 marks · Paper 1 style · no calculator**

Differentiate $y = \frac{2x+1}{x-3}$, simplifying your answer.

Find $\frac{dy}{dx}$. **[3]**

7. **3 marks · Paper 1 style · no calculator**

Let $f(x) = \ln(x^2 + 4)$.

Find $f'(x)$ and the gradient of the graph at $x = 2$. **[3]**

8. **4 marks · Paper 1 style · no calculator**

Find the equation of the normal to $y = \sqrt{2x + 5}$ at the point where $x = 2$.

Find the equation. **[4]**

9. **4 marks · Paper 1 style · no calculator**

Find the coordinates of the point on $y = e^{2x} - 4x$ where the tangent is parallel to the line $y = 2x + 1$.

Find the point. **[4]**

10. **5 marks · Paper 1 style · no calculator**

The tangent to $y = x^3 - 2x$ at the point $P(2, 4)$ meets the curve again at Q.

Find the coordinates of Q. **[5]**

Answers and worked solutions

Question 1

3 marks

Answer: $12x^2 + \frac{2}{x^2} + \frac{5}{2\sqrt{x}}$

$12x^2$ A1

$+\frac{2}{x^2}$ A1

$+\frac{5}{2\sqrt{x}}$ A1

Question 2

2 marks

Answer: $30x(3x^2-1)^4$

chain rule M1

$30x(3x^2-1)^4$ A1

Question 3

2 marks

Answer: $-2\sin 2x\, e^{\cos 2x}$

chain rule M1

$-2\sin 2x\, e^{\cos 2x}$ A1

Question 4

3 marks

Answer:

$2x\sin 3x + 3x^2\cos 3x$

product rule M1

$2x\sin 3x + 3x^2\cos 3x$ A1A1

Question 5

3 marks

Answer: $\frac{1-2\ln x}{x^3}$

quotient rule M1

$\frac{x-2x\ln x}{x^4}$ A1

$\frac{1-2\ln x}{x^3}$ A1

Question 6

3 marks

Answer: $-\frac{7}{(x-3)^2}$

$\frac{2(x-3)-(2x+1)}{(x-3)^2}$ M1A1

$-\frac{7}{(x-3)^2}$ A1

Question 7

3 marks

Answer: $\frac{2x}{x^2+4}$; $\frac{1}{2}$

$\frac{2x}{x^2+4}$ A1A1

$\frac{1}{2}$ A1

Question 8

4 marks

Answer: $y = -3x + 9$

$\frac{dy}{dx} = \frac{1}{\sqrt{2x+5}} = \frac{1}{3}$ M1A1

normal gradient -3, point $(2,3)$ A1

$y = -3x + 9$ A1

Question 9

4 marks

Answer: $\left(\frac{1}{2}\ln 3,\ 3-2\ln 3\right)$

$2e^{2x} - 4 = 2$ M1A1

$x = \frac{1}{2}\ln 3$ A1

$\left(\frac{1}{2}\ln 3,\ 3-2\ln 3\right)$ A1

Question 10

5 marks

Answer: $(-4, -56)$

$\frac{dy}{dx} = 3x^2 - 2 = 10$ A1

tangent $y = 10x - 16$ A1

$x^3 - 12x + 16 = 0$ M1

$(x-2)^2(x+4) = 0$ A1

$Q(-4, -56)$ A1

Every solution is also on ibmathrevision.com/hlaa/rules-of-differentiation-exam-practice
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