Differentiation Rules: exam practice

10 questions · 29 marks · worked solutions and markschemes

Name _____ Date _____ Score / 29

- 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/hlai/differentiation-rules-exam-practice

1. **2 marks · Paper 1 style · calculator allowed**

Find the gradient of $y = \dfrac{x^3 + 2x}{x}$, $x \neq 0$, at $x = 3$.

Find the gradient. **[2]**

2. **3 marks · Paper 1 style · calculator allowed**

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

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

3. **2 marks · Paper 1 style · calculator allowed**

The volume of a cube of side x cm is $V = x^3$.

Find $\dfrac{dV}{dx}$ when $x = 4$ and interpret it. **[2]**

4. 2 marks · Paper 1 style · calculator allowed

Let $f(x) = \frac{x^2}{4} - 3x$.

Find the value of x for which the gradient is -1. **[2]**

5. 3 marks · Paper 1 style · calculator allowed

Let $f(x) = 2x^3 - 3x^2 - 36x$.

Find $f'(x)$ and the values of x for which $f'(x) = 0$. **[3]**

6. 3 marks · Paper 1 style · calculator allowed

The gradient of $y = ax^2 + bx$ is 7 at $x = 1$ and -1 at $x = -1$.

Find a and b. **[3]**

7. 3 marks · Paper 2 style · calculator allowed

The temperature of an oven is $T(t) = 20 + 15t - 0.5t^2$ (°C) for $0 \le t \le 20$ minutes.

Find the maximum temperature and the rate of change at $t = 5$. **[3]**

8. 3 marks · Paper 1 style · calculator allowed

Find the coordinates of the points on $y = x^3 - 3x^2$ where the gradient is 9.

Find the points. **[3]**

9. 4 marks · Paper 2 style · calculator allowed

Let $f(x) = x^3 - 12x + 5$.

Find the coordinates of the local maximum and local minimum. **[4]**

10. 4 marks · Paper 2 style · calculator allowed

Let $f(x) = x^4 - 8x^2 + 3$.

Find all stationary points and their nature. **[4]**

Answers and worked solutions

Question 1 — 2 marks

Answer: 6

$y = x^2 + 2$, $\frac{dy}{dx} = 2x$ **M1**

6 **A1**

Question 2 — 3 marks

Answer: $20x^3 + \frac{6}{x^3} + \frac{1}{\sqrt{x}}$

$20x^3$ **A1**

$+\frac{6}{x^3}$ **A1**

$+\frac{1}{\sqrt{x}}$ **A1**

Question 3 — 2 marks

Answer: 48

$3x^2 = 48$ **A1**

volume increases at about $48\ \text{cm}^3$ per cm of side **R1**

Question 4 — 2 marks

Answer: 4

$\frac{x}{2} - 3 = -1$ **M1**

$x = 4$ **A1**

Question 5 — 3 marks

Answer: $x = 3$, $x = -2$

$6x^2 - 6x - 36$ **A1**

$6(x-3)(x+2) = 0$ **M1**

$x = 3$, $x = -2$ **A1**

Question 6 — 3 marks

Answer: $a = 2$, $b = 3$

$2a + b = 7$, $-2a + b = -1$

*M*1**A1**

$a = 2$, $b = 3$ **A1**

Question 7 — 3 marks

Answer: $132.5\,°C$; $10\,°\frac{C}{\text{min}}$

$T'(t) = 15 - t$ **A1**

maximum $132.5\,°C$ at $t = 15$ **A1**

$10\,°\frac{C}{\text{min}}$ **A1**

Question 8 — 3 marks

Answer: $(3, 0)$ and $(-1, -4)$

$3x^2 - 6x = 9$ **M1**

$x = 3$, $x = -1$ **A1**

$(3, 0)$ and $(-1, -4)$ **A1**

Question 9 — 4 marks

Answer: max $(-2, 21)$; min $(2, -11)$

$f'(x) = 3x^2 - 12 = 0$ **M1**

$x = \pm 2$ **A1**

maximum $(-2,\ 21)$ **A1**

minimum $(2,\ -11)$ **A1**

Question 10 — 4 marks

Answer: max $(0, 3)$; min $(\pm 2, -13)$

$4x^3 - 16x = 0$ **M1**

$x = 0$: maximum $(0, 3)$ **A1**

$x = \pm 2$: minima **A1**

$(\pm 2,\ -13)$ **A1**

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