

**Dr Oliver Mathematics**  
**Mathematics**  
**Differentiation Part 1**  
**Past Examination Questions**

This booklet consists of 34 questions across a variety of examination topics.  
The total number of marks available is 131.

1. Given that  $y = 5x^3 + 7x + 3$ , find

(a)  $\frac{dy}{dx}$ , (3)

(b)  $\frac{d^2y}{dx^2}$ . (1)

2. The curve  $C$  has equation  $y = 4x^2 + \frac{5-x}{x}$ ,  $x \neq 0$ .

The point  $P$  on  $C$  has  $x$ -coordinate 1.

Show that the value  $\frac{dy}{dx}$  at  $P$  is 3.

3. Given that  $y = 6x - \frac{4}{x^2}$ ,  $x \neq 0$ , find  $\frac{dy}{dx}$ . (2)

4. Given that  $y = 2x^2 - \frac{6}{x^3}$ ,  $x \neq 0$ , find  $\frac{dy}{dx}$ . (2)

5. (3)

$$y = (x - 1)(x^2 - 4).$$

Show that  $\frac{dy}{dx} = 3x^2 - 2x - 4$ .

6. Differentiate with respect to  $x$ :

(a)  $x^4 + 6\sqrt{x}$ , (3)

(b)  $\frac{(x+4)^2}{x}$ . (4)

7. Given that (4)

$$y = 4x^3 - 1 + 2x^{\frac{1}{2}}, \quad x > 0,$$

find  $\frac{dy}{dx}$ .

8. The curve  $C$  has equation  $y = 4x + 3x^{\frac{3}{2}} - 2x^2$ ,  $x > 0$ . (3)

Find an expression for  $\frac{dy}{dx}$ .

9. Given that  $y = 3x^2 + 4\sqrt{x}$ ,  $x > 0$ , find

(a)  $\frac{dy}{dx}$ , (2)

(b)  $\frac{d^2y}{dx^2}$ . (2)

10. (a) Write  $\frac{2\sqrt{x} + 3}{x}$  in the form  $2x^p + 3x^q$ , where  $p$  and  $q$  are constants. (2)

Given that  $y = 5x - 7 + \frac{2\sqrt{x} + 3}{x}$ ,  $x > 0$ ,

(b) find  $\frac{dy}{dx}$ , simplifying the coefficient of each term. (4)

11. (2)

$$f(x) = 3x + x^3.$$

Differentiate to find  $f'(x)$ .

12. The curve  $C$  has equation  $y = kx^3 - x^2 + x - 5$ , where  $k$  is a constant. (2)

Find  $\frac{dy}{dx}$ .

13. Given that  $\frac{2x^2 - x^{\frac{3}{2}}}{\sqrt{x}}$  can be written in the form  $2x^p - x^q$ , (2)

(a) write down the value of  $p$  and write down the value of  $q$ .

Given that  $y = 5x^4 - 3 + \frac{2x^2 - x^{\frac{3}{2}}}{\sqrt{x}}$ ,

(b) find  $\frac{dy}{dx}$ , simplifying the coefficient of each term. (4)

14. Given that  $y = 2x^3 + \frac{3}{x^2}$ ,  $x \neq 0$ , find  $\frac{dy}{dx}$ . (3)

15.

$$f(x) = \frac{(3 - 4\sqrt{x})^2}{\sqrt{x}}, \quad x > 0.$$

(a) Show that  $f(x) = 9x^{-\frac{1}{2}} + Ax^{\frac{1}{2}} + B$ , where  $A$  and  $B$  are constants to be found. (3)

(b) Find  $f'(x)$ . (3)

16. Given that  $y = x^4 + x^{\frac{1}{3}} + 3$ , find  $\frac{dy}{dx}$ . (3)

17. The curve  $C$  has equation (4)

$$y = \frac{(x+3)(x-8)}{x}, \quad x > 0.$$

Find  $\frac{dy}{dx}$  in its simplest form.

18. Given that (6)

$$y = 8x^3 - 4\sqrt{x} + \frac{3x^2 + 2}{x}, \quad x > 0,$$

find  $\frac{dy}{dx}$ .

19. The curve  $C$  has equation (4)

$$y = \frac{1}{2}x^3 - 9x^{\frac{3}{2}} + \frac{8}{x} + 30, \quad x > 0.$$

Find  $\frac{dy}{dx}$ .

20. Given that  $y = 2x^5 + 7 + \frac{1}{x^3}$ ,  $x \neq 0$ , find, in its simplest form,  $\frac{dy}{dx}$ . (3)

21. The curve  $C$  has equation  $y = (x+1)(x+3)^2$ . (3)

Find  $\frac{dy}{dx}$ .

22. Given that  $y = x^4 + 6x^{\frac{1}{2}}$ , find, in the simplest form,  $\frac{dy}{dx}$ . (3)

23. (2)

$$y = x^2(x+2).$$

Find  $\frac{dy}{dx}$ .

- 24.

$$y = 5x^3 - 6x^{\frac{4}{3}} + 2x - 3.$$

- (a) Find  $\frac{dy}{dx}$ , giving each term in its simplest form. (4)

- (b) Find  $\frac{d^2y}{dx^2}$ . (2)

25. The curve  $C$  has equation (3)

$$y = 2x - 8\sqrt{x} + 5, \quad x \geq 0.$$

Find  $\frac{dy}{dx}$ , giving each term in its simplest form.

26.

$$f(x) = \frac{(3 - x^2)^2}{x^2}, \quad x \neq 0.$$

(a) Show that

$$f(x) = 9x^{-2} + A + Bx^2, \quad (3)$$

where  $A$  and  $B$  are constants to be found.

(b) Find  $f'(x)$ .

27. Given that  $y = x^3 + 4x + 1$ , find the value of  $\frac{dy}{dx}$  when  $x = 3$ . (4)

28. Differentiate with respect to  $x$ , giving each answer in its simplest form.

(a)  $(1 - 2x)^2$ , (3)

(b)  $\frac{x^5 + 6\sqrt{x}}{2x^2}$ . (4)

29. Given that  $y = 2x^5 + \frac{6}{\sqrt{x}}$ , find, in the simplest form,  $\frac{dy}{dx}$ . (3)

30. Given that  $y = 4x^3 - \frac{5}{x^2}$ , find, in the simplest form,  $\frac{dy}{dx}$ . (3)

31. The curve  $C$  has equation (5)

$$y = \frac{(x^2 + 4)(x - 3)}{2x}.$$

Find  $\frac{dy}{dx}$  in its simplest form.

32. Given that  $y = 3x^2 + 6x^{\frac{1}{3}} + \frac{2x^3 - 7}{3\sqrt{x}}$ , find  $\frac{dy}{dx}$ . Give each term in your answer in its simplest form. (6)

33. The curve  $C$  has equation  $y = 2x^3 + kx^2 + 5x + 6$ , where  $k$  is a constant. Find  $\frac{dy}{dx}$ . (2)

34. Given (5)

$$y = \sqrt{x} + \frac{4}{\sqrt{x}} + 4, \quad x > 0.$$

find the value of  $\frac{dy}{dx}$  when  $x = 8$ , writing your answer in the form  $a\sqrt{2}$ , where  $a$  is a rational number.