

## Differentiation 12C

$$1 \text{ a } f(x) = x^7 \\ f'(x) = 7x^6$$

$$\text{b } f(x) = x^8 \\ f'(x) = 8x^7$$

$$\text{c } f(x) = x^4 \\ f'(x) = 4x^3$$

$$\text{d } f(x) = x^{\frac{1}{3}} \\ f'(x) = \frac{1}{3}x^{\frac{1}{3}-1} = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3x^{\frac{2}{3}}}$$

$$\text{e } f(x) = x^{\frac{1}{4}} \\ f'(x) = \frac{1}{4}x^{\frac{1}{4}-1} = \frac{1}{4}x^{-\frac{3}{4}} = \frac{1}{4x^{\frac{3}{4}}}$$

$$\text{f } f(x) = \sqrt[3]{x} = x^{\frac{1}{3}} \\ f'(x) = \frac{1}{3}x^{\frac{1}{3}-1} = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3x^{\frac{2}{3}}}$$

$$\text{g } f(x) = x^{-3} \\ f'(x) = -3x^{-3-1} = -3x^{-4}$$

$$\text{h } f(x) = x^{-4} \\ f'(x) = -4x^{-4-1} = -4x^{-5}$$

$$\text{i } f(x) = \frac{1}{x^2} = x^{-2} \\ f'(x) = -2x^{-2-1} = -2x^{-3} = -\frac{2}{x^3}$$

$$\text{j } f(x) = \frac{1}{x^5} = x^{-5} \\ f'(x) = -5x^{-5-1} = -5x^{-6} = -\frac{5}{x^6}$$

$$\text{k } f(x) = \frac{1}{\sqrt{x}} = x^{-\frac{1}{2}} \\ f'(x) = -\frac{1}{2}x^{-\frac{1}{2}-1} = -\frac{1}{2}x^{-\frac{3}{2}} = -\frac{1}{2x^{\frac{3}{2}}}$$

$$1 \text{ l } f(x) = \frac{1}{\sqrt[3]{x}} = x^{-\frac{1}{3}} \\ f'(x) = -\frac{1}{3}x^{-\frac{1}{3}-1} = -\frac{1}{3}x^{-\frac{4}{3}} = -\frac{1}{3x^{\frac{4}{3}}}$$

$$\text{m } f(x) = x^3 \times x^6 = x^{3+6} = x^9 \\ f'(x) = 9x^8$$

$$\text{n } f(x) = x^2 \times x^3 = x^5 \\ f'(x) = 5x^4$$

$$\text{o } f(x) = x \times x^2 = x^3 \\ f'(x) = 3x^2$$

$$\text{p } f(x) = \frac{x^2}{x^4} = x^{-2} \\ f'(x) = -2x^{-2-1} = -2x^{-3} = -\frac{2}{x^3}$$

$$\text{q } f(x) = \frac{x^3}{x^2} = x \\ f'(x) = 1x^0 = 1$$

$$\text{r } f(x) = \frac{x^6}{x^3} = x^3 \\ f'(x) = 3x^2$$

$$2 \text{ a } y = 3x^2 \\ \frac{dy}{dx} = 2 \times 3x^{2-1} = 6x$$

$$\text{b } y = 6x^9 \\ \frac{dy}{dx} = 9 \times 6x^{9-1} = 54x^8$$

$$\text{c } y = \frac{1}{2}x^4 \\ \frac{dy}{dx} = 4 \times \frac{1}{2}x^{4-1} = 2x^3$$

$$\text{d } y = 20x^{\frac{1}{4}} \\ \frac{dy}{dx} = \frac{1}{4} \times 20x^{\frac{1}{4}-1} = 5x^{-\frac{3}{4}} = \frac{5}{x^{\frac{3}{4}}}$$

**2 e**  $y = 6x^{\frac{5}{4}}$   
 $\frac{dy}{dx} = \frac{5}{4} \times 6x^{\frac{5}{4}-1} = \frac{15}{2}x^{\frac{1}{4}}$

**f**  $y = 10x^{-1}$   
 $\frac{dy}{dx} = -1 \times 10x^{-1-1} = -10x^{-2}$

**g**  $y = \frac{4x^6}{2x^3} = 2x^3$   
 $\frac{dy}{dx} = 3 \times 2x^{3-1} = 6x^2$

**h**  $y = \frac{x}{8x^5} = \frac{1}{8}x^{-4}$   
 $\frac{dy}{dx} = -4 \times \frac{1}{8}x^{-4-1} = -\frac{1}{2}x^{-5} = -\frac{1}{2x^5}$

**i**  $y = -\frac{2}{\sqrt{x}} = -2x^{-\frac{1}{2}}$   
 $\frac{dy}{dx} = \left(-\frac{1}{2}\right) \times (-2)x^{-\frac{1}{2}-1} = x^{-\frac{3}{2}} = \frac{1}{x^{\frac{3}{2}}}$

**j**  $y = \sqrt{\frac{5x^4 \times 10x}{2x^2}} = 5x^{\frac{3}{2}}$   
 $\frac{dy}{dx} = \frac{3}{2} \times 5x^{\frac{3}{2}-1} = \frac{15}{2}x^{\frac{1}{2}} = \frac{15\sqrt{x}}{2}$

**3 a**  $y = 3\sqrt{x} = 3x^{\frac{1}{2}}$   
 $\frac{dy}{dx} = \frac{1}{2} \times 3x^{\frac{1}{2}-1} = \frac{3}{2}x^{-\frac{1}{2}} = \frac{3}{2\sqrt{x}}$

When  $x = 4$ ,  $\frac{dy}{dx} = \frac{3}{2\sqrt{4}} = \frac{3}{4}$

**b** When  $x = 9$ ,  $\frac{dy}{dx} = \frac{3}{2\sqrt{9}} = \frac{3}{6} = \frac{1}{2}$

**c** When  $x = \frac{1}{4}$ ,  $\frac{dy}{dx} = \frac{3}{2\sqrt{\frac{1}{4}}} = \frac{3}{1} = 3$

**d** When  $x = \frac{9}{16}$ ,  $\frac{dy}{dx} = \frac{3}{2\sqrt{\frac{9}{16}}} = \frac{3}{\frac{3}{2}} = 2$

**4**  $2y^2 - x^3 = 0$   
 $2y^2 = x^3$   
 $y^2 = \frac{1}{2}x^3$   
 $y = \frac{1}{\sqrt{2}}x^{\frac{3}{2}}$

$\frac{dy}{dx} = \frac{3}{2} \times \frac{1}{\sqrt{2}}x^{\frac{3}{2}-1} = \frac{3}{2\sqrt{2}}x^{\frac{1}{2}} = \frac{3}{2}\sqrt{\frac{x}{2}}$