Exercise 7. **Differentiating common functions**

In Problems 1 to 6 find the differential coefficients of the given functions with respect to the variable.

1. (a) $5x^5$ (b) $2.4x^{3.5}$ (c) $\dfrac{1}{x}$

2. (a) $\dfrac{-4}{x^2}$ (b) 6   (c) $2x$

3. (a) $2\sqrt{x}$ (b) $3\sqrt[3]{x^5}$ (c) $\dfrac{4}{\sqrt{x}}$

4. (a) $\dfrac{-3}{\sqrt[3]{x}}$ (b) $(x-1)^2$ (c) $2\sin 3x$

5. (a) $-4\cos 2x$ (b) $2e^{6x}$ (c) $\dfrac{3}{e^{5x}}$

6. (a) $4\ln 9x$ (b) $\dfrac{e^x - e^{-x}}{2}$ (c) $\dfrac{1-\sqrt{x}}{x}$

7. Find the gradient of the curve $y = 2t^4 + 3t^3 - t + 4$ at the points (0, 4) and (1, 8).

8. Find the co-ordinates of the point on graph
    y = 5x2 − 3x + 1 where the gradiet is 2.

9. (a) Differentiate
    $$y = \frac{2}{\theta^2} + 2\ln 2\theta - 2(\cos 5\theta + 3\sin 2\theta) - \frac{2}{e^{3\theta}}$$
    (b) Evaluate $\dfrac{dy}{d\theta}$ when $\theta = \dfrac{\pi}{2}$, correct to 4
    significant figures.

10. Evaluate $\dfrac{ds}{dt}$, correct to 3 significant figures,
    when $t = \dfrac{\pi}{6}$ given $s = 3\sin t - 3 + \sqrt{t}$

Exercise 8. Differentiating products

In Problems 1 to 8 differentiate the given products with respect to the variable.

1. $x \sin x$

2. $x^2 e^{2x}$

3. $x^2 \ln x$

4. $2x^3 \cos 3x$

5. $\sqrt{x^3} \ln 3x$

6. $e^{3t} \sin 4t$

7. $e^{4\theta} \ln 3\theta$

8. $e^t \ln t \cos t$

9. Evaluate $\dfrac{di}{dt}$, correct to 4 significant figure,

   when $t = 0.1$, and $i = 15t \sin 3t$

10. Evaluate $\dfrac{dz}{dt}$, correct to 4 significant figures,
    when $t = 0.5$, given that $z = 2e^{3t} \sin 2t$

Exercise 9. **Differentiating quotients**

In Problems 1 to 7, differentiate the quotients with respect to the variable.

1. $\dfrac{\sin x}{x}$

2. $\dfrac{2\cos 3x}{x^3}$

3. $\dfrac{2x}{x^2 + 1}$

4. $\dfrac{\sqrt{x}}{\cos x}$

5. $\dfrac{3\sqrt{\theta^3}}{2\sin 2\theta}$

6. $\dfrac{\ln 2t}{\sqrt{t}}$

7. $\dfrac{2xe^{4x}}{\sin x}$

8. Find the gradient of the curve $y = \dfrac{2x}{x^2 - 5}$ at the point $(2, -4)$

Exercise 10. Function of a function

In Problems 1 to 9, find the differential coefficients with respect to the variable.

1. $(2x - 1)^6$

2. $(2x^3 - 5x)^5$

3. $2\sin(3\theta - 2)$

4. $2\cos^5 \alpha$

5. $\dfrac{1}{(x^3 - 2x + 1)^5}$

6. $5e^{2t+1}$

7. $2\cot(5t^2 + 3)$

8. $6\tan(3y + 1)$

9. $2e^{\tan\theta}$

Exercise 11. Successive differentiation

1. If $y = 3x^4 + 2x^3 - 3x + 2$ find
    (a) $\dfrac{d^2 y}{dx^2}$ (b) $\dfrac{d^3 y}{dx^3}$

2. (a) Given $f(t) = \dfrac{2}{5}t^2 - \dfrac{1}{t^3} + \dfrac{3}{t} - \sqrt{t} + 1$
          determine $f''(t)$
    (b) Evaluate $f''(t)$ when $t = 1$

In Problems 3 and 4, find the second differential coefficient with respect to the variable.

3. (a) $3 \sin 2t + \cos t$ (b) $2 \ln 4\theta$

4. (a) $2\cos^2 x$ (b) $(2x - 3)^4$