

## Week 4: Differentiation

### Solutions

1.  $y = 2x^3$

$$y' = 3 \cdot 2x^2 = 6x^2$$

(a) Find  $y'$

**Solution:**  $y' = 6x^2$

(b) Find  $\frac{dy}{dx}$

**Solution:**  $\frac{dy}{dx} = 6x^2$

3.  $y = x^3 - 4x^2 - 3x + 9$

(a) Find  $y'$

**Solution:**  $y' = 3x^2 - 8x - 3$

(b) Find the range values of  $x$  for which  $y$  is increasing

**Solution:**  $y$  is increasing when the gradient is positive, i.e. when  $x < -\frac{1}{3}$  and  $x > 3$

4. Let  $y = 5x^2 + 4\sin(3x)$  Find  $\frac{dy}{dx}$

**Solution:**  $\frac{dy}{dx} = 10x + 12\cos(3x)$

5. Given that  $y = \frac{1}{x+2}$  find  $\frac{dy}{dx}$

(a) using the product rule,

**Solution:**  $\frac{dy}{dx} = (-1)(x+2)^{-2} + (x+2)^{-1} = \frac{2}{(x+2)^2}$

(b) using the quotient rule.

**Solution:**  $\frac{dy}{dx} = \frac{0(x+2) - 1(x+2)}{(x+2)^2} = \frac{2}{(x+2)^2}$

6.  $y = \frac{x^2}{x+4}$  Find  $\frac{dy}{dx}$

**Solution:**  $\frac{dy}{dx} = \frac{2x+8}{(x+4)^2}$

7. Differentiate with respect to  $x$

(a)  $(x^2 - 4)^3$

**Solution:**  $6x(x^2 - 4)^2$

(b)  $2(3x^2 + 1)^6$

**Solution:**  $72x(3x^2 + 1)^5$

(c)  $x^{2+3}$

**Solution:**  $(2x + 3)x^{2+3}$