

# Differentiation

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1. Find  $dy/dx$  for the following:

(a)  $y = 3x^5$

(f)  $y = 3x^4 + 6x^2$

(b)  $y = 4$

(g)  $y = 2x + \frac{1}{2}x^2$

(c)  $y = 4x^3 + 5$

(h)  $y = -10x^6 + 2x^3 - 2x$

(d)  $y = -7x^5 + 3x^2$

(i)  $y = 8x^3 - 5x - 14$

(e)  $y = 6x^4 + 5x$

(j)  $y = 5x + 4x^{\frac{1}{2}}$

2. Differentiate the function  $y = 4x^2 - 8x + 6$  with respect to  $x$  and find the gradient when  $x = -3$ .

3. Find the gradient of the function  $y = 2x^3 + 3x^4 + 12x^{-2}$  when  $x = 2$ .

4. Find  $dy/dx$  for the following:

(a)  $y = 5x + \frac{2}{x^2}$

(e)  $\frac{1}{x^2} + \frac{1}{x} + \frac{1}{\sqrt{x}}$

(b)  $y = 3\sqrt{x}$

(f)  $y = \sqrt[3]{x} + \frac{3}{x}$

(c)  $y = 4x\sqrt{x}$

(g)  $y = 3x^2 - \sqrt[4]{x}$

(d)  $y = 4x^{-2} + 5\sqrt{x}$

(h)  $y = 4x^3 - \sqrt[4]{x^3}$

5. Find the gradient of  $y = 3x^2 - 3x + 2$  when  $x = -2$  and when  $x = +2$ .

6. Is the graph of  $y = 3x^3 - 9x + 2$  steepest at  $x = 1$ ,  $x = 0$ , or  $x = -1$ ?

7. Find  $dy/dx$  for the following:

(a)  $y = 2x(7x^5 + 3x^3)$

(d)  $y = (x - 4)(x + 3)$

(b)  $y = x^2(3x^2 - 2)$

(e)  $y = -x^4 + 3x(x^3 - x)$

(c)  $y = (2x + 3)(x + 1)$

(f)  $y = -2(x + 3)(x - 3)$

8. Find  $dy/dx$  for the following:

(a)  $y = \frac{(x^5 + 3x^3 - 2x^2)}{x}$

(c)  $y = \frac{(4x^6 + 5x^4 - 10x^2)}{2x^2}$

(b)  $y = \frac{(6x^4 - 12x^2)}{3x}$

(d)  $y = \frac{(2x^2 - 2x)}{\sqrt{x}}$

9. Write down a function which, when differentiated, gives  $2x$ .  
Which other functions would also give  $2x$  when differentiated?

10. (a) Differentiate the function  $y = ax^2 - bx + c$

(b) For what value of  $x$  (in terms of  $a$ , and  $b$ ) does the graph of this function have zero gradient?

11. (a) Calculate the gradient of the graph of the function  $y = x^3 - 4x$ , when  
 $x = -2$ ,  
 $x = 0$ ,  
 $x = +2$ .

(b) What do these values tell you about the shape of the curve of  $y = x^3 - 4x$ ?

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1.  $15x^4$ ,  $0$ ,  $12x^2$ ,  $-35x^4 + 6x$ ,  $24x^3 + 5$ ,  
 $12x^3 + 12x$ ,  $2 + x$ ,  $-60x^5 + 6x^2 - 2$ ,  $24x^2 - 5$ ,  $5 + 2x^{-1/2}$

2, 3.  $8x - 8$ ,  $-32$ ;  $117$

4  $5 - 4x^{-3}$ ,  $1.5x^{-1/2}$ ,  $6x^{1/2}$ ,  $-8x^{-3}$ ,  $+ 2.5x^{-1/2}$ ,  
 $2x^3 - x^{-2} - \frac{1}{2}x^{-(3/2)}$ ,  $\frac{1}{3}x^{-3/2} - 3x^{-2}$ ,  $6x - \frac{1}{4}x^{-3/4}$ ,  $12x^2 - \frac{3}{4}x^{-1/4}$ .

5.  $-15$ ,  $9$

7.  $84x^5 + 24x^3$ ,  $12x^3 - 4x$ ,  $4x + 5$ ,  $2x - 1$ ,  $8x^3 - 6x$ ,  $-4x$ .

8.  $4x^3 + 6x - 2$ ,  $6x^2 - 4$ ,  $8x^3 + 5x$ ,  $3x^{1/2} - x^{-1/2}$ .

10, 11.  $2ax - b$ ,  $b/2a$ ;  $8$ ,  $-4$ ,  $8$ .