

## More Differentiation

### Problem Set 17

1. Use the product rule to differentiate the following functions.

(a)  $y = (2x + 1)(5x^2 - 6)$

(c)  $y = (x^9 + 2x^3)x^{-4}$

(b)  $y = 3x^2(4x + 2)$

(d)  $y = (x^4 - 3x^3 + 2x)(x^2 - 2)$

2. Use the quotient rule to differentiate the following functions.

(a)  $y = \frac{x^3}{x + 1}$

(c)  $y = \frac{x^2 + 1}{x^3 + 2x}$

(b)  $y = \frac{x + 4}{3x - 7}$

(d)  $y = \frac{\sqrt{x}}{5x + 2}$

3. Use the chain rule to differentiate the following functions.

(a)  $y = (x^3 + 8)^{10}$

(c)  $y = \sqrt{x^2 + 4x + 1}$

(b)  $y = (7x^3 - 5x - 4)^3$

(d)  $y = \frac{1}{x^5 + x}$

4. Differentiate the function  $f(x) = \frac{1}{\sqrt{(x^3 + 6x)(x^2 + 4)}}$ .

5.  $f(x) = x^2 - 4x + 3$ . Find the intervals on which  $f(x)$  is increasing and decreasing.

6. Find the intervals on which  $f(x) = 5 + 3x^2 - x^3$  is strictly increasing and strictly decreasing.

7. Prove that  $y = (2x - 1)^3$  is an increasing function.

8. Find the stationary points for the following functions.

(a)  $f(x) = x^2 - 4x + 3$

(b)  $f(x) = x^3 - 3x^2 - 9x + 5$

9. For each of the functions in question 8, classify the type of stationary points you found.

10.  $f(x) = 3x^4 - 4x^3 + 5$ . Find the stationary points of  $f(x)$  and use the first derivative test to determine their nature.

11. Let  $y = x^3 - 12x$ . Find the stationary points, classify them and then use this information to sketch the graph of this function.

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Ans: 1a)  $30x^2 + 10x - 12$ , b)  $36x^2 + 12x$ , c)  $5x^4 - 2x^{-2}$ , d)  $6x^5 - 15x^4 - 8x^3 + 24x^2 - 4$ ,  
2a)  $\frac{2x^3 + 3x^2}{(x+1)^2}$ , b)  $\frac{19}{(3x-7)^2}$ , c)  $\frac{-x^4 - x^2 - 2}{(x^3 + 2x)^2}$ , d)  $\frac{2 - 5x}{2\sqrt{x}(5x + 2)^2}$ ,  
3a)  $30x^2(x^3 + 8)^9$ , b)  $3(21x^2 - 5)(7x^3 - 5x - 4)^2$ , c)  $\frac{x+2}{\sqrt{x^2+4x+1}}$ , d)  $\frac{-5x^4-1}{(x^5+x)^2}$