D RULES OF DIFFERENTIATION

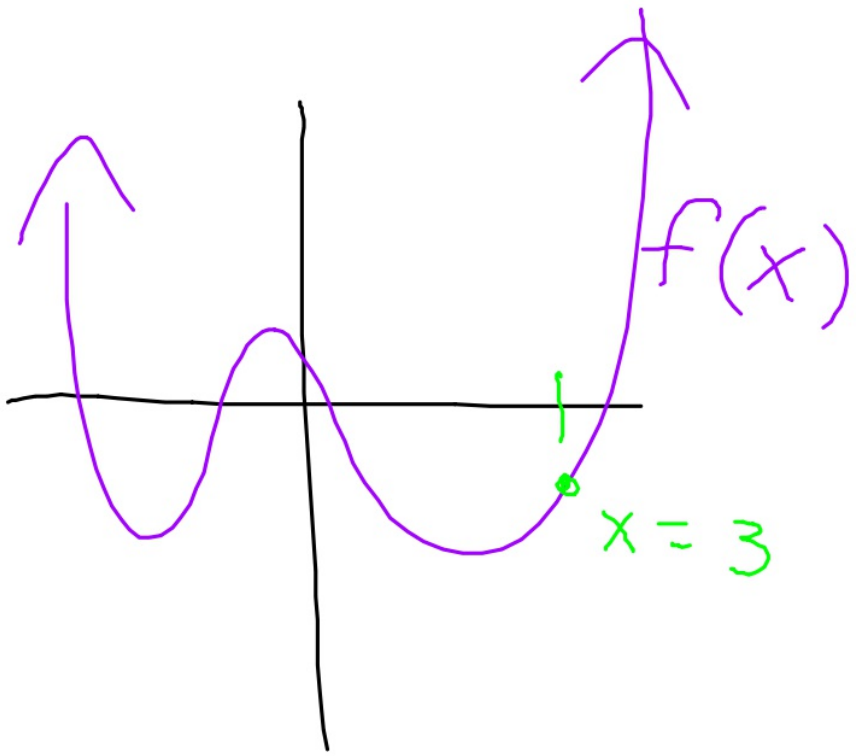
Differentiation is the process of finding a derivative or gradient function.

We have now determined the following rules for differentiating:

Function	$f(x)$	$f'(x)$
a constant	a	0
x^n	x^n	nx^{n-1}
a constant multiple of x^n	ax^n	anx^{n-1}
multiple terms	$u(x)+v(x)$	$u'(x)+v'(x)$

$f(x) = 3x^4 + 2x^3 - 5x^2 + 7x + 6$ then

$f'(x) = 12x^3 + 6x^2 - 10x + 7$



Find $f'(x)$ for $f(x)$ equal to:

$7x - \frac{4}{x} + \frac{3}{x^3}$

$f(x) = 7x - 4x^{-1} + 3x^{-3}$

$f'(x) = 7 + 4x^{-2} - 9x^{-4}$

$7 + \frac{4}{x^2} - \frac{9}{x^4}$

$\frac{x^2 + 4x - 5}{x}$

$\frac{x^2}{x} + \frac{4x}{x} - \frac{5}{x}$

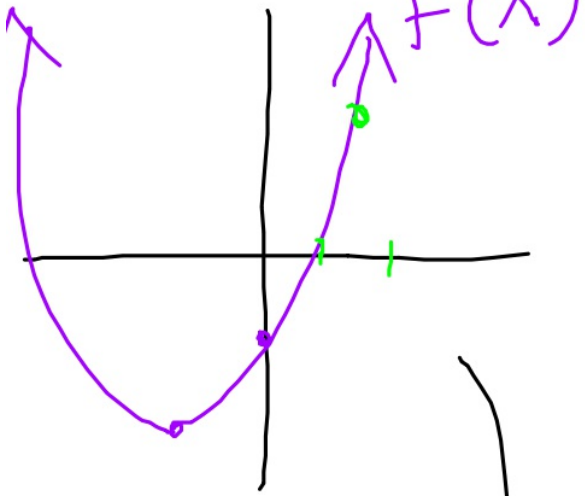
- rewrite as multiple fractions
- simplify
- differentiate

$x + 4 - 5x^{-1}$

$f'(x) = 1 + 5x^{-2}$

$f'(x) = 1 + \frac{5}{x^2}$

At what point on the graph of $y = 2x^2 + 5x - 3$ does the tangent have gradient 13?



set the derivative equal to 13

$y' = 4x + 5$

$13 = 4x + 5$

$-5 \quad -5$

$8 = 4x$

$2 = x$

$(2, 15)$

$y = 2(2)^2 + 5(2) - 3$

At what point on the graph of $y = x^2 - 4x + 7$ does the tangent have gradient 2?

$y' = 2x - 4$

$2 = 2x - 4$

$x = 3$

$y = 3^2 - 4(3) + 7$

$(3, 4)$

The tangent to $f(x) = 2x^2 - ax + b$ at the point (2, 7) has a gradient of 3.

Find a and b.

$f'(x) = 4x - a$

$3 = 4(2) - a$

$a = 5$

$7 = 2(2)^2 - 5(2) + b$

$7 = -2 + b$

$b = 9$

The tangent to $f(x) = x^3 + ax + 5$ at the point where $x = 1$, has a gradient of 10. Find a.

$f(x)' = 3x^2 + a$

$10 = 3(1)^2 + a$

$10 = 3 + a$

$-3 \quad -3$

$7 = a$

Assignment:

Exercise 20D

3, 5, 6, 8, 9, 11a-c, 13, 14