# MATH 100 – WORKSHEET 5
## THE DERIVATIVE

### 1. DERIVATIVES BY DEFINITION

**Definition.** $f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$

(1) Find $f'(a)$ if
  (a) $f(x) = x^2$, $a = 3$.

  (b) $f(x) = x^3 - 2x$, any $a$. (you may use $(a+h)^3 = a^3 + 3a^2h + 3ah^2 + h^3$)

  (c) $f(x) = \frac{1}{x}$.

(1) If $f, g$ are functions and $a, b$ are numbers then $(af + bg)' = af' + bg'$

(2) $\frac{\mathrm{d}}{\mathrm{d}x}(x^r) = rx^{r-1}$          (3) $\frac{\mathrm{d}}{\mathrm{d}x}(e^x) = e^x$.

(1)

(a) Differentiate $f(x) = \frac{5x^3 - 2x + 1}{\sqrt{x}}$.

(b) Let $g(x) = Ax^{5/2} + x^2$. Suppose that $g'(4) = 0$. What is $A$?

(2) Find the *second* derivative of

(a) $5e^x$

(b) $\sqrt{x} + 5e^x$

(3) The line $y = 5x + B$ is tangent to the curve $y = x^3 + 2x$. What is $B$?