

# Derivatives - Part 1

## Revision Sheet for Limits; Practice for Derivatives

Q1. Find the limits of the expressions below (review the last class recording)

a.  $\lim_{x \rightarrow 3} (3 + |x - 3|)$

d.  $\lim_{x \rightarrow 0} \left( \frac{1 - \cos(x)}{2x^2} \right)$

f.  $\lim_{x \rightarrow \infty} \left( \frac{3x^2 + 3x + 2}{5x^2 - x - 2} \right)$

b.  $\lim_{x \rightarrow 0} \left( \frac{\sqrt{x^2 + 64} - 8}{x^2} \right)$

e.  $\lim_{x \rightarrow -1} \left( \frac{x^2 + 3x + 2}{x^2 - x - 2} \right)$

g.  $\lim_{x \rightarrow \infty} (x \sin(1/x))$

c.  $\lim_{x \rightarrow 8} \left( \frac{x - 8}{\sqrt{x + 1} - 3} \right)$

Q2. Find the first-derivative of each the following expressions, with respect to x:

a.  $f(x) = \cos(x^2) + \sin(\sqrt{x})$

*[Hint: revise all the rules of the derivatives, including the chain rule]*

b.  $f(x) = \sin(x - \sin(x^2))$

c.  $f(x) = \sqrt{x^2 + 9}$

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

e.  $f(x) = \sin^{-1}(x)$  *[Hint: Let  $y = f(x)$ ; thus  $\sin(y) = x$ ; Now differentiate both sides w.r.t.  $X$ ]*

Q3. Find the first-derivative of each the following expressions, with respect to  $x^2$ :

A.  $f(x) = \cos(x^2)$

B.  $f(x) = \sqrt{x^2 + 9}$

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

D.  $f(x) = \sin(x)$  *[Hint: Let  $x^2 = u$ ; Use chain rule to express  $\frac{df(x)}{du}$  as  $\frac{df(x)}{dx} \times \frac{dx}{du}$ ]*

Q4. Find the first and second derivatives,  $\frac{dy}{dx}$  and  $\frac{d^2y}{dx^2}$  for each, based on the constraints

given:

a.  $x^2 + y^2 = 16$

b.  $x^2 - y^2 = 20$

c.  $x^2 + y^2 + 2xy + 8x + 6y = 0$

d.  $\frac{16}{x^2} + \frac{16}{y^2} - \frac{1}{xy} = 0$