Last name:(blockletters)_____ **First/Given Name:**_____

Student Number:_____

MATH 121 - TEST 1 (Based on Assignments 1, 2, and 3)
Version 1A Fall 2010

This test consists of 3 questions to be answered in the space provided.
Show all work and give explanations when needed.

1. (a) One of the functions in the following table could be **linear**. Identify that function, and give a possible formula for it.
   (b) One of the functions in the following could be **exponential**. Identify that function, and give a possible formula for it.

x	-2	-1	0	1	2
$f(x)$	12	15.5	18	20	19
$g(x)$	4	6	9	13.5	20.25
$h(x)$	13	10.5	8	5.5	3

incr & decr: neither linear nor exp'l

x 1.5 each step

−2.5 −2.5 −2.5

a) h(x) is linear: it has the same change (Δh) for every step (Δx) in x

formula:

$h = mx + b$

Intercept is $\boxed{b = 8}$ at $x = 0$

slope is -2.5 $\left(\frac{\Delta h}{\Delta x}\right)$

so $\boxed{h(x) = -2.5x + 8}$ is a possible formula for h(x).

b) g(x) is exponential

formula:

$g(x) = g_0 e^{kx}$

or $g_0 a^x$

Using $g(x) = g_0 a^x$,

at $x = 0$, $g = 9$, so $\boxed{g_0 = 9}$

at $x = 1$, $g = 13.5$, so

$13.5 = 9a^1$

$a = \frac{13.5}{9} = 1.5$

so $\boxed{g(x) = 9(1.5)^x}$

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2. (a) Use algebraic manipulations to evaluate

$$\lim_{x\to\infty} \frac{3x^3 - 2x + 1}{2x^2 - 4}$$

(b) Find all values of k for which the limit below exists.

$$\lim_{x\to\infty} \frac{3x^k - 2x + 1}{2x^2 - 4}$$

a) $\lim_{x\to\infty} \frac{3x^3-2x+1}{2x^2-4} \overset{1/x^3}{=} \lim_{x\to\infty} \frac{3-2/x^2+1/x^3}{2/x-4/x^3} \to \frac{3}{0} \to \infty$

This limit does not exist

b) $\lim_{x\to\infty} \frac{3x^k-2x+1}{2x^2-4} \overset{1/x^2}{=} \lim_{x\to\infty} \frac{3x^k/x^2 - 2/x + 1/x^2}{2-4/x^2}$

$= \lim_{x\to\infty} \frac{3\frac{x^k}{x^2}}{2}$

If $K > 2$, then $\lim_{x\to\infty} \frac{x^k}{x^2} \to \infty \Rightarrow$ limit DNE

" $K = 2$, " " $\frac{3\frac{x^2}{x^2}}{2} \to 3/2 \Rightarrow$ limit exists

" $K < 2$, " " $\frac{3}{2}\frac{x^k}{x^2} \to 0 \Rightarrow$ limit exists

The limit exists if $K \leq 2$

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3. Evaluate the following derivatives. You do not need to simplify the result.

   (a) $\frac{d}{dx}\left(x^8 + 8\sin(x)\right)$

   (b) $\frac{d}{dx}\left(\ln(4x^2)\right)$

   (c) $\frac{d}{dx}\arctan(x)$

a) $8x^7 - 8\cos(x)$

b) $\frac{1}{4x^2} \cdot 8x = \frac{2}{x}$

c) $\frac{d}{dx}\arctan(x) = \frac{1}{1+x^2}$