Pre-Calculus A 120 **Name:**_____
Midterm **November 2018**

Show all work for each of the following in the space provided. **[TOTAL: 68 Marks]**

1. Complete the chart and sketch **one** full cycle for the functions in the space provided below. Be sure to **clearly label** and scale both axes on your graphs. [15]

$$-3(y-2) = 12cos(3\vartheta - 30°) + 9$$

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	
MAPPING NOTATION	

Sketch→

2. The base function $f(x) = \sqrt{x}$ is transformed into a new function $g(x)$. The following transformations are applied:

Reflected in the y-axis, stretched horizontally by a factor of 3, stretched vertically by a factor of 4 and translated 1 unit to the left and 6 units up.

(a) Write an equation using function notation $g(x) = a\ f[b(x+c)]+d$ of the transformed function $g(x)$. [4]

(b) Write a mapping rule that would transform the graph of $f(x)$ into the graph of $g(x)$. [4]

(c) Given that the ordered pair (9 , 3) lies on the graph of $f(x)$, what are the coordinates of this point on the graph of $g(x)$? [2]

(d) Without using the ordered pair from part (c), determine the coordinates of an ordered pair that would fall on the on the **inverse** of $g(x)$? [2]

3. Given that $f(x) = \sqrt{3-x}$, $g(x) = x^2 - 1$, $and\ w(x) = 1 - 3x$…

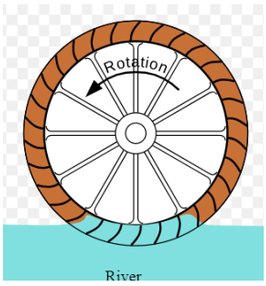
(a) Evaluate: $(g \circ w \circ f)(-6)$ [4]

(b) Determine an expression in simplest form for $\dfrac{g(2a-h)-g(2a)}{(3h)w(1)}$ [4]

4. The picture below depicts a waterwheel that was used to power a sawmill back in the late 1800s. The wheel has a radius of 3.5 m and is set up in such a manner that the blades on the wheel rotate and reach a depth of 1 m **below** the surface of the water. As the blades are rotated by the water, a clever young Mathematician follows the path of one of the blades and records the following data:
   - Blade is located at its lowest point at 2.4 s and the same blade reaches its highest point at 4.2 s

(a) Draw a sketch that depicts the height above the water of this particular blade of the waterwheel at any time in seconds. ***Be sure the graph is clearly labeled and scaled***!

[4]



(b) Determine a function *h(t)* that would determine the height above the ground in metres of the blade at any time in seconds. [4]

(c) Determine the height above the water (or below the water) of this particular blade 2 minutes and 13 seconds after the young Mathematician began recording data. [2]

(d) Determine the angular velocity in radians per second of this waterwheel. [2]

(f) Determine the **first three instances** that this particular blade being examined by the young Mathematician would have been located at a height of 3.4 m above the water. [5]

5. Evaluate the following expression without using a calculator: (***Sketch must be provided for each angle***) [12]

$$\sin\left(\frac{19\pi}{6}\right) - \tan^2\left(\frac{31\pi}{3}\right)\sec(47\pi) + \sin^2\left(-\frac{37\pi}{4}\right) + 5\csc\left(-\frac{23\pi}{2}\right)$$