Directions: You have 90 minutes to answer the following questions. You must show all your work as neatly and clearly as possible and indicate the final answer clearly. You may use a calculator. You may choose to have only 8 problems (each worth 12 points) graded or 9 problems (each worth 11) graded or 10 problems (each worth 10) graded. For example if you do not want to have Problem 6 graded, you MUST put an “X” in the points section of Problem 6. In this case, all other problems will be worth 11 points each and you can score a maximum of $9 \times 11 = 99$ points.

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<th>Problem</th>
<th>Possible</th>
<th>Points</th>
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<td><strong>Total</strong></td>
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</table>
(1) (Page 214, Example 1) Let \( f(x) = \sin(x) \) and \( p(x) = -A \sin(2x) - k \) where \( A \), and \( k \) are positive constants. Circle all correct answers.

(I) The graph of \( p \) can be obtained by stretching \( f \) horizontally by a factor of \( A \), reflecting it about the \( x \)-axis, shifting it 2 units left and shifting it up by \( k \) units.

(II) The graph of \( p \) can be obtained by stretching \( f \) horizontally by a factor of \( A \), reflecting it about the \( y \)-axis, shifting it 2 units left and shifting it down by \( k \) units.

(III) The graph of \( p \) can be obtained by stretching \( f \) horizontally by a factor of 2, stretching it vertically by a factor of \( A \), reflecting it about the \( x \)-axis, and shifting it up by \( k \) units.

(IV) The graph of \( p \) can be obtained by compressing \( f \) horizontally by a factor of \( 1/2 \), stretching it vertically by a factor of \( A \), reflecting it about the \( x \)-axis, and shifting it down by \( k \) units.

(V) The period of \( p \) is \( \pi \).

(VI) The period of \( p \) is \( 2\pi \).

(VII) The midline of \( p \) is \( y = 0 \).

(VIII) The midline of \( p \) is \( y = -k \).

(IX) The amplitude of \( p \) is 2.

(X) The amplitude of \( p \) is \( -A \).
(2) Determine which of the functions given in the table below is linear, exponential or neither. Find formulas for the linear and exponential function. You must show your work.

<table>
<thead>
<tr>
<th></th>
<th>f(x)</th>
<th>g(x)</th>
<th>h(x)</th>
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<tbody>
<tr>
<td>−2</td>
<td>4</td>
<td>48</td>
<td>20/3</td>
</tr>
<tr>
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<td>1</td>
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<td>16/3</td>
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<tr>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3/4</td>
<td>8/3</td>
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</table>
(3) (Worksheet II) Find exact solutions for each of the following equations. If possible, you must simplify your answer.

(a) $5.3(1.7)^{2x} = 4(9.4)^{7x}$

(b) $2 \cdot 16^z = 15 - 7 \cdot 4^z$
(4) (Worksheet IV & V) For each part (a)–(d), circle the correct choice.

(a) The function given by \( h(x) = \frac{1 + x^2}{x - x^3} \) is:

- even
- odd
- neither

(b) The function given by \( h(x) = -3x^3 + \tan(x) \) is:

- even
- odd
- neither

(c) The range of the function given by \( g(x) = \sqrt{a - x} + b \) is:

- (i) \([a, \infty)\)
- (ii) \([b, \infty)\)
- (iii) \([0, \infty)\)
- (iv) \((-\infty, a]\)
- (v) \((-\infty, b]\)

(d) The domain of the function \( h(x) = \ln(3x^2) \) is:

- (i) \([1/\sqrt{3}, \infty)\)
- (ii) \((0, \infty)\)
- (iii) \((-\infty, 0) \cup (0, \infty)\)
- (iv) \((-\infty, \infty)\)
- (v) \((-\infty, 0)\)
(5) (Page 252, Problem 18) A beetle starts at the point \((0, -3)\) on the circle of radius 3 centered at the origin and walks clockwise a distance of 10 units around the circle.

(a) Give an angle in radians which represents the beetle’s final position relative to its starting position.

(b) Find the \(x\) and \(y\) coordinates (accurate to two decimal places) of the final position of the beetle.
(6) (Page 222, Problem 14) Find the formula for the quadratic function \( g \) that contains the following points \((3, 18), (0, 15)\) and \((-2, -7)\). You must show your work.
(7) (Page 236, Problem 7) Suppose you are on a ferris wheel (that turns in a counterclockwise direction) and that your height, in meters, above the ground at time, $t$, in minutes, is given by

$$h(t) = 25 \cos \left( \frac{\pi}{7} t \right) + 8.$$

(a) How high above the ground are you at time $t = 0$?

(b) What is your position on the wheel at $t = 0$? (That is, what o’clock?)

(c) What is the diameter of the wheel?

(d) How long does one revolution take?

(e) At what height above the ground are you when you are at 6 o’clock position?
(8) (Worksheet V)
(a) If \( h(t) = 2^t \), find a formula for the new function \( p(t) \) that results when \( h \) is shifted horizontally by 5 units to the left, horizontally compressed by a factor of 1/3 and then reflected about the \( y \) axis.

(b) Find any intercepts of your formula for \( p \).
(9) (Page 225, Problem 40) If an astronaut on the Moon were to throw a ball upwards, the height, $h$ (in meters), of the ball after $t$ seconds in the air would be given by:

$$h(t) = 2 + 0.64t - 0.08t^2.$$ 

What is the approximate maximum height (accurate to two decimal places) that the ball reached during its flight? (You must use the technique of completing the square to solve this problem and must show your work.)
(10) (Page 152, Problem 22) Suppose 2 mg of a certain drug is injected into a patient’s bloodstream. As the drug is metabolized, the quantity diminishes at the continuous rate of 3.8% per hour. Suppose the patient must receive an additional 2 mg of the drug whenever its level has diminished to 0.25 mg. When must the patient receive the third injection?