Instructions:

- You have 55 minutes to complete this exam. It consists of 10 questions on 8 pages including this cover sheet and is worth a total of 100 points. The value of each question is listed below and with each question. Partial credit might not be awarded on some questions.

- You may not use any books, notes or self-supplied scratch paper during this exam.

- Calculators are permitted EXCEPT those calculators that have symbolic algebra or calculus capabilities. In particular, the following calculators and their upgrades are not permitted: TI-89, TI-92, and HP-49. In addition, neither PDAs, laptops nor cell phones are permitted.

- Make sure to read each question carefully.

- Please write clearly and make sure to justify your answers. Correct answers with no supporting work may receive no credit. If you find a solution to a problem using a graph from your calculator (where appropriate), you need to sketch that graph and label all relevant information.

- Unless otherwise specified, make sure your answers are in exact form (i.e. not decimal approximations).

- Make sure to circle your answers.

- A random sample of graded exams will be xeroxed before being returned.

<table>
<thead>
<tr>
<th>Question:</th>
<th>(1)</th>
<th>(2)</th>
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<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>Total</th>
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<tbody>
<tr>
<td>Points:</td>
<td>9</td>
<td>6</td>
<td>14</td>
<td>8</td>
<td>7</td>
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</table>
(1). Suppose that \( f(x) = 5x^2 - 20x + 3 \)

(a) (7 points) Write \( f(x) \) in vertex form.

(b) (2 points) Identify the vertex.

(2). The following questions concern revenue.

(a) (2 points) Suppose that a manufacturer is able to sell \( n(p) = 80 - 3p \) items when the unit price (in dollars) is \( p \). Find a formula for the revenue \( R(p) \) if the unit price is set at \( p \) dollars.

(b) (4 points) Suppose that the revenue (in dollars) for selling \( q \) laptops is given by \( R(q) = 195 + 30q - q^2 \). Find the number of laptops sold which will maximize the revenue.
3. The graph of the function $h$ is given below.

(a) (4 points) Use interval notation to write the intervals over which $h$ is increasing.

(b) (4 points) Use interval notation to write the intervals over which $h$ is decreasing.

(c) (4 points) Identify the location and value of any relative maximums of $h$.

(d) (2 points) Identify the location and value of any relative minimums of $h$.

4. Use the following table of values for $f$ and $g$ to find the value of the indicated expressions (indicate if the given expression is undefined)

<table>
<thead>
<tr>
<th>$x$</th>
<th>-2</th>
<th>-1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x)$</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>-3</td>
<td>10</td>
</tr>
<tr>
<td>$g(x)$</td>
<td>4</td>
<td>-4</td>
<td>8</td>
<td>5</td>
<td>-5</td>
<td>3</td>
</tr>
</tbody>
</table>

(a) (2 points) $(f \circ g)(2) =$ ______

(b) (2 points) $(f \cdot g)(3) =$ ______

(c) (2 points) $(g \circ f)(2) =$ ______

(d) (2 points) $\left(\frac{g}{f}\right)(-1) =$ ______
(5). (7 points) Divide the following polynomials. Note: synthetic division will not work.

\[
\frac{3x^3 - 4x^2 + 2x - 5}{x^2 + 2}
\]

Quotient polynomial = \( Q(x) = \) ________________

Remainder polynomial = \( R(x) = \) ________________

(6). (9 points) A soccer ball is hit from the ground and lands 12 meters away from where it was hit. Furthermore, it reached a maximum height of 9 meters during its travel. Assuming that the path of the ball is a parabola (ignoring air resistance), find a quadratic function to model the height of the ball when it has traveled \( x \) meters horizontally.
(7). The graph of the polynomial $g$ is given below

(a) (6 points) List the roots of $g$ and circle the correct answer whether their multiplicities are odd or even.
   (note: not all spaces may be filled in)

   root: $x =$ ______  multiplicity: ODD / EVEN
   root: $x =$ ______  multiplicity: ODD / EVEN
   root: $x =$ ______  multiplicity: ODD / EVEN
   root: $x =$ ______  multiplicity: ODD / EVEN

(b) (1 point) Circle the correct answer: Is the leading coefficient of $g$ positive or negative?

   Leading coefficient: POSITIVE / NEGATIVE

(c) (1 point) Circle the correct answer: Is the degree of $g$ odd or even?

   Degree: ODD / EVEN
(8). Suppose that

\[ P(x) = x^3 + 4x^2 - 7x - 10 \]

(a) (5 points) Find a polynomial \( Q(x) \) such that \( (x - 2)Q(x) = P(x) \) using polynomial division.

(b) (5 points) Find a polynomial \( S(x) \) such that \( (x + 5)S(x) = P(x) \) using polynomial division.
(9). Given the rational function \( r(x) = \frac{(x + 1)^2}{(x + 3)(x - 4)^2} \).

(a) (2 points) Find the y-intercept(s), state if there are none.

(b) (3 points) Find the x-intercept(s), state if there are none.

(c) (2 points) Find the equation of any vertical asymptotes.

(d) (3 points) Find the equation of any horizontal asymptotes.

(e) (8 points) Sketch a graph of \( r \), making sure to plot and label all information from parts (a)-(d).
(10). The piecewise defined function $P(x)$ is given by:

$$P(x) = \begin{cases} 
-2 & \text{if } x < -4 \\
-x^2 - 8 & \text{if } -4 \leq x < 2 \\
x - 5 & \text{if } x \geq 2 
\end{cases}$$

(a) (4 points) Find the following:

(i). $P(-5) = \underline{\quad}$  
(ii). $P(-2) = \underline{\quad}$  
(iii). $P(2) = \underline{\quad}$  
(iv). $P(7) = \underline{\quad}$

(b) (7 points) Plot and label your points from part (a) and then sketch the graph of $y = P(x)$. 

[Graph with labeled axes and grid]