Mathematics 116 first part of take-home portion of test two
due Monday, May 17, 2010
please show your work in order to get full credit

1. For the quadratic function \( y = f(x) = 2x^2 + 8x - 3 \)
   
   (a) Simplify the expression \( f(-x) + f(x) \)

   (b) Simplify the difference quotient \( \frac{f(x + h) - f(x)}{h} \)

   (c) Simplify the expression \( \frac{f(x + h) - 2f(x) + f(x - h)}{h^2} \)

2. The U.S. Food and Drug Administration lists the following RDI’s (reference daily intakes) for the antioxidants vitamin C, vitamin E, and zinc:

   Vitamin C: 60 mg  Vitamin E: 30 mg  Zinc: 15 mg

Suppose that you have three brands of dietary supplements on your shelf. Among other ingredients, all three contain the antioxidants mentioned above. The amounts of these antioxidants in each supplement are indicated in the following table. How many ounces of each supplement should you combine to obtain the RDI’s for vitamin C, vitamin E, and zinc?

<table>
<thead>
<tr>
<th>Vitamin C (mg/oz)</th>
<th>Vitamin E (mg/oz)</th>
<th>Zinc (mg/oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>supplement I</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>supplement II</td>
<td>5</td>
<td>1.25</td>
</tr>
<tr>
<td>supplement III</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

3. A transit agency assumes that there is a linear relation between the number of riders and the fare. When the fare was $1.20, the daily number of riders was 500,000, and when the fare was raised to $1.50, the daily number of riders was only 450,000. What fare would maximize the revenue?

4. Sketch the following non-linear system, and find all solutions:

\[
\begin{align*}
  y &= x^2 - 8x - 9 \\
  y &= 8(x - 9)
\end{align*}
\]

5. Given the points \( P(-1, 1), Q(1, 3) \) and \( R(3, 2) \), find a parabola which contains the three points \( P, Q, \) and \( R \). Do this by finding constants \( A, B, \) and \( C \) so that the parabola equation \( y = Ax^2 + Bx + C \) is satisfied by the coordinates of the three points. Then calculate the vertex of the parabola and sketch the parabola and the three points. (see the next page for problem six)
6. During each month, the Philadelphia and Denver mints each make differing numbers of pennies, nickels, dimes, and quarters. The number of each is summarized in the table:

<table>
<thead>
<tr>
<th></th>
<th>pennies</th>
<th>nickels</th>
<th>dimes</th>
<th>quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philadelphia</td>
<td>100</td>
<td>40</td>
<td>32</td>
<td>30</td>
</tr>
<tr>
<td>Denver</td>
<td>40</td>
<td>30</td>
<td>60</td>
<td>150</td>
</tr>
</tbody>
</table>

Over a period of several months, it is desired to produce at least 800 pennies, 480 nickels, 480 dimes, and 600 quarters. Find how many months each mint should operate to minimize total costs of production if

(a) the Philadelphia mint costs $10 a month and the Denver mint costs $8 a month to operate

(b) the Philadelphia mint costs $6 a month and the Denver mint costs $12 a month to operate

(all units are in millions in this problem)
(fractions of a month are OK as answers)