Name:
E-mail:

All questions must be answered on this test form!
For each question you must show your work and (or) provide a clear argument.
If you need scratch paper, use the last pages and the back of the form.

Question 1 A utility function is given by \( u(x_1, x_2) = x_1 x_2 \). Originally, prices are \( p_1 = p_2 = 1 \) and wealth is \( w = 360 \) but increase to \( p_1 = 4 \) and \( p_2 = 9 \). Then 15 points

The equivalent variation is given by \( EV = \)

(Recall that \( e(p, u) = 2 \sqrt{up_1 p_2} \).)
Question 2  Suppose that an expenditure function is given by $e(p_1, p_2, u) = p_1u^2$. Specify two different utility functions that generate this expenditure function. One of the utility functions must be convex and monotone. 

The quasiconcave & monotone utility function is $u(x_1, x_2) =$

The other utility function is $u(x_1, x_2) =$

14 points
**Question 3** Let $X = \{a, b, c, d\}$ and suppose that a choice structure is given by

$$\mathcal{B} = \{\{a, b, c\}, \{a, b\}, \{a, c, d\}\},$$

and

$$C(\{a, b, c\}) = \{c\}, \ C(\{a, b\}) = \{a\}, \ C(\{a, c, d\}) = \{c\}.$$

Specify two different preference orderings (for which preferences between any two choices are strict) that rationalize these preferences.

**Preferences 1:** (Insert $\succ$ or $\preceq$)

\[
\begin{array}{cccccccc}
  a & b & a & c & a & d & b & c \\
  b & c & b & d & c & d & a & c \\
\end{array}
\]

**Preferences 2:** (Insert $\succ$ or $\preceq$)

\[
\begin{array}{cccccccc}
  a & b & a & c & a & d & b & c \\
  b & c & b & d & c & d & a & c \\
\end{array}
\]
**Question 4** Suppose that a utility function is given by

\[
u(x_1, x_2) = \begin{cases} 
x_1 + x_2 & \text{if } x_1 + x_2 < 10; \\ 10 & \text{if } 10 \leq x_1 + x_2 \leq 20; \\ x_1 + x_2 - 10 & \text{if } 20 < x_1 + x_2. 
\end{cases}
\]

Suppose that prices are \(p_1 = 1, \ p_2 = 2\). Find a numerical value for wealth, \(w\), such that a (particular) solution, \(x^*_U\), of the utility maximization problem given \(w\) does not correspond to a (particular) solution, \(x^*_E\), of the expenditure minimization problem where the required utility in the expenditure minimization problem is \(u = u(x^*_U)\).  

12 points

\[
\begin{array}{c}
w = \quad , \quad x^*_U = ( \quad , \quad ), \quad x^*_E = ( \quad , \quad )
\end{array}
\]
Question 5 Suppose a utility function is given by \( u(x_1, x_2) = \min\{2x_1, 4x_2\} \). Then

\[
e(p, u) =
\]
Question 6  An indifference curve providing utility $u = 5$ for a monotone and homothetic preference relation is depicted below.

In the box below, describe the set of all prices at which the expenditure function $e(p, u)$ is not differentiable:  

A monotone and quasiconcave utility function that generates exactly the same expenditure function is $u(x_1, x_2) =$
**Question 7** A utility function is given by $u(x_1, x_2) = \min\{2x_1 + x_2, x_1 + 2x_2\}$. Then (in the following Walrasian demand is denoted as usual by $x(p_1, p_2, w)$)

<table>
<thead>
<tr>
<th>$x(p_1, p_2, w)$</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x(2, 2, 20)$</td>
<td>(     ,   )</td>
</tr>
<tr>
<td>$x(2, 3, 60)$</td>
<td>(     ,   )</td>
</tr>
<tr>
<td>$x(2, 5, 60)$</td>
<td>(     ,   )</td>
</tr>
<tr>
<td>$x(2, 10, 60)$</td>
<td>(     ,   )</td>
</tr>
<tr>
<td>$x(5, 3, 60)$</td>
<td>(     ,   )</td>
</tr>
</tbody>
</table>
**Question 8** Suppose that the consumption set is $X = \mathbb{R} \times \mathbb{R}_+$. An expenditure function is given by

$$e(p,u) = \frac{p_1(u p_2 - p_1)}{p_2}.$$ 

Then

$$x_1(p,w) =$$

(Note: The algebra in this question can take more time)