Question 1 Suppose that demand is linear. At a price of $P = 10$, demand is $Q = 40$ and the price elasticity of demand is $-0.4$. Therefore

The demand function is $Q_D(P) =$  

10 points

Question 2 Suppose you have the following information about demand and supply

<table>
<thead>
<tr>
<th>Price</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_D$</td>
<td>100</td>
<td>90</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>$Q_S$</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>

Then the equilibrium price is between $P =$ and $P =$  

2 points

The price elasticity of supply at $P = 4$ is  

4 points

The price elasticity of demand at $P = 5$ is  

4 points
Question 3 The demand and supply curve for a product is given by $Q_D(P) = 100 - 2P$ and $Q_S(P) = 20 + 3P$. Thus, the equilibrium price and quantity are

\[
P = \quad \text{, } Q = \quad 5 \text{ points}
\]

Now suppose that the government provides a subsidy of 2 Dollars to producers, i.e., if consumers pay $P$ then producers receive $P + 2$ for the product. The new equilibrium price and quantity are

\[
P = \quad \text{, } Q = \quad 5 \text{ points}
\]
**Question 4** Consider the indifference curves depicted below. For a particular choice of prices and income, one of the goods is a Giffen good.

10 points

1. Graph two budget lines (they must share either the vertical intercept or the horizontal intercept) that demonstrate that one of the goods is a Giffen good.

2. Clearly indicate the two optimal consumption choices in the graph.
**Question 5** A person’s utility function is given by \( u(x_1, x_2) = \min\{2x_1 + 4x_2, 4x_1 + x_2\} \).

1. Suppose prices are \( p_1 = 2, p_2 = 1 \) and \( I = 24 \). Determine the optimal consumption graphically, by drawing the budget line and the indifference curve through the optimal consumption point.

   The optimal consumption is \( x_1 = \), \( x_2 = \)

2. Now suppose the price of good 2 increases to \( p_2 = 6 \), but the person’s income is increased to \( \tilde{I} \) such that the person is equally well off. Graph the budget line and indicate the optimal consumption in the graph.

   Income \( \tilde{I} = \)

12 points
Question 6 Two friends A, and B live in different cities a and b. For simplicity suppose they consume only two goods, but the prices of the two goods differ. The prices of the two goods are \( p_1 = 2, p_2 = 4 \) in city A and \( p_1 = 5 \) and \( p_2 = 1 \) in city B. Both have an income of \( I = 40 \). The two friends discuss their consumption habits. It turns out that A cannot afford B’s consumption in city a and B could not afford A’s consumption in city b. Nevertheless, it turns out that each is strictly better off where they are and would not want to change places with the other person. In the grid below, graph the budget lines, optimal consumption choices and indifference curves for A and B that are compatible with this information.  

12 points
Question 7 A person’s utility function is given by \( u(x_1, x_2) = 2x_1 + x_2 \).

(a) Suppose income is \( I = 120 \) and prices are \( p_1 = 4, \ p_2 = 6 \). Then optimal consumption is (Note: A sketch of indifference curves and the budget line may help you answer the question).  

\[
\begin{align*}
x_1 &= \text{ } \\
x_2 &= \text{ }
\end{align*}
\]

4 points

(b) Consider another consumer who has perfect substitute preferences. Prices are the same as in (a), but income may be different. The person optimal consumption is (10, 10). A perfect substitutes utility function that is compatible with this behavior is given by  

\[
\begin{align*}
  u(x_1, x_2) &= \\
\end{align*}
\]

4 points

(c) Another individual has perfect complements preferences. The person’s income is \( I = 180 \), prices are the same as in (b). The person consumes 30 units of good 1. A perfect complements utility function that is compatible with this behavior is given by  

\[
\begin{align*}
  u(x_1, x_2) &= \\
\end{align*}
\]

4 points
Question 8 Solve the following optimization problem graphically. You must clearly indicate the feasible set by shading, and you must graph at least three lines, representing the objective, including the one through the solution. 12 points

\[ \min_{x_1, x_2} 2x_1 + x_2, \text{ subject to } (i) \ x_1 - 2x_2 \geq 10, \ (ii) \ x_1 + x_2 \geq 30, \ (iii) \ x_1 \geq 0, \ (iv) \ x_2 \geq 0. \]

The solution is \( x_1 = \) \( x_2 = \)
Question 9 Solve the following optimization problem graphically. You must clearly indicate the feasible set by shading, and you must graph at least three lines, representing the objective, including the one through the solution.

\[ \text{max}_{x_1, x_2} 2x_1 + 3x_2, \text{ subject to } \]
\[ (i) \ 2x_1 \leq x_2, \quad (ii) \ x_1 + x_2 \leq 21, \quad (iii) \ x_1 \leq 10, \quad (iv) \ x_2 \geq 6, \quad (v) \ x_1 \geq 0. \]

The solution is \( x_1 = \) \( x_2 = \)