Answer the following questions. Please make any necessary assumptions for those questions whose information is not sufficient for you to find out the solutions.

1. Suppose there are \(N\) firms, and firm \(i\)'s cost function can be represented as:

\[
C_i(y_i) = \frac{y_i^2}{2i} + 2, \quad i = 1, \ldots, N
\]

And there are also \(N\) consumers in the market, whose utility function and budget constraints are as the following:

\[
U_i(y_i, x_i) = \sqrt{y_i x_i}, \quad i = 1, \ldots, N.
\]

\[
P_y y_i + P_x x_i = 2i.
\]

\(x_i\) refers to the consumer's demand on other goods, and consumer \(i\) has income \(2i\).

Answer the following questions:

a. (5%) Calculate the marginal cost, variable cost, and average cost functions for firm \(i\).

b. (10%) Derive the industry supply curve.

c. (10%) Derive the market demand function.

d. (5%) What are the equilibrium price and quantity?

2. Two firms (A and B) are considering bringing out competing brands of a healthy cigarette. Payoffs to the companies are as follows (A's profits are given first).

<table>
<thead>
<tr>
<th></th>
<th>Firm B</th>
<th>Produce</th>
<th>Don't Produce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm A</td>
<td>Produce</td>
<td>3,3</td>
<td>5,4</td>
</tr>
<tr>
<td></td>
<td>Don't Produce</td>
<td>4,5</td>
<td>2,2</td>
</tr>
</tbody>
</table>

a. (10%) Does this game have any Nash equilibrium? Please explain.

b. (10%) Does this game present any first-mover advantages for either firm A or firm B?

c. (10%) Would firm B find it in its interest to bribe firm A to stay out of the market?
3. The following three arguments are about the "burden of the national debt."
   i. Our children and grandchildren will be burdened by heavy interest payments. Higher taxes will be necessary to make these payments.
   ii. It will ruin the nation when we repay the enormous debt.
   iii. Like any family or business, a nation has a limited capacity to borrow. If it exceeds this limit, it is in danger of being unable to pay its creditors. It may go bankrupt, with calamitous consequences.
   a. Point out the errors in each argument. (10%)
   b. Under what circumstances will a budget deficit result in "crowding out"? Explain why it may be a serious problem. (5%)
   c. Is there a true burden of the portion of the national debt owed to foreigners? (5%)

4. The Laffer curve is the relation between the tax rate \( t \) and tax revenue \( T \). The Laffer effect occurs when the Laffer curve slopes downward, i.e., when an increase in the tax rate causes a substantial reduction in the amount of labor supplied that tax revenue falls. If the demand for labor is perfectly elastic at wage \( w \) and the supply of labor \( S(w) \) is an upward-sloping function of the after-tax wage rate \( w = (1 - t)w \), then the tax revenue received by the government is \( T = \frac{dS}{dw}w \). Given this tax revenue function, what must be true of the relationship between the elasticity of labor supply \( (w/S)(dS/dw) \) and the tax rate \( t \) for the Laffer effect to occur? (15%)

5. The IS-LM model can be described by the goods and money market clearing equations:

   \[ IS(Y^*, r^*) = r^* - S(Y^*, r^*) + D = 0 \]

   \[ LM(Y^*, r^*) = L(Y^*, r^*) - \frac{M^d}{\rho} = 0 \]

   Where \( J \) = real investment expenditure, \( S \) = real savings, \( D \) = real government deficit, \( L \) = demand for real money balance, \( M^d \) = nominal supply of money, \( \rho \) = price level. The equilibrium level of income combined with the equilibrium rate of interest \( (Y^*, r^*) \) simultaneously clears both the goods market and the money market.

   Now consider a classical macroeconomic model in which the level of income is fixed at the full employment level \( Y_f \) and the price level \( \rho \) is a variable. Thus for the classical model, the solutions are:

   \( r^* = \rho^* (D, M^d, Y_f) \)

   \( Y^* = \rho^* (D, M^d, Y_f) \)

   Find the comparative statics impact of a change in the money supply \( M^d \) on this classical model (i.e., find \( \frac{dr^*}{\partial M^d} \) and \( \frac{dY^*}{\partial M^d} \)). Interpret your results. (15%)