1. NCHart is a corporation that has developed and patented a new drug to treat heart disease. There are no substitutes for this drug, giving NCHart a monopoly.

   (a) Draw a correctly labeled graph of NCHart making a positive economic profit, and show each of the following.

      (i) The profit-maximizing quantity, labeled Q_m
      (ii) The profit-maximizing price, labeled P_m

   (b) At Q_m from part (a)(i), is demand elastic, unit elastic, or inelastic? Explain using information from the graph.

   (c) Instead of maximizing profit, suppose NCHart considers providing the new drug to as many patients as possible as long as it can generate enough revenue to cover its total costs.

      (i) On your graph from part (a), show the quantity that is consistent with this goal, labeled Q_z.
      (ii) At Q_z from part (c)(i), is there a deadweight loss? Explain.

   (d) NCHart's patent expires next year, and a new firm, TXDrug, is considering whether to Enter this market or Stay Out. NCHart can either produce Q_m or Q_z. The firms independently and simultaneously choose their actions. The first entry in the payoff matrix represents NCHart's payoff and the second entry represents TXDrug's payoff. Both firms have complete information. Use the payoff matrix below to answer the following questions.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2" align="center">TXDrug</td></tr>
<tr><td align="center">Stay Out</td><td align="center">Enter</td></tr>
<tr><td rowspan="2">NCHart</td><td>Q_m</td><td align="center">$10, $0</td><td align="center">$4, $1</td></tr>
<tr><td>Q_z</td><td align="center">$0, $0</td><td align="center">–$2, –$1</td></tr>
</table>

      (i) Does TXDrug have a dominant strategy? Explain using strategies and payoffs from the payoff matrix.
      (ii) What is the best response for NCHart if TXDrug chooses to Stay Out?
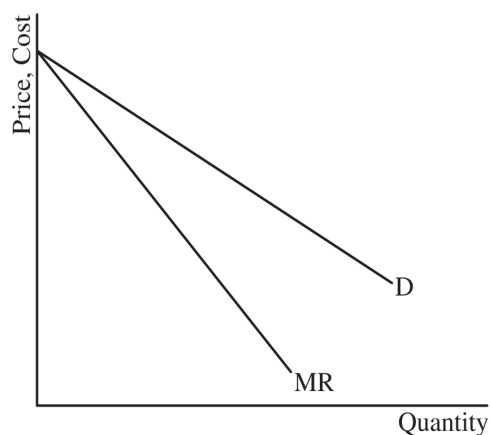   (iii) Identify the Nash equilibrium.

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   Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

GO ON TO THE NEXT PAGE.

2. Copper is produced in a perfectly competitive market with an upward-sloping supply curve and a downward-sloping demand curve. Assume the production of copper results in liquid waste, which seeps into local rivers. The contaminated river water causes human illnesses and crop failures downstream. The marginal external cost from producing copper is constant across all quantities of copper produced.

(a) Draw a correctly labeled graph of the copper market with the marginal social benefit (MSB), marginal private benefit (MPB), marginal social cost (MSC), and marginal private cost (MPC) curves, and show each of the following.

        (i) The market equilibrium quantity, labeled Q_M
        (ii) The socially efficient quantity, labeled Q_S

(b) Suppose the demand for copper decreases. On your graph in part (a), show the deadweight loss at the new market equilibrium, shaded completely.

(c) Suppose the government is considering levying a tax on copper.
        (i) What per-unit tax level would achieve the socially optimal quantity?
        (ii) Explain why a lump-sum tax on producers will not achieve the socially optimal quantity in the short run.
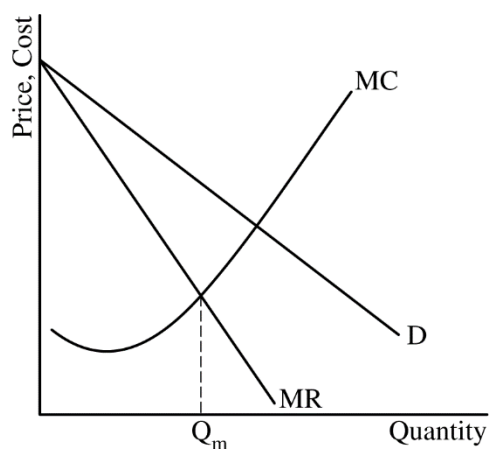
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Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

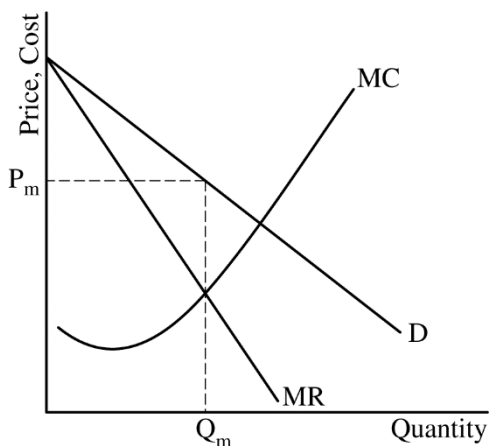## Question 1: Long   10 points

(a) Draw a correctly labeled graph for NCHart showing downward-sloping demand (D) and marginal revenue (MR) curves with the marginal revenue curve below the demand curve. **1 point**
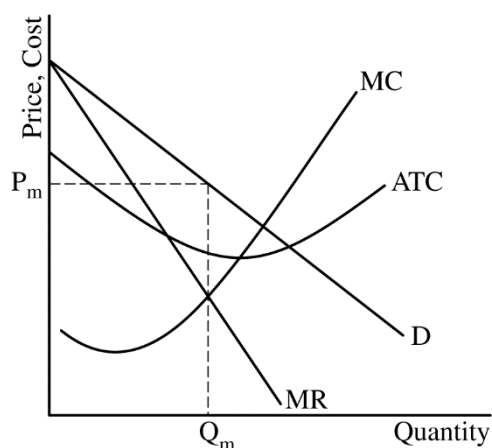

For the second point, the graph must show the marginal cost (MC) curve and the profit-maximizing quantity, labeled Q_m, where MR=MC. **1 point**

For the third point, the graph must show the profit-maximizing price, labeled P_m, above Q_m from the demand curve. **1 point**
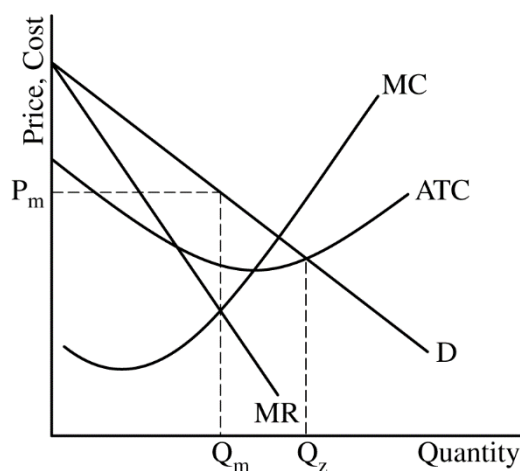
For the fourth point, the graph must show the ATC below the demand curve at Q_m with the MC curve rising and intersecting the ATC curve at its minimum.	**1 point**

	Total for part (a)	**4 points**

(b)	State that demand is elastic and explain that MR is positive at Q_m or that Q_m is less than the quantity at which marginal revenue equals zero.	**1 point**

(c) (i)	On your graph from part (a), show the quantity that is consistent with the goal of NCHart generating enough revenue to cover its total costs labeled as Q_z.	**1 point**

(ii)	State there is a deadweight loss at Q_z and explain that P (or D)<MC, as shown.	**1 point**
	Note: Deadweight loss will exist at Q_z if the demand is drawn such that the quantity at which D=ATC is less than the quantity at which D=MC, because P (or D)>MC.	
	Note: Deadweight loss will NOT exist at Q_z if the demand is drawn such that the quantity at which D=ATC is equal to the quantity at which D=MC, because P (or D)=MC.	

	Total for part (c)	**2 points**

(d) (i)	State that no, TXDrug does not have a dominant strategy, and explain that if NCHart chooses Q_m, then TXDrug's best response is to Enter because \$1 > \$0, but if NCHart chooses Q_z, then TXDrug's best response is to Stay Out because \$0 > −\$1.	**1 point**
(ii)	State that the best response for NCHart is to produce Q_m.	**1 point**
(iii)	Identify the Nash equilibrium as NCHart produces Q_m and TXDrug chooses to Enter.	**1 point**

Total for part (d)   3 points

Total for question 1   10 points