1. There are four different types of firms in a perfectly competitive market in which each firm is a price taker.

<table>
<thead>
<tr>
<th>Type</th>
<th>Annual Fixed Cost</th>
<th>Marginal Cost</th>
<th>Annual Production Capacity</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>200</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>180</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>150</td>
<td>30</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>D</td>
<td>100</td>
<td>40</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

For example, there are 10 firms of type D. Each of these firms has annual fixed cost of 100 and a marginal cost per unit of production of 40 up to its annual production capacity of 10.

The annual demand in this market is $Q = 400 - P$ and is not expected to change.

(a) [10] Draw the industry supply and demand curves. In the short run, given the firms in the market and their capacities, what is price in the market?

**Answer:** The industry supply curve is a step function with a step at $P = 10$ that is 100 units long, then a step at $P = 20$ that is 100 units long, then a step at $P = 30$ that is 100 units long, and then a step at $P = 40$ that is 100 units long. The demand intersects supply at $P = 40, Q = 360$. 
(b) [10] There are no other firms that have the capabilities to enter this market, and no firm can expand its annual production capacity beyond 10, but in the long run firms can exit. Explain how you know that this market is not in long-run equilibrium.

**ANSWER:** Type D firms are losing money. At least some of them will have to exit.

(c) [10] In the long-run equilibrium, what will the price in the market be? How many firms of each type will be in the market? (There are still no other firms that have the capabilities to enter this market.)

**ANSWER:** The minimum AC of type D firms is $P = 50$. At that price, all other types make profit and produce a total of 300 units. Five firms of type D survive and each produce 10 units, and just break even. Total industry production is 350.
(d) [10] Now assume that new firms can enter and exactly replicate any of the existing types. Which type or types of firm(s) will survive in this market? What will be the long-run equilibrium price?

**Answer:** Type A firms have the lowest minimum long-run AC, $AC = 30$, so if all firm types can be replicated, only type A firms will survive. In the long run, 37 firms of type A are in the market, each producing 10 units, and the market price is $P = 30$.

2. There are two firms that are able to produce PuffQuin, a form of cereal made from the grain Quinoa. The annual demand for PuffQuin is $P = 1000 - Q$ and not expected to change.

Firm A has a labor-intensive production process at its plant. It has annual fixed cost of 200 and marginal cost per unit of output of 200, but can only produce up to 700 units of output per year.

Firm B has a very mechanized plant that has annual fixed cost of 500 and marginal cost per unit of output of zero, but can only produce up to 200 units of output per year.

No other firms can enter the market and neither firm can expand its capacity.

(a) [10] If firm A were the only firm in the market, how much would it produce and what price would it charge?

**Answer:** Setting $MR = MC$ yields $P = 600$, $Q = 400$. Since this is less than the firm’s capacity constraint, this is where the firm will produce.
(b) [10] If firm B were the only firm in the market, how much would it produce and what price would it charge?

**ANSWER:** Setting $MR = MC$ yields $P = 500, Q = 500$, but this exceeds the firm’s capacity. Up to its capacity of 200, $MR > MC$ for every unit, so the firm should produce $Q = 200$ and charge $P = 800$.

(c) [10] If both firms were in the market, but they were owned by the same company and acted to maximize joint profits, how much would the company produce and what price would it charge?

**ANSWER:** The firm now has a step-function marginal cost function. Its cost is $MC = 0$ for $q \leq 200$ and $MC = 200$ for $200 < q \leq 900$. The $MR$ curve intersects this $MC$ on the part where $MC = 200$ at $Q = 400$. So, the firm sets $P = 600$. The price and quantity are the same as in part (a), but the firm now makes more money because it produces the first 200 units at lower cost (even after accounting for the extra fixed costs it must now pay).
Both firms are in the market, but they are separately owned and acting non-cooperatively. Each chooses its quantity to produce and the total quantity in the market determines the price along the market demand curve. That is, they are Cournot competitors. What is the one-shot Cournot equilibrium in this market?

**Answer:** Firm A, faces a demand of \( P = 1000 - Q_A - Q_B \) \( \implies \) \( MR = 1000 - 2Q_A - Q_B \). Setting \( MR = MC \) \( \implies \) \( Q_A = 400 - Q_B / 2 \), which is firm A’s best response function up to its capacity of 700 (which will never be a binding constraint). Firm B, faces a demand of \( P = 1000 - Q_A - Q_B \) \( \implies \) \( MR = 1000 - 2Q_B - Q_A \). Setting \( MR = MC \) \( \implies \) \( Q_B = 500 - Q_A / 2 \), which is firm B’s best response function up to its capacity of 200, which could be a binding constraint. If you solved these simultaneously to find the intersection of the best response functions, you’d get \( Q_A = 200, Q_B = 400 \), but that would exceed firm B’s capacity constraint. So, instead, firm B would produce out to its capacity of \( Q_B = 200 \). When firm B produces 200, firm A’s best response is to produce 300. The Cournot equilibrium occurs at \( q_A = 300, q_B = 200, P = 500 \). At these outputs, each firm is maximizing its profits given the output of the other firm.
3. Berkeley and Oakland are filled with interesting, and not-so-interesting, restaurants. They are all different, but they clearly compete with one another, so it would be reasonable to view them as monopolistically competitive. Assume that the industry was in long-run equilibrium before the changes discussed below.

Berkeley is considering increasing its restaurant tax from 5% of the price of the meal to 10%. (The tax is paid by the restaurant, but it knows the tax when it sets its price.) Oakland would make no change to its tax rate.

(a) [10] In the short-run, before any restaurants can enter or exit the market, what effect would this tax change have on the price of restaurant meals in Berkeley? What effect would this have on the price of restaurant meals in Oakland?

ANSWER: It would raise the price of meals in Berkeley due to higher MC, which would shift out demand for Oakland dinners and probably raise its price.

(b) [10] In the long run, what effect would this have on the number of restaurants in Berkeley? What effect would this have on the number of restaurants in Oakland?

ANSWER: Due to the higher MC, some firms in Berkeley would no longer be able to cover their total costs and would exit. As a result, the demand curve of other firms in Berkeley and in Oakland would shift out. Oakland restaurants do not have the cost increase so they are now making profits. New restaurants would enter in Oakland.
Berkeley decides not to increase the restaurant tax, but instead increases the restaurant license fee from $10,000 per year to $20,000 per year. This fee has to be paid regardless of how many meals the restaurant sells or how much revenue it receives.

(c) [10] In the short-run, before any restaurants can enter or exit the market, what effect would this fee change have on the price of restaurant meals in Berkeley? What effect would this have on the price of restaurant meals in Oakland?

**ANSWER:** In the short run, this would have no effect. Firms in Berkeley would have higher fixed costs, but that doesn’t change the demand they face or their MC, so they would charge the same prices as before. Since Berkeley restaurants don’t change, nothing changes in the demand Oakland restaurants face.

(d) [10] In the long run, what effect would this have on the number of restaurants in Berkeley? What effect would this have on the number of restaurants in Oakland?

**ANSWER:** The license fee makes some Berkeley restaurants that were just barely covering costs now become unprofitable. Some of them exit. As they do, the demand curves faced by the remaining firms in Berkeley and firms in Oakland shift out. In the new equilibrium, there are fewer restaurants in Berkeley and more in Oakland than there were before the license fee was raised.
4. A textbook publisher faces two different markets for a certain leading economics textbook. There are undergraduates and MBA students. The textbook author has also produced a book-on-CD version of the book (in the actual stirring economist voice of the textbook author) that the user can listen to in the car. Creating the book (writing, editing, creating pretty figures, etc) has cost the publisher $100,000. Creating the CD (recording studio rental, sound engineering, etc) cost an additional $20,000. The marginal cost of producing each book going forward is $20 and the marginal cost of each CD is $1. The publisher thinks that most undergrads don’t have cars and won’t value the CD, but the busy MBA students will really like it. Unfortunately, the publisher cannot tell undergrads from MBAs, though she knows that there are 1000 of each type of buyer. A smart MBA who works for the publisher suggests that they offer two versions of the book, one with the CD and one without. After some market research, the publisher learns that the willingness to pay (WTP) of each type of buyer is:

<table>
<thead>
<tr>
<th>Product</th>
<th>WTP of MBAs</th>
<th>WTP of Undergrads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book Alone</td>
<td>90</td>
<td>70</td>
</tr>
<tr>
<td>Book+CD</td>
<td>120</td>
<td>80</td>
</tr>
</tbody>
</table>

(a) [15] With this information, what price does the smart MBA suggest that the publisher charge for each product, Book Only and Book+CD?

**ANSWER:** The MBAs value the Book+CD version a lot more than just the book. If the firm sells at $P_B = 70$ then the most it can charge for Book+CD is $P_{BC} = 100$. Any higher $P_{BC}$ and the MBAs would prefer to just buy the book.

After making this suggestion in (a), the smart MBA notices that the market research was faulty due to an error in the statistical analysis. The MBA gets the raw data, redoes the analysis and finds that it is the undergrads who actually like the CD more (they create a legal MP3 file and listen while they walk to class...just-in-time studying). The revised information is:

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<tbody>
<tr>
<td>Book Alone</td>
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<td>70</td>
</tr>
<tr>
<td>Book+CD</td>
<td>110</td>
<td>100</td>
</tr>
</tbody>
</table>

(b) [15] Based on this revised information, how does the smart MBA suggest that the publisher price the products?

**ANSWER:** Now the type of consumer that values the book more values the upgrade to Book+CD less. MBAs value the Book at 90, but the upgrade to Book+CD at only 20, while UGs value the Book at 70 and upgrade at 30. This sort of negative correlation between values suggests that the firm should consider bundling. Indeed, the profit-maximizing strategy is to charge $P_{BC} = 100$ and not sell the Book alone (or sell it for more than 100).
5. A manufacturer produces a product and sells it to a retailer. The retailer then resells it to consumers. Both the manufacturer and the retailer have some market power, which leads to “the double marginalization problem.”

(a) [15] What is the double marginalization problem and who is harmed by it? the manufacturer? the retailer? the consumers?

**ANSWER:** Double marginalization occurs when an upstream firm that has market power sells to a downstream firm that also has market power in reselling to the final consumer. Each firm adds a markup above its marginal cost, but neither firm takes into account the increasing its own markup lowers the profits of the other firm in the vertical chain. As a result, the two firms together markup the product more than is jointly profit maximizing. This harms the two firms jointly as their total profits fall. It probably also harms each firm individually compared to the case in which they coordinate their pricing. It clearly harms the consumer as the final retail price is higher than it would be if the firms coordinated.

(b) [15] Explain two different strategies that are used to reduce or eliminate the double marginalization problem.

**ANSWER:** The strategies to eliminate double marginalization are aimed to align the incentives of the two firms or to require one firm not to take a margin. If the upstream firm uses a **two-part tariff** or **declining marginal price schedule** it can sell to the downstream firm at its marginal cost on the margin while still extracting profits through an entry fee or higher price on inframarginal units. If the firms **vertically integrate** by merging, then they can coordinate pricing inside the firm. Another approach is for the the upstream firm to try to control the downstream firm’s markup either by requiring it to sell a given quantity each period, known at **quantity forcing**, or in some cases by announcing a **suggested retail price** to consumers, making it difficult for the retailer to charge more than that price.

**Please Sign Honor Code Oath:** I understand that this exam is an individual effort exercise. I swear on my honor that I have not consulted with another person or made use of notes or other materials during the exam.

Signature: ____________________________