1. Each of the following statements is misguided. Explain what is wrong with the reasoning:

1. It doesn't hurt an unregulated monopolist to have its cost rise since the monopolist can simply raise its price to cover the extra costs.

Remember that the monopolist cares about profits, which are $Q^m \times (P-AC)$, where $Q^m$ is chosen by the monopolist at the point where $MR=MC$. If marginal costs go up, then $Q^m$ will go down because $MR$ and $MC$ will intersect at a lower quantity. The effect of this is to reduce profits, thus hurting the monopolist. At the lower quantity, the monopolist will indeed be able to charge a higher price, as stated above, but it will also face higher $AC$ due to the cost increase. The effect of this on profits depends on which is larger, the change in $P$ or the change in $AC$. Overall, profits are likely to go down if a monopolist’s costs rise, even though it can increase its price. (You should be able to draw the diagram to illustrate what is happening.)

2. Consider a monopolist that is regulated under price cap regulation and prices at the cap. This regulated monopolist does not benefit from an outward shift in the demand curve since it can't raise its price in response to the higher demand.

An outward shift in the demand curve will allow the firm to sell more output at the price that it is charging. The firm can therefore make more profit even without being able to raise its price. (Again, you should be able to draw the graph.)

3. There is no reason to subsidize private universities since their fees are high enough.

Higher education, whether public or private, has positive externalities. Since private universities that produce education do not get the benefits of these externalities, they will tend to produce too little education (relative to the social optimum). The reason for the subsidy is, therefore, to give universities an incentive to produce more education and thus to achieve the social optimum.

4. In a high fire-risk area like the Berkeley-Oakland hills, there would be no problem to have a fire department run by a private firm because everybody would be willing to pay for it.

As any public good, fire protection faces the two problems known as "free-rider problem" (you get the benefits of the service even if you don't pay, since public goods are nonexcludable) and the "drop-in-the-bucket problem" (fire protection is so costly that its provision does not depend on whether one single person pays). Because of these, any single individual has no incentive to pay once the service (the fire department) is set up. You might argue, however, that the nonexcludability characteristic is not present in the case of fire protection: if you don't pay, fire-fighters won't come to your home
when your house is burning. But your burning house is a danger to your neighbour, who (if she's paying) would demand the firefighters to extinguish your fire as part of the protection she is paying for. You also get the benefits of the fire department extinguishing your neighbor's fire, since then it won't burn your house.

5. The costs of National Parks should be covered by charging admission fees, because we shouldn’t have National Parks if the people who use them are not willing to pay enough to cover these costs.

The socially optimal price to charge a person for any good is the marginal cost of providing the good to that person. The marginal cost of having an extra person enter a National Park is zero (as long as the park isn’t overcrowded, in which case we’d have an externality). So the socially optimal admission price is zero. The confusion here arises from not distinguishing total cost from marginal cost. We should only have National Parks if the total amount that people are willing to pay to go to them exceeds the total cost of having the Parks. But once we have them, the marginal cost of a person using them is zero, and so the admission price should be zero.

II. REGULATION OF NATURAL MONOPOLY

As you well know, food service in campus is a monopoly. Let us suppose that increasing returns to scale (IRTS) exist, such that the provision of food on campus is a natural monopoly. (There are people who believe that IRTS do not exist and that a competitive market could provide food service. That is, lots of vendors could set up operations in dorms and on-campus locations. I actually see no reason this cannot occur. But, for the sake of argument, let's agree with Food Service that IRTS exist.) The relevant curves for Food Service look like the graph on the right. Note that AC is falling because of IRTS, and that MC is below AC because AC is falling. Trace this graph onto your answer sheet.

1. Label the price and output that Food Service would choose if it maximized profits. Label them $P_m$ and $Q_m$.

See Figure 1.

2. Suppose the University forced Food Service to price at marginal cost. Label the price and output that would result. Label them $P_c$ and $Q_c$.

See Figure 1.

3. Food service would have negative profits if it priced at marginal cost. Show the area of loss on the graph.

The loss is the shaded rectangle in Figure 1.
4. If the University forced Food Service to price at marginal cost, it would have to subsidize Food Service by the amount of loss shown in 3. The University decides that it will not subsidize Food Service. Suppose that the University forced Food Service to price at average cost. **Trace the graph into your answer sheet again.** Label the price and output that would result from pricing at average cost $P_a$ and $Q_a$. For comparison, put the monopolist's price and output, $P_m$ and $Q_m$, on this graph too.

**See Figure 2.**

5. Show the gain in consumer surplus that arises from lowering the price from $P_m$ to $P_a$.

The gain in CS is the entire shaded area in Figure 2.

6. Show that the gain in consumer surplus exceeds the loss in profits to Food Service.

**At $P_m$, profits are the rectangle whose width is zero to quantity $Q_m$ and whose height is the difference between $P_m$ and the AC at $Q_m$. This rectangle is contained with (ie is part of) the shaded area that represents the gain in consumer surplus. So the loss of profits is less than the gain in consumer surplus.**

7. As well as pricing too high, Food Service does not keep costs as low as possible. Workers are paid higher than market wages as a way to subsidize them, and workers have little incentive to be as productive as possible. The AC curve is therefore higher than necessary. In the graph on the right, $AC_0$ is the curve when costs are kept as low as possible; $AC_1$ is the curve that represents Food Service's costs (including the high wages and less-than-fully productive workers). **Trace this graph onto your answer sheet.** Show:

a) The price and output that Food Service will choose if the University forces it to price at its average cost (but the University does not force it to keep costs as low as possible).

**See $P_1$ and $Q_1$ in Figure 3.**

b) The loss of consumer surplus that arises because Food Service does not keep costs as low as possible.

The loss of consumer surplus is the shaded area in Figure 3. Why? If Food Service kept its costs as low as
possible, the relevant AC curve would be AC₀ instead of AC₁. Then, if forced by the University to price at AC, the price would be P₀ and the quantity produced would be Q₀.

8. Can you think of a way for the University to assure that costs are as low as possible? (There is no correct answer here.) Your answer should recognize that it is difficult for the University to determine market wages and is especially difficult to determine whether workers are fully productive.

The University could hire a couple of students in the Econ Department to study the wages (and other costs) paid by a more competitive firm in the same industry (food services) outside campus, to estimate Food Service AC curve. It could then force Food Service to price at that AC. That should make Food Service to bring its cost structure in line with more competitive firms, even though it isn’t competing with anybody. (Remember that because of IRTS, allowing more firms to compete with Food Service won’t solve the problem. In fact, it would increase the cost and price, because each individual firm would be producing less at a higher cost.) Also, Food Service will have an incentive to hire more productive workers (the University may not know how productive Food Service workers are, but Food Service does), otherwise it would suffer losses. The problem with this approach is that the estimation may not be accurate and the University could be setting a price ceiling that is too low. The University would have to monitor the progress of Food Service so as not to drive it out of business. (Food service on campus is valued by students and should be provided.) On the other hand, students will be paying lower prices (and some Econ students will be earning extra money).

9. Finally: Students have to wait in line to get and pay for their food. The opportunity cost of this time is an externality, since Food Service does not have to pay this cost. As a result, Food Service has an incentive to shift costs to students, by hiring fewer workers and making students wait longer. Can you think of any way to correct this problem? (Again, there is no right answer. In fact, I haven't even been able to think of one good solution. Do you have any ideas?)

A standard way of dealing with externalities is to levy a tax. However, a tax would not address the situation with Food Service. First, Food Service prices are already too high, due to its inefficiency and waste. So adding a tax would just push prices further above the true MC. Second, a tax is useful for reducing the quantity produced when, because of the externality, the firm is producing more than is socially optimal. The problem with Food Service is not that it is producing more than is socially optimal; the problem is that Food Service is shifting costs to students (through long waits). We need a solution that prevents them from shifting costs like this.

A no-tax alternative would be for the University to determine the number of attendants necessary for each shift and to force Food Services to have this minimum number working at all times. (This number, presumably, is higher than the current number.) Food Services would then hire more productive workers in order to keep its costs down. This solution, of course, has problems of its own. In order to know how many attendants are necessary, the University would need to know how productive those workers are, and, as stated above, this is difficult to determine. On the other hand, such a solution might reduce the social cost of waiting more than would the tax.
Lastly, we might instead try to require competition. This could lower costs from waiting in line, but would raise average costs faced by firms since we have IRTS (i.e., the condition for a natural monopoly).

III. EXTERNALITIES

The production of plastic creates air pollution which, in sufficient quantities, can harm people's health. Assume that the plastic industry is perfectly competitive. We know that the industry will produce more output than is socially optimal, since firms do not bear the costs of pollution (that is, pollution is a negative externality). Without government intervention, the market output will be 50 million units at a price of $10, where $10 is the minimum AC of firms in the industry. The marginal social cost of plastic is $15 at this level of output. Since marginal cost exceeds price, output is too high.

The socially optimal output is 30 million units at a price of $13. This output can be attained by levying an excise tax of $3 on each unit of plastic. Assume that the demand and marginal social cost (MSC) curves are linear, as shown in the graph on the right.

The triangles in Figure 4 labeled A, B, C, & D will be referred to in the answers below. For use later on, we'll calculate their areas now:

\[
\begin{align*}
\text{Area } A &= \frac{30 \text{ million units} \times $3}{2} = $45 \text{ million} \\
\text{Area } B &= \frac{30 \text{ million units} \times $3}{2} = $45 \text{ million} \\
\text{Area } C &= \frac{20 \text{ million units} \times $3}{2} = $30 \text{ million} \\
\text{Area } D &= \frac{20 \text{ million units} \times $5}{2} = $50 \text{ million}
\end{align*}
\]

1. Calculate the loss of consumer surplus associated with the $3 tax. This is the loss that buyers of plastic incur when we move to the socially optimal output level.

   The loss of consumer surplus associated with the $3 tax is the area \((A+B+C)\) in Figure 4, equal to $120 million.

2. Calculate the reduction in pollution costs that occurs because of the tax.

   Pollution costs without the tax (that is, when producing 50 million units at \(P=10\), with \(MSC=15\)) are area \((B+C+D)\); these costs with the tax (when producing 30 million units at \(P=MSC=13\)) are area \(B\). Then, the reduction in pollution costs is \((B+C+D) - B = (C+D)\), which is equal to $80 million.
3. Calculate the government revenues from the tax.

The government revenues from the tax is equal to area (A+B), that is, $90 million.

4. Using your answers to 1-3, show that the gains exceed the losses from the tax.

The gains from the tax consist of the reduction in pollution costs plus government revenues from the tax (which we can assume are redistributed to consumers or used to pay for services provided to consumers by the government, like schools, hospitals, etc.). The loss from the tax is the reduction in consumers' surplus due to the increase in the price.

Then:

\[
\begin{align*}
\text{Gains from the tax:} & \quad (C + D) + (A + B) = $170 \text{ million} \\
\text{Losses from the tax:} & \quad -(A + B + C) = -$120 \text{ million} \\
\text{Net gain from tax:} & \quad D = $50 \text{ million}
\end{align*}
\]

Notice that this net gain equals the deadweight loss that society would face if the government didn't levy the excise tax on plastic.

5. The government generally cannot determine the correct tax to levy, since it does not know the demand and marginal social cost curves. Suppose the government levies a $5 tax, which is the marginal cost of pollution at the level of output that occurs without government intervention (that is, at 50 million units).

Do the gains from this $5 tax exceed the losses, or vice versa? You can answer this by just looking at the graph, without any calculation.

The letters in the graph denote the area that is defined by the lines around it. The gains and losses from a $5 tax are:

- **Gain in reduced pollution cost:** D+H
- **Gain in Tax revenue to govt:** F+G
- **Loss in Consumer Surplus:** F+G+E+H
- **No change in profits (since profits are 0 before and after tax)**

So net gain/loss is 
\[
(D+H)+(F+G)-(F+G+E+H) = D-E
\]

It's clear from the graph that the gains still exceed the losses (D > E), which means that we are better off than without the tax. However, the net gain from the $5 tax is smaller than the net gain from the (optimal) $3 tax. This must be the case, since the market reaches the social optimum with a $3 tax.