**Econ 4545 Environmental Economics**

**Review Questions**

Revised Oct 9, 2018

**I.       What is Economics, and what does it have to do with the environment?**

1. What does it mean to say that resources are scarce, and what does that scarcity have to do with the environment?

2. Consider yourself, and some person of the opposite gender, in a spacecraft with just enough resources so that the two of you can live in misery for 50 years and have two kids, who then live 50 years in misery having two kids - on and on forever—its sustainable. What is the point of this scenario?

3. Recently in class we discussed how a common concern is that the scarcity of natural resources will lead to a significant decrease in our standard of living. The argument, put simply, is that natural resources are inputs into the production of goods and service, the stock of natural resources is declining, and the production of goods a services is increasing, and this suggests the shit will hit the fan (natural resource stocks will hit critically low levels causing a dramatic drop in the production of goods and services).

In steps, I want you to critique this line of reasoning.

(A): First divide resources into two non-overlapping categories: natural (N) and other (O) and define in words the isoquant for the production of one unit of consumption goods (C=1).

(B) Now, without getting very specific, try to define this isoquant in terms of the production function expressed mathematically.

(C) Now, draw an example isoquant for one unit of consumption (N on the vertical axis, O on the horizontal axis).  For part (C) do not sweat the specific curvature or endpoints of your isoquant.

(D) Explain, to the best of your ability, how the influence of natural resources on maintaining consumption at C=1 is influenced by the shape of the isoquant for C=1 and whether it hits the horizontal axis. Your answer should include different shaped C=1 isoquants (each example isoquant on a separate graph). Perhaps at least three. Your answer should include a description in words of what it means when an example isoquant does, or does not, touch the horizontal axis.

Before you answer part D, your group should graph a bunch of different possible C=1 isoquants and discuss what each shape implies, and its implications for natural resource scarcity limiting consumption. (Note that I don't want to see all of the isoquants drawn in this learning phase, I simply think that drawing a bunch of different isoquant curves will help you figure out the implications of natural resource scarcity for maintaining production and consumption at C=1.)

**Answer**: An isoquant for C=1 is all combinations of N and O that are **just capable** of producing one unit of consumption. As an aside, the shape and position of this isoquant is determined completely by the state of technical knowledge. It has nothing to do with preferences or the amounts of N or O that currently exist. (Show with a graph what "just capable" means.) Most student answers spaced the "just capable" part, which is necessary for a correct definition.

The general form of the production function is C=f(N,O). This production function identifies the maximum amount of C goods that can be produced from any non-negative combination of N and O. The isoquant is simply those combinations of N and O that solve the equation 1=f(N,O). For example, if one had a specific functional form for f(N,C), and one wanted the isoquant for C=1 with N on the vertical axis, one would solve 1=f(N,O) for N. For example, …. Some of the student groups went with very specific (too specific at this point) functional forms for the production function. Doing this imposed unnecessary restrictions on the production function, and makes the reader wonder if the distinction between a production function and an example of a production function is well understood.

The extent to which N will limit consumption depends on how easily O substitutes for N. Put simply the more easily other resources substitute for natural resources, the less we need to worry about running out of natural resources. This is the main point you need to make combined with an understanding that the isoquant determines how easily O substitutes for N.

One aspect of substitutability is whether N is *essential*; that is, whether some N is required to produce C. If it is essential and there is no N, then it becomes impossible to produce consumption goods if N is depleted.1

In terms of the isoquant for C=1, N is not essential if the isoquant touches the horizontal axis. A point on the C=1 isoquant that is on the horizontal axis is a point where C=1 and no N is being used. In explanation, if the isoquant touches the horizontal axis it is possible to produce C=1 using only O resources. See example figures A and B. (Note that in Figure A, O is not essential, but O is essential in Figure B.

[Austin, the grader, commented for part D: "Great variability in responses. Many incorrect interpretations of what it means to hit the horizontal axis. Some groups said it means that this point is impossible to produce (it's not), while another said it implied natural resources were essential for producing C=1, when the exact opposite is true. Many groups failed to relate whether or not a graph touched the axis to its implications for maintaining consumption at C=1 into the future."]

If N is essential for producing C=1, the isoquant for C=1 will become flat (horizontal) at the minimum required level of N. See example figures C and D. Figure E is an example where natural resources are immaterial to production (they are not really resources).

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1 N might not be essential for all levels of consumption. For example, it might be essential at higher levels but not at lower levels.

Note that in ranges when the isoquant is vertical or horizontal, N and O do not substitute for one another. For example In Figures E and F, substitution between N and O is never possible. In Figures C and D it is not possible to substitute O for N once N declines to the level $N_{min}$. In Figures A and B it is always possible to use less N by using more O. In Figure G both O and N are essential and O and N do not substitute for one another: they are perfect compliments: society needs $N_{min}$ and $O_{min}$ to produce one unit of consumption and increases the amount of N or O without increasing the amount of the other will not increase consumption. Figure G is called a Leontief production function. In Figure A, N and O are perfect substitutes: they always substitute for one another at a constant rate.

If you are worried about natural resource scarcity limiting consumption, you hope that N is not essential for any level of consumption. And, you hope that the isoquant is steep (N on the vertical, O on the horizontal). A steep isoquant says that if N declines, you won't need much more O to produce C=1. If isoquants all looked like Figure E one would not worry about natural resource scarcity. If isoquants looked like Figures F or G one might worry a lot.

I suspect—don't really know—that isoquants look something like Figure H in that both N and O are essential for levels of production that will keep us alive, and that we are not close to falling below those essential levels.

Note that the slope of the isoquant is called the marginal rate of technical substitution and is defined as the rate at which O substitutes for N hold consumption output constant, so the all of the above could be expressed in terms of $MRTS_{ON}$ .

While note part of the question important issues in terms of how natural resources limit growth is the rate of technical progress (which will change the shape and position of the isoquants) and whether there is a market economy where the price of a resource increases as its scarcity increases.

Some additional comments on the answers

The isoquant tells us not about the quantity of resources available. The isoquant is simply a way to represent part of the state to technical knowledge. Specifically the isoquant for C=1 identifies the state of technology for production one unit of consumption goods.

An isoquant by itself does not typically identify the input combination that should be used.

4. Define an *efficient allocation of resources*.

**Answer:** An allocation of resources is efficient if there no other allocations where some members of society would be better off and none would be worse off.

5. Argue that the market will internalize externalities such that government intervention is

unnecessary. Now argue that, in practice, government intervention will sometimes be required to eliminate the inefficiency caused by the externality.

6. Is London now more or less polluted than it was 400 years ago? First present an explanation for why it should be more polluted now. Then an explanation for why is should be less polluted now. What do you think, is it more or less polluted now?

**Rough answer**: There are two real and opposing forces at work: (1) *materials balance*, which suggests that London should now be more polluted, and (2) a clean environment being a luxury good, which suggests that London now should be less polluted. London now has many more people and the per-capita level of consumption of goods and services has increased many-fold in the last 400 years. These two changes, given materials balance, says that the total weight of all emissions (the stuff Londoners emitted back into the environment) is now at least thousands of times greater than it was 400 years ago. So, emissions have increased. And, if pollution as a proportion of emissions has remained constant or increased, pollution now must be higher. So, pollution in London has declined only if the pollution as a proportion of emissions has dropped, by a lot. What might cause such a drop? Increased income, which has happened. Increased income combined with a clean environment being a luxury good, means that current Londoners are willing to sacrifice a larger proportion of their current income for a cleaner environment than were the poor of generations past. This factor has caused current Londoners to spend a greater proportion of their wealth, than the past, decreasing the proportion of emissions that are pollutants. The question is which effect is stronger. I don't know but guess that if one measure the effects of pollution in terms of lost life-years, there is now much less pollution in London– 400 years ago probably a majority of the population lived short and dirty lives because of pollution (bad sanitation). While people in London still have their lives shortened by pollution, it is now by much less time: cancer kill mostly the non-young, bad sanitation kills the babies.

7. The criteria that economists propose for how resources should be allocated always include efficiency and equity, but typically do not include sustainability. Why? Discuss.

8. Assume that society's concern for the future declines (we care less about the future than we used to). Does this make it more **likely** that we would want to drive species X to extinction? Yes or no and explain.

**Rough answer:** The simple answer is it "it depends on the species". One can think of examples where it becomes more likely as concern for the future declines, and examples where it becomes less likely as concern for the future declines. Most people will think of examples of the former but not of examples of the latter. If you don't think of examples of the latter, you will reach the wrong conclusion, and answer incorrectly. So, let's start with an example of the latter. Consider a species that is now a minor irritant but over time its population size will increase and it will become a big problem. Further assume the cost of eliminating the species is high. As concern for the future declines, it becomes less likely that we will want to drive this species to extinction now – high cost now, the benefits of eliminating the species are future benefits, and the future now counts less. (Note that the future might want to eliminate the species in the future, when it is a big problem.) Alternatively, consider a species whose meat we enjoy to eat after the animal is

dead. Enjoying the meat requires that we kill members of the species. If we kill them all now, there will none in the future available for killing and eating. The more we care about the future, the more likely it is that we will want to save some of the species for the future; the less we care about the future the more likely it is that we would want to kill off and eat all members of the population now. Consider a second example of the first type. We like to have Wambubas around (they are fun to watch), they are currently close to extinction, and we can bring the species back from the brink with a very expensive breeding program, if it is undertaken now - if we wait, they will be gone. We need to decide whether to save the species by undertaking the expensive breeding program. How to decide what is efficient. We should look at the high current cost and compare it to the present value of the stream of benefits from watching Wambubas now and in the future. If the present value of the future benefit stream is greater than the cost of the breeding program we want to save them, otherwise extinction. As our concern for the future declines, the present value of that benefit stream declines, and it becomes more likely that we will want to let them disappear now.

Comments on some of the student answers: Caring nothing about the future does imply we want to drive a species to extinction today. It implies we want to make the decision on the basis of the current benefits and costs of killing off the population. For example, assume we care nothing about the future and like to eat beef. In this case we would only kill the last cow if the enjoyment from the last steak (we have already eaten many) is greater than the cost of killing the last cow.

The question said a deceased concern for the future, not the elimination of all concern for the future.

9. Assume that we do not know the preferences of a significant proportion of society. What can we say about whether an allocation is or is not efficient?

**Answer**: Not much. An allocation is inefficient only if it is possible to make some members better off without making any other member worse off. We can tell how each person in the known preferences group is affected (better off, worse off, or unaffected) by a proposed reallocation but we will never know how those in the not-known preference group would be affected.

Saying this another way, if we only looked at that part of society whose members have known preferences, we could determine whether the allocation was efficient for this subset of society, but who knows how everyone else in society is affected. For example, if we know it is possible to make some people in the known-preferences group better off without making anyone in the known-preferences group worse off we might be tempted to say the allocation is inefficient. But that is not necessarily true. The change might have required some member of the unknown-preferences group to be worse off.

Thinking from the other direction: If we know that the allocation is efficient from the perspective of the known-preference group, it still might be inefficient from society's perspective.

This is a difficult question from a logical perspective.

10. Assume that, everything else constant, pollution makes us worse off.  If it is possible to reduce pollution without decreasing the production of any goods or services or increasing the use of resources, what can be concluded about the current allocation of resources?  Why?

**Answer:** If firms can decrease the amount they pollute without decreasing production or using more inputs, and pollution is a bad, the firms can make others better off without making themselves worse off. So, before they do it the allocation is inefficient.

Do they have an incentive to do it? Not a profit incentive, but if they are nice guys and aware that it is possible, they will do it.

11. Assume that the competitive firms in the widget industry produce excess air pollution from an efficiency perspective because the air is a common property resource.  If this inefficiency is eliminated by a Pigouvian tax on air pollution, what will happen to the number of firms in the widget industry?  Efficiency-wise, is this a good or bad thing?

**Answer:** The tax will increase the marginal private cost of producing widgets. Assuming a competitive market for widgets when the post-tax equilibrium is achieved, the price of widgets will have increased by the amount of the tax, as it should, industry output will have decreased, and there will likely be fewer widget firms.

Whether this is good or bad is a normative judgment. It is efficiency increasing. From society's perspective, the industry was overproducing widgets. Society want to produce widgets up to the point where MSB = MSC. At the competitive output level in the absence of the tax MSC >MSB. When the appropriate tax is in place, at the profit maximizing level of output MSC =MPC + tax.

12. What is meant by the term property rights?  If one owns the property rights for a resource, what powers are conferred by those rights?

13. **Answer:** "Property rights refer to a bundle of entitlements defining the owner's right, privileges, and limitations for use of the resource" (Tietenberg). As a property owner, one has three inherent rights: (1) the right to all of the costs and benefits accrued with their defined property. (2) The right to transfer these rights to another party. And (3), the right and ability to exclude others from using the resource. One might continue with examples of different degrees of property rights; e.g. an example of common property (no property rights), limited property rights and complete property rights. What would be examples of each? An interesting issue is whether owners are responsible for negative external effects caused by their use of the resources they own? E.g. does a property owner have the right, a property right, to drive to extinction, a species that currently lives only on his property? Can the government forbid them from doing this? If the government requires that they maintain the species, does the government have to compensate them?  Does the government have to compensate the owner of the resource if it limits the owner's use of the resource to pollute?  That is, what exactly do you own?

14. What is a market transaction (trade)?  Do not give me an example of a market transaction, but

rather tell me what a transaction is, and what properties it must have to be a market transaction. How does a market transaction differ from other types of transactions? Now, give me an example of a market transaction. Now give me an example of a transaction that is not a market transaction.

15. What is a market failure? Give me an example of an environmental market failure, and explain why it is a market failure. Choose an example that has not been discussed in class. Note that this question has three parts.

**Answer:** A *market failure* is something inherent to the market system that causes the market equilibrium allocation of resources to be inefficient.

Different types of market failure are: ill-defined property rights (including, but not limited to common property), lack of complete markets, the existence of externalities, excess market power (monopoly and oligopoly power), and public goods.

An important distinction is the distinction between market and *nonmarket failures*. Consider a world of no market failures (externalities, etc.), but where the market equilibrium allocation of resources is inefficient, because of, for example, a government price control. In this case, the allocation of resources is inefficient, but it is not a failure of the market. If left to its own devices, the market allocation would have been efficient. The inefficiency was imposed on the market by an outside agent (the government), so the market cannot be blamed. This is a nonmarket failure. A lot of people feel the government is the author of many nonmarket failures.

Examples of environmental market failures abound. Students mentioned bears, bison and mining wastes.

When explaining why your example causes the market to fail, it is important that you show that the market allocation will be inefficient in the presence of your example. To do this, you need to show that at the market equilibrium allocation, the allocation is not efficient from society's perspective. One could accomplish this by demonstrating that at the market equilibrium, marginal social costs of production (or consumption) do not equal marginal social benefits, implying the commodity is either overproduced (too much consumed) or under-produced (too little consumed).

Comments:

*Market failure* is not the same thing as *inefficiency*.
That is, market failure implies inefficiency, but inefficiency does not imply market failure. Said differently, market failure is sufficient, but not necessary for inefficiency.

Make sure you understand the distinction between necessary and sufficient.

*Efficiency* is not the same thing as *optimality*
Optimality implies efficiency, but efficiency does not imply optimality
Optimality is efficiency and equity together.

Lack of equity in a market allocation of resources is not a market failure. The market is not designed to achieve an equitable allocation.

Weather is not an example of a market failure. It is a state of nature that affects us: it is given exogenously. Therefore, there is nothing to allocate, so it cannot be misallocated. (I wrote these last sentences before I spent much time thinking about global warming. My mistake)

16. Define the following terms in a way that an Econ. 2010 student would understand: efficiency, equity, market failures, and nonmarket failures.

17. If someone is a member of society **might** it ever be efficiency increasing to kill them? True or false and explain.


18. Define an efficient allocation of resources in an intertemporal context.

19. Assume that you have a new significant other. And, assume that when you are together in public you both prefer "making out" all of the time to all other activities. Discuss whether making out all of the time you are together in public is efficient or inefficient.

**Answer**: I don' know. Assume society consists of the two of you and a bunch of people standing around, and they like to watch you make out. In this case it could be efficient from society's perspective for you to spend all of your outdoor time making out.

Alternatively, assume society consists of the two of you and a bunch of people standing around, and watching you, which they are forced to do, grosses them out. In this case, spending all of your public time making out might or might not be efficient. If the grossed-out watchers are rich and you are poor such that they paying you to stop would be a Pareto Improvement, you making out all of the time is not efficient. If you prefer making out to having the maximum bribe they would pay to get you to stop, your making out all of the time is efficient.

The issue is how much of your public time together needs to be allocated to making out to achieve efficiency.

Grading: If the person said it is efficient, give them three points on the quiz (they are wrong).
If the person said it is inefficient, give tem three points on the quiz (they are wrong).
If the person clearly stated that it might or might be efficient give them a minimum of 6 points.
For these people give them zero to four additional points for the degree to which they explained why it might or might not be efficient.

I will spot check some of the quizzes and if the grade is too high I will adjust it downward, along with the grader's grade.

20. Critique the following two statements about efficiency. Consider two things: whether the statement is correct and whether the statement is a definition of efficiency. Provide explanations.

(1) "Efficiency - An allocation of resources is said to be efficient if it is possible to change things so one member of society is made better off by making another member worse off."
(2) "Efficient: To effectively use or distribute a good or a resource in order for the maximum utility to be achieved with the minimum use of resources, time, and effort. An allocation of resources is efficient if it makes a member of society better off without making anyone else worse off."
Answer:

21. Does a system of perfectly competitive markets result in an efficient allocation of society's scarce resources?  Explain.

22. What is a common property resource?  Give me an example of an environmental resource that is a common property resource.

23. What is an externality? Give me an example of an environmental externality?

24. Identify for me one of your concerns about the environment, and discuss whether those concerns are efficiency based, equity based or both.  Argue that your concerns can be described as efficiency based and/or, equity based, even if you believe they are not.  One page or less please.

25. Who, in your opinion, should be included in society when one considers equity and efficiency?  Why? This question is only asking your opinion.

26. Would you expect the number and magnitude of perceived environmental and recreational externalities to increase or decrease over time?  Defend your answer.

27. Define what is meant by a luxury/superior good. Make sure the reader understands the difference between luxury good and normal and inferior goods. Then discuss whether a clean environment is a luxury good. And, if so, what are the implication of it being a luxury good.

28. What is an externality? Give an example of an action by one economic agent that affects another economic agent that is not an externality.  Explain why your example is not an externality.

29. Assume a world that consists of two time periods.  Denote the individuals in period 1 as *generation 1* and denote the individuals in period two as *generation 2*. Assume a world of just two goods, *cases of beer* and copies of the book *David Copperfield*. (Assume books and cases of beer are divisible.)  Further assume individuals in generation 1 are willing to trade beer for books at the rate of 2 cases for one book, and generation 2 is willing to trade beer for books at the rate of one case for one book.  Currently each generation has 10 cases of beer and 10 books.  Is the current intertemporal allocation of beer and book efficient? Explain.  Which generation is the literary generation? What is the efficient allocation of book between the two generations?

**Answer:**  No, it is not efficient because it is possible to change the allocation of beer and books between the two generations and make one generation better off without making the other

generation worse off. For example, if generation 2 gives generation 1 one book in exchange for one case of beer, generation 2 will remain at the same level of welfare. However, generation 1 will be made better off. How do we know this? Given generation 1's rate at which they are willing to exchange books for beer, if they give up one case of beer they will only need to be compensated a half of a book to remain at the same level of welfare. But in the one to one exchange with generation 2 they receive one book, so generation 1 is made better off by this exchange.

If generation 2 gave generation 1, 3/4 of a book in exchange for a case of beer, both generations would be better off.

If generation one has all of the books and generation 2 has all of the beer, the allocation would be efficient. Are there other efficient allocations?

30. Make an argument that criminal law can be used to internalize negative externalities.

**Answer**: Simply put, negative externalities exist because the private marginal cost of producing the negative external effect is less than the social marginal cost, and the externality can be internalized by increasing the private marginal cost so that it equal to social marginal cost at the efficient level of the external effect. There are many ways to do this. One is with a tax, another is with criminal law. The efficiency justification for criminal law is that it increases the private cost of producing negative external effects; I might go to jail, or worse. When I take this into account, I reduce the amount of the effect I produce. For example, I assault fewer people because I worry about getting caught and going to jail. "Don't do the crime unless you can do the time." The difficulties, as with a pollution tax, include monitoring the level of the external effect you produce, and setting the tax/penalty at just the right level.

31. I smoke, and you suffer from the second-hand smoke. Property right with respect to smoking are not well defined, and there is no regulation of smoking; I am smoking an inefficient amount (too much) – there is an externality-type market failure. The government "feels for you" so compensates you for the damages you are incurring from the smoke (pays you a dollar amount such that your total utility ends up being what it would have been if I did not smoke). Has efficiency been achieved? Yes or No? Explain your answer.

**Answer**: the inefficiency remains. The problem is that I smoke too much from society's perspective (the net benefits to society of my last cigarette smoked is less than the net benefits to me (the pleasure I get from the cigarette), so society's net benefits would go up if I smoke somewhat less. Compensating you for my second-hand smoke, while maybe a nice thing from an equity point of view, does nothing to encourage me to take account of the damage to you when I smoke. After the compensation, the net benefits to me from my last cigarette are still greater than society's net benefits from my last cigarette.

Think of it this way. Even after the government gives you a bunch of money there is still the potential for us to enter into an exchange trade (I smoke less and you pay me off) such that both

of us will be better off.  In fact, after the compensation there is likely more potential for such an efficiency increasing exchange because you now have more money so a higher WTP to reduce the amount of second-hand smoke you incur.

Said another way, even after the compensation, the net benefits to me from my last cigarette are zero, so I gained nothing from smoking it, and you are made worse off by it, not an efficient thing.

Comments on some of your answers: A few are still quite confused on how to determine whether an allocation is or is not efficient, and this caused those in the confused group to get things backwards on this question.
First I will state the confusion in general terms and then as it applies in this case. If it is possible to make someone better off without making someone else worse off the current allocation is inefficient. Everyone seems to understand this. If an action is then undertaken that makes one party better off and no other party worse off this action is a Pareto Improvement. We all seem to understand this. However, just because one Pareto Improvement has occurred does not mean there is not the potential for more. Or said differently, things might still be efficient. Consider, for example, two people on a desert Island, you and me. You have good wine and lots of white truffles (you hate both, but I love both). I, on the other hand, have two things I hate but you love: bud light and pickled herring. We trade the wine for the bud light making us both better off (there has been a Pareto Improvement). But at this point the allocation is not efficient because there is still the potential for another Pareto Improvement (we trade the pickled herring and the truffles).

So, what does this have to do with the government compensating you for the damages from my second-hand smoke? The compensation makes you better off without making me worse off (OK fine) but things are not efficient after the compensation because there is still the potential to make one or both of us better off without making the other worse off. Efficiency only exists when all of the potentials have been exhausted.

For those of you still suffering from some confusion, consider the term *fully grown*.  It means that one will grow no more; there is no more *potential* for growth. Now consider a small child. That child is not fully grown because she will grow more (potential for growth remains). If between the ages of 6 and 7 the child grows 3 inches, we would say that some of the potential growth has been realized but we would not say the kid is fully grown – potential remains.  As long as there is potential to make some members better off and none worse off, the allocation is not efficient. The fact that there have been some efficiency gains, does not mean there is not potential for more gains. As long as potential exists, the allocation is not efficient.

32. Can bad weather be a failure of the market? Yes or no. What is the critical determinant of whether it can be a market failure?

33. I live in the woods with Goldilocks and three bears.  Goldilocks and I recently inherited a bunch of stuff.  After receiving the UPS boxes of stuff, we traded our dead relatives' trinkets until the only exchanges between the two of us that would make one better off would make the other worse.   However, if either Goldilocks or I then trade some trinkets for honey with the bears

both parties to that trade can be made better off without hurting the non-trading person. Assume everyone can enforce their property rights.

Before the trade with the bears, is society's allocation of stuff efficient? Yes or No and explain.

Now consider another scenario.

I live in the woods with Goldilocks and three bears. Goldilocks and I recently inherited a bunch of stuff. After receiving the UPS boxes of stuff, we traded our dead relatives' trinkets until the only exchanges between the two of us that would make one better off would make the other worse. However, if either Goldilocks or I then give the bears some trinkets for some honey, the bears are made better off, but the person is not made better off or worse off by the exchange. Assume everyone can enforce their property rights.

Before the exchange with the bears, is society's allocation of stuff efficient? Yes or No and explain.

34. Assume the market demand curve for a particular good is fully coincidental with the marginal social benefit function and can be described by $MSB = 24 - 2Q$, where q refers to the quantity of the good. Assume the good is produced by a monopolist. Further assume the marginal private cost of production can be described by $MPC = x$ (where x is some specific dollar amount), and that marginal social costs are always double the marginal private costs. Graph the functions and algebraically determine the market level of output and the efficient level of output from society's perspective. What is the efficient level of output from the monopolist's perspective?

**Answer:** In this question there are two market failures: monopoly power and the wedge between the MPC and MSC of production. Ceteris paribus, the wedge between MPC and MSC causes overproduction from an efficiency perspective. Ceteris paribus, the monopoly power causes underproduction. Either effect could dominate the other, or they might just cancel each other out with the result that the allocation is efficient.

Note that $MSB = 24 - 2Q$ is both the marginal social benefits curve and the demand curve for the product; that is $MSB = P = 24 - 2Q$. Therefore $TR = (24 - 2Q)Q$, and MR from the firm's perspective is $24 - 4Q$. The monopolist firm will choose that Q which equates MR and MPC. The profit max amount is the efficient amount from society's perspective. The efficient level of output from society's perspective is at the Q which equates MSB and MSC.

Note that MPC is a constant x and $MSC = 2x$. So, monopoly profits are maximized at the point where $24 - 4Q = x$. Solving, one gets $Q_{monop} = 6 - x/4$. The efficient level from society's perspective is where $24 - 2Q = 2x$. Solving $Q$ social $= 12 - x$. Whether the profit maximizing output or the efficient output from society perspective is larger depends on the magnitude of x. E.g. if $x = 1$, $Q_{monop}$ is 5.75 and $Q_{social}$ is 11. Alternatively, if $x = 10$, $Q_{monop} = 3.5$ and $Q_{social} = 2$. (If x is less than 8, $Q_{social}$ is greater than $Q_{monop}$.

35. You have no fire insurance and your neighbor is penniless. Assume that the minimum amount you would accept for your home is $250,000. Further assume that the minimum you would accept for the contents of your home is $25,000. You are on the way out the door to go bowling (your favorite pastime) when your crazy neighbor calls to say he will burn down your house in one hour (enough time for you to remove the contents but not enough time for the police or fire department to arrive - you live far from town). You consider the alternatives and go bowling rather than empty the house. How much are you damaged by the fire? How much do you value the bowling trip?

What did you learn by about the damages from injuries from answering this question?

**Answer:** If you go bowling, you lose the content of your home, which you value at $25,000. You rationally choose to bowl, which indicates you are better off bowling and losing the contents than saving the contents and missing the bowling, so the bowling trip is worth at least $25,000 to you.

The damage to you includes the $25,000, so are, at least, $275,000. If you had not optimized but stayed home and removed the contents you would have lost more ($250,000 plus the value of the trip)

Note the following:

Your house burns independently of whether you bowl

Your damages are the damages to you after you optimally react to the fact that your house will burn down. Damages to you would be greater than $275,000 if you had not gone bowling.

36. Pollution from a widget factory damages a lake-side resort. If the resort does nothing revenues and profits decline by $100. However, the resort can clean up the damages for $60. In which case, revenues remain the same and profits decline by only $40. How much is the resort damaged by the pollution?

**Answer:** $40. The damage is the reduction in maximum profits caused by the actions of the polluter. The polluter is not responsible for stupidity on the part of the resort.

37. I dent your car and it will cost $1000 to fix it. However, the minimum amount you would have to be paid to live with the dent is $5. How much are you damaged by my denting your car and why?

Answer: $5. You are indifferent between getting the dent fixed and getting $5. If you were paid more than $5, you would be better off because I dented your car.

38. Do common property resources always cause the allocation of resources to be inefficient? Yes or No and explain.
**Answer**: Common property causes inefficiency only if the resource is scarce (most are). If a resource is not scarce, efficiency dictates that access to it is uncontrolled. That is, it should be

free. If, for example, a monopolist controlled access to it creating an artificial scarcity and then sold it a positive price, a market failure would occur. Note that all resources started out as common property resources and this was not an issue when supply was great, and demand was low. However, over time the scarcity of many resources increases, increasing the need to solve the common property problem. As an aside, some of you mentioned outer space and sunlight as examples of common property resources that are not scarce. Orbital slots around the earth are quite scarce and access to them is regulated by an international body. Sunlight is also scarce (consider night, winter, and sites far from the equator). Some sites have better access to sunlight (the "sunny side of the street") and buildings often block access to the sun. There is often market for access to sunlight. I used to live in a condo where units on the south side of the building sold for much more than units on the north side. People pay big bucks to get access to the sun in the winter. The price of farm land depends on the length of the growing season and average temperatures.

29. Assume a world that will last only one period and that it has only one good, x, which is in fixed supply. Assume society consists of N members. Define an efficient allocation of x. Describe trade in this society. Further imagine that some members are able to steal x from other members. Assume that if you are stolen from you don't get hurt or mad, so are only worse off because you have less x to consume. What, if anything, can one say about the allocation of x after all the stealing is over? Does stealing cause a market failure, is it an externality?  Explain.

**Answer:** The allocation of x is efficient if the only way to reallocate x to make one member of society better off requires that another member be made worse off. Note that all possible allocations are efficient, assuming that all of the supply of x is allocated (implicit in the assumption that the supply is fixed) and everyone consider x to be a good. There will be no trade. There is nothing to trade. After the painless stealing, the allocation will also be efficient. Did the stealing cause inefficiency? No. There is no market failure. There really is no market. I would say that there is no externality. From an efficiency point of view the stealer has the correct incentive with respect to achieving efficiency, so I would argue that one cannot argue that the stealers are not correctly taking there actions into account with respect to efficiency. Stealers can't mess it up on efficiency grounds. Of course, stealing might be considered grossly unfair. Some further thoughts: Externalities are causes of market failure, so, in this sense, are a "type of market failure". However, externalities can be produced by economic agents that are not operating in a market context. Note that one could answer the question assuming more x becomes a bad for some individuals at some quantities. In that case, all allocations are not efficient. If some individuals have too much x they could give some of their x away making themselves and the receiver better off.  But, even in this case, the stealing would not cause inefficiency; people who had too much would not steal.  Hopefully the stealers would steal from those who have too much.

40. Part 1: The world consists of only cats and mice. Each group has plenty to eat and their own separate homes, but spend the afternoons together (1:00 to 3:00 p.m.) – play time. During play time, cats have two options: sleeping and torturing mice. Cats always prefer torturing to sleeping. Assume they don't eat or kill the mice – remember, the cats have plenty to eat. The mice have been genetically engineered to love only torture – always preferring torture to sleep - they are masochists. (Assume the mice are not capable of torturing each other or bothering the cats.) If a

mouse is not being tortured, it sleeps - the next best thing to torture. Describe an efficient allocation of everyone's play time. Is there more than one efficient allocation of time? Does you answer depend on whether the cats but not mice are members of society? Does your answer depend on whether the mice but not the cats are members of society? Explain your answers. Is efficiency likely to be achieved?

**Answer to part 1**: There is only one efficient allocation of play time; the cats torture the whole time. In explanation, if the cats are not spending all of their playtime torturing, it is possible to make both the cats and mice better off. Only when all the time is spent in torture does it become impossible to make everyone better off.

Efficiency will be achieved, everyone wants the same thing.

In this case, the efficient allocation does not depend on whether only cats are members of society, only mice, or both. If only mice are members, the efficient allocation of time is all torture. If only cats are members the efficient amount of time is all torture.

**Consider how the answer to Part 1 would change with different assumptions**: If we did not know the preferences of the cats and/or the mice, we would not be able to determine whether an allocation was efficient – we would not know what makes a member better or worse off. The same is true in for U.S. society, if we don't know everyone's preferences we are incapable of telling whether an allocation is, or is not, efficient.

If cats are indifferent between sleeping and torturing, then the answer to which allocation(s) are efficient depends on who is a member of society. If both cats and mice are members, then there is only one efficient allocation: all torture all of the time. If cats are members but mice are not, then all allocations of torture are efficient. If mice are members but cats are not, the only efficient allocation is all torture.

**Part 2**: Now assume the cats have lost their love for torture, preferring to sleep through play time; they can sleep through anything. Assuming that both cats and mice are members of society, describe an efficient allocation of playtime in this situation. Is the efficient allocation of time unique? Is efficiency likely to be achieved?

**Answer to Part 2**: Every possible allocation of cat time between sleeping and torturing is efficient. For example, if the cats sleep the whole time, the allocation is efficient, and if the cats spend the whole time torturing mice the allocation is efficient. The cats would prefer the allocation where they get to sleep the whole time. The mice would prefer any allocation where the cats torture rather than sleep and the more torture the better. Efficiency will be achieved because every allocation is efficient.

One might ask what the mice will do when the cats are asleep. Efficiency requires that the mice allocate their time when the cats are asleep such that the only way one or more mice can be made better off requires that other mice be made worse off. Efficiency requires that they sleep as well.

**Part 3**: How would answer to the last question differ if the cats were not members of society? With no intervention (by a government or central planner), will the equilibrium allocation be efficient.

**Answer to Part 3**: The efficient allocation would require the cats spend all of their playtime awake torturing the mice. If there is no intervention, the equilibrium allocation will be cats asleep and no torture. This is inefficient if only the mice are members of society. Efficiency will be achieved only if an outside party forces the cats to remain awake and torture.

**Part 4**: Now assume cats always prefer torture and mice always prefer sleep. Discuss efficiency in this context. If there is no outside interference will efficiency be achieved?

**Answer to Part 4**: What is an efficient allocation depends on who is a member of society. If cats are and mice are not, there is only one efficient allocation, all torture all of the time. And, yes it will be achieved.

If mice are members of society but cats are not, there is only one efficient allocation: no torture, ever. Is this likely to be achieved? No, the cats will torture the mice unless some outside force stops them.

If both mice and cats are members, every amount of torture is efficient. And, since every allocation is efficient, efficiency will be achieved.

**Final thoughts:** Keep in mind that there are an infinite number of allocations of playtime, going from zero torture to all torture. So, in the question you needed to tell me which were efficient in which situations, and whether they would likely be achieved. Given that there are an infinite number of allocations, I don't know which one you are talking about if you refer to an allocation as "it" or "the allocation". You can't just say, "The allocation is efficient" – you have to make sure the reader knows what specific allocation you are talking about.

41. (A) Define what is meant by the term "market failure" (Don't define market failure by example)

(B) Now define one specific type of market failure that plagues the natural resource/environmental sector of the economy.  (Your definition of a specific type of market failure should also be example free)

(C) Explain, as if to another individual in this class, the impact this specific <u>type</u> of market failure will have on the allocation of resources.

(D) Now give an example of this type of market failure in the natural resource/environmental sector.

 (E) Now discuss two ways the government might correct your example of market failure.

**Answer:**

(A) A *market failure* is something inherent to the market system that causes the market equilibrium allocation of resources to be inefficient.

An important distinction is the distinction between *market* and *nonmarket* failures. Consider a world of no market failures (externalities, etc.), but where the market equilibrium allocation of resources is inefficient, because of a government price control. In this case, the allocation of resources is inefficient, but it is not a failure of the market. If left to its own devices, the market allocation would have been efficient. The inefficiency was imposed on the market by an outside agent (the government), so the market cannot be blamed. This is a *nonmarket failure*. A lot of people feel the government is the author of many nonmarket failures.

Further note that the market has not failed if the equilibrium allocation is efficient but not fair. Markets did not evolve to achieve fairness. They cannot be deemed failures for failing to achieve something not in their job description.

The word "inherent" is important.

(B) Market failures include: ill-defined property rights (including, but not limited to common property), lack of complete markets (including, but not limited to the lack of futures markets) externalities, excess market power (monopoly and oligopoly power), public goods, and distortions in the capital markets.

(C) I chose externalities as the type of market failure that I will discuss.

Externalities: There is an externality if an economic agent(s) does something that directly influences (not indirectly through market prices) some other economic agent(s) and there is the potential to make one of the parties better off without making some of the others involved worse off. Or, equivalently, there is an externality if an external effect is produced at an inefficient level.

Examples of externality-type environmental market failures abound.

The biggest omission in answers to part (C) was the complete absence of a definition. For example, simply saying that "Externalities can be positive or negative." is not a definition.

Ceteris paribus, an externality is an external effect produced at an inefficient level. If an economic agent's actions produce a positive or negative effect on others but the agent producing the effect does not have an incentive to fully take the effect into account, the agent will not produce the effect up to the point where the marginal benefit to society from the last unit produced equals the marginal cost to society.

Individual agents produce thing up to the point where the marginal benefit to the agent equals the marginal cost to the agent (this maximizes the agent's net benefits from the action). If marginal private benefits equal marginal social benefits and marginal private costs equal marginal social costs, the agent will produce the efficient amount from society's perspective, even though the agent is pursuing only his or her own interests.

When the agent's actions involve an external benefit or costs that he or she is not internalizing, a wedge is driven between marginal private and social benefits and/or marginal private and social costs. In this case, there is a divergence between what is best for the individual and what is best for society.

In part (C) it is important that you show that the market allocation will be inefficient in the presence of the type of market failure you specified. To do this, you need to show that at the market equilibrium allocation social efficiency is not achieved because of the market failure. One could accomplish this by demonstrating that at the market equilibrium, marginal social costs of production (or consumption) do not equal marginal social benefits, implying the commodity is either overproduced (too much consumed) or under-produced (too little consumed).

(D) Unregulated and untaxed smokestack emissions, absent Coasian bargaining, are an example of a negative externality.

Note that the presence of pollution does not imply the presence of an externality. There is no externality if the pollution (the external effect) is at its efficient level. So, your answer better not be "pollution."

Don't confuse an external effect and an externality.

42. Society consists of you and me. A move from allocation A to allocation B makes you better off and me worse off. Allocation A is efficient. Is this last statement necessarily correct? Yes or no, and explain. Allocation B is efficient. Is this last statement necessarily correct? Yes or no, and explain.

**Answer**: Part 1: No. There is not enough information to tell whether A is or is not efficient. Use a utility-possibilities frontier to show examples.

See the counter-example $A_1$ to $B_1$ demonstrating that point A need not be efficient.

Part 2: No. One cannot tell whether B is efficient—it might or might not be—and one cannot even say whether it is more or less efficient than A.

See the counter-example $A_1$ to $B_2$ demonstrating that point B need not be efficient

Grading
3 points for each "no", even if your explanation made no sense to me.

Two points for each explanation. If you answered "yes" to a question you can't get explanation points.

If you simply say the answer is no and do not proved an explanation of why it is no (for example, you simply say, "It is not necessarily efficient."), you did not get points.

Many of you, even those who correctly answered "no" to each part, said things that indicate the concept of efficiency is not understood.

Be sure I will ask about efficiency again.

43.