

- A total of 61 points is available (+3 extra credit)
- Discounting formulas are given on the back of the exam

*I understand that—under the UC Davis code of academic conduct—it is my responsibility as a student not to seek an unfair advantage over others by cheating, or by talking or allowing eyes to wander during exams.*

signature (optional): \_\_\_\_\_

Questions 1-10 are to be recorded on your scantron sheet. **Only the scantron will be graded** so make sure your answers are recorded carefully there. Standard scantron guidelines apply. You must:

1. use the UCD 2000 form
2. use pencil, pencil, pencil
3. bubble in your student ID number
4. bubble in a test form—you have **Test Form A**
5. erase stray marks fully. No stray marks in the row of black lines along the left margin.

**True or false:**

On your scantron, record (T)rue or (F)alse for EACH statement below. 2 points each.

- T F 1. Increasing the discount rate ( $r$ ) results in a smaller present value of net benefits ( $PVNB$ ) when a project generates high immediate costs and delayed benefits.
- T F 2. If one alternative in a set has the highest benefit-to-cost ratio we know it's the option that maximizes net benefits.
- T F 3. Compliance cost includes abatement cost as well as other costs, like making changes to a production process.
- T F 4. While Garrett Hardin argued that common property often leads to the "tragedy of the commons", Elinor Ostrom challenged the conventional wisdom that (1) common property is both poorly managed and (2) should be completely privatized or regulated by central authorities.
- T F 5. As described in the arsenic case study and discussed in lab, the EPA was focused on identifying the arsenic standard that maximized net benefits.

**MULTIPLE CHOICE:** On your scantron, record the **single, best** answer. **2 points each**

6. Stand-still traffic on a non-toll freeway due to congestion is an example of

- A. Free-riding
- B. Over-use of an open access resource
- C. Under-provision of a pure public good
- D. All of the above.

7. Regression analysis entails estimating

- A. the relationship between one variable and another single or set of variables
- B. the degree to which lower income groups are disproportionately affected by a policy.
- C. factors that decrease the divergence between willingness to accept and willingness to pay.
- D. the value of future dollars in today's dollars, accounting for inflation.

*For questions #8 and #9:* You overhear two classmates—Alice and Corina—talking about how the example midterms for ESP 162 have a copyright message on the bottom of each page prohibiting transfer of the exams by any medium. Despite this, Alice anonymously uploads the file to a website and is rewarded with greater access to materials for other courses. Corina thinks this is a bad choice because this will cause the professor to stop sharing future exams with future students in the same class. Alice responds that she doesn't care.

8. The deviation between Alice's action and the choice that is ideal for students in the long run can be explained by the presence of

- A. a negative externality
- B. a rival good
- C. bounded rationality
- D. bounded self-interest

9. Corina's perspective is consistent with which of the following:

- A. the invisible hand
- B. a rival good
- C. bounded self-interest
- D. bounded willpower

10. In class we discussed research assessing how the burden of a gasoline tax might fall on various income groups. When the majority of the burden falls on *higher* income groups (instead of lower income groups) this is called

- A. recessive
- B. progressive
- C. digressive
- D. regressive
- E. compressive

<<<<<<<< For the remainder of the exam, record your answers in the space provided. >>>>>>>>

**FILL IN THE BLANK:** Enter the correct word or phrase in the blank space. **2 points each**

**Question 11.**

If you calculate the cost of attending UC Davis using only the bills you have to pay (tuition and fees, room and board, health insurance, and books and supplies) you are missing the full set of \_\_\_\_\_ costs.

**Question 12.**

Under \_\_\_\_\_ ethics an action is judged by its intrinsic rightness based on a duty or moral obligation. Alternatively, teleological ethics judges an action based on \_\_\_\_\_  
\_\_\_\_\_.

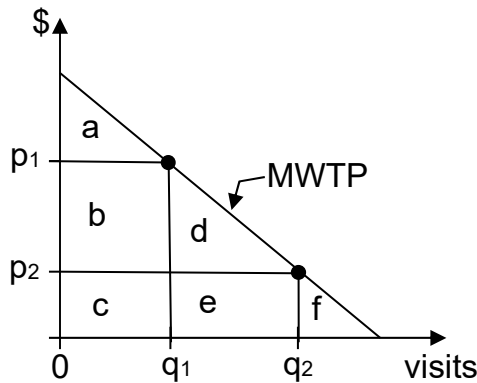
**SHORT ANSWER:** Answer in the space provided. Make sure to show your work for calculations.

**Question 13. 2 points**

In the “The Colbert Report” video on VSL we watched in class, Stephen Colbert remarks that, when the EPA changed their estimate of the VSL from \$7.8M to \$6.9M, they “lowered the value of a person”. As discussed in class, briefly explain (1) the way in which this statement is inaccurate or misleading and (2) a better interpretation of what the VSL actually reflects. **(3 sentences or less.)**

**Question 14. 3 points**

Suppose you are asked to interpret the results of a travel cost survey. The figure below presents data for two families (1 and 2), including their travel cost per trip ( $p_1, p_2$ ) and the number of trips they take ( $q_1, q_2$ ). Assume that the families are identical except for their travel costs. The figure below also presents a marginal willingness to pay (demand) curve, assuming that it is given by a straight line intersecting the two points.



Consider family 1 experiencing this amenity--what area characterizes the:

A. total benefits?

B. total costs?

C. net benefits?

**Question 15. 4 points**

In 2015, Volkswagen was caught using a “cheat device” in their diesel vehicles. The cars detected when they were being emissions tested and regulated their performance in order to appear in compliance with emissions standards. On the road, the cars saw performance and fuel economy improvements at the expense of increased NOX emissions. NOX reacts with ozone to form smog, an air pollutant toxic to humans that contributes to premature death.

(For both questions below, **write the numerical expression for the answer**, i.e. the expression you would enter into a calculator.)

- A. Before the cheating was discovered, suppose that Volkswagen thought they would get caught and fined \$200M (M=million) with probability 0.01, caught and fined only \$500K (K=thousand) with probability 0.05, and not caught (and not fined) with probability 0.94. In this scenario, what is the expected fine for Volkswagen?
  
  
  
  
  
  
  
  
  
  
- B. Suppose that this action increased the risk of premature mortality for everyone in the United States, 300M people, by 0.0001. Also suppose our estimate of the value of a statistical life (VSL) is \$7M. What is the expected welfare loss of premature mortality?

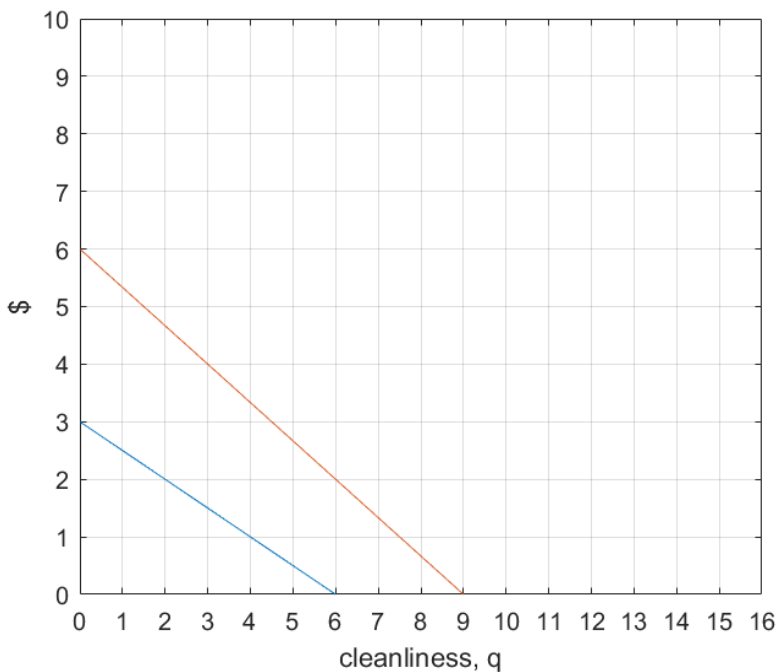
**Question 16. 4 points**

- A. You plant an acre of trees that you expect to cut in 30 years. It will cost \$50,000 to cut the trees which will sell for \$90,000. What is the present value of net benefits, given a discount rate of 4%?  
**(Write the numerical expression for the answer, i.e. the expression you would enter into a calculator.)**
  
  
  
  
  
  
  
  
  
  
- B. Suppose instead that you have an existing stock of trees. You harvest some every year at a cost of \$15,000 and revenue of \$20,000. You expect your first harvest to start one year from today, and to stop after 25 years. What is the present value of net benefits, given a discount rate of 4%?  
**(Write the numerical expression for the answer, i.e. the expression you would enter into a calculator.)**

**Question 17. 6 points**

Ernst and Pierce are officemates who both value the quantity of cleanliness ( $q$ ) in their shared office. However, Ernst values this cleanliness more. The marginal willingness to pay (MWTP) curves for cleanliness for both Ernst (MWTP<sub>E</sub>) and Pierce (MWTP<sub>P</sub>) are depicted in the figure below. Assume that office cleanliness is a *non-rival* good.

- Place the labels “MWTP<sub>E</sub>” and “MWTP<sub>P</sub>” next to the appropriate curves in the figure.
- Draw the aggregate marginal willingness to pay for cleanliness over the two housemates. Label it “AMWTP”. (Make sure that every segment of your AMWTP curve is clear.)
- Suppose that when  $Q=0$ , the marginal cost curve is equal to \$4. Also suppose that each additional unit of cleanliness is *increasingly costly* to provide (i.e. we have “increasing marginal costs”). Draw a marginal cost curve that is consistent with this information and label it “MC”.
- In the figure, along the horizontal axis label the level of cleanliness that maximizes social (household) net benefits with “Q\*”. Label with “Q<sub>P</sub>” and “Q<sub>E</sub>” the amounts that Pierce and Ernst would each rationally and individually provide on their own (without a housemate).
- With both housemates present (and without negotiation between housemates) the predicted level of cleanliness is given by what quantity (Q\*, Q<sub>P</sub> or Q<sub>E</sub>)?



**Question 18. 7 points**

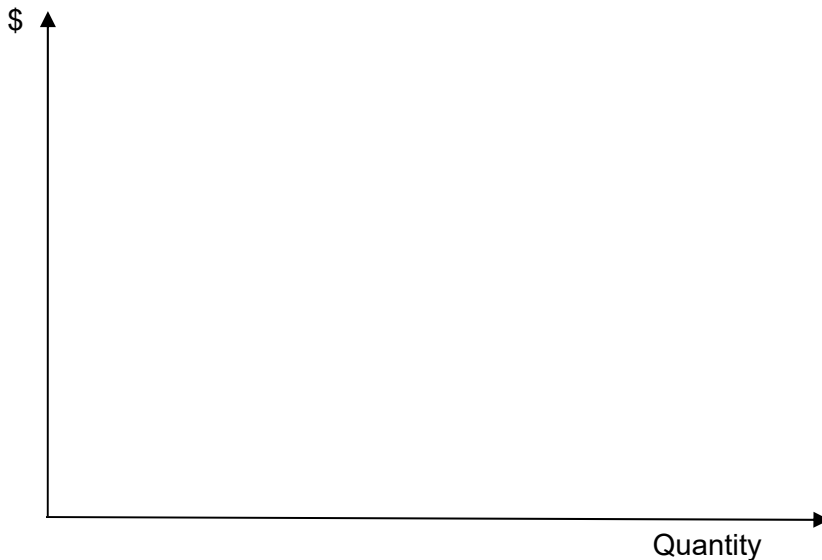
In the figure below, the horizontal axis reflects the level of use of an open access resource. In the figure, draw the following elements:

- i. A demand curve that reflects a decreasing marginal benefit for each unit of use—label it “**MB**”.
- ii. A curve depicting constant marginal private costs of using the resource (i.e. the incremental cost is the same as more units are used)—label it “**MPC**”.
- iii. Suppose each additional unit of use generates a constant marginal external cost. Draw a marginal social cost curve that reflects with this assumption—label it “**MSC**”.
- iv. Identify and label in the figure:
  - a. The socially efficient rate of output—label it “**Q\***”.
  - b. The predicted market rate of output—label it “**Q<sup>P</sup>**”.
- v. Add a letter or letters to the figure to represent area(s) as needed to answer this question:

The *social* net benefits at the socially efficient rate of output are given by:

- vi. Explain in **plain English** why social net benefits start to decline at quantities **greater than Q\***.  
(two sentences or less.)

[\*\*Assume that the MB and MSC curves intersect at some point in your figure.]



**Question 19. 7 points.**

A. Name, define and provide an example for each of the two *main* types of economic value for non-market goods:

1. Name: \_\_\_\_\_

Definition (one sentence):

Example (one sentence):

2. Name: \_\_\_\_\_

Definition (one sentence):

Example (one sentence):

B. Describe two differences between the two main types of environmental non-market valuation methods, abbreviated S.P. and R.P. (two sentences):



**Question 20. 4 points**

Two countries are considering their strategic choices with respect to managing a resource that affects both countries. The matrices below show their payoffs from making a decision to either contribute to managing the resource or shirking instead. In each cell, the first number in parentheses is the payoff to Country 1 and the second number is the payoff to Country 2.

- a. Define a Nash Equilibrium (**2 sentences or less**).
  
  
  
  
  
  
  
  
  
  
- b. Which matrix below depicts a set of payoffs for which the Nash Equilibrium would be consistent with the “Tragedy of the Commons” as discussed in class? **CIRCLE ONE.**

Payoff matrix 1

		Country B	
		Contribute	Shirk
Country A	Contr.	(4,4)	(1,3)
	Shirk	(3,1)	(0,0)

Payoff matrix 2

		Country B	
		Contribute	Shirk
Country A	Contr.	(1,2)	(-1,4)
	Shirk	(4,-1)	(0,0)

Based on the payoff matrix you selected above:

- c. Identify the Nash Equilibrium action of Country A: \_\_\_\_\_  
and Country B: \_\_\_\_\_

**EXTRA CREDIT. (up to 3 points)**

Briefly define the First Theorem of Welfare Economics and then explain how it can be used to support the case for government intervention in the form of environmental policy. **(3 sentences or less)**

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**REFERENCE ONLY: DISCOUNTING FORMULAS**

1. Present value of a single future value  $FV_t$  from some future period  $t$ :

$$PV = FV_t \left[ \frac{1}{(1+r)^t} \right]. \quad (1)$$

2. Present value of a stream of constant future values  $\overline{FV}$  starting at  $t = 1$ ,  
a. over an *infinite time horizon* (forever):

$$PV = \sum_{t=1}^{\infty} \frac{\overline{FV}}{(1+r)^t} = \frac{\overline{FV}}{r}. \quad (2)$$

- b. over a finite time horizon ( $T$ ):

$$PV = \frac{\overline{FV}}{r} - \frac{\overline{FV}}{r(1+r)^T} = \frac{\overline{FV}}{r} \left( 1 - \frac{1}{(1+r)^T} \right). \quad (3)$$