

- A total of 60 points is available (+2 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 C**
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)true or (F)alse for EACH statement below. **2 points each.**

- T F 1. In a *travel cost survey*, there is a danger of over-estimating an individual's willingness to pay for an environmental good due to hypothetical bias.
- T F 2. The utilitarian perspective is consistent with teleological ethics.
- T F 3. In the context of addressing the Tragedy of the Commons, the conventional economic wisdom has emphasized the role of community members in the process of decision making and the need to invest in the capacity of resource users to self-organize while political scientist Elinor Ostrom and collaborators have emphasized the importance of top-down management including establishing property rights.
- T F 4. As discussed in the Jolls et al. (1998) article: behavioral economics observes that (1) people may use of rules-of-thumb to make economic decisions to compensate for cognitive limitations, and (2) this does not mean that behavior is random or impossible to predict.
- T F 5. In the "taxonomy of costs" discussed in class—which had four levels of analyzing policy costs—the notion of "abatement cost" was the hardest to estimate and most comprehensive.

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

6. Which of the following is not an example of an externality?
- A. Your sibling steals your socks to upset you.
 - B. Your roommate leaves the kitchen dirty after making lunch.
 - C. Your neighbor plays terrible music that irritatingly comes over your fence.
 - D. Your neighbor plays enjoyable music that pleasantly comes over your fence.
7. Which of the following is (are) always true about a measure of individual willingness-to-pay (WTP) for a change in environmental quality?
- A. It requires an actual payment be made
 - B. It reflects anthropocentric values
 - C. It is equal to willingness-to-accept (WTA) for the same degree of change.
8. Your classmate argues that, regardless of the outcome of the arsenic in drinking water cost-benefit analysis, it is just intrinsically wrong to allow any arsenic to be present in drinking water because the government has a duty to protect the health of the people. This argument reflects what perspective(s) on making choices?
- A. egalitarian ethics
 - B. teleological ethics
 - C. deontological ethics
 - D. consequentialism
9. The first theorem of welfare economics (FTWE) states that
- A. A market economy will result in a (Pareto) efficient outcome regardless of the conditions.
 - B. A market economy will result in a (Pareto) efficient outcome if a series of conditions are met.
 - C. A centrally planned economy will be (Pareto) efficient if there are no externalities.
 - D. A centrally planned economy will be (Pareto) efficient if there are externalities.
10. The idea that people do not have unlimited abilities to process all the information needed to make rational choices is known as
- A. Bounded rationality
 - B. Bounded willpower
 - C. Bounded self interest
 - D. Bounded computation

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

Question 11. When evaluating a policy, such as a gasoline tax, we call it regressive when the costs fall heavily (i.e. disproportionately) on _____.

Question 12. A rival and non-excludable good is known in general as a(n) _____ . Alternatively, a non-rival and non-excludable good is known in general as a(n) _____ .

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

Question 13. 3 points.

Suppose there are two different occupations that are identical except for the annual risk of death on the job and the annual wage.

Occupation 1 -- wage: \$50,000; risk of death: 1×10^{-6}

Occupation 2 -- wage: \$50,050; risk of death: 3×10^{-6}

What is the value of statistical life implied by this data? (Write out the expression that you would type into a calculator—no need to simplify.)

Question 14. 7 points

A. State and define the two main types of methods or tools used for environmental valuation:

1. _____ Definition (one sentence):

2. _____ Definition (one sentence):

B. Explain the difference between use and non-use value (one or two sentences):

C. In the table below:

- i. **Write in the two valuation methods** you identified in part A of this question (initials are fine).
- ii. In **each of the 4 cells**, circle “YES” if it is possible to apply that valuation method for that type of value, and “NO” otherwise.

	<i>Valuation method 1:</i>	<i>Valuation method 2:</i>
<i>Use value</i>	YES / NO	YES / NO
<i>Non-use value</i>	YES / NO	YES / NO

Question 15. 3 points

A. To find aggregate demand for a non-rival good, individual demand curves are summed (**CIRCLE ONE**)→ HORIZONTALY / VERTICALLY.

B. This is because (**two sentences or less**):

Question 16. 5 points.

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.	(0,0)	(-2,4)
	Shirk	(4,-2)	(2,2)

Payoff matrix 2

		Country B	
		Contribute	Shirk
Country A	Contr.	(2,2)	(-2,3)
	Shirk	(3,-2)	(0,0)

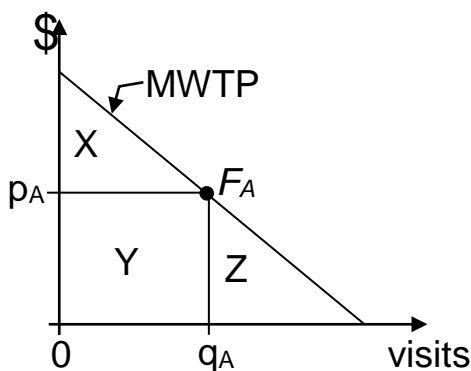
Based on the payoff matrix you selected above:

C. Identify the Nash Equilibrium action of Country A: _____

and Country B: _____

Question 17. 2 points

Suppose that the MWTP curve in the figure below represents the marginal willingness to pay for households visiting Yosemite National Park, as estimated using a travel cost survey. The travel cost and number of visits demanded by one particular family, A, is represented by F_A . Using this information, what are the net benefits to family A from park visits? (Specify using one or more letters from the figure—put your answer in this box.)



Question 18. 4 points

Consider the stream of costs and benefits presented below. Note that it is consistent with the standard profile of costs and benefits for large investments in public projects as discussed in class.

	Cost	Benefit
Today	80	0
One year from now	0	5
Two years from now	0	40

- A. Assuming a discount rate of 3%, what is the project's present value of net benefits (PVNB)? Write your final answer in a single numerical equation.
- B. Suppose instead the discount rate is not 3% but something higher—would we expect the PVNB to go up, down, or stay the same? Why? (2 sentences or less).

Question 19. 3 points

Suppose that you are considering investing in an oyster fishery. You are uncertain about the costs of producing oysters because ocean acidification in the future (from carbon dioxide emissions) will make it harder for oysters to grow shells in sea water. Because of this you don't know whether costs will be low, medium, or high. The costs to raise your oysters and their probabilities are summarized in the table. The benefit of producing the oysters is known with certainty (you have pre-negotiated sales contracts for the product): the benefits from the product will be \$7 million.

Outcome	Cost (\$ millions)	Probability
Low impact	4	0.25
Medium impact	8	0.25
High impact	10	0.5

Calculate the expected net benefits (**show your work**) and state whether the investment is an efficient alternative to the status quo:

Question 20. 9 points

The figure below shows the market for a good in the presence of an externality (e.g. from pollution generated by production of the good). There are curves reflecting the marginal benefit (MB), marginal private cost (MPC) and marginal social cost (MSC).

- i. How does the size of the marginal external cost (MEC) from production change as more of the good is produced? **Circle one:**
 - a. The MEC increases
 - b. The MEC decreases
 - c. The MEC is constant (stays the same)

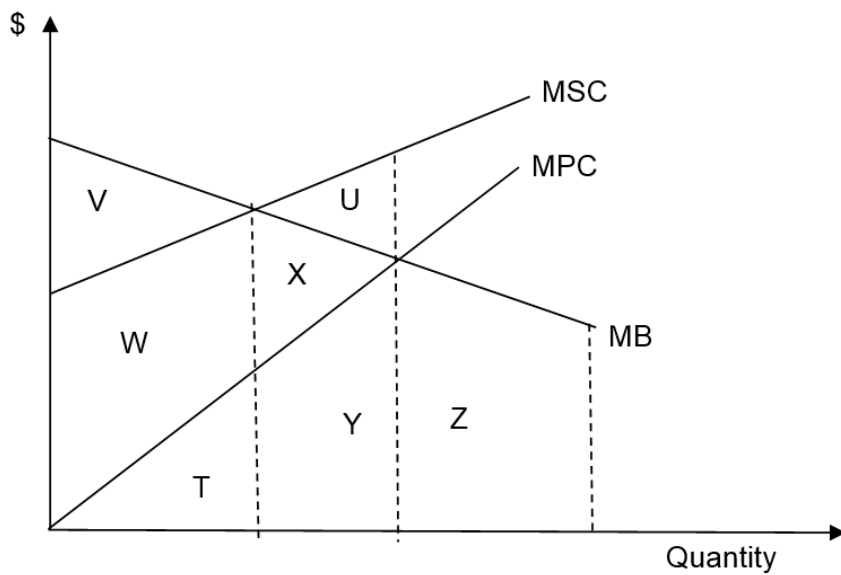
- ii. Identify and label in the figure:
 - a. The socially efficient rate of output—label it “Q*”.
 - b. The predicted market rate of output—label it “Q_P”.

iii. Add a letter or letters to the figure to represent area(s) as needed to answer these questions:

The *social* net benefits at Q* are given by:

The total external cost (total pollution damage) at Q* is given by:

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



EXTRA CREDIT. 2 points

Name **one of the two** different motivations for why future payoffs are typically discounted in cost-benefit analyses (as discussed in class and/or the reading from the EPA's Guidelines for Preparing Economic Analysis) and **briefly describe it** (1 sentence only).

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):

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