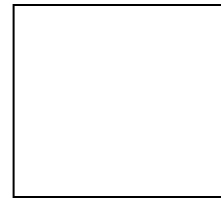


- A total of 66 points is available
- Discounting formulas are given on the back of the exam



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): _____

True or false:

Circle (T)true or (F)alse for EACH statement below. **2 points each.**

- T F 1. A proposed water treatment plant upgrade costs \$15M in the first year to build. The benefits of the upgrade start in year 2 and will accrue for decades. In calculating the present value of net benefits (PVNB), the higher the discount rate, the less likely the PVNB will be positive.
- T F 2. Use of rules-of-thumb to make economic decisions is one way people may compensate for cognitive limitations. Unfortunately rules of thumb may lead to unpredictable mistakes, making it impossible to predict economic decisions.
- T F 3. If our decision-making criteria is (Kaldor-Hicks) efficiency and a project's benefit-to-cost ratio is greater than one, then we know that the project is preferred to the status quo.
- T F 4. According to Fullerton and Stavins (1998), economists use only market prices to value non-market (environmental) goods.
- T F 5. In a contingent value survey, there is a danger of over-estimating an individual's willingness to pay for an environmental good due to hypothetical bias.
- T F 6. According to a National Public Radio story on our reading list (2015, "Obama Reluctant To Raise Federal Gas Tax") in 2015 interest in raising the gas tax began increasing due to the falling price of gasoline.
- T F 7. Compliance costs are less comprehensive than abatement costs.

MULTIPLE CHOICE: Circle **all** that apply. **2 points each**

8. Which of the following are examples of rival goods:
- A. Clean air on the Quad
 - B. A depleted fish stock harvested by commercial fishermen.
 - C. Hammocks on the Quad
 - D. Music on the radio
9. Which of the following **does not appear** in the list of characteristics of resource systems that are predictive of collapse as summarized by Ostrom (2009, “A General Framework for Analyzing Sustainability of Socio-Ecological Systems”)?
- A. very large, highly valuable, open-access systems
 - B. resource harvesters are diverse, do not communicate
 - C. resource harvesters have unequal ownership rights to the resource
 - D. resource harvesters fail to develop rules and norms for managing the resource
10. When the costs of a policy, such as a gasoline tax, fall disproportionately on lower income communities, we call the policy
- A. progressive
 - B. suppressive
 - C. regressive
 - D. impressive

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

Question 11. Giving a needy person money without the expectation of receiving a good, service, or repayment is an example of _____, which is one of the three main types of departures from rational behavior (as discussed in class and in the reading from Jolls et al. (1998).)

Question 12. Under _____ ethics actions are judged based on whether they are consistent with one’s duties and obligations; in contrast, under _____ ethics actions are judged based on their instrumental value in meeting a desirable goal.

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

Question 13. 3 points What is market failure and its most likely cause in environmental settings (as discussed in class and by the EPA’s Guidelines for Preparing Economic Analyses (2010))? **(3 sentences or less)**

Question 14. 7 points [Hint: read the whole question before starting to answer.]

	1.	2.
What are the two main types of economic value we hold for the environment?		
Describe an example of each type of value as provided <i>either</i> (1) on the UC Davis campus or (2) in a U.S. National Park. <i>(Be specific enough to ensure the value fits uniquely in one column but not the other.)</i>		
Name a specific valuation tool that you could use to value the particular amenity you identified above.		
Briefly describe data that you might collect to conduct the analysis you named directly above (briefly, what kind of data and how collected).		

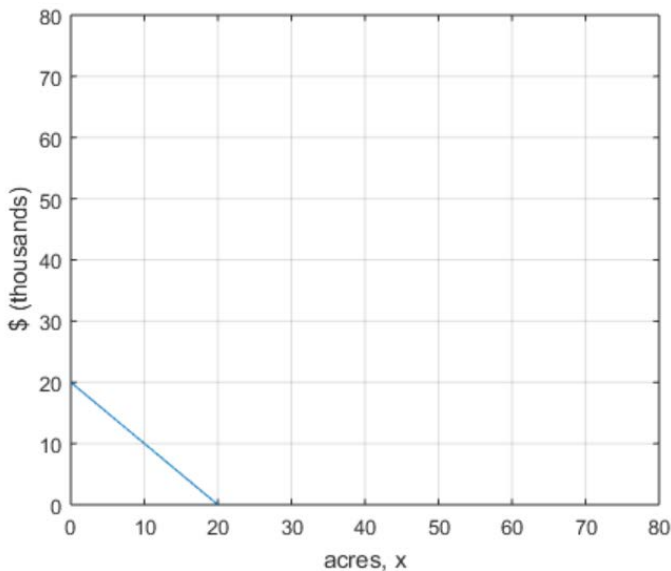
Question 15. 5 points. The curve presented in the figure below represents the marginal willingness to pay (MWTP) of a single household for city park space in their neighborhood. Suppose that there are only 3 such households in the neighborhood and each one derives exactly the same benefits from the park. Use of the park by one household doesn't diminish the capacity of the other households to enjoy the park as well.

A. **Draw** the aggregate MWTP for all three households combined in the figure and **label it AMWTP**.

B. Suppose each additional acre of park space can be supplied at a cost of \$10,000. **Draw** a marginal cost curve reflecting this assumption in the figure and **label it MC**.

C. How many acres of park would an individual household rationally provide on its own?

D. What is the socially efficient number of acres of park space? (Approximate value from figure is ok.)



Question 16. 4 points. Consider the following matrix of payoffs resulting from two individuals making strategic decisions. In each cell the payoff to Player 1 is listed first.

		Player 2	
		Contribute	Shirk
Player 1	Contribute	3, 2	1, 3
	Shirk	2, 1	2, 2

A. Does there exist a Nash Equilibrium (N.E.)? (**circle one**) yes / no.

B. Explain your answer to part A in plain English, specifically: What is a N.E. and why is/isn't there a N.E. in this case? (**3 sentences or less**)

Question 17. 7 points. Suppose your long-term housemate is desperate to get a puppy for your house. She presents you with the following cost-benefit analysis to show that it is a good idea.

She has gathered numbers from the American Pet Association on the estimated range of annual costs, including food (\$500-\$750), health care (\$200-\$300) and toys, etc. (\$25-\$50). (All values are expressed in \$2016.)

Assumptions:

- Discount rate = 10%
- Puppy lifetime = 10 years

Item	Annual values	Lifetime present value
<i>Costs</i>		
Food	\$500	\$3,072
Health Care	\$200	\$1,229
Toys, etc.	\$50	\$307
<i>Total Costs</i>	<i>\$750</i>	<i>\$4,608</i>
<i>Benefits</i>		
Companionship		A
Unconditional love		B
<i>Total Benefits</i>		<i>A + B</i>
<i>Net Benefits</i>		<i>A + B - \$4,608 > 0</i>

A. Drawing on various lists of best (or worst) practice in cost-benefit analysis from class, state three problems you might highlight from the cost-benefit analysis prepared by your housemate.

i.

ii.

iii.

B. Name 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):

i.

ii.

C. You decide to check the math on the calculation of present value of total costs. Write down the expression that you would type into a calculator to verify your housemate's number:

Question 18. 2 points

Consider a project that will generate the following three costs (with no other costs in intervening years):

- \$3M (M=million) today
- \$6M in 10 years, and
- \$9M in 20 years.

Your discount rate is 7%. What is the present value of the costs of this policy? (Write the numerical expression for the answer, i.e. the expression you would enter into a calculator.)

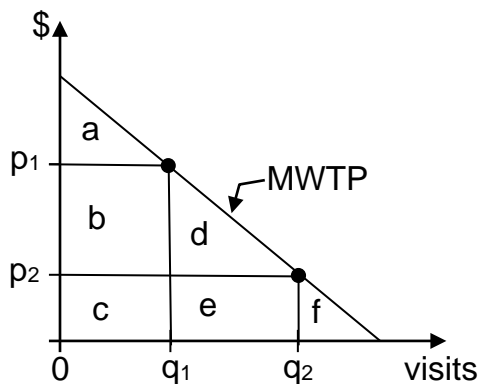
Question 19. 3 points. You are considering hiking the Lost Coast this spring break but you are worried about the weather. Suppose that the weather can be either sunny (50% chance), cloudy (30% chance) or rainy (20%, chance). Your state-contingent net benefits are summarized below:

sunny	cloudy	rainy
200	50	-100

Write down the expression you would enter into a calculator to evaluate your expected net benefits:

Question 20. 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.

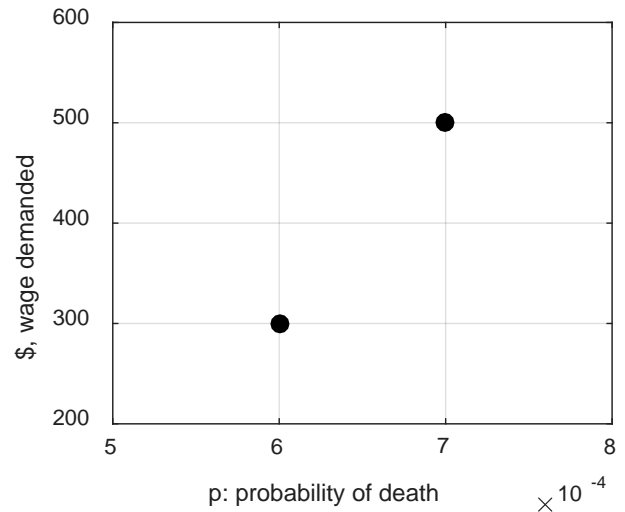


Consider family 2 experiencing this amenity--what area characterizes the:

- A. total benefits?
- B. total costs?
- C. net benefits?

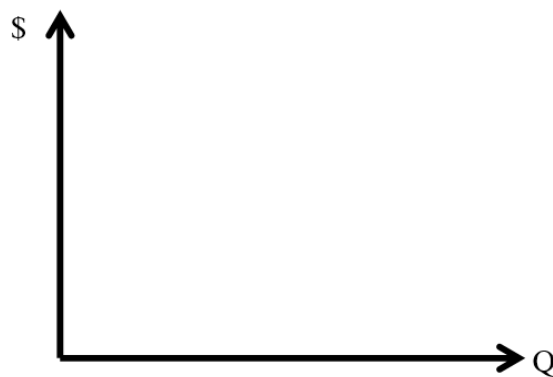
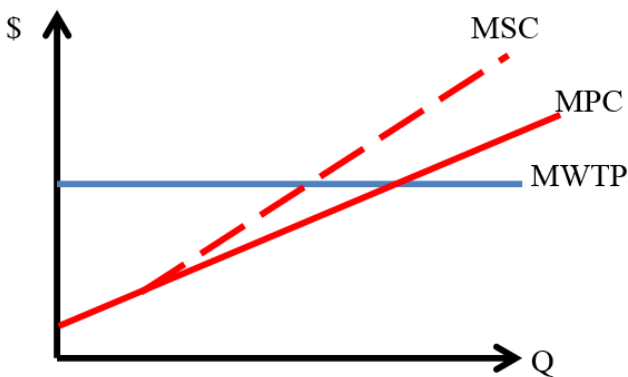
Question 21. 3 points.

Researchers are trying to estimate the value of a statistical life (VSL). They have gathered data on two different occupations that they assume are essential identical except for wages earned and the risk of death. Given the data in the figure, what is the implied VSL? (You must show your work for credit.)



Question 22. 5 points. As plotted in the figure below, the manufacturing of smartphone batteries (Q) occurs with increasing marginal production costs. Unfortunately, the factory also discharges damaging pollutants into the environment that affect the surrounding community, resulting in the marginal social cost curve presented below.

- In the figure on the left: **Identify** the socially optimal level of production and **label it Q^***
- In the figure on the left: **Identify** the predicted level of production and **label it Q_e**
- In the figure on the right: **Draw** the implied marginal external cost curve associated with battery production.
- Explain** what the shape of this curve tells you about the relationship between production and external damages. (2 sentences or less)



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):

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