

**AAE / ECON / Env. St. 343**  
**Environmental Economics**

**Homework #6**  
**Suggested Answers**

Provide short answers to the 8 questions below. No required reading.

Suppose a new mineral is discovered by UW researchers named Buckyite. The total stock of Buckyite is 82 units and it is non-renewable. The inverse demand for Buckyite is described by  $P=90-0.5Q$ , the marginal extraction cost (MEC) is equal to \$10 in every period, and the discount rate is  $r=0.1$ .

1. What is the back-stop price for Buckyite?

*Back-stop price is the price at which demand is zero  $\Rightarrow P=90-0.5*(0) = \$90$ .*

2. If supply were not scarce, how much Buckyite would be produced in a given period?

*In a competitive market, the supply curve would be the MEC curve and  $P=MEC \Rightarrow 90-0.5Q=10 \Rightarrow Q=160$ .*

3. Let T represent the time period in which Buckyite is completely depleted. According to the Hotelling rule, what must the price of Buckyite be in period T-1?

*By Hotelling:  $P(T-1)-MEC = [P(T)-MEC]/(1+r) \Rightarrow P(T-1) = ([P(T)-MEC]/(1+r)) + MEC \Rightarrow P(T-1) = ([\$90 - \$10]/1.1) + \$10 = \$82.73$ .*

4. Calculate the entire Hotelling price path for Buckyite. What is the initial price and how many periods will it take to deplete Buckyite? Hint: after calculating the price at T-1, calculate  $M\pi(T-1)$ ,  $Q(T-1)$ , and the remaining stock at T-1. You can work backwards to the initial time period by setting up the following table:

Period	P(t)	MEC	$M\pi(t)$	Demand Q(t)	Remaining Stock
T	90.00	10	80.00	0.00	0.00
T-1	82.73	10	72.73	14.55	0.00
T-2	76.12	10	66.12	27.77	14.55
T-3	70.11	10	60.11	39.79	42.31

*The initial price of Buckyite will be \$70.10 and it will take approximately 3 periods to deplete Buckyite.*

5. Suppose the discount rate increases to  $r=0.22$ . Intuitively, what do you expect to happen to the price path of Buckyite. Will the initial price be higher or lower? Will the stock be depleted more or less quickly?

*A higher discount rate will lower the initial price of Buckyite because the opportunity cost of holding Buckyite in the ground has increased. With lower prices, more Buckyite will be demanded and the stock will be depleted faster.*

6. Calculate approximately how many periods it will take to deplete Buckyite when  $r=0.22$ .

Period	P(t)	MEC	$M\pi(t)$	Demand Q(t)	Remaining Stock
T	90.00	10	80.00	0.00	0.00
T-1	75.57	10	65.57	28.85	0.00
T-2	63.75	10	53.75	52.50	28.85

*It will take approximately 2 periods to deplete Buckyite when  $r=0.22$ .*

The following information applies to questions 6 and 7. Suppose we were to find out today of a tremendous breakthrough by UW researchers: they accomplish, for the first time in history, the process of cold fusion. This is the process of combining hydrogen nuclei to release energy. The researchers were able to accomplish this by using as a substrate –that is, as a necessary “facilitator” of the chemical process –the metal palladium. The common understanding among experts is that this discovery will lead to cheap, clean, abundant fuel, though moving cold fusion from the lab to commercial uses such as generating electricity and fueling automobiles **remains several years away**.

7. What, if any, is the effect of the breakthrough on the **current** price of the metal palladium? Explain.

*The marginal user cost of Palladium increases, because the future value of Palladium increases. Therefore, since  $P=MUC + MEC$ , the current price of Palladium increases.*

8. What, if any, is the effect of the breakthrough on the **current** price of petroleum? Explain.

*The marginal user cost of petroleum decreases, because the future value of petroleum decreases since palladium represents a substitute. Therefore, the current price of petroleum drops.*