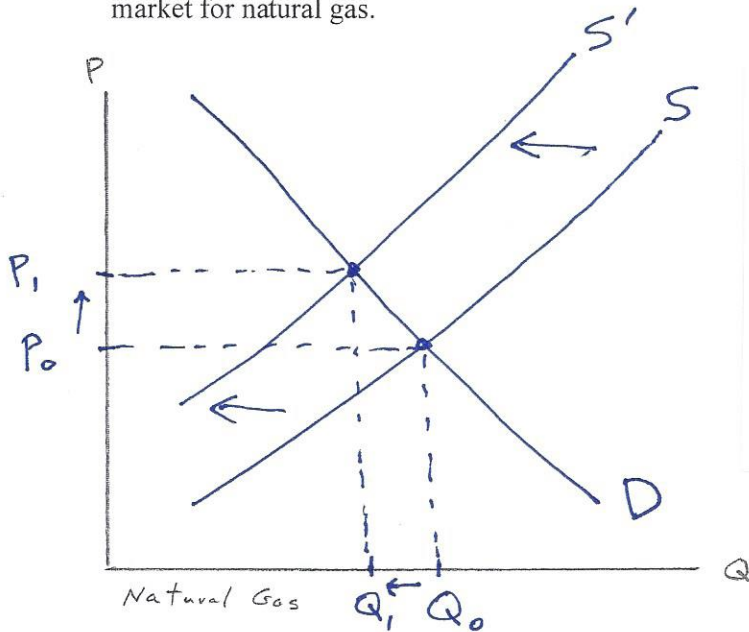


100 points total. Point values for each question are as indicated. Answer each question in the space provided. General advice: show your work, including any formulas or diagrams that you use in reasoning through your answers.

1. (10 pts.) Saudi Arabia and Russia, two major players in the world market for crude oil, decide to ramp up production, sending oil prices downward. In North Dakota and Texas in the U.S., many oil wells have an associated product, natural gas, that bubbles to the surface alongside the oil being extracted. Briefly explain and illustrate in the diagram below the effect of falling oil prices on the market for natural gas.



From WSJ 10/12/16:

A long period of low oil prices has saved motorists money at the pump, but languishing crude prices could drive up heating bills. That is because the natural-gas supply is closely connected to oil drilling. Low crude prices have led U.S. oil producers to idle more than a thousand rigs over the past two years, resulting in a big decline in so-called associated gas, a byproduct of oil drilling. This gas typically represents about 40% of total supply, but its production isn't particularly responsive to gas prices.

*For some oil wells in the United States, gas is a by-product of oil production.*

2. (10 pts.) We have discussed two different lines along which economic systems can be classified. We also watched a short video clip explaining how agriculture in China works. How would you categorize the Chinese system of agriculture according to each of the classification approaches? Briefly explain both the two taxonomies and how Chinese agriculture fits into each.

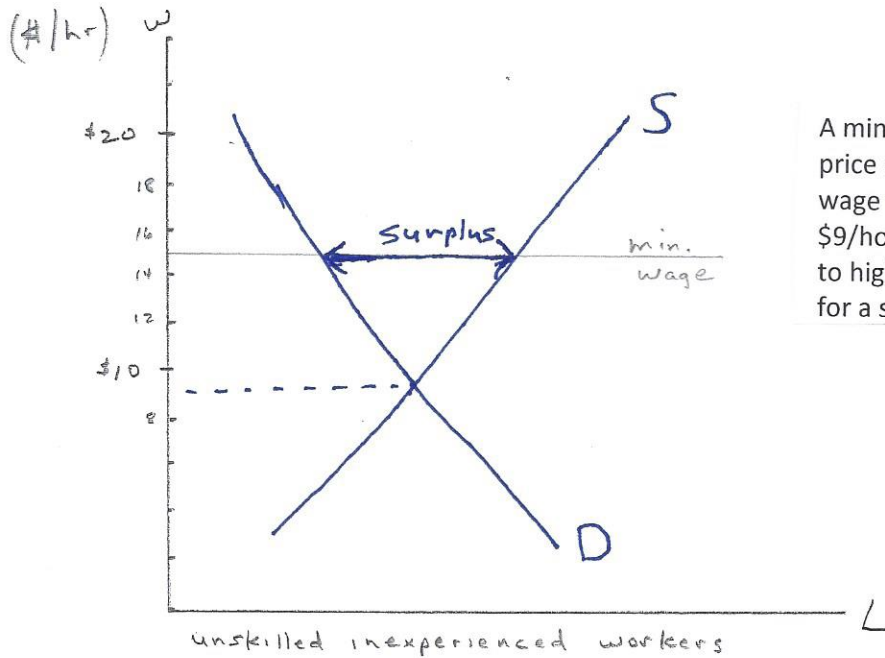
Economic systems can be classified according to the decision-making process (how they answer the questions What, How, and For Whom) and according to the ownership of resources.

Decision-making process: Centrally planned or command economies centralize the decision-making process, while market systems decentralize the decision-making process and rely on the interaction of households and firms in markets to make resource allocation decisions.

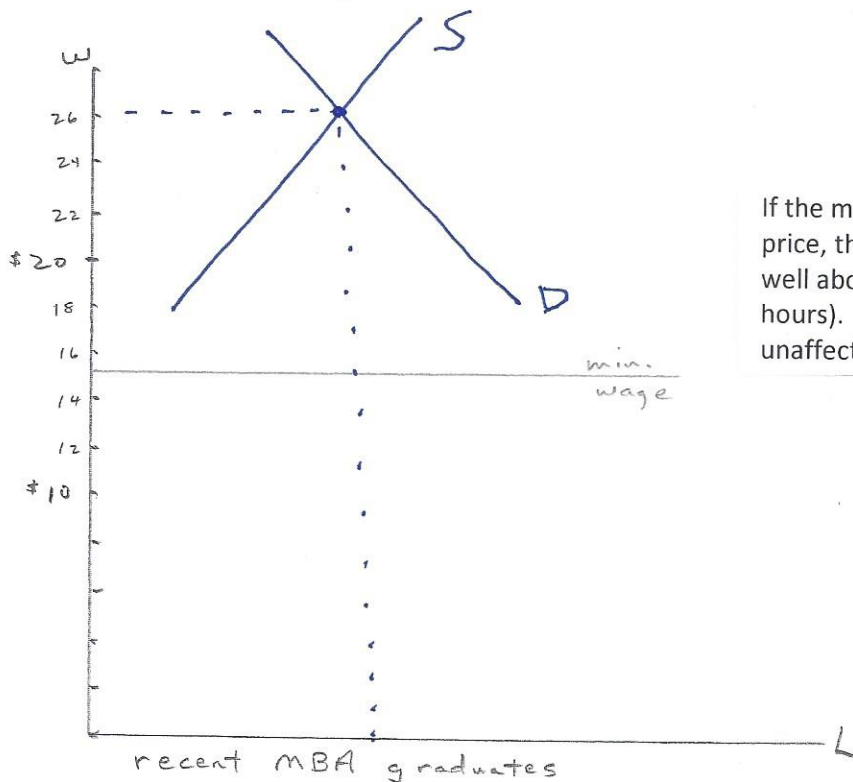
Ownership of resources: Socialism refers to an economic system where the scarce resources of that society are commonly or publicly owned. Capitalism refers to an economic system where scarce resources are privately owned. A critical function of government in such a system is the definition and enforcement of property rights.

Chinese farmers are given production quotas to meet, but are free to grow what they want after they meet their quota. They generally have permanent rights to farm their land, but do not own it in the sense that they cannot sell their rights to someone else.

3. (10 pts.) Citing their concern for the well-being of low-income households, Seattle's city council implements a series of increases in the citywide minimum wage from \$9/hour to \$11/hour (last year) to \$13/hour (this year) to \$15/hour (next year). If they were to have asked you for your assessment of the impact of such a policy on different labor markets, what would you have told them? Explain and illustrate the impact of imposing a \$15/hour minimum wage on the labor markets for (1) unskilled, inexperienced high school students looking for a summer job, and (2) recent graduates of good MBA programs.



A minimum legal price set above the market-clearing price will create a surplus of the product. If the market wage for unskilled, inexperienced teenage workers is \$9/hour, then a \$15/hour minimum wage will likely lead to high unemployment rates among teenagers looking for a summer job.



If the market-clearing price is above the legal minimum price, there will be no effect. MBA starting salaries are well above \$15/hour (\$60k per year = \$30/hour on 2000 hours). So the labor market for new MBA's should be unaffected by this increase in the minimum wage.

4. (15 pts.) Lexington's city council decides to try to improve social well-being in a different way—combating obesity by reducing the caloric intake of its citizens. A citywide tax on carbonated soft drinks sweetened with sugar is implemented, raising the price of (for example) name-brand beverages like Coke and Pepsi from \$4 to \$5 for a 12-pack of 12 oz. cans. Grocery stores and other sellers experience a 35% decline in sales.

a) Calculate own-price elasticity of demand for sugary soft drinks.

$$E_{x, P_x} = - \frac{\% \Delta Q_x}{\% \Delta P_x} = - \frac{-0.35}{\frac{5-4}{\frac{1}{2}(5+4)}} = \frac{.35}{\frac{1}{4.5}} = 1.575$$

*demand is elastic*

- b) The cross-price elasticity of demand between sugary and diet soft drinks is 0.7. How much extra shelf-space will be allocated to diet carbonated beverages in grocery stores after the sugar tax is imposed? Briefly explain your answer.

$$E_{x, P_y} = \frac{\% \Delta Q_x}{\% \Delta P_y} \quad \text{where } x = \text{diet} \text{ and } y = \text{sugary} \\ \text{soft drinks}$$

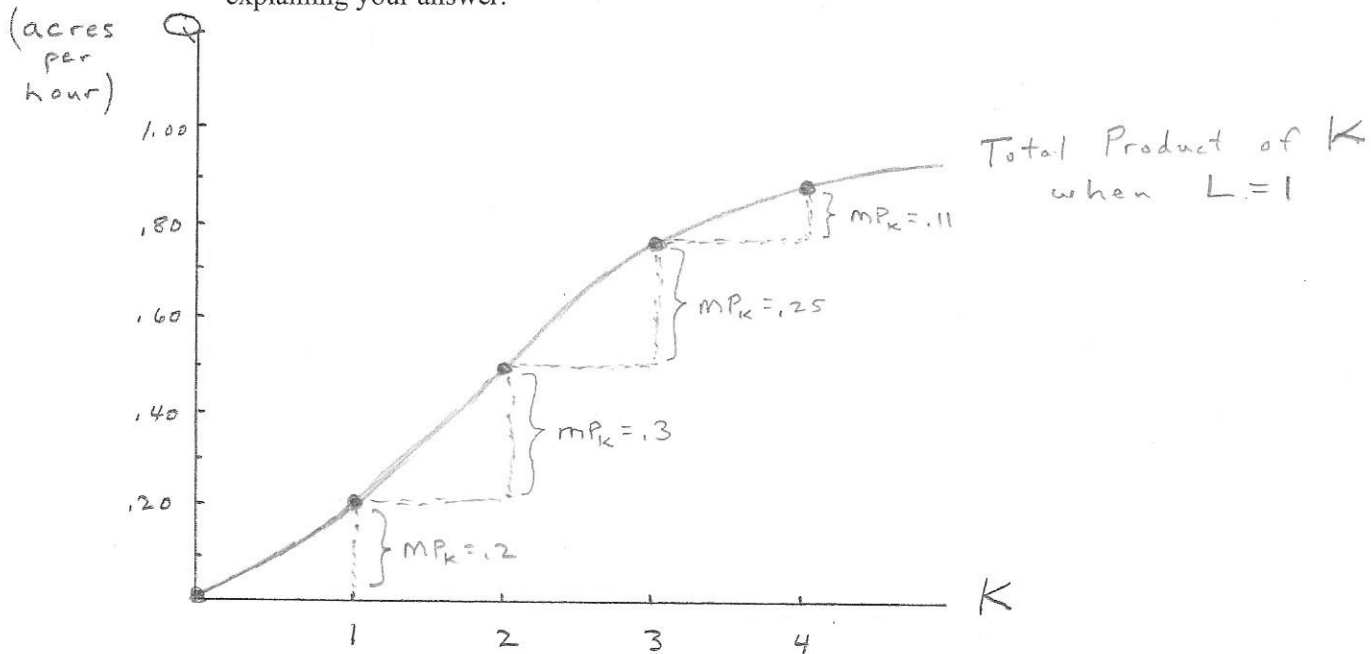
$$0.7 = \frac{\% \Delta Q_x}{\frac{5-4}{\frac{1}{2}(5+4)}} \Rightarrow 0.7 = \frac{\% \Delta Q_x}{\frac{1}{4.5}}$$

$$\text{change in shelf space} = \% \Delta Q_x = (0.7) * (.22) = 15.6\%$$

- c) The income elasticity of demand for sugary soft drinks is -0.2. Will this tax fall more heavily on low-income or high-income households? Briefly explain.

A negative income elasticity for sugary soft drinks means that quantity demanded falls as household rises. If low-income households drink more sugary soft drinks than middle and high-income households, then they will be hit harder by this new excise tax on sugary soft drinks than wealthier households.

5. (10 pts.) You have bought a new house with a one-acre lot that has to be mowed on a regular basis. You plan on doing the job yourself, but need to buy a lawn mower. After some research you figure out the following: If you buy a push reel-type mower ( $K=1$ ), you can mow one acre of grass in five hours (300 minutes). If you buy a gas-powered push mower ( $K=2$ ), you can mow one acre in two hours (120 minutes). Your labor combined with a gas-powered self-propelled mower ( $K=3$ ) gets an acre of grass mowed in 80 minutes. You sitting on a small lawn tractor ( $K=4$ ) accomplishes the one-acre job in 70 minutes. Do you see the law of eventually diminishing marginal returns at work in this production experiment? To fully explain your answer, you should keep the labor input fixed at one person-hour, and calculate how many acres of grass one person-hour of  $L$  can produce when combined with increasing amounts of  $K$ . Illustrate in the diagram below and refer to your graph in explaining your answer.



$K$	$L$	$Q$	$MP_K = \frac{\Delta Q}{\Delta K}$
0	1	0 acres	> .20
1	1	.20	> .30
2	1	.50	> .25
3	1	.75	> .11
4	1	.86	

As more and more units of  $K$  are added to a fixed amount of  $L$ , output eventually increases at a decreasing rate  $\Rightarrow$  diminishing returns to capital.

6. (10 pts.) You decide to go with the small lawn tractor, but before you buy it the owner of a landscape company approaches you and offers to mow your grass for the entire season for \$1500. Another decision to make! You can purchase a small lawn tractor for \$1000. After using it for a season you could sell it for \$750. You anticipate spending \$100 for gas, oil, and maintenance on the mower for the season. You would have to take the purchase price out of your Credit Union account where it is earning 5%. If you mow your own yard, you can count on spending 20 hours keeping your grass cut until it stops growing sometime in mid-November. You value your leisure time at \$50 per hour. Your neighbor, who makes twice as much money as you do, highly recommends the landscape company. What is right for you?

Economic costs of owning a mower and cutting your own grass for the year:

- ① You lose the use of \$1000 for the year because it is tied up in a lawn tractor.

$$0.05 * \$1000 = \$50 \text{ interest earnings foregone}$$

- ② At the end of the year the asset that you own is not worth as much as it was at the beginning of the year.

$$\$1000 - \$750 = \$250 \text{ economic depreciation of the asset}$$

- ③ operating expenses - an explicit cost  
gas, oil, maintenance = \$100

- ④ opportunity cost of your time spent mowing vs. playing golf or whatever else amuses you.

$$20 \text{ hours} * \$50/\text{hr} = \$1000$$

Total economic cost of mowing your

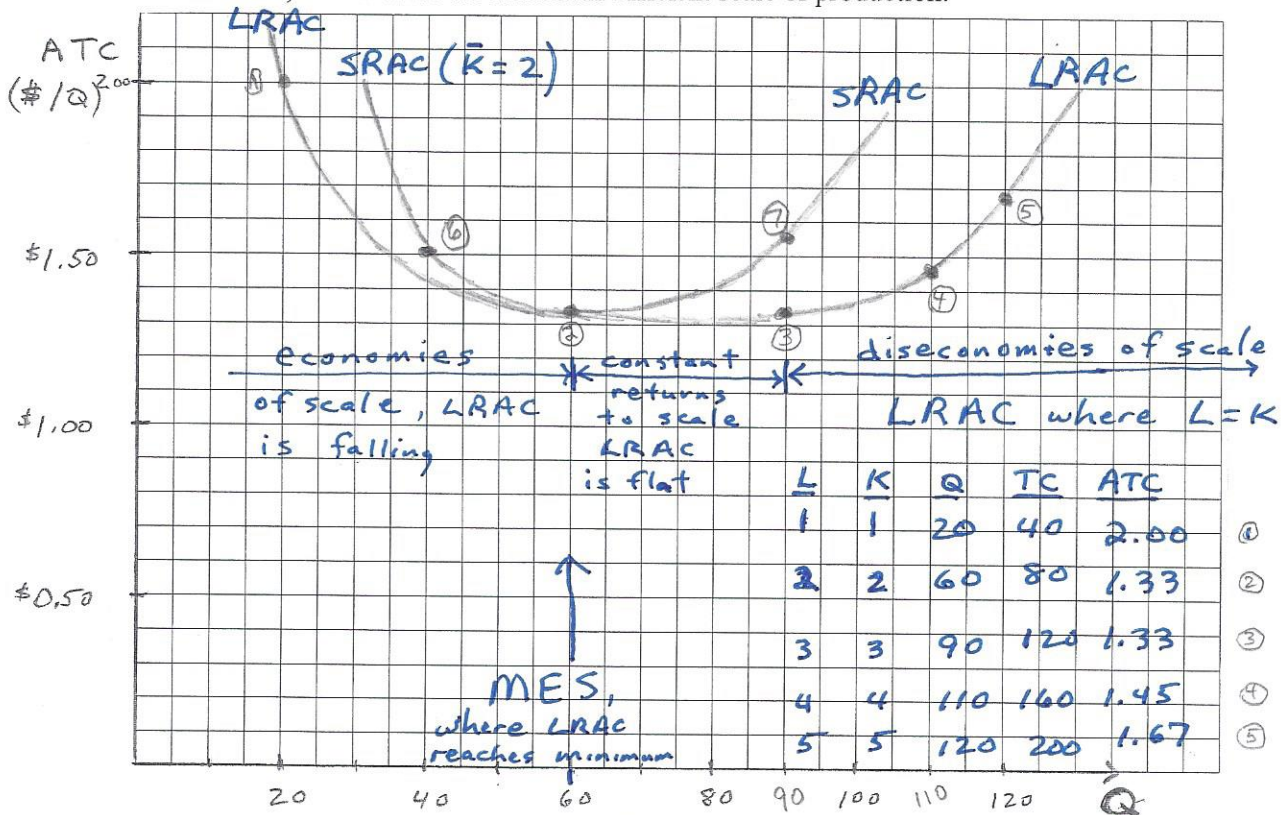
$$\text{own yard} = 50 + 250 + 100 + 1000 = \$1400.00$$

which is cheaper than outsourcing this task to someone else for \$1500.

7. (15 pts.) Labor and capital are used to produce widgets according to the production table below:

		Labor Input				
		1	2	3	4	5
Capital Input	1	20	40	55	65	75
	2	40	60	75	85	90
	3	55	75	90	100	105
	4	65	85	100	110	115
	5	75	90	105	115	120

Per unit-prices for labor and capital are  $w = \$20$  and  $v = \$20$ . For this particular production function, when both input prices are the same, the long-run least-cost combination of inputs occurs where  $K = L$ . Using this information, graph five points on this firm's long-run average cost curve in the diagram below. Be sure to point out if there are economies or diseconomies of scale, and indicate the minimum efficient scale of production.



8. (10 pts.) Suppose you have chosen  $K = 2$  and are stuck with that plant size in making short-run production decisions. If you want to produce  $Q = 40$ , how would you do it and what would your per-unit costs be? If you wanted to produce  $Q = 90$ , how would you do it and what would your per-unit costs be? Graph these two points on the firm's short-run average total cost curve for plant size  $K = 2$ .

$$\bar{K} = 2, L = 1, Q = 40, TC = 60, ATC = 1.50 \quad (6)$$

$$\bar{K} = 2, L = 5, Q = 90, TC = 140, ATC = 1.55 \quad (7)$$

$$\bar{K} = 2, L = 2, Q = 60, TC = 80, ATC = 1.33 \quad (2)$$

(2) Note that when using the long-run cost-minimizing combination of inputs,  $SRAC = LRAC$

9. (10 pts.) We discussed six product and plant-level reasons why a firm might experience economies of scale. Briefly discuss each (five will get you full credit.)

Product-level reasons why a firm might experience economies of scale:

Fixed setup costs

Specialization of inputs

Learning by doing

Plant-level reasons why a firm might experience economies of scale:

Physical engineering relationships

Economies of massed reserves (inventories)

Meshing of lumpy inputs

[See class powerpoint notes for elaboration]