

Practice Midterm #2 Suggested Solutions

1. International question: Write one paragraph—four sentences or so—explaining what the *balance of trade* is, and why it is an important concept in international economics.

The balance of trade is the value of a country's net exports—that is, the total value of its exports minus the total value of its imports. If net exports are positive there is a trade surplus, and if they are negative there is a trade deficit.

Large and persistent trade surpluses or deficits will put pressure on exchange rates to adjust such that the currencies of surplus nations strengthen relative to the currencies of deficit nations.

2. Growth question: China's total GDP today is about 1/6 that of the United States. China's population is about four times that of the United States. The current level of GDP per capita in the United States is about \$45,000 of marketed final goods and services produced per year. Current projections are that—if nothing goes wrong—GDP per capita in China will grow at an average rate of 6% per year for the foreseeable future. Current projections are that GDP per capita in the U.S. will grow at an average rate of 2% per year for the foreseeable future. In what year do you project that average GDP per capita in China will equal its level in the United States? What will the level of annually produced GDP per capita be in that year?

Recall that GDP per capita is GDP divided by population. Assuming as stated that the level of U.S. GDP is six times higher than China's and that China has four times the population of the U.S., per capita GDP is 24 times higher in the U.S. than in China.

By the rule of 72, per capita GDP in the U.S. will double every $72/2 = 36$ years, while it will double every $72/6 = 12$ years in China. This means that in 36 years per capita GDP will double three times in China—that is, it will increase eightfold every 36 years.

Starting at their relative sizes of 24 to 1 at the present, in the future the levels will be expected to grow as follows:

	U.S.	China
at present	24	1
in 36 years	48	8
in 72 years	96	64
In 108 years	192	512

The table above shows that they will be equal at some year between 72 years and 108 years in the future. To get a more precise answer, use the formula for exponential growth: in t years, a quantity C_0 growing at an annual rate of $k\%$ will increase to $C_t = C_0 \cdot e^{kt}$.

The number of years t in the future when the per capita levels of GDP will be the same in the U.S. and China is given by:

$$\begin{aligned}24 \cdot e^{0.02t} &= 1 \cdot e^{0.06t} \\ \Rightarrow \ln [24 \cdot e^{0.02t}] &= \ln [e^{0.06t}] \\ \Rightarrow \ln 24 + \ln [e^{0.02t}] &= \ln [e^{0.06t}] \\ \Rightarrow \ln 24 + 0.02t &= 0.06t \\ \Rightarrow 0.04t &= \ln 24 \\ \Rightarrow t = \frac{\ln 24}{0.04} &\approx 79.45\end{aligned}$$

That is, in approximately 79.45 years (that is, in 2090 or so) the per capita level of GDP will be the same in the U.S. and China (given the above assumptions).

The level of per capita GDP at that time is given by:

$$45,000 \cdot e^{0.02(79.45)} \approx 220,448.14$$

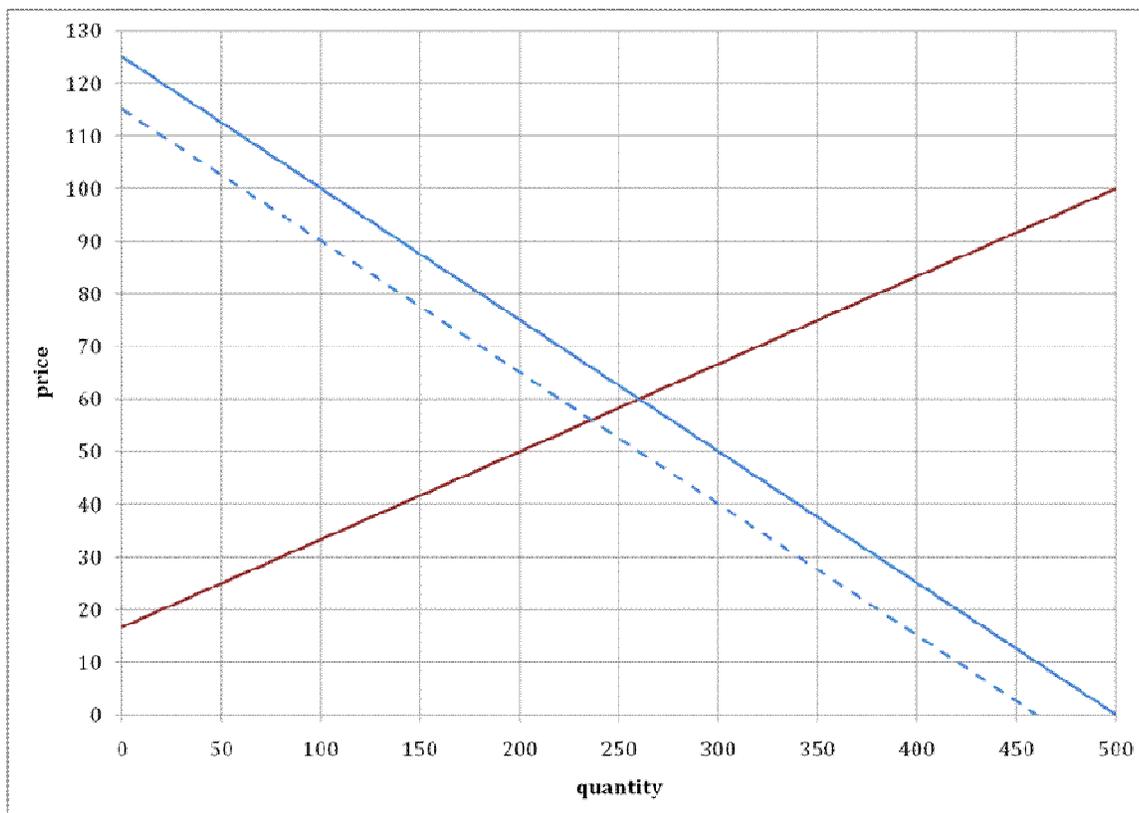
That is, the per capita GDP of both the U.S. and China will be about \$220,448 in 2090.

3. Supply and Demand question: The supply and demand curves for the market for tennis rackets are:

$$Q_D = 500 - 4P \Rightarrow P = -\frac{1}{4}Q_D + 125$$

$$Q_S = -100 + 6P \Rightarrow P = \frac{1}{6}Q_S + \frac{100}{6}$$

The government wants to raise money to provide public tennis courts, so they impose a \$10 tax on each tennis racket sold.



- a. How many rackets were sold before the tax went into place?

The equilibrium price P^* occurs where $Q_D = Q_S$:

$$500 - 4P^* = -100 + 6P^* \Rightarrow 600 = 10P^* \Rightarrow P^* = 60$$

The equilibrium quantity is thus: $500 - 4(60) = -100 + 6(60) = 260$

That is, 260 rackets were sold before the tax went into place.

- b. How many rackets were sold after the tax went into place?

After the tax is imposed, we'll have $Q_D = Q_S$ and $P_D = P_S + 10$, which together imply:

$$500 - 4(P_S + 10) = -100 + 6P_S \Rightarrow 500 - 4P_S - 40 = -100 + 6P_S \Rightarrow 560 = 10P_S \Rightarrow P_S = 56$$

$$P_D = P_S + 10 = 56 + 10 = 66$$

$$Q_D = 500 - 4(66) = Q_S = -100 + 6(56) = 236$$

That is, 236 rackets are sold after the tax is imposed.

- c. What is the after-tax price of rackets to the consumers?

The after-tax price to the consumers is $P_D = 66$, that is, \$66 (see part b above).

- d. How much money will the government raise to build new tennis courts?

The tax revenue raised is the quantity sold times the amount of the tax per racket:

$$236 \cdot \$10 = \$2,360$$

- e. What are the advantages and disadvantages of taxing tennis rackets in this case instead of implementing a general sales tax on all goods?

Advantages: The people who will be using the courts are the ones who are paying for it, which seems fair.

Disadvantages: Taxing everyone through a general sales tax would make playing tennis more attractive, which the government might want to do to capture the social benefits that might result from increased exercise and improved health.

- f. If we count the government revenue as part of the total surplus, what is the total surplus after imposing the tax?

The government revenue is \$2,360 (see part d above).

The consumer surplus is: $\frac{(125-66) \cdot 236}{2} = 6962$; that is: \$6,962.

Producer surplus is: $\frac{(56-\frac{100}{6}) \cdot 236}{2} = \frac{(\frac{236}{6}) \cdot 236}{2} = \frac{13,924}{3} \approx 4641.33$; that is: \$4,641.33.

Total surplus is thus: $\$2,360 + \$6,962 + \$4,641.33 = \$13,963.33$.

- g. Give a short argument for why we should nevertheless implement this tax.

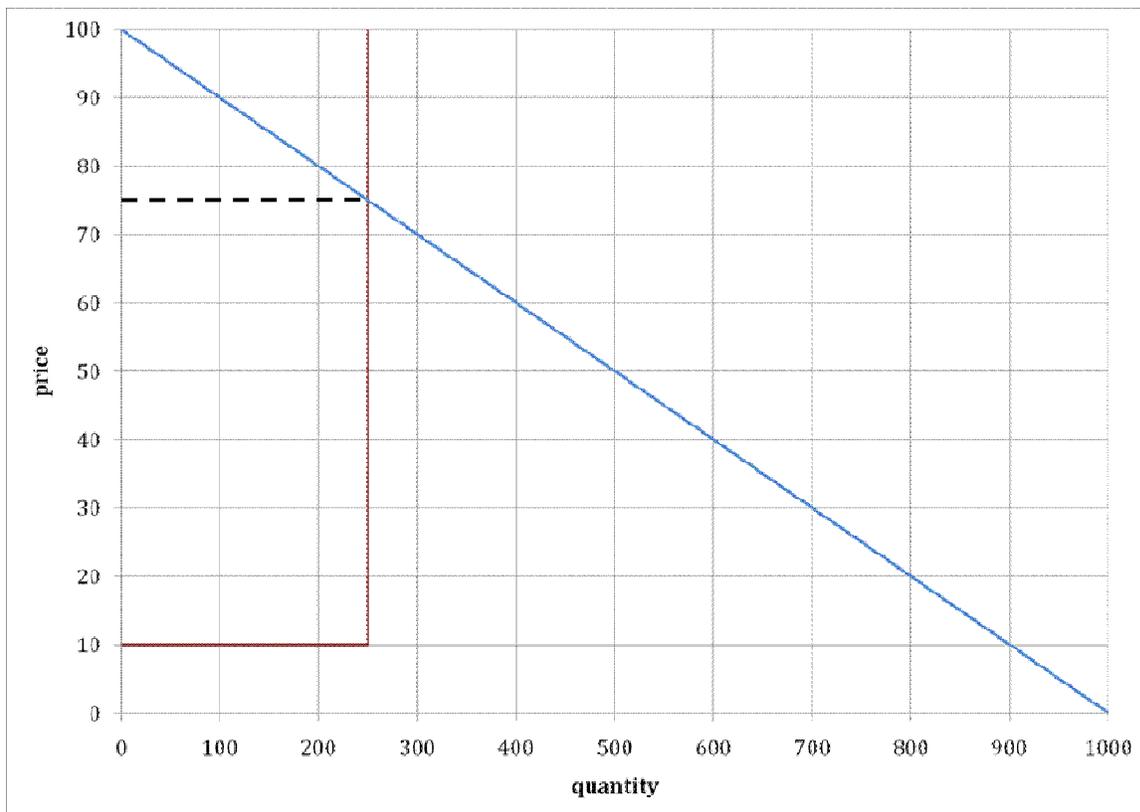
Though fewer rackets will be purchased as a result of the per-racket tax, the construction of new courts will allow those with rackets to use them more often (or at all). Also, the demand for rackets may increase when there more courts to play on.

This tax may induce an increased level of tennis playing, which may be more optimal given the positive externalities that might result from a healthier and more productive population.

4. Supply and Demand question: Let us return to the city of Avicenna and the market for yoga lessons. Suppose that the daily demand curve for lessons is: $Q_D = 1000 - 10P$, where Q_D is the number of lessons sold and P is the price of a lesson in dollars.

Note that $Q_D = 1000 - 10P \Rightarrow P = 100 - 0.1Q_D$.

- a. Suppose that there are only 25 qualified and competent yoga instructors in Avicenna, each of whom can teach 10 students a day and has a reservation wage of \$10 a student. What is the market equilibrium price of yoga lessons? What is the daily quantity? What is the daily producer surplus? What is the daily consumer surplus? What is the daily contribution of yoga lessons to measured GDP?



As seen in the graph above, the constraint of a maximum of 250 lessons supplied is binding since the demand is so great. The quantity of lessons in equilibrium is thus 250 per day.

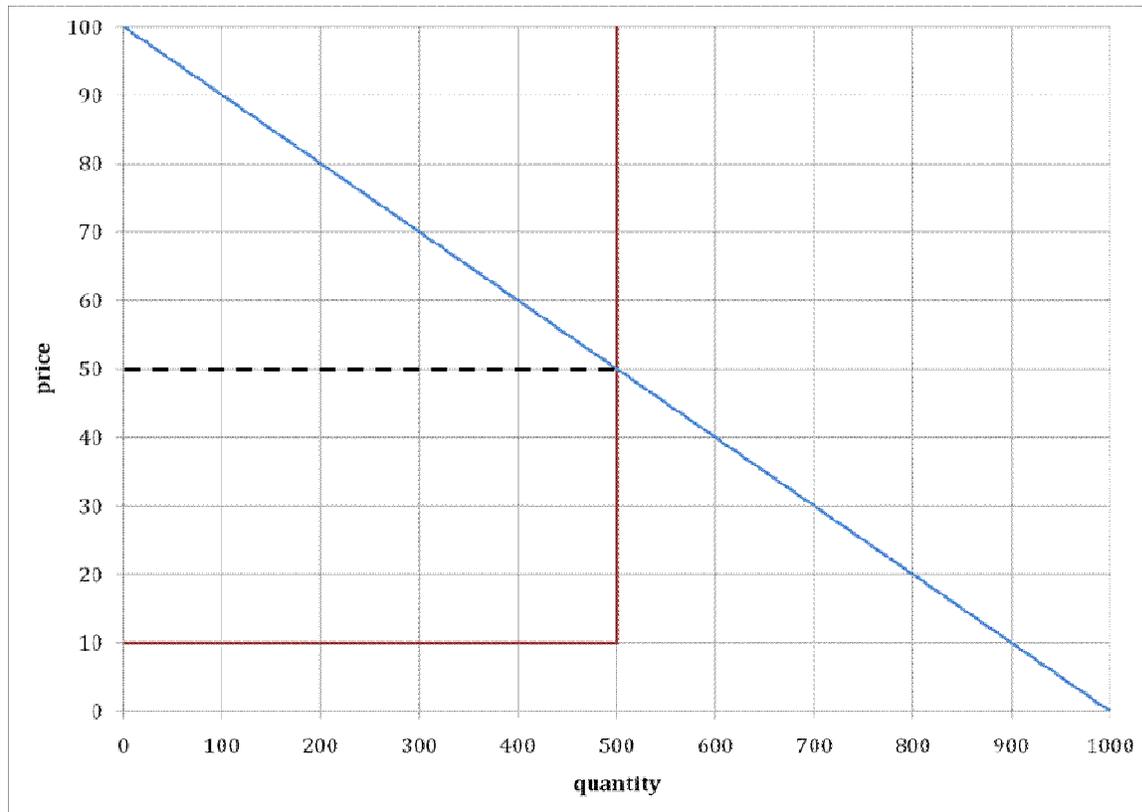
$P = 100 - 0.1(250) = 75$, so the equilibrium price is \$75.

The producer surplus (PS) is $(75 - 10) \cdot 250 = 16,250$; that is, \$16,250 per day.

The consumer surplus (CS) is $\frac{(100-75) \cdot 250}{2} = 3125$; that is, \$3,125 per day.

Since these are final services, the daily contribution of the yoga lessons to GDP is their full market price times the quantity: $\$75 \cdot 250 = \$18,750$ per day.

- b. Suppose that there are only 50 qualified and competent yoga instructors in Avicenna, each of whom can teach 10 students a day and has a reservation wage of \$10 a student. What is the market equilibrium price of yoga lessons? What is the daily quantity? What is the daily producer surplus? What is the daily consumer surplus? What is the daily contribution of yoga lessons to measured GDP?



As seen in the graph above, the constraint of a maximum of 500 lessons supplied is binding since the demand is so great. The quantity of lessons in equilibrium is thus 500 per day.

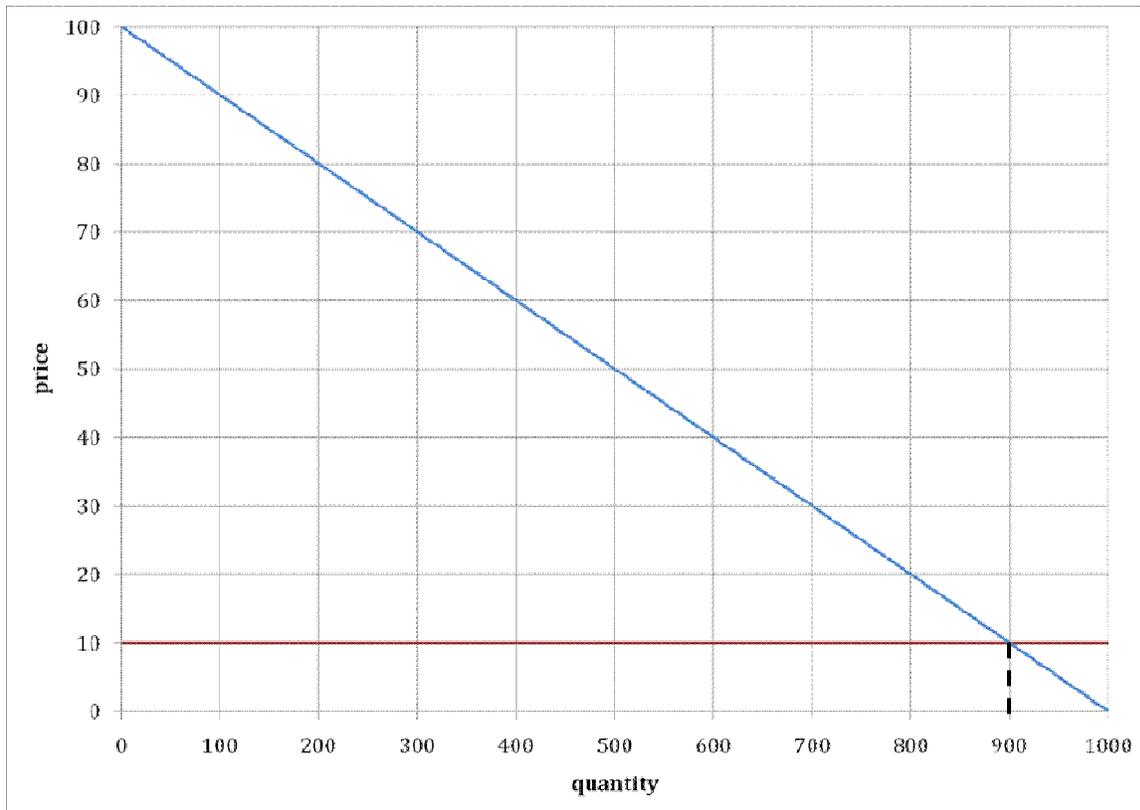
$P = 100 - 0.1(500) = 50$, so the equilibrium price is \$50.

The producer surplus (PS) is $(50 - 10) \cdot 500 = 20,000$; that is, \$20,000 per day.

The consumer surplus (CS) is $\frac{(100-50) \cdot 500}{2} = 12,500$; that is, \$12,500 per day.

Since these are final services, the daily contribution of the yoga lessons to GDP is their full market price times the quantity: $\$50 \cdot 500 = \$25,000$ per day.

- c. Suppose that there are 100 qualified and competent yoga instructors in Avicenna, each of whom can teach 10 students a day and has a reservation wage of \$10 a student. What is the market equilibrium price of yoga lessons? What is the daily quantity? What is the daily producer surplus? What is the daily consumer surplus? What is the daily contribution of yoga lessons to measured GDP?



As seen in the graph above, the demand curve will intersect with the horizontal section of the supply curve, so the equilibrium price of lessons is simply \$10.

The equilibrium quantity is thus $Q_D = 1000 - 10(10) = 900$ per day.

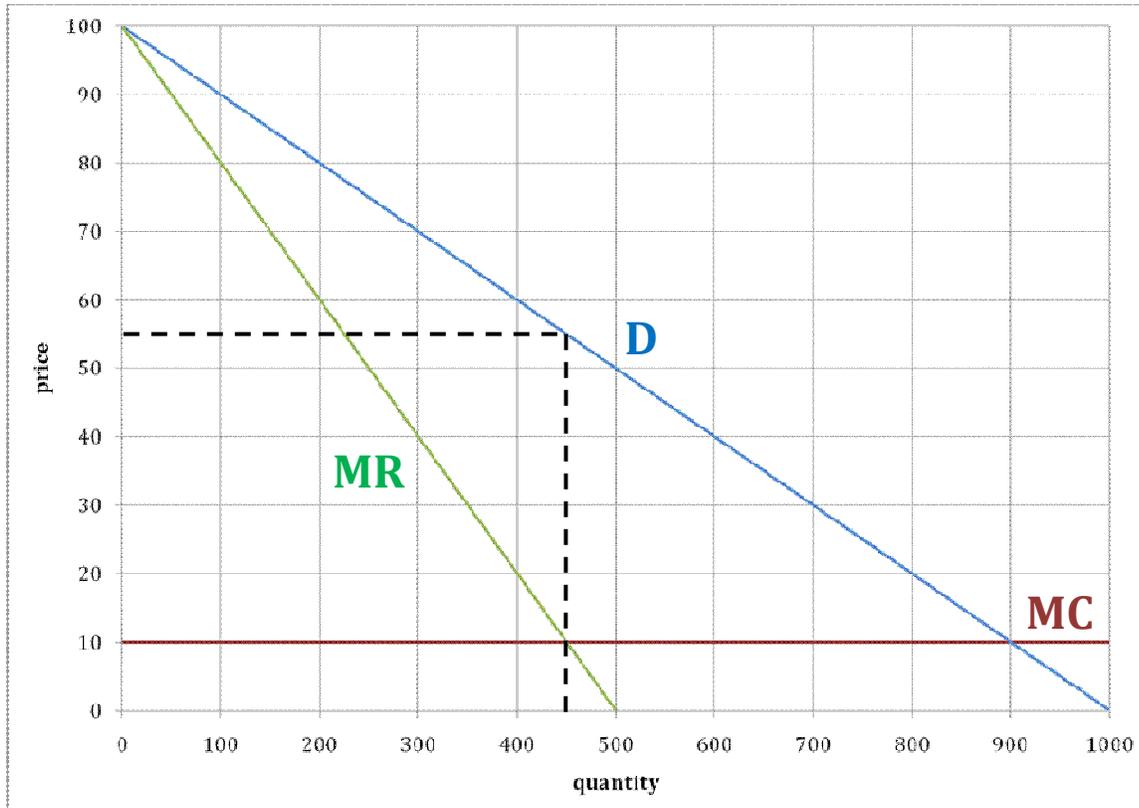
The producer surplus (PS) is $(10 - 10) \cdot 900 = 0$; that is, \$0 per day.

The consumer surplus (CS) is $\frac{(100-10) \cdot 900}{2} = 40,500$; that is, \$40,500 per day.

Since these are final services, the daily contribution of the yoga lessons to GDP is their full market price times the quantity: $\$10 \cdot 900 = \$9,000$ per day.

5. Market Structure question: Suppose that the Production and Distribution Coordination bureaucracy in the city of Avicenna around Euphoric State University decides that, to ensure quality, all yoga lessons must be provided by a single monopoly Euphoric Yoga Consortium. The daily demand curve for lessons is: $Q_D = 1000 - 10P$, where Q_D is the number of lessons sold and P is the price of a lesson in dollars. There are 100 qualified and competent yoga instructors in Avicenna, each of whom can teach 10 students a day and has a reservation wage of \$10 a student.

Note that $Q_D = 1000 - 10P \Rightarrow P = 100 - 0.1Q_D$.



- a. Suppose the Euphoric Yoga Consortium is organized as a profit-seeking monopoly firm. What is the price that it will charge for yoga lessons?

$$\text{EYC's total revenue is } TR = P \cdot Q_D = (100 - 0.1Q_D) \cdot Q_D = 100Q_D - 0.1Q_D^2$$

$$\text{The marginal revenue is thus } MR = \frac{dTR}{dQ_D} = 100 - 0.2Q_D$$

Profit is maximized at the quantity where marginal revenue equals marginal cost (which in this case is \$10):

$$MR = MC \Rightarrow 100 - 0.2Q_D = 10 \Rightarrow 0.2Q_D = 90 \Rightarrow Q_D = 450$$

The profit-maximizing price given by the demand curve:

$$P = 100 - 0.1(450) = 55$$

The profit-maximizing price that the monopolist EYC sets is \$55.

- b. What is the daily quantity of yoga lessons that will be given at that price?

At the price of \$55, the daily quantity of yoga lessons will be 450 (see part a above).

- c. What is the daily consumer surplus?

The daily consumer surplus (CS) is $\frac{(100-55) \cdot 450}{2} = 10,125$; that is, \$12,125 per day.

- d. What is the amount of its daily revenue that EYC will be willing to devote to campaign contributions for people running for seats on PDC if they can be confident of electing a PDC that will see things their way and ensure quality of yoga lessons by preserving EYC's important social role as guarantor of quality in the yoga lesson business?

Under the monopoly system, EYC enjoys a daily profit of $(55 - 10) \cdot 450 = 20,250$; that is, \$20,250.

If all the yoga instructors competed rather than participated in a monopolistic EYC, their profit would be zero (see question 4c).

The EYC will be willing to contribute up to 100% of its daily *profit*—\$20,250 per day—to preserve its monopoly (and whatever positive profits might remain after the contributions to the PDC). Thus the amount of revenue that the EYC is willing to contribute to the PDC is up to \$20,250 per day.

- e. What is the daily amount of money that the assembled yoga instructors of Avicenna will be willing to contribute to people running for seats on PDC if they can be confident of electing a PDC that will see things their way and lift the oppressive dead bureaucratic monopoly-capitalistic hand of EYC from its position on the throat of the people?

The assembled yoga instructors fit in one of two groups: either they work giving lessons through the EYC or they give no lessons.

Those who work for EYC are sharing part of substantial profit; they would have no interest in lobbying for a more competitive yoga market in Avicenna.

Those who don't work for EYC aren't teaching any lessons and thus are earning zero surplus. But if the monopolistic EYC were replaced by a perfectly competitive market, these instructors would be earning zero surplus anyway. They wouldn't be willing to contribute anything toward convincing PDC to make the yoga market in Avicenna more competitive.