Name: _____

Quiz # 1 **PAI 723**
October 18, 2023 **Professor David Popp**

You have the entire class period (80 minutes) in which to take the quiz. The questions are worth a total of 100 points. The number of points for each question should serve as a guide to the amount of time to spend on each question. Each question is designed to be answered in the space provided. *A short, direct answer is preferable to a long-winded explanation that includes unnecessary information.* Also, please keep in mind that partial credit is available for each question. It is in your best interest to attempt each problem on the quiz. If you do not have time to finish the math, at least include an illustration to show that you know how to proceed.

This is a closed book quiz. No notes, texts, or other reference materials may be used. The use of calculators is permitted.

Be sure to show all your work for each question. Providing a correct answer without showing how you got it will not get you full credit. You may use the back of the page for scratch work. I will not look on the back for answers or work unless you specifically tell me to do so. *Thus, if there is anything on the back of the page that you want graded, be sure to note this on the front of the page*.

Helpful formulas:

$$elasticity = \frac{\%change\ Q}{\%\ change\ P} = \frac{\frac{\Delta Q}{Q_0}}{\frac{\Delta P}{P_0}} = \frac{\Delta Q}{\Delta P}\frac{P_0}{Q_0}$$

area of a triangle = 1/2 (base) x (height)

area of a rectangle = (length) x (width)

NOTE: PLEASE READ THE FOLLOWING AND SIGN BELOW TO ACKNOWLEDGE READING THE HONOR CODE BEFORE BEGINNING. ALSO NOTE THAT BY HANDING IN THE QUIZ, YOU IMPLICITLY AGREE TO THE FOLLOWING, WHETHER OR NOT A SIGNATURE FOLLOWS:

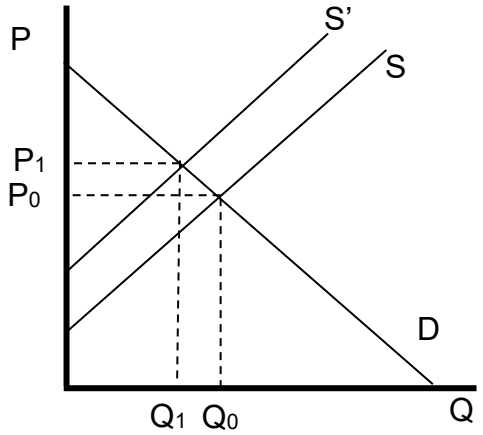
Providing or receiving help on this quiz is a violation of both class rules and Syracuse University's policy and academic honesty. I will not (or have not) discuss the contents of the quiz with other students until all classes have had an opportunity to complete the quiz.

Signed by: _____

Good luck!

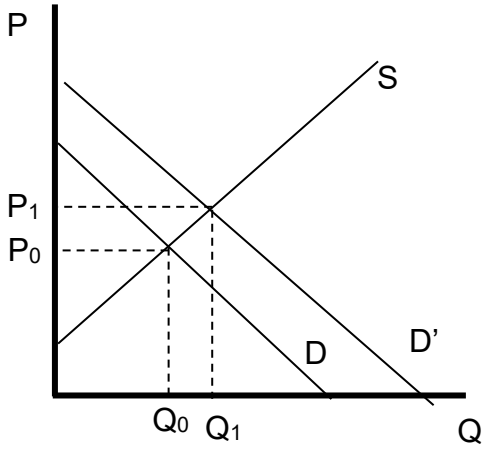
1. (21 points) Use supply and demand diagrams to illustrate each of the following scenarios. Explain briefly. ***Be sure to show how both the equilibrium price and quantity change in each case.***

a) Workers for US automakers are currently on strike. Suppose that the strike continues for months, reducing the ability of US auto manufacturers to produce vehicles. How will that affect the market for autos produced by US companies (the US brands affected are produced by General Motors, Ford, and Chrysler)?



Striking workers mean these companies produce fewer vehicles. As a result, the supply curve shifts up and to the left. Equilibrium quantity falls and the equilibrium price increases.

b) Production of vehicles made by other automakers is not affected by the autoworkers strike. If US auto brands are affected by the strike as you predict in part (a), how will the market for vehicles made by other manufacturers be affected?

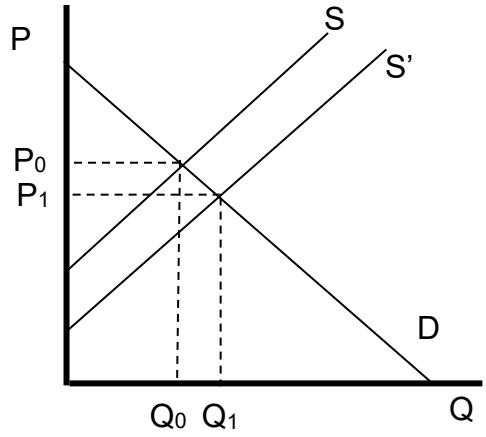


The key here is that the question asks about cars produced by other manufacturers. They are not affected by the strike, so the supply curve for these cars does not change. Instead, these cars are a substitute for cars produced by US automakers. Since fewer cars from US automakers are available, and those that are available are more expensive, demand for cars from other producers increases. Demand shifts up and to the right. The equilibrium price and quantity both rise.

A common error on part (b) was to shift the supply curve down and to the right, stating that other manufacturers would increase supply. While it is true that they will increase supply, that is because increased demand causes them to *move along the supply curve* from the old equilibrium to the new equilibrium.

The reason that shifting supply is incorrect is that it is the increased price (which results from higher demand) that causes other companies to increase quantity. Shifting supply means that the quantity supplied would be higher *at any price*. But that is not true. If the price did not increase from P_0 to P_1, these brands would not make more cars available. For supply to shift, there must be something that affects availability at any price, such as a reduction in the costs of production.

c) Advances in artificial intelligence allow robot wait staff to serve restaurant customers for lower costs than human wait staff. How does this technological advance affect the market for restaurant meals?



Robot wait staff lower costs for restaurant owners. For any given quantity, they can sell restaurant meals at a lower price than before. Thus, the supply curve shifts down and to the right. Equilibrium quantity rises, and equilibrium price falls.

2. (24 points) As a consultant to the World Bank, you have been asked to advise them how to best improve access to medicine in low-income communities. Based on recent market research, you have estimated the following elasticities for medicine in low-income communities:

Price elasticity of demand: -0.25
Income elasticity: 0.8

The World Bank is considering two options: reducing the price of medicine or increasing monthly income. Because increasing incomes is costlier than lowering the price of a single good, they cannot afford as large an increase in incomes due to financial constraints. Which of the following initiatives would lead to a greater increase in medicine purchases: reducing the price of medicine from $10 to $5 per bottle or increasing monthly income by 10 percent?

We use the elasticities to calculate how much access to medicine would change in response to each proposal. First, consider lowering the price of medicine to $5. This is a 50% decrease in price (=$\Delta P/P_0$ = (5-10)/10 = -0.5). For this calculation, be careful to include negative signs when necessary. A common error was to say the change in price was 50% (0.5), rather than -50% (-0.5). This error led some students to conclude that the quantity of medicine purchased fell when the price fell. Using the elasticity formula, we can solve for the percentage change in quantity:

$$\epsilon = \frac{\%\Delta Q}{\%\Delta P}$$
$$-0.25 = \frac{\%\Delta Q}{-0.5}$$
$$\%\Delta Q = (-0.25)(-0.5) = 0.125$$

Thus, the 50% decrease in price would increase quantity by 12.5%.

Now, consider increasing income by 10%. Again, we use the elasticity formula to solve for the change in quantity. Be careful to use 0.1, and not 10, to represent 10% in the formula below:

$$\epsilon = \frac{\%\Delta Q}{\%\Delta I}$$
$$0.8 = \frac{\%\Delta Q}{0.1}$$
$$\%\Delta Q = (0.8)(0.1) = 0.08$$

A 10% change in income would increase quantity by 8%. **Thus, the price decrease leads to a greater increase in medicine purchases.**

Some people struggled with this calculation because they used the wrong elasticity formula. You cannot use the $\frac{\Delta Q}{\Delta I}\frac{I_0}{Q_0}$ formula here because you do not know the initial income or quantity. But you don't need that information to use the above formula.

Note that calculating the percentage change is necessary to get the question right. Although the magnitude of the income elasticity is larger than the price elasticity, the proposed change in price is also larger. Simply comparing the magnitudes of the elasticities would only work for comparing price changes of equal magnitude. However, here the change in price is much larger. Thus, you must show the calculation to know which has the larger effect.

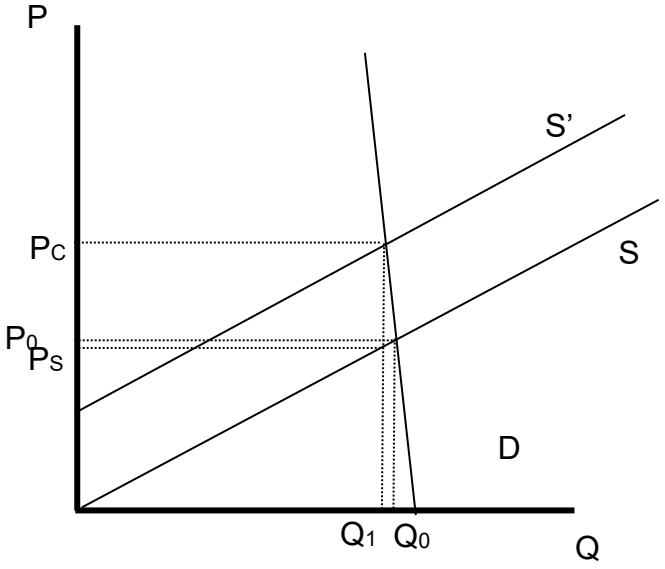
3. (20 points) Angered by rising food prices, Senator I.M. Healthy proposes taxing food producers. The Senator argues that the tax will lead to a significant reduction in the profits these companies earn.

For the purposes of this question, you may assume that food is sold in a perfectly competitive market and that food is a necessary good for consumers. Below, use a supply and demand diagram to illustrate the likely effect of a tax on food, with the tax collected from food producers as proposed by the Senator.

How will the tax affect prices for consumers and producers? Who is likely to bear the bigger burden of the tax?

Explain intuitively why that is the case, and why you have drawn your supply and demand curves as you did.

The tax will not have the desired effect. Demand for food is very inelastic. People are not sensitive to changes in price because food is a necessity. Inelastic demand is represented on the graph below by a very steep demand curve.



We represent the tax by shifting the supply curve, since the *legal incidence* of the tax (e.g. who the government collects payments from) is on food producers. However, because demand is inelastic, these food producers are able to pass along their higher costs to consumers. Intuitively, consumers need food, so they are willing to pay higher prices when the companies pass the costs of the tax on to them. The price consumers pay, P_C, is well above the original equilibrium price, P_0. But there is little change in quantity of food sold (falls from Q_0 to Q_1) and little change in the price producers receive (P_S). Thus, their profits remain nearly identical. Because of inelastic demand, the *economic incidence* of the tax is on consumers.

A common error was flipping the two prices (e.g. putting P_S on top and P_C on the bottom. That would be the case in a subsidy, but not for a tax. Be careful to avoid memorizing what the graphs might look like, and instead remember that you can find the two prices by referring to the *original* supply and demand curves.

4. (35 points) In Quebec, the market for maple syrup is heavily regulated. This question considers the effect of such regulation. The following demand and supply curves describe the market per gallon of maple syrup:

Demand: $P = 80 - 1.5Q$
Supply: $P = 10 + Q$

where P is the price per gallon, and Q represents gallons of syrup, in millions (e.g. $Q = 1$ represents 1,000,000 gallons of maple syrup).

a) Calculate the equilibrium price and the number of gallons of syrup sold.

The equilibrium occurs where supply equals demand:

$$80 - 1.5Q = 10 + Q$$
$$70 = 2.5Q$$
$$Q = 70/2.5$$
$$\mathbf{Q = 28, \text{ or } 28{,}000{,}000 \text{ gallons of syrup}}$$

To find the price, we substitute the equilibrium quantity into either the demand or supply equation:

Either:

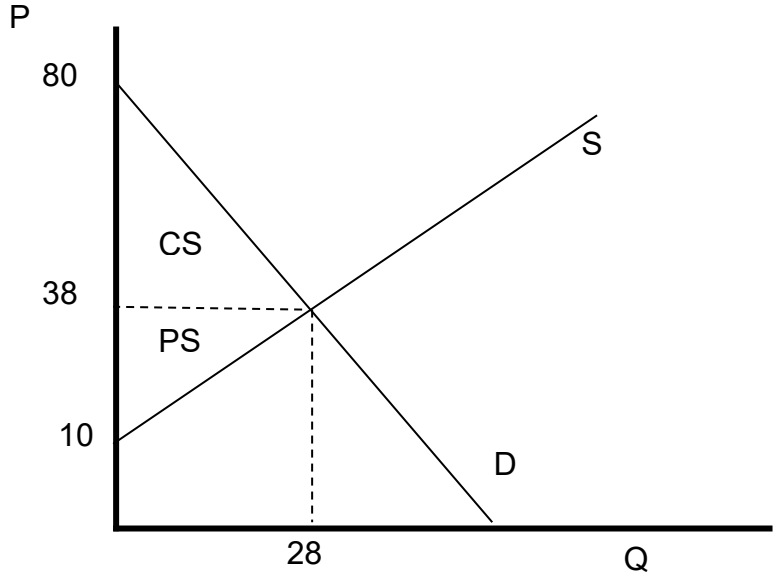
$$P = 80 - 1.5(28) = \mathbf{\$38}$$

Or:

$$P = 10 + 28 = \mathbf{\$38}$$

b) Calculate the producer and consumer surplus associated with the equilibrium found in part (a). Illustrate on a graph.

The graph appears below. Note that the equations are already solved for P. Thus, we know that the *y*-intercept (on the price axis) for demand is \$80. Note that the *y*-intercept of the supply equation is \$10. A common error was to start this line at the origin. Doing so will make your calculations of producer surplus incorrect.



Consumer surplus is everything above the price and below the demand curve, labeled CS on the graph. This is a triangle with a height of 42 (= 80-38) and a base of 28. Its area = 0.5(42)(28) = **\$588**. Since the units of *Q* are 1,000,000 gallons, you more accurately write this as **\$588,000,000**. I accepted either answer.

Producer surplus is everything below the price and above the supply curve, labeled PS on the graph. This is a triangle with a height of 28 (= 38-10) and a base of 28. Its area = 0.5(28)(28) = **\$392** or **\$392,000,000**.

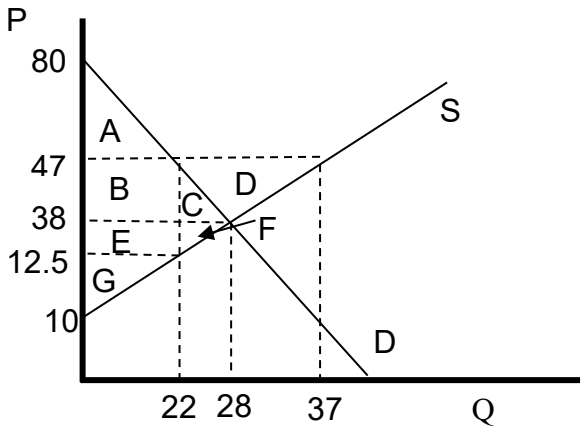
Note that to calculate producer surplus correctly, it is important that your supply curve hit the P axis at 10, and not simply start at the origin. That is consistent with the supply curve, where $P = 10 + Q$. When $Q = 0$, $P = 10$.

c) To protect maple syrup producers, Quebec's government sets a minimum price for syrup. All syrup must be sold for a price of at least $47 per gallon.

How many gallons of maple syrup will be sold with this new price support in place? How many gallons will suppliers want to sell at this price? What is the excess supply of syrup available? Illustrate on a graph.

The minimum price is above the equilibrium price. Thus, there will be an excess supply of syrup – more producers will want to sell syrup than will consumers be willing to buy syrup. The new quantity sold will be limited by the number of consumers willing to purchase syrup at this higher price. We find this by substituting $47 for P in the demand equation, and then solving for Q. In the graph below, this represents the point where the price line of 47 hits the demand curve:

$$47 = 80 - 1.5Q$$
$$33 = 1.5Q$$
$$Q = 33/1.5$$
$$\boldsymbol{Q = 22, \text{ or } 22{,}000{,}000 \text{ gallons}}$$



To find the number of gallons that suppliers want to sell, we plug the price of $47 into the supply equation. This represents the point where the price line of 47 hits the supply curve on the graph above:

$$47 = 10 + Q$$
$$Q = 37$$
$$\boldsymbol{Q = 37, \text{ or } 37{,}000{,}000 \text{ gallons}}$$

Since suppliers make 37,000,000 million gallons of syrup available, and consumers only purchase 22,000,000 gallons, the excess supply is **15,000,000** gallons of syrup (= 37,000,000 – 22,000,000).

d) Find the new consumer surplus associated with your answer to part (c).

Consumer surplus is everything above the new price of $47 and below the demand curve. This is area **A** above. This is a triangle with a height of 33 (=80-47) and a base of 22. Its area = 0.5(33)(22) = **$363**. Since the units of *Q* are 1,000,000 gallons of syrup, this represents **$363,000,000**.

e) Suppose that the government supports the $47 per gallon price by purchasing any excess maple syrup suppliers make available but are unable to sell to consumers. How much syrup must the government buy? How much producer surplus do syrup producers receive if the government buys the excess supply of syrup at the price of $47 per gallon? Illustrate on a graph. You may use your graph on part (c) if you wish, but please refer to the relevant areas from that graph in the space below if you do.

For this question, the trick is to remember that if the government buys the surplus syrup, producers are able to sell all 37,000,000 gallons of syrup. Thus, producer surplus includes all sales out to the supply curve at 37 on the graph in part (c).

Using the graph from part (c), the new producer surplus is everything below the price of $47 and above supply. This is simply the triangle **BCDEFG**. The triangle has a height of 37 (=47–10) and a base of 37. Its area = 0.5(37)(37) = **$684.5**, or **$684,500,000**.

A common error here was to omit area D from the producer surplus. Area D represents extra value created for producers from the government's purchase. Along with C and F, it is the area where the payment from the government exceeds the cost of producing syrup, so that the producers gain extra profits from the purchase.

f) If the government decides to support syrup producers by buying the excess supply at a price equal to the minimum price of $47, how much will the government spend on maple syrup? Considering this cost to taxpayers, is the economy as whole better or worse off after the price support? By how much?

We know from part (c) that the excess supply is 15,000,000 gallons. To buy each of these at $47 per gallon costs the government (and thus taxpayers) **$705,000,000**.

To determine whether the economy as a whole is better or worse off, we compare the sum of consumer and producer surplus before the price support to the sum of consumer and producer minus the cost to the government after the price support.

Before the price support, total welfare was $980,000,000.

After the price support, the sum of consumer and producer surplus is $1,047,500,000. However, buying the extra gallons of syrup costs $705,000,000. Thus, net welfare after the policy is just $342,500,000.

Total welfare has fallen by **$637,500,000**.

Intuitively, welfare falls because the additional producer surplus that producers gain is the difference between the $47 price they receive and the cost of producing a gallon of syrup. Yet, the government must pay the full $47 for each excess gallon of syrup.

A common mistake here was simply to compare the sum of consumer and producer surplus afterwards, ignoring the cost to taxpayers. Those costs are important, and are why the welfare falls. A small portion of the government payment is simply a transfer to producers, as it creates extra producer surplus (area D on the graph). The rest is simply wasted money – the government is paying the cost to produce unwanted maple syrup.

Similarly, some students simply identified C and F as deadweight loss. That would be correct if the government did not purchase the excess supply. Because of that purchase, we need to include both the extra benefit that generates for maple syrup producers, as well as the cost to the government to purchase maple syrup at those high prices.

(As an aside, while I didn't ask you to find the areas on the graph, C and F aren't included as "extra" value generated by the subsidy because they were already part of either consumer or producer surplus before the subsidy. Area D is the only new surplus created, and it comes at a substantial cost).