Exam #3 (70 points *QM*, 30 points *BER*)

- *Show your work for partial credit.* It is very difficult to give partial credit if the only thing on your page is "$x = 3$".

- If possible, take the exam during an *uninterrupted period of no more than 4 hours.* (It should not take anywhere near that long.) In any case, do not spend more than 4 hours on the exam.

- *Other than this cheat sheet, all you are allowed to use for help are the basic functions on a calculator (or a spreadsheet program.* Partial translation: no books, no notes, no websites, no talking to other people, and no advanced calculator features like programmable functions or present value formulas.

- People who have taken the exam can talk to each other all they want, and people who have not taken the exam can talk to each other all they want, but communication between the two groups about class should be limited to three phrases: "Yes", "No", and "Have you taken the exam?"

- A **Pareto efficient** (or **Pareto optimal**) allocation or outcome is one in which it is not possible find a different allocation or outcome in which nobody is worse off and at least one person is better off. An allocation or outcome B is a **Pareto improvement over A** if nobody is worse off with B than with A and at least one person is better off.

- **Total revenue** is price times quantity: $TR = pq$.

- The **price elasticity of demand at point A** measures the percentage change in quantity demanded (relative to the quantity demanded at point A) resulting from a 1% increase in the price (relative to the price at point A). The formula is

$$\varepsilon(A) = \frac{\% \text{ change in } q}{\% \text{ change in } p} = \frac{\dfrac{\Delta q}{q_A}}{\dfrac{\Delta p}{p_A}} = \frac{\Delta q}{\Delta p} \cdot \frac{p_A}{q_A} = \frac{q_B - q_A}{p_B - p_A} \cdot \frac{p_A}{q_A}.$$

In English If, at point A, a small change in price causes the quantity demanded to increase by a lot, demand at point A is elastic; if quantity demanded only changes by a little then demand at point A is inelastic; and if quantity demanded changes by a proportional amount then demand at point A has unit elasticity.

In math If, at point A, the price elasticity of demand is less than -1 (e.g., -2), then demand at point A is elastic; if the elasticity is greater than -1 (e.g., $-\frac{1}{2}$), then demand at point A is inelastic; if the elasticity is equal to -1 then demand at point A has unit elasticity.

(5 points)   Name:

1. For each item, indicate the likely impact on the supply and demand for apples. Then indicate the effect on the equilibrium price and quantity. If you use a graph, all you need to have is an arrow indicating which curve(s) shift which way.

   (a) (5 points) News reports suggest that an apple a day really does keep the doctor away.

   (b) (5 points) Worms destroy a large part of the apple crop.

   (c) (5 points) New farming methods make apple orchards more productive.

2. (5 points) Explain, as if to a non-economist, why the intersection of the market supply curve and the market demand curve identifies the market equilibrium.

3. Below is a hypothetical demand curve for oranges.

P ($/pound)

Q (millions of pounds per day)
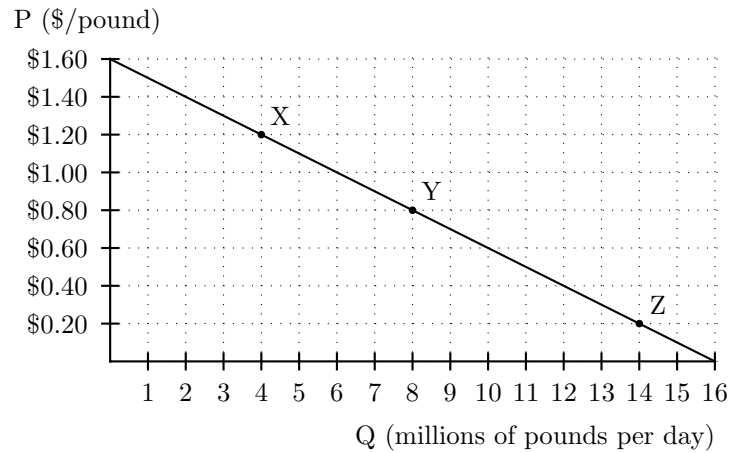
(a) (5 points) During normal years, the supply curve is such that point Y is the equilibrium. Of the other two points, one is the equilibrium during "bad" years (when frost damages the orange crop), and one is the equilibrium during "good" years (when the orange crop thrives). Which one is point X? Circle one: X = bad good

(b) (5 points) What is the total revenue at point X? At point Y? At point Z? (Use correct units!)

(c) (5 points) The orange growers' profit is total revenue minus total costs. If total costs are the same in all years, do the growers have higher profits in "bad" years or "good" years? (Circle one.)

4. Below is a hypothetical market for oranges.

P ($/pound)

Q (millions of pounds per day)
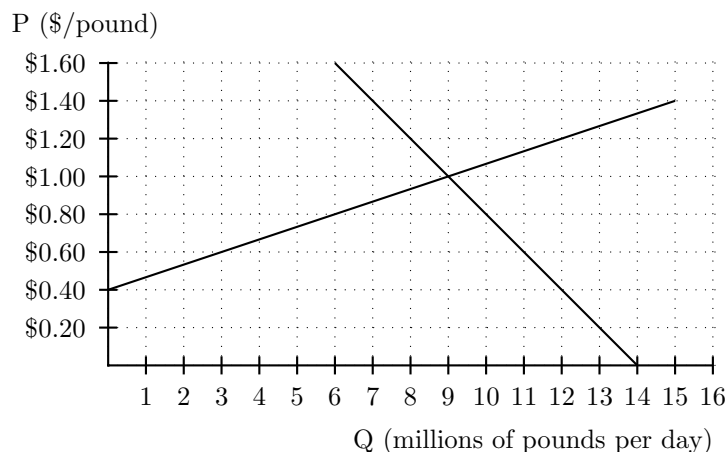
Suppose that the government decides to impose a per-unit tax of \$.80 on the buyers of oranges.

(a) (5 points) Show the impact of this tax on the supply and demand curves above.

(b) (5 points) Explain why the tax shifts the curves the way it does. Your answer here must be quantitative, i.e., must explain not only the *direction* of the curve shift(s) but also the *amount* of the curve shift(s).

(c) (5 points) Calculate the economic incidence of the tax, i.e., the amount of the tax burden borne by the buyers ($T_B = p_2 + t - p_1$) and the amount borne by the sellers ($T_S = p_2 - p_1$). Then calculate their ratio $\dfrac{T_B}{T_S}$.

(d) (5 points) Calculate the price elasticity of supply, ε_S, at the original (pre-tax) equilibrium. Then calculate the price elasticity of demand, ε_D, at the original (pre-tax) equilibrium. Then calculate their ratio, $\frac{\varepsilon_S}{\varepsilon_D}$. How does this ratio compare to the ratio of the tax burdens?

5. (5 points) How would the *economic incidence* of the tax change if the *legal incidence* of the tax were shifted from the buyers to the sellers?

6. (5 points) Show the result if the government had instead imposed an $.80 per-unit tax on the sellers. (No need to explain.)

P ($/pound)

$1.60
$1.40
$1.20
$1.00
$0.80
$0.60
$0.40
$0.20

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Q (millions of pounds per day)