Follow all instructions carefully. There are 4 sections to the exam. Think before writing; be brief and concise. Do explain your answers and graphs, but excess verbiage will not be rewarded. Some questions are harder than others. If a question seems too hard, move on to another one and then return to the harder questions later. Do not panic, the exam will be curved.

No books, no notes, no calculators.

There are 72 points on the exam, so you should take about one minute per point, leaving a few minutes to read instructions and proofread your answers.

Unless indicated otherwise, all questions refer to perfectly competitive markets and all changes are short-run. You should explain each answer clearly and concisely. All graphs should be labeled and reasons should be given for each answer.

On each bluebook you use, write your name, your Teaching Fellows name and the exam section number.

NO SECTIONS THIS WEEK!
Part I

Answer this section in a SEPARATE BLUE BOOK labeled “Part I”. Both print and sign your name and your teaching fellow’s name on the bluebook. Be sure to explain each answer, clearly and briefly.

This section has 18 points total.

1. (9 points total) Consider the market for corn, which is perfectly competitive.
   (a) (2 points) Suppose that a new kind of seed allows farmers to grow more corn using the same land, fertilizer and other inputs. Graph the effect on price and quantity of this change.
   (b) (3 points) Suppose that the government places a tax of $t$ dollars per bushel of corn, to be paid by the consumer. Graph the effect of the tax on price and quantity. Indicate both the price paid by the buyer and the price received by the seller.
   (c) (4 points) What is the effect of the tax on producer surplus and consumer surplus? Also indicate the deadweight loss.

2. (2 points) Universal Music recently lowered the price of music CDs from about $18.00 to about $12.00. If the company’s quantity sold increases by 66% as a result, what is the elasticity of demand for CD’s produced by the company?

3. (4 points) Give an argument for why supply equals demand in equilibrium, using graphs if that is helpful.

4. (3 points) Graph the effect of a price floor in a perfectly competitive market. Indicate the deadweight loss.
Part II

Answer this section in a SEPARATE BLUE BOOK labeled “Part II”. Both print and sign your name and your teaching fellow’s name on the bluebook. Be sure to explain each answer, clearly and briefly.

This section has 18 points total.

1. (4 points total) Yale student Howie Dean divides his non-sleep time between parties and study.
   (a) (2 points) If Howie is awake for 16 hours per day, what is the equation for his time “budget-line” (i.e. what is the constraint on his decision between parties and study?)
   (b) (2 points) Graph Howie’s optimal choice and then show how his choice would change if he went from 8 hours of sleep per night to 6 hours of sleep.

2. (5 points) What is the slope of the indifference curve? Use simple algebra to explain why this is so.

3. (9 points total) Suppose that Fred divides his consumption between food and drink. His marginal utility of food is $2/Q_1$ and his marginal utility of drink is $1/Q_2$, where $Q_1$ is the quantity of food he consumes and $Q_2$ is the quantity of drink. Say that $p_1$ is the price of food and $p_2$ is the price of drink.
   (a) (3 points) What 2 equations describe Fred’s optimal consumption of food and drink? (Don’t solve the equations, just state them.)
   (b) (3 points) Graph the effect of an increase in the price of housing on Fred’s consumption of the two goods. Draw the two goods so that they are complements.
   (c) (3 points) Use graph(s) to decompose the effect of the price increase into income and substitution effects.
Part III

Answer this section in a SEPARATE BLUE BOOK labeled “Part III”. Both print and sign your name and your teaching fellow’s name on the bluebook. Be sure to explain each answer, clearly and briefly.

This section has 18 points total.

1. (9 points total) The Aluminum Company of American makes aluminum from Bauxite (which is an ore mined from the ground) and Electricity. The quantity of Bauxite employed is \( B \), while the quantity of Electricity is \( E \). Say that the price of Bauxite is \( p_b \) and the price of Electricity is \( p_e \).

   (a) (2 points) First assume that the quantity of Bauxite delivered from the mine is fixed at \( \bar{B} \). Graph the firm’s optimal use of Electricity.

   (b) (3 points) Now assume that the firm can choose both \( B \) and \( E \). Graph the firm’s optimal choice of inputs conditional on an output level \( \bar{Q} \).

   (c) (2 points) What equations define the optimal outputs you just graphed?

   (d) (2 points) Conditional on the same output \( \bar{Q} \), how does the firm’s input use change as the price of electricity increases?

2. (3 points) Explain how you would find marginal cost once you are given optimal inputs as a function of input prices and output.

3. (4 points total) Consider the cost function \( a + bQ + dQ^2 \), where \( a, b \) and \( d \) are constants.

   (a) (1 points) What is fixed cost?

   (b) (1 points) What is variable cost?

   (c) (2 points) What is average cost?

4. (2 points) Express profits in terms of price, average cost and output.
Part IV

Answer this section in a SEPARATE BLUE BOOK labeled “Part IV”. Both print and sign your name and your teaching fellow’s name on the bluebook. Be sure to explain each answer, clearly and briefly.

This section has 18 points total.

1. (2 points) Draw indifference curves that illustrate “perfect complements.”

2. (7 points total) Suppose that marginal cost for an individual, perfectly competitive firm is \( mc = q^2 \).
   
   (a) (3 points) If price is 9, what is the firm’s profit-maximizing output quantity? Why?
   
   (b) (4 points) If there are \( N \) firms in the market, what is the market supply function? (Be sure to solve for supply price as a function of quantity.)

3. (7 points total) Consider a situation with two goods, \( x_1 \) and \( x_2 \).
   
   (a) (3 points) Use an indifference curve analysis to show how optimal consumption of a consumer will change if there is an tax of \( t \) dollars per unit placed on good 2. (Draw the goods so that they are substitutes)
   
   (b) (4 points) On your graph, how much would the consumer be willing to pay to have the tax removed? (I.e., what change in income gives the same change in utility as the tax?)

4. (2 points) What are sunk costs? How will a firm’s exit decision change if sunk costs increase?