1. Consider a perfectly competitive firm with a production function
   \[ q = f(x_1, x_2, x_3), \]
where \( x_1 \) denotes units of capital, \( x_2 \) denotes unskilled workers, and \( x_3 \) denotes skilled workers. The firm maximizes profits using an input mix of \( x_1 = 200 \), \( x_2 = 70 \), and \( x_3 = 50 \). The initial price of capital is $80 per unit. Suppose the firm faces a change in the price of capital to $96 per unit. As a consequence, it increases its employment of unskilled workers to 77, while at the same time laying off 5 skilled workers.

   (a) What is the cross-elasticity of demand for unskilled workers with respect to capital?
   (b) What is the cross-elasticity of demand for skilled workers with respect to capital?
   (c) Are the two inputs "unskilled labor" and "capital" substitutes or complements? Why?
   (d) Are the two inputs "skilled labor" and "capital" substitutes or complements? Why?
   (e) Are the results from (a) through (d) consistent with the so-called "capital-skill complementarity hypothesis"? Why (not)?

2. Suppose the supply curve in a particular industry is given by
   \[ E = 2.110w + \] and the demand curve in that industry is given by
   \[ E = 8.050w - \], where \( E = \) employment and \( w = \) hourly wage.

   (a) Calculate the equilibrium wage and employment level in that industry. Illustrate your solution in a graph.
   (b) Now suppose the government imposes a payroll tax of $8 on the firm for every employee-hour it hires. What happens to the initial equilibrium in that industry? In your explanation, also calculate the new equilibrium wage and employment level, and illustrate your solution in a graph [you can include the solution in the graph you already drew in part (a)].
   (c) In the new equilibrium, what is the total cost of hiring an employee-hour of work? Therefore, what share of the $8 tax will the firm pay, and how much will be shifted to the worker? In what respect does the fraction of the payroll tax that workers pay depend on the elasticity of the supply curve?
   (d) Does it matter whether the $8 payroll tax is imposed on the firm or on the worker? Why (not)?

3. Suppose that the market for labor economists is subject to a cobweb adjustment process, because it takes time to train new labor economists. Specifically, suppose that the supply curve is given by
   \[ w = 10 + 5E \] and the demand curve by
   \[ w = 50 - 3E. \]

   (a) What is the initial equilibrium wage and employment level?
   (b) Now suppose the government urgently needs labor economists to evaluate a new training program. This sudden demand shock shifts the demand curve up to
   \[ w = 70 - 3E. \]
   Calculate the wage and employment levels in each "round" of the cobweb game as the wage and employment levels slowly adjust to the shock [you can stop with the 6th round].
(c) Sketch the adjustment process in a graph.
(d) What is the new equilibrium level of wage and employment?

4. Consider the case when the labor market is not perfectly competitive, specifically the case when a firm can influence wages.
   (a) What is a monopsony? What is the difference between a perfectly discriminating monopsonist and a non-discriminating monopsonist?
   (b) Sketch in a graph how the discriminating monopsonist determines the optimal employment level and the optimal wage. How does the optimal employment level and wage compare to the competitive equilibrium? In this graph mark the producer surplus and the worker surplus? Is there any deadweight loss? Explain.
   (c) Sketch in a graph how the non-discriminating monopsonist determines the optimal employment level. How does the optimal employment level and wage compare to the competitive equilibrium? In this graph mark the producer surplus and the worker surplus? Is there any deadweight loss? Explain.
   (d) Consider a nondiscriminatory monopsonist firm which faces a perfectly elastic demand for its product at a price of $4. This firm also faces an upward sloping labor supply curve \( E = 10w - 50 \). This implies that the firm faces a marginal cost of labor curve given by \( MC = 0.2E + 5 \). Assume further that each worker can produce 3 units of output per hour, and that there are no other costs of production. How many workers will the firm hire per hour to maximize profits? What is the hourly wage? What are the firm’s hourly profits?

5. Consider an economy in which workers can choose to work in two types of jobs: a dirty job or a clean job. Suppose there are 100 workers in the economy, and that the workers' utility function implies that they prefer the clean over the dirty job.
   (a) In general, what is a "compensating wage differential", and what is a "reservation price"?
   (b) Suppose worker 1's reservation price for accepting the dirty job is $100, worker 2's reservation price is $200, worker 3's reservation price is $300, and so on. Moreover, suppose there are exactly 10 jobs in the economy that are dirty jobs, i.e. demand for dirty jobs is perfectly inelastic at 10 jobs. What is the equilibrium wage differential between clean and dirty jobs? Illustrate your solution in a graph. In terms of their "dirt aversion", which type of workers will be employed?
   (c) Suppose now that an advertising campaign "Dirty jobs rule!", paid for by the employers who offer dirty jobs, changes the attitudes of the labor force towards working in a dirty job. Specifically, suppose worker 1 now has a reservation price of $-1,000 (i.e. he is willing to "pay" or give up $1,000 for the right to work in the dirty job), worker 2's reservation price is $-900, and so on. Include this new supply curve in your graph from part (b). Suppose that there are still exactly 10 dirty jobs in the economy. What is the new equilibrium wage differential? Does this compensating differential imply that dirty jobs pay more or less than clean jobs?