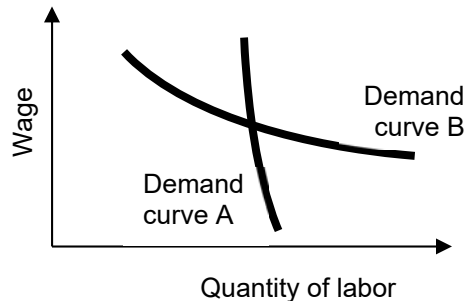


### FINAL EXAMINATION VERSION A

INSTRUCTIONS: This exam is closed-book, closed-notes. Simple calculators are permitted, but graphing calculators, calculators with alphabetical keyboards, computers, wireless devices and mobile phones are NOT permitted. Point values for each question are noted in brackets. Maximum total points are 200.

**I. Multiple choice:** Please circle the one best answer to each question. [2 pts each, 38 pts total]

- (1) Which labor demand curve below is *more* elastic?
- Demand curve A.
  - Demand curve B.
  - Both have the same elasticity because they pass through the same point.
  - Cannot be determined from information given.



- (2) Suppose  $\log(W) = 8.0 + 0.075 S$ . If  $S$  increases by one unit, then
- $W$  increases by 7.5 units.
  - $W$  increases by 7.5 percent.
  - $W$  increases by 0.075 percent.
  - $W$  increases by 8.0 units.
  - $W$  increases by 8.0 percent.
- (3) The absolute value of the slope of a worker's indifference curve is called the
- marginal utility.
  - marginal product.
  - marginal rate of substitution.
  - wage.

- (4) Suppose a firm produces output using both labor and capital, and suppose the price of capital *rises*. Then the amount of labor hired
- increases due to the substitution effect but decreases due to the scale effect.
  - decreases due to the substitution effect but increases due to the scale effect.
  - increases due to both substitution and scale effects.
  - decreases due to both substitution and scale effects.

- (5) In the simple model of a competitive labor market,
- the equilibrium wage is zero.
  - the equilibrium quantity is zero.
  - total surplus is zero.
  - unemployment is zero.

- (6) Suppose employers are required by law to provide a free lunch that workers may or may not want. This mandated benefit tends to decrease the equilibrium employment level
- the same amount, regardless of whether workers actually value the lunch.
  - more if workers actually value the lunch.
  - less if workers actually value the lunch.
  - None of the above, because mandated benefits always increase the equilibrium wage and employment level.

- (7) Agreements between employers not to "poach" each others' workers
- tend to keep wages up.
  - are recommended by the government.
  - are illegal under antitrust laws.
  - never occur because they are unprofitable.

(8) Consider a diagram of hedonic equilibrium with the wage on the vertical axis and risk of injury on the horizontal axis. At any point on the hedonic wage function, the slope equals

- a. the slope of some worker's indifference curve.
- b. the slope of some employer's isoprofit curve.
- c. Both of the above.
- d. None of the above.

(9) Perfect equality implies a Gini coefficient of

- a. negative one.
- b. zero.
- c. one-half.
- d. one.
- e. infinity.

(10) Technological change has likely increased the

- a. relative demand for unskilled workers in the U.S.
- b. relative demand for skilled workers in the U.S.
- c. relative supply of unskilled workers in the U.S.
- d. relative supply of skilled workers in the U.S.

(11) Until the 1960s, most immigrants into the United States came from

- a. Canada.
- b. Latin America.
- c. Asia.
- d. Europe.

(12) Most workers who are laid off from a job

- a. take another job immediately at a higher wage.
- b. are unemployed for a while, then take another job at a higher wage.
- c. take another job immediately at a lower wage.
- d. are unemployed for a while, then take another job at a lower wage.

(13) The resistance-curve model of strikes assumes that

- a. the firm is uncertain about the union's resolve.
- b. union members are uncertain about the firm's ability to pay high wages.
- c. workers are uncertain about the value of belonging to the union.
- d. the firm is uncertain about the competitive wage.

(14) Unions tend to increase

- a. the dispersion in wages among workers at the same employer.
- b. the return to schooling.
- c. the average wage.
- d. all of the above.

(15) Profit-sharing schemes can be less effective in large firms because they encourage

- a. workers to sabotage each other.
- b. workers to collude to reduce effort.
- c. free riding.
- d. quality deterioration.
- e. All of the above.

(16) A compensation scheme where workers are paid according to the rank order of their output is called, in economics,

- a. a piece rate.
- b. an efficiency wage.
- c. a tournament.
- d. a profit-sharing plan.

(17) Which pay scheme discourages both shirking and quitting?

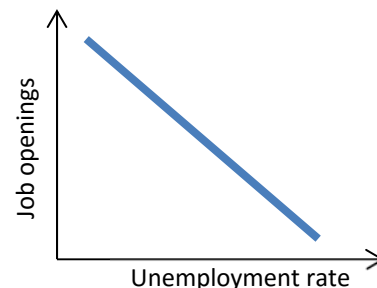
- a. piece rates.
- b. time rates.
- c. tournaments.
- d. efficiency wages.

(18) If unemployment in some industry follows a predictable recurring annual pattern, this is called

- a. frictional unemployment.
- b. seasonal unemployment.
- c. structural unemployment.
- d. cyclical unemployment.

(19) The diagram at right shows the unemployment-vacancies curve (sometimes called the Beveridge curve). During a recession,

- a. the economy moves along the curve, up and to the left.
- b. the economy moves along the curve, down and to the right.
- c. the whole curve shifts up and to the right.
- d. the whole curve shifts down and to the left.



**II. Problems:** Please insert your answer to each question in the box provided. You may use margins and graphs for scratch work. Only the answers in the boxes will be graded.

(1) [Measuring the labor force: 6 pts] The U.S. Bureau of Labor Statistics reported that in September 2017, 154.3 million people were employed, 6.8 million people were unemployed, and 94.5 million working-age people were not in the labor force.

- a. Compute the unemployment rate to the nearest tenth of a percentage point.
- b. Compute the employment rate (or employment-to-population ratio) to the nearest tenth of a percentage point.
- c. Compute the labor force participation rate to the nearest tenth of a percentage point.

|  |   |
|--|---|
|  | % |
|  | % |
|  | % |

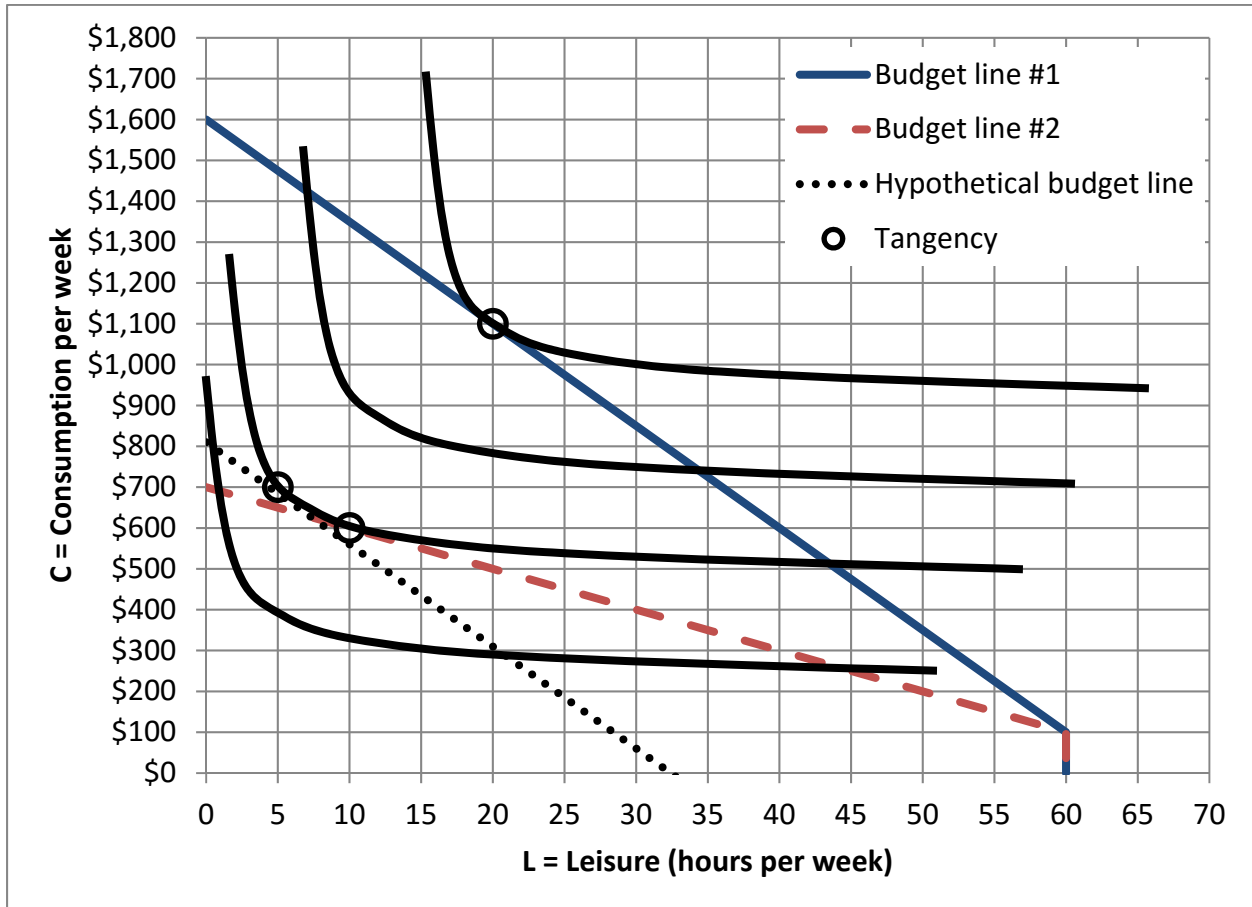
(2) [Hicks-Marshall rules: 6 pts]

- a. Industry #1 and Industry #2 are similar, except that the elasticity of substitution of labor for capital is 2.1 in Industry #1 and 0.9 in Industry #2. Which industry will have *more elastic demand for labor*, according to the Hicks-Marshall rules?
- b. Industry #3 and Industry #4 are similar, except that the elasticity of demand for their products is different. The elasticity of demand for the product of Industry #3 is -0.8. The elasticity of demand for the product of Industry #4 is -3.5. Which industry will have *more elastic demand for labor*, according to the Hicks-Marshall rules?
- c. Industry #5 and Industry #6 are similar, except that labor's share of total cost is 80% in Industry #5 and 50% in Industry #6. Which industry will have *more elastic demand for labor*, according to the Hicks-Marshall rules?<sup>1</sup>

|  |
|--|
|  |
|  |
|  |

<sup>1</sup> Assume as usual that in both industries, the elasticity of product demand is larger in absolute value than the elasticity of substitution in production.

(3) [Individual labor supply—income and substitution effects: 22 pts] The graph below shows Beth’s indifference curves, two true budget lines, and one hypothetical budget line parallel to budget line #1.



- a. According to this graph, what is Beth’s total available time for work or leisure?
- b. How much nonlabor income does Beth enjoy?
- c. What is Beth’s wage rate on budget line #1?
- d. What is Beth’s wage rate on budget line #2?

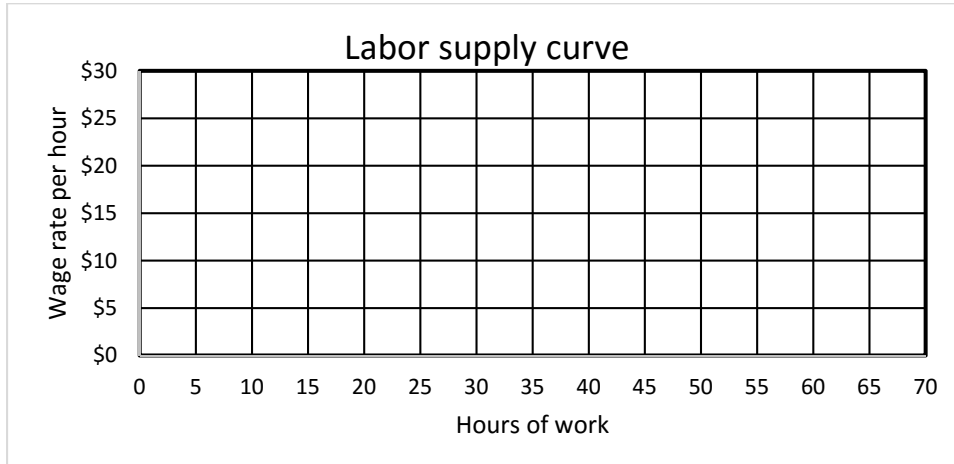
|    |          |
|----|----------|
|    | hours    |
| \$ |          |
| \$ | per hour |
| \$ | per hour |

Consider Beth’s response to the change in the wage rate from budget line #1 to budget line #2.

- e. Does the *income effect* of this change cause Beth to work *more* or to work *less*?
- f. Compute the change in hours of work due to the *income effect* alone.
- g. Does the *substitution effect* of this change cause Beth to work *more* or to work *less*?
- h. Compute the change in hours of work due to the *substitution effect* alone.
- i. Does the *total effect* of this change cause Beth to work *more* or to work *less*?
- j. Compute the total change in hours of work caused by the change in the wage rate.

|  |       |
|--|-------|
|  | hours |
|  | hours |
|  | hours |
|  | hours |

k. Using the information in this indifference-curve graph, plot two points on Beth's *labor supply curve* in the graph below and sketch the curve.



(4) [SR labor demand: 9 pts] Suppose United Manufacturing Company has the following production function.

$$q = 4 (K E)^{1/2} .$$

A little calculus shows that the marginal product of labor is

$$MP_E = (2) (K/E)^{1/2} .$$

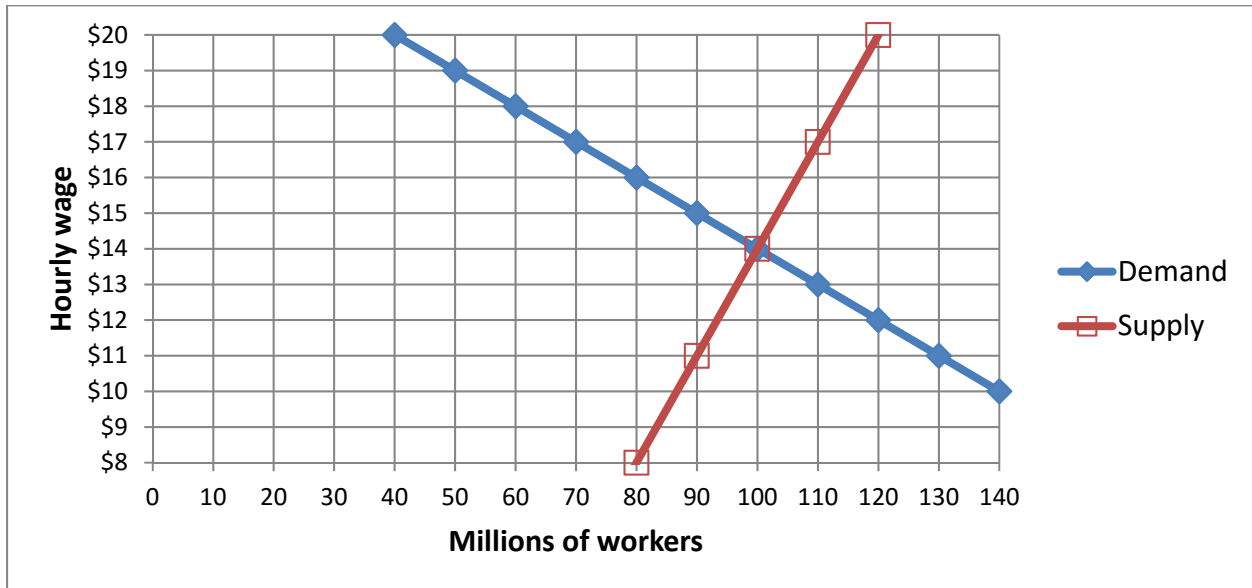
The price of output is \$10, the wage is \$20 per hour, and the price of capital is \$5. The capital stock is fixed at  $K=16$  units.

a. How much labor  $E$  should United employ in the short run?

b. How much output  $q$  will United produce?

c. How much profit will United enjoy?

(5) [Payroll tax or subsidy: 14 pts] The graph below shows demand and supply for workers in a particular labor market.



Suppose the government gives a **payroll subsidy of \$ 4** per hour.

- Find the new level of employment.
- Find the new net labor cost per hour paid by employers (excluding the subsidy).
- Find the new total wage per hour received by workers (including the subsidy).
- Compute the gain in employer surplus as a result of the subsidy (per hour).
- Compute the gain in worker surplus as a result of the subsidy (per hour).
- Compute the direct cost of the subsidy program to the government—that is, the amount the government will pay workers or employers (per hour)..
- Compute the deadweight loss caused by the subsidy (per hour).

|    |         |
|----|---------|
|    | million |
| \$ |         |
| \$ |         |
| \$ | million |
| \$ | million |
| \$ | million |
| \$ | million |

(6) [Monopsony: 18 pts] Suppose a monopsony employer's demand for workers is given by

$$VMP = 70 - (E/20).$$

Labor supply to the employer is given by

$$w = -20 + (E/10).$$

- a. [4 pts] Compute the efficient level of employment (E), where the value of the next worker's time equals that worker's contribution to the firm's revenue. Show your work and circle your final answer.

- b. [2 pts] Recall that if labor supply is a straight line, then marginal labor cost is also a straight line, with the same intercept and twice the slope of labor supply. Give the equation for marginal labor cost (MLC).

**MLC =**

- c. [4 pts] What level of employment (E) will the employer choose to maximize profit? Show your work and circle your final answer.

- d. [4 pts] What wage (w) will the employer pay? Show your work and circle your final answer.

- e. [4 pts] Suppose the government imposes a minimum wage of \$15 per hour. What level of employment (E) will the employer now choose? Show your work and circle your final answer.

(7) [Simple model of schooling decision: 10 pts] Suppose a person lives for two periods and must choose between two careers. If the person chooses “no college,” the person earns \$150 thousand in the first period, and then \$318 thousand in the second period. If the person chooses “college,” the person earns nothing in the first period and pays college costs of \$50 thousand, and then earns \$530 thousand in the second period.

First, suppose the person’s discount rate between the two periods is  $r = 10\%$ .

- a. Compute the net present value as of the first period of “no college,” to the nearest thousand dollars. Show your work and circle your final answer.

- b. Compute the net present value as of the first period of “college,” to the nearest thousand dollars. Show your work and circle your final answer.

- c. Which career will the person choose: “no college” or “college”?

Next, consider the discount rate  $r^*$  between the two periods would make the person exactly indifferent between the two careers.

- d. Compute  $r^*$ . Show your work and circle your final answer.

- e. If the person’s discount rate were *less* than  $r^*$  (found in part d) would that person choose “no college” or “college”?



(8) [Roy model: 4 pts] Suppose Country X and Country Y each have workers whose skill ( $S$ ) ranges from 0 to 100. The relationship between wages and skill in Country X is given by  $W_X = 10 + 3S$ . The relationship in Country Y is given by  $W_Y = 50 + S$ . Assume that moving costs are \$20.

a. [4 pts] For what range of values of  $S$  will workers in Country X want to migrate to Country Y? Show your work and circle your final answer.

b. Is this immigrant flow positively or negatively selected? Justify your answer.

(9) [Oaxaca decomposition: 6 pts] Suppose we have computed the following statistics using data on hourly wages ( $W$ ) and schooling ( $S$ ) for a large sample of green and blue workers:

|               | Regression equation         | Average years of schooling |
|---------------|-----------------------------|----------------------------|
| Green workers | $\ln(W_G) = 1.2 + 0.10 S_G$ | 13                         |
| Blue workers  | $\ln(W_B) = 1.0 + 0.08 S_B$ | 10                         |

a. Compute the raw log wage differential—that is,  $\overline{\ln(W_G)} - \overline{\ln(W_B)}$ .

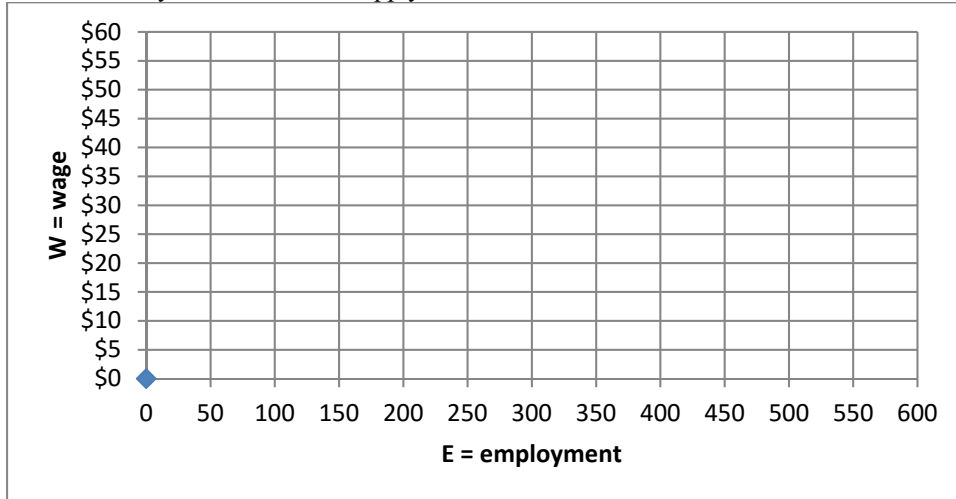
b. Compute the log wage differential due to schooling.

c. Compute the log wage differential due to discrimination in the labor market, in Oaxaca's definition.

(10) [Monopoly union model: 10 pts] Suppose labor demand (VMP) by a particular firm is given by  $W = 50 - 0.1 E$ , where  $W$  is the hourly wage and  $E$  is employment (number of workers). The competitive wage is  $W_C = \$10$ .

a. Compute the competitive level of employment. Show your work and circle your final answer.

b. Using a straightedge, graph and label the labor demand curve in the graph below. Also plot a horizontal line at  $W_C$ , which is effectively the firm's labor supply curve.



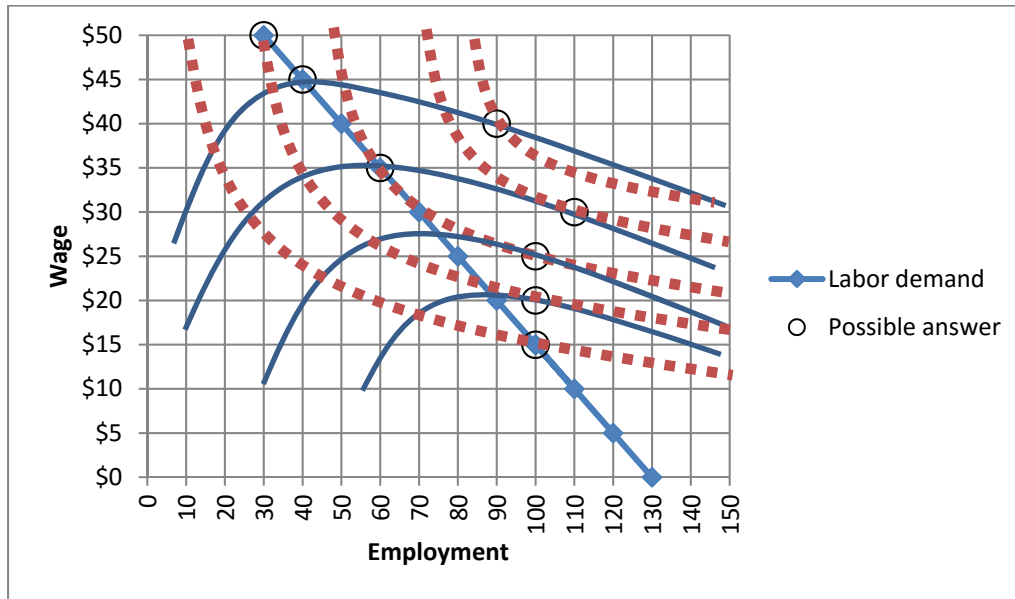
Assume the firm faces a monopoly union, whose utility function is given by  $U = (W - W_C) \times E$ . (This assumption is sometimes called “rent maximization.”) A little calculus shows that the union's marginal utility of employment is  $MU_E = W - W_C$  and its marginal utility of wages is  $MU_W = E$ .

c. Compute the wage set by the union and the resulting level of employment. [Hint: Set the union's  $MRS = MU_E / MU_W$  equal to the |slope| of the labor demand curve.] Show your work and circle your final answers.

d. Plot this outcome in the graph above and label it “Rent max.”

e. Compute the efficiency loss from this outcome. Circle your final answer.

(11) [Efficient bargaining model: 8 pts] The graph below shows a labor demand curve (or VMP curve) for a firm. The solid curves are the firm's isoprofit curves. The dotted curves are the union's indifference curves. Choose answers to the questions below from among the circled points on the graph.



First suppose the union is a *monopoly*, setting the wage unilaterally and then allowing the firm to choose employment.

a. What wage will the union choose? What level of employment will the firm choose in response?

|       |    |
|-------|----|
| W= \$ | E= |
|-------|----|

Now suppose the union and the firm engage in *efficient bargaining*, choosing the wage and the employment level simultaneously.

b. Find an efficient combination of wage and employment that will be just as good for the firm as your answer to (a), and better for the union than your answer to (a).

|       |    |
|-------|----|
| W= \$ | E= |
|-------|----|

c. Find an efficient combination of wage and employment that will be just as good for the union as your answer to (a), and better for the firm than your answer to (a).

|       |    |
|-------|----|
| W= \$ | E= |
|-------|----|

d. List one other efficient combination of wage and employment and **sketch the contract curve in the graph.**

|       |    |
|-------|----|
| W= \$ | E= |
|-------|----|

(12) [Union wage effects: 6 pts] Suppose an industry initially pays a wage of \$15 per hour. Then part of the industry becomes unionized. The unionized part then pays \$18 per hour while the nonunion part pays \$12. Assume nothing else changes except unionism.

a. Compute the *wage gain* due to unionism.

|  |   |
|--|---|
|  | % |
|--|---|

b. Compute the *wage gap* due to unionism.

|  |   |
|--|---|
|  | % |
|--|---|

c. Does the change in the nonunion wage indicate *threat effects* or *spillover effects*? Explain your reasoning.

(13) [Piece rates and time rates: 10 pts] Amanda wraps packages at two possible employers. Employer #1 pays a piece rate: **\$0.50 per package**. Employer #2 simply pays a time rate of **\$15 per hour** and fires anyone who does not wrap at least 30 packages per hour.

Amanda's marginal cost of effort to wrap packages is  $MC = 0.01 N$ , where  $N$  is the number of packages wrapped per hour. It can be shown using integral calculus that Amanda's total cost of effort per hour is  $TC = 0.005 N^2$ . Suppose Amanda worked at Employer #1.

a. How many packages would she wrap per hour?

|  |
|--|
|  |
|--|

b. What would be her hourly pay?

|    |
|----|
| \$ |
|----|

c. What would be her hourly net benefit at Employer #1 (that is, hourly pay minus total cost of effort per hour).

|    |
|----|
| \$ |
|----|

Suppose Amanda worked at Employer #2.

d. What would be her hourly net benefit at Employer #2 (that is, hourly pay minus total cost of effort per hour).

|    |
|----|
| \$ |
|----|

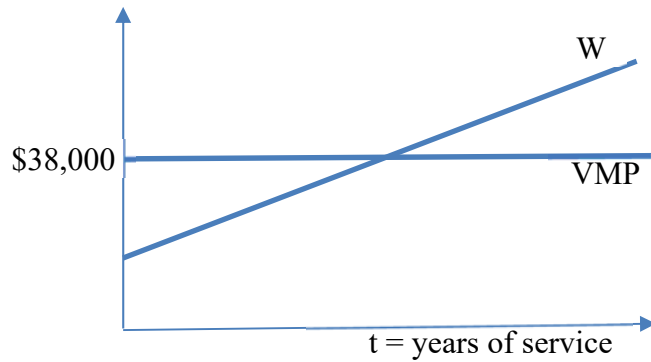
e. Which employer will Amanda prefer?

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|  |
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(14) [Mandatory retirement: 9 pts] Suppose a firm uses delayed compensation to discourage shirking. The workers' VMP is constant at \$38,000 per year, but the firm instead pays a wage of

$$W = (\$20,000 + 1000 t)$$

where  $t$  denotes years of service with the firm. To simplify calculations, assume that workers' discount rate is 0%, and that wages are adjusted continuously rather than once a year. Use the graph at right for scratch work.



- a. After how many years of service does the wage equal VMP? Show your work and circle your final answer.

- b. After how many years of service will the firm want to impose mandatory retirement? [Hint: This is the value of  $t$  where the area under the  $W$  curve equals the area under the  $VMP$  curve.] Show your work and circle your final answer.

- c. Assume that the firm is able to impose mandatory retirement somehow, as computed in part (b). Suppose a worker were fired after only 30 years of service and forced to take another job at \$38,000 for the rest of her career. How much would the worker lose in total? Show your work and circle your final answer.

(15) [Markov model: 10 pts] Suppose people move between employment and unemployment every month according to the following Markov transition matrix. Note that two numbers are missing.

|      |              | To         |              |
|------|--------------|------------|--------------|
|      |              | Employment | Unemployment |
| From | Employment   | (a)        | 0.02         |
|      | Unemployment | 0.38       | (b)          |

- a. What number belongs in place of (a)?
- b. What number belongs in place of (b)?
- c. What percent of employed people lose or leave their jobs or every month?
- d. What percent of unemployed people find jobs every month?
- e. Compute the steady-state unemployment rate.

|  |   |
|--|---|
|  |   |
|  |   |
|  | % |
|  | % |
|  | % |

(16) [Job search: 10 pts] An unemployed worker is searching for a job. Suppose the marginal benefit of further search, as a function of the wage offer in hand, is  $MB = 65 - 3W$ , and the marginal cost of further search, as a function of the wage offer in hand, is  $MC = 5 + W$ .

a. What is the worker's reservation wage?

b. Would the worker accept a job at \$12 per hour? Why or why not?

Suppose unemployment insurance benefits were *increased*.

c. Which curve would shift: MB or MC? Why?

d. Would the reservation wage increase or decrease? Why?

e. Would the average time to find a new job increase or decrease? Why?

**III. Critical thinking:** Write a one-paragraph essay answering *only one* question below (your choice). [4 pts]

- (1) In 1776, Adam Smith argued that one reason for differences in pay across occupations was “the easiness and cheapness, or the difficulty and expense of learning them.”<sup>2</sup> What modern theory of wage differentials did Smith anticipate? Why is it necessary to pay workers higher wages if their occupation is more difficult and expensive to learn?
- (2) The manager of a software company is worried that her programmers are checking Facebook when they should be writing code. She is considering whether to change her payment scheme from \$20 per hour to \$1 per line of code, but she wants your advice. What would be one advantage of the new payment scheme? What would be two disadvantages? What is your overall recommendation?

Circle the question you are answering and write your answer below. Full credit requires correct economic reasoning, legible writing, good grammar including complete sentences, and accurate spelling.

[end of exam]

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<sup>2</sup> Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, New York: Modern Library (1937) [1776], p. 100.