Chapter 3
Productivity, Output, and Employment

Multiple Choice Questions

1. A mathematical expression relating the amount of output produced to quantities of capital and labor utilized is the
   (a) real interest rate.
   (b) productivity relation.
   (c) production function.
   (d) marginal product.
   Answer: C
   Level of difficulty: 1
   Section: 3.1

2. In the production function $Y = AF(K, N)$, $A$ is _____, $K$ is _____, and $N$ is _____.
   (a) total factor productivity; the capital stock; the number of workers employed
   (b) total factor productivity; investment; the number of workers employed
   (c) the productivity of labor; the capital stock; the size of the labor force
   (d) the productivity of labor; investment; the size of the labor force
   Answer: A
   Level of difficulty: 1
   Section: 3.1

3. In the production function $Y = AF(K, N)$, total factor productivity is
   (a) $Y/A$.
   (b) $A$.
   (c) $K/N$.
   (d) $Y/N$.
   Answer: B
   Level of difficulty: 1
   Section: 3.1

4. Suppose the economy’s production function is $Y = A K^{0.3} N^{0.7}$. If $K = 2000$, $N = 100$, and $A = 1$, then $Y = 246$. If $K$ and $N$ both rise by 10%, and $A$ is unchanged, by how much does $Y$ increase?
   (a) 5%
   (b) 10%
   (c) 15%
   (d) 20%
   Answer: B
   Level of difficulty: 2
   Section: 3.1
5. If $Y = A \times N \times (75 + K/N)$, where $K = 1000$, $N = 20$, and $A = 10$, what happens if $K$ doubles and $N$ doubles?
   (a) $Y$ is unchanged.
   (b) $Y$ increases 50%.
   (c) $Y$ doubles.
   (d) $Y$ quadruples.
   Answer: C
   Level of difficulty: 2
   Section: 3.1

6. Suppose the economy’s production function is $Y = AK^{0.3}N^{0.7}$. When $K = 1000$, $N = 50$, and $A = 15$, what is $Y$?
   (a) 1842
   (b) 6106
   (c) 750,000
   (d) 123
   Answer: A
   Level of difficulty: 1
   Section: 3.1

7. Suppose that in 2003 Freedonia had GDP equal to 2000 million, the capital stock was equal to 1700 million, the number of employees equaled 70 million. The production function is $Y = AK^{0.25}N^{0.75}$. Total factor productivity of the economy in that year was approximately equal to
   (a) 0.09.
   (b) 2.61.
   (c) 4.19.
   (d) 12.87.
   Answer: D
   Level of difficulty: 3
   Section: 3.1

8. The table below represents Freedonia’s macroeconomic data for 2003 and 2004.

<table>
<thead>
<tr>
<th>Year</th>
<th>$Y$</th>
<th>$K$</th>
<th>$N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>2000</td>
<td>1700</td>
<td>70</td>
</tr>
<tr>
<td>2004</td>
<td>2100</td>
<td>1785</td>
<td>75</td>
</tr>
</tbody>
</table>

Suppose that the production function is given by $Y = AK^{0.25}N^{0.75}$. Between 2003 and 2004, total factor productivity of Freedonia’s economy increased by
   (a) –1.5%.
   (b) 5.0%.
   (c) 5.5%.
   (d) 12.7%.
   Answer: A
   Level of difficulty: 3
   Section: 3.1
9. The two main characteristics of the production function are
   (a) it slopes downward from left to right, and the slope becomes flatter as the input increases.
   (b) it slopes upward from left to right, and the slope becomes steeper as the input increases.
   (c) it slopes upward from left to right, and the slope becomes flatter as the input increases.
   (d) it slopes downward from left to right, and the slope becomes steeper as the input increases.
   Answer: C
   Level of difficulty: 1
   Section: 3.1

10. If the marginal product of capital doesn’t change as the amount of capital increases, a figure showing the relationship between output and capital
    (a) is a straight line with constant upward slope.
    (b) is a straight line with a slope of zero.
    (c) is a vertical line.
    (d) slopes upward with a slope that declines as the amount of capital increases.
    Answer: A
    Level of difficulty: 2
    Section: 3.1

11. The marginal product of capital is the increase in
    (a) capital needed to produce one more unit of output.
    (b) output from a one-unit increase in capital.
    (c) labor needed to accompany a one-unit increase in capital.
    (d) output from a one-dollar increase in capital.
    Answer: B
    Level of difficulty: 1
    Section: 3.1

12. The fact that the production function relating output to capital becomes flatter as we move from left to right means that
    (a) the marginal product of labor is positive.
    (b) the marginal product of capital is positive.
    (c) there is diminishing marginal productivity of labor.
    (d) there is diminishing marginal productivity of capital.
    Answer: D
    Level of difficulty: 1
    Section: 3.1

13. The marginal product of labor
    (a) is measured by the slope of the production function relating capital to employment.
    (b) is larger when the labor supply is relatively larger.
    (c) is smaller when the labor supply is relatively smaller.
    (d) decreases as the number of workers already employed increases.
    Answer: D
    Level of difficulty: 1
    Section: 3.1
14. The fact that the production function relating output to labor becomes flatter as we move from left to right means that
   (a) the marginal product of labor is positive.
   (b) the marginal product of capital is positive.
   (c) there is diminishing marginal productivity of labor.
   (d) there is diminishing marginal productivity of capital.
   Answer: C
   Level of difficulty: 1
   Section: 3.1

15. An adverse supply shock would
   (a) shift the production function up and decrease marginal products at every level of employment.
   (b) shift the production function down and decrease marginal products at every level of employment.
   (c) shift the production function down and increase marginal products at every level of employment.
   (d) shift the production function up and increase marginal products at every level of employment.
   Answer: B
   Level of difficulty: 1
   Section: 3.1

16. An invention that speeds up the Internet is an example of
   (a) an income effect.
   (b) an increase in labor.
   (c) a substitution effect.
   (d) a supply shock.
   Answer: D
   Level of difficulty: 1
   Section: 3.1

17. A supply shock that reduces total factor productivity directly affects which term in the production function \( Y = AF(K, N) \)?
   (a) \( A \)
   (b) \( F \)
   (c) \( K \)
   (d) \( N \)
   Answer: A
   Level of difficulty: 1
   Section: 3.1

18. Economists often treat the economy’s capital stock as fixed because
   (a) labor is a more important factor of production than capital, so economists ignore capital.
   (b) it takes a long time for new investment and the scrapping of old capital to affect the overall quantity of capital.
   (c) there is very little capital in the economy compared to the amount of labor.
   (d) unless the interest rate changes, the capital stock doesn’t change.
   Answer: B
   Level of difficulty: 1
   Section: 3.2
19. Changes in the capital stock occur _____, and changes in the amount of labor that firms employ occur _____.
   (a) quickly; quickly
   (b) slowly; slowly
   (c) slowly; quickly
   (d) quickly; slowly
   Answer: C
   Level of difficulty: 1
   Section: 3.2

20. An increase in the real wage rate will cause
   (a) the labor demand curve to shift to the right.
   (b) the labor demand curve to shift to the left.
   (c) the quantity of labor demanded to rise.
   (d) a movement along the labor demand curve.
   Answer: D
   Level of difficulty: 1
   Section: 3.2

21. A decrease in the real wage would result in a
   (a) movement along the labor demand curve, causing an increase in the number of workers hired by the firm.
   (b) shift of the labor demand curve, causing an increase in the number of workers hired by the firm.
   (c) movement along the labor demand curve, causing a decrease in the number of workers hired by the firm.
   (d) shift of the labor demand curve, causing a decrease in the number of workers hired by the firm.
   Answer: A
   Level of difficulty: 1
   Section: 3.2

22. An increase in the number of workers hired by a firm could result from
   (a) a decrease in the marginal product of labor.
   (b) a decrease in the marginal revenue product of labor.
   (c) an increase in the real wage.
   (d) a decrease in the real wage.
   Answer: D
   Level of difficulty: 1
   Section: 3.2

23. What two factors should you equate in deciding how many workers to employ?
   (a) The marginal product of labor and the marginal product of capital
   (b) The marginal product of labor and the real wage rate
   (c) The marginal product of labor and the real interest rate
   (d) The marginal product of capital and the real wage rate
   Answer: B
   Level of difficulty: 1
   Section: 3.2
### Question 24
One reason that firms hire labor at the point where \( w = MPN \) is

(a) if \( w < MPN \), the cost \( (w) \) of hiring additional workers exceeds the benefits \( (MPN) \) of hiring them, so they should hire fewer workers.
(b) if \( w > MPN \), the cost \( (w) \) of hiring additional workers is less than the benefits \( (MPN) \) of hiring them, so they should hire more workers.
(c) if \( w < MPN \), the cost \( (w) \) of hiring additional workers equals the benefits \( (MPN) \) of hiring them, so they have the right number of workers.
(d) if \( w > MPN \), the cost \( (w) \) of hiring additional workers exceeds the benefits \( (MPN) \) of hiring them, so they should hire fewer workers.

Answer: D
Level of difficulty: 2
Section: 3.2

### Question 25
Firms hire labor at the point where the

(a) nominal wage rate equals the marginal product of labor.
(b) real wage rate equals the marginal revenue product of labor.
(c) nominal wage rate equals the marginal revenue product of labor.
(d) real wage rate equals the marginal revenue product of capital.

Answer: C
Level of difficulty: 1
Section: 3.2

### Question 26
The Upstart Company has the following production function.

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Number of Cases Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>31</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
</tr>
</tbody>
</table>

If the company hires 4 workers, which of the following could be the real wage rate?

(a) 2
(b) 4
(c) 6
(d) 8

Answer: B
Level of difficulty: 2
Section: 3.2
27. The Widget Company has the following production function.

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Number of Widgets Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
</tr>
</tbody>
</table>

If widgets sell for $6 each and the wage rate is $33, how many workers will the company hire?

(a) 0  
(b) 1  
(c) 2  
(d) 4  

Answer: D  
Level of difficulty: 2  
Section: 3.2

28. Your boss wants to know if you should lay off any workers. You answer that you should lay off workers if the

(a) marginal revenue product of labor is greater than the nominal wage rate.  
(b) marginal product of labor is greater than or equal to the real wage rate.  
(c) marginal revenue product of labor is equal to the nominal wage rate.  
(d) marginal product of labor is less than the real wage rate.

Answer: D  
Level of difficulty: 1  
Section: 3.2

29. Zowie! Surfboards has the following production function.

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Number of Surfboards Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
</tr>
</tbody>
</table>

If surfboards sold for $30 and the nominal wage rate was $200, how many workers would the firm employ?

(a) 2  
(b) 3  
(c) 4  
(d) 5  

Answer: C  
Level of difficulty: 2  
Section: 3.2
30. The marginal product of labor (measured in units of output) for Expando Corp. is given by

\[ MPN = A(400 - N) \]

where \( A \) measures productivity and \( N \) is the number of labor hours used in production. Suppose the price of output is $3 per unit and \( A = 2.0 \). What will be the demand for labor if the nominal wage is $18?

(a) 57
(b) 107
(c) 197
(d) 397

Answer: D
Level of difficulty: 2
Section: 3.2

31. An adverse supply shock, such as a reduced supply of raw materials, would

(a) increase the marginal product of labor.
(b) decrease the marginal product of labor.
(c) decrease the marginal product of capital, but have no effect on the marginal product of labor.
(d) not affect the marginal product of labor.

Answer: B
Level of difficulty: 1
Section: 3.2

32. Which of the following events would lead to an increase in the marginal product of labor for every quantity of labor?

(a) An increase in the real wage
(b) A decrease in the real wage
(c) A favorable supply shock such as a fall in the price of oil
(d) An adverse supply shock, such as a reduced supply of raw materials

Answer: C
Level of difficulty: 2
Section: 3.2

33. A winter ice storm has paralyzed the entire east coast, reducing productivity sharply. This supply shock shifts the marginal product of labor curve

(a) up and to the right, raising the quantity of labor demanded at any given real wage.
(b) down and to the left, reducing the quantity of labor demanded at any given real wage.
(c) up and to the right, reducing the quantity of labor demanded at any given real wage.
(d) down and to the left, raising the quantity of labor demanded at any given real wage.

Answer: B
Level of difficulty: 1
Section: 3.2
34. A technological breakthrough in using photons for computers will increase the productivity of those working with computers a hundredfold. You would expect this breakthrough to shift the
(a) marginal product of labor curve up and to the right, raising the quantity of labor demanded at any given real wage.
(b) marginal product of labor curve down and to the left, reducing the quantity of labor demanded at any given real wage.
(c) labor supply curve up, reducing the quantity of labor demanded at any given real wage.
(d) labor supply curve down, raising the quantity of labor demanded at any given real wage.
Answer: A
Level of difficulty: 1
Section: 3.2

35. The aggregate supply of labor is the
(a) total amount of time a person works over his or her lifetime.
(b) total amount of time a person spends in the labor force over his or her lifetime.
(c) unemployment rate.
(d) sum of the labor supplied by everyone in the economy.
Answer: D
Level of difficulty: 1
Section: 3.3

36. If Jeff’s wage rate rises, he decides to work fewer hours. From this, we can infer that
(a) for Jeff, the substitution effect is greater than the income effect.
(b) for Jeff, the substitution effect is equal to the income effect.
(c) for Jeff, the substitution effect is less than the income effect.
(d) Jeff is a nitwit.
Answer: C
Level of difficulty: 2
Section: 3.3

37. As a result of the superb economics essay that you wrote during this quarter, you won the Adam Smith prize of $100. The receipt of these funds would be an example of
(a) the substitution effect being stronger than the income effect.
(b) the income effect being stronger than the substitution effect.
(c) a pure income effect.
(d) a pure substitution effect.
Answer: C
Level of difficulty: 1
Section: 3.3

38. A person is more likely to increase labor supply in response to an increase in the real wage, the _____ is the income effect and the _____ is the substitution effect.
(a) larger; larger
(b) larger; smaller
(c) smaller; larger
(d) smaller; smaller
Answer: C
Level of difficulty: 2
Section: 3.3
39. A permanent increase in the real wage rate has a _____ income effect on labor supply than a temporary increase in the real wage, so labor supply is _____ with a permanent wage increase than for a temporary wage increase.

(a) larger; more  
(b) larger; less  
(c) smaller; more  
(d) smaller; less

Answer: B  
Level of difficulty: 2  
Section: 3.3

40. The survey on labor supply by Killingsworth found that

(a) labor supply rises in response to a permanent increase in the real wage, but falls in response to a temporary increase in the real wage.  
(b) labor supply rises in response to a temporary increase in the real wage, but falls in response to a permanent increase in the real wage.  
(c) labor supply rises in response to both a temporary and a permanent increase in the real wage.  
(d) labor supply falls in response to both a temporary and a permanent increase in the real wage.

Answer: B  
Level of difficulty: 2  
Section: 3.3

41. Suppose the marginal product of labor is

\[ MPN = 200 - 0.5N \]

where \( N \) is aggregate employment. The aggregate quantity of labor supplied is \( 300 + 8w \), where \( w \) is the real wage. What is the equilibrium real wage?

(a) 5  
(b) 10  
(c) 15  
(d) 20

Answer: B  
Level of difficulty: 3  
Section: 3.4

42. Suppose the marginal product of labor is

\[ MPN = 200 - 0.5N \]

where \( N \) is aggregate employment. The aggregate quantity of labor supplied is \( 300 + 8w \), where \( w \) is the real wage. What is the equilibrium quantity of employment?

(a) 12  
(b) 190  
(c) 380  
(d) 760

Answer: C  
Level of difficulty: 3  
Section: 3.4
43. Suppose the marginal product of labor is

\[ MPN = 200 - 0.5N \]

where \( N \) is aggregate employment. The aggregate quantity of labor supplied is \( 300 + 8w \), where \( w \) is the real wage. If a supply shock increases the marginal product of labor by 10 (to \( MPN = 210 - 0.5N \)), by how much does the real wage increase?

(a) 1  
(b) 2  
(c) 3  
(d) 4  
Answer: B  
Level of difficulty: 3  
Section: 3.4

44. Suppose the marginal product of labor is

\[ MPN = 200 - 0.5N \]

where \( N \) is aggregate employment. The aggregate quantity of labor supplied is \( 300 + 8w \), where \( w \) is the real wage. If a supply shock increases the marginal product of labor by 10 (to \( MPN = 210 - 0.5N \)), by how much does employment increase?

(a) 0  
(b) 4  
(c) 8  
(d) 16  
Answer: D  
Level of difficulty: 3  
Section: 3.4

45. A tremendous flood along the Mississippi River destroys thousands of factories, reducing the nation’s capital stock by 5%. What happens to current employment and the real wage rate?

(a) Both employment and the real wage rate would increase.  
(b) Both employment and the real wage rate would decrease.  
(c) Employment would increase and the real wage would decrease.  
(d) Employment would decrease and the real wage would increase.  
Answer: B  
Level of difficulty: 2  
Section: 3.4

46. A sharp increase in stock prices makes people much wealthier. If the main effect of this increased wealth is felt on labor supply, what happens to current employment and the real wage rate?

(a) Both employment and the real wage rate would increase.  
(b) Both employment and the real wage rate would decrease.  
(c) Employment would increase and the real wage would decrease.  
(d) Employment would decrease and the real wage would increase.  
Answer: D  
Level of difficulty: 2  
Section: 3.4
47. An adverse oil-price shock reduces labor demand. What happens to current employment and the real wage rate?
   (a) Both employment and the real wage rate would increase.
   (b) Both employment and the real wage rate would decrease.
   (c) Employment would increase and the real wage would decrease.
   (d) Employment would decrease and the real wage would increase.
   Answer: B
   Level of difficulty: 2
   Section: 3.4

48. The equilibrium level of employment, achieved after the complete adjustment of wages and prices, is known as the
   (a) zero-unemployment level of employment.
   (b) natural state.
   (c) invisible handshake.
   (d) full-employment level of employment.
   Answer: D
   Level of difficulty: 1
   Section: 3.4

49. Full-employment output is the level of output that firms in the economy supply when
   (a) taxes are zero.
   (b) wages and prices have fully adjusted.
   (c) the unemployment rate is zero.
   (d) all capital is fully utilized.
   Answer: B
   Level of difficulty: 1
   Section: 3.4

50. What is the unemployment rate if there are 150 million people employed, 25 million people unemployed, and 25 million not in the labor force?
   (a) 14.3%
   (b) 13.4%
   (c) 12.5%
   (d) 25.0%
   Answer: A
   Level of difficulty: 2
   Section: 3.5

51. The _____ is the number of unemployed divided by the labor force and the _____ is the number of employed divided by the adult population.
   (a) unemployment rate; employment rate
   (b) unemployment rate; employment ratio
   (c) unemployment ratio; participation rate
   (d) discouraged worker ratio; employment rate
   Answer: B
   Level of difficulty: 1
   Section: 3.5
52. What is the participation rate if there are 125 million people in the labor force, 100 million people employed, and 25 million not in the labor force?
   (a) 83%
   (b) 80%
   (c) 75%
   (d) 67%
   Answer: A
   Level of difficulty: 2
   Section: 3.5

53. How many people are unemployed if the employment ratio is 75%, there are 90 million people employed, and there are 20 million people not in the labor force?
   (a) 20 million
   (b) 10 million
   (c) 5 million
   (d) 0 million
   Answer: B
   Level of difficulty: 2
   Section: 3.5

54. The city of Hope has a labor force of 1000. Twenty people lose their jobs each month and remain unemployed for exactly one month before finding jobs. On January 1, May 1, and September 1 of each year, 50 people lose their jobs for a period of four months before finding new jobs. What is the unemployment rate in any given month?
   (a) 2%
   (b) 3%
   (c) 5%
   (d) 7%
   Answer: D
   Level of difficulty: 1
   Section: 3.5

55. The city of Hope has a labor force of 1000. Twenty people lose their jobs each month and remain unemployed for exactly one month before finding jobs. On January 1, May 1, and September 1 of each year, 50 people lose their jobs for a period of four months before finding new jobs. What is the average duration of an unemployment spell?
   (a) 2.15 months
   (b) 2.85 months
   (c) 3.14 months
   (d) 3.43 months
   Answer: A
   Level of difficulty: 2
   Section: 3.5
56. Frictional unemployment arises when
   (a) unskilled or low-skilled workers find it difficult to obtain desirable, long-term jobs.
   (b) labor must be reallocated from industries that are shrinking to areas that are growing.
   (c) workers must search for suitable jobs and firms must search for suitable workers.
   (d) output and employment are below full-employment levels.
   Answer: C
   Level of difficulty: 1
   Section: 3.5

57. Cyclical unemployment arises when
   (a) unskilled or low-skilled workers find it difficult to obtain desirable, long-term jobs.
   (b) labor must be reallocated from industries that are shrinking to areas that are growing.
   (c) workers must search for suitable jobs and firms must search for suitable workers.
   (d) output and employment are below full-employment levels.
   Answer: D
   Level of difficulty: 1
   Section: 3.5

58. According to Okun’s law, an increase in the unemployment rate will cause _____ in the level of employment and _____ in the level of output.
   (a) an increase; an increase
   (b) an increase; a decrease
   (c) a decrease; an increase
   (d) a decrease; a decrease
   Answer: D
   Level of difficulty: 1
   Section: 3.6

59. Assume that the full–employment level of output is $5000 billion and the natural unemployment rate is 5%. Suppose the current unemployment rate is 8%. What would be the current level of output according to Okun’s law (when the Okun’s law coefficient is 2)?
   (a) $4500 billion
   (b) $4700 billion
   (c) $4900 billion
   (d) $5000 billion
   Answer: B
   Level of difficulty: 2
   Section: 3.6
60. According to Okun’s law, if output grew 7% and full-employment output rose 5%, what would be the change in the unemployment rate?
   (a) –4%
   (b) –1%
   (c) 1%
   (d) 4%
   Answer: B
   Level of difficulty: 2
   Section: 3.6

■ Essay Questions

1. Suppose the production function is \( Y = A K^{0.3} N^{0.7} \). Suppose in 1990, \( K = 1000 \), \( N = 100 \), and \( Y = 199.5 \). In 2000, capital, labor, and output have doubled, so \( K = 2000 \), \( N = 200 \), and \( Y = 399 \).
   (a) By what percentage did productivity grow from 1990 to 2000?
   (b) If output had risen to 798 instead of 399, and capital and labor doubled, by what percentage would productivity have grown from 1990 to 2000?

   Answers:
   (a) From the production function, you can calculate that \( A = 1 \) in both 1990 and 2000, so \( A \) is unchanged.
   (b) Since output doubles (relative to the case in which \( Y = 399 \) in 2000) with the same amounts of capital and labor, \( A \) doubled.
   Level of difficulty: 2
   Section: 3.1

2. In the U.S. economy in 1991, real GDP was 4861.4 (in billions of 1987 dollars), the capital stock was 13,806.2 (in billions of 1987 dollars), and employment was 118.4 (in millions of workers). In 1992 the numbers were: real GDP 4986.3, capital stock 14,040.8, employment 119.2. Suppose the production function in both years is \( Y = A K^{0.25} N^{0.75} \).
   (b) How much did total factor productivity grow from 1991 to 1992?
   (c) Calculate the percent increase in real output between 1991 and 1992.
   (d) Suppose tax incentives had raised the capital stock in 1992, making it 10% higher, to 15,444.9. If employment didn’t change, what would have been the percent increase in real output between 1991 and 1992?
   (e) Instead of the increase in the capital stock in part (d), suppose employment was 10% higher in 1992, making it 131.1. With the capital stock fixed at 14,040.8, what would have been the increase in real output between 1991 and 1992?

   Answers:
   (a) 1991: 12.49; 1992: 12.70
   (b) +1.7%
   (c) +2.6%
   (d) \( Y = 5107.5 \), a 5.1% increase
   (e) \( Y = 5356.2 \), a 10.2% increase
   Level of difficulty: 3
   Section: 3.1
3. Suppose a firm’s hourly marginal product of labor is given by \( MPN = A (200 - N) \).
   (a) If \( A = 0.2 \) and the real wage rate is $10 per hour, how much labor will the firm want to hire?
   (b) Suppose the real wage rate rises to $20 per hour. How much labor will the firm want to hire?
   (c) With the real wage rate at $10 per hour, how much labor will the firm want to hire if \( A \) rises to 0.5?

   \textbf{Answers:}
   (a) The firm will hire labor such that \( w = MPN \), or 10 = 0.2(200 - N), so \( N = 150 \).
   (b) Now 20 = 0.2(200 - N), so \( N = 100 \). The firm’s labor demand falls when the wage rate rises.
   (c) Now 10 = 0.5(200 - N), so \( N = 180 \). The increase in productivity increases labor demand.

   Level of difficulty: 2
   Section: 3.2

4. How would each of the following events affect Cheryl Shirker’s supply of labor?
   (a) Cheryl’s firm announces a reorganization plan, in which she will get a big promotion and raise
      in six months.
   (b) Cheryl’s speculative investment in plutonium futures pays off big, netting her a profit of
      $300,000.
   (c) Cheryl’s father, who had planned to leave her a large bequest, must spend all his wealth on
      medical bills after a prolonged illness.

   \textbf{Answers:}
   (a) The higher future real wage reduces current labor supply.
   (b) Higher wealth reduces labor supply.
   (c) Lower wealth increases labor supply.

   Level of difficulty: 2
   Section: 3.3

5. Suppose the marginal product of labor in the economy is given by \( MPN = 200 - 0.5 \, N \), while the
   supply of labor is \( 100 + 4w \).
   (a) Find the market-clearing real wage rate.
   (b) What happens if the government imposes a minimum wage of 40? Is there involuntary
      unemployment?
   (c) What happens if the government imposes a minimum wage of 60? Is there involuntary
      unemployment?

   \textbf{Answers:}
   (a) The market-clearing real wage rate equates the demand and supply of labor. Setting \( w = MPN = 
       200 - 0.5 \, N \) and solving for \( N \) gives \( N = 400 - 2w \), which represents labor demand. Equating
       labor demand to labor supply gives 400 - 2w = 100 + 4w, or 300 = 6w, or w = 50.
   (b) A minimum wage of 40 has no effect, as it is below the market wage, so involuntary
       unemployment is 0.
   (c) A minimum wage of 60 is binding, as it is above the market wage. At \( w = 60 \), labor demand is
       \( 400 - (2 \times 60) = 280 \), while labor supply is \( 100 + (4 \times 60) = 340 \). So unemployment is 60
       workers.

   Level of difficulty: 2
   Section: 3.3
6. How would each of the following events affect the level of employment and the real wage rate?
   (a) A tremendous boom occurs in the stock market, increasing people’s wealth by $100 billion overnight.
   (b) A major government loan-guarantee program goes bust, losing $500 billion. To pay off the loss, the government announces that tax rates will rise 30% in the future.
   (c) A nuclear mishap contaminates all auto plants in the Detroit area, destroying their capital.
   (d) Medical science cures the common cold, causing fewer work days lost due to illness, thus greatly increasing labor productivity.

   **Answers:**
   (a) Increased wealth reduces labor supply; the shift of the labor supply curve to the left brings a new equilibrium with lower employment and a higher real wage.
   (b) The loss of wealth increases labor supply, leading to higher employment and a lower real wage.
   (c) The loss of capital lowers the marginal product of labor, reducing labor demand; the shift of the labor demand curve to the left lowers the real wage and employment.
   (d) Increased productivity increases the demand for labor; in equilibrium the real wage and employment increase.

   Level of difficulty: 2  
   Section: 3.3

7. Over the past 100 years, what has happened to the average workweek in the U.S. manufacturing industry? Why has this occurred? What are the implications for the size of the income and substitution effects?

   **Answers:** The average workweek in manufacturing has declined from about 56 hours a week a century ago to just over 40 hours a week more recently. The primary reason for the decline in the workweek is the higher real wage. This suggests that the income effect of a permanently higher real wage dominates the substitution effect, as workers choose to have more leisure and to work fewer hours per week.

   Level of difficulty: 2  
   Section: 3.3

8. Suppose oil prices fall temporarily, as oil becomes more plentiful. What impact is this likely to have on the production function, the marginal products of labor and capital, labor demand, employment, and the real wage?

   **Answer:** More output can now be produced by the same amounts of capital and labor, since oil is more abundant and cheaper. The production function shifts upward, with the marginal products of labor and capital rising. Since the marginal product of labor is higher, so is labor demand. As a result of the shift to the right in the labor demand curve, employment rises, as does the real wage.

   Level of difficulty: 2  
   Section: 3.4
9. In April 2000, the United States had a labor force of 141,230,000, employment of 135,706,000, and there were 67,986,000 people not in the labor force (all numbers rounded to the nearest 1000).
(a) Calculate the unemployment rate.
(b) Calculate the participation rate.
(c) Calculate the employment ratio.

Answers:
(a) Unemployment = labor force – employment = 141,230,000 – 135,706,000 = 5,524,000, so the unemployment rate is 5,524,000/141,230,000 = 3.9%.
(b) The participation rate is the fraction of the adult population in the labor force. The adult population is the labor force + the number not in the labor force = 141,230,000 + 67,986,000 = 209,216,000. The participation rate is then 141,230,000/209,216,000 = 67.5%.
(c) The employment ratio is the employed fraction of the adult population, which is 135,706,000/209,216,000 = 64.9%.

Level of difficulty: 2
Section: 3.5

10. The city of Hope has a labor force of 1000. Twenty people lose their jobs each month and remain unemployed for exactly one month before finding jobs. On January 1, May 1, and September 1 of each year 50 people lose their jobs for a period of four months before finding new jobs.
(a) What is the unemployment rate in any given month?
(b) How many unemployment spells are there in a year?
(c) What is the average duration of an unemployment spell?
(d) On any given date, how many people are undergoing short spells, and how many are undergoing long spells?

Answers:
(a) 70/1000 = 7%
(b) Short spells: 20 each month × 12 months = 240. Long spells: 50 each × 3 times a year = 150. Total spells = 240 + 150 = 390. Note that most are short spells.
(c) The total duration of all spells is (240 spells × 1 month) 240 months + (150 spells × 4 months) 600 months = 840 months. Average duration = total duration/total spells = 840/390 = 2.15 months.
(d) Short: 20; long: 50. Note that most of the unemployed at a given time are undergoing long spells.

Level of difficulty: 2
Section: 3.5
11. Suppose the Okun’s law coefficient is 2, the full-employment level of output is $5000 billion, and the natural rate of unemployment is 6%.

(a) What is the current level of output if the current unemployment rate is 8%?

(b) Suppose the unemployment rate falls to 5%; what is the current level of output?

(c) Suppose structural changes in the economy raise the natural rate of unemployment to 7%, and lower the full-employment level of output to $4800 billion. If the current unemployment rate is 8%, what is the current level of output?

**Answers:**

(a) From the Okun’s law relationship \((\bar{Y} - Y)/\bar{Y} = 2 (u - \bar{u})\), we can solve for \(Y\) to get 
\[
Y = [1 - 2(u - \bar{u})] \bar{Y} = [1 - 2(0.08 - 0.06)]5000 = 0.96 \times 5000 = $4800 billion.
\]

(b) 
\[
Y = [1 - 2(0.05 - 0.06)]5000 = 1.02 \times 5000 = $5100 billion.
\]

(c) 
\[
Y = [1 - 2(0.08 - 0.07)]4800 = 0.98 \times 4800 = $4704 billion.
\]

Level of difficulty: 2
Section: 3.6