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MIME 310 ENGINEERING ECONOMY

Class Test #1 – Wednesday, 13 February, 2008 – 90 minutes

PRINT your family name / initial and record your student ID number in the spaces provided below.

FAMILY NAME / INITIAL																			
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This test consists of 17 multiple-choice questions, and two problems requiring a full solution. The multiple-choice question are worth a total of 75 points. There are no penalties for incorrect answers. The problems are worth a total of 25 points.

MULTIPLE-CHOICE QUESTIONS
Circle the correct answers on this test paper and record them on the computer answer sheet.

Multiple-choice Statements – Circle the correct answer on this paper and record it on the computer answer sheet. (3 points each for a total of 15)

Note: There are no penalties for incorrect answers.

1. Assuming that there is no shift in the supply or demand curves, what will bring the market into equilibrium if the demand for a product is too high relative to its supply? The price will:
 - A) rise, demand will fall, and supply will rise.
 - B) rise, demand will rise, and supply will fall.
 - C) fall, demand will fall, and supply will rise.
 - D) fall, demand will rise, and supply will fall.

2. If you are willing to pay up to \$20 for a shirt, but you only have to pay the market price of \$16, the \$4 difference is:
 - A) your consumer surplus
 - B) the producer's deficit
 - C) your consumer deficit
 - D) the producer's surplus

3. The law of diminishing marginal returns states that for a given production process, as more and more variable resources (e.g., labour) are added, output:
- A) decreases at an increasing rate.
 - B) decreases at a decreasing rate.
 - C) increases at an increasing rate.
 - D) increases at a decreasing rate.
4. In a total cost function, if the marginal cost is greater than the average cost at a particular production rate, the production of an additional unit will cause the:
- A) average cost to increase.
 - B) average cost to remain unchanged.
 - C) marginal cost to decrease.
 - D) marginal cost to remain unchanged.
5. In a statement of cash flow, which one of the following elements would be considered a use of funds?
- A) An increase in fixed assets at cost
 - B) An increase in retained earnings
 - C) A decrease in accounts receivables
 - D) An increase in accounts payable

Problems with Multiple-choice Answers – Circle the correct answer on this paper and record it on the computer answer sheet. (5 points each for a total of 60)

Note: There are no penalties for incorrect answers.

6. If the number of widgets demanded changes from 19 to 21 when the price changes from \$1.50 to \$0.50, the arc elasticity of demand is:
- A) -5
 - B) unitary elastic
 - C) 1/10
 - D) -1/5
 - E) none of the choices given above
- $$AE = [-(19 - 21) / (19 + 21)] / [(1.50 - 0.50) / (1.50 + 0.50)]$$

$$= (2 / 20) / (1.00 / 1.00) = 0.10$$

Use the following information to answer questions 7 to 9.

An asset costs \$30 000 and has an estimated salvage value of \$5000 at the end of a useful life of 5 years.

7. Using the straight-line method to depreciate the asset over its useful life, the depreciation charge for tax purposes in the third year of use of the asset is:
- A) \$5000
 - B) \$6000
 - C) \$24 000
 - D) Cannot determine depreciation charge without annual depreciation rate
 - E) none of the choices given above
- The salvage value is ignored when depreciating for tax purposes.

$$DC = 30\ 000 / 5 = 6000$$

8. Using the declining-balance method with an annual depreciation rate of 20 percent, the book value of the asset after three years of use is:
- A) \$3840
 B) \$15 000
 C) \$15 360
 D) \$19 200
 E) none of the choices given above
- $$BV_3 = 30\,000 (1 - 0.2)^3 = 15\,360$$
9. Using the sum-of-the-years'-digits method, and assuming a constant annual production rate, the depreciation charge for accounting purposes in the second year of use of the asset is:
- A) \$6667
 B) \$8000
 C) \$15 000
 D) Cannot determine depreciation charge without annual depreciation rate
 E) none of the choices given above
- Sum-of-the-years'-digits: $1 + 2 + 3 + 4 + 5 = 15$

$DC_2 = (30\,000 - 5000) (4 / 15) = 6666.67$

Use the financial statements shown below to answer questions 10 to 13.

Marble Comics Group
Year-end Balance Sheets
(\$ millions)

	<u>1998</u>	<u>1999</u>		<u>1998</u>	<u>1999</u>
Cash	75	135	Accounts payable	89	110
Accounts receivable	230	214	Notes payable	<u>227</u>	<u>442</u>
Inventory	<u>240</u>	<u>188</u>	Current liabilities	316	552
Current assets	545	537	Long-term debt	615	440
Net fixed assets	<u>788</u>	<u>890</u>	Common stock	55	55
			Retained earnings	<u>347</u>	<u>380</u>
Total Assets	1333	1427	Total Liab. & S. Equity	1333	1427

Income Statement for 1999
(\$ millions)

Net sales	905
Less: Cost of goods sold	522
Less: General & admin. expenses	93
Less: Depreciation	<u>110</u>
EBIT	180
Less: Interest on long-term debt	<u>61</u>
Earnings before taxes	119
Less: Taxes	<u>30</u>
Net income	89
Dividends paid	56
Addition to retained earnings	33

10. Marble Comics' debt ratio at the end of 1999 is:

A) 0.46
B) 0.70
 C) 0.74
 D) 0.89
 E) 2.28

$$\text{Debt ratio: Liabilities} / (\text{Liabilities} + \text{Shareholders' Equity})$$

$$(552 + 440) / (552 + 540 + 55 + 380) = \underline{0.6952}$$

11. Marble Comics' profit margin for 1999 is:

A) 3.6 %
 B) 9.8 %
 C) 13.1 %
D) 19.9 %
 E) 22.3 %

$$\text{Profit margin: EBIT} / \text{Sales}$$

$$180 / 905 = \underline{0.1989}$$

12. Marble Comics' return on equity for 1999 is:

A) 6.2 %
 B) 20.5 %
C) 21.3 %
 D) 22.1 %
 E) 161.8 %

$$\text{Return on equity: Net income} / \text{Average common shareholders' equity}$$

$$89 / [(55 + 347) + (55 + 380)] / 2 = \underline{0.2127}$$

13. If you were to prepare a statement of cash flow for 1999, what would be the cash flow from investment activities?

A) (\$175)
 B) \$0
 C) (\$102)
 D) \$102

$$\text{Cash flow from investment activities: Change in net fixed assets} + \text{Depreciation}$$

$$(890 - 788) + 110 = \underline{212} \text{ (investment, therefore negative)}$$

E) none of the choices given above

14. You have just borrowed \$20 000 to buy a new car. The loan agreement calls for 60 monthly payments of \$444.89 to begin one month from today. If interest is compounded monthly, what nominal annual rate is charged on the loan?

A) 12.68 %
 B) 14.12 %
C) 12.00 %
 D) 13.25 %
 E) none of the choices given above

$$\text{The monthly interest rate (i) charged on the loan is such that:}$$

$$20\,000 = 444.89 (P/A, i, 60)$$

$$\text{With } N=60, PV=20\,000 \text{ and } PMT= -444.89 \text{ CPT I/Y} \rightarrow 1.000 \%$$

$$\therefore \text{Nominal annual interest rate: } (1.0) 12 = \underline{12.0 \%$$

15. The current market price of a V Corporation bond is \$1297.58. A 10 percent coupon rate is paid semi-annually, and the par value per bond is \$1000. What is the yield-to-maturity (stated as a nominal annual rate) given that the bond matures 10 years from today?

A) 8 %
B) 6 %
 C) 4 %
 D) 3 %
 E) 10 %

$$\text{Semi-annual coupon payment: } 1000 (0.10) / 2 = 50$$

$$\text{The semi-annual yield-to maturity (i) is such that:}$$

$$1297.58 = 50 (P/A, i, 20) + 1000 (P/F, i, 20)$$

$$\text{With } N=20, PV=1297.58, PMT= -50 \text{ and } FV= -1000, \text{ CPT I/Y} \rightarrow 2.999 \% \text{ or } 3.0 \%$$

$$\therefore \text{YTM: } (3.0) 2 = \underline{6 \%$$

16. The annual maintenance costs on equipment you have just purchased are expected to be \$500, \$700, \$1400, and \$1400, respectively, for the next four years. At 10 percent interest compounded annually, what equal annual amount is equivalent (ordinary annuity) to this series? (Round to the nearest ten dollars)

- A) \$840
 B) \$850
 C) \$940
 D) \$960
 E) \$1000

Present value at $t=0$ of annual maintenance costs:

$$500 (P/F, 10\%, 1) + 700 (P/F, 10\%, 2) + 1400 (P/F, 10\%, 3) + 1400 (P/F, 10\%, 4)$$

$$500 (0.9091) + 700 (0.8264) + 1400 (0.7513) + 1400 (0.6830) = 3041.05$$

$$\text{Equivalent annual amount: } 3041.05 (A/P, 10\%, 4) = 3041.05 (0.3155) = \underline{959.45}$$

17. The RobM Bank offers you the choice between two loan options:

#1: interest at a rate of 10 % compounded quarterly

#2: interest at a rate of 10.3 % compounded semi-annually

Which option do you prefer and why?

- A) #1, lower effective annual rate
 B) #2, lower effective annual rate
 C) #1, higher effective annual rate
 D) #2, higher effective annual rate
 E) #1, more compounding periods per year

$$\text{EIR for \#1: } (1 + 0.025)^4 - 1 = 0.1038$$

$$\text{EIR for \#2: } (1 + 0.0515)^2 - 1 = 0.1057$$

Option #1, with the lower effective rate, is preferred.

FULL-SOLUTION PROBLEMS

For full marks, give complete solutions on the lines provided and record your answers in the boxes.

18. Pam has decided that it is time to provide for the education of her quintuplets (5) who turned 12 years old today. She plans for each of them to attend 3 years of university for which the annual tuition fees per child are \$10 000, payable at the beginning of each year. Accordingly, Pam will make annual deposits in a savings account, up until the time her five children enter university in six-years' time at the age of 18. The interest rate on her savings account will be 8 percent over the next 6 years, and will increase to 12 percent thereafter. Assume annual compounding.

What amount must Pam deposit today and at the end of every subsequent year (i.e. the first of 7 deposits is made today) in order to provide for her children's education? (10 points)

VERSION 1. The deposit today (D) and the 6 subsequent deposits (D, ordinary annuity) must accumulate to an amount equivalent to the annual university costs of her 5 children, evaluated at the time at which they start their university education.

Annual university costs: $10\,000 (5) = 50\,000$

Present value of annual university costs (annuity due) at $t=6$:

$$50\,000 (P/A, 12\%, 3) (1.12) = 134\,503$$

Future value of Pam's 7 deposits (annuity due + last payment) at $t=6$:

$$D (F/A, 8\%, 6) (1.08) + D = D (7.3359) (1.08) + D$$

$$D (8.9228) = 134\,503$$

$$\therefore D = 15\,074$$

VERSION 2. The deposit today (D) and the 6 subsequent deposits (D, ordinary annuity) must accumulate to an amount equivalent to the annual university costs of her 5 children, evaluated at the time at which they start their university education.

Annual university costs: $10\,000 (5) = 50\,000$

Present value of annual university costs (annuity due) at $t=6$:

$$50\,000 (P/A, 12\%, 3) (1.12) = 134\,503$$

Future value of Pam's 7 deposits (annuity due + last payment) at $t=6$:

$$D (F/A, 10\%, 6) (1.10) + D = D (7.7156) (1.10) + D$$

$$D (9.4872) = 134\,503$$

$$\therefore D = 14\,177$$

ANSWER

\$15 074

19. Consider the following production function:

$$Q = 21 S + 9 S^2 - S^3$$

in which Q is the total product and S is the variable input, both expressed in thousands of units per month.

19.1 Determine the input level that marks the transition point between Stages I and II of production, i.e. the input level that maximises average product. (5 points)

$$\begin{aligned} \text{AP: } Q/S &= 21 + 9S - S^2 \\ \text{Maximum AP at } d\text{AP}/dS &= 0 \\ 9 - 2S &= 0 \rightarrow S = \underline{4.5} \end{aligned}$$

ANSWER

4500 units

19.2 Determine the input level that maximises total product. (5 points)

$$\begin{aligned} \text{Maximum Q at } dQ/dS &= 0 \\ 21 + 18S - 3S^2 &= 0 \\ (7 - S)(3 + 3S) &= 0 \\ \therefore \text{Roots: } -3 \text{ and } \underline{7} \end{aligned}$$

ANSWER

7000 units

19.3 Determine the input level that maximises marginal product. (5 points)

$$\begin{aligned} \text{MP} = dQ/dS &= 21 + 18S - 3S^2 \\ \text{Maximum MP at } d\text{MP}/dS &= 0 \\ 18 - 6S &= 0 \rightarrow S = 3 \end{aligned}$$

ANSWER

3000 units

Answer Key for Version 2

1. D
2. B
3. C
4. A
5. C
6. B
7. A
8. D
9. C
10. D
11. B
12. B
13. E
14. D
15. D
16. B
17. A