

**KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS**  
**DEPARTMENT OF MATHEMATICS & STATISTICS**  
**MATH131 - Term 142**

**Date:** April 21, 2015

**Exam 2**

**Duration:** 120 minutes

---

---

**Name:** \_\_\_\_\_

**ID #:** \_ \_ \_ \_ \_

**Section #:** \_ \_

**Serial #:** \_ \_

---

**Instructions:**

- Write neatly and eligibly. You may lose points for messy work.
- Show all your work. No points for answers without justification.
- **Electronic approved calculators** are allowed. Mobiles are NOT allowed.
- Make sure that you have **9** pages of problems (Total of **7** Questions).

<b>Question #</b>	<b>Score</b>
<b>1</b>	<b>/ 10</b>
<b>2</b>	<b>/ 10</b>
<b>3</b>	<b>/ 10</b>
<b>4</b>	<b>/ 10</b>
<b>5</b>	<b>/ 20</b>
<b>6</b>	<b>/ 20</b>
<b>7</b>	<b>/ 20</b>
<b>Total</b>	<b>/ 100</b>

**Question 1**

**(3 + 3 + 4 = 10 points)**

To three decimal places, find the effective rate,  $r_e$ , that corresponds to each of the following rates:

a) A nominal rate of 12% compounded semiannually?

b) A nominal rate of 8% compounded quarterly?

c) A nominal rate of 4% compounded continuously?

**Question 2**

**(6 + 4 = 10 points)**

- a) How many months would it take for a principal of \$800 to accumulate to \$1,000 if invested at 9% compounded monthly?
- b) Assume the principle in **(a)** was invested at the same rate but for two years. Find the accumulated value after two years.

**Question 3**

**(4 + 2 + 4 = 10 points)**

An annuity consisting of equal payments of \$250 payable at the end of every quarter for nine years. Assume a rate of 5% compounded quarterly, find:

a) The future value of this annuity.

b) The compound interest.

c) The present value of this annuity.

**Question 4****(10 points)**

An initial investment of \$100,000 in a business guarantees the following cash flows:

Year	Cash Flow
1	\$20,000
2	\$20,000
3	\$20,000
4	\$30,000
5	\$30,000
6	\$40,000
7	\$40,000

Assume an interest rate of 7% compounded annually, find the net present value of this business. Is the investment profitable, and why?

## Question 5

(5 + 5 + 5 + 5 = 20 points)

- a) An online test has a total of five questions. The first two questions are true-false questions, and the last three questions are multiple choice questions with five choices for each. In how many ways the test can be answered?
- b) A committee has 12 members. In how many ways can subcommittee of five members be formed?
- c) How many distinguishable arrangements of all the letters in the word **Jeddah** are possible?
- d) A company personnel director must hire seven people: four for the assembly department and three for the shipping department. There are ten applicants who are equally qualified to work in each department. In how many ways can the personnel director fill the positions?

Question 6

(10 + 5 + 5 = 20 points)

A business problem has been modelled as to:

Maximize

$$P = 50x + 80y$$

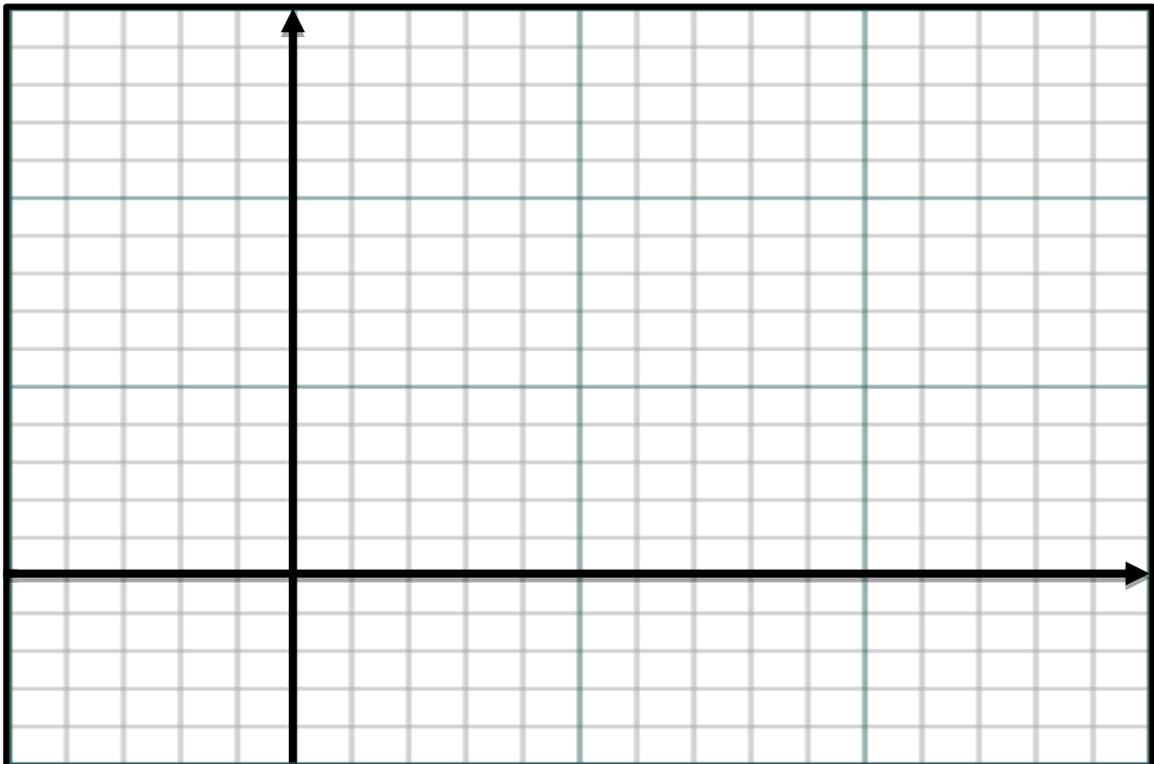
subject to the constraints:

$$x + 3y \leq 24$$

$$2x + 2y \leq 24$$

$$x, y \geq 0$$

- a) Find the feasible region described by the problem and show that it has four corners.



b) Evaluate the objective function at the corners to find the maximum of  $P$ .

c) Assume the constraints were changed and results in new corners given by:

$$A(0, 0), B(0, 8), C(10, 0), \text{ and } D(8, 3)$$

If the objective function remains the same, what do you conclude about the new optimal solution and where does it occur?

## Question 7

(4 + 4 + 12 = 20 points)

A company pays **skilled** and **semiskilled** workers in its assembly department \$14 and \$8 per hour, respectively. In the shipping department, **shipping clerks** are paid \$9 per hour and **shipping clerk apprentices** are paid \$6 per hour.

The company requires at least 90 workers in the assembly department and at least 60 in the shipping department. However, because of union agreements, at least twice as many semiskilled workers must be employed as skilled workers. Also, at least twice as many shipping clerks must be employed as shipping clerk apprentices. The company would like to estimate the minimum hourly wage.

a) One of your colleges, at the company, modelled this situation as to:

Minimize

$$W = 14y_1 + 8y_2 + 9y_3 + 6y_4$$

subject to:

$$y_1 + y_2 \geq 90$$

$$y_2 - 2y_1 \geq 0$$

$$y_3 + y_4 \geq 60$$

$$y_3 - 2y_4 \geq 0$$

$$y_1, y_2, y_3, y_4 \geq 0$$

Start by indicating what are the variables:  $y_1$ ,  $y_2$ ,  $y_3$  and  $y_4$ , represent, briefly explain why this model is true?

b) Find the dual of the above problem.

- c) Use the dual and the simplex method, show that the minimum hourly wage is \$1,200. Based on that, recommend the number of each type of worker (skilled, semiskilled, shipping clerks, and shipping clerk apprentices) that the company must employ so that the total hourly wage paid to these employees is a minimum.