King Fahd University of Petroleum and Minerals
Department of Mathematics

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Math 105
Major Exam I
Term 222
February 27, 2023
Net Time Allowed: 90 Minutes

Name ID .

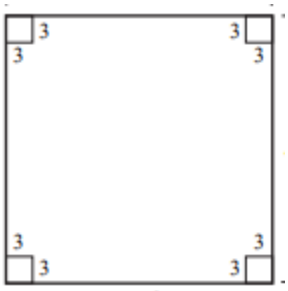
Check that this exam has 15 questions.

Important Instructions:

1. All types of smart watches or mobile phones are NOT allowed during the examination.
2. Use HB 2.5 pencils only.
3. Use a good eraser. DO NOT use the erasers attached to the pencil.
4. Write your name, ID number and Section number on the examination paper and in the upper left corner of the answer sheet.
5. When bubbling your ID number and Section number, be sure that the bubbles match with the numbers that you write.
6. The Test Code Number is already bubbled in your answer sheet. Make sure that it is the same as that printed on your question paper.
7. When bubbling, make sure that the bubbled space is fully covered.
8. When erasing a bubble, make sure that you do not leave any trace of penciling.

Q1. A company is designing a package for its product. One part of the package is to be an open box made from a square piece of aluminum by cutting out a 3-in. square from each corner and folding up the sides. (See Figure.) The box is to contain 75 in^3. What are the dimensions of the square piece of aluminum that must be used?

a) 11 in by 11 in
b) 1 in by 1 in
c) 10 in by 10 in
d) 6 in by 6 in
e) 3in by 3 in



Q2. A builder makes a certain type of concrete by mixing together 2 parts portland cement (made from lime and clay), 3 parts sand, and 5 parts crushed stone (by volume). If 700 ft^3 of concrete are needed, how many cubic feet of **crushed stone**?

a) 350
b) 300
c) 250
d) 150
e) 400

Q3. A T-shirt manufacturer produces M shirts at a total labor cost (in dollars) of 1.4M and a total material cost of 0.3M. The fixed cost for the plant is $6000. If each shirt sells for $4.70, how many must be sold by the company to realize a profit?

a) 2001
b) 3001
c) 2021
d) 4701
e) 2201

Q4. Suppose a company offers you a sales position with your choice of two methods of determining your yearly salary. One method pays $20,000 plus a bonus of 3% of your yearly sales. The other method pays a straight 7% commission on your sales. For what yearly sales amount is it better to choose the first method?

a) Less than $500000
b) Less than $400000
c) Less than $200000
d) Less than $550000
e) Less than $450000

Q5. If the points A(0, 0), B(0, 4), C(2, 3), and D(2, k) are the vertices of a parallelogram. (Opposite sides of a parallelogram are parallel.) Then k =

a) 7
b) 5
c) 6
d) 8
e) 2

Q6. A house purchased for $240,000 is expected to double in value in 15 years. Then a linear equation that describes the house's value after r years.

a) $y = f(r) = 16000r + 240000$
b) $y = f(r) = 16000r + 480000$
c) $y = f(r) = 15000r + 240000$
d) $y = f(r) = 15000r + 480000$
e) $y = f(r) = 16000r$

Q7. The demand function for an office supply company's line of plastic rulers is $p = 0.8 - 0.0004q$, where p is the price (in dollars) per unit when q units are demanded (per day) by consumers. Find the level of production that will maximize the manufacturer's total revenue, and determine this revenue (r).

a) $q = 1000\, unit, r = \$400$
b) $q = 944\, unit, r = \$401$
c) $q = 1000\, unit, r = \$440$
d) $q = 900\, unit, r = \$400$
e) $q = 1000\, unit, r = \$500$

Q8. A gardener has two fertilizers that contain different concentrations of nitrogen. One is 2% nitrogen and the other is 10% nitrogen. How many pounds of each should she mix to obtain 20 pounds of a 9% concentration?

a) 2.5 pounds 2% nitrogen and 17.5 pounds 10% nitrogen
b) 2 pounds 2% nitrogen and 18 pounds 10% nitrogen
c) 3.5 pounds 2% nitrogen and 16.5 pounds 10% nitrogen
d) 3 pounds 2% nitrogen and 17 pounds 10% nitrogen
e) 2.2 pounds 2% nitrogen and 17.8 pounds 10% nitrogen

Q9. An airplane travels 900 mi in 2 h, with the aid of a tailwind. It takes 2 h, 30 min, for the return trip, flying against the same wind. Find the speed of the airplane in still air and the speed of the wind.

a) Speed of the airplane is 6.75 mi per min, and 0.75 mi per min for wind.
b) Speed of the airplane is 6.15 mi per min, and 0.75 mi per min for wind.
c) Speed of the airplane is 6.75 mi per min, and 0.65 mi per min for wind.
d) Speed of the airplane is 6.75 mi per min, and 0.70 mi per min for wind.
e) Speed of the airplane is 6.70 mi per min, and 0.70 mi per min for wind.

Q10. If the solution of the system $\begin{cases} y = \frac{x^2}{x-1} + 1 \\ y = \frac{1}{x-1} \end{cases}$ is (a, b), then $a + 3b =$

a) -3
b) -2
c) -1
d) 0
e) 3

Q11. The market equilibrium point for a product occurs when 13,500 units are produced at a price of $4 per unit. The producer will supply no units at $1, and the consumers will demand no units at $20. Find the supply and demand equations if they are both linear.

a) Supply: $p = \frac{1}{4500}q + 1$, demand: $p = -\frac{4}{3375}q + 20$
b) Supply: $p = \frac{1}{5500}q + 1$, demand: $p = -\frac{4}{3375}q + 20$
c) Supply: $p = \frac{1}{4500}q + 1$, demand: $p = -\frac{4}{3475}q + 20$
d) Supply: $p = \frac{1}{4500}q + 1$, demand: $p = -\frac{4}{4375}q + 20$
e) Supply: $p = \frac{1}{4000}q + 1$, demand: $p = -\frac{4}{3375}q + 20$

Q12. The roe reduced form of $\begin{bmatrix} 1 & 1 & 7 \\ 1 & -1 & -1 \\ 2 & -3 & -6 \\ 3 & 1 & 13 \end{bmatrix}$

a) $\begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 4 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
b) $\begin{bmatrix} 1 & 0 & 3 \\ 0 & -1 & -4 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
c) $\begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & 4 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
d) $\begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & 4 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
e) $\begin{bmatrix} 1 & 0 & 3 \\ 0 & 0 & 0 \\ 0 & 1 & 4 \\ 0 & 0 & 0 \end{bmatrix}$

Q13. The solution of the following system

$$\begin{cases} x + 2y + 5z + 5w = -3 \\ x + y + 3z + 4w = -1 \\ x - y - z + 2w = \quad 3 \end{cases}$$

$a)\ x = 1 - r - 3s, y = -2 - 2r - s, z = r, w = s$

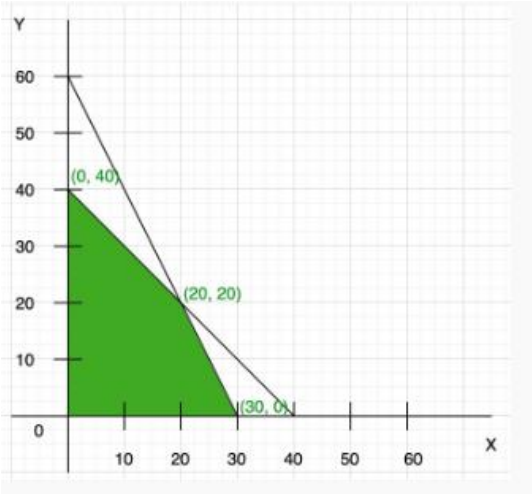
$b)\ x = 1 - r - 3s, y = -2 - 2r - s, z = 0, w = s$

$c)\ x = 1 - r - s, y = -2 - 2r - s, z = r, w = s$

$d)\ x = 1 - 3s, y = -2 - 2r - s, z = r, w = s$

$e)\ x = 1 - r - 3s, y = -2 - 2r, z = r, w = s$

Q14. The shaded region represents the feasible region in the following diagram is



$a)\ x + y \leq 40, \quad 2x + y \leq 60, \quad x \geq 0, \ y \geq 0$

$b)\ x + y \leq 60, \quad 2x + y \leq 40, \quad x \geq 0, \ y \geq 0$

$c)\ x - y \leq 40, \quad 2x - y \leq 60, \quad x \geq 0, \ y \geq 0$

$d)\ x + y \leq 40, \quad 2x + y \leq 40, \quad x \geq 0, \ y \geq 0$

$e)\ x + y \leq 60, \quad 2x + y \leq 60, \quad x \geq 0, \ y \geq 0$

Q15. Maximize the objective function $C = 5x + y$, subject to the constraints

$$2x - y \geq -2$$

$$4x + 3y \leq 12$$

$$x, y \geq 0$$

a) 15
b) 14
c) 2
d) 31/5
e) 16