

**Exam 1 is on Friday, February 7 from 4:30pm – 6:30pm!**

## Work-out Problems

*Study tip: Show all your work!*

**Exercise 1.** Suppose you are given the following system of equations:

$$\begin{cases} 0.03x + 0.04y = 50 \\ x + y = 1400 \end{cases}.$$

Solve the system of equations by using each of the following methods, and then determine the type of the system.

1. the method of graphing

2. the method of substitution,

3. the method of addition, and

4. `rref()` in a calculator.

5. Is this system: *independent*, *inconsistent*, or *dependent*?

**Exercise 2.** Suppose you are given the following system of equations:

$$\begin{cases} x - 3y = 5 \\ -2x + 6y = -10 \end{cases} .$$

1. Solve the system of equations. If there are infinitely many solutions, write a parametric solution using  $t$  and/or  $s$ . If there is no solution, write “No Solution”.
2. Is this system: *independent*, *inconsistent*, or *dependent*?

**Exercise 3.** Let  $x$  be the number of Popeyes chicken sandwiches made and sold, and let the cost and revenue (in dollars) be given by the equations  $C(x) = 0.99x + 252$  and  $R(x) = 3.99x$ .

1. Sketch the cost, revenue, and profit equations on the same graph.

2. Find and interpret the break-even quantity.

**Exercise 4.** Pivot the given augmented matrix about the boxed element. *Do not* completely reduce the matrix to reduced row-echelon form. Specify clearly, *using the correct notation*, what row operation you are doing in each step.

$$\left[ \begin{array}{ccc|c} 1 & 4 & -2 & 1 \\ 0 & \boxed{3} & -9 & 12 \\ 0 & -2 & 3 & -7 \end{array} \right]$$

**Exercise 5.** Aggie Success scholarship fund receives a gift of \$145,000. The money is invested in stocks, bonds, and CDs. CDs pay 3.3% interest, bonds pay 4.1% interest, and stocks pay 7.7% interest. Aggie Success invests \$30,000 more in bonds than in CDs. If the annual income from the investments is \$8072.50, how much was invested in each account? Round to the nearest cent.

**Exercise 6.** Find the solution(s) to the systems corresponding to the following augmented matrices. If there are infinitely many solutions, write a parametric solution using  $t$  and/or  $s$ . If there is no solution, write “No Solution”.

1. 
$$\left[ \begin{array}{ccc|c} 1 & 0 & 5 & -2 \\ 0 & 1 & -8 & 9 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

2. 
$$\left[ \begin{array}{ccc|c} 1 & 0 & 5 & 5 \\ 0 & 1 & -1 & -1 \\ 0 & 0 & 1 & 1 \end{array} \right]$$

**Exercise 7.** At a county fair, adult tickets sold for \$5.50, senior tickets for \$4.00, and child tickets for \$1.50. On the opening day, the number of child and senior tickets sold was 30 more than half the number of adult tickets sold. The number of senior tickets sold was 5 more than four times the number of child tickets. How many of each type of ticket were sold if the total receipts from the ticket sales were \$14,970?



**Exercise 8.** The supply and demand equations for the world famous cupcake shop *For Heaven's Cakes!* are known to be linear. When cupcakes are priced at \$2 each, the supplier produces 200 cupcakes. However, when cupcakes prices are increased to \$8 each, the supplier produces 400 cupcakes. Above \$8, consumers are not willing to buy a cupcake, and they would be willing to snatch up 800 cupcakes if the shop gave them out for free.

1. When the price is \$3.50 per cupcake, is there a shortage of cupcakes or surplus of cupcakes?
2. How many cupcakes must be sold and at what price should they be sold in order to achieve market equilibrium?

**Exercise 9.** Reduce matrix  $A$  below to reduced row-echelon form, without using a calculator. Then, check your answer using `rref()` in a calculator.

$$A = \left[ \begin{array}{cc|c} 1 & -2 & 4 \\ 0 & -3 & 6 \end{array} \right]$$

## Multiple Choice Problems

*Study tip: Write out all your work when you complete the multiple-choice problems.*

**Multiple Choice 1.** A farmer will supply organic carrots to a restaurant. The restaurant's demand equation for organic carrot bunches is given by  $p(x) = -0.1x + 6$ , and its supply equation is given by  $p(x) = 0.125x + 1.5$  where  $p$  is measured in dollars, and  $x$  is the number of bunches of organic carrots. What is the unit price at which a bunch of organic carrots should be sold to achieve market equilibrium? (Round to the nearest cent, if necessary.)

- (a) \$4
- (b) \$5.20
- (c) \$20
- (d) \$5.60
- (e) None of these.

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**Multiple Choice 2.** Leia is arranging for a concert to be held in the student center. The use of the hall will be free but they have several costs they will incur: They will have security costs (\$300), the cost of the main band (\$2,500), and the cost of the supporting band (\$420). They will also incur a cost of \$1 per person, since, on arrival, every ticket holder will be given a bottle of water. Leia has decided to sell tickets for \$15 per person. What is the break-even number of tickets for this event?

- (a) 245 tickets
- (b) 230 tickets
- (c) 215 tickets
- (d) 4 tickets
- (e) None of these.

**Multiple Choice 3.** Which of the following matrices are in reduced row-echelon form (RREF)?

$$\begin{array}{ll} \text{I.} & \left[ \begin{array}{cccc|c} 1 & 0 & -3 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{array} \right] \quad \text{II.} & \left[ \begin{array}{ccc|c} 1 & 0 & 0 & 3 \\ 0 & 0 & 1 & 6 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 \end{array} \right] \\ & \text{III.} & \left[ \begin{array}{ccc|c} 1 & 0 & 2 & 3 \\ 0 & 1 & 0 & 7 \\ 0 & 0 & 1 & 9 \end{array} \right] \end{array}$$

- (a) I only.
- (b) II only.
- (c) III only.
- (d) I and II only.
- (e) All three are in RREF.

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**Multiple Choice 4.** Using  $x$ ,  $y$ , and  $z$  as the variables, find the solution to the system that has the following augmented matrix in row reduced echelon form

$$\left[ \begin{array}{ccc|c} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 1 & 0 \end{array} \right]$$

- (a) There is no solution.
- (b)  $(x, y, z) = (1 + 4t, -3 - 2t, t)$ , where  $t$  is any real number
- (c)  $(x, y, z) = (1 - 4t, -3 + 2t, t)$ , where  $t$  is any real number
- (d)  $(x, y, z) = (-3, -1, 1)$
- (e)  $(x, y, z) = (1, -3, 0)$

**Multiple Choice 5.** Given a matrix below, which row operation must be performed to complete the process of pivoting about the entry in row one, column one?

$$\left[ \begin{array}{ccc|c} 1 & -2 & -1 & 3 \\ 0 & 6 & 0 & 1 \\ -2 & 0 & 3 & 2 \end{array} \right] \xrightarrow{???} \left[ \begin{array}{ccc|c} 1 & -2 & -1 & 3 \\ 0 & 6 & 0 & 1 \\ 0 & -4 & 1 & 8 \end{array} \right]$$

- (a)  $2R_1 + R_3 \longrightarrow R_3$
- (b)  $3R_1 + R_3 \longrightarrow R_3$
- (c)  $3R_1 + R_2 \longrightarrow R_2$
- (d)  $-\frac{1}{2}R_3 \longrightarrow R_3$
- (e)  $2 + R_3 \longrightarrow R_3$

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**Multiple Choice 6.** A line passes through the points  $(-3, 2)$  and  $(-3, \frac{5}{4})$ . Which of the following statements is **false**? (There is exactly one false statement).

- (a) The line has  $x$ -intercept  $(-3, 0)$ .
- (b)  $(-3, -24)$  is a point on the line.
- (c) The line has no  $y$ -intercept.
- (d) The equation of the line is  $x = -3$ .
- (e) The line has a slope of 0.

**Multiple Choice 7.** Texas A&M has purchased new class shirts for the class of 2023 for the price of \$2,023. These shirts should last them for 4 years, after which we can assume a scrap value of \$23. Assume straight line depreciation. How much are the class shirts worth 2 years after they were purchased?

- (a) \$500
- (b) \$1523
- (c) \$1023
- (d) \$1000
- (e) None of these.

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**Multiple Choice 8.** Let

$$M = \begin{bmatrix} 4 & -2 \\ 5 & -4 \\ x & 8 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 2 & -3 \end{bmatrix}^T - 6 \begin{bmatrix} 3 & 4 \\ -2 & 0 \\ 6 & \frac{y+1}{3} \end{bmatrix}.$$

Find  $m_{32}$ .

- (a) 8
- (b)  $2y - 22$
- (c)  $\frac{y}{3} - \frac{71}{3}$
- (d)  $2x - 2y - 26$
- (e)  $m_{32}$  is not defined.

**Multiple Choice 9.** A designer has a monthly fixed cost of \$10,000 for operation and a production cost of \$30 per design. She collects \$3,750 in revenue when she sells 50 designs. Find her profit when 223 designs are sold.

- (a) \$35
- (b) -\$5,750
- (c) \$20,035
- (d) \$16,725
- (e) None of these.

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**Multiple Choice 10.** Find the values of  $r$ ,  $s$  and  $p$  that satisfy the equation below and then find the sum of the three values,  $r + s + p$ .

$$2 \begin{bmatrix} 3 & -1 \\ 0 & r \end{bmatrix} + \begin{bmatrix} 1 & -1 & 7 \\ 0 & 3 & -2 \end{bmatrix} \begin{bmatrix} 1 & -1 & p \\ 2 & 0 & s \end{bmatrix}^T = \begin{bmatrix} 29 & -14 \\ -9 & 3r \end{bmatrix}$$

- (a) 5
- (b) 7
- (c) 11
- (d) 3
- (e) There is not enough information to determine the value of  $r + s + p$ .