MATH 141, FALL 2019
EXAM I - VERSION A

Print name (LAST, First): Answer Key

UIN #: ____________

SEAT #: ____________

THE AGGIE CODE OF HONOR

"An Aggie does not lie, cheat, or steal, or tolerate those who do." By signing below, you indicate that all work is your own and that you have neither given nor received help from any external sources.

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Approved calculators are allowed, but all other electronic devices must be **off and out of sight** during the exam.

PART I: Circle your answer to the multiple choice problems on the problem and **copy your answers to the sheet at page 8.** You can use the blank spaces below the question for scratch.

PART II: Show all necessary work in the space provided for each problem. Answers must be justified with sufficient work, and partial credit will be given for appropriate work shown. Where applicable, round appropriately. You may use your approved calculators. However, **algebraically calculation** means you need to show all your work (in that case you can use your calculator for only four operations).

PART I-MULTIPLE CHOICE: Circle your answer to the multiple choice problems on the problem and **copy your answers to the sheet at page 8.** You can use the blank spaces nearby the question for scratch.

B3. 1. (5 points) For the matrices $A = \begin{bmatrix} 3 & a \\ 1 & 7 \end{bmatrix}$, and $B = \begin{bmatrix} 1 & b & 2 \\ -4 & 0 & 2 \end{bmatrix}$, and $C = \begin{bmatrix} -2 & 1 \\ 4 & c \\ 8 & 5 \end{bmatrix}$ which of the following matrix does not exist?

(a) $B + C^T$ ✓
(b) $B^T + C$ ✓
(c) AB ✓
(d) AC ✗
(e) BC ✓

B6. 2. (5 points) Given the equation $9x + 3y = 5$, if x decreases by 7 units, what is the corresponding change in y?

(a) y increases by 21 units.
(b) y decreases by 21 units.
(c) y increases by 14 units.
(d) y decreases by 14 units.
(e) None of these.

$m = \frac{\Delta y}{\Delta x}$, $y = \frac{-9x}{3} + \frac{5}{3} = -3x + \frac{5}{3}$, $m = -3$

$\Delta y = m \cdot \Delta x = -3(-7) = +21.$

B4. 3. (5 points) Texas A&M University, Department of Computer Science decides to buy a computer worth \$10,000. The computer is being depreciated linearly over 20 years to its scrap value \$600. What is the value of the computer 5 years after buying?

(a) \$8,750
(b) \$8,650
(c) \$8,550
(d) \$7,650
(e) \$7,750

$t = 0$, $p = 10\,000$, $b = 10\,000$

$t = 20$, $p = 600$

$p = m \cdot t + b$, $m = \frac{600 - 10000}{20 - 0} = -470$

$p(5) = -470 \cdot 5 + 10000 = 7650$

B1. 4. (5 points) Which matrix below is the result of the row operation $R_2 \to R_2 - 3R_1$ performed on the given matrix.

$$\left[\begin{array}{cc|c} 1 & 3 & 5 \\ 3 & 13 & 21 \end{array}\right]$$

(a) $\left[\begin{array}{cc|c} 1 & 3 & 5 \\ 0 & 4 & 6 \end{array}\right]$ (b) $\left[\begin{array}{cc|c} 1 & 0 & 5 \\ 0 & 1 & 9 \end{array}\right]$ (c) $\left[\begin{array}{cc|c} 1 & 3 & 5 \\ 0 & 13 & 21 \end{array}\right]$ (d) $\left[\begin{array}{cc|c} 1 & 0 & 1/2 \\ 0 & 1 & 3/2 \end{array}\right]$ (e) $\left[\begin{array}{cc|c} 1 & 3 & 5 \\ 0 & -4 & -6 \end{array}\right]$

$a_{22} = 13 - 3 \cdot 3 = 4$

B7. 5. (5 points) Consider the following matrix operation:

$$2\begin{bmatrix} a & 4 \\ 0 & -1 \end{bmatrix} + \begin{bmatrix} 6 & b \\ -2 & 0 \end{bmatrix}^T = \begin{bmatrix} 8 & 6 \\ 2 & -2 \end{bmatrix}.$$

What is the value of $a + b$?

(a) 1
(b) 2
(c) 3
(d) 4
(e) 5

$a = 1$
$b = 2$
$a + b = 3$

B2.

6. (5 points) What is the solution(s) of the following system of linear equations? (Use t if the system has infinitely many solutions)

$$\begin{aligned} -2x + y + z &= 2 \\ 2x - 3z &= 9 \\ 4x - 2y - 2z &= -3 \end{aligned}$$

(a) $x = 1.5,\ y = 2,\ z = 0$
(b) $x = 1,\ y = 1 - t,\ z = t$
(c) No solution
(d) $x = t,\ y = 2t,\ z = t$
(e) $x = 2,\ y = 3,\ z = t$

B5.

7. (5 points) Sandy eats a mixture of oats, raisins and walnuts for her breakfast. Matrix M shows the nutritional contents of the three different kinds of food per gram. Each entry represents the number of units of the vitamin per gram of food. Matrix N shows the number of grams of each type of food that Sandy has for breakfast.

$$M = \begin{array}{r} \\ \text{Vitamin X} \\ \text{Vitamin Y} \\ \text{Vitamin Z} \end{array} \begin{array}{c} \begin{array}{ccc} \text{oats} & \text{raisins} & \text{walnuts} \end{array} \\ \begin{bmatrix} 3 & 2 & 4 \\ 2 & 4 & 5 \\ 2 & 5 & 1 \end{bmatrix} \end{array} \qquad N = \begin{array}{r} \\ \text{oats} \\ \text{raisins} \\ \text{walnuts} \end{array} \begin{array}{c} \text{grams} \\ \begin{bmatrix} 27 \\ 55 \\ 68 \end{bmatrix} \end{array}$$

Let P be the product of these two matrices. Which of the following is true about the matrix P?

(a) $P = NM =$ the total amount of vitamin X,Y and Z consumed by Sandy. X
(b) $P = MN =$ the total amount of vitamin X,Y and Z consumed by Sandy.
(c) $P = NM =$ the total amount of vitamin X,Y and Z in raisins. X
(d) $P = MN =$ the total amount of vitamin X,Y and Z in walnuts. X
(e) None of these

$P = M \cdot N$

PART II-WORKOUT Show all necessary work in the space provided for each problem. Answers must be justified with sufficient work, and partial credit will be given for appropriate work shown. Where applicable, round appropriately. You may use your approved calculators. However, **algebraically calculation** means you need to show all your work (in that case you can use your calculator for only four operations).

B8 med. 8. (8 points) A firm has monthly fixed costs of \$15,000 associated with the production of clocks that cost \$10 per clock to produce. The firm sells all the clocks it produces at \$25 per clock.

(a) (3 points) What are the cost, revenue and profit functions?

$C = 10 \cdot x + 15000$

$R = 25 \cdot x$

$P = 15 \cdot x - 15000$

(b) (2 points) Compute the profit or loss corresponding to production level of 500 clocks.

$P(500) = 15 \cdot 500 - 15000 = -7500$

(c) (3 points) Find the break-even point **algebraically**

$C = R$ so $P = R - C = 0$

$0 = 15 \cdot x - 15000$ so $15 \cdot x = 15000$ so $x = 1000$.

9. (8 points) A farmer plans to plant two crops, A and B . The cost of cultivating crop A is \$35/acre whereas that of crop B is \$70/acre. The farmer has a maximum of \$7425 available for land cultivation. Each acre of crop A requires 18 labor-hours, and each acre of crop B requires 21 labor-hours. The farmer has a maximum of 3146 labor-hours available. If she expects to make a profit of \$175/acre on crop A and \$210/acre on crop B, how many acres of each crop, x and y, respectively, should she plant in order to maximize her profit, P? Set up, but do not solve the linear programming problem.

B9. mod.

x = # acres of A

y = # acres of B

cost: $35 \cdot x + 70 \cdot y \leq 7425$

hours: $18 \cdot x + 21 \cdot y \leq 3146$.

profit: $175 \cdot x + 210 \cdot y$.

$x \geq 0, \quad y \geq 0$.

10. (8 points) A person has 36 coins, all of which are nickels, dimes and quarters. If there are twice as many dimes as nickels and if the face value of the coins is \$4, how many of each type of coin must this person have?

n = # nickles (0.05)

d = # dimes (0.10)

q = # quarter (0.25)

$n + d + q = 36$

$2 \cdot n = d$

$0.05 \cdot n + 0.10 \cdot d + 0.25 \cdot q = 4$.

$n = 10$

$d = 20$

$q = 6$.

B14 mod.

11. (8 points) Solve the following system of equations.(If there are infinitely many solutions, enter a parametric solution using t and/or s).

$$\begin{array}{llll} -2x & +6y & +4z & =12 \\ 3x & -9y & -6z & =-18 \end{array}$$

$x = t$

$y = s$

$z = \frac{1}{2}(t - 3s + 6)$

B12 mod.

12. (8 points) At a unit price of \$430, the quantity demanded of a certain product is 66 units. If the unit price increases to \$650, the quantity demanded decreases by 22 units.
(a) (5 points) Find the demand equation $p = D(x)$ (assuming it is linear) where p is the unit price and x is the number of units demanded for this product.

$p = 430$, $x = 66$

$p = 650$, $x = 44$

$p = m \cdot x + b$

$m = \frac{430 - 650}{66 - 44} = -10$

$430 = -10 \cdot 66 + b$ so $b = 1090$

$p = -10 \cdot x + 1090$.

(b) (3 points) At what price will no units be demanded?

$p = -10 \cdot x + 1090 = 1090$.

B13 mod.

13. (3 points each) Determine if the following matrices are in row reduced form. If YES, write the resulting system of equations (Assume variables are x, y and z.) If NO, give a reason why and write the next best row operation you would use in the Gauss-Jordan Elimination Method.

(a) $\left[\begin{array}{ccc|c} 1 & 0 & 0 & -2 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 3 \end{array}\right]$ Yes.

$x = -2$.
$y = 4$.
$z = 3$.

(b) $\left[\begin{array}{ccc|c} 1 & 5 & 6 & -10 \\ 0 & 1 & 7 & 14 \\ 0 & 0 & 1 & 3 \end{array}\right]$ NO.

R_2 is not with a 1 some where and 0 every where else. $R_1 \rightarrow R_1 - 5 \cdot R_2$.

(c) $\left[\begin{array}{ccc|c} 1 & 0 & 0 & 0 \\ 0 & 3 & 9 & 6 \\ 0 & 0 & 0 & 1 \end{array}\right]$ NO. R_2 does not have a leading 1.

$R_2 \rightarrow \frac{1}{3} \cdot R_2$.

B11 mod.

14. (7 points) Let $A = \begin{bmatrix} 2 & 1 \\ 0 & -3 \end{bmatrix}$, $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. Find the matrix AB.

$$AB = \begin{bmatrix} 2a + c & 2b + d \\ -3c & -3d \end{bmatrix}$$

B10 · mod ·

15. (3 points each) Matrix A is a 2×3 matrix, matrix B is a 3×5 matrix, matrix C is a 3×2 matrix, and matrix D is a 2×5 matrix. Find the dimensions of the operations below, if they exist. If it does not exist write DNE.

(a) BD^T $\underline{3 \times 2}$ $3 \times 5 \cdot 5 \times 2$

(b) $AC - CA$ $\underline{\text{DNE}}$ $2 \times 3 \cdot 3 \times 2 - 3 \times 2 \cdot 2 \times 3$

(c) $AB + D$ $\underline{2 \times 5}$ $2 \times 3 \cdot 3 \times 5 + 2 \times 5$

Circle Your Multiple Choice Answers Underneath

1. (a) (b) (c) (d) (e)
2. (a) ~~(b)~~ (c) (d) (e)
3. (a) (b) (c) (d) (e)
4. (a) (b) (c) (d) (e)
5. (a) (b) (c) (d) (e)
6. (a) (b) (c) (d) (e)
7. (a) (b) (c) (d) (e)

SCORE SHEET: DO NOT WRITE BELOW!

Question	P1	8	9	10	11	12	13	14	15	TOTAL
Max Pts	35	8	8	8	8	8	9	7	9	100
Score										