Name: Answer key Per: _____ Date: _____

Serafino • Precalculus S2

7R Matrices Unit Review

Do on separate paper!

Matrix Operations: $A=\begin{bmatrix}1 & 2 & 3\\ 4 & 5 & 6\end{bmatrix}$ $B=\begin{bmatrix}-2 & 3 & 1\\ 4 & -5 & 0\end{bmatrix}$ $C=\begin{bmatrix}1 & 4\\ 2 & 3\end{bmatrix}$ $D=\begin{bmatrix}2 & 0\\ 4 & -1\\ 6 & 3\end{bmatrix}$

1. Perform the operations without a calculator:

a. $3A-2B$ $\begin{bmatrix}7 & 0 & 7\\ 4 & 25 & 18\end{bmatrix}$

b. C^3 $\begin{bmatrix}41 & 84\\ 42 & 83\end{bmatrix}$

c. $2A-(B+D^T)$ $\begin{bmatrix}2 & -3 & -1\\ 4 & 16 & 9\end{bmatrix}$

d. DB $\begin{bmatrix}-4 & 6 & 2\\ -12 & 17 & 4\\ 0 & 3 & 6\end{bmatrix}$

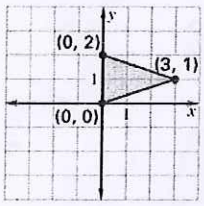
e. C^{-1} $\begin{bmatrix}-3/5 & 4/5\\ 2/5 & -1/5\end{bmatrix}$

f. $|BD|-|C|$ 75

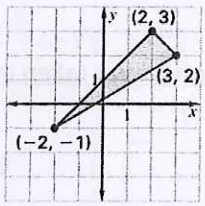
g. Solve for Matrix X: $B-2X=A$ $\begin{bmatrix}-3/2 & 1/2 & -1\\ 0 & -5 & -3\end{bmatrix}$

2. Perform the operation with a calculator: $E=\begin{bmatrix}2 & -1 & 3\\ 0 & 4 & 1\\ -6 & -2 & 4\end{bmatrix}$ a. $|E|$ 114 b. E^{-1} $\begin{bmatrix}3/19 & -1/57 & -13/114\\ -1/19 & 13/57 & -1/57\\ 4/19 & 5/57 & 4/57\end{bmatrix}$

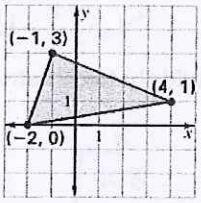
3. Find the area of Triangles: a) Set up the Matrix Determinant formula b) Calculate the area with a calculator

a. 

$A=\frac{1}{2}\begin{vmatrix}0 & 2 & 1\\ 3 & 1 & 1\\ 0 & 0 & 1\end{vmatrix}$ $=3\ u^2$

b. 

$A=\frac{1}{2}\begin{vmatrix}2 & 3 & 1\\ 3 & 2 & 1\\ -2 & -1 & 1\end{vmatrix}$ $=4\ u^2$

c. 

$A=\frac{1}{2}\begin{vmatrix}-1 & 3 & 1\\ 4 & 1 & 1\\ -2 & 0 & 1\end{vmatrix}$ $=8.5\ u^2$

Solving Systems with Cramer's Rule: a) Set up the system b) Set up the Cramer's Rule b) Do the math with a calc.

4. On the quiz, you will only be asked to use Cramer's rule to solve for ONE variable. So, for the problems below, you're going to a) pick a variable to solve for b) SET UP Cramer's rule for that variable c) Use your calc to solve. ⋆ Some systems may need some rearranging...

a. $-5x-5y=25$, $-2x-4y=16$ $x=-2$, $y=-3$

$x=\frac{\begin{vmatrix}25 & -5\\ 16 & -4\end{vmatrix}}{10}$ $y=\frac{\begin{vmatrix}-5 & 25\\ -2 & 16\end{vmatrix}}{10}$

b. $x-3y=5$, $-3x+6y=8$ $x=-18$, $y=-\frac{23}{3}$

$x=\frac{\begin{vmatrix}5 & -3\\ 8 & 6\end{vmatrix}}{-3}$ $y=\frac{\begin{vmatrix}1 & 5\\ -3 & 8\end{vmatrix}}{-3}$

c. $-4x-6z=-12$, $-6x-4y-2z=6$, $-x+2y+z=9$ $x=-3$, $y=1$, $z=4$

$x=\frac{\begin{vmatrix}-12 & 0 & -6\\ 6 & -4 & -2\\ 9 & 2 & 1\end{vmatrix}}{|A|}$ $y=\frac{\begin{vmatrix}-4 & -12 & -6\\ -6 & 6 & -2\\ -1 & 9 & 1\end{vmatrix}}{|A|}$

d. $-6x-y+z=-7$, $4z=-6$, $4x-24y+24z=17$ $x=\frac{5}{4}$, $y=-2$, $z=-\frac{3}{2}$

e. $3a+b=-c+7$, $a+3b-c=13$, $b=2a-1$

$3a+b+c=7$
$a+3b-c=13$
$-2a+b=-1$

$a=2$ $b=3$ $c=-2$

f. $13=3x-y$, $14y-3x+2z=-3$, $z=2x-4y$

$-3x+y=-13$
$-3x+14y+2z=-3$
$-2x-4y+z=0$

$x=5$ $y=2$ $z=2$

Applications of Matrix Multiplication & Solving with RREF:

Performance	*Adults*	*Students*
Opening night	420	300
Second night	400	450
Final night	510	475

5. The School Play: The play is running for three nights: Opening night (Thursday), the Second night (Friday) and the Final night (Saturday). People placed online orders for tickets in the following quantities, which can be represented in the Sales table to the right:

a) Write the Sales Matrix S. Write another Sales Matrix, S^T (Label rows/columns to help you)

$$S = \begin{matrix} \\ 1st \\ 2nd \\ 3rd \end{matrix}\begin{matrix} a & s \end{matrix}\begin{bmatrix} 420 & 300 \\ 400 & 450 \\ 510 & 475 \end{bmatrix} \qquad S^T = \begin{matrix} \\ a \\ s \end{matrix}\begin{matrix} 1st & 2nd & 3rd \end{matrix}\begin{bmatrix} 420 & 400 & 510 \\ 300 & 450 & 475 \end{bmatrix}$$

b) What cell in matrix S represents the least number of students going? $S_{1,2}$

Why could that be? Thursday night, they have HW

c) What cell in matrix S represents the least number of adults going? $S_{2,1}$

Why could that be? Friday, They worked all week & are tired.

d) Student tickets are \$5 and adult tickets are \$10, write a matrix, C, that represents the cost of each type of ticket. Note: You could write FOUR different types of matrices.

$$C = \begin{matrix} \\ \$ \end{matrix}\begin{matrix} s & a \end{matrix}\begin{bmatrix} 5 & 10 \end{bmatrix} \quad C = \begin{matrix} \\ \$ \end{matrix}\begin{matrix} a & s \end{matrix}\begin{bmatrix} 10 & 5 \end{bmatrix} \quad C = \begin{matrix} s \\ a \end{matrix}\begin{matrix} \$ \end{matrix}\begin{bmatrix} 5 \\ 10 \end{bmatrix} \quad C = \begin{matrix} a \\ s \end{matrix}\begin{matrix} \$ \end{matrix}\begin{bmatrix} 10 \\ 5 \end{bmatrix}$$

Does the order of adults vs. students matter?

Yes! It matters if you multiply it with S.

e) Multiply two matrices to find how much money was taken in each night.

$$\begin{matrix} \\ 1st \\ 2nd \\ 3rd \end{matrix}\begin{matrix} a & s \end{matrix}\begin{bmatrix} 420 & 300 \\ 400 & 450 \\ 510 & 475 \end{bmatrix} \cdot \begin{matrix} \\ a \\ s \end{matrix}\begin{matrix} \$ \end{matrix}\begin{bmatrix} 10 \\ 5 \end{bmatrix} = \begin{matrix} \\ 1st \\ 2nd \\ 3rd \end{matrix}\begin{matrix} \$ \end{matrix}\begin{bmatrix} 5700 \\ 6250 \\ 7475 \end{bmatrix}$$

What is the total revenue?

\$19425

~~Multiply the matrices to find out how much money you made from each type of ticket~~

~~What is the total revenue?~~

f) Ugh! The theater department wants to be able to buy an Audrey II for Little Shop of Horrors next year, and to do so, it actually need \$20,000 total revenue from the play. They decide to keep it open for a 4th night, at a far cheaper price so they can make it to their goal. Adult tickets will still be twice as much as student tickets. The sales for the 4th night are exactly like the second night. Set up and solve a matrix equation that shows how much should the theater department charge for each type of ticket to hit their target revenue?

\$20,000 − 19,425 = \$575 left to make

Let a = cost of adult ticket

s = cost of student ticket

$400a + 450s = 575$

$-a + 2s = 0$

\$ $2s = a$

\# $400a + 450s = 575$

Sales are same as 2nd night

Student ticket:	\$0.46
Adult ticket	\$0.92

6. Ba–da–bababa:
I'm buying McDonalds for all my Precalc classes.
These are their orders:

Orders:	Per 1	Per 3	Per 5
Big Macs	6	8	4
Wraps	5	3	10
Salads	2	6	4
McNuggets	2	4	3
Fries	2	3	2

5 x 3

a) Turn the table into Matrix O, the Order Matrix. Also, write O^T.

$$O = \begin{matrix} & 1 & 2 & 3 \\ b \\ w \\ s \\ n \\ f \end{matrix}\begin{bmatrix} 6 & 8 & 4 \\ 5 & 3 & 10 \\ 2 & 6 & 4 \\ 2 & 4 & 3 \\ 2 & 3 & 2 \end{bmatrix} \qquad O^T = \begin{matrix} & b & w & s & n & f \\ 1 \\ 2 \\ 3 \end{matrix}\begin{bmatrix} 6 & 5 & 2 & 2 & 2 \\ 8 & 3 & 6 & 4 & 3 \\ 4 & 10 & 4 & 3 & 2 \end{bmatrix}$$

b) I look it up online, and see: A 20–pc Nuggets box is \$5, Salad is \$4.79, Big Mac is \$3.99, a Wrap is \$1.69 and a large Fries is \$1.79. Pick one of your Matrix Os and write Matrix P, a Price matrix, so that when you multiply them, you can see how much this lunch going to cost me, per class period. Label rows and columns to make life easy.

$$P = \begin{matrix} & b & w & s & n & f \\ \$ \end{matrix}\begin{bmatrix} 3.99 & 1.69 & 4.79 & 5 & 1.79 \end{bmatrix}$$

$$P \cdot O = \begin{matrix} & 1 & 2 & 3 \\ \$ \end{matrix}\begin{bmatrix} 55.55 & 91.10 & 70.60 \end{bmatrix}$$

c) Write a different equation so that if you multiply Matrix P and Matrix O (in a different order), you see how much I am going to spend on each type of food item.

c)

d) Matrix C (right) represents how many TOTAL calories each class consumed by eating Big Macs, McNuggets and Salads. Define your variables and set up a linear system and use RREF to solve for how many calories, each item.

	Total Calories
Per 1	5,302
Per 3	9,316
Per 5	5,908

Let b = calories in big mac
n = calories in Nuggets
S = calories in salad

$6b + 2n + 2s = 5302$
$8b + 4n + 6s = 9316$
$4b + 3n + 4s = 5908$

Big Mac: 467 cal Nuggets: 960 cal Salad: 290 cal

e) How many calories are in each individual nugget?

$\frac{960}{20} =$ 48 calories in each

Setting up and Solving Systems with RREF:
For each of the situations below, a) define your variables, b) Set up linear equations, c) Solve.

7. San Diego Diner: Ron & Veronica ordered breakfast at a diner. Ron paid $3.25 for 4 eggs and 2 pancakes. Veronica paid $3.50 for 2 eggs and 2 pancakes. What is the cost of each item?

Let e = cost of egg
p = cost of pancake

	e	p	$
r	4	2	3.50
v	2	2	3.25

No solution!!
(Not my idea... I copied from a textbook + changed the names... should've checked.)

(But if Ron paid $3.50 and Veronica paid $3.25, then egg: $0.125, pancake $1.50)

8. Taping Shows: You make a VHS tape of your three favorite TV shows for your friend: Family Guy, Lost, and One Tree Hill. You can completely fill the tape with 7 episodes. You want include twice as many episodes of Lost as Family Guy. An episode of Family Guy lasts 30 minutes. An episode of Lost and One Tree Hills lasts 60 minutes. Your VCR tape can only hold 360 minutes of recording. How many episodes of each show can you tape?

Let f = # episodes of Family Guy
l = " Lost
t = " One Tree...

$30f + 60l + 60t = 360$
$f + l + t = 7$
$2f - l = 0$

2 Family Guys
4 Losts
1 One Tree Hill

9. Arcade: The local arcade uses 3 different colored tokens for their game machines. For $20, you can buy the following options of token packages: 14 gold, 20 silver and 24 bronze OR 20 gold, 15 silver and 19 bronze OR 30 gold, 5 silver, 13 bronze. How much is each token worth?

Let g = $ of gold
s = $ of silver
b = $ of bronze

$14g + 20s + 24b = 20$
$20g + 15s + 19b = 20$
$30g + 5s + 13b = 20$

Gold is 50¢
Silver is 35¢
Bronze is 25¢

Setting up and Solving for ONE VARIABLE with CRAMER'S RULE:

10. Track Meet: RHS competed in a track meet. They had 20 students won medals in first, second or third place in various events. First place is worth 5 points, second place is worth 3 points, and third place is worth 1 point. The students at RHS won total of 68 points. The number of second place finishes was as many as first and third place combined. How many runners finished in FIRST place?

$5f + 3s + 1t = 68$
$f + s + t = 20$
$-f + s - t = 0$

$$f = \frac{\begin{vmatrix} 68 & 3 & 1 \\ 20 & 1 & 1 \\ 0 & 1 & -1 \end{vmatrix}}{\begin{vmatrix} 5 & 3 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & -1 \end{vmatrix}} = 7$$

7 1st place finishes

11. Dogs & Cats: You want to make some money over the summer and you have a completely empty house, so you decide to watch pets when the families in your neighborhood when they're away. You can accommodate 68 animals in your home. You know you can handle 3 times as many cats as dogs. You want to keep things clean, so you'll need 4 more litter boxes than the number of cats. How many LITTER BOXES do you need

Let l = # litter boxes

$d + c + l = 68$
$3d - c = 0$
$c - l = -4$

$$l = \frac{\begin{vmatrix} 1 & 1 & 68 \\ 3 & -1 & 0 \\ 0 & 1 & -4 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 3 & -1 & 0 \\ 0 & 1 & -1 \end{vmatrix}} = 55$$

55 litter boxes