Name: ____________________

MASTERY QUIZ DAY 10 Math 237 – Linear Algebra
Version 1 Fall 2017

Show all work. Answers without work will not receive credit. You may use a calculator, but you must show all relevant work to receive credit for a standard.

E1. Write an augmented matrix corresponding to the following system of linear equations

$$\begin{aligned} x + 3y - 4z &= 5 \\ 3x + 9y + z &= 0 \\ x - z &= 1 \end{aligned}$$

E3. Solve the system of linear equations.

$$\begin{aligned} 2x + y - z + w &= 5 \\ 3x - y - 2w &= 0 \\ -x + 5z + 3w &= -1 \end{aligned}$$

Solution:

$$\text{RREF}\left(\left[\begin{array}{cccc|c} 2 & 1 & -1 & 0 & 5 \\ 3 & -1 & 0 & -2 & 0 \\ -1 & 0 & 5 & 0 & -1 \end{array}\right]\right) = \left[\begin{array}{cccc|c} 1 & 0 & 0 & -\frac{1}{12} & 1 \\ 0 & 1 & 0 & \frac{7}{4} & 3 \\ 0 & 0 & 1 & \frac{7}{12} & 0 \end{array}\right]$$

So the solutions are

$$\left\{ \begin{bmatrix} 1+a \\ 3-21a \\ -7a \\ 12a \end{bmatrix} \,\middle|\, a \in \mathbb{R} \right\}$$

□

E4. Find a basis for the solution set of the system ...

V1. Let V be the set of all points on the line $x + y = 2$ with the operations, for any $(x_1, y_1), (x_2, y_2) \in V$, $c \in \mathbb{R}$,

$$\begin{aligned} (x_1, y_1) \oplus (x_2, y_2) &= (x_1 + x_2 - 1, y_1 + y_2 - 1) \\ c \odot (x_1, y_1) &= (cx_1 - (c-1), cy_1 - (c-2)) \end{aligned}$$

Determine if V is a vector space or not.

Solution:

1) Since real addition is associative, $\oplus$ is associative.

2) Since real addition is commutative, $\oplus$ is commutative.

3) $(x_1, y_1) \oplus (1, 1) = (x_1, y_1)$, so $(1, 1)$ is an additive identity element.

4) $(x_1, y_1) \oplus (2 - x_1, 2 - y_1) = (1, 1)$, so $(2 - x_1, 2 - y_1)$ is the additive inverse of (x_1, y_1).

5)

$$\begin{aligned}
c \odot (d \odot (x_1, y_1)) &= c \odot (dx_1 - (d-1), dy_1 - (d-1)) \\
&= (c\,(dx_1 - (d-1)) - (c-1), c\,(dy_1 - (d-1))) \\
&= (cdx_1 - cd + c - (c-1), cdy_1 - cd + c - (c-1)) \\
&= (cdx_1 - (cd-1), cdy_1 - (cd-1)) \\
&= (cd) \odot (x_1, y_1)
\end{aligned}$$

6) $1 \odot (x_1, y_1) = (x_1 - (1-1), y_1 - (1-1) = (x_1, y_1)$

7)

$$\begin{aligned}
c \odot ((x_1, y_1) \oplus (x_2, y_2)) &= c \odot (x_1 + y_1 - 1, x_2 + y_2 - 1) \\
&= (c(x_1 + y_1 - 1) - (c-1), c(x_2 + y_2 - 1) - (c-1)) \\
&= (cx_1 + cx_2 - 2c + 1, cy_1 + cy_2 - 2c + 1) \\
&= (cx_1 - (c-1), cy_1 - (c-1)) \oplus (cx_2 - (c-1), cy_2 - (c-1)) \\
&= c \odot (x_1, y_1) \oplus c \odot (x_2, y_2)
\end{aligned}$$

8)

$$\begin{aligned}
(c+d) \odot (x_1, y_1) &= ((c+d)x_1 - (c+d-1), (c+d)y_1 - (c+d-1)) \\
&= (cx_1 - (c-1), cy_1 - (c-1)) \oplus (dx_1 - (d-1), dy_1 - (d-1)) \\
&= c \odot (x_1, y_1) \oplus c \odot (x_2, y_2)
\end{aligned}$$

$\square$

E1: ☐ **E3:** ☐ **E4:** ☐ **V1:** ☐