Name:	
J#:	Dr. Clontz
Date:	

Math 237 – Linear Algebra Fall 2017

#### Version 1

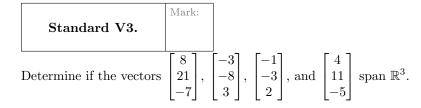
Show all work. Answers without work will not receive credit. You may use a calculator, but you must show all relevant work to receive credit for a standard.



Let V be the set of all pairs of real numbers with the operations, for any  $(x_1, y_1), (x_2, y_2) \in V, c \in \mathbb{R}$ ,

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2, y_1 + y_2)$$
  
 $c \odot (x_1, y_1) = (0, cy_1)$ 

- (a) Show that this scalar multiplication  $\odot$  distributes over scalar addition.
- (b) Determine if V is a vector space or not. Justify your answer.



Standard V4.	Mark:

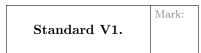
Determine if the set of all lattice points, i.e.  $\{(x,y) \mid x \text{ and } y \text{ are integers}\}$  is a subspace of  $\mathbb{R}^2$ .

Name:	
J#:	Dr. Clontz
Date:	

Math 237 – Linear Algebra Fall 2017

## Version 2

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.



Let V be the set of all polynomials with the operations, for any  $f, g \in V$ ,  $c \in \mathbb{R}$ ,

$$f \oplus g = f' + g'$$
$$c \odot f = cf'$$

(here f' denotes the derivative of f).

- (a) Show that this scalar multiplication  $\odot$  distributes over vector addition  $\oplus$ .
- (b) Determine if V is a vector space or not. Justify your answer.

Standard V3.

Determine if the vectors 
$$\begin{bmatrix} -3\\1\\1 \end{bmatrix}$$
,  $\begin{bmatrix} 5\\-1\\-2 \end{bmatrix}$ ,  $\begin{bmatrix} 2\\0\\-1 \end{bmatrix}$ , and  $\begin{bmatrix} 0\\2\\-1 \end{bmatrix}$  span  $\mathbb{R}^3$ 

Standard V4.	Mark:
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Let W be the set of all polynomials of even degree. Determine if W is a subspace of the vector space of all polynomials.

Name:	
J#:	Dr. Clontz
Date:	

Math 237 – Linear Algebra Fall 2017

Version 3

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.

Let V be the set of all real numbers with the operations, for any  $x, y \in V$ ,  $c \in \mathbb{R}$ ,

$$x \oplus y = \sqrt{x^2 + y^2}$$
$$c \odot x = cx$$

- (a) Show that the vector addition  $\oplus$  is associative.
- (b) Determine if V is a vector space or not. Justify your answer.

Determine if the vectors 
$$\begin{bmatrix} 2 \\ 0 \\ -2 \\ 0 \end{bmatrix}$$
,  $\begin{bmatrix} 3 \\ 1 \\ 3 \\ 6 \end{bmatrix}$ ,  $\begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$ , and  $\begin{bmatrix} 1 \\ 2 \\ 0 \\ 1 \end{bmatrix}$  span  $\mathbb{R}^4$ .

Standard V4.	Mark:

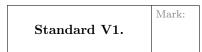
Let W be the set of all 2 by 2 matrices which are not invertible. Determine if W is a subspace of  $M_{2,2}$ .

Name:	
J#:	Dr. Clontz
Date:	

Math 237 – Linear Algebra Fall 2017

## Version 4

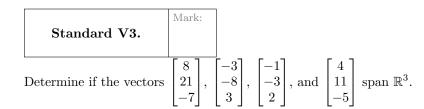
Show all work. Answers without work will not receive credit. You may use a calculator, but you must show all relevant work to receive credit for a standard.



Let V be the set of all pairs of real numbers with the operations, for any  $(x_1, y_1), (x_2, y_2) \in V, c \in \mathbb{R}$ ,

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2, y_1 + y_2)$$
  
 $c \odot (x_1, y_1) = (c^2 x_1, c^3 y_1)$ 

- (a) Show that this scalar multiplication  $\odot$  distributes over vector addition  $\oplus$ .
- (b) Determine if V is a vector space or not. Justify your answer.



Standard V4.	Mark:

Determine if the set of all lattice points, i.e.  $\{(x,y) \mid x \text{ and } y \text{ are integers}\}$  is a subspace of  $\mathbb{R}^2$ .

Name:	
J#:	Dr. Clontz
Date:	

Math 237 – Linear Algebra Fall 2017

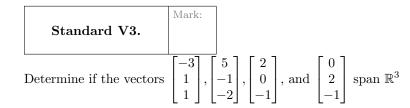
## Version 5

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.

Let V be the set of all real numbers together with the operations  $\oplus$  and  $\odot$  defined by, for any  $x,y \in V$  and  $c \in \mathbb{R}$ ,

$$x \oplus y = x + y - 3$$
$$c \odot x = cx - 3(c - 1)$$

- (a) Show that this scalar multiplication  $\odot$  is associative.
- (b) Determine if V is a vector space or not. Justify your answer



Standard V4.	Mark:
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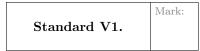
Let W be the set of all polynomials of even degree. Determine if W is a subspace of the vector space of all polynomials.

Name:	
J#:	Dr. Clontz
Date:	

Math 237 – Linear Algebra Fall 2017

## Version 6

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.



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

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2 - 1, y_1 + y_2 - 1)$$
  
 $c \odot (x_1, y_1) = (cx_1 - (c - 1), cy_1 - (c - 2))$ 

- (a) Show that this vector space has an additive identity element.
- (b) Determine if V is a vector space or not. Justify your answer.

Standard V3.	Mark:		
Determine if the vectors	$\begin{bmatrix} 2 \\ 0 \\ -2 \\ 0 \end{bmatrix},$	$\begin{bmatrix} 3\\1\\3\\6 \end{bmatrix}, \begin{bmatrix} 0\\0\\1\\1 \end{bmatrix}, \text{ and}$	$d \begin{bmatrix} 1 \\ 2 \\ 0 \\ 1 \end{bmatrix} \operatorname{span} \mathbb{R}^4$

Standard V4.	Mark:

Let W be the set of all 2 by 2 matrices which are not invertible. Determine if W is a subspace of  $M_{2,2}$ .