

MAT 250

Quiz 5

Spring 2026

1. Which of the following subsets are subspaces of \mathbb{R}^2 ? Select T for True if a subspace, F for False if not a subspace. Answers are in order i), ii), iii).

i) $\{\mathbf{v} = (x, y)^T : x \cdot y = 0\}$

ii) $\{\mathbf{v} = (x, y)^T : |\mathbf{v}| > 0\}$

iii) $\{\mathbf{v} = (x, y)^T : \mathbf{v} = c_1(1, 1)^T + c_2(1, 0)^T, c_1, c_2 \in \mathbb{R}\}$

a) TTT

b) FFF

c) FFT

d) FTT

e) TFT

Correct Answer: FFT

2. Let $\mathbf{u} = (1, 2)^T$ and $\mathbf{v} = (4, 1)^T$ be column vectors in \mathbb{R}^2 . Find the orthogonal projection $proj_{\mathbf{u}}\mathbf{v}$ (of \mathbf{v} onto \mathbf{u}). Now choose another vector \mathbf{w} which has this same projection, so that $proj_{\mathbf{u}}\mathbf{w} = proj_{\mathbf{u}}\mathbf{v}$.

a) $(-4, 1)^T$

b) $(-\frac{8}{5}, \frac{19}{5})^T$

c) $(-4, -1)^T$

d) $(-\frac{4}{5}, \frac{9}{5})^T$

e) $(-\frac{8}{5}, \frac{9}{5})^T$

Correct Answer: $(-\frac{8}{5}, \frac{19}{5})^T$

3. Let S be the subset of \mathbb{R}^2 consisting of all column vectors $\mathbf{v} = (x, y)^T$ which satisfy the following requirement: \mathbf{v} is a multiple of $(-1, 2)^T$ or \mathbf{v} is a multiple of $(3, -6)^T$. Determine if S is a subspace of \mathbb{R}^2 and if so, find a basis. What is the size of the basis? If S is not a subspace, then choose no basis.

a) no basis

b) 0

c) 1

d) 2

e) 3

Correct Answer: 1

4. Let $\mathbf{v} = (-1, 2, 1)^T$ and $\mathbf{w} = (3, -6, -3)$ be column vectors in \mathbb{R}^3 . Let S be the span of these two vectors: $S = Span(\{\mathbf{v}, \mathbf{w}\})$. Determine if S is a subspace of \mathbb{R}^3 and if so, find a basis. What is the size of the basis? If S is not a subspace, then choose no basis.

a) no basis

b) 0

c) 1

d) 2

e) 3

Correct Answer: 1

5. Same S as in the previous question. Find the projection of $\mathbf{u} = (1, 0, 1)^T$ into S .

a) $(0, 0, 0)^T$

b) $(1, 2, -1)^T$

c) $(2, 1, 1)^T$

d) $(3, 6, 3)^T$

e) $(1, 0, -1)^T$

Correct Answer: $(0, 0, 0)^T$