Let $u$ be a vector and $m$ be a scalar. Which of the following best describes the vector $mu$, in terms of length and direction, when $m = -0.7$?

A. It is orthogonal to $u$
B. It has shorter length than $u$ and points in the same direction as $u$
C. It has shorter length than $u$ and points in the opposite direction as $u$
D. It has longer length than $u$ and points in the same direction as $u$
E. It has longer length than $u$ and points in the opposite direction as $u$
Question 2

Given the vectors $a_1 = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$, $a_2 = \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$, $a_3 = \begin{bmatrix} 0 \\ 3 \\ 0 \end{bmatrix}$. Which of the following is not a linear combination of $a_1$, $a_2$, and $a_3$?

A. $\begin{bmatrix} \sqrt{5} \\ -\sqrt{5} \\ 0 \end{bmatrix}$

B. $\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

C. $\begin{bmatrix} -\sqrt{5} \\ \sqrt{5} \\ 1 \end{bmatrix}$

D. $\begin{bmatrix} -3 \\ -2 \\ 0 \end{bmatrix}$

E. $\begin{bmatrix} 91 \\ 75 \\ 0 \end{bmatrix}$
Question 3

Given two nonzero vectors $u$ and $v$ in $\mathbb{R}^4$ and two nonzero integers $a$ and $b$. Which of the following statement is not true?

A. $0$ is a linear combination of $u$ and $v$

B. $-\frac{1}{\sqrt{17}}v$ is a linear combination of $u$ and $v$

C. Any vector of the form $au + bv$ is a linear combination of $u$ and $v$

D. Any vector of the form $\frac{1}{a}u + \frac{1}{b}v$ is a linear combination of $u$ and $v$

E. Any vector of the form $\frac{a}{u} + \frac{b}{v}$ is a linear combination of $u$ and $v$
Given the vectors $a_1, a_2, a_3, a_4, b \in \mathbb{R}^5$. If $b \in \text{Span}\{a_1, a_2, a_3, a_4\}$ then

A. $b$ is a linear combination of $a_1, a_2, a_3, a_4$.
B. $b = a_1 + a_2 + a_3 + a_4$
C. The system whose augmented matrix is $[a_1 \ a_2 \ a_3 \ a_4 \ b]$ is inconsistent.
D. The matrix $[a_1 \ a_2 \ a_3 \ a_4 \ b]$ has a pivot on the rightmost column.
E. (A) and (D)
Question 5

Given

\[
\begin{bmatrix}
  a_1 & a_2 & a_3 & b
\end{bmatrix} = \begin{bmatrix}
  1 & 5 & 0 & -7 \\
  -3 & 1 & -5 & 9 \\
  4 & -8 & 7 & 0
\end{bmatrix} \rightarrow \begin{bmatrix}
  1 & 0 & 0 & 3 \\
  0 & 1 & 0 & -2 \\
  0 & 0 & 1 & -4
\end{bmatrix}
\]

Which of the following is true?

A. \( b = -3a_1 + 2a_2 + 4a_3 \)
B. \( b = 3a_1 - 2a_2 - 4a_3 \)
C. \( b \notin Span\{a_1, a_2, a_3\} \)
D. The vector equation \( x_1a_1 + x_2a_2 + x_3a_3 = b \) has infinitely many solutions
E. Not enough info to describe the relationship between the vectors