Topic: Multiplying matrices by vectors

Question: Find the matrix-vector product, $A\vec{v}$.

$$A = \begin{bmatrix} -1 & 5 & 4 \\ 3 & 2 & 7 \\ -1 & 0 & 1 \end{bmatrix}$$

$$\vec{v} = (-2,0,4)$$

Answer choices:

A $\begin{bmatrix} -2 \\ -10 \\ -4 \end{bmatrix}$

B $\begin{bmatrix} 18 \\ 22 \\ 6 \end{bmatrix}$

C $\begin{bmatrix} 23 \\ 24 \\ 6 \end{bmatrix}$

D $\begin{bmatrix} 14 \\ 22 \\ 6 \end{bmatrix}$

Solution: B

To find $A\vec{v}$, we'll multiply the matrix A by the column vector $\vec{v}$. We know the product is defined since the matrix has 3 columns and the vector has 3 rows.

$$A\vec{v} = \begin{bmatrix} -1 & 5 & 4 \\ 3 & 2 & 7 \\ -1 & 0 & 1 \end{bmatrix} \begin{bmatrix} -2 \\ 0 \\ 4 \end{bmatrix}$$

$$A\vec{v} = \begin{bmatrix} -1(-2) + 5(0) + 4(4) \\ 3(-2) + 2(0) + 7(4) \\ -1(-2) + 0(0) + 1(4) \end{bmatrix}$$

$$A\vec{v} = \begin{bmatrix} 2 + 0 + 16 \\ -6 + 0 + 28 \\ 2 + 0 + 4 \end{bmatrix}$$

$$A\vec{v} = \begin{bmatrix} 18 \\ 22 \\ 6 \end{bmatrix}$$

Topic: Multiplying matrices by vectors

Question: Find the matrix-vector product, $M\vec{v}$.

$$M = \begin{bmatrix} -5 & -3 & 1 & 6 \\ 0 & 4 & -2 & 1 \end{bmatrix}$$

$$\vec{v} = (1, -3, 5, -4)$$

Answer choices:

A $\begin{bmatrix} -27 \\ -26 \end{bmatrix}$

B $\begin{bmatrix} -25 \\ -2 \end{bmatrix}$

C $\begin{bmatrix} 33 \\ 26 \end{bmatrix}$

D $\begin{bmatrix} -15 \\ -26 \end{bmatrix}$

Solution: D

To find $M\vec{v}$, we'll multiply the matrix M by the column vector $\vec{v}$. We know the product is defined since the matrix has 4 columns and the vector has 4 rows.

$$M\vec{v} = \begin{bmatrix} -5 & -3 & 1 & 6 \\ 0 & 4 & -2 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ -3 \\ 5 \\ -4 \end{bmatrix}$$

$$M\vec{v} = \begin{bmatrix} -5(1) - 3(-3) + 1(5) + 6(-4) \\ 0(1) + 4(-3) - 2(5) + 1(-4) \end{bmatrix}$$

$$M\vec{v} = \begin{bmatrix} -5 + 9 + 5 - 24 \\ 0 - 12 - 10 - 4 \end{bmatrix}$$

$$M\vec{v} = \begin{bmatrix} -15 \\ -26 \end{bmatrix}$$

Topic: Multiplying matrices by vectors

Question: Find the matrix-vector product, $\vec{v}M$.

$$M = \begin{bmatrix} -4 & -5 & 6 \\ 8 & 3 & -4 \end{bmatrix}$$

$$\vec{v} = (-2,1)$$

Answer choices:

A $[16 \quad 13 \quad -16]$

B $[0 \quad 7 \quad -8]$

C $[16 \quad -7 \quad -16]$

D $[16 \quad -7 \quad -10]$

Solution: A

To find $\vec{v}M$, we'll multiply the row vector $\vec{v}$ by the matrix M. We know the product is defined, since the vector has 2 columns and the matrix has 2 rows.

$$\vec{v}M = \begin{bmatrix}-2 & 1\end{bmatrix}\begin{bmatrix}-4 & -5 & 6\\ 8 & 3 & -4\end{bmatrix}$$

$$\vec{v}M = \begin{bmatrix}-2(-4)+1(8) & -2(-5)+1(3) & -2(6)+1(-4)\end{bmatrix}$$

$$\vec{v}M = \begin{bmatrix}8+8 & 10+3 & -12-4\end{bmatrix}$$

$$\vec{v}M = \begin{bmatrix}16 & 13 & -16\end{bmatrix}$$