I have ask Maggie Wu about Q6 and Nathan Peweerdt about Q8

Q1: $\|\vec{u}\|_2 = \sqrt{0^2 + 4^2 + (-1)^2}$

$= \sqrt{17} = 4.12$

Q2: opposite direction : $\begin{pmatrix} 0 \\ -4 \\ 1 \end{pmatrix}$

unit vector $\hat{u} = \left(\frac{1}{\|\vec{u}\|}\right)\vec{u}$

$= \left(\frac{1}{\sqrt{0^2+(-4)^2+1^2}}\right)\begin{pmatrix} 0 \\ -4 \\ 1 \end{pmatrix}$

$= \frac{1}{\sqrt{17}}\begin{pmatrix} 0 \\ -4 \\ 1 \end{pmatrix}$

$= \begin{pmatrix} 0 \\ -4\sqrt{17} \\ \sqrt{17} \end{pmatrix} = \begin{pmatrix} 0 \\ -16.49 \\ 4.12 \end{pmatrix}$

Q3: $\cos\theta = \frac{\vec{u}\cdot\vec{v}}{\|\vec{u}\|\|\vec{v}\|}$

$= \frac{0\times(-2)+4\times3+(-1)\times7}{\sqrt{0^2+4^2+(-1)^2}\times\sqrt{(-2)^2+3^2+7^2}}$

$= \frac{5}{\sqrt{17}\times\sqrt{62}}$

$= \frac{5}{\sqrt{1054}} = 0.15$

Q4: No, because the angle between $\vec{u}$ and $\vec{v}$ is not 0.

Or, $\cos\theta$ is not 0 in this case.

Q5: $\|\vec{u}\|_1 = |0| + |4| + |-1| = 5$

Q6: $$AB = \begin{pmatrix} 2\times4+0\times0+1\times4 & 2\times-2+0\times2+1\times0 & 2\times7+0\times-1+1\times3 \\ 3\times4+(-1)\times0+4\times4 & 3\times-2+-1\times2+4\times0 & 3\times7+-1\times-1+4\times3 \\ -2\times4+5\times0+0\times4 & -2\times-2+5\times2+0\times0 & -2\times7+5\times-1+0\times3 \end{pmatrix}$$

$$= \begin{pmatrix} 8+0+4 & -4+0+0 & 14+0+3 \\ 12+0+16 & -6-2+0 & 21+1+12 \\ -8+0+0 & 4+10+0 & -14-5+0 \end{pmatrix}$$

$$= \begin{pmatrix} 12 & -4 & 17 \\ 28 & -8 & 34 \\ -8 & 14 & -19 \end{pmatrix}$$

$$BA = \begin{pmatrix} 4\times2+-2\times3+7\times-2 & 4\times0+-2\times-1+7\times5 & 4\times1+-2\times4+7\times0 \\ 0\times2+2\times3+-1\times-2 & 0\times0+2\times-1+-1\times5 & 0\times1+2\times4+-1\times0 \\ 4\times2+0\times3+3\times-2 & 4\times0+0\times-1+3\times5 & 4\times1+0\times4+3\times0 \end{pmatrix}$$

$$= \begin{pmatrix} 8-6-14 & 0+2+35 & 4-8+0 \\ 0+6+2 & 0-2-5 & 0+8+0 \\ 8+0-6 & 0+0+15 & 4+0+0 \end{pmatrix}$$

$$= \begin{pmatrix} -12 & 37 & -4 \\ 8 & -7 & 8 \\ 2 & 15 & 4 \end{pmatrix}$$

They are not equal

Q7: $tr(AB) = 12-8-19 = -15$

$tr(BA) = -12-7+4 = -15$

Q8: $$\begin{pmatrix} 8 & -4 & 14 \\ 12 & -6 & 21 \\ -8 & 4 & -14 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 0 \\ 0 & -2 & 1 \\ 0 & 10 & -5 \end{pmatrix} + \begin{pmatrix} 4 & 0 & 3 \\ 16 & 0 & 12 \\ 0 & 0 & 0 \end{pmatrix}$$

$$= \begin{pmatrix} 12 & -4 & 17 \\ 28 & -8 & 34 \\ -8 & 14 & -19 \end{pmatrix}$$

Q9: They are the same. They are different ways to calculate matrix multiplication.