Step-1

Given that $u=(1+i,1-i,1+2i)$ and $v=(i,i,i)$

We have to find the lengths of u and v.

Step-2

We know that if $x=(x_1,\ldots,x_n)$ then the length of x is $\|x\|=\sqrt{x_1^{\,2}+\ldots+x_n^{\,2}}$

Now the length of u is

$$\begin{aligned}\|u\|^2 &= |1+i|^2+|1-i|^2+|1+2i|^2\\ &= \left(1^2+1^2\right)+\left(1^2+(-1)^2\right)+\left(1^2+2^2\right)\\ &= 2+2+5\\ &= 9\end{aligned}$$

$$\Rightarrow \|u\|=\sqrt{9}=3$$

Hence $\boxed{\|u\|=3}$

Step-3

Now the length of v is

$$\begin{aligned}\|v\|^2 &= |i|^2+|i|^2+|i|^2\\ &= 1^2+1^2+1^2\\ &= 3\end{aligned}$$

$$\Rightarrow \|v\|=\sqrt{3}$$

Hence $\boxed{\|v\|=\sqrt{3}}$

Step-4

Since $u=(1+i,1-i,1+2i)$

So $u=\begin{bmatrix}1+i\\1-i\\1+2i\end{bmatrix}$

Then $U^H = [1-i \quad 1+i \quad 1-2i]$

And $v = (i, i, i)$

Then $v = \begin{bmatrix} i \\ i \\ i \end{bmatrix}$ and $v^H = [-i \quad -i \quad -i]$

Step-5

Now we have to find $u^H v$

Now

$$u^H v = [1-i \quad 1+i \quad 1-2i] \begin{bmatrix} i \\ i \\ i \end{bmatrix}$$

$$= [i(1-i) + i(1+i) + i(1-2i)]$$
$$= [i - i^2 + i + i^2 i - 2i^2]$$
$$= [3i + 2]$$
$$= [2 + 3i]$$

Therefore, $\boxed{u^H v = [2+3i]}$

Step-6

Now we have to find $v^H u$

Now

$$v^H u = [-i \quad -i \quad -i] \begin{bmatrix} 1+i \\ 1-i \\ 1+2i \end{bmatrix}$$

$$= [-i(1+i) - i(1-i) - i(1+2i)]$$
$$= [-i - i^2 - i - i^2 - i - 2i^2]$$
$$= [-3i - 2i^2]$$
$$= [2 - 3i]$$

Therefore, $\boxed{v^H u = [2-3i]}$