F) $||\vec{w}||$ $\sqrt{3^2+1^2+-1^2} = \sqrt{9+1+1} = \boxed{\sqrt{11}}$

G) $\text{Proj}_{\vec{v}}\vec{w}$ $\frac{u \cdot v\,(v)}{||v||}$ $\frac{(\langle 2,1,-4\rangle \cdot \langle 1,0,2\rangle)\langle 1,0,2\rangle}{\sqrt{1+4}}$

w_1 w_2

$2 \cdot 1 + 1 \cdot 0 + -4 \cdot 2$

$2 + -8 =$

$\frac{-6\langle 1,0,2\rangle}{\sqrt{5}}$ $\frac{\langle -6,0,-12\rangle}{\sqrt{5}}$ $\boxed{\langle \frac{-6}{\sqrt{5}}, 0, \frac{-12}{\sqrt{5}}\rangle}$

H) w_2 for part G $\langle 2,1,-4\rangle + \langle +6/\sqrt{5}, -0, +12/\sqrt{5}\rangle$

$w_2 = u - w_1$ $2 + 6/\sqrt{5},\ 1-0,\ -4 + 12/\sqrt{5}$

$4.683281573,\ 1,\ 1.366563146$

$w_2 = \boxed{\langle 4.69, 1, 1.37\rangle}$

I) direction cosines for $\vec{w}$ $\langle 3,1,-1\rangle$ $\sqrt{3^2+1^2+-1^2} = \sqrt{11}$

$\cos\alpha = \frac{x}{||w||} = 3/\sqrt{11}$

$\cos\beta = \frac{y}{||w||} = 1/\sqrt{11}$

$\cos\gamma = \frac{z}{||w||} = -1/\sqrt{11}$

J) direction angles for $\vec{w}$

$\boxed{25.24°}$
$\boxed{72.45°}$
$\boxed{107.55°}$

K) angle between $\vec{u}$ and $\vec{v}$

$\cos\theta = \frac{\vec{u} \cdot \vec{v}}{||u||\,||v||}$ $\frac{\langle 2,1,-4\rangle \cdot \langle 1,0,2\rangle}{\sqrt{2^2+1^2+4^2}\ \sqrt{1^2+0^2+2^2}}$ $2+0+-8 = \frac{-6}{\sqrt{105}}$

$\sqrt{21}$ $\sqrt{5}$

$\cos\theta = -6/\sqrt{105}$

$\theta = \cos^{-1} -6/\sqrt{105}$

$= \boxed{125.84°}$