17 The magnitude of $\mathbf{v}$ is

$$\|\mathbf{v}\| = \sqrt{(1)^2 + (1)^2 + (0)^2} = \sqrt{2}.$$

The magnitude of $\mathbf{u}$ is

$$\|\mathbf{u}\| = \sqrt{(2)^2 + (1)^2 + (-2)^2} = 3.$$

The dot product of $\mathbf{v}$ and $\mathbf{u}$ is

$$\mathbf{v} \cdot \mathbf{u} = (1)(2) + (1)(1) + (0)(-2) = 3.$$

The dot product of $\mathbf{u}$ and $\mathbf{v}$ is

$$\mathbf{u} \cdot \mathbf{v} = (2)(1) + (1)(1) + (-2)(0) = 3.$$

The cross product of $\mathbf{v}$ and $\mathbf{u}$ is

$$\mathbf{v} \times \mathbf{u} = \langle (1)(-2) - (0)(1), (0)(2) - (1)(-2), (1)(1) - (1)(2) \rangle = \langle -2, 2, -1 \rangle = -2\mathbf{i} + 2\mathbf{j} - \mathbf{k}.$$

The cross product of $\mathbf{u}$ and $\mathbf{v}$ is

$$\mathbf{u} \times \mathbf{v} = \langle (1)(0) - (-2)(1), (-2)(1) - (2)(0), (2)(1) - (1)(1) \rangle = \langle 2, -2, 1 \rangle = 2\mathbf{i} - 2\mathbf{j} + \mathbf{k}.$$

The magnitude of the cross product of $\mathbf{v}$ and $\mathbf{u}$ is

$$\|\mathbf{v} \times \mathbf{u}\| = \sqrt{(-2)^2 + (2)^2 + (-1)^2} = 3.$$

The angle between $\mathbf{v}$ and $\mathbf{u}$ is

$$\arccos\left(\frac{\mathbf{v} \cdot \mathbf{u}}{\|\mathbf{v}\| \, \|\mathbf{u}\|}\right) = \arccos\left(\frac{(3)}{(\sqrt{2})(3)}\right) = \frac{\pi}{4}.$$

The component of $\mathbf{u}$ in the direction of $\mathbf{v}$ is

$$\frac{\mathbf{v} \cdot \mathbf{u}}{\|\mathbf{v}\|} = \frac{(3)}{(\sqrt{2})} = \frac{3\sqrt{2}}{2}.$$

The projection of $\mathbf{u}$ onto $\mathbf{v}$ is

$$\frac{\mathbf{v} \cdot \mathbf{u}}{\|\mathbf{v}\|^2}\mathbf{v} = \frac{(3)}{(\sqrt{2})^2}\langle 1, 1, 0 \rangle = \frac{3}{2}\langle 1, 1, 0 \rangle = \left\langle \left(\frac{3}{2}\right)(1), \left(\frac{3}{2}\right)(1), \left(\frac{3}{2}\right)(0) \right\rangle = \left\langle \frac{3}{2}, \frac{3}{2}, 0 \right\rangle = \frac{3}{2}\mathbf{i} + \frac{3}{2}\mathbf{j}.$$

31 Either

$$\mathbf{r} = (1, 2, 3) + t\langle -3, 0, 7 \rangle = (1 - 3t, 2, 3 + 7t)$$

or

$$x = 1 - 3t, \ y = 2, \ z = 3 + 7t.$$