3. (2 pts)

$$\|\vec{a}\| = \sqrt{8^2 + (-2)^2 + 1^2} = \sqrt{69} \qquad 7\vec{b} = \boxed{49\vec{j} - 28\vec{k}}$$

$$4\vec{b} - 6\vec{a} = 28\vec{j} - 16\vec{k} - \left(48\vec{i} - 12\vec{j} + 6\vec{k}\right) = \boxed{-48i + 40\vec{j} - 22\vec{k}}$$

7. (2 pts) $\cos\theta = \dfrac{\vec{p} \bullet \vec{q}}{\|\vec{p}\|\|\vec{q}\|} = \dfrac{43}{\sqrt{21}\,\sqrt{283}} = 0.55778 \qquad \theta = \cos^{-1}\left(0.55778\right) = \boxed{0.97098 \text{ rad}}$

The dot product is not zero so the two vectors aren't orthogonal and the angle is neither zero or π and so the two vectors are not parallel either.

9. (2 pts) $\text{proj}_{\vec{a}}\,\vec{b} = \dfrac{\vec{a} \bullet \vec{b}}{\|\vec{a}\|^2}\vec{a} = \dfrac{1}{5}\left\langle 0, 2, -1\right\rangle = \boxed{\left\langle 0, \dfrac{2}{5}, -\dfrac{1}{5}\right\rangle}$

11. (2 pts) Remember that $\vec{w} \times \vec{v} = -\left(\vec{v} \times \vec{w}\right)$.

$$\vec{v} \times \vec{w} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & -6 & 1 \\ 0 & 1 & -1 \end{vmatrix} \begin{matrix} \vec{i} & \vec{j} \\ 2 & -6 \\ 0 & 1 \end{matrix} = 6\vec{i} + 0\vec{j} + 2\vec{k} - \left(-2\vec{j}\right) - \vec{i} - \left(0\right)\vec{k} = \boxed{5\vec{i} + 2\vec{j} + 2\vec{k}}$$

$$\vec{w} \times \vec{v} = \boxed{-5\vec{i} - 2\vec{j} - 2\vec{k}}$$

12. (2 pts) First label the points *P*=(9, 0, 1), *Q*=(-1, 1, 4) and *R*=(7, 0, 4) then the following two vectors are in the plane,

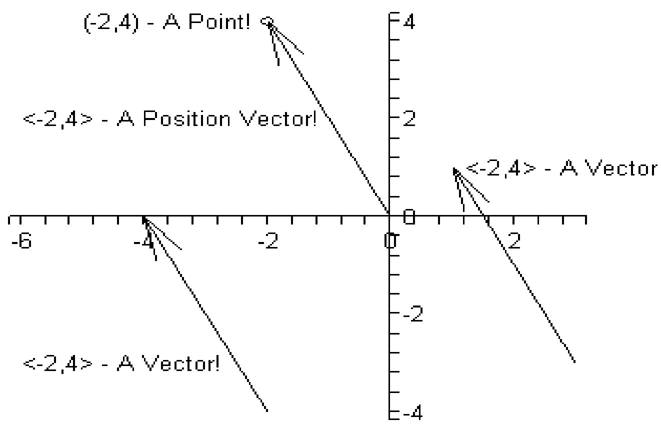
$$\overrightarrow{PR} = \left\langle -2, 0, 3\right\rangle \qquad \overrightarrow{QR} = \left\langle 8, -1, 0\right\rangle$$

Then the cross product of these two vectors will be orthogonal to the plane containing the vectors and hence the points.

$$\overrightarrow{PR} \times \overrightarrow{QR} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -2 & 0 & 3 \\ 8 & -1 & 0 \end{vmatrix} \begin{matrix} \vec{i} & \vec{j} \\ -2 & 0 \\ 8 & -1 \end{matrix} = 24\vec{j} + 2\vec{k} + 3\vec{i} = \boxed{3\vec{i} + 24\vec{j} + 2\vec{k}}$$

Not Graded

1. $(-2,4)$ is a point and $\langle -2,4 \rangle$ is a vector. Here's a sketch of the point and several possible representation of the vector.



2. $\|\vec{a}\| = \sqrt{(-5)^2 + 2^2} = \sqrt{29}$ $\quad 7\vec{b} = \boxed{\langle -21,-70 \rangle}$ $\quad 4\vec{b} - 6\vec{a} = \langle -12,-40 \rangle - \langle -30,12 \rangle = \boxed{\langle 18,-52 \rangle}$

4.

(a) $\|\vec{w}\| = \sqrt{130}$ $\qquad \vec{u} = \frac{1}{\sqrt{130}}\langle 9,0,-7 \rangle = \boxed{\left\langle \frac{9}{\sqrt{130}},0,-\frac{7}{\sqrt{130}} \right\rangle}$

(b) $\|\vec{v}\| = \sqrt{113}$ $\qquad \vec{u} = -\frac{1}{\sqrt{113}}\left(2\vec{i} + 3\vec{j} - 10\vec{k}\right) = \boxed{-\frac{2}{\sqrt{113}}\vec{i} - \frac{3}{\sqrt{113}}\vec{j} + \frac{10}{\sqrt{113}}\vec{k}}$

5. $\vec{a} \bullet \vec{b} = (-1)(9) + (2)(4) + (6)(2) = \boxed{11}$

6. $\vec{a} \bullet \vec{b} = (14)(3)\cos\left(\frac{\pi}{6}\right) = \boxed{21\sqrt{3}}$

8. $\cos\theta = \dfrac{\vec{x} \bullet \vec{y}}{\|\vec{x}\|\|\vec{y}\|} = \dfrac{0}{(17)(42)} = 0 \qquad \theta = \dfrac{\pi}{2}$

The dot product is zero (and the angle is $\frac{\pi}{2}$) and so the two vectors are orthogonal.

10. $\text{proj}_{\vec{a}}\,\vec{b} = \dfrac{\vec{a} \bullet \vec{b}}{\|\vec{a}\|^2}\vec{a} = \dfrac{1}{30}\langle 1,-2,-5 \rangle = \boxed{\left\langle \dfrac{1}{30},-\dfrac{1}{15},-\dfrac{1}{6} \right\rangle}$

13. First label the vectors $\vec{a} = \langle 3,0,0 \rangle$, $\vec{b} = \langle 1,-4,2 \rangle$ and $\vec{c} = \langle 2,-4,1 \rangle$ then compute the volume of the parallelepiped that is determined by these vectors. If the volume is zero then they all lie in the same plane.

$$\vec{a} \bullet \left(\vec{b} \times \vec{c} \right) = \begin{vmatrix} 3 & 0 & 0 \\ 1 & -4 & 2 \\ 8 & -1 & 0 \end{vmatrix} \begin{matrix} 3 & 0 \\ 1 & -4 \\ 8 & -1 \end{matrix} = 12 \neq 0$$

So, the vectors do NOT all lie in the same plane.