3.4 1ae, 2a, 3a, 4a, 7, 8a, 9, 11, 15, 20, 24

1.a. $\vec{v}\times\vec{w} = \left(\begin{vmatrix} 2 & -3 \\ 6 & 7 \end{vmatrix}, -\begin{vmatrix} 0 & -3 \\ 2 & 7 \end{vmatrix}, \begin{vmatrix} 0 & 2 \\ 2 & 6 \end{vmatrix} \right) = (32, -6, -4)$

e. $\vec{v} - 2\vec{w} = (0,2,-3) - (4,12,14) = (-4,-10,-17)$

$\vec{u}\times(\vec{v}-2\vec{w}) = \left(\begin{vmatrix} 2 & -1 \\ -10 & -17 \end{vmatrix}, -\begin{vmatrix} 3 & -1 \\ -4 & -7 \end{vmatrix}, \begin{vmatrix} 3 & 2 \\ -4 & -10 \end{vmatrix} \right) = (-44, 55, -22)$

2.a. $\vec{u}\times\vec{v}$ is orthogonal to both $\vec{u}$ and $\vec{v}$, as is any vector in the same direction as $\vec{u}\times\vec{v}$.

$\vec{u}\times\vec{v} = \left(\begin{vmatrix} 4 & 2 \\ 1 & 5 \end{vmatrix}, -\begin{vmatrix} -6 & 2 \\ 3 & 5 \end{vmatrix}, \begin{vmatrix} -6 & 4 \\ 3 & 1 \end{vmatrix} \right) = (18, 36, -18)$

so $(1,2,-1)$ is orthogonal to $\vec{u}$ and $\vec{v}$, for example.

3a. $\vec{u}\times\vec{v} = (-7,-1,3)$, so the area of the parallelogram is $\|\vec{u}\times\vec{v}\| = \sqrt{59}$

4a. $\vec{u} = \overrightarrow{PQ} = (-1,-5,2)$ and $\vec{v} = \overrightarrow{PR} = (2,0,3)$

so $\vec{u}\times\vec{v} = \left(\begin{vmatrix} -5 & 2 \\ 0 & 3 \end{vmatrix}, -\begin{vmatrix} -1 & 2 \\ 2 & 3 \end{vmatrix}, \begin{vmatrix} -1 & -5 \\ 2 & 0 \end{vmatrix} \right) = (-15, 7, 10)$

Thus $\|\vec{u}\times\vec{v}\| = \left[(-15)^2 + (7)^2 + (10)^2\right]^{1/2} = \sqrt{374}$

$\Rightarrow$ AREA OF TRIANGLE IS $\frac{1}{2}\sqrt{374}$