1) a) \( P(1, 2, 4) \); \( \vec{u} = \langle 1, -1, 3 \rangle \)
\( x = 1 + t \)
\( y = 2 - t \)
\( z = 4 + 3t \)

b) \( \vec{u} = \langle 4, 2, -1 \rangle \), so:
\( \frac{x-3}{4} = \frac{y-2}{2} = \frac{z+1}{-1} \) or \( \frac{x+1}{4} = \frac{y}{2} = \frac{z-2}{-1} \) or any other equivalent set of equations.

c) \( P(2, 3, 1) \); \( \vec{u} = \begin{vmatrix} 1 & 1 & 1 \\ 4 & -1 & 1 \\ -1 & 2 & -2 \end{vmatrix} = \langle 0, 7, 7 \rangle \)
\( \Rightarrow 0(x-2) + 7(y-3) + 7(z-1) = 0 \Rightarrow 7y + 7z = 28 \Rightarrow y + z = 4 \)

2) \( \vec{r}(t) = \langle t^2, t+1, e^{t-2} \rangle \)
   a) \( \vec{r}'(2) = \langle 4, 3, 1 \rangle \)
   \( |\vec{r}'(2)| = \sqrt{16 + 9 + 1} = \sqrt{26} \)

b) \( \vec{r}'(t) = \langle 2t, 1, e^{t-2} \rangle \Rightarrow \vec{r}'(2) = \langle 4, 1, 1 \rangle \)
\( x = 4 + 4t \)
\( y = 3 + t \)
\( z = 1 + t \)

3) \( \vec{r}''(t) = \langle 0, -32 \rangle \)
   \( \vec{r}'(t) = \langle v_{0x}, -32t + v_{0y} \rangle \)
   \( = \langle 20\sqrt{3}, -32t + 60 \rangle \)
   \( \vec{r}(t) = \langle 20\sqrt{3} t, -16t^2 + 60t \rangle \)

   \( x(t) = 20\sqrt{3} t = 60\sqrt{3} \Rightarrow \text{uprights} = 3 \)
   \( y(3) = -16(9) + 60(3) = 180 - 154 = 36 \text{ feet} \ldots \text{clears uprights}. \)

4) a) \( \vec{u} \times \vec{v} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & -1 \\ 2 & -1 & 0 \end{vmatrix} = \langle -1, -2, -3 \rangle \Rightarrow \frac{\vec{u} \times \vec{v}}{|\vec{u} \times \vec{v}|} = \frac{1}{\sqrt{14}} \langle -1, -2, -3 \rangle \)

b) \( \vec{r}'(t) = \langle 1, e^t, \cos t \rangle \Rightarrow \vec{r}'(0) = \langle 1, 1, 1 \rangle \)
   \( \text{is } t = 0 \Rightarrow \vec{r}(0) = \frac{1}{\sqrt{3}} \langle 1, 1, 1 \rangle \)

c) \( \frac{x-2}{2} = \frac{y-1}{4} = \frac{z}{-1} \)
\( \vec{u} = \langle 2, 4, -1 \rangle \)
\( \vec{u} = \langle 2, -1, 0 \rangle \) \( \text{is on line but not plane: TRUE} \)

d) \( \vec{D} = \vec{PQ} = \langle 1, 2, 3 \rangle \)
\( w = \vec{F} \cdot \vec{D} = \langle 1, -1, 3 \rangle \cdot \langle 1, 2, 3 \rangle = 1 - 2 + 9 = 8 \).