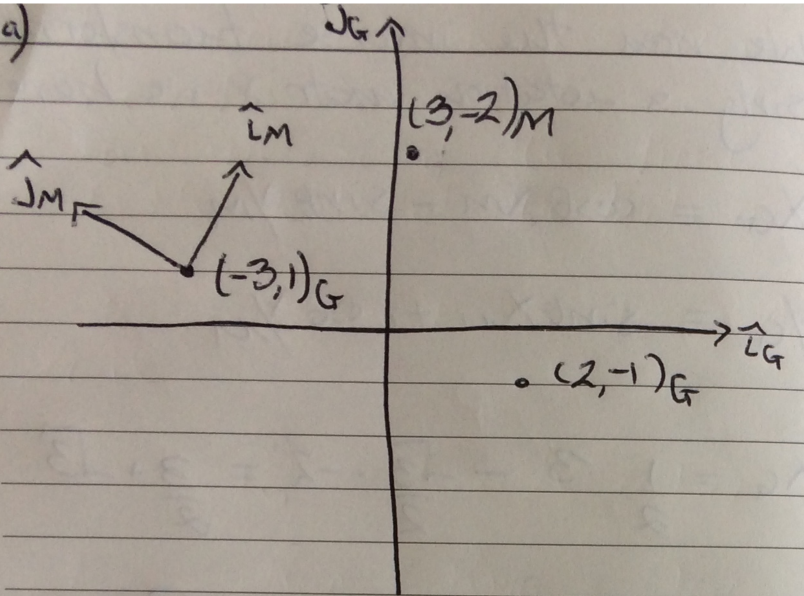
2. a)



b) The transformation is

$$\vec{r}_M = R_{MG}\, T_{MG}\, \vec{r}_G$$

where

$$R_{MG} = \begin{bmatrix} 1/2 & \frac{\sqrt{3}}{2} & 0 \\ -\sqrt{3}/2 & 1/2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

and

$$T_{MG} = \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix}$$

Let's multiply the matrices for fun

$$R_{MG}T_{MG} = \begin{bmatrix} 1/2 & \frac{\sqrt{3}}{2} & \frac{3}{2} - \frac{\sqrt{3}}{2} \\ -\sqrt{3}/2 & 1/2 & -\frac{3\sqrt{3}}{2} - 1/2 \\ 0 & 0 & 1 \end{bmatrix}$$

so that

$$\vec{r}_M = \begin{bmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{3-\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} & \frac{-3\sqrt{3}-1}{2} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 - \frac{\sqrt{3}}{2} + \frac{3-\sqrt{3}}{2} \\ -\sqrt{3} - \frac{1}{2} + \frac{-3\sqrt{3}-1}{2} \\ 1 \end{bmatrix}$$

$$\Rightarrow \vec{r}_M = \begin{bmatrix} \frac{5-\sqrt{3}}{2} \\ -1 - 5\sqrt{3}/2 \\ 1 \end{bmatrix}$$

- This looks about right.