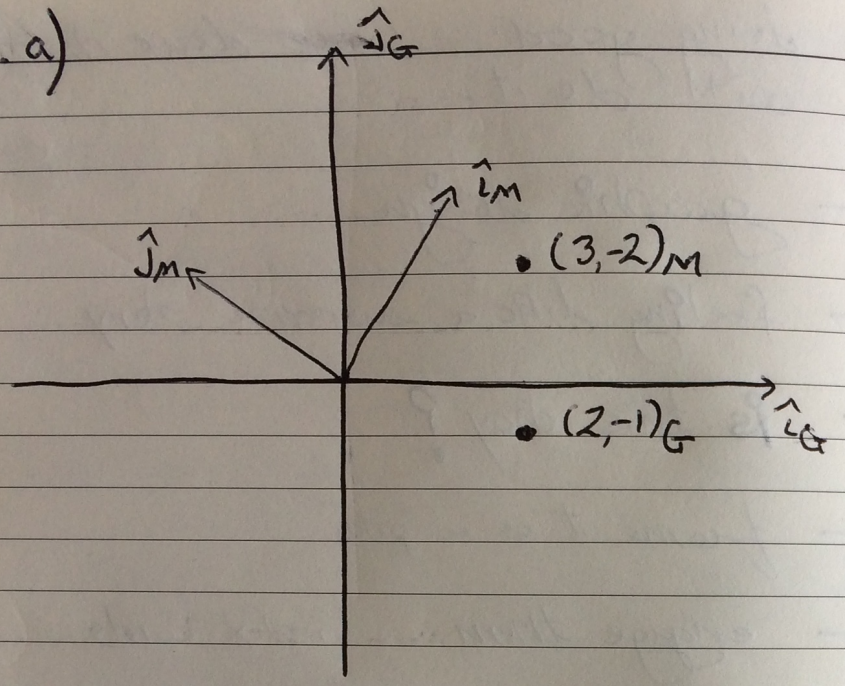
1. a)



b) Frame M is a counterclockwise rotation of $\pi/3$ radians. By rotation matrix

$$x_M = \cos\theta\, x_G + \sin\theta\, y_G$$

$$y_M = -\sin\theta\, x_G + \cos\theta\, y_G$$

- $\theta = \pi/3$ so that $\cos\theta = 1/2$; $\sin\theta = \sqrt{3}/2$

$$x_M = \frac{1}{2}\cdot 2 + \frac{\sqrt{3}}{2}\cdot -1 = 1 - \frac{\sqrt{3}}{2}$$

$$y_M = -\frac{\sqrt{3}}{2}\cdot 2 + \frac{1}{2}\cdot -1 = -\sqrt{3} - \frac{1}{2}$$

- This looks about right looking at the axes.

c) We need the inverse transformation. Using a rotation matrix we have

$$x_G = \cos\theta\, x_M - \sin\theta\, y_M$$

$$y_G = \sin\theta\, x_M + \cos\theta\, y_M$$

$$\Rightarrow x_G = \frac{1}{2}\cdot 3 - \frac{\sqrt{3}}{2}\cdot -2 = \frac{3}{2} + \sqrt{3}$$

$$\Rightarrow y_G = \frac{\sqrt{3}}{2}\cdot 3 + \frac{1}{2}\cdot -2 = \frac{3\sqrt{3}}{2} - 1$$

- This looks about right looking at the axes.