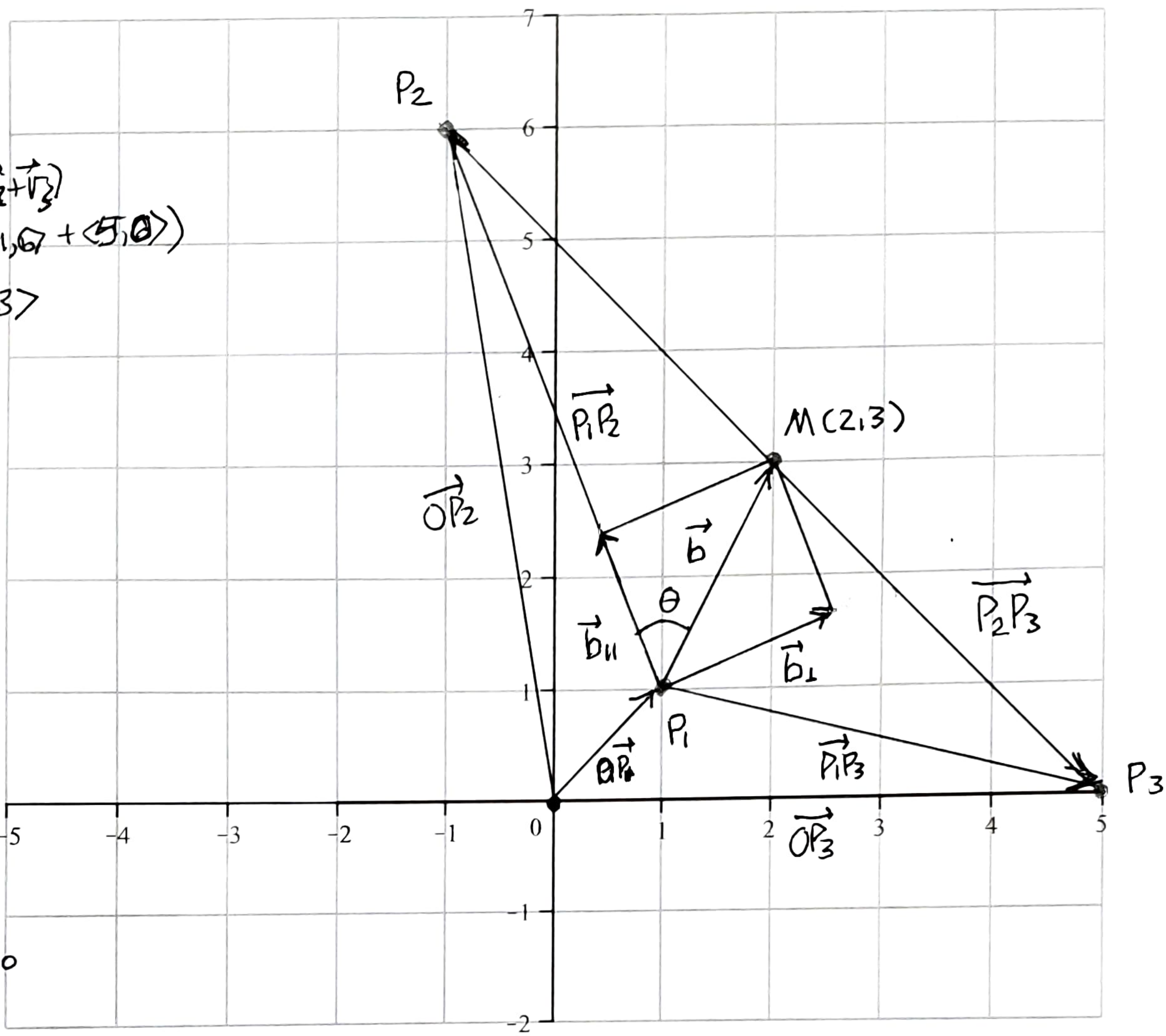
$P_1(1,1), P_2(-1,6), P_3(5,0)$

a), b)

$\overrightarrow{OM} = \frac{1}{2}(\vec{r}_2+\vec{r}_3)$
$= \frac{1}{2}(\langle -1,6\rangle + \langle 5,0\rangle)$
$= \langle 2,3\rangle$



c) $\theta \approx 45°$

d) $\vec{b}_{\parallel} \approx \langle -1.6, 1.4\rangle$, $\vec{b}_{\perp} = \langle 1.5, 0.6\rangle$

e) $\overrightarrow{P_1P_2} = \langle -1,6\rangle - \langle 1,1\rangle = \langle -2,5\rangle$, $|\overrightarrow{P_1P_2}| = \sqrt{4+25} = \sqrt{29}$

$\hat{a} \equiv \widehat{P_1P_2} = \overrightarrow{P_1P_2}/|\overrightarrow{P_1P_2}| = \frac{1}{\sqrt{29}}\langle -2,5\rangle$

e) $b_{\parallel} = \hat{a}\cdot\vec{b} = \frac{1}{\sqrt{29}}\langle -2,5\rangle \cdot \langle 1,2\rangle$

$= \frac{1}{\sqrt{29}}(-2(1)+5(2)) = \frac{-2+10}{\sqrt{29}} = \frac{8}{\sqrt{29}}$

$\vec{b}_{\parallel} = b_{\parallel}\hat{a} = \frac{8}{\sqrt{29}}\frac{1}{\sqrt{29}}\langle -2,5\rangle = \boxed{\frac{8}{29}\langle -2,5\rangle}$ $\boxed{\approx \langle -0.55, 1.38\rangle}$

$\vec{b}_{\perp} = \vec{b} - \vec{b}_{\parallel} = \langle 1,2\rangle - \langle -\frac{16}{29}, \frac{40}{29}\rangle$

$= \langle \frac{29+16}{29}, \frac{58-40}{29}\rangle = \boxed{\frac{1}{29}\langle 45, 18\rangle}$ $\boxed{\approx \langle 1.55, 0.62\rangle}$

$= \frac{9}{29}\langle 5,2\rangle$

c) $\overrightarrow{P_1M} = \overrightarrow{OM} - \vec{r}_1 = \langle 2,3\rangle - \langle 1,1\rangle$
$= \langle 1,2\rangle \equiv \vec{b}$

$|\vec{b}| = \sqrt{1+4} = \sqrt{5}$, $\hat{b} = \frac{1}{\sqrt{5}}\langle 1,2\rangle$

$\cos\theta = \hat{a}\cdot\hat{b} = \frac{1}{\sqrt{29}}\langle -2,5\rangle \cdot \frac{1}{\sqrt{5}}\langle 1,2\rangle$

$= \frac{1}{\sqrt{29}\sqrt{5}}(-2(1)+5(2)) = \frac{8}{\sqrt{29}\sqrt{5}}$

$\boxed{\theta = \arccos\left(\frac{9}{\sqrt{5}\sqrt{29}}\right) \approx 48.4°}$