2/67 $\underline{r} = \left(\frac{2}{3}t^3 - \frac{3}{2}t^2\right)\underline{i} + \left(\frac{t^4}{12}\right)\underline{j}$

$\underline{v} = \dot{\underline{r}} = (2t^2 - 3t)\underline{i} + \left(\frac{1}{3}t^3\right)\underline{j}$

$\underline{a} = \dot{\underline{v}} = (4t - 3)\underline{i} + (t^2)\underline{j}$

At $t = 2\,s$ $\begin{cases} \underline{v} = (2\cdot 2^2 - 3\cdot 2)\underline{i} + \frac{1}{3}2^3\underline{j} = 2\underline{i} + \frac{8}{3}\underline{j} \ \text{mm/s} \\ \underline{a} = (4\cdot 2 - 3)\underline{i} + 2^2\underline{j} = 5\underline{i} + 4\underline{j} \ \text{mm/s}^2 \end{cases}$

$$\cos\theta = \frac{\underline{v}\cdot\underline{a}}{va} = \frac{\left(2\underline{i} + \frac{8}{3}\underline{j}\right)\cdot(5\underline{i} + 4\underline{j})}{\sqrt{2^2 + \left(\frac{8}{3}\right)^2}\cdot\sqrt{5^2 + 4^2}}$$

$$\underline{\theta = 14.47^\circ}$$

At $t = 3\,s$ $\begin{cases} \underline{v} = (2\cdot 3^2 - 3\cdot 3)\underline{i} + \left(\frac{1}{3}3^3\right)\underline{j} = 9\underline{i} + 9\underline{j} \ \frac{mm}{s} \\ \underline{a} = (4\cdot 3 - 3)\underline{i} + (3^2)\underline{j} = 9\underline{i} + 9\underline{j} \ \frac{mm}{s^2} \end{cases}$

$\underline{v} \parallel \underline{a} \Rightarrow \underline{\theta = 0}$