

13.4

$$\textcircled{8} \quad \vec{r}(t) = (v_0 \cos \theta)t \hat{i} + \left[(v_0 \sin \theta)t - 4.9t^2 \right] \hat{j}$$

$$= (200 \cos \theta)t \hat{i} + \left[(200 \sin \theta)t - 4.9t^2 \right] \hat{j}$$

$$(200 \sin \theta)t - 4.9t^2 = 0$$

$$(200 \cos \theta)t = 900$$

$$t \left[200 \sin \theta - 4.9t \right] = 0$$

$$4.9t = 200 \sin \theta$$

$$t = \frac{200 \sin \theta}{4.9}$$

$$200 \cos \theta \cdot \frac{200 \sin \theta}{4.9} = 900$$

$$4000 \sin \theta \cos \theta = 4410$$

$$4000 \sin \theta \cos \theta = 4410$$

$$2000 \sin 2\theta = 4410$$

$$\sin 2\theta = \frac{441}{2000}$$

$$2\theta = 12.738^\circ \text{ or } 2\theta \approx 167.262^\circ$$

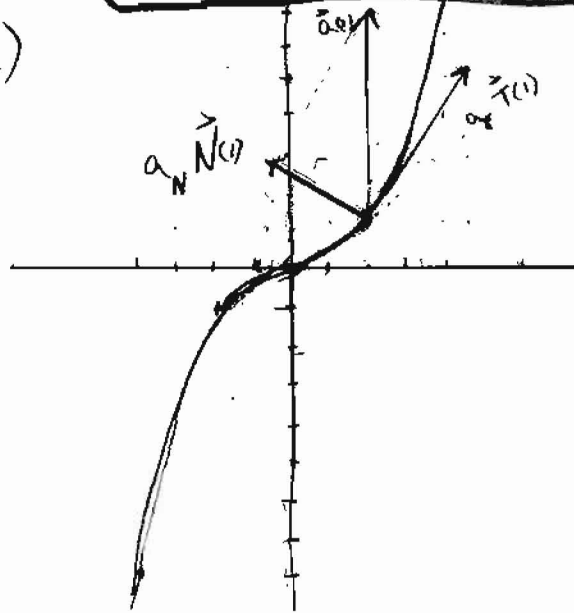
$$\theta \approx 6.369^\circ \text{ or } \theta \approx 83.631^\circ$$

13.4

10

$$\vec{r}(t) = 2t \vec{i} + t^3 \vec{j}$$

a)



t	x	y
-1	-2	-1
0	0	0
1	2	1
2	4	8
-2	-4	-8

$$b) \quad \vec{v}(t) = 2\vec{i} + 3t^2 \vec{j}$$

$$\vec{a}(t) = 6t \vec{j}$$

$$\vec{a}(1) = 6\vec{j}$$

$$c) \quad \vec{T}(t) = \frac{2\vec{i} + 3t^2 \vec{j}}{\sqrt{4 + 9t^4}} \Rightarrow \vec{T}(1) = \frac{1}{\sqrt{13}} (2\vec{i} + 3\vec{j})$$

$$\vec{a}_T(1) = (6\vec{j}) \cdot \frac{1}{\sqrt{13}} (2\vec{i} + 3\vec{j})$$

$$= \frac{18}{\sqrt{13}}$$

$$\Rightarrow \vec{a}_T \vec{T}(1) = \frac{18}{13} (2\vec{i} + 3\vec{j})$$

$$\approx 2.77\vec{i} + 4.15\vec{j}$$

$$a_N(1) = \sqrt{|\vec{a}|^2 - a_T^2}$$

$$= \sqrt{36 - \frac{18^2}{13}}$$

$$= \frac{12}{\sqrt{13}}$$

$$\vec{N} = \frac{1}{\sqrt{13}} [-3\vec{i} + 2\vec{j}]$$

$$a_N \vec{N} = \frac{12}{13} (-3\vec{i} + 2\vec{j})$$

$$= -\frac{36}{13} \vec{i} + \frac{24}{13} \vec{j}$$

$$\approx -2.77\vec{i} + 1.85\vec{j}$$