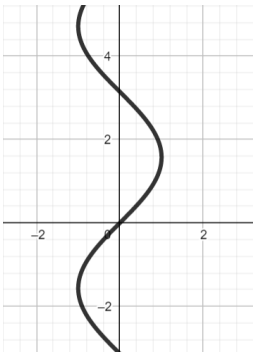
Calc III - Ch 13 - Required Practice **ANSWERS ONLY**

13.1

#1. $-1 < t \le 2 \quad or \quad (-1, 2]$

#2. $\left\langle 1, \frac{1}{2}, 3 \right\rangle$

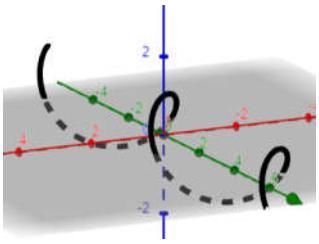
#3.



$\vec{r} = \langle t,\ 2t,\ 3t \rangle$

#4. $\begin{cases} x = t \\ y = 2t \quad 0 \le t \le 1 \\ z = 3t \end{cases}$

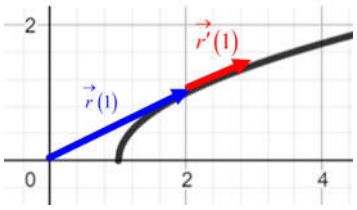
#5.



#6. $(0,0,0)$ *and* $(1,0,1)$

13.2

#1.



$\vec{r}'(t) = \left\langle 1,\ \frac{1}{2\sqrt{t}} \right\rangle$

#2. $\vec{r}'(t) = \langle t\cos t + \sin t,\ -2t\sin 2t + \cos 2t \rangle$

#3. $\vec{r}'(t) = \langle 0,\ 0,\ 4e^{4t} \rangle$.

#4. $\vec{T}(1) = \left\langle \frac{2}{3}, \frac{2}{3}, \frac{1}{3} \right\rangle$

#5. $\vec{r}'(t) = \langle 1,\ 2t,\ 3t^2 \rangle$

$\vec{T}(1) = \left\langle \frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}} \right\rangle$

$\vec{r}''(t) = \langle 0, 2, 6t \rangle$

$\vec{r}'(t) \times \vec{r}''(t) = \langle 6t^2, -6t, 2 \rangle$

#6. $\begin{cases} x = 3 + t \\ y = 2t \quad -\infty < t < \infty \\ z = 2 + 4t \end{cases}$

#7. $66°$

#8. $\langle 4, -3, 5 \rangle$

13.3

#1. $20\sqrt{29}$

#2. $\vec{r}(s) = \left\langle 2 - \frac{s}{\sqrt{29}},\ 1 - 3\frac{s}{\sqrt{29}},\ 5 + 4\frac{s}{\sqrt{29}} \right\rangle$

#3. $\vec{T}(t) = \left\langle \frac{2}{\sqrt{29}}\cos t,\ \frac{5}{\sqrt{29}},\ \frac{-2}{\sqrt{29}}\sin t \right\rangle$

$\vec{N}(t) = \langle -\sin t,\ 0,\ -\cos t \rangle$

$\kappa = \frac{2}{29}$

#4. $\frac{2}{\left(4t^2+1\right)^{3/2}}$

#5. $\frac{2}{\left(4t^2-8t+5\right)^{3/2}}$

#6. (i) greater at P (ii) $\kappa_P \approx 1.4,\quad \kappa_Q \approx 1$

#7. $\vec{T}(0) = \langle 0,\ 1,\ 0 \rangle$

$\vec{N}(0) = \left\langle \frac{-1}{\sqrt{2}},\ 0,\ \frac{-1}{\sqrt{2}} \right\rangle$

$\vec{B}(0) = \left\langle \frac{-1}{\sqrt{2}},\ 0,\ \frac{1}{\sqrt{2}} \right\rangle$

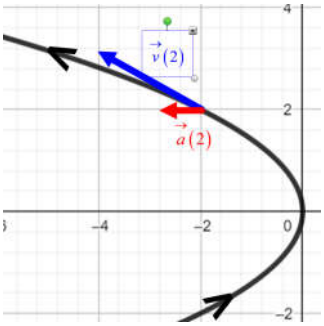
#8. $Normal\ plane: -6x + y = \pi$
$Osculating\ plane: x + 6y = 6\pi$

13.4

#1. $\vec{v}(2) = \langle -2,\ 1 \rangle$

$speed = \sqrt{5}$

$\vec{a}(2) = \langle -1,\ 0 \rangle$



#2. $\vec{v}(t) = \langle 2t,\ 3t^2,\ 2t \rangle$

$speed = \sqrt{9t^4 + 8t^2}$

$\vec{a}(t) = \langle 2,\ 6t,\ 2 \rangle$

#3. $\vec{r}(t) = \left\langle \frac{1}{3}t^3 + t,\ -\sin t + t + 1,\ -\frac{1}{4}\cos 2t + \frac{1}{4} \right\rangle$

#4. $t = 4,$

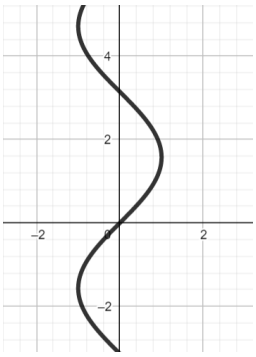
#5. (i) $range = 22092.5\ m$
(ii) $max\ height = 3188.77\ m$
(iii) $speed\ at\ impact = 500.25\ m/s$

#6. $initial\ speed = 29.71\ m/s$

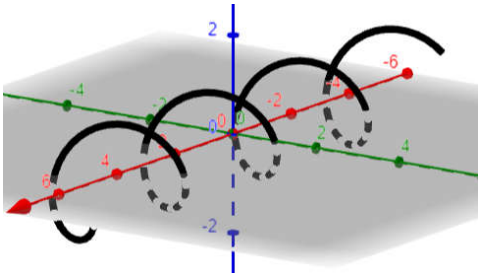
#7. $10°$ *and* $80°$

Ch13 Test Review

#1.



#2.



#3. $\vec{r}(t)=\langle 1+3t,\ -1+2t,\ 2+5t\rangle$

$x=1+3t,\ y=-1+2t,\ z=2+5t$

$0\le t\le 1$

#4. $\vec{r}(t)=\langle t,\ 2t,\ 3t\rangle$

$x=t,\ y=2t,\ z=4t$

$0\le t\le 1$

#5. $\vec{r}(t)=\langle 2\cos t,\ 2\sin t,\ 4\cos t\sin t\rangle$

#6. $\vec{r}(t)=\langle t,\ t^2,\ 4t^2+t^4\rangle$

#7. $\vec{r}(t)=\langle t\cos t+\sin t,\ 2t,\ -2t\sin 2t+\cos 2t\rangle$

#8. $\vec{T}(1)=\left\langle \frac{2}{3},\ \frac{2}{3},\ \frac{1}{3}\right\rangle$

#9. $x=3+t,\ y=2t,\ z=2+4t;\ -\infty<t<\infty$

#10. $\vec{r}(t)=\left\langle t^2,\ t^3,\ \frac{2}{3}t^{3/2}-\frac{2}{3}\right\rangle$

#11. $\vec{r}(t)=\left\langle \frac{1}{2}t^2+1,\ e^t,\ te^t-e^t+2\right\rangle$

#12. $\frac{7}{3}$

#13. $\frac{1}{27}\left(\left(\sqrt{13}\right)^2-8\right)\approx 1.4397$

#14. 1.27798

#15. $\frac{\sqrt{76}}{14\sqrt{14}}\approx 0.1664$

#16. $\vec{T}(t)=\frac{1}{\sqrt{29}}\langle 2\cos t,\ 5,\ -2\sin t\rangle$

$\vec{N}(t)=\langle -\sin t,\ 0,\ -\cos t\rangle$

$\kappa=\frac{2}{29}$

#17. $\vec{T}(t)=\frac{1}{\sqrt{1+5t^2}}\langle 1,\ t,\ 2t\rangle$

$\vec{N}(t)=\frac{1}{\sqrt{25t^2+5}}\langle -5t,\ 1,\ 2\rangle$

$\kappa=\frac{\sqrt{25t^2+5}}{\left(1+5t^2\right)^2}$

#18. $x+2y+3z=6$

#19. $\vec{v}(t)=\langle 2t,\ 3t^2,\ 2t\rangle$

$speed=\sqrt{8t^2+9t^4}$

$\vec{a}(t)=\langle 2,\ 6t,\ 2\rangle$

#20. $\vec{v}(t)=\langle \sqrt{2},\ e^t,\ -e^{-t}\rangle$

$speed=\sqrt{2+e^{2t}+e^{-2t}}$

$\vec{a}(t)=\langle 0,\ e^t,\ e^{-t}\rangle$

#21. (i) $range=22433.6\ m$

(ii) $max\ height=3388.7\ m$

(iii) $speed\ at\ impact=503.6\ m/s$

#22. $29.71\ m/s$

#23. $\kappa_{(3,0)} = 0.1875,\ \kappa_{(0,4)} = 0.4444$

#24. (i) 60.8 *ft downrange*, 3.81 *ft above ground*
(ii) *max height* = 21.44 *ft*
(iii) 64.09 *ft downrange*