13.2 3, 9, 15, 19, 25, 33, 45, 51

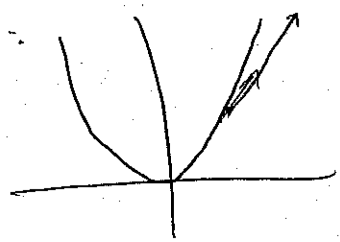
<u>3</u> Do it componentwise.

$$\lim_{t\to 0} \langle e^{2t}, \ln(t+1), 4\rangle = \langle 1, 0, 4\rangle$$

<u>9</u> Do it componentwise

$$\vec{r}\,'(s) = \langle 3e^{3s}, -e^{-s}, 4s^3\rangle$$

<u>15</u> $\vec{r}(t) = \langle t, t^2\rangle$:



~~$r'(t) =$~~

tangent vector at $t=1 \Rightarrow r'(1) = \langle 1, 2\rangle$

$\vec{r}(t) = \langle t^3, \cancel{6t^5}\ t^6\rangle$ $\quad \vec{r}\,'(t) = \langle 3t^2, 6t^5\rangle$ @ $t=1$ $\langle 3, 6\rangle$

Same direction but second is much longer.

<u>19</u>

$$\frac{d}{dt}\left(r_1(t) \times r_2(t)\right) = \left[r_1(t) \times r_2'(t)\right] + \left[r_1'(t) \times r_2(t)\right]$$

$r_1(t) = \langle t^2, t^3, t\rangle \quad r_1'(t) = \langle 2t, 3t^2, 1\rangle$

$r_2(t) = \langle e^{3t}, e^{2t}, e^t\rangle \quad r_2'(t) = \langle 3e^{3t}, 2e^{2t}, e^t\rangle$

$$\det\begin{pmatrix} i & j & k \\ t^2 & t^3 & t \\ 3e^{3t} & 2e^{2t} & e^t \end{pmatrix} + \det\begin{pmatrix} i & j & k \\ 2t & 3t^2 & 1 \\ e^{3t} & e^{2t} & e^t \end{pmatrix} =$$

$i\left(t^3e^t - 2te^{2t}\right)$
$-j\left(t^2e^t - 3te^{3t}\right) + k\left(2t^2e^{2t} - 3t^3e^{3t}\right)$
$+ i\left(3t^2e^t - e^{2t}\right) - j\left(2te^t - e^{3t}\right)$
$+ k\left(2te^{2t} - 3t^2e^{3t}\right)$

$= \ldots$

25

$$\frac{d}{dt}\vec{r}(g(t)) = g'(t)\, r'(g(t))$$

$$= 4\, r'(4t+9\rangle$$

$$= 4\left\langle e^{4t+9},\ 2e^{8t+18},\ 0\right\rangle.$$

33 $r'(s)$ at $s=2$ = $\left\langle \frac{-4}{s^2}, 0, \frac{+8}{s^4}\right\rangle$ at $s=2$

$$= \left\langle -1, 0, \tfrac{1}{2}\right\rangle.$$

For a line I need a point & a vector. The tangent vector I just found is the vector and the point is $r(2)$:

$$\left\langle \tfrac{4}{2}, 0, \tfrac{-1}{3}\right\rangle.$$

So the line is $\vec{r}(t) = \langle 2, 0, -\tfrac{1}{3}\rangle + t\langle -1, 0, \tfrac{1}{2}\rangle.$

45 $\vec{R}(t) = \left\langle \ln t,\ \frac{8}{3}t^{3/2},\ -\frac{16}{5}t^{5/2}\right\rangle$

I want

$$\vec{R}(4) - \vec{R}(1) = \left\langle \ln 4, \frac{64}{3}, \frac{-512}{5}\right\rangle - \left\langle 0, \frac{8}{3}, \frac{-16}{5}\right\rangle$$

$$= \left\langle \ln 4, \frac{56}{3}, \frac{-496}{5}\right\rangle$$

31

$r''(t) = 16k$, $\vec{v}(0) = \langle 1,0,0\rangle$, $\vec{v}'(0) = \langle 0,1,0\rangle$

$r'(t) = \langle c_1, c_2, 16t + c_3\rangle$

2 $\Rightarrow$ $c_1, c_3 = 0$, $c_2 = 1$

$r'(t) = \langle 0, 1, 16t\rangle$

$r(t) = \langle c_1, t + c_2, 8t^2 + c_3\rangle$

~~r(0) =~~

1 $\Rightarrow$ $c_1 = 1$, $c_2 = 0$, $c_3 = 0$

So

$r(t) = \langle 1, t, 8t^2\rangle$

~~w/o initial conditions~~