1. $\bar{r}(t) = t^2 \bar{i} + \sin 2t \, \bar{j} + \cos 2t \, \bar{k}$

$\bar{r}'(t) = 2t \bar{i} + 2\cos 2t \, \bar{j} - 2\sin 2t \, \bar{k}$

$\|\bar{r}'(t)\| = \sqrt{4t^2 + 4} = 2\sqrt{t^2+1} = \dfrac{ds}{dt}$

$$\bar{T}(t) = \frac{\bar{r}'(t)}{\frac{ds}{dt}} = \frac{t}{\sqrt{t^2+1}} \bar{i} + \frac{\cos 2t}{\sqrt{t^2+1}} \bar{j} - \frac{\sin 2t}{\sqrt{t^2+1}} \bar{k}$$

$$\bar{T}'(t) = \frac{(t^2+1)^{\frac{1}{2}} - t \frac{1}{2}(t^2+1)^{-1/2} 2t}{t^2+1} \bar{i} + \frac{-2\sin 2t \sqrt{t^2+1} - \cos 2t \frac{1}{2}(t^2+1)^{-\frac{1}{2}} 2t}{t^2+1} \bar{j}$$

$$- \frac{2\cos 2t \sqrt{t^2+1} - \sin 2t \frac{1}{2}(t^2+1)^{-1/2} 2t}{t^2+1} \bar{k}$$

$$= \frac{1}{(t^2+1)^{3/2}} \bar{i} + \frac{-2(t^2+1)\sin 2t - t\cos 2t}{(t^2+1)^{3/2}} \bar{j} - \frac{2(t^2+1)\cos 2t - t\sin 2t}{(t^2+1)^{3/2}} \bar{k}$$

$$\|\bar{T}'(t)\| = \frac{1}{(t^2+1)^{3/2}} \sqrt{1 + 4(t^2+1)^2 + t^2} = \frac{\sqrt{(1+t^2)(1+4(t^2+1)}}{(t^2+1)^{3/2}}$$

$$\mathcal{K} = \frac{\|\bar{T}'(t)\|}{\frac{ds}{dt}} = \frac{\frac{\sqrt{5+4t^2}}{(t^2+1)}}{2\sqrt{t^2+1}} = \frac{1}{2} \frac{\sqrt{5+4t^2}}{(t^2+1)^{3/2}}$$

$\bar{r}'(t) = \langle 2t, 2\cos 2t, -2\sin 2t \rangle$

$\bar{r}''(t) = \langle 2, -4\sin 2t, -4\cos 2t \rangle$

$\|\bar{r}'' \times r'\| = \sqrt{64 + 64t^2 + 16}$

$= 4\sqrt{5+4t^2}$

$$\bar{r}'' \times \bar{r}' = \begin{vmatrix} \bar{i} & \bar{j} & \bar{k} \\ 2t & 2\cos 2t & -2\sin 2t \\ 2 & -4\sin 2t & -4\cos 2t \end{vmatrix} = \bar{i}(-8) - \bar{j}(-8t\cos 2t + 4\sin 2t) + \bar{k}(-8t\sin 2t - 4\cos 2t)$$

2. $\bar{r}(t) = t\cos t\,\bar{\imath} - t\sin t\,\bar{\jmath} + t^2\bar{k}$

$$\bar{r}'(t) = (\cos t - t\sin t)\bar{\imath} + (-\sin t - t\cos t)\bar{\jmath} + 2t\bar{k}$$

$$\|\bar{r}'(t)\| = \left(\cos^2 t - 2t\cos t\sin t + t^2\sin^2 t + \sin^2 t + 2t\cos t\sin t + t^2\sin^2 t + 4t^2\right)^{\frac{1}{2}}$$

$$= \sqrt{1+5t^2} = \frac{ds}{dt}$$

$$\bar{T}(t) = \frac{\cos t - t\sin t}{\sqrt{1+5t^2}}\bar{\imath} - \frac{\sin t + t\cos t}{\sqrt{1+5t^2}}\bar{\jmath} + \frac{2t}{\sqrt{1+5t^2}}\bar{k}$$

$\bar{T}'(t) =$ UGH!

$$\bar{r}''(t) = (-\sin t - \sin t - t\cos t)\bar{\imath} + (-\cos t - \cos t + t\sin t)\bar{\jmath} + 2\bar{k}$$

$$= (-2\sin t - t\cos t)\bar{\imath} + (-2\cos t + t\sin t)\bar{\jmath} + 2\bar{k}$$

$$\bar{r}' \times r'' = \begin{vmatrix} \bar{\imath} & \bar{\jmath} & \bar{k} \\ \cos t - t\sin t & -\sin t - t\cos t & 2t \\ -2\sin t - t\cos t & -2\cos t + t\sin t & 2 \end{vmatrix}$$

$$= \bar{\imath}\left(-2\sin t + 2t\cos t - 2t^2\sin t\right) - \bar{\jmath}\left(2\cos t + 2t\sin t + 2t^2\cos t\right) + \bar{k}\left(-2 - t^2\right)$$

$$\kappa = \frac{\|\bar{r}' \times \bar{r}''\|}{\left(\frac{ds}{dt}\right)^3} = \frac{\sqrt{8 + 16t^2 + 5t^4}}{(1+5t^2)^{3/2}}$$