

$$1a) \vec{r}(t) = (t^3 + 1, e^{-t}, 2t^2)$$

$$b) \vec{r}'(t) = (3t^2, -e^{-t}, 4t)$$

$$c) \vec{r}''(t) = (6t, e^{-t}, 4)$$

$$d) \langle \vec{r}(t), \vec{r}'(t) \rangle = (t^3 + 1) \cdot 3t^2 - e^{-2t} + 8t^3 \\ = 3t^5 + 3t^2 + 8t^3 - e^{-2t}$$

$$e) \langle \vec{r}'(t), \vec{r}''(t) \rangle = 18t^3 - e^{-2t} + 16t$$

$$2. \int_0^1 te^t \hat{i} - \sin t \hat{j} + \frac{1}{1+t^2} \hat{k} dt$$

$$= \left(te^t \Big|_0^1 - e^t \Big|_0^1 \right) \hat{i} + \cos t \Big|_0^1 \hat{j} + \arctan(t) \Big|_0^1 \hat{k}$$

$$= (e - e + 1) \hat{i} + (\cos 1 - 1) \hat{j} + \arctan 1 \hat{k}$$

$$= \hat{i} + (\cos 1 - 1) \hat{j} + \frac{\pi}{4} \hat{k}$$

$$\left[\text{or } = (1, \cos 1 - 1, \pi/4). \right]$$