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1)  $x = 8t^3$ ,  $y = 4t^3 - 7t$ ,  $z = t + 3$

i) Velocity =  $\frac{dr}{dt}$

$$r = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$$

$$r = 8t^3\mathbf{i} + (4t^3 - 7t)\mathbf{j} + (t + 3)\mathbf{k}$$

$$\frac{dr}{dt} = 24t^2\mathbf{i} + (12t^2 - 7)\mathbf{j} + \mathbf{k}$$

ii) Acceleration =  $\left(\frac{d^2r}{dt^2}\right) = 48t\mathbf{i} + 24t\mathbf{j}$

2)  $T = \frac{dr}{dt}$

$$\left|\frac{dr}{dt}\right|$$

$$r = 3t\mathbf{i} + t^3\mathbf{j} + t^2\mathbf{k}$$

$$\frac{dr}{dt} = 3\mathbf{i} + 3t^2\mathbf{j} + 2t\mathbf{k}$$

$$\left.\frac{dr}{dt}\right|_{t=1} = 3\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$$

$$\left|\frac{dr}{dt}\right| = \sqrt{3^2 + 3^2 + 2^2}$$

$$= \sqrt{9 + 9 + 4}$$

$$\left|\frac{dr}{dt}\right| = \sqrt{22}$$

$$T = \frac{3\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}}{\sqrt{22}}$$