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1. A particle moves along a curve $x = 8t^3$, $y = 4t^3 - 7t$ and $z = t + 3$, where t is time. Find its
① velocity ② acceleration.

① velocity = $\frac{dr}{dt}$

$$r = xi + yj + zk$$

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

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

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

- 2) Find the unit tangent vector to the space curve $x = 3t$, $y = t^3$ and $z = t^2$ at $t = 1$.

$$T = \frac{dr/dt}{|dr/dt|}$$

$$r = 3ti + t^3j + t^2k$$

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

at $t = 1$

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

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

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

$$= \sqrt{22}$$

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