PROB. 13-122

$m = 2\text{ kg}, \quad \vec{F} = (8-6t)\hat{i} + (4-t^2)\hat{j} + (4+t)\hat{k}\ \text{N}$

AT $t=0$, $\vec{v} = (150)\hat{i} + (100)\hat{j} + (-250)\hat{k}\ \frac{m}{s}$

a) FIND t WHERE $\vec{v}_2 = (0)\hat{i} + (v_y)\hat{j} + (v_z)\hat{k}\ \frac{m}{s}$

$$m\vec{v}_1 + \int \vec{F}\,dt = m\vec{v}_2$$

$$\int \vec{F}\,dt = \left(8t - 6\frac{t^2}{2}\right)\hat{i} + \left(4t - \frac{t^3}{3}\right)\hat{j} + \left(4t + \frac{t^2}{2}\right)\hat{k}\ \text{N}\cdot\text{s}$$

$$(2\text{ kg})\left[(150)\hat{i} + (100)\hat{j} + (-250)\hat{k}\ \frac{m}{s}\right]$$

$$+\left[(8t-3t^2)\hat{i} + \left(4t - \frac{1}{3}t^3\right)\hat{j} + \left(4t + \frac{1}{2}t^2\right)\hat{k}\right]$$

$$= (2\text{ kg})\left[(0)\hat{i} + (v_y)\hat{j} + (v_z)\hat{k}\right]\frac{m}{s}$$

X-DIRECTION:

$300 + (8t - 3t^2 = 0, \quad 3t^2 - 8t - 300 = 0$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-8) \pm \sqrt{64 - 4(3)(-300)}}{2(3)}$$

$$t = 1.333 \pm 10.09 \boxed{= 11.42\text{ s}}$$

b) FIND $\vec{v}_2$:

Y-DIRECTION: $200 + \left(4t - \frac{1}{3}t^3\right) = 2v_y$

$$v_y = \frac{1}{2}\left[200 + 4(11.42) - \frac{1}{3}(11.42)^3\right] = -125.5\ \frac{m}{s}$$

Z-DIRECTION: $-500 + \left(4t + \frac{1}{2}t^2\right) = 2v_z$

$$v_z = \frac{1}{2}\left[-500 + 4(11.42) + \frac{1}{2}(11.42)^2\right] = -194.5\ \frac{m}{s}$$

$$\boxed{\vec{v}_2 = (0)\hat{i} + (-125.5)\hat{j} + (-194.5)\hat{k}\ \frac{m}{s}}$$