1. a) Coming to rest means $v=0$, so set $v=0$ and solve for t:

$$0 = A - Bt^2 \Rightarrow t = \sqrt{\frac{A}{B}} = \sqrt{\frac{12\,m/s}{3\,m/s^3}} = \sqrt{4s^2} = 2s$$

b) $$\Delta x = \int_0^{2s} (A - Bt^2)\,dt = \left(At - \frac{Bt^3}{3}\right)\Bigg|_0^{2s} = A(2s) - \frac{B(2s)^3}{3}$$

$$= 12\frac{m}{s}(2s) - \frac{\left(3\frac{m}{s^3}\right)(2s)^3}{3} = 16\,m$$

2. Integrate to get change in velocity.

$$\Delta V = \int_0^t At\,dt = \frac{At^2}{2} = \underbrace{V(t) - V_0}_{\text{definition of } \Delta V}$$

$$\Rightarrow V(t) = \frac{At^2}{2} + V_0$$

so $$\Delta x = \int_0^t \left(\frac{At^2}{2} + V_0\right) dt = \frac{At^3}{6} + V_0 t = \underbrace{X(t) - X_0}_{\text{definition of } \Delta x}$$

$$\Rightarrow X(t) = \frac{At^3}{6} + V_0 t + X_0$$

$$X(20s) = \frac{(2\,m/s^3)(20s)^3}{6} + \left(-50\frac{m}{s}\right)(20s) + 2000\,m$$

$$= 3667\,m$$