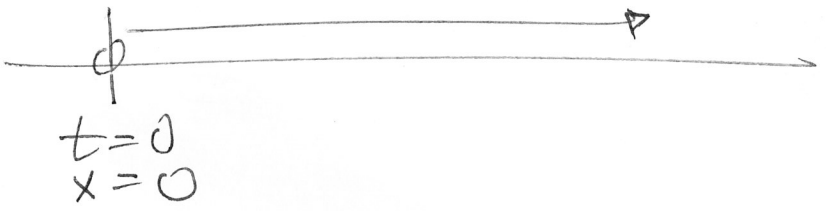
Given: metallic particle accelerated so that

$$v(t) = 4t^2 - 12$$



Req'd: $a(t), s(t)$, + units.

Assumptions: Straight line motion.

Strategy: I know $v(t) \Rightarrow$ integrate and differentiate to find other kinematic variables.

Estimate: given that $v(t) = \mathcal{O}t^2 \Rightarrow a = \frac{dv}{dt} = \mathcal{O}t$ = linear.

$s(t) = \int v(t)\,dt = \mathcal{O}t^3$

↳ this symbol means "order" as in power.

Soln: Units:

$v(t)\left[\frac{m}{s}\right] = 4t^2 - 12$

↳ must be m/s

↳ $4t^2 = m/s = (\quad)s^2 \Rightarrow \left(\frac{m}{s^3}\right)s^2$

$\Rightarrow$ 4 has units of $\boxed{m/s^3}$

$$a(t) = \frac{d}{dt}(v(t)) = \frac{d}{dt}(4t^2 - 12) = 8t = 8\frac{m}{s^3} \cdot t$$

↳ has units of m/s^2

$$\boxed{a(t) = 8t \ m/s^2} = 8\frac{m}{s^3} t$$

$$s(t) = \int_{t_0}^{t} v(t)\,dt = \int_0^t (4t^2 - 12)\,dt = \frac{4t^3}{3} - 12t \Big|_0^t$$

$$\boxed{s(t) = 1.33t^3 - 12t} \text{ (units are all m!)}$$

$$= 1.33\frac{m}{s^3}t^3 - 12\frac{m}{s}t$$

$s(t=0) = 0$ ✓ checks.

Discussion

Matches general expectations of estimate and units work. I'm intrigued by the question of what would have happened if $s(t=0) = 1m$. Probably should have integrated as follows.

$$\int_{t=0}^{t} (4t^2 - 12)\,dt = \frac{4t^3}{3} - 12t + C \Big|_0^t = \frac{4t^3}{3} - 12t + \cancel{C} - \cancel{C}$$

cancels