Particle Motion (on a line)

displacement function: $s(t)$ or $x(t)$

velocity function: $v(t) = \frac{ds}{dt} = s'(t)$

acceleration function: $a(t) = \frac{dv}{dt} = v'(t)$

Ex. A particle moving on a line such that $v(t) = 9 - t^2$, $t \geq 0$. At time $t = 4$, the particle is at $x = 10$.

(a) Where is the particle at time $t = 0$?

(b) Is the particle's speed increasing or decreasing when $t = 4$?

(c) Find the distance travelled by the particle in the 1st ten seconds.

(a) $s(t) = \int v(t)\,dt$

$= \int (9 - t^2)\,dt$

$= 9t - \frac{1}{3}t^3 + C$

$s'(4) = 9(4) - \frac{1}{3}(4)^3 + C = 10$

$C = -\frac{14}{3}$

$$s(t) = 9t - \frac{1}{3}t^3 - \frac{14}{3}$$

$$s(0) = -\frac{14}{3}$$

$F = ma$

↑ pulling left ↑ neg

(b) $a(t) = \frac{d}{dt}\left[v(t)\right] = -2t$

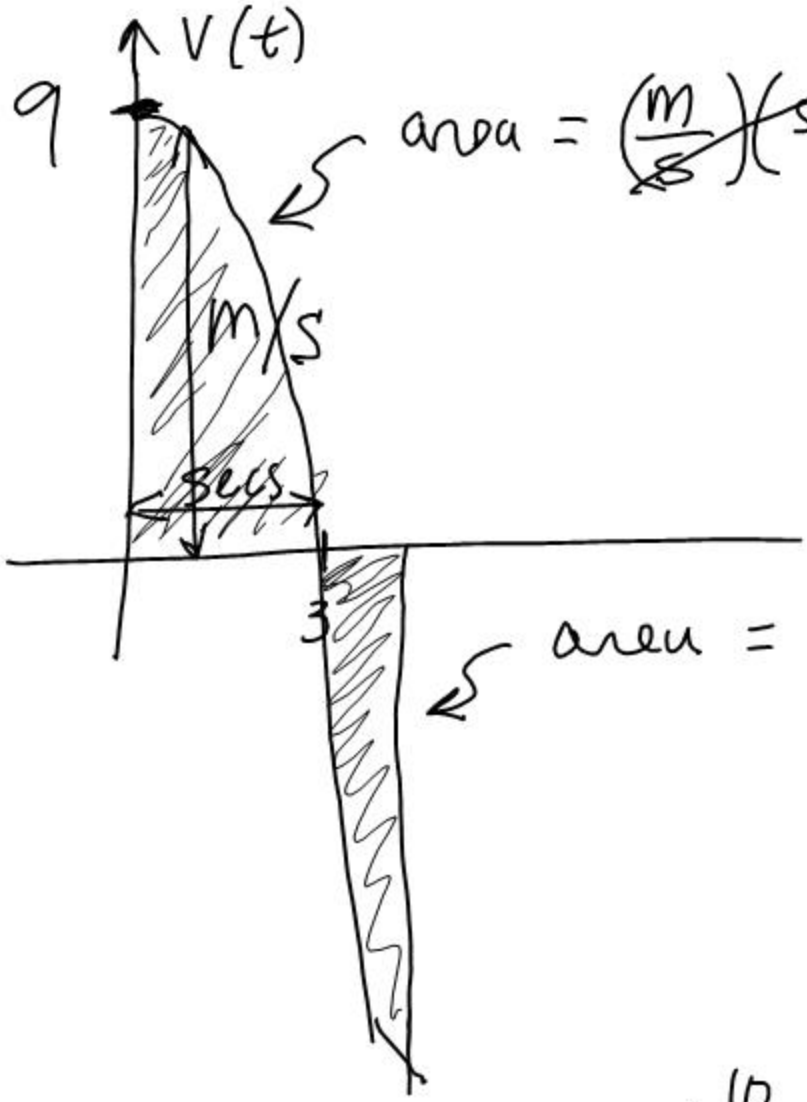
$a(4) = -8$ ← force pulling left

$v(4) = 9 - (4)^2 = -7$ ← moving left

same sign

The particle's speed is increasing.

(c)



area = $\frac{m}{\cancel{s}}(\cancel{s})$ = distance or displacement

area = displacement only

distance travelled = $\int_0^{10} |9-t^2|\,dt = 279$

displacement = $\int_0^{10} (9-t^2)\,dt = -243$

$\frac{m}{s} \cdot s = m$