29:011 Sum 2013
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Motion in One Dimension

Object is at x_0 at $t = 0$

1) Constant velocity v_0

$$x = x_0 + v_0 t$$

2) Constant acceleration a

Velocity at $t = 0$ is v_0

$$v = v_0 + a t$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

If t is eliminated:

$$v^2 = v_0^2 + 2a(x - x_0)$$

GET EQ 2.9 FROM 2.4 AND 2.8

$$x = v_0 t + \frac{1}{2} a t^2 \qquad (2.8)$$

$$v = v_0 + at \qquad (2.4)$$

Solve 2.4 for t: $v - v_0 = at$

$$\Rightarrow \quad t = (v - v_0)/a$$

put this into (2.8)

$$x = v_0\left(\frac{v - v_0}{a}\right) + \frac{1}{2}a\left(\frac{v - v_0}{a}\right)^2$$

$$= \frac{v_0 v - v_0^2}{a} + \frac{1}{2}a\left(\frac{v^2 - 2v_0 v + v_0^2}{a^2}\right)$$

FACTOR a OUT

$$= \frac{1}{a}\left[v_0 v - v_0^2 + \frac{v^2}{2} - v_0 v + \frac{v_0^2}{2}\right]$$

COMBINE $= -v_0^2/2$

$$x = \frac{1}{a}\left[-\frac{v_0^2}{2} + \frac{v^2}{2}\right] = \frac{1}{2a}\left(v^2 - v_0^2\right)$$

(X) by $2a$ on both sides: $2ax = v^2 - v_0^2$

OR $\boxed{v^2 = v_0^2 + 2ax}$ (2.9)