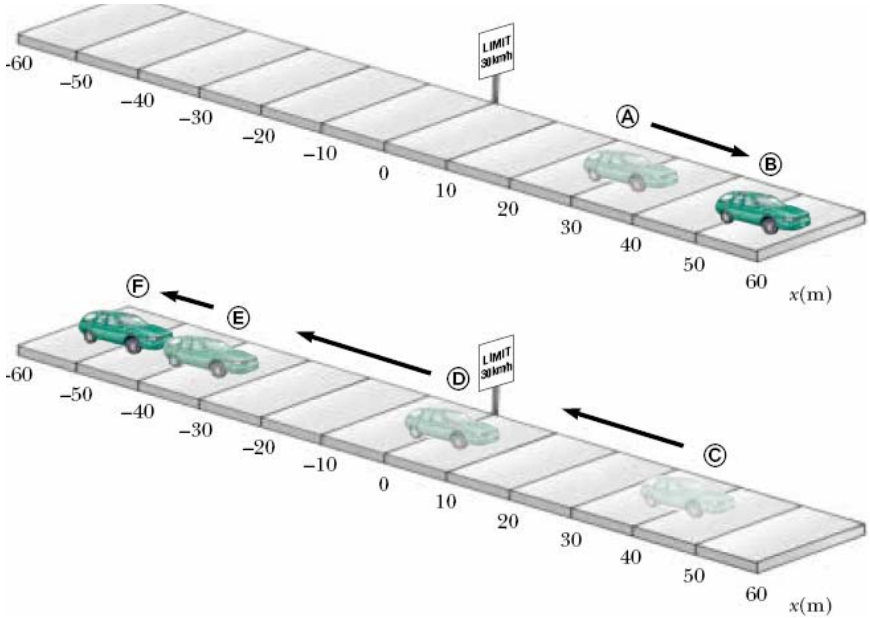
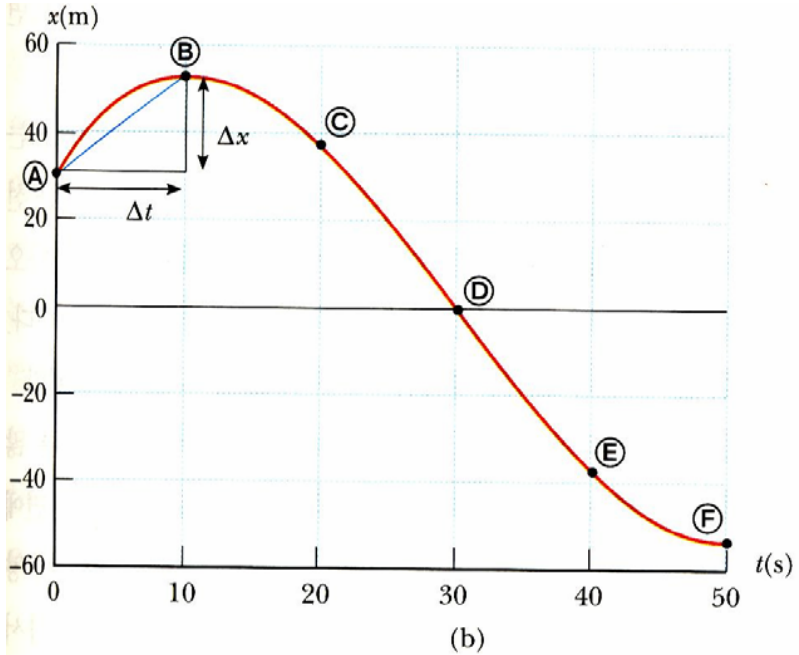
# 제2장 1 차원(직선) 운동




## 2-1 변위($\Delta x$) 와 평균속도($v$)

$$\text{평균속도 } \bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

$$\text{전체평균속도} = \frac{\text{전체거리}}{\text{전체시간}}$$

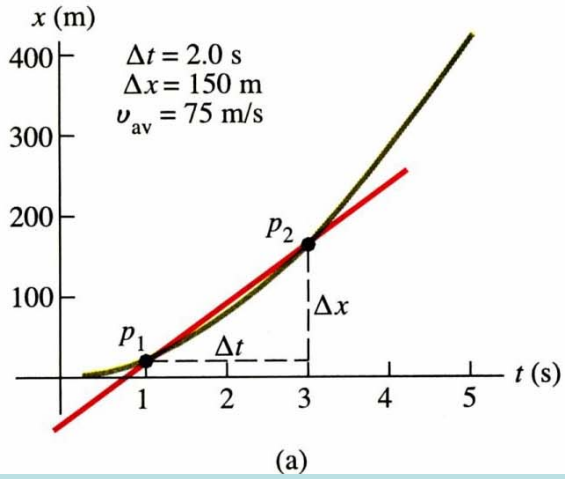
## 2-2 순간 속도($v$)와 속력

$$\text{순간속도 } v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

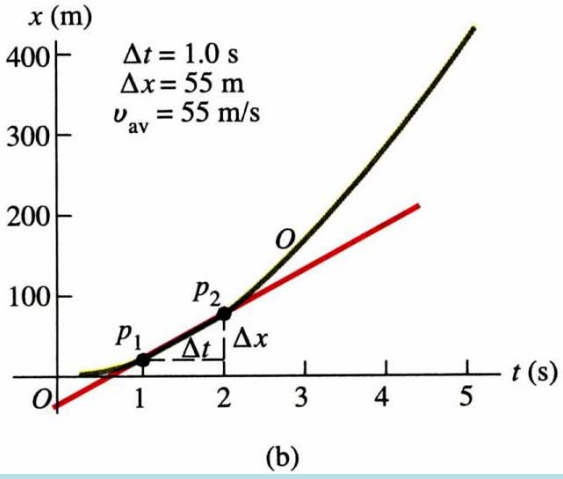
$$\text{순간속력} = |\vec{v}| : \text{속도의 크기(스칼라)}$$

• $x-t$ 그래프에서 속력 = 기울기

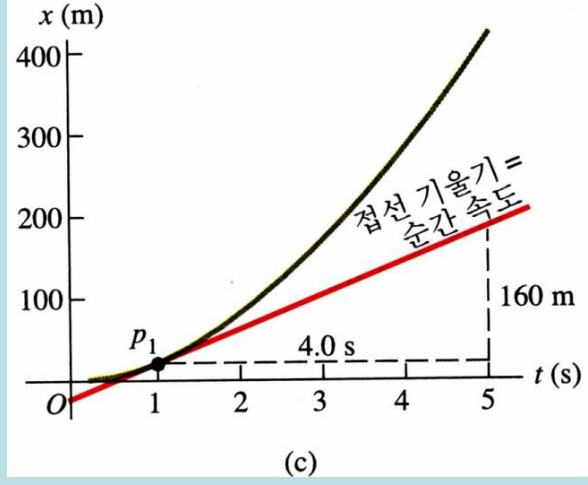
순간속도 $v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$



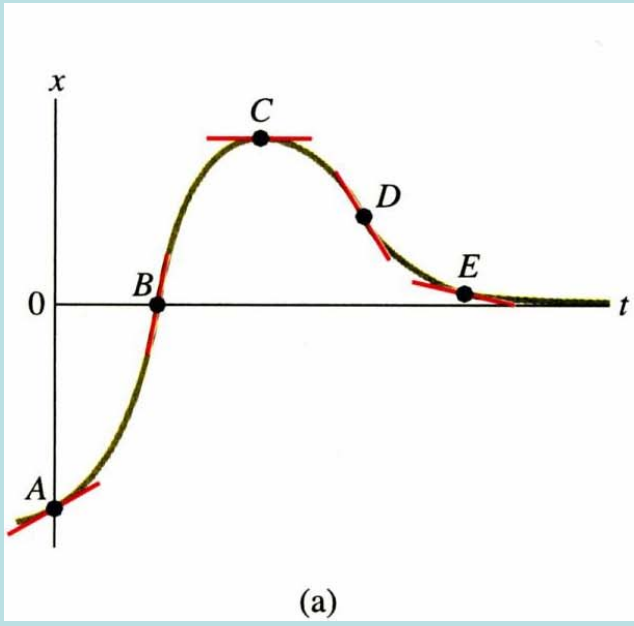

(a)



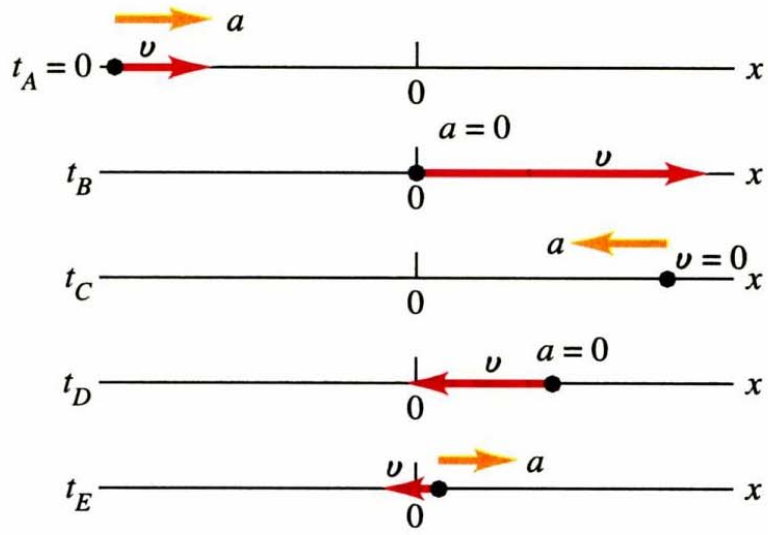

(b)




(c)

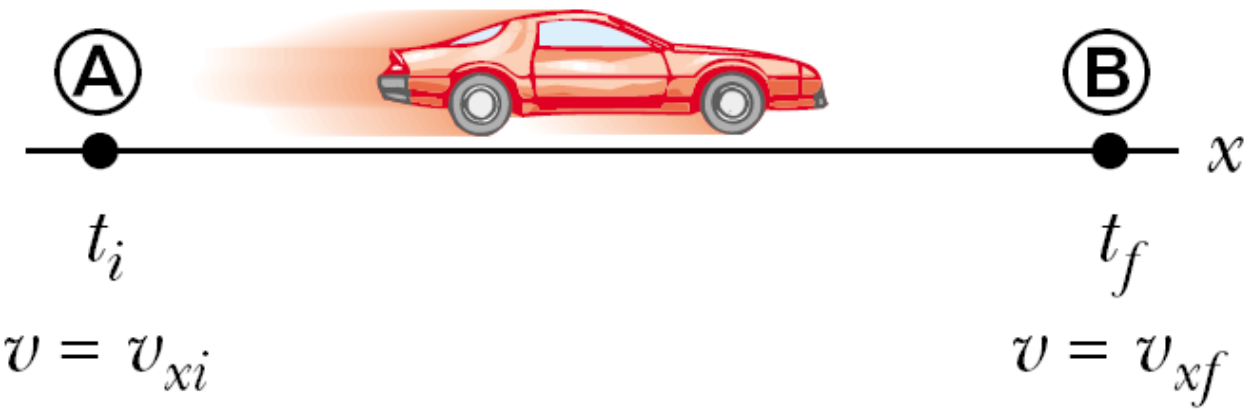



(a)




(b)

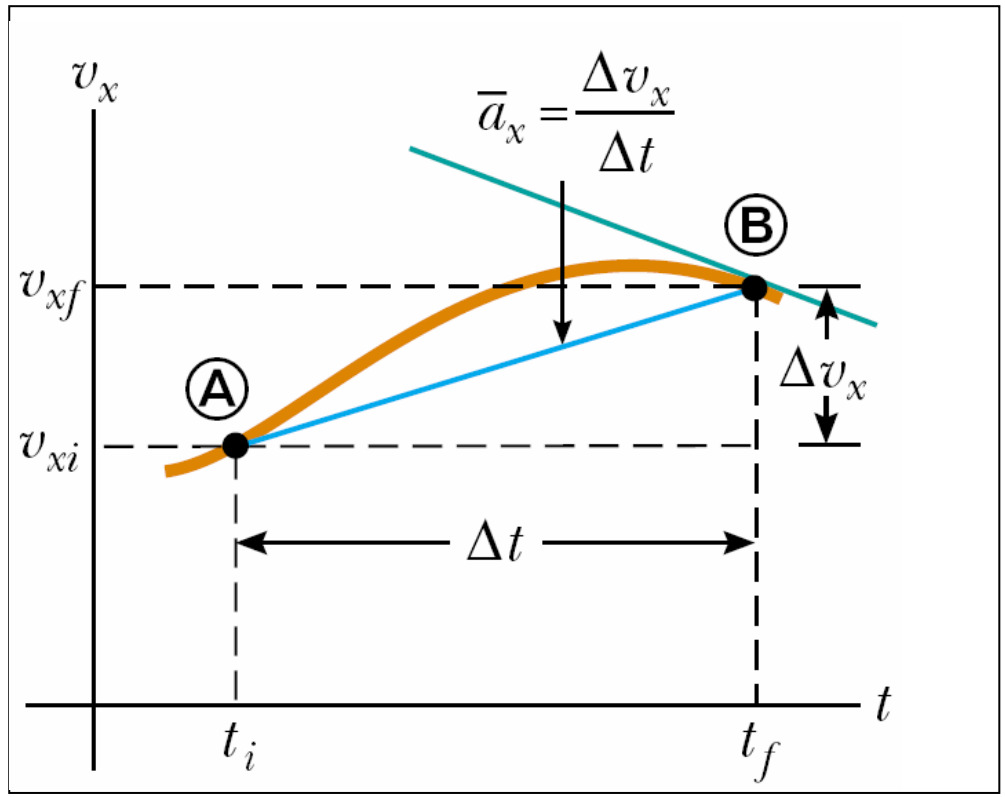
# 2-3 가속도 (평균가속도와 순간가속도)




평균가속도 $\bar{a} = \dfrac{\Delta v}{\Delta t} = \dfrac{v_f - v_i}{t_f - t_i}$

순간가속도 $a = \lim\limits_{\Delta t \to 0} \dfrac{\Delta v}{\Delta t} = \dfrac{dv}{dt}$

$= \dfrac{d}{dt}\left(\dfrac{dx}{dt}\right) = \dfrac{d^2x}{dt^2}$



# 2-4 등가속도 운동 (예: 자유낙하)

$t_1 = 0;\ v_0 \ \Rightarrow\ t_2 = t;\ v$

평균가속도 $\bar{a} = \dfrac{v - v_0}{t - 0} = \dfrac{v - v_0}{t} = a$

$\therefore v = v_0 + at$ ----(1)

$t = 0;\ x_0 \ \Rightarrow\ t = t,\ x$

평균속도 $\bar{v} = \dfrac{x - x_0}{t - 0} = \dfrac{x - x_0}{t}$ --(2)

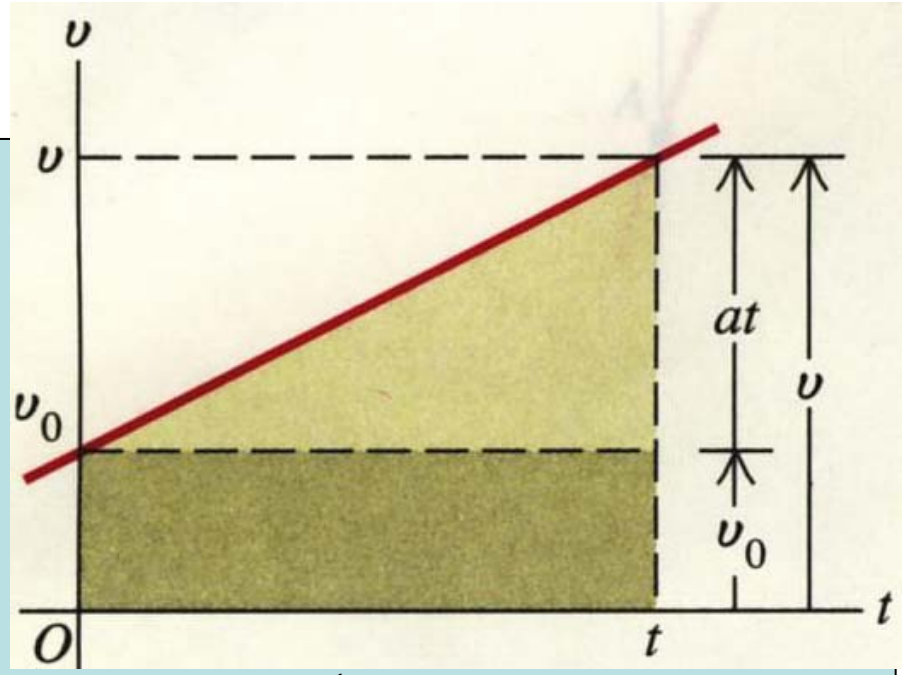
산술평균속도 : $\tilde{v} = \dfrac{v + v_0}{2}$

$\bar{v} = \tilde{v}$ $\Leftarrow$(등가속도운동에서만 성립)

$\bar{v} = \dfrac{1}{2}(v_0 + at + v_0) = v_0 + \dfrac{1}{2}at$ --(3)

(2) = (3) 이므로

$\dfrac{x - x_0}{t} = v_0 + \dfrac{1}{2}at$




$x = x_0 + v_0 t + \dfrac{1}{2}at^2$ ---(4)

(4)식에 $t = \dfrac{v - v_0}{a}$ 를 대입하면

$x = x_0 + v_0\left(\dfrac{v - v_0}{a}\right) + \dfrac{1}{2}a\left(\dfrac{v - v_0}{a}\right)^2$

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

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

$2a\Delta x = v^2 - v_0^2$ ------(5)

<적분을 이용한 풀이>

등가속도=$a$, $t_1=0;\ x_0, v_0 \rightarrow t_2=t;\ x, v$

A..속도($v$)계산

$$\frac{dv}{dt}=a$$

$$dv=adt$$

$$\int_{v_0}^{v} dv=\int_0^t adt=a\int_0^t dt=at$$

$$v-v_0=at$$

$$\therefore v=v_0+at \text{ ---------(1)}$$

B..거리($x$)의계산

(1)식에서

$$\frac{dx}{dt}=v_0+at$$

$$dx=v_0dt+(at)dt$$

$$\int_{x_0}^{x} dx=v_0\int_0^t dt+a\int_0^t tdt$$

$$x-x_0=v_0t+\frac{1}{2}at^2$$

$$x=x_0+v_0t+\frac{1}{2}at^2 \text{ ----(2)}$$

C..거리($x$)와 속도($v$)의 관계식

(1)에서 $t=\frac{v-v_0}{a}$를 (2)에 대입하면

$$x=x_0+v_0\left(\frac{v-v_0}{a}\right)+\frac{1}{2}a\left(\frac{v-v_0}{a}\right)^2$$

$$2a(x-x_0)=2v_0v-2v_0^2+v^2-2v_0v+v_0^2$$

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

$$2a\Delta x=v^2-v_0^2 \text{ ------(3)}$$

## 2-5 자유낙하 (g = 9.8 m/s², 일정)

$t = 0;\ v_0 = 0,\ y_0 = 0$

$t = t;\ \ v = ?,\ y_0 = ?$

- 속도$(v) = v_o + at,\ \ a = -g$

$v = v_0 - gt \text{ -------- } (1)$

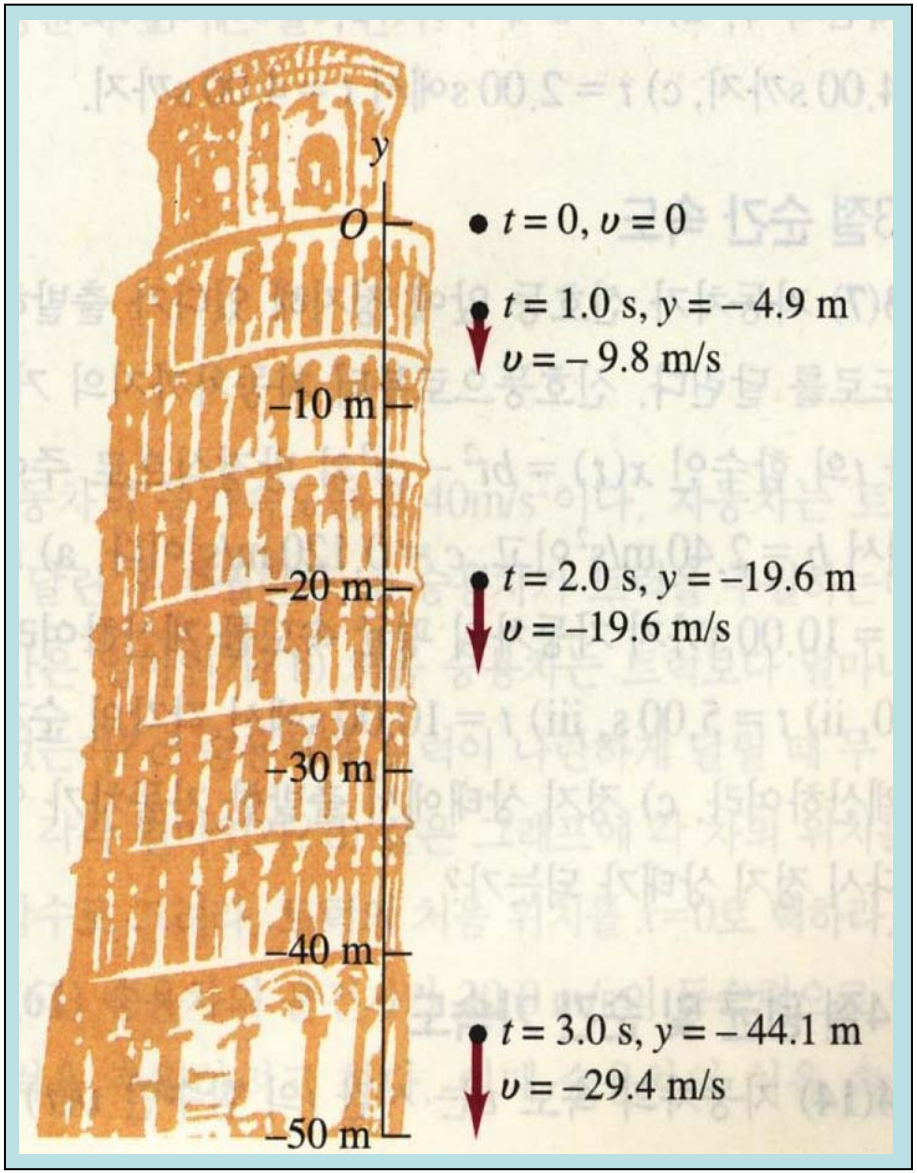
$v = -gt$

$v = -9.8(m/s^2)t = -9.8t\ (m/s^2)$

- 거리$(y) = y_0 + v_0 t + \frac{1}{2}at^2$

$y = y_0 + v_0 t - \frac{1}{2}gt^2 \text{ ----- } (2)$

$y = -\frac{1}{2}(9.8)(m/s^2)t^2 = -4.9t^2\ (m/s^2)$



# 낙하 운동 (동영상)