التاريخ / / ٢٠١

الموضوع :

Motion in one dimention

(1) Statics : it is that part of mechanic which deals with condition under which the objects remains and rest.

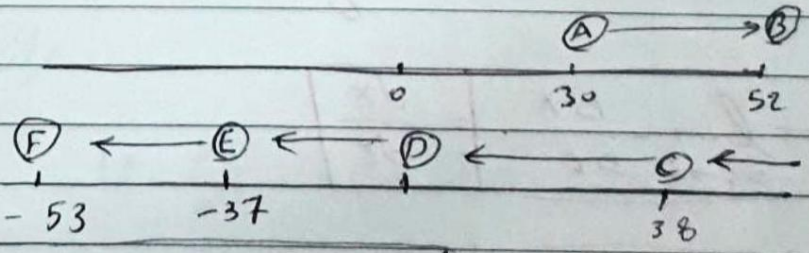
(2) Dynamic : it is that part of Mechanic which deals with physical causes of motion.

(3) Kinematics : it is that part of mechanic which deals with the description of motion.

Ex1

Position	t (s)	x (m)
A	0	30
B	10	52
C	20	38
D	30	0
E	40	-37
F	50	-53

Speed → distance



$$v_{avg.\ A\to B} = \frac{x_f - x_i}{t_f - t_i}$$

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سرعة ← Velocity ← إزاحة / الزمن
إنطلاق ← Speed ← مسافة / الزمن

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~~Speed average~~

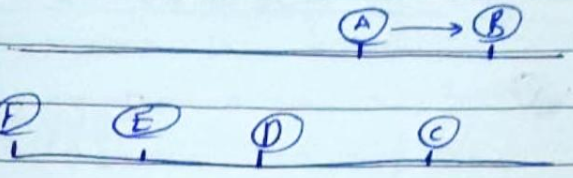
$V_{avg}^{A \to B} = \frac{52 - 30}{10 - 0} = 2.2 \ m/s$

Velocity average

$V_{avg} = \frac{52 - 30}{10 - 0} = 2.2 \ m/s$

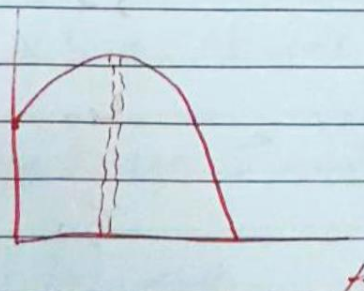
$V_{avg\ A \to F} = \frac{127}{50} = 0 \ m/s$

$V_{avg_{A \to F}} = \frac{-83}{50} = 0 \ m/s$



$V_s = \frac{distance}{time} = \frac{d}{\Delta t}$

$V = \frac{displacement}{time}$ ⊖



$V = \frac{\Delta x}{\Delta t}$

$= \frac{x_2 - x_1}{t_2 - t_1}$

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

$$v = \frac{dx}{dt}$$

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$V_{x_{avg}}$ Velocity

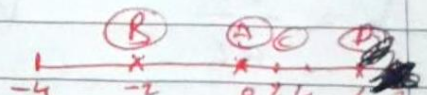
V_{avg} speed

instantaneous velocity ≠ instantaneous speed

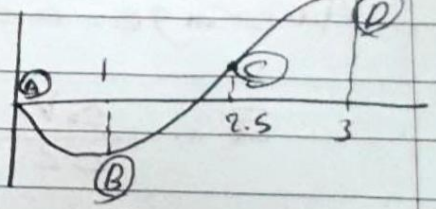
Because of (velocity) has unit vector

ex: 2.3 . p.27

$$\boxed{X = -4t + 2t^2}$$



(A) $t=0 \xrightarrow{to} t=1$ and $t=1 \xrightarrow{to} t=3.5$



disp.? $\Delta X = X_f - X_i$.

$$\Delta X_{A\to B} = X_f - X_i = [-4(1)+2(1)^2] - [-4(0)+2(0)^2] = -2m$$

$$\Delta X_{B-D} = X_f - X_i = [-4(3)+2(3)^2] - [-4(1)+2(1)^2] = +8m$$

(B) Velocity

$$v = \frac{dx}{dt} = -4 + 2(2t) = -4 + 4t \xrightarrow{\text{at } t=0}$$

or: $v = \frac{dx}{dt} \Rightarrow \frac{\Delta X_{A\to B}}{\Delta t_{A\to B}} = \frac{-2}{1-0} = -2\ m/s$

$\frac{\Delta X_{B\to D}}{\Delta t} = \frac{+8}{3-1} = 4\ m/s$

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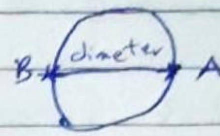
التاريخ / / ٢٠١   الموضوع :

ملاحظة: بطريقة [اشتقاق ← تعويض] ← السرعة اللحظية او الانطلاق اللحظي
[instantinens]

Motion in Two Dimention (circular round)

speed $\Rightarrow$ $V_\ell = \dfrac{2\pi r}{\Delta t}$

velocity $\Rightarrow$ $V_x = \dfrac{\text{dimeter}}{\Delta t}$



instantaneous Velocity

$V_x = \dfrac{dx}{dt}$ $\quad V_x = \lim\limits_{\Delta t \to 0} \dfrac{\Delta X}{\Delta t} = \dfrac{dx}{dt}$

displacement → velocity → acceleration
تعجيل ← سرعة ← ازاحة

Average acceleration

$$\bar{a} = \frac{\Delta V_x}{\Delta t} = \frac{V_2 - V_1}{t_2 - t_1}$$

instantaneous accelaration

$$a = \frac{\Delta V}{\Delta t}$$

$$a_{ins} = \lim_{\Delta t \to 0} \frac{\Delta V}{\Delta t} = \frac{dV}{dt}$$

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Linear motion with cons. acc.

$$a = \frac{dv}{dt} \qquad (a = Cons.)$$

$$\int dv = \int a\,dt = V = at + C_1$$

when $t = 0$, $v = V_0$

$$V_0 = a(0) + C_1 \Rightarrow C_1 = V_0$$

$$V = at + V_0$$

$$\boxed{V = V_0 + at} \quad \text{——} \quad (1)$$

$$\boxed{V = \frac{dx}{dt}}$$

$$\frac{dx}{dt} = V_0 + at$$

$$\int dx = \int v_0\,dt + \int at\,dt$$

$$X = V_0 t + \frac{1}{2} a t^2 + C_2$$

when $X = 0$, $t = 0 \Rightarrow C_2 = 0$

$$\boxed{X = V_0 t + \frac{1}{2} a t^2} \quad \text{——} \quad (2)$$

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

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

$$a = v \frac{dv}{dx} \Rightarrow \int v\,dv = \int a\,dx$$

$$\frac{v^2}{2} = ax + C_3$$

$V = V_o$ then $X = 0$

$$\frac{V_o^2}{2} = 0 + C_3 \Rightarrow C_3 = \frac{V_o^2}{2}$$

$$\frac{v^2}{2} = ax + \frac{V_o^2}{2}$$

$$\boxed{V^2 = V_o^2 + 2aX} \quad (3)$$

Uniform motion

V = Cons. then a = zero

$$X = V_o t$$

$V_o = V_{ins} = V_{avg} = V$

$$V = \frac{X}{t}$$

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ex: $x = 50t + 10t^2$

(a) calculat the average velocity of a particle during the ~~first~~ first 3 sec

(b) calculat the ins. vel. at $t=3s$

(c) calculat the ins. acc^n at $t=3s$

slove

(a) $x_f = 50(3) + 10(3)^2 = 240$

$x_i = 50(0) + 10(0)^2 = 0$

$$v_{avg.} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{240 - 0}{3 - 0}$$

$$= \boxed{80 \text{ cm/s}}$$

(b) $$v = \frac{dx}{dt} = 50 + 20t \quad \text{in } t=3 \text{ sec}$$

$$V = 50 + 20(3) = 110 \text{ m/s}$$

(c) $$a = \frac{dv}{dt}$$

$$= 20 \text{ m/s}^2$$

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ex $V_x = 40 - 5t^2$

(a) find the average acc^n in the time interval (فترة زمنية) $t=0$ to $t=2s$

(b) Determinate the acc^n at $t=2s$

Sol.

$$V_f = 40 - 5(2)^2 = 20$$

$$V_i = 40 - 5(0)^2 = 40$$

$$\bar{a}_{avg} = \frac{\Delta V}{\Delta t} = \frac{V_f - V_i}{t_f - V_i} = \frac{20 - 40}{2}$$

$$= -10\ m/s^2$$

(b) $$a_i = \frac{dv}{dt}$$

$$a_i = -10t$$

$$= -10(2) = -20\ m/s^2$$

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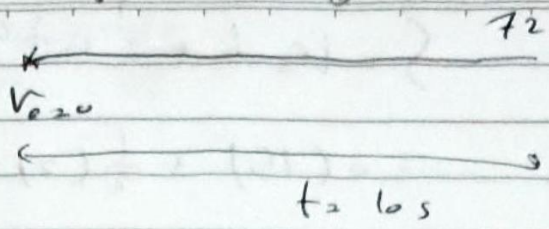
distance = displacement

الموضوع : التاريخ / / ٢٠١

ex



(a) $a_{avg.} = ?$ $S = ?$

$V_{0=0}$ $V = 72\,km/h = \frac{72 \times 1000}{3600} = 20\,m/s$

$V = V_0 + at$

$20 = 0 + a(10) \Rightarrow a = \frac{20}{10} = 2\,m/s^2$

$S = V_0 t + \frac{1}{2} a t^2$

$S = 0(t) + \frac{1}{2}(2)(10)^2$

$= 100\,m$

(b) $t = ?$ $V = 108\,km/h$

$V = V_0 + at$

$V = \frac{108 \times 1000}{3600} = 30\,m/s$

$30 = 20 + 2(t)$

$t = 5\,sec$

total time $= 10 + 5 = 15\,s$

المطلوب إيجاد الزمان
نقوم أزيادة السرعة من
72 → 108
$V_0 = 72$ كما في الـ

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التاريخ / / ٢٠١

الموضوع :

⑤ total displacement

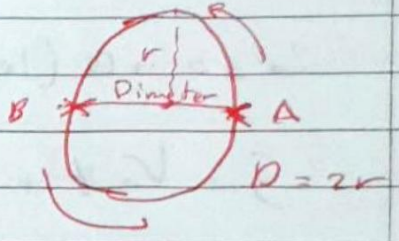
$$S = V_0 t + \frac{1}{2} a t^2$$

$$= 0(15) + \frac{1}{2}(2)(15)^2$$

$$S = 225 \text{ m}$$

Velocity $V_x = \frac{\text{dimeter}}{\text{time}}$

Speed $V = 1.5 \frac{D\pi}{t}$



$d = 2\pi r \times 1.5$

2.3 Particle under constant velocity

$$V_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{x_f - x_i}{t_f - 0}$$

$$\boxed{x_f = x_i + V_x t}$$

in Circular path with constant speed

$$V = \frac{d}{\Delta t} \Rightarrow \Delta t = \frac{d}{V} = \frac{2\pi r}{V}$$

2.4 Acceleration

$$a_{x\,avg} = \frac{\Delta V_x}{\Delta t} = \frac{V_{xf} - V_{xi}}{t_f - t_i}$$

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$$a_x = \lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t} = \frac{dv}{dt}$$

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

$$a_x = \frac{d}{dt}\left(\frac{dx}{dt}\right) \quad (v_x)$$

$$a_x = \frac{d^2x}{dt^2}$$

ex 12.6 p. 34 (مكرر)

$v_x = 40 - 5t^2$ $\quad a_{x\,avg} = ?$ $\quad t=0 \to t=2s$

① $a_{x\,avg} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$

$v_f = 40 - 5(2)^2 = 20\ m/s$

$v_i = 40 - 5(0) = 40\ m/s$

$a_x = -10\ m/s^2$

② a_x in $t = 2s$

$a_x = \frac{dv}{dt} = -10t$

$a_x = -10(2) = -20\ m/s^2$

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2.6 particle under cons. accelerations

$$a_x = \frac{v_{xf} - v_{xi}}{t - 0}$$

$$\boxed{v_{xf} = v_{xi} + a_x t}$$ for cons. acc^n.

$v_{x\,avg} = \frac{v_{xf} - v_{xi}}{2}$ for cons. acc^n

Linear motion with Cons. acc^n

$$\boxed{v = v_0 + at} \quad (1)$$

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

$$\boxed{v^2 = v_0^2 + 2ax} \quad (3)$$

$x = v_0 t + \frac{1}{2} a t^2$ with cons. v

$a = 0$, $x = vt \Rightarrow v = \frac{x}{t}$

2.7 Freely falling objects

For description the motion of freely falling body the acc^n (a) in linear is replaced

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by (y) and the displacement (x) is replaced by (y), then the equation becomes.

$$V = V_0 + gt \quad (1)$$

$$y = V_0 t + \frac{1}{2} g t^2 \quad (2)$$

$$V^2 = V_0^2 + 2gy \quad (3)$$

Notes ① when the motion is upward (g) is (-ve)

② " " " " downward [g] is (+ve)

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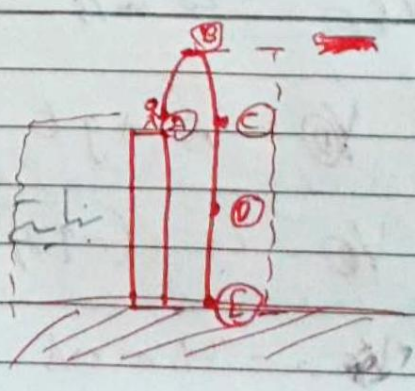

(A) ...

Sol. $t_{(A)} = 0$

$$V_f = V_i - gt$$

$$0 = 2_0 + (-9.2)(t)$$

$$t = 2.045$$

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(2)

$$y = V_i t + \frac{1}{2} g t^2$$

$$y = (20)(2.04) + \frac{1}{2}(-9.8)(2.04)^2$$

$$y = 20.4\,m$$

(3) $V_f^2 = V_i^2 + 2gy$ $\quad B \to C$

$$V_{f_C}^2 = 0 + 2(9.8)(20.4)$$

$$V_{f_C}^2 = 400\ m^2/s^2$$

$$V_{f_C} = -20\ m/s$$

(4) $V_D = V_i + gt$

$$V_D = 20 + (-9.8)(5)$$

$$V_D = -29.0\ m/s$$

$$y_D = V_i t + \frac{1}{2} g t^2 \quad A \to D$$

$$y_D = 20(5) + \frac{1}{2}(-9.8)(5)^2$$

$$y_D = -22.5\ m$$

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