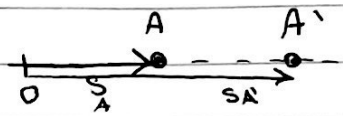
Dynamics :-

Chapter 12 :-

* 12-2 :- Rectilinear Motion

- Displacement : $\Delta S = \vec{S}_{A'} - \vec{S}_{A}$



- Velocity :
  - $\vec{V}_{avg} = \frac{\Delta \vec{S}}{\Delta t}$
  - $\vec{V} = \frac{d\vec{s}}{dt}$
  - Speed $\vec{V}_{sp} = |\vec{V}|$
  - $(V_{sp})_{avg} = \frac{S_T}{\Delta t}$

- Acceleration :
  - $\vec{a}_{avg} = \frac{\Delta V}{\Delta t}$
  - $\vec{a} = \frac{dv}{dt} = \frac{d^2\vec{S}}{dt^2}$

• اشارة التسارع لاتدل على اتجاه الحركة بل تدل أو تعبر عن كون الجسم تسارع او تباطؤ

- Constant Motion with Constant acceleration :-

[1] $V_2 = V_1 + a_c t$

[2] $S_2 = S_1 + V_1 t + \frac{a_c t^2}{2}$

[3] $V_2^2 = V_1^2 + 2 a_c \Delta S$

* 12-5 :- Rectangular Coordinates for Curvilinear Motion

$$\vec{r}(t) = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}$$

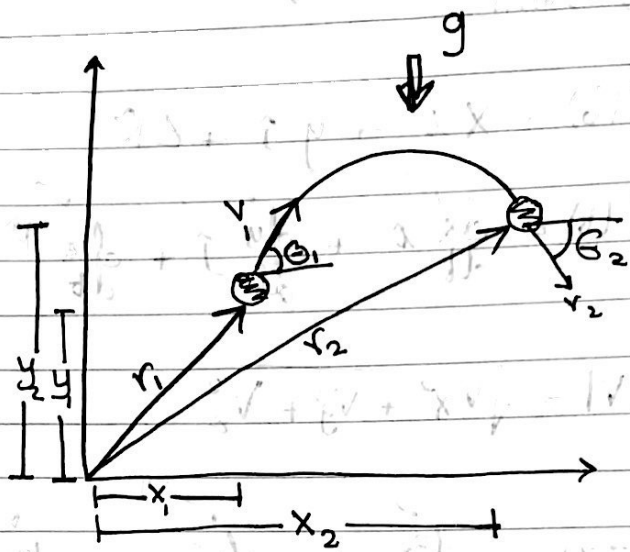
$$\vec{v}(t) = \underbrace{\frac{dx}{dt}}_{v_x}\,\hat{i} + \underbrace{\frac{dy}{dt}}_{v_y}\,\hat{j} + \underbrace{\frac{dz}{dt}}_{v_z}\,\hat{k}$$

Tangent $\rightarrow$ $|v| = \sqrt{v_x^2 + v_y^2 + v_z^2}$

$$\vec{a}(t) = \underbrace{\frac{d^2x}{dt^2}}_{a_x}\,\hat{i} + \underbrace{\frac{d^2y}{dt^2}}_{a_y}\,\hat{j} + \underbrace{\frac{d^2z}{dt^2}}_{a_z}\,\hat{k}$$

* Notes about Questions

* 12.6: Projectile Motion



- Horizontally:
  → V_x is Constant
  → $X_2 = X_1 + V_{ix} t$

- Vertically:
  $V_{2y} = V_{1y} - gt$

  $V_{2y}^2 = V_{1y}^2 - 2g(y_2 - y_1)$

  $y_2 = y_1 + V_{1y} t - \frac{gt^2}{2}$

- على نفس الارتفاع V_y تكون متساوية مقدارياً ومتعاكسة اتجاهاً (في حالة الاتزان)

Notes about Questions

12.7 : Curvilinear Motion :- Normal Tangential Coordinates.

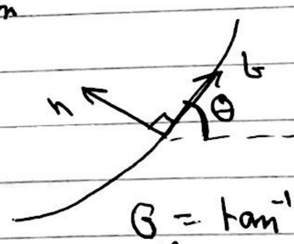
Axis
- t-axis :- tangential to the Motion, positive with Motion $\vec{U}_t$
- n-axis :- $\perp$ to t-axis, positive towards the Center $\vec{U}_n$
- b-axis $\perp$ to n, t - axis, positive ; By Right-hand Rule. $\vec{U}_b$

Velocity : $\vec{V} = V . \vec{U}_t = \dot{S} \vec{U}_t$ (V ← Magnitude; $\dot{S}$ ← بالنسبة للزمن)

Acceleration :- $a = a_t + a_n$

$$= \ddot{S} \vec{U}_t + \frac{\dot{S}^2}{\rho} \vec{U}_n$$

Note: $\vec{U}_t = \frac{V}{\rho} \vec{U}_n$



$\theta_{xt} = \tan^{-1} \frac{dy}{dx}$

$a = \sqrt{a_t^2 + a_n^2}$ ← لا يساوي صفر

Motion
- Rectilinear :- V : Constant, $a = 0$
- Straight line : $\rho = \infty$ $a_t = \dot{V}$ $a_n = 0$
- Curvilinear :- V : Constant, $a_t = 0$ $a_n = \frac{V^2}{\rho}$

$$\rho = \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}} \Big/ \left|\frac{d^2y}{dx^2}\right|$$

Scanned with CamScanner

Dynamics :-

* Notes about Questions

① When you have a function to differentiate

Ex : $y = 8x^3$

To diff :-

$$\dot{y} = 8 \times 3 X \dot{X}$$
$$\ddot{y} = (24)(X\ddot{X} + \dot{X}\dot{X})$$

and So on...

② If you have a Constant Speed $a_b = 0$

So ~~acceleration~~

$a_x \cos\theta + a_y \sin\theta = 0$

In Question 112

The player run at the same Speed

12.8 Cylindrical Coordinates (r, θ) polar Coordinates

Axises:-

- r-axis : + ve in the direction of increasing r (If θ is Constant) $\vec{U}_r$
  اذا θ ليس ثابت إ 8 زحلقة الدائرة .
- θ-axis :- ⊥ r-axis / + in the direction of increasing θ $\vec{U}_\theta$
- z-axis ⊥ r-axis , ⊥ θ-axis (right hand rule) $\vec{U}_z$

• Position (r) :- $\vec{r}(t) = r\vec{U}_r$

• velocity :- $\vec{V}(t) = \underbrace{\dot{r}\vec{U}_r}_{V_r} + \underbrace{r\dot{\theta}\vec{U}_\theta}_{V_\theta}$

المحصلة باتجاه ال Tangent

Note: $\dot{\vec{U}}_r = \dot{\theta}\, U_\theta$ (rad/s)

• Acceleration :- $\vec{a}(t) = \underbrace{[\ddot{r} - r\dot{\theta}^2]\vec{U}_r}_{\vec{a}_r} + \underbrace{[r\ddot{\theta} + 2\dot{r}\dot{\theta}]\vec{U}_\theta}_{\vec{a}_\theta}$

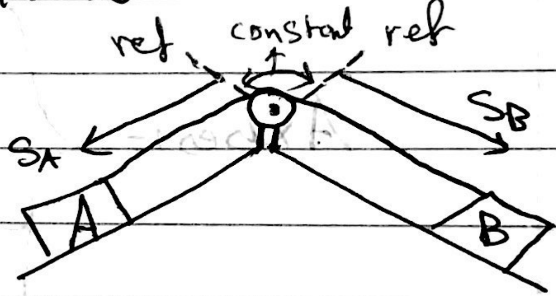
المحصلة مش ضروري تكون عـ T

ملاحظة مهمة : اذا كل معادلة فيها تعويض لـ θ مباشرة
مثل : $X = 2\theta$ دائماً نعوضها بالـ Radians
اما اذا كانت داخل cos نحولها لـ درجات

12.9 Absolute Dependant Motion Analysis of two Particles.

* Robes / pulley Kind of Questions

L constant ← ; ↑ frictionless



$L = S_A + S_B + d$

$V_A = -V_B$

$a_A = -a_B$

سالب ↙ موجب ↙

The − sign Means Direction : الكل يطول ام يقصر

- **Notes of Questions**