إسألني عن الهندسة 2013

تقدم

ملخص لقوانين

Physics 1

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Subject:

* Physics ..

Chapter two ⇒ Motion in 1-D

2.1 ⇒ Position, velocity and speed.

Displacement $(\Delta x) = x_f - x_i$

$v_{x,avg} = \frac{\Delta x}{\Delta t}$

v_{avg} (average speed / scalar quantity) $= \frac{d}{\Delta t} = \frac{\text{total distance}}{\text{total time}}$

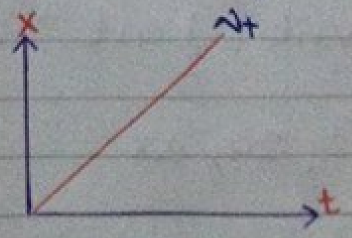
2.2 ⇒ Instantaneous velocity and speed.

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

The instantaneous ~~velo~~ speed = The magnitude of inst. velocity

2.3 ⇒ Particle Under constant velocity.

$v_x = \text{slope} = \frac{\Delta x}{\Delta t}$



$x_f = x_i + v_x t$

→ Position as a function of time for the particle Under a constant velocity

Subject:

2.4 ⇒ acceleration

$a_{x,avg} = \frac{\Delta V_x}{\Delta t}$ (average accelration)

$$a_x = \lim_{x \to 0} \frac{\Delta V_x}{\Delta t} = \frac{d V_x}{dt} = \frac{d^2 x}{d^2 t^2}$$

2.5 ⇒ Motion diagrams.

constan velocity ⇒ acceleration = Zero

Velocity and acceleration at the same direction ⇒ velocity is increasing

V_x and a_x at ~~the~~ oposite direction ⇒ V_x is ~~dee~~ dicreasing

2.6 ⇒ Particle under constant acceleration

$$V_{xf} = V_{xi} + a_x t \quad (a_x \text{ is constant})$$

$$V_{x,avg} = \frac{V_{xi} + V_{xf}}{2}$$

$$x_f = x_i + V_{xi} t + \frac{1}{2} a_x t^2$$

$$V_{xf}^2 = V_{xi}^2 + 2 a_x \Delta x$$

$$x_f = x_i + \frac{1}{2}(V_{xi} + V_{xf}) t$$

Kinematic Equations for motion of a Particle under a constant a_x

Subject:

3

2.7 ⇒ Free Falling Object. (motion in y-axis)

$a_y = g = -9.8\ m/s^2$ (- ; For the direction ↓)

$v_{fy} = v_{yi} + -gt$

$y_f = y_i + v_{yi}t - \frac{1}{2}gt^2$

$y_f = y_i + \frac{1}{2}(v_{fy} + v_{iy})t$

$v_{yf}^2 = v_{iy}^2 + 2a\Delta y$

2.8 ⇒ Kinematic Equation Derived from calculus.

$\Delta x = \int_{v_i}^{v_f} v_x \cdot dx$ = Area Under the Curve

$v_x = \int_{a_{xi}}^{a_{xf}} a_x \cdot dx$ = Area under the Curve.

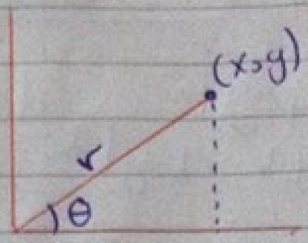
Subject:

Chapter (3) - Vectors

3.1 ⇒ Coordinate System.

$x = r.\cos\theta$

$y = r.\sin\theta$



$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

$r = \sqrt{x^2 + y^2}$

(x,y) ⇒ cartesian coordinate

(r, θ°) ⇒ polar coordinate

3.2 ⇒ Vector and scalar quantity.

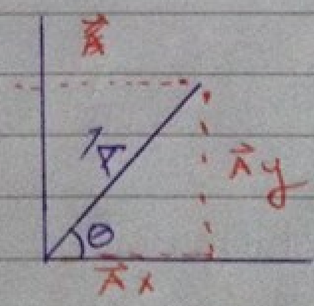
Scalar ⇒ Value, Unit, no direction ⇒ (distance)

Vector ⇒ Value, Unit, direction. ⇒ (displacement)

3.4 ⇒ Components of a vector

$\vec{A}_x = \vec{A} \cos\theta$

$\vec{A}_y = \vec{A} \sin\theta$



$A = \sqrt{(A_y)^2 + (A_x)^2}$

$\theta = \tan^{-1}\left(\frac{A_y}{A_x}\right).$

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Subject:

(7.3 + 11.1) ⇒ ابحان لشابتر (٢)   5

7.3 ⇒ The scalar Product of two Vectors.

$\vec{A}\cdot\vec{B} = AB.\cos\theta$ (dot product / scalar Product) (7.3)
$\vec{A}\times\vec{B} = AB.\sin\theta$ (Cross product) (11.1)

$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$

$|\vec{A}| = A = \sqrt{(A_{x\hat{i}})^2 + (A_{y\hat{j}})^2 + (A_{z\hat{k}})^2}$

Chapter (4) - motion in 2-D.

4.1 ⇒ The Position, velocity, and acceleration Vectors.

$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$
$\vec{v}_{avg} = \frac{\Delta\vec{r}}{\Delta t}$. $\vec{v} = \frac{d\vec{r}}{dt}$ (instantaneous)

$\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t}$. $\vec{a} = \frac{d\vec{v}}{dt}$ (instantaneous)

4.2 ⇒ Two-Dimensional motion (acceleration is constant)
$\vec{r} = x\hat{i} + y\hat{j}$
$\vec{v} = v_x\hat{i} + v_y\hat{j}$

∴ First equation ⇒ $(\vec{v}_f = (v_{xi} + a_x t)\hat{i} + (v_{yi} - gt)\hat{j}$

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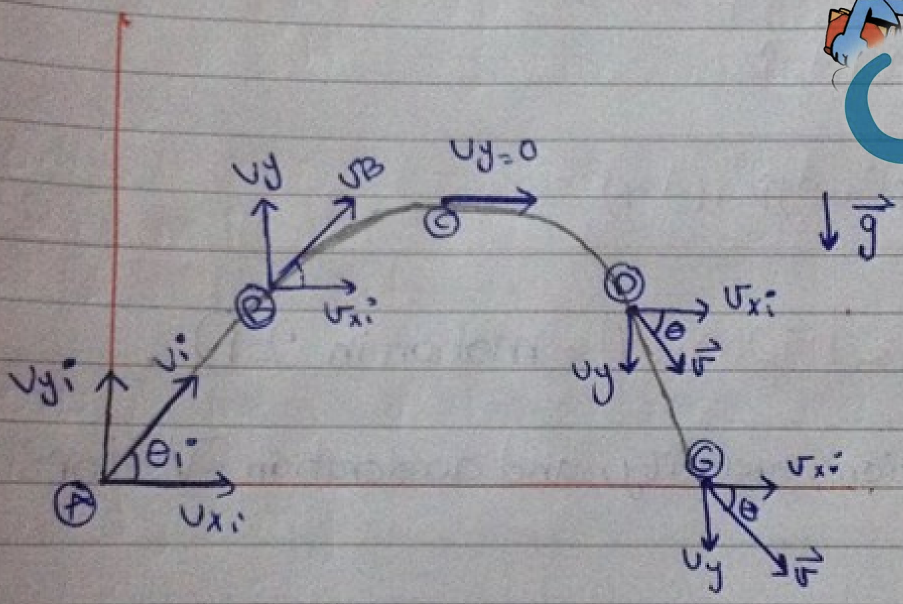
Sec. equation $\Rightarrow \vec{r}_f = \vec{r}_i + \vec{v}_i t + \frac{1}{2}\vec{a}t$ 6

$$\left[\vec{r}_f = (x_i + v_{xi}t + \frac{1}{2}a_x t^2)\hat{i} + (y_i + v_{yi}t + \frac{1}{2}a_y t^2)\hat{j}\right]$$

4.3 $\Rightarrow$ Projectile motion



The x-component of velocity is constant

Because there is no acceleration in the x-direction

The y-component of velocity is zero at the peak.

$v_{xi} = v_i \cos\theta_i$

$v_{yi} = v_i \sin\theta_i$

Subject: /   /

Horizontal Range and maximum Height of a Projectile.

$$\text{Max. height} = \frac{v_i^2 \sin^2\theta_i}{2g}$$

$$\text{Range} = \frac{v_i^2 \sin 2\theta_i}{g}$$

$$\text{Time at max-height} = \frac{v_i \sin\theta_i}{g}$$

4.4 ⇒ Particle in Uniform Circular motion.

$a_r = \frac{v^2}{r}$ (centripetal acceleration)

$r \rightarrow$ raduis

Period of circular motion ($T = \frac{2\pi r}{v}$)

$a_t = \frac{dv}{dt}$ (Tangential acceleration).

$a_{total} = \sqrt{a_t^2 + a_r^2}$

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Horizontal Range and maximum Height of a Projectile.

Max. height = $\frac{v_i^2 \sin^2\theta_i}{2g}$

Range = $\frac{v_i^2 \sin 2\theta_i}{g}$

Time at max-height = $\frac{v_i \sin\theta_i}{g}$

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Chapter 5 - The laws of motion

5.1 => The concept of force ..

5.2 => Newton's first law

Newoton's First law:- If an Object does not interact with other objects it's possible to identify a refrence frame in which the object has zero acceleration.

5.4 => Newton's Second law.

$\sum \vec{F} = m\vec{a}$

$\sum \vec{F}_x = ma_x \qquad \sum F_y = ma_y \qquad \sum F_z = ma_z$

5.5 => The gravitational force and weight.

$\vec{F}_g = m\vec{g}$

5.6 => Newton's Third law

$\vec{F}_{12} = \vec{F}_{21}$

5.8 -> Forcess of friction.

Force kinetic frictio (f_k) = $\mu_k n$

static friction (f_s) = $\mu_s n$ *n: normal force

Subject:

-: Chapter 6 * motion and other Applications of Newoton's Law

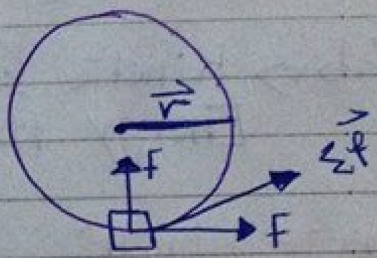
6.1 ⇒ Particle in uniform circular motion.

$a_c = \frac{v^2}{r}$

$\sum f = m a_c \Rightarrow \sum f = \frac{m v^2}{r}$

6.2 ⇒ Non-uniform circular motion.

$\sum \vec{F} = \sum \vec{F}_r + \sum \vec{F}_t$



Chapter 7 ⇒ Energy of system.

7.2 ⇒ work done by constant Force

$W = \vec{F} \cdot \vec{r}$

$W = \vec{F}\vec{r} \cos\theta$

Force is constant.

7.3 ⇒ work done by varying force.

$W = \int_{x_i}^{x_f} f_x \, dx$. Area under the curve.

Subject:

Work done by spring ($F_s = -kx$)
spring force

k: Spring constant

$$W_{spring} = \int_{x_i}^{x_f} -kx \cdot dx = -\frac{1}{2}kx^2 \Big]_{x_i}^{x_f}$$

$$= \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$$

$$W_{app} = -W_{spring}$$

$$= \frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2$$

E 7.6 ⇒ Kinetic Energy and the Work-Kinetic Energy theorem.

K.energy = $\frac{1}{2}mv^2$

$$\boxed{W_{ext} = \Delta K}$$

K.E Theorem: when work is done on a system and the only change in the system is in it's speed, the net work done on the system equals the change in kinetic energy of the system.

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7.6 ⇒ Potential Energy of a system.

$W_{ext} = \vec{F}_{app} \cdot \Delta\vec{r} = mg\hat{j} \cdot \Delta y \hat{j}$

$= mgy_f - mgy_i$

$U_g = mgy$ (Gravitational Potential Energy).

$U_s = \frac{1}{2} k x^2$ (Elastic Potential Energy)

~~7.7~~ ⇒ Conservative and non conservative force.

Conservative Force:

↳ properties ⇒ [1] The work done by a Cons. force on aparticle moving between any ~~for~~ two points indepent of the path taken by the particle.

[2] The work done by any cons. force on aparticle moving in a closed path is zero.

Non-conservative force ⇒ doesn't satisfy properties 1+

$E_{mech} = K + U$ (mechanical Energy).

7.8 ⇒ Relationship between Conservative Forces and Potential Energy.

$$\Delta U = -\int_{x_i}^{x_f} F_x \cdot dx$$

$$U_f = -\int F_x \cdot dx + U_i$$

$$\therefore \quad F_x = -\frac{dU}{dx}$$

Chapter 8: Conservation of energy #

$$\Delta K + \Delta U = 0$$

$$E_{mech} = K + U \Rightarrow \Delta E_{mech} = 0$$

$$K_f + U_f = K_i + U_i$$

$$\frac{1}{2} m v_f^2 + mgy_f = \frac{1}{2} m v_i^2 + mgy_i$$

$$\Delta E_{system} = \Delta K + \Delta E_{int}$$

$$\Delta E_{int} - f_k \cdot d = 0$$

13

Subject: / /

$\Delta E_{mech} = \Delta K + \Delta U = -f_k \cdot d$

$\therefore \Delta E_{mech} = -f_k \cdot d + \sum W_{other\ forces}$. (8.4)

8.5 ⇒ Power

$P = \frac{W}{\Delta t}$ (J/s) | (watt)

$P = \frac{dE}{dt}$ (Instantaneous Power)

Chapter 9 # linear momentum.

9.1 ⇒ linear momentam.

$\vec{P} = m\vec{V}$

$\vec{P}_x = m\vec{V}_x$, $\vec{P}_y = m\vec{V}_y$, $\vec{P}_z = m\vec{V}_z$

$* \ \vec{F} = \frac{d\vec{P}}{dt}$

9.2 ⇒ Islolated System (Momentum)

$\vec{P}_{1i} + \vec{P}_{2i} = \vec{P}_{1f} + \vec{P}_{2f}$

momentum in isolated system is constant.

Subject: 14

9.3 ⇒ Non-isolated System (Momentum)..

Impulse of force $= \int_{t_i}^{t_f} \sum \vec{F} \cdot dt$

* $[\Delta \vec{p} = I]$ ⇒ The chang in the momentum = Impulse of the net force acting on the particle.

$$I = \sum \vec{F} \cdot \Delta t$$

$$(\sum \vec{F})_{avg} = \frac{I}{\Delta t} = \frac{\Delta \vec{p}}{\Delta t}$$

9.4 ⇒ Collisions in One Dimension.

Perfectly Inelastic collisions

$$m_1 \vec{v}_{i1} + m_2 \vec{v}_{i2} = (m_1 + m_2) \vec{v}_f$$

$$\vec{v}_f = \frac{m_1 \vec{v}_{1i} + m_2 v_{2i}}{m_1 + m_2}$$

Subject:

Elastic collision :-

$m_1\vec{v}_{i1} + m_2\vec{v}_{i2} = m_1\vec{v}_{f1} + m_2\vec{v}_{f2}$

$[v_{1i} + v_{1f} = v_{2i} + v_{2f}]$

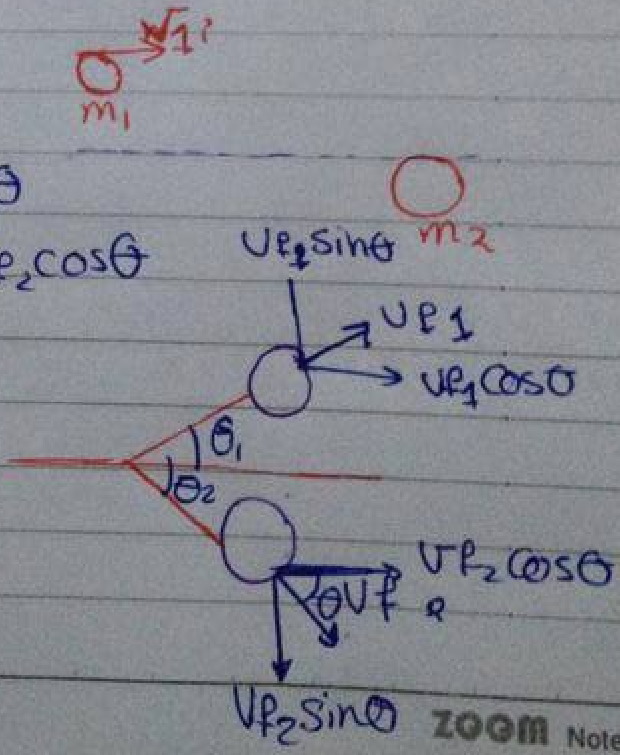
$$\left[\begin{array}{l} v_{2f} = \left(\dfrac{2m_1}{m_1+m_2}\right)v_{1i} \\ \\ v_{1f} = \left(\dfrac{m_1-m_2}{m_1+m_2}\right)v_{1i} \end{array}\right]$$

if Particle 2 Inetialy at rest

9.5 ⇒ Collisions in two-Dimension.

$m_1 v_{1ix} + m_2 v_{2ix} = m_1 v_{1fx} + m_2 v_{2fx}$

$m_1 \vec{v}_{1iy} + m_2 v_{2iy} = m_1 \vec{v}_{f1y} + m_2 \vec{v}_{f2y}$



$m_1 v_{1f}\sin\theta = m_2 v_{f2}\sin\theta$

$m_1 v_{1i} = m_1 v_{1f}\cos\theta + m_2 v_{f2}\cos\theta$