ملخص القوانين المستخدمة
103 فيز الأبواب: 2-6
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Chapter 2:

Displacement is defined as follows:	$\Delta x = x_f - x_i$ (2.1)
Average Velocity	$\overline{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$ (2.2)
Average Speed	$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$ (2.3)
Instantaneous Velocity	$v_x = \frac{dx}{dt}$ (2.5)
Average Acceleration	$\overline{a}_x \equiv \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{t_f - t_i}$ (2.6)
Instantaneous Acceleration	$a_x = \frac{dv_x}{dt}$ (2.7)

Kinematic Equations for Motion of a Particle Under Constant Acceleration

Equation	Information Given by Equation
$v_{xf} = v_{xi} + a_x t$	Velocity as a function of time
$x_f = x_i + \frac{1}{2}(v_{xi} + v_{xf})t$	Position as a function of velocity and time
$x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$	Position as a function of time
$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$	Velocity as a function of position

Freely Falling Objects	Same Equations as Above with: 1- a ➔ -9.8 2- v is + if ↑ and – if ↓ 3- x ➔ y 4- y is + if above firing level and – if below firing level

Chapter 3:

Conversion Between Coordinate Systems	$A_x = A\cos\theta$ (3.8) $A_y = A\sin\theta$ (3.9) $\tan\theta = \frac{A_y}{A_x}$ (3.10) $A = \sqrt{A_x^2 + A_y^2}$ (3.11)
Unit Vectors:	$\lvert\hat{i}\rvert = \lvert\hat{j}\rvert = \lvert\hat{k}\rvert = 1$
We express a vector using unit vetors as:	$A = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$
magnetude of the R:	$R = \sqrt{R_x^2 + R_y^2 + R_z^2} = \sqrt{(A_x + B_x)^2 + (A_y + B_y)^2 + (A_z + B_z)^2}$

Chapter 4:

Displacement in 2-D	$\Delta r = r_f - r_i$ (4.1)
Average Velocity in 2-D:	$\bar{\mathrm{v}} = \frac{\Delta r}{\Delta t} = \frac{r_f - r_i}{t_f - t_i}$ (4.2)
Instantaneous Velocity in 2-D:	$v = \frac{dr}{dt}$ (4.3)
	$v = \frac{dr}{dt} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j} = \mathrm{v}_x\hat{i} + \mathrm{v}_y\hat{j}$ (4.7)
Average Acceleration in 2-D:	$\bar{\mathrm{a}} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$ (4.4)
Instantaneous acceleration in 2-D:	$a = \frac{dv}{dt}$ (4.5)
Position in 2-D:	$r = x\hat{i} + y\hat{j}$ (4.6)
Motion with constant acceleration in2-D	$v_{xf} = v_{xi} + a_x t$ $x_f = v_{xi}t + \frac{1}{2}a_x t^2$ $v_{xf}^2 = v_{xi}^2 + 2a_x x_f$ $v_{yf} = v_{yi} + a_y t$ $y_f = v_{yi}t + \frac{1}{2}a_y t^2$ $v_{yf}^2 = v_{yi}^2 + 2a_y y_f$
Position (displacement) in 2-D	$r_f = v_i t + \frac{1}{2}at^2$ (4.9)
Projectile Motion	$v_{xi} = v_i \cos\theta_i$ (4.10a) $x_f = v_{xi}t = \left(v_i \cos\theta_i\right)t$ (4.11a) $v_{yi} = v_i \sin\theta_i$ (4.10b) $\mathrm{y_f} = v_{yi}t + \frac{1}{2}a_y t^2 = (v_i \sin\theta_i)\mathrm{t} - \frac{1}{2}gt^2$ (4.12)
Trajectory Equation (Parabola)	$y = ax - bx^2$
Time of Flight (Full projectile)	$t_{fleight} = \frac{2v_i \sin\theta_i}{g}$
Maximum Height:	$h = \frac{v_i^2 \sin\theta_i^2}{2g}$ (4.13)
Range (max at θ =45°)	$R = \frac{v_i^2 \sin 2\theta_i}{g}$ (4.14)
For y motion consider free falling:	1- a ➔ -9.8 2- v is + if ↑ and – if ↓ 3- x ➔ y 4- y is + if above firing level and – if below firing level
Central Acceleration in circular motion	$a_c = \frac{v^2}{r}$ (4.15)
Total Acceleration in circular motion	$a = a_r + a_t \quad a_t = \frac{dv}{dt} \quad a_r = \text{-}a_c = \text{-}\frac{v^2}{r}$ $\therefore a = \sqrt{a_r^2 + a_t^2}$

Chapter 5:

At Equilibrium: **a** = 0 Or: **v**= constant (including 0) Or $\sum \boldsymbol{F} = 0$	$\sum \boldsymbol{F} = m\boldsymbol{a}$ (5.2) $\sum F_x = ma_x \quad \sum F_y = ma_y \quad \sum F_z = ma_z$ (5.3)
Signs:	$\uparrow$ **+** , $\downarrow$ **-** , $\rightarrow$ **+** , $\leftarrow$ **-**
Atwood's Machines:	Step No. 1: Free-Body Diagram Step No. 2: Direction Step No. 3: Equations of motion (one for each object) Step No. 4: Add/Subtract equations to get rid of T Step No. 5: Find a Step No. 6: use a In (3) to find T Notes: if you got a in (-): No friction? No Problem! Friction? Repeat (2 to 6)
Forces of Friction:	$\boldsymbol{f_s} = \mu_s n$ (1) $\boldsymbol{f_k} = \mu_k n$ (1)
Uniform circular Motion	$\sum \boldsymbol{F} = ma_c = m\frac{v^2}{r}$ (6.1)
Speed of Conical Pendulum bob	$\mathrm{v} = \sqrt{Lg \sin\theta \tan\theta}$
Max. velocity of a car in a circular motion only due to friction (no banking)	$v = \sqrt{r\mu_s g}$ (4)
Angle of Banking (assumed no friction)	$\theta = \tan^{-1}\left(\frac{v^2}{gr}\right)$