Reminder of chapter 4

Motion in two and three dimension

1- The position in three dimensions: $\vec{r} = x(t)\,i + y(t)\,j + z(t)\,k$

2- The displacement: $\Delta\vec{r} = \vec{r}_2 - \vec{r}_1 = \Delta x\,i + \Delta y\,j + \Delta z\,k$

3- The average velocity: $\vec{v}_{avg} = \frac{\Delta\vec{r}}{\Delta t} = \frac{\Delta x}{\Delta t}i + \frac{\Delta y}{\Delta t}j + \frac{\Delta z}{\Delta t}k$

4- The instantaneous velocity: $\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}(x\,i + y\,j + z\,k) = v_x\,i + v_y\,j + v_z\,k$

5- The average acceleration: $\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t}$

6- The instantaneous acceleration: $\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}(v_x\,i + v_y\,j + v_z\,k) = a_x\,i + a_y\,j + a_z\,k$

Projectile Motion

1- The magnitude of initial velocity on X axis, Y axis are respectively are $v_o\cos\theta_o$, $v_o\sin\theta_o$, the angle: $90 > \theta_o \geq 0$

2- The horizontal velocity at any time is constant: $v_{ox} = v_o\cos\theta_o$.

3- The horizontal displacement at any time: $\Delta x = v_{ox}\,t = t\,v_o\cos\theta_o$

4- The horizontal range: $R = \frac{v_o^{\,2}\sin 2\theta_o}{g}$

5- The maximum horizontal range at $\theta_o = 45^o$: $R_{max} = \frac{v_o^{\,2}}{g}$

6- The vertical velocity at any time:
$v_y = v_o\sin\theta_o + a\,t$

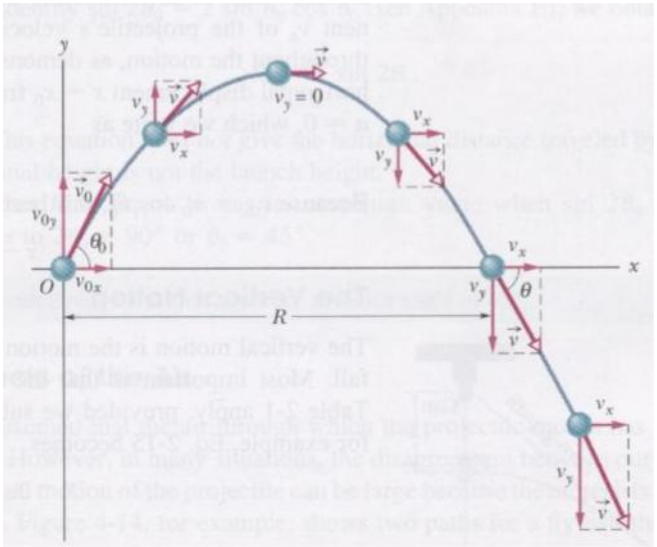
7- The vertical displacement at any time:
$\Delta y = t\,v_o\sin\theta_o + \frac{1}{2}a\,t^2$

8- The vertical velocity ant any displacement:
$v_y^{\,2} = (v_o\sin\theta_o)^2 + 2\,a\,\Delta y$

9- The vertical displacement ant any vertical velocity: $\Delta y = \frac{(v + v_o\sin\theta_o)}{2}t$

10- The final velocity: $v = \pm\sqrt{v_x^{\,2} + v_y^{\,2}}$

11- The angle of the final velocity respect to the horizontal: $\tan\theta = \frac{v_y}{v_x}$



12- The equation of the path (parabolic path), assuming $x_o =$ $y_o =$ zero is: $y = x\tan\theta_o + \frac{a\,x^2}{2\,v_o^{\,2}\cos^2\theta_o}$

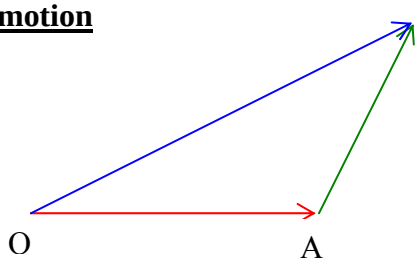
Notice: $a = -g = -9.8\ m/s^2$.

Relative motion

1- The relative position: $\vec{r}_{PO} = \vec{r}_{AO} + \vec{r}_{PA}$

2- The relative velocity: $\vec{v}_{PO} = \vec{v}_{AO} + \vec{v}_{PA}$

3- The relative acceleration: $\vec{a}_{PO} = \vec{a}_{AO} + \vec{a}_{PA}$



Vectors sum

$\vec{OP} = \vec{OA} + \vec{AP}$

Uniform circular motion

1- The magnitude of the radian acceleration of a particle, moving with uniform circular motion (constant speed): $a_r = \frac{v^2}{r}$

2- The periodic time of the motion: $T = \frac{2\pi r}{v}$