Physics

1. Kinematics

1 – D

(1) How to describe motion: a. select reference frame b. particle

a. $v = \frac{x}{t}$ (v, velocity, vector, direction + magnitude; x, displacement, vector, the line connecting the beginning and end positions; t, time, scalar)

b. $v = \frac{s}{t}$ (speed, scalar, magnitude)

c. instantaneous velocity:

Using derivatives, $v = \frac{dx}{dt}, a = \frac{dv}{dt}$

(2) In linear motion, the motion where the magnitude and direction of acceleration do not change (when the acceleration is in the same direction as the velocity) is called uniform acceleration linear motion.

(3) Formula:

$$a = \frac{\Delta v}{\Delta t} \rightarrow \Delta v = a\Delta t$$

$$v_f = v_i + \Delta v = v_i + at$$

$$\Delta x = \frac{v_i + v_f}{2} t = v_i t + \frac{1}{2} a t^2 = \frac{{v_f}^2 - {v_i}^2}{2a}$$

(4) Apply: Free fall

The motion of a regular object with zero initial velocity under the action of gravity is also called free fall motion.

(a = g, $v_i = 0$)

Formula: $v_f = gt, \Delta x = \frac{v_f}{2} t = \frac{1}{2} g t^2 = \frac{{v_f}^2}{2g}$

We can conclude the formula to calculate t as well.

2 – D

(1) Projectile: Synthesis of two 1 – D motion.

Horizontal (x-axis): $v_x = c$ (constant)

Vertical (y-axis): Free fall

(2) Use formulas on x and y axis respectively.

Total displacement/instantaneous velocity: Pythagorean theorem

Direction: tan $\alpha = \frac{y}{x}$.

2. Dynamics

(1) Newton's law

Newton's first law: Inertia

$$\Sigma F = 0 \rightarrow a = 0$$

Newton's second law:

$$F = ma$$

Newton's third law:

$$F = -F'$$

(2) Gravitational forces:

a. It is caused by fields.

b.

$$F = \frac{Gm_1m_2}{r^2}$$

$G = 6.67 \times 10^{-11} N \cdot m^2/kg^2$, according to Cavendish.

Gravitational force = Gravity + Centripetal force