

Python Logic Building Problems with Physics Context

Problem 1: Calculate Distance Using Speed and Time

Problem Statement: Write a program to calculate the distance traveled by an object, given its speed and the time it travels.

Formula:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Input: Speed (in meters per second) and time (in seconds).

Output: Distance traveled (in meters).

Example:

Input: Speed = 10, Time = 5

Output: Distance = 50 meters

Problem 2: Calculate Force Using Newton's Second Law

Problem Statement: Write a program to calculate the force applied on an object using Newton's second law of motion.

Formula:

$$\text{Force} = \text{Mass} \times \text{Acceleration}$$

Input: Mass (in kilograms) and acceleration (in meters per second squared).

Output: Force (in Newtons).

Example:

Input: Mass = 5, Acceleration = 3

Output: Force = 15 N

Problem 3: Gravitational Potential Energy

Problem Statement: Write a program to calculate the gravitational potential energy of an object.

Formula:

$$\text{Potential Energy} = m \times g \times h$$

where $g = 9.8 \text{ m/s}^2$ (acceleration due to gravity), m is the mass, and h is the height.

Input: Mass (in kilograms) and height (in meters).

Output: Gravitational potential energy (in joules).

Example:

Input: Mass = 2, Height = 10

Output: Potential Energy = 196 J

Problem 4: Kinetic Energy of an Object

Problem Statement: Write a program to calculate the kinetic energy of an object in motion.

Formula:

$$\text{Kinetic Energy} = \frac{1}{2} m v^2$$

where m is the mass and v is the velocity.

Input: Mass (in kilograms) and velocity (in meters per second).

Output: Kinetic energy (in joules).

Example:

Input: Mass = 10, Velocity = 3

Output: Kinetic Energy = 45 J

Problem 5: Ohm's Law – Voltage Calculation

Problem Statement: Write a program that calculates the voltage across a resistor given current and resistance using Ohm's Law.

Formula:

$$V = I \times R$$

where V is voltage, I is current, and R is resistance.

Input: Current (in amperes) and resistance (in ohms).

Output: Voltage (in volts).

Example:

Input: Current = 2, Resistance = 5

Output: Voltage = 10 V

Problem 6: Projectile Motion – Maximum Height

Problem Statement: Write a program to calculate the maximum height reached by a projectile, given its initial velocity and launch angle (ignoring air resistance).

Formula:

$$h_{\text{max}} = \frac{v^2 \times \sin^2(\theta)}{2g}$$

where v is the initial velocity, θ is the launch angle in degrees, and $g = 9.8 \text{ m/s}^2$.

Input: Initial velocity (in meters per second) and angle (in degrees).

Output: Maximum height (in meters).

Example:

Input: Velocity = 20, Angle = 45

Output: Height = 20.4 meters

Problem 7: Harmonic Oscillator – Period of a Spring

Problem Statement: Write a program to calculate the period of a spring-mass system (simple harmonic oscillator).

Formula:

$$T = 2\pi \sqrt{m/k}$$

where T is the period, m is the mass, and k is the spring constant.

Input: Mass (in kilograms) and spring constant k (in N/m).

Output: Period T (in seconds).

Example:

Input: Mass = 1, Spring constant = 50

Output: Period = 0.89 s

Problem 8: Free Fall – Time to Hit the Ground

Problem Statement: Write a program to calculate the time it takes for an object to hit the ground when dropped from a certain height (ignoring air resistance).

Formula:

$$t = \sqrt{2h/g}$$

where h is the height and $g = 9.8 \text{ m/s}^2$.

Input: Height (in meters).

Output: Time to hit the ground (in seconds).

Example:

Input: Height = 20

Output: Time = 2.02 seconds

Problem 9: Work Done by a Force

Problem Statement: Write a program to calculate the work done by a constant force acting on an object.

Formula:

$$\text{Work} = F \times d \times \cos(\theta)$$

where F is the force, d is the displacement, and θ is the angle between the force and displacement vectors.

Input: Force (in newtons), displacement (in meters), and angle (in degrees).

Output: Work done (in joules).

Example:

Input: Force = 100, Displacement = 10, Angle = 30

Output: Work = 866 J

Problem 10: Power Consumption of a Device

Problem Statement: Write a program to calculate the power consumed by an electrical device.

Formula:

$$P = W / t$$

where P is power, W is work (energy), and t is time.

Input: Work (in joules) and time (in seconds).

Output: Power (in watts).

Example:

Input: Work = 500, Time = 50

Output: Power = 10 W