SCIENCE 9 – QUARTER 4 REVIEWER – for Mendeleev do not distribute the copy

Topics Covered:

1. Projectile Motion
2. Momentum, Impulse, and Collisions
3. Mechanical Energy
4. Heat, Temperature, and First Law of Thermodynamics
5. Heat Engines
6. Electricity Generation, Transmission, and Distribution

1. PROJECTILE MOTION

What is Projectile Motion?

Projectile motion is the motion of an object thrown into the air and influenced only by **gravity**.

Examples:

- ✓ Basketball shot
- ✓ Thrown baseball
- ✓ Cannonball
- ✓ Arrow

The path followed by a projectile is called a **parabolic path**.

Two Components of Projectile Motion

Horizontal Motion

- ✓ Moves with **constant velocity**
- ✓ No acceleration (ignoring air resistance)

Key Idea

Gravity **does not affect horizontal motion**.

Vertical Motion

- ✓ Motion is affected by **gravity**
- ✓ Acceleration due to gravity:

g = **9.8 m/s² downward**

Objects moving vertically experience **uniform acceleration**.

Free Fall

Free fall happens when **gravity is the only force acting on an object**.

Examples:

- ✓ Falling rock
- ✓ Dropped ball

Acceleration of free fall:

$g = \mathbf{9.8\ m/s^2}$

Highest Point of Projectile

At the **highest point**:

- ✓ Vertical velocity = **0**
- ✓ Horizontal velocity = **constant**

The object **still moves horizontally**.

Key Projectile Formulas

Horizontal Motion

Distance:

$d = vt$

Where

v = horizontal velocity

t = time

Vertical Motion

Height or displacement:

$y = vt + \frac{1}{2}gt^2$

Important Concepts

Range

The **horizontal distance** traveled by a projectile.

Maximum range occurs when the angle is **45°**.

Angle and Height

Angle	Effect
Small angle	longer horizontal distance
Large angle	higher height
45°	maximum range

2. MOMENTUM AND IMPULSE

Momentum

Momentum is the **quantity of motion of an object**.

Formula:

$p = mv$
Where:
p = momentum
m = mass
v = velocity
Units:
kg·m/s

Impulse

Impulse is the **change in momentum caused by a force acting over time**.
Formula:
$\text{Impulse} = F\Delta t$
Also:
$\text{Impulse} = \Delta p$
Meaning:
Impulse = Change in Momentum

Conservation of Momentum

Total momentum **before collision = total momentum after collision**
Example:
Two marbles collide and exchange velocities.

Types of Collision

Elastic Collision

- Objects **bounce**
- **Momentum conserved**
- **Kinetic energy conserved**

Example:
Billiard balls

Inelastic Collision

- Objects **stick together**
- **Momentum conserved**
- **Kinetic energy NOT conserved**

Example:
Car crashes

3. MECHANICAL ENERGY

Mechanical energy is the **energy due to motion and position**.
Types:

1. Potential Energy
2. Kinetic Energy

Potential Energy
Energy stored due to **position or height**.
Formula:
$PE = mgh$
Where:
m = mass
g = gravity (9.8 m/s^2)
h = height
Example:
Water in a dam

Kinetic Energy
Energy of **motion**.
Formula:
$KE = \frac{1}{2}mv^2$
Example:
Moving car

Conservation of Mechanical Energy
Energy **changes form but total stays constant**.
Example: Pendulum
Top of swing:
PE = maximum
KE = zero
Bottom:
KE = maximum
PE = minimum

Example: Roller Coaster
Top:
High PE
Low KE
Bottom:
Low PE

High KE

4. HEAT AND TEMPERATURE

Heat

Heat is **energy transferred because of temperature difference**.

Units:

Joules (J)

Heat flows from:

Hot object → Cold object

Temperature

Temperature measures the **average kinetic energy of molecules**.

Units:

- Celsius
- Kelvin

Key Difference

Heat	Temperature
Energy transfer	Measure of molecular motion
Joules	Kelvin / Celsius

5. FIRST LAW OF THERMODYNAMICS

The First Law explains **energy conservation in thermodynamics**.

Formula:

$\Delta U = Q - W$

Where:

ΔU = change in internal energy

Q = heat added to system

W = work done by system

Meaning

Internal energy changes when:

- Heat is added
- Work is done

Example

If a system:
Receives heat → energy increases
Does work → energy decreases

6. HEAT ENGINES

A heat engine converts **heat energy into mechanical work**.
Examples:

- Car engine
- Steam engine
- Power plant turbines

Heat Engine Process

1. Heat absorbed from hot reservoir
2. Work produced
3. Remaining heat released to cold reservoir

Efficiency of Heat Engine

Efficiency measures **how much heat becomes useful work**.
Formula:
Efficiency = Work / Heat Input

Example:
Heat input = 100 J
Work = 60 J
Efficiency = 60%

7. ELECTRICITY GENERATION AND DISTRIBUTION

Electricity travels through **three main stages**:

1. Generation
2. Transmission
3. Distribution

1. Generation

Electricity is produced in **power plants**.
Examples:

- Hydroelectric
- Geothermal
- Wind
- Nuclear

Energy source → turbine → generator

2. Transmission
Electricity travels through **high-voltage transmission lines**.
Purpose:
Reduce energy loss over long distances.
Uses:
Step-up transformers

3. Distribution
Electricity is delivered to **homes and buildings**.
Uses:
Step-down transformers

Example Flow of Electricity
Power Plant
↓
Transmission Lines
↓
Transmission Substation
↓
Distribution Substation
↓
Homes / Buildings