Physics 12 Topics

A: Vector Kinematics in Two Dimensions
(Vectors and Relative Velocity)

It is expected that students will:

A1. identify scalars and vectors
A2. identify the resultant vector and component vectors on vector diagrams
A3. write vector equations describing the vector addition of two or more velocities or displacements
A4. write vector equations describing the subtraction of two velocities or displacements
A5. use graphical methods to resolve a vector into two perpendicular components
A6. resolve a vector into components using trigonometry
A7. use graphical methods or trigonometry to add or **subtract vectors**
A8. **describe relative velocity**
A9. use vector analysis to determine velocities, displacement, and time of travel for navigation problems
A10. gather and organize data, produce and interpret graphs, and determine relationships between variables

H: Equilibrium

It is expected that students will:

H1. define translational equilibrium
H2. use free-body diagrams and vector analyses to determine the sum of the forces acting at a single point on an object
H3. solve problems for common objects in translational equilibrium
H4. define torque and identify situations involving the application of torque
H5. solve problems involving:

- torque
- force
- lever arm

H6. define centre of gravity and determine its location for objects of uniform shape and density
H7. define rotational equilibrium
H8. determine the sum of the forces and the torques on an object
H9. define static equilibrium
H10. demonstrate that in static equilibrium, any location can be chosen as the pivot point
H11. solve problems for common objects in static equilibrium

B: Vector Kinematics in Two Dimensions
(Motion with Constant Acceleration)

It is expected that students will:

B1. identify situations involving the use of kinematics
B2. solve problems involving:

- displacement
- initial velocity
- final velocity
- average velocity
- acceleration
- time

B3. describe the shape of the path taken by a projectile fired at some angle above the horizon if friction is negligible
B4. Understand that horizontal motion of a projectile is independent of its vertical motion if friction is negligible
B5. demonstrate that the horizontal velocity of a projectile is constant if friction is ignored
B6. state that a projectile experiences a constant downward acceleration due to gravity if friction is negligible

B7. resolve a projectile's velocity into horizontal and vertical components
B8. solve projectile motion problems involving:

- range
- maximum height
- time of flight
- displacement
- velocity
- acceleration

C: Dynamics (Forces)

It is expected that students will:

C1. state Newton's laws of motion
C2. identify workplace and community situations involving Newton's three laws
C3. apply Newton's laws of motion to common situations
C4. solve problems involving:

- force
- mass
- accleration

C5. describe force as a vector quantity
C6. define gravitational field strength
C7. solve problems involving:

- the force of gravity (weight)
- gravitational field strength
- mass

C8. solve problems involving:

- force of friction
- coefficient of friction
- normal force

D: Vector Dynamics (Two-Dimensional Dynamics)

It is expected that students will:

D1. resolve a force into two orthogonal components
D2. determine the magnitude and direction of a force given its two orthogonal components
D3. determine the net force from two or more forces
D4. construct free-body diagrams for objects in various situations
D5. use free-body diagrams to solve problems involving balanced or unbalanced forces
D6. solve problems involving objects on inclines

E: Work, Energy, and Power

It is expected that students will:

E1. define work
E2. solve problems involving:

- work
- force
- displacement

E3. determine graphically the amount of work done on objects by constant or linearly varying forces
E4. define energy
E6. differentiate between kinetic energy and gravitational potential energy and give examples of each
E7. solve problems involving:

- kinetic energy
- mass
- gravitational potential energy
- height
- velocity

E8. state the law of conservation of energy and apply it to real-life situations
E9. define power
E10. solve problems involving:

- power
- work
- time
- efficiency

F: Momentum
(One-Dimensional Momentum)

It is expected that students will:

F1. define momentum and impulse
F2. state that momentum and impulse are vector quantities
F3. identify and compare momentum of common objects
F4. solve problems involving:

- net force
- time
- impulse
- velocity
- mass
- momentum

F5. state the law of conservation of momentum
F6. determine whether a collision is elastic or inelastic
F7. solve problems related to collisions or explosions involving:

- mass
- initial velocity
- final velocity
- momentum

G: Momentum
(Two-Dimensional Momentum)

It is expected that students will:

G1. analyse conservation of momentum in two dimensions
G2. give examples of common situations involving momentum and impulse
G3. solve problems for two objects involved in an oblique collision or for a stationary object exploding into no more than three fragments, involving:

- mass
- momentum
- velocity
- impulse

I: Circular Motion

It is expected that students will:

I1. describe the velocity of an object moving in uniform circular motion at any point in that motion
I2. demonstrate that the acceleration of an object may result in a change in direction with no change in speed
I3. define centripetal acceleration and centripetal force
I4. solve problems involving:

- centripetal force
- speed
- radius of revolution
- period of revolution
- object's mass

I5. analyse and describe the forces acting on common objects in circular motion

J: Gravitation

It is expected that students will:

J1. state Newton's law of universal gravitation
J2. apply Newton's law of universal gravitation to solve problems involving:

- force
- mass
- distance of separation

J3. describe the gravitational field of a body in terms of an inverse square relationship
J4. indicate that the work required to move an object in a gravitational field is given by the area below a graph of gravitational force versus distance of separation
J5. define gravitational potential energy
J6. solve problems involving:

- gravitational potential energy relative to zero at infinity
- mass
- distance of separation

J7. calculate the work required to change the separation distance between objects
J8. analyse and describe orbiting systems in terms of universal gravitational and centripetal forces

J9. solve problems involving orbiting systems
J10. calculate the total energy of an orbiting object

K: Electrostatics
(Electric Force and Electric Field)

It is expected that students will:

K1. state Coulomb's law
K2. solve problems using Coulomb's law for two point charges, involving:

- electric force
- charge
- distance of separation
- Coulomb's constant

K3. calculate the net electric force on a point charge due to two other point charges
K4. define electric field
K5. calculate the net electric field at any point on a line containing two point charges
K6. describe the electric field lines for simple charge distributions
K7. describe situations that produce uniform or non-uniform electric fields
K8. solve problems for a charge in an electric field, involving:

- force
- charge
- electric field

L: Electrostatics
(Electric Potential Energy and Electric Potential)

It is expected that students will:

L1. define the following:

- electric potential energy
- electric potential
- electric potential difference

L2. solve problems for a charge in an electric field, involving:

- electric potential difference
- electric potential energy
- charge

L3. solve problems for a uniform electric field, involving:

- electric potential difference
- electric field
- distance between two locations in a field

L4. solve problems for two point charges, involving:

- electric potential energy
- charge
- distance of separation

- Coulomb's constant

L5. calculate the work required to move a charge between two locations in an electric field

L6. solve problems using the law of conservation of energy for a charge in an electric field, involving:

- speed
- mass
- charge
- distance
- work
- electric field
- electric potential difference

M: Electric Circuits (Ohm's Law and Kirchhoff's Laws)

It is expected that students will:

M1. define electric current
M2. solve problems involving:

- current
- time
- charge

M3. relate conventional current direction to the direction of electron flow in a conductor
M4. define resistance in terms of Ohm's law
M5. solve problems involving:

- electric potential difference
- current
- resistance

M6. calculate the total (equivalent) resistance for resistors connected in parallel, series, or a combination
M7. state Kirchhoff's laws and apply them to circuits containing one source of electric potential difference
M9. demonstrate the correct placement and use of an ammeter and voltmeter in a circuit
M11. solve problems using:

- resistance
- current
- electric potential difference

N: Electric Circuits (Power and Energy)

It is expected that students will:

N1. define electric power
N2. solve problems involving:

- electric power
- electric potential difference
- current
- resistance

- efficiency

O: Electromagnetism
(Magnetic Forces)

It is expected that students will:

O1. state the rules that explain how magnetic poles interact with each other
O2. determine the direction of the magnetic field lines for a permanent magnet
O3. use the right-hand rule to determine the magnetic field direction for a current-carrying wire or a solenoid
O4. determine the direction of the force exerted on a current-carrying conductor or a moving charge that is within a magnetic field
O5. solve problems for a current-carrying conductor placed in a magnetic field, involving:

- magnetic force
- current
- length of conductor in the field
- magnetic field

O6. solve problems for a charge moving through a magnetic field, involving:

- magnetic force
- charge
- speed
- magnetic field
- centripetal force
- mass
- radius

O8. solve problems for a solenoid, involving:

- current
- magnetic field (in the centre of the solenoid)
- number of turns per metre of solenoid

O9. give examples of practical uses for solenoids in the home and workplace

P: Electromagnetism
(Magnetic Induction)

It is expected that students will:

P1. solve problems for a conductor moving perpendicularly through a uniform magnetic field, involving:

- electromotive force (emf) between the ends of the conductor
- speed of the conductor
- magnetic field
- length of the conductor

P2. define magnetic flux
P3. calculate the magnetic flux through a loop of wire placed parallel or perpendicular to a magnetic field
P4. identify, from appropriate diagrams, situations that would produce an induced emf in a coil
P5. apply Faraday's law to solve problems involving:

- time
- change in flux
- induced emf
- number of turns

P6. apply Lenz's law to determine the direction of the induced current in a loop of wire
P7. describe how a generator uses induction to produce an electric current

P11. solve problems for an ideal transformer, involving:

- primary voltage
- secondary voltage
- number of primary windings
- number of secondary windings
- primary current
- secondary current

P12. identify a transformer as step-up or step-down