PHYSICS DUMMY NOTES

For Graduation / B.Sc. Level Revision

Mechanics • Waves • Thermodynamics • Electricity • Optics • Modern Physics

This is an original dummy/sample note created for practice, teaching layout, and student revision. It is not copied from any commercial textbook.

Prepared by: _____ Date: _____

Table of Contents

How to Use These Notes

- Read the concept first, then memorise only the final formula after understanding each symbol.
- Practise numerical problems daily; physics becomes easier when formula use becomes natural.
- For university exams, write definitions, assumptions, diagrams, equations, and final result clearly.
- Use SI units throughout unless a question specifically provides another system of units.

Common SI Base Units

- Length: metre (m), Mass: kilogram (kg), Time: second (s).
- Electric current: ampere (A), Temperature: kelvin (K), Amount of substance: mole (mol).
- Derived units include newton (N), joule (J), watt (W), pascal (Pa), coulomb (C), and volt (V).

Unit 1: Mechanics

1.1 Physical Quantities and Vectors

A physical quantity is any measurable property of a body or phenomenon. Scalar quantities have magnitude only, while vector quantities have both magnitude and direction. In mechanics, displacement, velocity, acceleration, force, and momentum are vectors.

Quantity	Meaning	SI Unit
Displacement	Shortest change in position with direction	m
Velocity	Rate of change of displacement	$\mathrm{m\ s^{-1}}$
Acceleration	Rate of change of velocity	$\mathrm{m\ s^{-2}}$
Force	Cause of change in motion	N

1.2 Equations of Motion

For motion with uniform acceleration in a straight line, the standard equations of motion are used. These equations are valid only when acceleration remains constant.

Formula	Use
$v = u + at$	Final velocity after time t
$s = ut + \frac{1}{2}at^2$	Displacement in time t
$v^2 = u^2 + 2as$	Relation without time
$s = \frac{1}{2}(u + v)t$	Average velocity form

Example

- A body starts from rest and accelerates at $2\ \mathrm{m\ s^{-2}}$ for 5 s. Final velocity: $v = 0 + 2 \times 5 = 10\ \mathrm{m\ s^{-1}}$.

1.3 Newton’s Laws of Motion

- First law: A body remains at rest or in uniform motion unless acted upon by an external unbalanced force.
- Second law: Force is the rate of change of momentum. For constant mass, $F = ma$.
- Third law: For every action, there is an equal and opposite reaction.

1.4 Work, Energy and Power

Work is done when a force produces displacement. Energy is the capacity to do work, and power is the rate of doing work. Conservation of energy is one of the most useful ideas in physics.

Concept	Formula	Unit
Work	$W = F\,s\cos\theta$	J
Kinetic energy	$K = \frac{1}{2}mv^2$	J
Potential energy	$U = mgh$	J
Power	$P = W/t$	W

Unit 2: Oscillations and Waves

2.1 Simple Harmonic Motion

Simple harmonic motion is periodic motion in which restoring force is directly proportional to displacement and always directed toward the mean position.

Term	Expression
Restoring force	$F = -kx$
Angular frequency	$\omega = 2\pi/T = 2\pi f$
Displacement	$x = A\sin(\omega t + \varphi)$
Time period of spring mass system	$T = 2\pi\sqrt{(m/k)}$

2.2 Waves

A wave transfers energy from one point to another without permanent transfer of matter. Mechanical waves need a medium, while electromagnetic waves can travel through vacuum.

Formula	Meaning
$v = f\lambda$	Wave speed equals frequency times wavelength
$I \propto A^2$	Intensity is proportional to square of amplitude
$y = A\sin(kx - \omega t)$	Travelling wave in positive x-direction

Exam Tip

- Clearly differentiate between transverse and longitudinal waves with examples: light is transverse; sound in air is longitudinal.

Unit 3: Thermodynamics

3.1 Temperature, Heat and Internal Energy

Temperature measures the degree of hotness of a body, while heat is energy transferred because of temperature difference. Internal energy is the sum of microscopic kinetic and potential energies of molecules.

3.2 First Law of Thermodynamics

The first law is a statement of conservation of energy for thermal processes. It connects heat supplied, change in internal energy, and work done by the system.

Law / Process	Expression	Remark
First law	$Q = \Delta U + W$	Heat supplied equals internal energy change plus work done
Isothermal	$\Delta U = 0$	Temperature constant
Adiabatic	$Q = 0$	No heat exchange
Isochoric	$W = 0$	Volume constant

3.3 Heat Engines

A heat engine converts heat energy into mechanical work in a cyclic process. Its efficiency can never be 100% because some heat must be rejected to the sink.

Quantity	Formula
Efficiency	$\eta = W/Q_1 = 1 - Q_2/Q_1$
Carnot efficiency	$\eta = 1 - T_2/T_1$

Unit 4: Electricity and Magnetism

4.1 Electrostatics

Electrostatics deals with electric charges at rest. Like charges repel and unlike charges attract. The force between two point charges is described by Coulomb's law.

Concept	Formula	Meaning
Coulomb force	$F = (1/4\pi\varepsilon_0)\, q_1 q_2/r^2$	Force between two point charges
Electric field	$E = F/q$	Force per unit positive test charge
Electric potential	$V = W/q$	Work done per unit charge

4.2 Current Electricity

Electric current is the rate of flow of charge. Ohm's law states that current through a conductor is proportional to potential difference if temperature and physical conditions remain constant.

Concept	Formula
Current	$I = Q/t$
Ohm's law	$V = IR$
Resistance of wire	$R = \rho L/A$
Electrical power	$P = VI = I^2R = V^2/R$

4.3 Magnetism

A moving charge produces magnetic effects. The force on a charge moving in a magnetic field depends on charge, velocity, magnetic field, and the angle between velocity and field.

Formula	Description
$F = qvB\sin\theta$	Magnetic force on moving charge
$F = BIL\sin\theta$	Force on current-carrying conductor
$\Phi = BA\cos\theta$	Magnetic flux
$\varepsilon = -d\Phi/dt$	Faraday's law of electromagnetic induction

Unit 5: Optics

5.1 Geometrical Optics

Geometrical optics studies light using rays. Reflection occurs when light bounces back from a surface, and refraction occurs when light changes direction while entering another medium.

Concept	Formula
Snell's law	$n_1 \sin i = n_2 \sin r$
Lens formula	$1/f = 1/v - 1/u$
Magnification	$m = v/u$ = image height/object height
Power of lens	$P = 1/f$ (f in metre)

5.2 Wave Optics

Wave optics explains phenomena such as interference, diffraction, and polarization. These phenomena cannot be fully explained by the simple ray model of light.

Phenomenon	Condition / Formula
Constructive interference	Path difference $= n\lambda$
Destructive interference	Path difference $= (2n + 1)\lambda/2$
Young's fringe width	$\beta = \lambda D/d$

Diagram Reminder

- For optics questions, draw clean ray diagrams with arrows, object, image, focus, pole/optical centre, and principal axis labelled.

Unit 6: Modern Physics

6.1 Quantum Nature of Radiation

Modern physics began when classical ideas failed to explain blackbody radiation, photoelectric effect, and atomic spectra. Quantum theory states that energy exchange can occur in discrete packets called quanta.

Concept	Formula
Photon energy	$E = hf = hc/\lambda$
Photoelectric equation	$hf = \varphi + K_{max}$
de Broglie wavelength	$\lambda = h/p$

6.2 Atomic and Nuclear Physics

Atomic physics studies the structure and energy states of atoms. Nuclear physics studies the nucleus, radioactivity, nuclear reactions, and mass-energy conversion.

Topic	Formula / Point
Bohr angular momentum	$mvr = nh/2\pi$
Mass-energy relation	$E = mc^2$
Radioactive decay	$N = N_0e^{-\lambda t}$
Half-life	$T_{1/2} = 0.693/\lambda$

Important Distinction

- Atomic transitions involve electrons and usually emit photons.
- Nuclear reactions involve the nucleus and generally release much larger energy.

Quick Formula Sheet

Area	Important Formulae
Mechanics	$v = u + at$; $s = ut + \frac{1}{2}at^2$; $F = ma$; $p = mv$; $W = Fs\cos\theta$; $K = \frac{1}{2}mv^2$
SHM & Waves	$F = -kx$; $\omega = 2\pi f$; $T = 2\pi\sqrt{(m/k)}$; $v = f\lambda$
Thermodynamics	$Q = \Delta U + W$; $\eta = W/Q_1$; $\eta_{Carnot} = 1 - T_2/T_1$
Electricity	$F = kq_1q_2/r^2$; $E = F/q$; $V = IR$; $R = \rho L/A$; $P = VI$
Magnetism	$F = qvB\sin\theta$; $\Phi = BA\cos\theta$; $\varepsilon = -d\Phi/dt$
Optics	$n_1 \sin i = n_2 \sin r$; $1/f = 1/v - 1/u$; $\beta = \lambda D/d$
Modern Physics	$E = hf$; $\lambda = h/p$; $E = mc^2$; $N = N_0e^{-\lambda t}$

Dimensional Analysis Reminder

Dimensional analysis checks whether an equation is physically possible. The dimensions on the left-hand side and right-hand side of any correct physical equation must be the same.

Quantity	Dimension
Velocity	$[LT^{-1}]$
Acceleration	$[LT^{-2}]$
Force	$[MLT^{-2}]$
Energy / Work	$[ML^2T^{-2}]$
Power	$[ML^2T^{-3}]$

Practice Questions

Short Answer Questions

1. Define scalar and vector quantities with two examples each.
2. State Newton’s three laws of motion.
3. Explain the principle of conservation of energy.
4. What is simple harmonic motion? Give one practical example.
5. Differentiate between isothermal and adiabatic processes.
6. Write Ohm’s law and mention its condition of validity.
7. Define refractive index and write Snell’s law.
8. What is the photoelectric effect? State Einstein’s photoelectric equation.

Numerical Practice

9. A car accelerates uniformly from rest to 20 m s^{-1} in 10 s. Find acceleration and distance covered.
10. A 2 kg body moving at 5 m s^{-1} is stopped by a constant force in 4 s. Find the force and work done.
11. A wave has frequency 500 Hz and wavelength 0.68 m. Find its speed.
12. A 10 Ω resistor carries 2 A current. Find voltage and power consumed.
13. Find the photon energy of light of wavelength 600 nm. Use $h = 6.63 \times 10^{-34}$ J s and $c = 3 \times 10^8$ m s^{-1}.

Long Answer / Theory Practice

14. Derive the equations of motion for uniformly accelerated motion.
15. Explain Carnot engine and derive its efficiency expression.
16. Describe Young’s double-slit experiment and obtain the expression for fringe width.
17. Discuss the limitations of classical physics that led to quantum theory.

Last-Minute Revision Checklist

- Revise all definitions and SI units.
- Practise at least five numerical problems from each unit.
- Learn derivations step-by-step, not by rote memorisation only.
- Draw labelled diagrams wherever applicable.

- Check dimensions and units in every numerical answer.

Student Note

- These notes are intentionally concise. For final examination preparation, match each topic with your university syllabus and previous-year question papers.