



KAMALDNP

kamaldnp.com • IT Training, Varanasi

PDF created by Raj Kamal using AI

Model Practice Paper — Applied Physics-I

BTEUP Diploma • 1st Semester (First Year — Common Curriculum, All 41 Branches)
Session 2026-27

Practice Questions / Model Paper — NOT a BTEUP board paper

Time: 2.30 Hours

Max. Marks: 60

General Instructions:

- All questions are compulsory. Each question has three parts (a), (b) and (c) — **answer any two** of the three parts in every question.
- Each part carries 6 marks; each question carries 12 marks.
- Draw neat, labelled diagrams wherever they are asked or wherever they support your answer.
- Write your answers in your own words, in the same order as the questions.

About this paper: This is an original practice (model) paper prepared by KAMALDNP Academy from the official BTEUP 2026-27 syllabus topics for this subject. It is NOT a BTEUP board paper, and no question in it is promised to appear in your examination. Its structure follows the board's last published paper pattern (5 questions, each with three parts of which any two are to be answered), scaled to this subject's theory maximum of 60 marks (external) in the verified 2026-27 scheme; the printed time follows the same last published pattern. The 2026-27 scheme's own paper format has not been published yet — when your board paper is in your hand, its printed instructions govern.

Q1. (From: Mechanics) — Answer any two of the following:

- (a) State Newton's three laws of motion, giving one example from daily life for each law. **(6)**

(b) Define work, energy and power with their SI units. A constant force of 50 N pushes a body through a distance of 8 m in the direction of the force in 4 seconds. Calculate the work done and the power developed. (6)

(c) A car of mass 1000 kg is moving on a level circular road of radius 50 m. The coefficient of friction between the tyres and the road is 0.4. Calculate the maximum speed at which the car can take the turn without skidding. (Take $g = 10 \text{ m/s}^2$.) Also name the force that provides the centripetal force in this case. (6)

Q2. (From: Electricity & Magnetism) — Answer any two of the following:

(a) Define electric charge, electric current and voltage, and write the SI unit of each. How much charge passes through a wire in 10 seconds when a steady current of 2 A flows in it? (6)

(b) State Ohm's law. A resistor of 4Ω and a resistor of 6Ω are connected in series across a 20 V battery. Find the total resistance of the combination, the current flowing in the circuit, and the voltage across each resistor. (6)

(c) Describe the magnetic effect of an electric current. With the help of a diagram description, explain the magnetic field around a straight current-carrying conductor, and write how an electromagnet is made and one of its uses. (6)

Q3. (From: Optics & Waves) — Answer any two of the following:

(a) State the laws of reflection and the laws of refraction of light. Write any three differences between reflection and refraction. (6)

(b) An object is placed 30 cm from a convex lens of focal length 20 cm. Using the lens formula, find the position of the image, and state its nature and magnification. State clearly the sign convention you use. (6)

(c) What is wave motion? Define frequency and wavelength, and write the relation between wave velocity, frequency and wavelength. A sound wave of frequency 170 Hz travels in air with a velocity of 340 m/s. Find its wavelength. (6)

Q4. (From: Modern Physics) — Answer any two of the following:

(a) Describe briefly the structure of an atom with a neat labelled diagram, including the nucleus, the shells (orbits), and how the electrons are arranged. Give one example of electron arrangement in an atom. (6)

(b) What are semiconductors? Differentiate between intrinsic and extrinsic semiconductors, and explain how p-type and n-type semiconductors are formed, naming the majority charge carrier in each. (6)

(c) Write a short note on lasers: what the word LASER stands for, the basic idea of how laser light is produced, any three properties of laser light, and two uses of lasers. (6)

Q5. (From: Optics & Waves + Modern Physics (mixed)) — Answer any two of the following:

(a) The refractive index of a glass is 1.5. Calculate the speed of light in this glass. (Take the speed of light in vacuum as $3 \times 10^8 \text{ m/s}$.) (6)

(b) A person standing in front of a high wall claps once and hears the echo after 1.5 seconds. Calculate the distance of the wall from the person. (Take the speed of sound in air as 340 m/s.) **(6)**

(c) Explain how a p-n junction is formed in a semiconductor. What is the depletion region, and write one simple use of a p-n junction? **(6)**



Model Answer Outline — Applied Physics-I

The key points a full-marks answer contains, question by question.

Practice Questions / Model Paper — NOT a BTEUP board paper

Q1(a)

- First law (law of inertia): a body continues in its state of rest or of uniform motion in a straight line unless acted upon by an external force; example: passengers jerk forward when a bus brakes suddenly
- Second law: the rate of change of momentum of a body is proportional to the applied force and takes place in the direction of the force; in formula form $F = ma$
- Second-law example: a larger force gives a larger acceleration to the same mass, or pushing an empty trolley is easier than pushing a loaded one
- Third law: to every action there is an equal and opposite reaction; the two forces act on different bodies
- Third-law example: a walker pushes the ground backwards and the ground pushes the walker forwards (or recoil of a gun)

Q1(b)

- Work is done when a force moves its point of application in its own direction: $W = F \times s$ (joule)
- Work done: $W = 50 \times 8 = 400 \text{ J}$
- Kinetic energy is the energy due to motion, $KE = (1/2) m v^2$; here the work done appears as energy transferred to the body
- Power is the rate of doing work: $P = W / t$ (watt)
- Power: $P = 400 / 4 = 100 \text{ W}$
- Final answer: work done = 400 J, power = 100 W

Q1(c)

- On a level road the centripetal force needed for the turn is provided by the friction between the tyres and the road
- Maximum available friction: $f = \mu m g$, and the needed centripetal force is $m v^2 / r$
- At the limiting speed: $m v^2 / r = \mu m g$, so $v = \sqrt{\mu g r}$
- Substitution: $v = \sqrt{(0.4 \times 10 \times 50)} = \sqrt{(200)}$
- Final answer: maximum safe speed $\approx 14.14 \text{ m/s}$; if the car goes faster than this, friction cannot provide enough centripetal force and the car skids outwards

Q2(a)

- Electric charge is the basic property of matter due to which it experiences electric and magnetic effects; SI unit coulomb (C)

- Electric current is the rate of flow of charge: $I = Q / t$; SI unit ampere (A)
- Substitution for the given data: $Q = I \times t = 2 \times 10 = 20 \text{ C}$
- Voltage (potential difference) is the work done per unit charge in moving it between two points: $V = W / Q$; SI unit volt (V)
- Final answer: charge passed = 20 coulomb in 10 seconds at 2 ampere

Q2(b)

- Ohm's law: the current through a conductor is directly proportional to the voltage across it (temperature remaining constant), $V = IR$
- For resistors in series the resistances add: $R = 4 + 6 = 10 \Omega$
- Total current: $I = V / R = 20 / 10 = 2 \text{ A}$ (the same current flows through both resistors in series)
- Voltage across the 4Ω resistor: $V_1 = IR_1 = 2 \times 4 = 8 \text{ V}$
- Voltage across the 6Ω resistor: $V_2 = IR_2 = 2 \times 6 = 12 \text{ V}$; check: $8 + 12 = 20 \text{ V}$, equal to the battery voltage

Q2(c)

- A current-carrying conductor produces a magnetic field around it; describe/draw concentric circular field lines around a straight wire, using the right-hand thumb rule to get their direction
- The field becomes stronger when the current is increased or near the wire, and its direction reverses when the current is reversed
- If the wire is wound into a coil (solenoid), the field is like that of a bar magnet, strong and nearly uniform inside the coil
- An electromagnet is made by passing current through a coil wound on a soft-iron core; its strength can be switched and controlled
- One use: electric bell, electric motor, lifting scrap iron in a junkyard crane, or relays

Q3(a)

- Law of reflection: the angle of incidence equals the angle of reflection, and the incident ray, reflected ray and normal at the point of incidence all lie in the same plane
- Laws of refraction: the incident ray, refracted ray and normal lie in the same plane, and $\sin i / \sin r$ is constant for a given pair of media (Snell's law)
- In refraction the ray bends because the speed of light changes on entering a different medium
- Difference: in reflection the light returns into the same medium and its speed does not change; in refraction it enters a new medium
- Difference: a ray bends towards the normal when going into a denser medium and away from the normal when going into a rarer medium, while reflection simply reverses the direction of travel

Q3(b)

- State the sign convention used (for example, real-is-positive) and the lens formula: $1/f = 1/v + 1/u$
- Formula step: $1/v = 1/f - 1/u$
- Substitution: $1/v = 1/20 - 1/30 = (3 - 2)/60 = 1/60$
- Image distance: $v = 60$ cm, on the opposite side of the lens from the object
- Magnification: magnitude = $v / u = 60 / 30 = 2$, so the image is twice the size of the object; the image is real and inverted ($m = -2$ under the Cartesian sign convention)

Q3(c)

- A wave transfers energy from one place to another without the transfer of matter
- Frequency f is the number of complete vibrations per second (hertz); wavelength λ is the distance between two nearest points vibrating in the same phase
- Relation between velocity, frequency and wavelength: $v = f \lambda$
- Formula step: $\lambda = v / f$
- Substitution: $\lambda = 340 / 170 = 2$
- Final answer: wavelength of the sound wave = 2 m

Q4(a)

- An atom has a small, dense, positively charged nucleus at the centre containing protons and neutrons, with electrons revolving around it in fixed orbits (shells)
- Bohr's idea: electrons move only in certain permitted orbits of fixed energy and do not radiate energy while in them
- An electron absorbs energy to jump to a higher orbit and emits energy when it falls back to a lower orbit
- Give the distribution idea with one small example, such as sodium (atomic number 11) as 2, 8, 1 in the K, L and M shells
- Labelled diagram expected: nucleus at the centre with two or three circular shells around it and electrons marked on them

Q4(b)

- A pure semiconductor (such as silicon or germanium) is called intrinsic; its conductivity is low and rises with temperature
- An extrinsic semiconductor is made by adding a small controlled amount of impurity to a pure semiconductor; this process is called doping
- n-type: doping with a pentavalent impurity (such as arsenic or phosphorus) gives extra free electrons, so electrons are the majority charge carriers
- p-type: doping with a trivalent impurity (such as boron or aluminium) creates holes, so holes are the majority charge carriers
- In both types the material as a whole remains electrically neutral

Q4(c)

- LASER stands for Light Amplification by Stimulated Emission of Radiation

- Working idea in brief: atoms are raised to an excited state (pumping), and a passing photon triggers them to emit identical photons together (stimulated emission)
- Property: laser light is monochromatic, i.e. of a single wavelength or colour
- Properties: it is highly coherent, very intense and travels as a narrow beam in one direction with very little spreading
- Two uses: cutting and welding metals, surgery and eye treatment, barcode scanning, optical-fibre communication, or holography (any two)

Q5(a)

- Refractive index of a medium: $\mu = \text{speed of light in vacuum (or air)} / \text{speed of light in the medium}$
- So the speed of light in the medium is $v = c / \mu$
- Substitution: $v = (3 \times 10^8) / 1.5$
- Final answer: speed of light in the glass = 2×10^8 m/s
- Note in the answer: light slows down in glass, which is why a ray bends (refracts) at the surface

Q5(b)

- The sound travels from the person to the wall and back, so it covers twice the distance of the wall
- Formula: total distance $2d = v \times t$, i.e. $d = (v \times t) / 2$
- Substitution: $d = (340 \times 1.5) / 2 = 510 / 2$
- Final answer: distance of the wall = 255 m
- Unit check: answer is in metres, and an echo is heard distinctly only when the reflecting surface is far enough away (about 17 m or more)

Q5(c)

- A p-n junction is formed when a p-type semiconductor and an n-type semiconductor are joined together in a single crystal
- Near the junction, electrons from the n-side and holes from the p-side diffuse across and combine
- This sets up a thin region near the junction with no free charge carriers, called the depletion region (depletion layer)
- A small potential barrier develops across the junction which opposes further diffusion of charge carriers
- One simple use: a p-n junction works as a diode and allows current mainly in one direction, so it is used for rectification (changing AC into DC)