

Newton's Academy

PHYSICS

Time: 3 Hrs.

Max. Marks: 70

General Instructions:

The question paper is divided into **four** sections:

- (1) **Section A:** Q. No. 1 contains **Ten multiple choice** type of questions carrying **One mark** each.
Q. No. 2 contains **Eight very short answer** type of questions carrying **One mark** each.
- (2) **Section B:** Q. No. 3 to Q. No. 14 contain **Twelve short answer** type of questions carrying **Two marks** each. (Attempt any **Eight**).
- (3) **Section C:** Q. No. 15 to Q. No. 26 contain **Twelve short answer** type of questions carrying **Three marks** each. (Attempt any **Eight**).
- (4) **Section D:** Q. No. 27 to Q. No. 31 contain **Five long answer** type of questions carrying **Four marks** each. (Attempt any **Three**).
- (5) Use of the log table is allowed. Use of calculator is **not** allowed.
- (6) Figures to the right indicate full marks.
- (7) For each multiple choice type of question, it is mandatory to write the correct answer along with its alphabet. e.g., (a)...../(b)...../(c)...../(d)..... No marks(s) shall be given, if **ONLY** the correct answer or the alphabet of the correct answer is written. Only the first attempt will be considered for evaluation.
- (8) **Physical Constants:**
 - (i) $\mu_0 = 4\pi \times 10^{-7} \text{ Wb/Am}$
 - (ii) $\sigma = 5.7 \times 10^{-8} \text{ J/m}^2\text{s K}^4$
 - (iii) $g = 9.8 \text{ m/s}^2$
 - (iv) $\pi = 3.142$

SECTION – A

Q.1. Select and write the correct answers for the following multiple choice type of questions: [10]

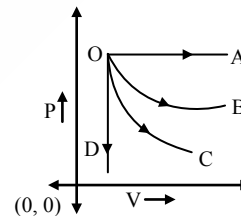
- (i) Raindrops are spherical in shape because of _____.

(a) surface tension	(b) capillarity
(c) downward motion	(d) acceleration due to gravity

- (ii) The average K.E. of a gas is _____.
 - (a) directly proportional to absolute temperature of gas
 - (b) directly proportional to square of absolute temperature of gas
 - (c) directly proportional to square root of absolute temperature of gas
 - (d) inversely proportional to absolute temperature of gas

- (iii) A graph of pressure versus volume for an ideal gas for different processes is as shown. In the graph curve OA represents _____.

(a) isochoric process	(b) isothermal process
(c) isobaric process	(d) adiabatic process



- (v) What changes are observed in a diffraction pattern if the whole apparatus is immersed in water?
- the wavelength of light increases
 - width of central maximum increases
 - width of central maximum decreases
 - frequency of light decreases
- (vi) The magnitude of the magnetic field at the centre of a circular current carrying coil varies _____.
- inversely with the square of the radius of the coil
 - directly with the radius of the coil
 - inversely with the radius of the coil
 - directly with the square of the radius of the coil
- (vii) Balmer series is obtained when all transitions of electron terminate on _____.
- 2nd orbit
 - 1st orbit
 - 3rd orbit
 - 4th orbit
- (viii) A simple harmonic oscillator has amplitude 16 cm and period 4 seconds. The interval of time required by it to travel from $x = 16$ cm to $x = 8$ cm is _____.
- $\frac{1}{2}$ second
 - $\frac{2}{3}$ second
 - $\frac{5}{6}$ second
 - $\frac{4}{3}$ second
- (ix) In potentiometer experiment, the cell balances at a length of 240 cm. When the cell is shunted by a resistance of 2Ω , the balancing length becomes 120 cm. The internal resistance of the cell is _____.
- 4Ω
 - 2Ω
 - 1Ω
 - 0.5Ω
- (x) A small piece of metal wire is dragged across the gap between the pole pieces of magnet in 0.5 second. The magnetic flux between the pole pieces is 8×10^{-4} weber. The emf induced in the wire is _____.
- 1.6 millivolt
 - 16 millivolt
 - 1.6 volt
 - 16 volt

Q.2. Answer the following questions:
[8]

- In which thermodynamic process the total internal energy of system remains constant?
- State the law of conservation of angular momentum.
- What is shunt?
- What happens to the fringe width in diffraction pattern if the diameter of wire is increased?
- What is perfectly black body?
- State the formula for electric field intensity at a point outside an infinitely long charged cylindrical conductor.
- The half-life of a nuclear species is 1.386 years. Calculate its decay constant per year.
- An automobile engine develops 62.84 kW while rotating at a speed of 1200 rpm. What torque does it deliver?

SECTION – B

Attempt any EIGHT questions of the following:

[16]

- Q.3. What is capillarity? State any two uses of capillarity.
- Q.4. Define: (i) Emissive power
(ii) Co-efficient of emission
- Q.5. State any two characteristics of progressive waves.
- Q.6. Draw neat, labelled diagram of a parallel plate capacitor with a dielectric slab between the plates.
- Q.7. State the formula for magnetic potential energy of a dipole and hence obtain the minimum and maximum magnetic potential energy.
- Q.8. What is gyromagnetic ratio? Write the necessary expression.
- Q.9. How does the wave theory of light fail to explain the observations from experiment on photoelectric effect.
[Give any two points]
- Q.10. A system releases 125 kJ of heat while 104 kJ of work is done on the system. Calculate the change in internal energy of the gas.
- Q.11. A plane wavefront of light of wavelength 4000 \AA is incident on two slits on a screen perpendicular to the direction of light ray. If the total separation of 10 bright fringes on a screen 2 m away is 2 cm, find the distance between the slits.
- Q.12. An emf of 96.0 mV is induced in the windings of a coil when the current in a nearby coil is increasing at the rate of 1.20 A/s. What is the mutual inductance (M) of the coils?
- Q.13. An aircraft of wing span of 50 m flies horizontally in earth's magnetic field of $6 \times 10^{-5} \text{ T}$. Calculate the velocity required to generate an e.m.f. of 1.2 V between the tips of the wings of the aircraft.
- Q.14. The surface density of a uniform disc of radius 10 cm is 2 kg/m^2 . Find its MI about an axis passing through its centre and perpendicular to its plane.

SECTION – C

Attempt any EIGHT questions of the following:

[24]

- Q.15. State zeroth law of thermodynamics. What are the limitations of first law of thermodynamics?
- Q.16. What is de-Broglie hypothesis? Obtain the relation for de-Broglie wavelength.
- Q.17. Derive an expression for kinetic energy of a rotating body.
- Q.18. Derive the laws of reflection of light using Huygens' theory.
- Q.19. Derive an expression for orbital magnetic moment of an electron revolving around the nucleus in an atom. State the formula for the Bohr magneton.
- Q.20. Explain the terms:
(a) Capacitive reactance
(b) Inductive reactance
(c) Impedance
- Q.21. Define α_{dc} and β_{dc} . Obtain the relation between them.
- Q.22. A pipe at both the ends has a fundamental frequency of 600 Hz. The first overtone of a pipe closed at one end has the same frequency as the first overtone of the open pipe. How long are the two pipes?
[Velocity of sound in air = 330 m/s]

- Q.23.** A small particle carrying a negative charge of 1.6×10^{-19} C is suspended in equilibrium between two horizontal metal plates 10 cm apart, having a potential difference of 4000 volts across them. Find the mass of the particle.
- Q.24.** A 1000 mH inductor, 36 μ F capacitor and 12 Ω resistor are connected in series to 120 V, 50 Hz AC source. Calculate:
- impedance of the circuit at resonance
 - current at resonance
 - resonant frequency
- Q.25.** A current of equal magnitude flows through two long parallel wires separated by 2 cm. If force per unit length of 4×10^{-2} N/m acts on both the wires respectively, calculate the current through each wire.
- Q.26.** Calculate the energy radiated in half a minute by a black body of surface area 200 cm² at 127° C.

SECTION – D

Attempt any **THREE** questions of the following:

[12]

- Q.27.** Discuss analytically the composition of two linear SHMs having same period and along the same path. Obtain the expression for resultant amplitude.
Find the resultant amplitude when the phase difference is
- zero radians
 - $\frac{\pi}{2}$ radians.
- Q.28.** What is a transformer? With the help of a suitable diagram describe working of transformer.
- Q.29.** Define angle of contact. State any two properties of angle of contact.
Find the difference of pressure between inside and outside of a spherical water drop of radius 2 mm, if surface tension of water is 73×10^{-3} N/m.
- Q.30.** State Kirchhoff's laws of electrical network.
When two cells of emfs E_1 and E_2 are connected in series so as to assist each other, their balancing length on potentiometer wire is found to be 3.2 m. When two cells are connected in series so as to oppose each other, the balancing length is found to be 0.7 m. Compare the emfs of two cells.
- Q.31.** State the first and second postulate of Bohr's atomic model. Compute the ratio of longest wavelengths of Lyman and Balmer series in hydrogen atom.