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 mark(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) $c = 3 \times 10^8$ m/s

(ii) $h = 6.63 \times 10^{-34}$ Js

(iii) $\pi = 3.142$

(iv) $g = 9.8$ m/s^2

(v) $\epsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2

(vi) $\mu_0 = 4\pi \times 10^{-7}$ Wb/A –m

(vii) $R_H = 1.097 \times 10^7$ m^{-1}

(viii) Real gas constant R = 8.31 J mol^{-1} K^{-1}

SECTION – A

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

(i) A body performing uniform circular motion has constant _____.
(a) velocity (b) kinetic energy
(c) displacement (d) acceleration

(ii) When soluble substance such as common salt (i.e. sodium chloride) is dissolved in water, surface tension of water _____.
(a) decreases (b) becomes zero
(c) remains the same (d) increases

(iii) Periodic time of angular oscillations of a bar magnet is proportional to the _____.
(a) ratio of moment of inertia and magnetic field
(b) ratio of magnetic field and moment of inertia
(c) square root of the ratio of moment of inertia and magnetic field
(d) square root of the ratio of magnetic field and moment of inertia

(iv) The coefficient of absorption of a body is equal to its coefficient of emission at a given temperature is called _____.
(a) Stefan's law (b) Newton's law of cooling
(c) Kirchhoff's law of heat radiation (d) Boyle's law

(v) The second law of thermodynamics deals with the transfer of _____.
(a) work done (b) energy
(c) pressure (d) heat

(vi) Which of the following phenomenon proves that light is a transverse wave _____.
(a) Reflection (b) Interference
(c) Diffraction (d) Polarization

(vii) Magnitude of induced e.m.f. produced between the ends of a conductor of length $\frac{\text{'L'}}{2}$ moving with a uniform velocity 'v' at right angles to a uniform magnetic field of intensity '2B' will be _____.
(a) $\frac{BLv}{4}$ (b) $\frac{BLv}{2}$
(c) BLv (d) 2BLv

(viii) Solar cell operates on the principle of _____.
(a) diffusion (b) recombination
(c) photovoltaic action (d) photoelectric effect

(ix) A body performing linear S. H. M. experiences a force of 0.2 N when displaced through 4 cm from the mean position. Its force constant will be _____.
(a) 2 N/m (b) 2.5 N/m
(c) 5 N/m (d) 8 N/m

(x) If a current of 1A flows through a solenoid of length 25 cm and made up of 250 turns of copper wire then the magnitude of magnetic induction inside the solenoid will be _____.
(a) 0.12568×10^{-3} T (b) 1.2568×10^{-3} T
(c) 1.2568×10^{2} T (d) 1.2568×10^{4} T

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

(i) State the formula for end correction in a resonance tube experiment.

(ii) Categorize the following into polar and non-polar dielectrics:
(a) H_2O (b) CO_2

(iii) Define potential gradient.

(iv) Calculate the period of a particle performing linear S.H.M. with maximum speed of 0.08 m/s and maximum acceleration of 0.32 m/s^2.

(v) Define gyromagnetic ratio.

(vi) State the conditions for current and impedance in parallel resonance circuit.

(vii) Radius of the third Bohr orbit is 0.477 nm. Calculate the radius of the second Bohr orbit.

(viii) Name the logic gate having single input- single output.

SECTION-B

Attempt any EIGHT questions of the following: **[16]**

Q.3. State the conditions for a steady interference pattern.

Q.4. Derive an expression for electric field intensity due to an infinitely long straight charged wire.

Q.5. What are eddy currents? Write two applications of eddy currents.

Q.6. Define and state formulae for:
(a) Inductive reactance (b) Capacitive reactance

Q.7. Draw a p –V diagram and explain the concept of positive work done and negative work done.

Q.8. State the law of length and the law of linear density for a vibrating string.

Q.9. For a moving coil galvanometer, show that $S = \frac{G}{n-1}$,
where S is shunt resistance.
G is galvanometer resistance
n is ratio of total current to the full scale deflection current.

Q.10. The de - Broglie wavelengths associated with an electron and a proton are same. Calculate the ratio of their kinetic energies.
[Given: $m_p = 1836\ m_e$]

Q.11. Derive an expression for 'Half Life Time' of a radioactive material using the 'Law of Radioactive Decay'.

Q.12. A motorcyclist performs stunt along the cylindrical wall of a 'Well of Death' of inner radius 4 m. Coefficient of static friction between the tyres and the wall is 0.4. Calculate the maximum period of revolution.
[Use $g = 10\ m/s^2$]

Q.13. Calculate the diameter of a water drop, if the excess pressure inside the drop is 80 N/m^2:
[Surface Tension of water = 7.2×10^{-2} N/m]

Q.14. Calculate the current through a long straight wire at a distance of 2.4 cm, where the magnetic field intensity is 16 μ T.

SECTION-C

Attempt any EIGHT questions of the following: **[24]**

Q.15. Explain construction and working of Ferry's Black Body.

Q.16. Show that the deflection produced in a moving coil galvanometer is directly proportional to the current flowing through its coil or vice-versa.

Q.17. With the help of a neat circuit diagram, explain the working of a half wave rectifier. Draw input-output waveforms.

Q.18. Obtain the expression for the period of simple pendulum performing S.H.M.

Q.19. Show that the beat frequency of two interfering sound waves is the difference between the individual frequencies of the two sound waves.

Q.20. Obtain an expression for orbital magnetic moment of an electron revolving around the nucleus of an atom.

Q.21. State Einstein's photoelectric equation. Hence, explain any two characteristics of photoelectric effect.

Q.22. Calculate the shortest wavelength of Paschen series and longest wavelength of Balmer series for H – atom.

Q.23. A 60 W filament lamp loses all its energy by radiation from its surface. The emissivity of the filament surface is 0.5 and the surface area is $5 \times 10^{-5}\ m^2$. Calculate the temperature of the filament.
[Given : $\sigma = 5.67 \times 10^{-8}\ Jm^{-2}\ s^{-1}\ K^{-4}$]

Q.24. Two capacitors of capacities C_1 and C_2 are connected in parallel and this combination is connected in series with a capacitor of capacity C_3. Calculate the equivalent capacity of the combination of capacitors.

Q.25. With an unknown resistance X in the left gap and a resistance of 30 Ω in the right gap of a meter-bridge, the null point is obtained at 40 cm from the left end of the wire. Calculate the unknown resistance and shift in the position of the null point, when resistance in each gap is increased by 15Ω.

Q.26. An inductor of inductance 200 mH is connected to an A.C. source of peak e.m.f. 210 V and frequency 50 Hz. Calculate the peak current and instantaneous voltage of the source when the current is at its peak value.

SECTION - D

Attempt any THREE questions of the following: **[12]**

Q.27. State and prove theorem of parallel axes.

Q.28. Define:

(i) Isothermal process (ii) Adiabatic process

One mole of an ideal gas is enclosed in an ideal cylinder at 1.0 mPa and 27°C. The gas is allowed to expand till its volume is doubled. Calculate the work done if the expansion is isobaric.

Q.29. Distinguish between streamline flow and turbulent flow. (Any Two points).

Calculate the terminal velocity with which an air bubble of diameter 0.4 mm rise through a liquid of viscosity 0.1 Ns/m^2 and density 900 kg/m^3. Density of air is 1.29 kg/m^3.

Q.30. What are Fraunhofer diffraction and Fresnel diffraction?

A plane wavefront of light of wavelength 5500Å is incident onto a slit perpendicular to the direction of light rays. If the total separation of 10 bright fringes on a screen 2 m away is 2 cm, calculate the distance between the slits.

Q.31. What is a transformer? State the working principle of transformer. Hence, distinguish between Step up and Step down transformer. (Any Two points).