CLASS XII (2019-20)
PHYSICS (042)
MOCK TEST -1

Time : 3 Hours **Maximum Marks : 70**

General Instructions :

(i) All questions are compulsory. There are 37 questions in all.
(ii) This question paper has four sections: Section A, Section B, Section C, Section D.
(iii) Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each and Section D contains three questions of five marks each.
(iv) There is no overall choice. However, internal choices has been provided in two question of one marks each, two question of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
(v) You may use the following values of physical constants wherever necessary.

$c = 3 \times 10^8\ \mathrm{m/s}$, $h = 6.63 \times 10^{-34}\mathrm{Js}$, $e = 1.6 \times 10^{-19}\mathrm{C}$, $\mu_0 = 4\pi \times 10^{-7}\mathrm{TmA}^{-1}$,

$\varepsilon_0 = 8.854 \times 10^{-12}\mathrm{C}^2\mathrm{N}^{-1}\mathrm{m}^{-2}$, $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\mathrm{Nm}^2\mathrm{C}^{-2}$, $m_e = 9.1 \times 10^{-31}\mathrm{kg}$,

Mass of neutron $= 1.675 \times 10^{-27}\mathrm{kg}$,

Mass of proton $= 1.673 \times 10^{-27}\mathrm{kg}$, Avogardro's number $= 6.023 \times 10^{23}$ per gram mole,

Boltzmann constant $= 1.38 \times 10^{-23}\mathrm{JK}^{-1}$.

SECTION-A

DIRECTION : (Q 1-Q 10) Select the most appropriate option from those given below each question

Q1. When a body is connected to the earth, then electrons from the earth, flow into the body. It means that the body is [1]

(a) unchanged (b) an insulator
(c) positively charged (d) negatively charged

Q2. The energy stored in a capacitor is actually stored [1]

(a) between the plates (b) on the positive plate
(c) on the negative plate (d) on the outer surfaces of the plates

Q3. A charge moving with uniform velocity produces [1]

(a) only an electric field (b) only a magnetic field
(c) electromagnetic field (d) none of these

Q4. The image formed by objective lens of a compound Microscope is [1]

(a) Virtual and diminished (b) Real and diminished
(c) Real and large (d) Virtual and Large

Q5. The magnifying power of a magnifying glass of power 12 dioptre is [1]

(a) 4 (b) 1200
(c) 3 (d) 25

Q6. In a closed circuit of resistance $10\,\Omega$, the linked flux varies with time according to relation $\phi = 6t^2 - 5t + 1$. At $t = 0.25$ second, the current (in Ampere) flowing through the circuit is [1]

(a) 0.4 (b) 0.2
(c) 2.0 (d) 4.0

Q7. In an oscillating LC circuit, maximum charge on the capacitor is Q. The charge on this capacitor, when the energy is stored equally between the electric and magnetic fields is [1]

(a) Q (b) $\frac{Q}{2}$
(c) $\frac{Q}{\sqrt{3}}$ (d) $\frac{Q}{\sqrt{2}}$

Q8. A parallel plate capacitor consists of two circular plates each of radius 2 cm separated by distance of 0.1 mm. If rate of change of potential difference is $5 \times 10^{13}\ \text{V-s}^{-1}$, then displacement current will be [1]

(a) $5.6\ \text{A}$ (b) $5.6 \times 10^2\ \text{A}$
(c) $5.6 \times 10^3\ \text{A}$ (d) $5.6 \times 10^4\ \text{A}$

Q9. Light of two different frequencies, whose photons have energies of 1 eV and 2.5 eV successively illuminate a metal whose work function is 0.5 eV. The ratio of maximum velocities of the emitted electrons will be [1]

(a) 1 : 5 (b) 1 : 4
(c) 1 : 2 (d) 1 : 1

Q10. In the nuclear fusion reaction ${}_1\text{H}^2 + {}_1\text{H}^3 \rightarrow {}_2\text{He}^4 + n$, the repulsive potential energy between the two nuclei is $7.7 \times 10^{-14}\ \text{J}$. The temperature at which the gases must be heated to initiate the reaction is nearly (Boltzmann's constant $k = 1.38 \times 10^{-23}\ \text{J-K}^{-1}$) [1]

(a) $10^9\ \text{K}$ (b) $10^7\ \text{K}$
(c) $10^5\ \text{K}$ (d) $10^3\ \text{K}$

DIRECTION : (Q11-Q15) Fill in the blanks with appropriate answer.

Q11. The net charge on a current carrying conductor is ..... . [1]

Q12. If a bar magnet of length 10 cm and pole strength 40 A-m is placed at an angle of 30° in a uniform magnetic field of intensity 2×10^{-4} T, then torque acting on it is ..... . [1]

Q 13. When the intensity of magnetic field is increased four times, the time period of suspended magnetic needle becomes ..... .

Q14. The value of maximum amplitude produced due to interference of two waves is given by $y_1 = 4\sin\ \omega t$ and $y_2 = 3\cos\omega t$ is ..... [1]

Q15. Excitation energy of a hydrogen-like ion, in its first excitation state is $40.8\ \text{eV}$. The energy needed to remove the electron from the ion in ground state, is ..... . [1]

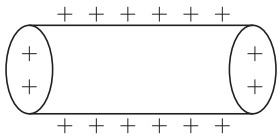
DIRECTION : (Q16-Q20) Answer the following

Q16. A concave mirror is held in water. What should be the change in focal length of the mirror? [1]

Q17. Magnetic field lines can be entirely confined within the core of a toroid but not within a straight solenoid, why? [1]

Q18. A cell of emf E and internal resistance r is connected across a variable resistor R. Plot a graph showing the variation of terminal potential V with resistance R. Predict from the graph, the condition under which V becomes equal to E. [1]

Q19. Sketch the electric field lines for a uniformly charged hollow cylinder as shown in the figure. [1]



Q20. Write any two properties of X-rays. [1]

OR

Write down two properties of electromagnetic wave. [1]

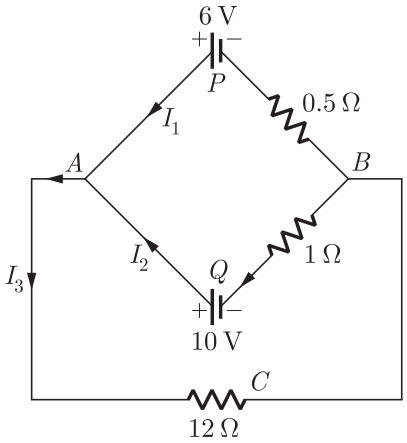
SECTION-B

Q21. Usually it has been seen in offices choke coil is needed in the fluorescent tubes with AC mains. Also, an ordinary resistor can not used instead of choke coil. Why? What is the value hidden in the question? [2]

Q22. Draw suitable graphs to show the variation of photoelectric current with collector plate potential for [2]

1. A fixed frequency but different intensities $I_1 > I_2 > I_3$ of radiation.
2. A fixed intensity but different frequencies $f_1 > f_2 > f_3$ of radiation.

Q23. Apply Kirchhoff's laws to the loops $ACBPA$ and $ACBQA$ to write the expressions for the current I_1 , I_2 and I_3 in the network. [2]



Circuit diagram of loops

Q24. What kinetic energy of a neutron will be associated by the de-Broglie wavelength $1.32 \times 10^{-10}\text{m}$? Given that mass of a neutron $= 1.675 \times 10^{27}\text{kg}$. [2]

Q25. Answer the following questions: [2]

1. The angle of dip at a location in southern India is about 18°. Would you except a greater or smaller dip angle in Britain?
2. Geologists claim that besides the main magnetic N-S pole, there are several local poles in the earth's surface oriented in different directions. How is such a thing possible at all?

Q26. Define magnifying power of a telescope. Also, write its expression. [2]

OR

Show that linear magnification of an image formed by a curved mirror may be expressed as ,

$$m = \frac{f}{f-u} = \frac{f-v}{f}$$

Where, letters have their usual meanings.

Q27. Define mean value and root mean square value of alternating current. [2]

OR

What is transformer? What do you mean by its efficiency?

SECTION C

Q28. (i) An electrostatic field line is a continuous curve, i.e. a field line cannot have sudden break. Why not? [3]

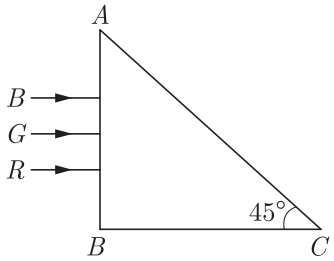
(ii) Explain, why two field lines never cross each other at any point?

(iii) A proton is placed in a uniform electric field directed along the positive X-axis. In which direction will it tend to move?

Q29. (i) Two slits are made 1 mm apart and the screen is placed 1 m away. What is the fringe separation, when blue-green light of wavelength 500 nm is used?

(ii) What should be the width of each slit to obtain 10 maxima of the double slit pattern within the central maximum of the single slit pattern? [3]

Q30. Three light rays, red R, green G and blue B are incident on a right angled prism ABC at face AB. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47, respectively. Our of the three, which colour of ray will emerge out of face AC? Justify your answer. Trace the path of these rays after passing through face AB. [3]



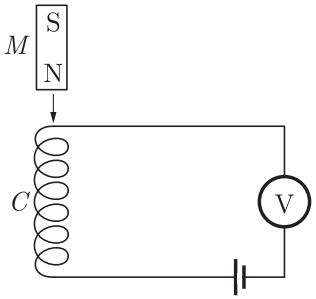
Q31. Obtain the first Bohr's radius and the ground state energy of a muonic H-atom [i.e. an atom in which a negatively charged muon (μ) of mass about 207 m_e orbits around a proton]. [3]

Q32. (i) A current is set up in a long copper pipe. Is there a magnetic field [3]

(a) inside

(b) outside the pipe

(ii) Figure shown below shows a bar magnet M falling under the gravity through an air cored coil C.



(a) Plot a graph showing variation of induced emf E with time t.

(b) What does the area enclosed by the $E-t$ curve depict?

OR

On a smooth plane inclined at 30° with the horizontal, a thin current carrying metallic rod is placed parallel to the horizontal ground. The plane is located in a uniform magnetic field of $0.15\,\mathrm{T}$ in the vertical direction. For what value of current can the rod be stationary? The mass per unit length of the rod is $0.03\,\mathrm{kg\,m^{-1}}$.

Q33. A beam of light consisting of two wavelengths 560 nm and 450 nm, is used to obtain interference fringes in a Young's double slit experiment. Find the lest distance from the central maximum, where the bright fringes due to both the wavelengths coincide. The distance between the two slits is 4mm and the screen is at a distance of 1 m from the slits. [3]

Q34. Calculate the binding energy (BE) per nucleon of ${}_{20}\mathrm{Ca}^{40}$ nucleus. Given: [3]

$$m({}_{20}\mathrm{Ca}^{40}) = 39.962589\ \mathrm{u}$$
$$m_n = 1.008665\ \mathrm{u}$$
$$m_p = 1.007825\ \mathrm{u}$$

(Take, 1 amu = 931 MeV).

SECTION D

Q35. Find an expression for the torque acting on an electric dipole placed in uniform electric field. A system of two charges, $q_A = 2.5 \times 10^{-7}\,\mathrm{C}$ and $q_B = 2.5 \times 10^{-7}\,\mathrm{C}$ located at points $A(0,0,-15\,\mathrm{cm})$ and $B(0,0,+15\,\mathrm{cm})$, respectively. Find the electric dipole moment of the system and the magnitude of the torque acting on it, when it is placed in a uniform electric field $5 \times 10^4\,\mathrm{NC^{-1}}$ making an angle 30° . [5]

OR

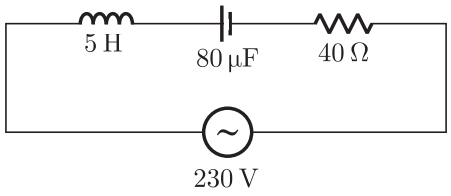
A capacitor of capacitance C is charged fully by connecting it to a battery of emf E. It is then disconnected from the battery. If the separation between the plates of the capacitor is not doubled, what will happen to

1. Charge stored by the capacitor?
2. Potential difference across it?
3. Field strength between the plates?
4. Energy stored by the capacitor?
5. Capacitance of the capacitor?

Q36. Explain with the help of a neat and labelled diagram, the principle, construction and working of a transformer. [5]

OR

The given circuit diagram shows a series L-C-R circuit connected to a variable frequency 230 V source.



1. Determine the source frequency which derives the circuit in resonance.
2. Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.
3. Determine the rms potential drop across the three elements of the circuit.
4. How do you explain the observation that the algebraic sum of the voltage across the three elements in capacitance (C) is greater than the supplied voltage?

Q37. Show that the refractive index of the material of a prism is given by [5]

$$\mu = \frac{\sin\frac{(A+\delta_m)}{2}}{\sin\left(\frac{A}{2}\right)}$$

Where, the symbols have their usual meanings.

OR

Define the term resolving power of an astronomical telescope. How does, it get affected on

1. increasing the aperture of the objective lens?
2. increasing the wavelength of light used?
3. increasing the focal length of the objective lens?