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SAMPLE PAPER - 06

Class: XII **MM: 70**

Subject: Physics **Time: 3 Hrs**

General Instruction:-

(i) All questions are compulsory. There are 33 questions in all.

(ii) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(iii) Section A contains ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.

(iv) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

(v) Use of calculators is not permitted. However, you may use log tables, if necessary.

(vi) You may use the following physical constant where ever necessary:

Gravitational constant $G = 6.6 \times 10^{-11}\ Nm^2\ kg^{-2}$

Gas constant $R = 8.314\ J\ mol^{-1}\ k^{-1}$

Mass of electron $= 9.110 \times 10^{-31}\ kg$

Mechanical equivalent of heat $= 4.185\ J\ cal^{-1}$

Standard atmospheric pressure $= 1.013 \times 10^5\ Pa$

Absolute zero (0 K) $= -273.15^0 C$

Acceleration due to gravity $= 9.8\ ms^{-2}$

SECTION-A

All questions are compulsory. In case of internal choices, attempt any one of them.

1. If an electron in hydrogen atom jumps from an orbit of level $n = 3$ to $n = 2$, then calculate the frequency of emitted radiation. [R = Rydberg constant, c = velocity of light]

Or

Find the shortest wavelength that can be obtained in hydrogen spectrum ($R = 10^7\ m^{-1}$).

2. The magnetic field of plane electromagnetic wave is given by

$$B = 2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$$

where, all quantities are in their SI units.

Then, write the name of the region to which this electromagnetic wave belongs.

3. A charge q_0 is placed in the centre of the cube. Calculate the flux through two opposite faces of the cube.

4. For a given lens, the magnification was found to be twice as larger as when the object was 0.15 m distant from it as when the distance was 0.1 m. Then, what is the focal length of the lens?

* You are advised to attempt this sample paper without referring the solutions given here. However, cross check your solutions with the solutions given at the end of paper after you complete the paper.

5. In a certain place, the earth's magnetic field is 0.52 G and its horizontal component is 0.26 G. Calculate the angle of dip at this place.

Or

Calculate the magnetic field at a distance of 20 cm from a wire carrying a current of 35 A.

6. What is the basic cause of quantisation of charge?

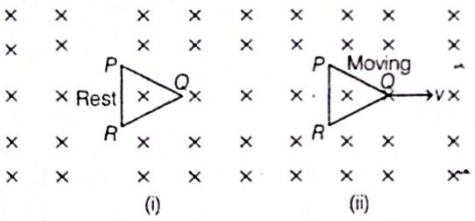
Or

If potential at a distance of 20 cm from the centre of a charged hollow sphere of radius 5 cm is 15 V, then what is the potential inside the sphere?

7. How does energy gap in a semiconductor change when it is doped with a pentavalent impurity?

8. Do all the electrons that absorb a photon come out as photoelectrons?

9. Figure shows two situations of a loop *PQR* in a perpendicular uniform magnetic field. In which position of the coil is there an induced emf?



10. The radius of inner most orbit of hydrogen atom is 5.1×10^{-11} m. What is the radius of orbit in second excited state?

Or

Compare the radii of two nuclei having mass numbers 3 and 81, respectively.

For question numbers 11, 12, 13 and 14, two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

11. **Assertion** Manganin and constantan are widely used in standard resistors.
Reason For manganin and constantan resistance, values would change very little with temperature.

12. **Assertion** If the electrons in an atom were stationary, then they would fall into the nucleus.
Reason Electrostatic force of attraction acts between negatively charged electrons and positive nucleus.

13. **Assertion** Thermal neutrons are much likely to cause fission of $^{235}_{92}U$ than fast neutrons.
Reason Fast neutrons can escape the nuclear reactor.

14. **Assertion** Nature of electrons motion in a solid is different from that in an isolated atom.
Reason Outer orbits of electrons from neighbouring atoms interact with each other or could even overlap in a solid.

SECTION-B

Questions 15 and 16 are case study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

Doppler Effect

15. According to Doppler effect, whenever there is a relative motion between a source of light and observer, the apparent frequency of light received by observer is different from the true frequency of light emitted actually from the source of light. Astronomers call the increase in wavelength due to Doppler effect as **red shift**, since a wavelength in the middle of the visible region of spectrum moves towards the red end of the spectrum.

When waves are received from a source moving towards the observer, there is an apparent decrease in wavelength, this is referred to as **blue shift.**

(i) In the context of Doppler effect in light, the term red shift signifies
(a) decrease in frequency
(b) increase in frequency
(c) decrease in intensity
(d) increase in intensity

(ii) The Doppler effect in light, find applications in measurement of
(a) speed of stars and galaxies
(b) speed of rotation of sun
(c) velocity of aeroplanes, rockets, etc
(d) All of the above

(iii) If source and observer are moving towards each other with a velocity, v_{radial} and c indicates velocity of light, then fractional change in frequency of light due to Doppler's effect will be
(a) $\frac{\Delta\nu}{\nu}=\frac{v_{radial}}{c}$ (b) $\frac{\Delta\nu}{\nu}=\frac{-v_{radial}}{c}$
(c) $\frac{\Delta\nu}{\nu}=\frac{c}{v_{radial}}$ (d) $\frac{\Delta\nu}{\nu}=\frac{-c}{v_{radial}}$

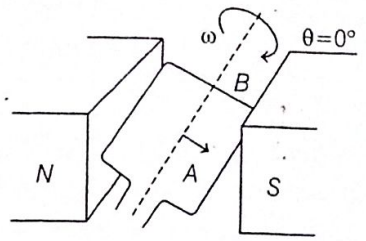
(iv) The source of light is moving towards observer with relative velocity of 3 kms^{-1}. The fractional change in frequency of light observed is
(a) 3×10^{-3} (b) 3×10^{-5}
(c) 10^{-5} (d) None of these

(v) The wavelength of spectral line coming from a distant star shift from 400 nm to 400.1 nm. The velocity of the star relative to earth is
(a) 75 kms^{-1} (b) 100 kms^{-1}
(c) 50 kms^{-1} (d) 200 kms^{-1}

AC Generator

16. An AC generator produces electrical energy from mechanical work, just the opposite of what a motor does. In it, a shaft is rotated by some mechanical means, such as an engine or a turbine starts working and an emf is induced in the coil.

It is based on the phenomenon of electromagnetic induction which states that whenever magnetic flux linked with a conductor (or coil) changes, an emf is induced in the coil.

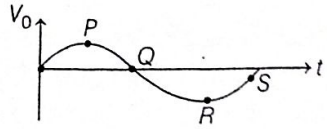


(i) Which method is used to induce an emf or current in a loop in AC generator?
(a) A change in the loop's orientation
(b) A change in its effective area
(c) Both (a) and (b)
(d) Neither (a) nor (b)

(ii) When the coil is rotated with a constant angular speed ω, the angle θ between the magnetic field vector B and the area vector A of the coil at any instant t, is
(a) $\theta=AB$ (b) $\theta=At$
(c) $\theta=\omega t$ (d) $\theta=Bt$

(iii) The change of flux is greatest at θ is equal to (given, $\phi_B=NBA\cos\omega t$)
(a) 90°, 270° (b) 90°, 45°
(c) 60°, 90° (d) 180°, 90°

(iv) The graph below shows the voltage output plotted against time. Which point on the graph shows that the coil is in a vertical position?



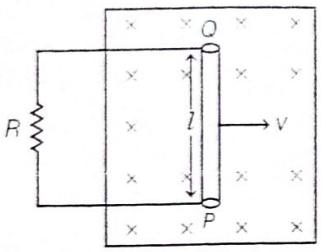
(a) P (b) Q
(c) R (d) S

(v) An AC generator consists of a coil of 1000 turns and cross-sectional area of 100 cm^2, rotating at an angular speed of 100 rpm in a uniform magnetic field of 3.6×10^{-2} T. The maximum emf produced in the coil is
(a) 1.77 V (b) 2.77 V
(c) 3.77 V (d) 4.77 V

SECTION-C

All questions are compulsory. In case of internal choices, attempt anyone.

17. A conducting rod PQ of length l, connected to a resistor R, is moved at a uniform speed v, normal to a uniform magnetic field B as shown in the figure below



Deduce the expression for the emf induced in the conductor.

Or

(i) In a series L-C-R circuit, obtain conditions under which impedance of the circuit is minimum.

(ii) A 200 km long telegraph wire has a capacity of 0.0014μF per km. If it carries an alternating current of 5 kHz, what should be the value of an inductance required to the connected in series, so that impedance is minimum? (Take, $\pi = \sqrt{10}$)

18. (i) Draw V-I characteristics of solar cell.
(ii) Mention two important criteria for selection of a material for solar cell fabrication.

19. (i) The isotopes $^{16}_{8}O$ has 8 protons, 8 neutrons and 8 electrons, while $^{8}_{4}Be$ has 4 protons, 4 neutrons and 4 electrons. Yet the ratio of their atomic masses is not exactly 2. Why?
(ii) Name the type of coolant used in nuclear reactor.

Or

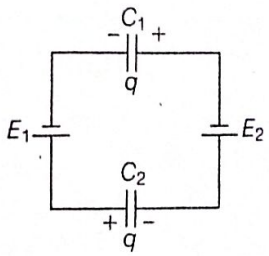
In accordance with the Bohr's model, find the quantum number that characterises the earth's revolution around the sun in an orbit of radius 1.5×10^{11} m with orbital speed 3×10^{4} m/s. (Mass of earth $= 6 \times 10^{24}$ kg)

20. Obtain relations between
(i) earth's magnetic field and its horizontal and vertical components,
(ii) angle of dip and the horizontal and vertical components of the earth's magnetic field.

Or

Two moving coil meters M_1 and M_2 having the following particulars :
$R_1 = 10\,\Omega$, $N_1 = 30$, $A_1 = 3.6 \times 10^{-3}$ m^2, $B_1 = 0.25$ T
$R_2 = 14\,\Omega$, $N_2 = 42$, $A_2 = 1.8 \times 10^{-3}$ m^2, $B_2 = 0.50$ T
(The spring constants are identical for the two meters).
Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of M_2 and M_1.

21. Determine the potential difference across the plates of the capacitor C_1 of the network shown in the figure. (Assume, $E_2 > E_1$).



22. (i) Name the phenomenon involved in tunning a radio set to a particular station.
(ii) If the frequency of music channel Sheela wants to hear is 800 kHz and the inductance of the tuner L-C circuit is 200 μH. What will be the capacitance of the tuner circuit?

23. Which level of the double ionised Lithium (Li^{2+}) has the same energy as the ground state energy of the hydrogen atom?

24. Draw ray diagram to show how a right angled isosceles prism can be used
(i) to deviate a ray by 90°?
(ii) to produce an inverted image without any deviation?

25. What is the speed of UV-rays in vacuum? If the amplitude of electric field of UV-wave is $E_0 = 200$ N/C and frequency is 50 MHz. Determine B_0, ω and k.

SECTION-D

All questions are compulsory. In case of internal choices, attempt anyone.

26. (i) If the frequency of incident light on a metal surfaced is doubled, will the kinetic energy of the photoelectrons be doubled? Give reasons.

(ii) Plot a graph showing the variation of stopping potential with frequency of incident radiation for metals A and B having threshold frequencies ν_{0_A} and ν_{0_B} such that $\nu_{0_A} < \nu_{0_B}$.

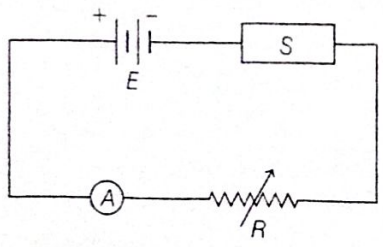
Or

Estimating the following two numbers should be interesting. The first number will tell you why radio engineers do not need to worry much about photons. The second number tells you why our eye can never 'count photons', even in barely detectable light?

(a) The number of photons emitted per second by a medium wave transmitter of 10 kW power, emitting radiowaves of wavelength 500 m.

(b) The number of photons entering the pupil of our eye per second corresponding to the minimum intensity of white light that we humans can perceive ($\sim 10^{-10}$ W/m^2). Take the area of the pupil to be about 0.4 cm^2 and the average frequency of white light to be about 6×10^{14} Hz.

27. In the given diagram, a piece of pure semiconductor S in series with a variable resistor R and source of constant voltage V. Would you increase or decrease the value of R to keep the reading of ammeter A constant, when semiconductor S is heated? Give reason. If semiconductor is replaced by metal and it is heated, then how the value of R should be changed to keep reading of ammeter A unchanged?



28. The given data shows the different value of image distance (v) for different value of object distance (u) for an object placed on the optical bench in front of a convex lens in an experimental setup to determine the focal length (f) of convex lens.

S. No.	Object distance (u) (cm)	Image distance (v) (cm)
1.	48	34
2.	44	37
3.	40	40
4.	35	47
5.	30	60

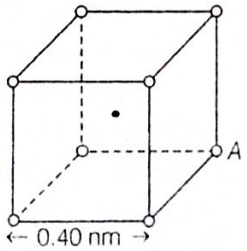
One method to find f is to use the lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$; using the given data.

Thus, from data, we find mean $f = 20$ cm

But can the focal length be found graphically by plotting u-v graph? If yes, then plot the graph and find focal length.

29. Figure represents a crystal unit of caesium chloride CsCl. The caesium atoms, represented by open circles are situated at the corners of a cube of side 0.40 nm, whereas a Cl atom is situated at the centre of the cube.

The Cs atoms are deficient in one electron while the Cl atom carries an excess electron.



o Shows Cs^+ atom

• Shows Cl^- atom

(i) What is the net electric field on the Cl atom due to eight Cs atoms?

(ii) Suppose that the Cs atom at the corner A is missing. What is the net force now on the Cl atom due to seven remaining Cs atoms?

30. Draw a circuit diagram showing the biasing of an LED. State the factor which controls

(i) wavelength of light

(ii) intensity of light emitted by the diode.

Or

What is the difference between an intrinsic semiconductor and *p*-type semiconductor? Explain, why a *p*-type semiconductor is electrically neutral, although $n_h >> n_e$.

SECTION-E

31. (i) A 1 m long conducting rod rotates with an angular frequency of 400 rad s^{-1} about an axis normal to the rod passing through its one end.
The other end of the rod is in contact with a circular metallic ring. A constant magnetic field of 0.5 T parallel to the axis exists everywhere.
Find an expression for the emf induced between the centre and the ring; and then calculate the value of induced emf from the given data.

(ii) Self-induction is called the inertia of electricity. Why?

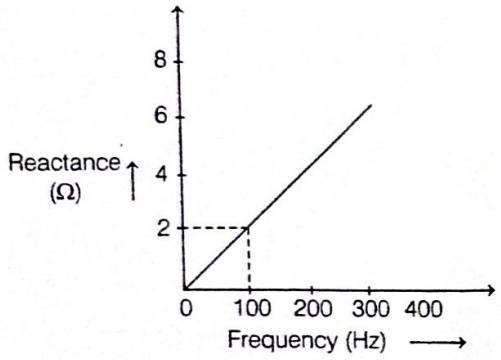
Or

(i) A circuit containing a 80 mH inductor and a 60 μF capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible.

(a) Obtain the current amplitude and rms-values.

(b) Obtain the rms values of potential drops across each element.

(ii) The figure below shows how the reactance inductor varies with frequency.



Calculate the value of the inductance of the inductor using the information given in the graph.

32. (i) Write the principle of a potentiometer. How can internal resistance of a cell be found with it?

(ii) (a) Why do we prefer a potentiometer with a longer bridge wire?

(b) How will the position of null point change on increasing the resistance from resistance box?
(Keeping other quantities constant in both cases)

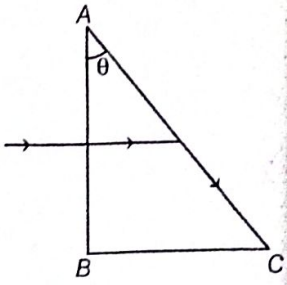
Or

Define resistivity of a conductor. How does the resistivity of a metallic conductor change with temperature? Draw approximate graph of resistivity plotted against temperature for

(i) metal, (ii) an alloy and

(iii) a semiconductor.

33. (i) A beam of light of wavelength 400 nm is incident normally on a right angled prism as shown in the figure at night.



It is observed that the light just grazes along the surface *AC* after falling on it.
Given that, the refractive index of the material of the prism varies with the wavelength λ as per the relation,

$$\mu = 1.2 + \frac{b}{\lambda^2}$$

Calculate the value of *b* and the refractive index of the prism material for a wavelength λ = 5000 Å.
[given, θ = $\sin^{-1}(0.625)$]

(ii) A glass lens is immersed in water. How is power of lens affected?

Or

(i) What is inteference of light? Write the condition for sustained interference pattern on screen.

What is the effect on the interference fringes to a Young's double slit experiment when

(a) the separation between the two slits is increased?

(b) the width of the source-slit is decreased?

(ii) In a Young's double slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ in K units.

What is the intensity of light at a point where path difference is $\frac{\lambda}{3}$?.