General Instructions

- **Time :** 2 Hours
- **Max. Marks :** 35

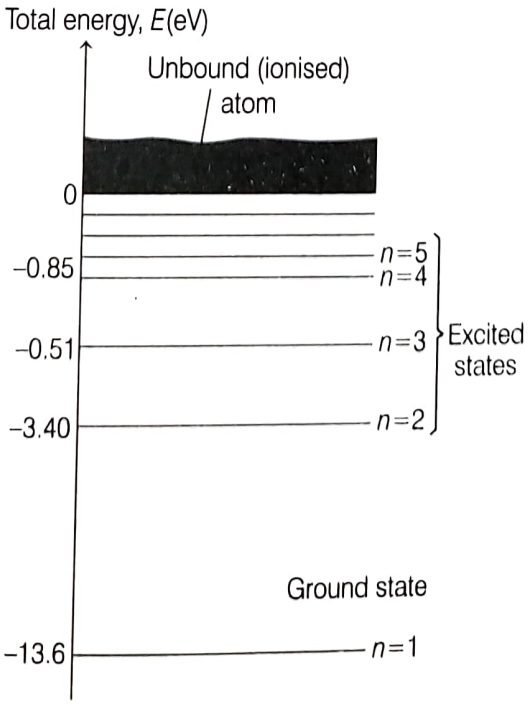
1. There are 9 questions in the question paper. All questions are compulsory.
2. Question no. 1 is a Case Based Question, which has five MCQs. Each question carries one mark.
3. Question no. 2-6 are Short Answer Type Questions. Each question carries 3 marks.
4. Question no. 7-9 are Long Answer Type Questions. Each question carries 5 marks.
5. There is no overall choice. However, internal choices have been provided in some questions. Students have to attempt only one of the alternatives in such questions.

As exact Blue-print and Pattern for CBSE Term II exams is not released yet. So the pattern of this paper is designed by the author on the basis of trend of past CBSE Papers. Students are advised not to consider the pattern of this paper as official, it is just for practice purpose.

1. Direction *Read the following passage and answer the questions that follows*

Excited State of Atom

At room temperature, most of the H-atoms are in ground state. When an atom receives some energy (i.e. by electron collisions), the atom may acquire sufficient energy to raise electron to higher energy state. In this condition, the atom is said to be in excited state. From the excited state, the electron can fall back to a state of lower energy, emitting a photon equal to the energy difference of the orbit.



In a mixture of H—He^+ gas (He^+ is single ionised He atom), H-atoms and He^+ ions are excited to their respective first excited states. Subsequently, H atoms transfer their total excitation energy to He^+ ions (by collisions).

(i) The quantum number n of the state finally populated in He^+ ions is

(a) 2 (b) 3 (c) 4 (d) 5

(ii) The wavelength of light emitted in the visible region by He^+ ions after collisions with H-atoms is

(a) 6.5×10^{-7} m (b) 5.6×10^{-7} m (c) 4.8×10^{-7} m (d) 4.0×10^{-7} m

(iii) The ratio of kinetic energy of the electrons for the H-atom to that of He^+ ion for $n = 2$ is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 1 (d) 2

(iv) The radius of the ground state orbit of H- atom is

(a) $\frac{\varepsilon_0}{h\pi me^2}$ (b) $\frac{h^2\varepsilon_0}{\pi me^2}$ (c) $\frac{\pi me^2}{h}$ (d) $\frac{2\pi h\,\varepsilon_0}{me^2}$

(v) Angular momentum of an electron in H-atom in first excited state is

(a) $\frac{h}{\pi}$ (b) $\frac{h}{2\pi}$ (c) $\frac{2\pi}{h}$ (d) $\frac{\pi}{h}$

2. For a given lens, the magnification was found to be twice as large when the object was 0.15 m distant from it than when the distance was 0.2 m. What is the focal length of the lens?

Or An astronomical telescope has objective and eyepiece of focal lengths 40 cm and 4 cm, respectively. Find the distance by which the lenses must be separated, so that image of an object 200 cm away from the objective can be seen at infinity. Also, draw the ray diagram.

3. (i) Why do we need the oil drops in Millikan's experiment to be of microscopic sizes? Why cannot we carry out the experiment with bigger drops?

(ii) What happens to the wavelength of a photon after it collides with an electron?

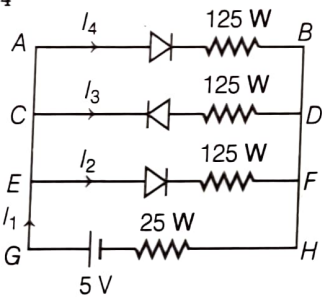
(iii) Can X-rays cause photoelectric effect?

4. (i) What is the ratio of the number of holes and the number of conduction electrons in an intrinsic semiconductor?

(ii) Draw the energy band diagram of n-type semiconductor.

(iii) Draw I versus V graph of a forward biased junction diode.

Or If each diode in figure has a forward bias resistance of 25 Ω and infinite resistance in reverse bias, what will be the values of the currents I_1, I_2, I_3 and I_4?



5. (i) Why is the core of a nuclear reactor one of its most important part?

(ii) Why is the number of neutrons in heavier nuclei more than the number of protons?

(iii) Name the element with which control rods in nuclear reactors are made up.

6. (i) Identify the part of the electromagnetic spectrum used in (i) radar and (ii) eye surgery. Write their frequency range.

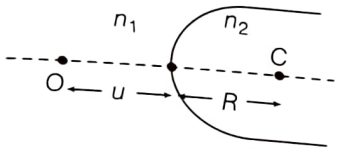
(ii) Prove that the average energy density of the oscillating electric field is equal to that of the oscillating magnetic field.

Or State clearly how a microwave oven works to heat up a food item containing water molecules. Why are microwaves found useful for the raw systems in aircraft navigation?

7. Show that the refractive index of the material of a prism is given by

$$\mu = \frac{\sin\frac{(A+\delta_m)}{2}}{\sin\left(\frac{A}{2}\right)}$$ where, symbols have their usual meanings.

Or (i) A point object O is kept in a medium of refractive index n_1 infront of a convex spherical surface of radius of curvature R which separates the second medium of refractive index n_2 from the first one, as shown in the figure. Draw the ray diagram showing the image formation and deduce the relationship between the object distance and the image distance in terms of n_1, n_2 and R.



(ii) When the image formed above acts as a virtual object for a concave spherical surface separating the medium n_2 from $n_1 (n_2 > n_1)$, draw this ray diagram and write the similar [similar to (i)] relation. Hence, obtain the expression for the lens Maker's formula.

8. (i) When the width of the slit is made double, how would this effect the size and intensity of the central diffraction band? Justify your answer with the help of diagram.

(ii) Write three characteristic features to differentiate between diffraction and interference.

Or (i) Consider two coherent sources S_1 and S_2 producing monochromatic waves to produce interference pattern. Let the displacement of the wave produced by S_1 be given by $y_1 = a\cos\omega t$ and the displacement by S_2 be $y_2 = a\cos(\omega t + \phi)$. Find out the expression for the amplitude of the resultant displacement at a point and show that the intensity at that point will be

$$I = 4a^2\cos^2\frac{\phi}{2}$$

Hence, establish the conditions for constructive and destructive interference.

(ii) What is the effect on the interference fringes in Young's double slit experiment, when

(a) the width of the source slit is increased and

(b) the monochromatic source is replaced by a source of white light?

9. (i) How is a depletion region formed in p-n junction?

(ii) With the help of a labelled circuit diagram, explain how a junction diode is used as a full wave rectifier. Draw its input and output waveforms.

(iii) How do you obtain steady DC output from the pulsating voltage?

Or (i) Explain with the help of suitable diagram, the two processes which occur during the formations of a p-n junction diode. Hence, define the terms (i) depletion region and (ii) potential barrier.

(ii) Draw a circuit diagram of a p-n junction diode under forward bias and explain its working.

Answers

1. (i) c, (ii) c, (iii) a, (iv) b, (v) a *2. 0.10 m Or 54 cm* *4. Or 0.05 A, 0.025 A, 0A, 0.05 A*