BUDHA DAL PUBLIC SCHOOL, PATIALA
Second Term Examination (5 December 2024)

Class XII (Science)
Subject - Physics
(Set - A)

Time: 3hrs **M.M. 70**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) **Section A** contains 16 questions, 12 MCQ and 4 Assertion Reasoning based of 1 mark each, **Section B** contains 5 questions of two marks each, **Section C** contains 7 questions of three marks each, **Section D** contains two case study based questions of four marks each **and Section E** contains three long answer questions of five marks each.
(5) Use of calculators is not allowed.

i) $c = 3 \times 10^8$ m/s
ii) $me = 9.1 \times 10^{-31}$ kg
iii) $e = 1.6 \times 10^{-19}$ C
iv) $\mu 0 = 4\pi \times 10^{-7}$ Tm$A-1$
v) $h = 6.63 \times 10^{-34}$ Js
vi) $\varepsilon 0 = 8.854 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$
Vii) Avogadro's number = 6.023×10^{23} per gram mole

Section - A

Q1. The photo electric effect with incident photon wavelength λ, the stopping potential is V_0. The correct variation (s) of V_0 with λ and $1/\lambda$ are :

Q2. A ray of light on passing through an equilateral glass prism, suffers a minimum deviation equal to angle of prism. The value of refractive index of the material of prism is

a) $\sqrt{2}$ b) $\sqrt{3}$ c) $1/\sqrt{2}$ d) $1/\sqrt{3}$

Q3. In YDSE when separation between two slits is increased, fringe width

a) decreases b) increases c) remains the same d) none of these

Q4. The peak value in B.E. curve is …… and for what nuclei?

a) 8.8 Me V/N for $_{26}Fe^{56}$
b) 6.8 Me V/N for S^{32}
c) 5.9 Me V/N for Li^6
d) None of the above

Q5. Pure Si at 500 K has equal number of electron (n_e) and hole (n_h) concentration of 1.5×10^{16} m^{-3}. Doping by indium increases n_h to 4.5×10^{22} m^{-3}. The doped semiconductor is of

a) n- type with electron concentration $n_e = 5 \times 10^{22}$ m^{-3}.

b) p- type with electron concentration $n_e = 2.5 \times 10^{10}$ m^{-3}.

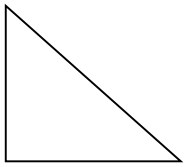
c) n- type with electron concentration $n_e = 2.5 \times 10^{23}$ m^{-3}.

d) p- type with electron concentration $n_e = 5 \times 10^{9}$ m^{-3}.

Q6. The shape of interference fringes in YDSE, when distance between the slit and screen is very large as compared to fringe width is

a) straight line b) parabolic c) circular d) cylindrical

Q7. A beam of light consisting of red, green and blue colours is incident on right angled prism. The refractive indices of the material of the prism for the above red, green and blue wavelength are 1.39, 1.44 and 1.47 respectively. The prism will



a) separate the red colour part from green and blue colours

b) Separate the blue colour part from the red and green colours

c) Separate all the three colours from one another.

d) Not separate the three colours at all

Q8. Which spectral series of hydrogen lie in the UV region?

a) Balmer b) Paschen c) Lyman d) Brackett

Q9. If the source of light used in Young's double slit experiment is changed from red to violet :

a) the fringes will become brighter.
b) consecutive fringes will come closer.
c) the intensity of minima will increase.
d) the central bright fringe will become a dark fringe.

Q10. The total energy of an electron in the nth stationary orbit can be obtained by

a) $E_n = 13.6\, n^2$ eV b) $E_n = \frac{13.6}{n}$ eV c) $E_n = \frac{13.6}{n^2}$ eV d) $E_n = -\frac{13.6}{n^2}$ eV

Q11. A thin lens made of glass of refractive index 1.5 has a focal length equal to 12 cm in air. It is now immersed in water of refractive index 4/3. Its new focal length is

a) 12 cm b) 24 cm c) 36 cm d) 48 cm

Q12. A nucleus with mass number 240 break into two fragments each of mass 120. The binding energy per nucleon of unfragmented nuclei is 7.6 MeV, while that of fragments is 8.5 MeV. The total gain in the B.E. in the process is

a) 216 MeV b) 0.9 MeV c) 9.4 MeV d) 804 MeV

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

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

Q13. **Assertion (A) :** Refractive index of a medium can be less than unity.

Reason (R) : The angle of incidence is equal to the angle of refraction.

Q14. **Read the two statements and choose if**

a) Statement – 1 is true: Statement – 2 is true: Statement – 2 is a correct explanation of Statement-1.
b) Statement – 1 is true: Statement – 2 is true: Statement – 2 is not a correct explanation of Statement-1.
c) Statement-1 is true, Statement-2 is false.
d) Statement-1 is false, Stement-2 is true.

Statement (1) : If a convex lens is kept in water, its convergent power increases.

Statement (2) : Focal length of lens depends on its refractive index w.r.t. surrounding medium.

Q15. **Assertion (A) :** Photoelectric effect demonstrates the wave nature of light.

Reason (R) : The number of photoelectrons is proportional to the frequency of light.

Q16. **Read the two statements and choose if**

a) Statement – 1 is true: Statement – 2 is true: Statement – 2 is a correct explanation of Statement-1.
b) Statement – 1 is true: Statement – 2 is true: Statement – 2 is not a correct explanation of Statement-1.
c) Statement-1 is true, Statement-2 is false.
d) Statement-1 is false, Stement-2 is true.

Statement (1) : Out of the following radiations; microwave, ultraviolet and x-rays, microwave has the shortest wavelength.

Statement (2) : Gamma rays are of nuclear origin but X-rays are produced due to sudden deceleration of high energy electrons while falling on a metal of high atomic number.

Section - B

Q17. The ratio of number density of free electrons to holes for two different materials, A and B, are (i) equal to one and (ii) less than one respectively. Name the type of semiconductor to which A and B belong. Draw energy level diagram for A and B.

Q18. Mark the statement true or false:

a) In Young's double slit expt, performed with a source of white light, only black and white fringes are observed.

b) Two slits in Young's double slit expt are illuminated by two different sodium lamps emitting light of same wavelength. No interference pattern will be obtained.

OR

A parallel beam of light of wavelength 600 nm is incident normally on a slit or width 'd'. If the distance between the slit and screen is 0.8 m and distance of 2^{nd} order maximum from the centre of the screen is 15 mm, calculate the width of the slit.

Q19. The graph shows the variation of photoelectric current (I) versus applied voltage (V) for two different photosensitive materials for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials but same intensity of incident radiation.

Q20. In the following figure which of the diodes are forward biased and which are reverse biased and why?

Q21. Explain what happens when a convex lens of refractive index 1.2 is immersed in a liquid of refractive index 1.3 .

Section - C

Q22. a) The energy levels of an atom are shown in figure. Which of them will result in the emission of a photon or wavelength 275 nm?

b) Which transition corresponds to emission of radiation of maximum wavelength?

Q23. Find the energy equivalent of one atomic mass unit, first in joule and then in MeV. Using this, express the mass defect of ${}_8O^{16}$ in MeV/C^2.

Given m_p = 1.00727 amu, mn = 1.00866 amu, m_{oxy} = 15.99053 MeV/c_2

Q24. An equilateral glass prism has a refractive index 1-6 in air. Calculate the angle of minimum deviation of the prism when kept in a medium of refractive index $4\sqrt{2}/5$

Q25. Four double convex lenses with following specifications are available

Lens	focal length	aperture
A	100 cm	10 cm
B	100 cm	5 cm
C	10 cm	2 cm
D	5 cm	2 cm

Which of the given four lenses should be selected as objective and eyepiece to construct an astronomical telescope and why? What will be the magnifying power and length of the tube of the telescope?

Q26. Draw the intensity pattern for single slit diffraction and double slit interference. Hence state two differences between interference and diffraction patterns.

Q27. State Bohr's postulate to define stable orbits in hydrogen atom. How does de Broglei's hypothesis explained the stability of these orbits.

Q28. a) Explain with the help of suitable diagram, the two processes which occur during the formation of p-n junction diode. Hence define the items (i) depletion region and (ii) potential barrier.

b) Draw a circuit diagram of a full-wave rectifier. Explain its working principle. Draw the input/output wave forms indicating clearly the functions of the two diodes used.

OR

Draw a circuit diagram of a full-wave rectifier. Explain its working principle. Draw the input/ output wave forms indicating clearly the functions of the two diodes used.

Section - D

Section – E

Q31. a) Draw ray diagram for compound microscope and derive expression for its magnify power.

OR

In figure light rays of blue, green and red wavelengths are incident on an isosceles right angled prism. Explain with reason which ray of light will be transmitted through the face AC. The refractive index of the prism for red, green and blue light are 1.39, 1.424 and 1.476 respectively.

Q32. a) State and prove prism formula.

b) Use the mirror equation to deduce that :

i) An object placed between f and 2f of a concave mirror produces a real image beyond 2f.

ii) A convex mirror always produces a virtual image independent of the location of the object.

OR

a) Light waves each of amplitude 'a' and frequency ω emanting from two coherent light sources superpose at a point. If the displacements due to these waves are given by $y_1 = a\cos\omega t$ and $y_2 = a\cos(\omega t + \phi)$. Where ϕ is the phase difference between the two, obtain the expression for the resultant intensity at the point.

b) A parallel beam of light of wavelength 600 nm is incident normally on a slit of width d. If distance between slit and screen is 0.8 m and distance of 2nd order minimum from the centre of the screen is 9.6 mm, calculate the width of the slit.

Q33. In an experiment of photoelectric effect, the graph between maximum kinetic energy (K_{max}) and frequency f of emitted photoelectron from metal surface is found to be a straight line as shown in figure. Calculate

a) threshold frequency.

b) work function of metal in electron volt.

c) Planck's constant and

d) Maximum kinetic energy of the emitted electron by light of frequency f = 8×10^{14} s^{-1}

OR

A person with a normal near point (25 cm) using a compound microscope with an objective of focal length 8.0 mm and an eye piece of focal length 2.5cm can bring an object placed 9.0 mm from the objective in sharp focus. What is the separation between the two lenses? Calculate the magnifying power of the microscope?