VISHNU BHAGWAN PUBLIC SCHOOL

Pre Board Exam (2023-24)

Class – 12

Subject –Physics

Time: 3:00 Hours **{SET-C}** 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 sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven 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) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.
(7) You may use the following values of physical constants where ever necessary
i. c = 3 x 10^8 m/s ii. Me = 9.1 x10^-31 kg
iii. e = 1.6 x 10^-19 C iv. μ0 = 4π x 10^-7 Tm$\boldsymbol{A}^{-}$
v. h = 6.63 x10^-34 Js vi. ε0 = 8.854 x10^-12 $C^2N^{-}\mathbf{1}\boldsymbol{m}^{-}\mathbf{2}$
vii. Avogadro's number = 6.023 X **1**0^2**3** per gram mole

Section-A (16X1=16)

1.A conductor of 10 ohm is connected across a 6 V ideal source. The power supplied by the source to the conductor is
(a) 1.8 W (b) 2.4 W (c) 3.6 W (d) 7.2 W
2.An isolated point charge particle produces an electric field E at a point 3 m away from it. The distance of the point at which the field is E/4 will be
(a) 2 m (b) 3 m (c) 4 m (d) 6 m
3.The ratio of the magnitudes of the electric field and magnetic field of a plane electromagnetic wave is
(a) 1 (b) C (c) 1/C (d)$1/C^2$
4.The formation of depletion region in a p-n junction diode is due to
(a) movement of dopant atoms (b) diffusion of both electrons and holes
(c) drift of electrons only (d) drift of holes only
5.The energy of an electron in nth orbit of hydrogen atom is En= - 13.6/n^2 eV.The negative sign of energy indicates that
(a) electron is free to move. (b) electron is bound to the nucleus.
(c) kinetic energy of electron is equal to potential energy of electron. (d) atom is radiating energy.
6.Specify the transition of electron in the wavelength of the line in the Bohr model of hydrogen atom which gives rise to the spectral line of highest wavelength.
(a) n = 3 to n = 1 (b) n=3 to n=2 . (c) n = 4 to n = 1 (d) n=4 to n=2
7.The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium nucleus is
(a) radioactive (b) unstable (c) easily fissionable (d) more stable nucleus than its neighbours
8. When air is replaced by a medium of dielectric constant K,the force of attraction between two charges separated by a distance r
(a) decreases K times (b) remains unchanged
(c) increases K times (d) increases K^2 times
9.An electron with angular momentum L moving around the nucleus has a magnetic moment given by
(a) e L/ 2m (b) e L/3m (c) e L /4m (d) e L / m
10. A ray of monochromatic light propagating in air, is incident on the surface of water. Which of the following will be the same for the reflected and refracted rays ?
(a) Energy carried (b) Frequency (c) speed (d) wavelength

11. A steady current of 8 mA flows through a wire. The number of electrons passing through a cross-section of the wire in 10 second.
(a) 4.0 X 10^{16} (b) 5.0 X 10^{17} (c) 1.6 x 10^{16} (d) 1.0 x 10^{17}
12.Which one of the following elements will requires the highest energy to take out an electron from them ? Pb, Ge, C and Si
(a) Ge (b) Si (c) C (d) Pb

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) If Assertion is true but Reason is false. d) If both Assertion and Reason are false.
13. Assertion (A) : For the radiation of a frequency greater than the threshold frequency, photoelectric current is proportional to the intensity of the radiation.
Reason (R) : Greater the number of energy quanta available, greater is the number of electrons absorbing the energy quanta and greater is number of electrons coming out of the metal.
14. Assertion(A): Putting p type semiconductor slab directly in physical contact with n type semiconductor slab cannot form the PN junction.
Reason(R): The roughness at contact will be much more than inter atomic crystal spacing and continuous full of charge careers is not possible.
15. Assertion(A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core clading interface.
Reason(R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.
16. Assertion(A): In Young's double slit experiment all fringes are of equal width
Reason(R): The fringe width depends upon wavelength of light (A) used, distance of screen from plane of slits (D) and slits separation (d).

Section –B (5X2=10)

17.(a) Briefly explain how a galvanometer is converted into an ammeter.
(b) Draw the graph showing intensity distribution of fringes with phase angle due to diffraction through single slit.
18. A hydrogen atom is in its third excited state.
(a) How many spectral lines can be emitted by it before coming to the ground state? Show these transitions in the energy level diagram.
(b) In which of the above transitions will the spectral line of shortest, wavelength be emitted.
19.(a) What is meant by ionisation energy ? Write its value for hydrogen atom?
(b) Define the term, mass defect. How is it related to stability of the nucleus?
20.A point object in air is placed symmetrically at a distance of 60 cm in front of a concave spherical surface of refractive index 1.5. If the radius of curvature of the surface is 20 cm, find the position of the image formed.
21. Define the following terms in relation to photoelectric effect.
(a) Stopping potential (b) Threshold frequency.

Section –C (7X3=21)

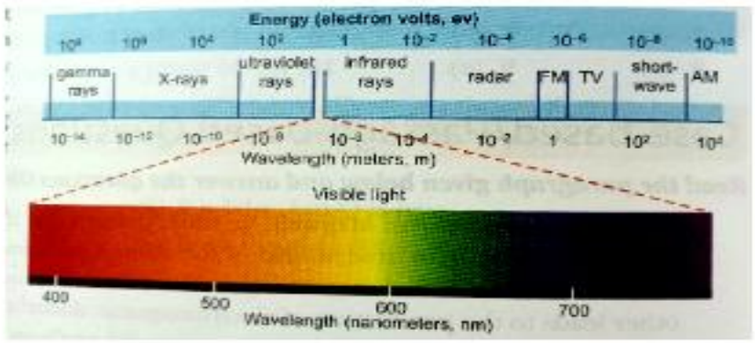
22. A given coin has a mass of 3.0 g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity assume that the coin is entirely made of 29Cu63 atoms (of mass 62.92960 u) Given Mp = 1.007825u and Mn = 1.008665u.
23.A ray of light is incident on a glass prism of refractive index μ and refracting angle A. If it just suffers total internal reflection at the other face, obtain a relation between the angle of incidence, angle of prism and critical angle.
24. A parallel plate capacitor (A) of capacitance C is charged by a battery to voltage V. The battery is disconnected and an uncharged capacitor (B) of capacitance 2C is connected across A. Find the ratio of
(i) final charges on A and B.
(ii) total electrostatic energy stored in A and B finally and that stored in A initially.
25.A series RL circuit with R = 10 ohm and L = (100/π) mH is connected to an ac source of voltage V = 141sin (100πt), where V is in volts and t is in seconds. Calculate
(a) Impedence of the circuit (b) phase angle, and (c) voltage drop across the inductor

26.(i) Distinguish between nuclear fission and fusion giving an example of each.
(ii) Explain the release of energy in nuclear fission and fusion on the basis of binding energy per nucleon curve.
27. Two cells of emf E1 and E2 and internal resistances r1 and r2 are connected in parallel, with their terminals of the same polarity connected together. Obtain an expression for the equivalent emf of the combination.
28.(1) The wavelength λ of a photon and the de Broglie wavelength of an electron of mass m have the same value. Show that the energy of the photon is 2λmc/h times the kinetic energy of the electron, where c and h have their usual meanings.
(2) A ray of monochromatic light passes through an equilateral glass prism in such a way that the angle of incidence is equal to the angle of emergence and each of these angles is 3/4 times the angle of the prism. Determine the angle of deviation and the refractive index of the glass prism.

Section-D (2X4=8)

Directions (Q.Nos. 29-30) These questions are case study based questions. Read the following paragraph and answer the questions.

29. Maxwell's equations are applicable for electromagnetic waves of all wavelength. We know that, electromagnetic waves include visible light waves, X- rays, Gama rays, radio waves, microwaves, ultraviolet and infrared waves. The electromagnetic waves have been detected with frequencies from at least 10 to 10^{24} Hz. The classification of EM waves according to frequency is the electromagnetic spectrum. The boundaries separating different regions of spectrum are not sharply defined.
We can detect only a very small segment of this spectrum directly through our sense of sight. We call this range of visible light. Different parts of visible spectrum evoke in humans the sensation of different colours.



Hint: Give answer any four parts:
(1) which of the following EM wave in order of increasing frequency.
(a) microwave <infrared< ultraviolet< gamma rays
(b) Gamma rays <ultraviolet <infrared< microwave
(c) ultraviolet< infrared <microwave< gamma rays
(d) Gamma rays<microwave< infrared <ultraviolet
(2) The ratio of velocity of the two light waves of wavelength 4000A° and 8000A° travelling in vacuum will be
(a) 1:2 (b) 2:1 (c) 1:1 (d) None
(3) Infrared radiations are detected by
(a)Spectrometer (b) nanometer (c) pyrometer (d) photometer
(4) Electromagnetic wave of wavelength 1500 nanometer lies in which region of the spectrum?
(a) Radio wave (b) microwave (c) infrared (d) ultraviolet
(5) Microwave oven act on the principle of
(a) Giving rotational energy to water molecules (b) giving vibration energy to water molecules
(c) giving translation energy to water molecules
(d) transferring electrons from lower to higher energy level in water molecule
30. Wave and particle light and other electromatic radiation sometimes act like wave and sometimes act like particles. Interference and diffraction demonstrate wave behaviour,while emission and absorption of photons demonstrate the particle behaviour. In 1924,the French French physicist Prince Louis victor de broglie put forward the bold hypothesis that moving particle of matter should display wave like properties under suitable conditions.His reasoning, freely paraphrased,went like this: Nature love symmetry.Light is dualistic in nature,behaving in some situation like waves and in other like particles.If nature is symmetric ,this duality should also hold

for matter.Electrons and protons, which we usually consider as particles may in some situation behave like wave.

If a particle acts like a wave, it should have a wavelength and frequency. The relation was proposed by de- broglie in his Ph.D for which he was awarded the Nobel prize in physics in 1929. The wavelength is given by $\lambda = h/p$ where p in momentum of particle and h is the plank constant. This wavelength is known as the de broglie wavelength of the particle. The dualism of matter is inherent in the de-broglie relation which contain a wave concept and a particle concept.in fact, the equation also applies to light when light shows its Photon character, each Photon has a momentum $p=h/\lambda$

Hint: Give answer any four parts:

(1) An electron is moving with an initial velocity V= Voi and is in a magnetic field B=Boj.Then its de broglie wavelength

(a) remains constant (b) increase with time

(c) decrease with time (d) increase and decrease periodically

(2) The de broglie wave corresponding to a particle of mass m and velocity v has a wavelength associated with it

(a) h/mv (b) hmv (c) mh/v (d) m/hv

(3) A proton and Alpha particle are accelerated through the same potential difference,the ratio of de broglie wavelength of proton to the de broglie wavelength of Alpha particle will be

(a) 1:2 (b) 2√2:1 (c) 2:1 (d) 1:1

(4) An electron of mass m and a photon have same energy E.The ratio of de- broglie wave associated with them (c being velocity of light) is

(a) 1/c √(E/2m) (b) √(E/2m) (c) c√(2mE) (d) 1/c √(2m/E)

(5) which of the following has a longest de broglie wavelength if they are moving with the same velocity ?

(a) neutron (b) proton (c) Alpha particle (d) beta particle

Section-E (3X5=15)

31. (1) State Huygen's principle. With the help of a diagram, show how a plane wave is reflected from a surface. Hence verify the law of reflection.

(2) A concave mirror of focal length 12cm forms a three times magnified virtual image of an object. Find the distance of the object from the mirror.

OR

(1) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope .

(2) The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.

32 (1) Use gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density.

(2) Draw the circuit diagram of a full wave rectifier and explain its working. Also,give the input and output waveforms.

OR

(1) Consider two identical point charges located at points (0,0) and (a,0).

(1) Is there a point on the line joining them at which the electric field is zero?

(2) Is there a point on the line joining them at which the electric potential is zero?

Justify your answers for each case.

(2) State the significance of negative value of electrostatic potential energy of a system of charges.

Three charges are placed at the corners of an equilateral triangle ABC if side 2cm. Calculate the electric potential energy of the system of three charges.

33. (1) With the help of a labelled diagram, describe the principle and working of an ac generator. Hence, obtain an expression for the instantaneous value of the emf generated.

(2) Define coefficient of self-induction. Obtain an expression for self-inductance of a long solenoid of length l, area of cross-section A having N turns.

OR

(1) Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R1 and R2. Hence derive lens maker's formula.

(2) A converging lens has a focal length of 10 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, find its new focal length.