VISHNU BHAGWAN PUBLIC SCHOOL

Pre Board Exam (2023-24)

Class – 12

Subject –Physics

Time: 3:00 Hours **{SET-A}** M.M:70

General Instructions:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper have 5 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 and 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 Section B, one question in Section C, 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) $c = 3 \times 10^8$ m/s

(ii) $m_e = 9.1 \times 10^{-31}$ kg

(iii) $e = 1.6 \times 10^{-19}$ C

(iv) $\mu_0 = 4\pi \times 10^{-7}$ Tm^{-1}

(v) $h = 6.63 \times 10^{-34}$ Js

(vi) $e_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

(vii)Avogadro's number = 6.023×10^{23} per gram mole

Section-A (16X1=16)

Directions (Q.Nos. 1-15) Select the correct option out of the four given options.

1. The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C. From the same charge object, the electric field of magnitude 16 N/C will be at a distance of

(a) 1 m (b) 2 m (c) 3 m (d) 6 m

2. A point P lies at a distance x from the mid-point of an electric dipole on its axis. The electric potential at point P is proportional to

(a) $1/x^2$ (b) $1/x^3$ (c) 1/x (d) $1/x^{½}$

3. A current of 0.8 A flows in a conductor of 40 Ω for 1 min. The heat produced in the conductor will be

(a) 1445 J (b) 1536 J (c) 1369 J (d) 1640 J

4. A cell of emf E is connected across an external resistance R. When current I is drawn from the cell the, potential difference across the electrodes of the cell drops V. The internal resistance r of the cell is

(a) (E-V /E}R (b) (E-V)R (c) (E-V)I}R (d) (E-V)/V}R

5. Beams of electrons and protons move parallel to each other in the same direction. They

(a) attract each other (b) repel each other (c) neither attract nor repel

(d) force of attraction or repulsion depends upon speed of beams.

6. A long strength wire of radius a carries a steady current I. The current of uniformly distributed across its area of cross-section.

The ratio of magnitude of magnetic field B 1 at and B 2 at distance 2a is

(a) ½ (b) 1 (c) 2 (d) 4

7. E and B represent the electric and the magnetic field of an electromagnetic wave respectively. The direction of propagation of the wave is along

(a) B (b) E (c) E×B (d) B×E

8. A ray of monochromatic light propagation in air is incident on the surface of water. Which of the following will be the same for the reflected and refracted ray ?

(a) Energy carried (b) Speed (c) Frequency (d) Wavelength

9. A beam of light travels from air into a medium. It's speed and wavelength in the

medium are 1.5×10^8 m/s and 230 nm, respectively. The wavelength of light in air will be
(a) 230 nm (b) 345 nm (c) 460 nm (d) 690 nm
10. Which one of the following metals does not exhibit emission of electrons from its surface when irradiated by visible light ?
(a) Rubidium (b) Sodium (c) Cadmium (d) Costume
11. A hydrogen atom males a transition from n=5 to n=1 orbit. The wavelength of photon emitted when it makes a transition from n=5 to n=2 orbit is
(a) 8/7 λ (b) 16/7 λ (c) 24/7 λ (d) 32/7 λ
12. 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

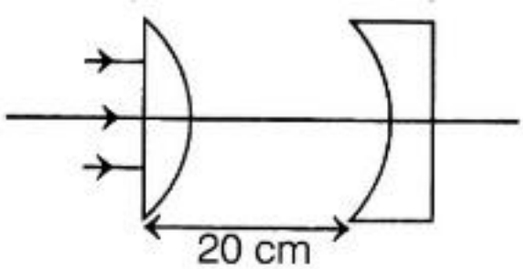
Directions (Q.Nos. 13-16) In question number 13 to 16 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
(a) Both Assertion (A) Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true and Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.
13. Assertion (A) Diamagnetic substances exhibit magnetism.
Reason (R) Diamagnetic materials do not have permanent magnetic dipole moment.
14. Assertion (A) Work done in moving a charge around a closed path in an electric field is always zero.
Reason (R) Electrostatic force is a conservative force.
15. Assertion (A) In Young's double slit experiment, all fringes are of equal width.
Reason (R) The fringe width depends upon wavelength of light (λ) used, the distance of screen from plane of slits (D) and slits separation (d).
16. Assertion (A) Putting p-type semiconductor slab directly in physical contact with n-type semiconductor slab cannot form the p-n junction.
Reason (R) The roughness at contact will be much more than inter-atomic crystal spacing and continuous flow of charge carriers is not possible.

Section-B (5X2=10)

17. Briefly explain, why and how a galvanometer is converted into an ammeter.
18. (i) How are infrared waves produced ? Why are these waves referred to as heat waves ? Give any two uses of infrared waves.

OR

(ii) How are X-rays produced ? Give any two uses of these.
19. In the given figure the radius of curvature of curved face in the plano-convex and the plano-convex lens is 15 cm each. The refractive index of the material of the lenses is 1.5. Find the final position of the image formed.



20. What happens to the interference pattern when two coherent sources are
(i) Infinitely close and (ii) far apart from each other.
21. (i) What is meant by ionisation energy ? Write its value for hydrogen atom.
(ii) Define the term mass defect. How is it related to stability of the nucleus ?

Section-C (7X3=21)

22. Draw energy band diagram for an n-type and p-type semiconductor at T > 0K.
23. Answer the following giving reasons :
(i) A p-n junction diode is damaged by a strong current.
(ii) Impurities are added in intrinsic semiconductors.

24. (i) Two charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of the electric fields at their surfaces.

OR

(ii) 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

(a) final charges on A and B.

(b) total electrostatic energy stored in A and B finally and that stored in A initially.

25. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of a charge carriers in the conductor and relaxation time.

26. Derive lens maker formula for thin lenses.

27. (i) Write three characteristics properties of nuclear force.

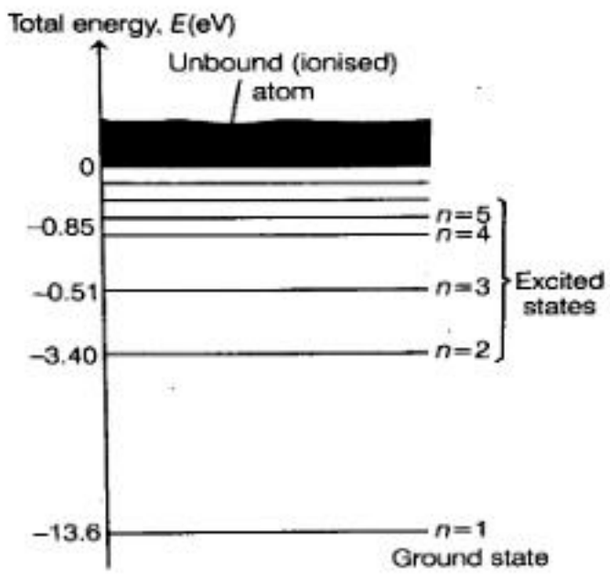
(ii) Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions that can be drawn from the graph.

28. Plot a graph showing temperature dependence of resistivity for metal. How is this behaviour explained?

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. At room temperature, most of H-atoms are in 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 ionized 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) 1 (c) 4 (d) 5

(ii) The energy required to excite H-atom from n=2 to n=4 is

(a) 2.55 eV (b) 4.25 eV (c) 4 eV (d) 0.85 eV

(iii) The ratio of kinetic energy of the electrons for the H-atom to that of He + ion for n=3 is

(a) 1/4 (b) 1/2 (c) 1 (d) 2

(iv) The radius of nth orbit of H-atom is r, then r and n are related as

(a) $r \propto n$ (b) $r \propto n^2$ (c) $r \propto 1/n$ (d) $r \propto 1/n^2$

30. Two sources are said to be coherent if they produce have of same frequency with a constant phase difference. Two independent sources of light cannot be coherent. Since, sound is a bulk property of matter, therefore two independent sources of sound can be identical in all respects and produce coherent wave. Division of amplitude are two ways

of coherent sources.
Where, intensity of two wave
(i) The similarity between the sound waves and light waves is
(a) Both are electromagnetic waves (b) both are longitudinal waves
(c) both have the same speed in a medium (d) they can produce interference
(ii) Light travel through a glass plate of thickness t and reflective index n. If c is the velocity of light in vacuum, then time taken by light to travel the thickness of the plate will be
(a) nt/c (b) t/nc (c) tc/n (d) c/nt
(iii) Intensities of the waves of light are I and 4I the maximum intensity of the resultant wave after superposition is
(a) 5I (b) 9I (c) 16I (d) 25I
(iv) The ratio of Intensities of two waves are given by 4:1. The ratio of the amplitude of the two wave is
(a) 2:1 (b) 1:2 (c) 4:1 (d) 1:4

Section-E (3X5=15)

31. Define critical angle for a given pair of media and total internal reflection. Obtain the relation between the critical angle and refractive index of the medium.

OR

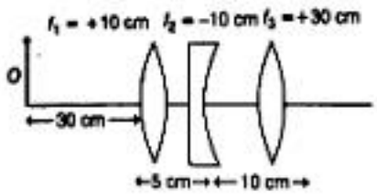
(a) Distinguish between nuclear fission and fusion giving an example of each.
(b) Explain the release of energy in nuclear fission and fusion on the basis of binding energy per nucleon curve.

32. (i) (a) State Huygens' principle. With the help of diagram, show how a plane wave is reflected from a surface. Hence, verify the law of reflection.
(b) A convex lens of focal length 12 cm produces three times magnified real image. Find the distance between object and image.

OR

(ii) (a) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define it's magnifying power. Write two limitations of a refracting telescope over a reflection telescope.
(b) The focal length of the objective and 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.

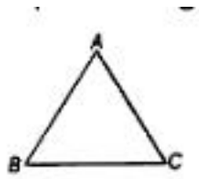
33. (i) A beam of light converges to a point P. Now, a lens is placed on the path of the convergent beam 12 cm apart from P. At what point does the beam converge, if the lens is
(a) A convex lens of focal length 20 cm
(b) and a concave lens of focal length 16 cm ?
(ii) Find the position of the image formed by the lens combination given in the following figure.



OR

(i) A ray of light incident of face AB of an equilateral glass prism, shows minimum deviation of 30°. Calculate the speed of light through the prism.

(ii)



Find the angle of incidence at face AB, so that the emergent ray grazes along the face AC.