CBSE Class 12 Physics 2006 - Outside Delhi

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: 3 Hours **Maximum Marks: 70**

General Instructions

(i) All questions are compulsory.

(ii) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks. You have to attempt only one of the choices in such questions.

(iii) Question numbers 1 to 5 are very short answer type questions, carrying one mark each.

(iv) Question numbers 6 to 12 are short answer type questions, carrying two marks each.

(v) Question numbers 13 to 24 are also short answer type questions, carrying three marks each.

(vi) Question numbers 25 to 27 are long answer type questions, carrying five marks each.

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

You may use the following values of physical constants wherever necessary:

$c = 3 \times 10^8 \text{ m/s}$

$h = 6.63 \times 10^{-34} \text{ Js}$

$e = 1.6 \times 10^{-19} \text{ C}$

$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$

$\varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$

Mass of electron $(m_e) = 9.1 \times 10^{-31} \text{ kg}$

Mass of neutron $= 1.675 \times 10^{-27} \text{ kg}$

Mass of proton $= 1.673 \times 10^{-27} \text{ kg}$

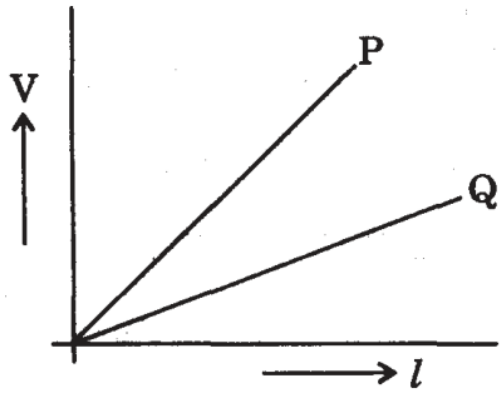
Avogadro's number $= 6.023 \times 10^{23}$ per gm mole

Boltzmann constant $= 1.38 \times 10^{-23} \text{ JK}^{-1}$

Questions

1. Define the term electric dipole moment. Is it a scalar or a vector quantity?

2. The variation of potential difference V with length l in case of two potentiometers P and Q is as shown. Which one of these two will you prefer for comparing emfs of two primary cells?



3. de Broglie wavelength associated with an electron accelerated through a potential difference V is λ. What will be its wavelength when the accelerating potential is increased to $4V$?

4. Give any one difference between FAX and e-mail systems of communication.

5. Steel is preferred for making permanent magnets whereas soft iron is preferred for making electromagnets. Give one reason.

6. You are given 'n' resistors, each of resistance 'r'. These are first connected to get minimum possible resistance. In the second case, these are again connected differently to get maximum possible resistance. Compute the ratio between the minimum and maximum values of resistance so obtained.

7. Two capacitors of capacitance 6 μF and 12 μF are connected in series with a battery. The voltage across the 6 μF capacitor is 2 V. Compute the total battery voltage.

OR

7. A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the plates is now reduced by half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in the second case.

8. Draw a labelled ray diagram to show the image formation in a refracting type astronomical telescope. Why should the diameter of the objective of a telescope be large?

9. Draw a circuit diagram using a metre bridge and write the necessary mathematical relation used to determine the value of an unknown resistance. Why cannot such an arrangement be used for measuring very low resistances?

10. Which one of the two, an ammeter or a milliammeter, has a higher resistance and why?

11. An alternating voltage of frequency f is applied across a series LCR circuit. Let f_r be the resonance frequency for the circuit. Will the current in the circuit lag, lead or remain in phase with the applied voltage when (i) $f > f_r$, (ii) $f < f_r$? Explain your answer in each case.

12. A point charge 'q' is placed at O as shown in the figure.



Is $V_P - V_Q$ positive or negative when (i) $q > 0$, (ii) $q < 0$? Justify your answer.

13. Using Gauss's theorem, show mathematically that for any point outside the shell, the field due to a uniformly charged thin spherical shell is the same as if the entire charge of the shell is concentrated at the centre. Why do you expect the electric field inside the shell to be zero according to this theorem?

14. Distinguish between frequency modulation and amplitude modulation. Why is an FM signal less susceptible to noise than an AM signal?

15. Write the order of frequency range and one use of each of the following electromagnetic radiations:

(i) Microwaves

(ii) Ultra-violet rays

(iii) Gamma rays

16. Sketch a graph between frequency of incident radiations and stopping potential for a given photosensitive material. What information can be obtained from the value of the intercept on the potential axis?

A source of light of frequency greater than the threshold frequency is placed at a distance of 1 m from the cathode of a photo-cell. The stopping potential is found to be V. If the distance of the light source from the cathode is reduced, explain giving reasons, what change will you observe in the

(i) photoelectric current,

(ii) stopping potential.

17. Define the terms half-life period and decay constant of a radioactive substance. Write their S.I. units. Establish the relationship between the two.

18. A neutron is absorbed by a $^{6}_{3}\text{Li}$ nucleus with the subsequent emission of an alpha particle.

(i) Write the corresponding nuclear reaction.

(ii) Calculate the energy released, in MeV, in this reaction.

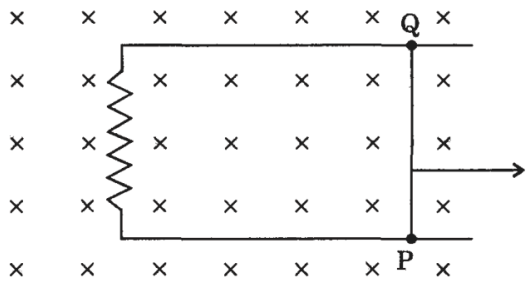
Given: mass $(^{6}_{3}\text{Li}) = 6.015126\,\text{u}$; mass (neutron) $= 1.0086654\,\text{u}$; mass (alpha particle) $= 4.0026044\,\text{u}$ and mass (triton) $= 3.0100000\,\text{u}$.

Take $1\,\text{u} = 931\,\text{MeV}/c^2$.

19. When an inductor L and a resistor R in series are connected across a 12 V, 50 Hz supply, a current of 0.5 A flows in the circuit. The current differs in phase from applied voltage by $\pi/3$ radian. Calculate the value of R.

OR

19. A 0.5 m long metal rod PQ completes the circuit as shown in the figure. The area of the circuit is perpendicular to the magnetic field of flux density 0.15 T. If the resistance of the total circuit is $3\,\Omega$, calculate the force needed to move the rod in the direction as indicated with a constant speed of $2\,\text{ms}^{-1}$.



20. State Faraday's laws of electrolysis. Express these in mathematical notation. Name any two applications of electrolysis.

21. What are eddy currents? How are these produced? In what sense are eddy currents considered undesirable in a transformer and how are these reduced in such a device?

22. A beam of light converges to a point P. A lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is

(a) a convex lens of focal length 20 cm,

(b) a concave lens of focal length 16 cm?

Do the required calculations.

23. Consider an optical communication system operating at $\lambda \sim 800$ nm. Suppose, only 1% of the optical source frequency is the available channel band-width for optical communication. How many channels can be accommodated for transmitting

(a) audio-signals requiring a band-width of 8 kHz,

(b) video TV signals requiring an approximate band-width of 4.5 MHz?

Support your answer with suitable calculations.

24. Explain (i) forward biasing, (ii) reverse biasing of a P-N junction diode. With the help of a circuit diagram, explain the use of this device as a half-wave rectifier.

25. Draw a neat and labelled diagram of a cyclotron. State the underlying principle and explain how a positively charged particle gets accelerated in this machine. Show mathematically that the cyclotron frequency does not depend upon the speed of the particle.

OR

25. State the Biot-Savart law for the magnetic field due to a current carrying element. Use this law to obtain a formula for magnetic field at the centre of a circular loop of radius R carrying a steady current I. Sketch the magnetic field lines for a current loop clearly indicating the direction of the field.

26. What are coherent sources of light? State two conditions for two light sources to be coherent.

Derive a mathematical expression for the width of interference fringes obtained in Young's double slit experiment with the help of a suitable diagram.

OR

26. State Huygens' principle. Using the geometrical construction of secondary wavelets, explain the refraction of a plane wavefront incident at a plane surface. Hence verify Snell's law of refraction.

Illustrate with the help of diagrams the action of (i) convex lens and (ii) concave mirror on a plane wavefront incident on it.

27. What are energy bands? How are these formed? Distinguish between a conductor, an insulator and a semiconductor on the basis of energy band diagram.

OR

27. Explain the function of base region of a transistor. Why is this region made thin and lightly doped?

Draw a circuit diagram to study the input and output characteristics of n-p-n transistor in a common emitter (CE) configuration. Show these characteristics graphically. Explain how current amplification factor of the transistor is calculated using output characteristics.

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