CBSE Class 12 Physics 2013 - 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 are 29 questions in total. Question Nos. 1 to 8 are very short answer type questions and carry one mark each.

(iii) Question Nos. 9 to 16 carry two marks each, Question Nos. 17 to 25 carry three marks each and Question Nos. 27 to 29 carry five marks each.

(iv) 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 the three questions of five marks each. You have to attempt only one of the given choices in such questions.

(v) Question No. 26 is a value based question carrying four marks.

(vi) 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:

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

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

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

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

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

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

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

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

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

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

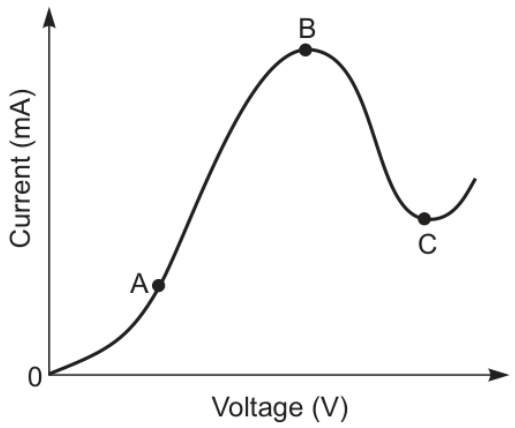
Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}

Questions

1. Two charges of magnitudes – 2Q and + Q are located at points (a, 0) and (4a, 0) respectively. What is the electric flux due to these charges through a sphere of radius '3a' with its centre at the origin?

2. How does the mutual inductance of a pair of coils change when (i) distance between the coils is increased and (ii) number of turns in the coils is increased?

3. The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any, over which the semiconductor has a negative resistance.



4. Two identical cells, each of emf E, having negligible internal resistance, are connected in parallel with each other across an external resistance R. What is the current through this resistance?

5. The motion of copper plate is damped when it is allowed to oscillate between the two poles of a magnet. What is the cause of this damping?

6. Define the activity of a given radioactive substance. Write its S.I. unit.

7. Welders wear special goggles or face masks with glass windows to protect their eyes from electromagnetic radiations. Name the radiations and write the range of their frequency.

8. Write the expression for the de Broglie wavelength associated with a charged particle having charge 'q' and mass 'm', when it is accelerated by a potential V.

9. Draw typical output characteristics of an n-p-n transistor in CE configuration. Show how these characteristics can be used to determine output resistance.

10. A parallel beam of light of 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is at a distance of2.5 mm from the centre of the screen. Calculate the width of the slit.

11. A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

12. A capacitor, made of two parallel plates each of plate area A and separation d, is being charged by an external ac source. Show that the displacement current inside the capacitor is the same as the current charging the capacitor.

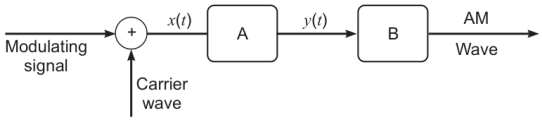
13. Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'.

OR

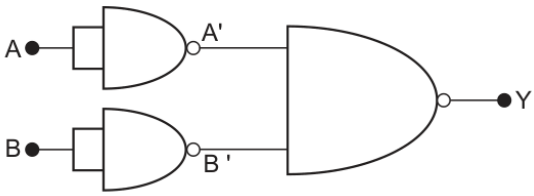
13. Describe briefly, with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of a cell.

14. A convex lens of focal length f_1 is kept in contact with a concave lens of focal length f_2. Find the focal length of the combination.

15. In the block diagram of a simple modulator for obtaining an AM signal, shown in the figure, identify the boxes A and B. Write their functions.



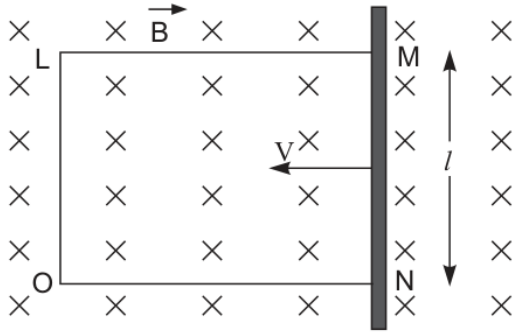
16. In the circuit shown in the figure, identify the equivalent gate of the circuit and make its truth table.



17. (a) For a given a.c., $i = i_m \sin \omega t$, show that the average power dissipated in a resistor R over a complete cycle is $\frac{1}{2} i_m^2 R$.

(b) A light bulb is rated at 100 W for a 220 V a.c. supply. Calculate the resistance of the bulb.

18. A rectangular conductor LMNO is placed in a uniform magnetic field of 0.5 T. The field is directed perpendicular to the plane of the conductor. When the arm MN of length of20 cm is moved towards left with a velocity of $10\,\text{ms}^{-1}$, calculate the emf induced in the arm. Given the resistance of the arm to be $5\,\Omega$ (assuming that other arms are of negligible resistance) find the value of the current in the arm.



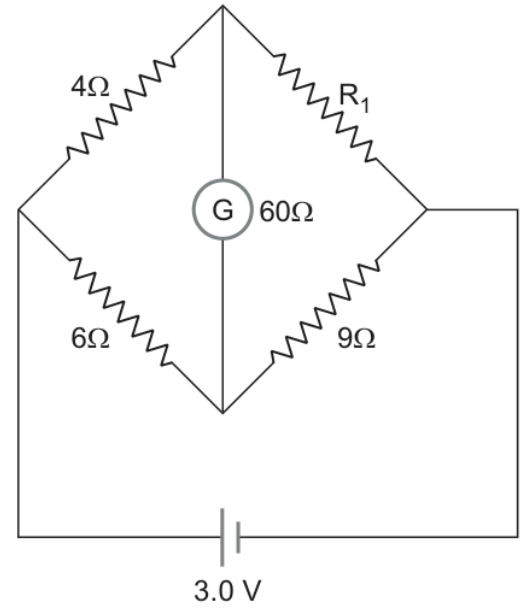
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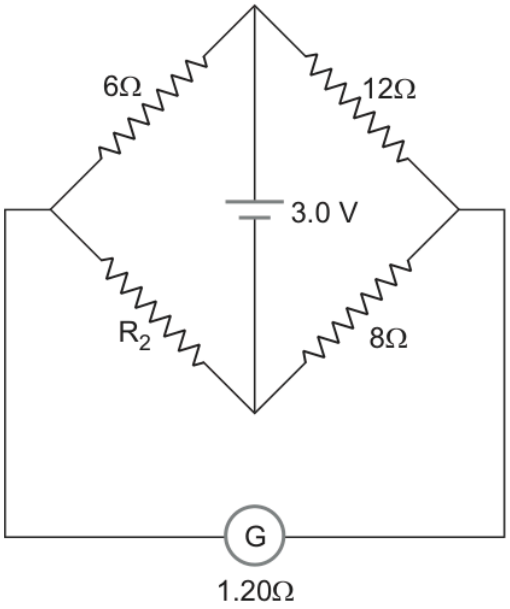
18. A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. The Earth's magnetic field at the plane is 0.4 G and the angle of dip is 60°. Calculate the emf induced between the axle and the rim of the wheel. How will the value of emf be affected if the number of spokes were increased?

19. Define the current sensitivity of a galvanometer. Write its S.I. unit.

Figure shows two circuits each having a galvanometer and a battery of 3 V.

When the galvanometers in each arrangement do not show any deflection, obtain the ratio R_1/R_2.





20. A wire AB is carrying a steady current of 12 A and is lying on the table. Another wire CD carrying 5A is held directly above AB at a height of 1 mm. Find the mass per unit length of the wire CD so that it remains suspended at its position when left free. Give the direction of the current flowing in CD with respect to that in AB. [Take the value of g = 10 ms^{-2}]

21. Draw V – I characteristics of a p–n junction diode. Answer the following questions, giving reasons: (i) Why is the current under reverse bias almost independent of the applied potential upto a critical voltage? (ii) Why does the reverse current show a sudden increase at the critical voltage? Name any semiconductor device which operates under the reverse bias in the breakdown region.

22. Draw a labelled ray diagram of a refracting telescope. Define its magnifying power and write the expression for it. Write two important limitations of a refracting telescope over a reflecting type telescope.

23. Write Einstein's photoelectric equation and point out any two characteristic properties of photons on which this equation is based. Briefly explain the three observed features which can be explained by this equation.

24. Name the type of waves which are used for line of sight (LOS) communication. What is the range of their frequencies?

A transmitting antenna at the top of a tower has a height of20 m and the height of the receiving antenna is 45 m. Calculate the maximum distance between them for satisfactory communication in LOS mode. (Radius of the Earth = 6.4×10^6 m)

25. (a) What is linearly polarized light? Describe briefly using a diagram how sunlight is polarised. (b) Unpolarised light is incident on a polaroid. How would the intensity of transmitted light change when the polaroid is rotated?

26. One day Chetan's mother developed a severe stomach ache all of a sudden. She was rushed to the doctor who suggested for an immediate endoscopy test and gave an estimate of expenditure for the same. Chetan immediately contacted his class teacher and shared the information with her. The class teacher arranged for the money and rushed to the hospital. On realising that Chetan belonged to a below average income group family, even the doctor offered concession for the test fee. The test was conducted successfully. Answer the following questions based on the above information: (a) Which principle in optics is made use of in endoscopy? (b) Briefly explain the values reflected in the action taken by the teacher. (c) In what way do you appreciate the response of the doctor on the given situation?

27. (a) Using Biot-Savart's law, derive the expression for the magnetic field in the vector form at a point on the axis of a circular current loop. (b) What does a toroid consist of ? Find out the expression for the magnetic field inside a toroid for N turns of the coil having the average radius r and carrying a current I. Show that the magnetic field in the open space inside and exterior to the toroid is zero.

OR

27. (a) Draw a schematic sketch of a cyclotron. Explain clearly the role of crossed electric and magnetic field in accelerating the charge. Hence derive the expression for the kinetic energy acquired by the particles.

(b) An α-particle and a proton are released from the centre of the cyclotron and made to accelerate.

(i) Can both be accelerated at the same cyclotron frequency? Give reason to justify your answer.

(ii) When they are accelerated in turn, which of the two will have higher velocity at the exit slit of the dees?

28. (a) Define electric dipole moment. Is it a scalar or a vector? Derive the expression for the electric field of a dipole at a point on the equatorial plane of the dipole.

(b) Draw the equipotential surfaces due to an electric dipole. Locate the points where the potential due to the dipole is zero.

OR

28. Using Gauss' law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point (i) outside and (ii) inside the shell. Plot a graph showing variation of electric field as a function of r > R and r < R. (r being the distance from the centre of the shell)

29. Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number n_i) to the lower state, (n_f).

When electron in hydrogen atom jumps from energy state $n_i = 4$ to $n_f = 3, 2, 1$, identify the spectral series to which the emission lines belong.

OR

29. (a) Draw the plot of binding energy per nucleon (BE/A) as a function of mass number A. Write two important conclusions that can be drawn regarding the nature of nuclear force.

(b) Use this graph to explain the release of energy in both the processes of nuclear fusion and fission.

(c) Write the basic nuclear process of neutron undergoing β-decay. Why is the detection of neutrinos found very difficult?

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