CBSE Class 12 Physics 2015 - Set 55/2 - Compartment

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. There are 26 questions in all.

(ii) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(iii) Section A contains five questions of 1 mark each; Section B contains five questions of 2 marks each; Section C contains twelve questions of 3 marks each; Section D contains one value-based question of 4 marks; and Section E contains three questions of 5 marks each.

(iv) There is no overall choice. However, internal choices are provided in one 2-mark question, one 3-mark question and all three 5-mark questions. Attempt only one alternative in each such question.

(v) You may use the supplied values of physical constants wherever 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}

Section A

1. A variable frequency AC source is connected to a capacitor. Will the displacement current change if the frequency of the AC source is decreased?

2. Draw the logic symbol of NAND gate and give its Truth Table.

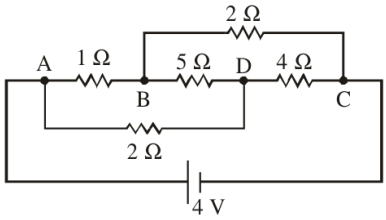
3. Plot a graph showing variation of capacitive reactance with the change in the frequency of the AC source.

4. Distinguish between amplitude modulation and frequency modulation.

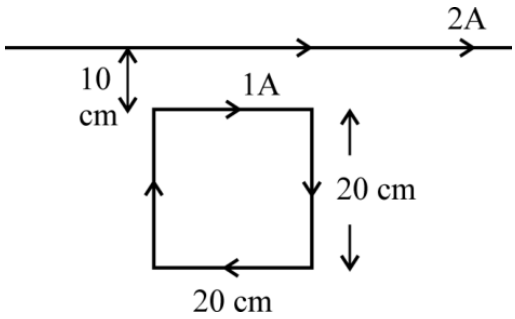
5. Why are electric field lines perpendicular at a point on an equipotential surface of a conductor?

Section B

6. Calculate the current drawn from the battery by the network of resistors shown in the figure.



7. A square loop of side 20 cm carrying current of 1A is kept near an infinite long straight wire carrying a current of 2A in the same plane as shown in the figure.



Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor.

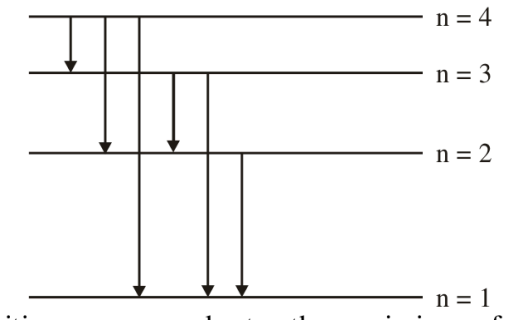
OR

7. A square shaped plane coil of area 100 cm^2 of 200 turns carries a steady current of 5A. It is placed in a uniform magnetic field of 0.2 T acting perpendicular to the plane of the coil. Calculate the torque on the coil when its plane makes an angle of 60° with the direction of the field. In which orientation will the coil be in stable equilibrium?

8. Name the types of e.m. radiations which (i) are used in destroying cancer cells, (ii) cause tanning of the skin and (iii) maintain the earth's warmth.

Write briefly a method of producing any one of these waves.

9. The figure shows energy level diagram of hydrogen atom.



(a) Find out the transition which results in the emission of a photon of wavelength 496 nm.

(b) Which transition corresponds to the emission of radiation of maximum wavelength? Justify your answer.

10. Define the term 'electric flux'. Write its SI unit. What is the flux due to electric field $\vec{E} = 3 \times 10^3 \hat{i}$ N/C through a square of side 10 cm, when it is held normal to $\vec{E}$?

Section C

11. A closely wound solenoid of 2000 turns and cross sectional area $1.6 \times 10^{-4}\,m^2$ carrying a current of 4.0 A is suspended through its centre allowing it to turn in a horizontal plane. Find (i) the magnetic moment associated with the solenoid, (ii) magnitude and direction of the torque on the solenoid if a horizontal magnetic field of 7.5×10^{-2} T is set up at an angle of 30° with the axis of the solenoid.

12. (a) The ratio of the widths of two slits in Young's double slit experiment is 4:1. Evaluate the ratio of intensities at maxima and minima in the interference pattern.

(b) Does the appearance of bright and dark fringes in the interference pattern violate, in any way, energy conservation law? Explain.

13. (a) Write the factors by which the resolving power of a telescope can be increased.

(b) Estimate the angular separation between first order maximum and third order minimum of the diffraction pattern due to a single slit of width 1 mm, when light of wavelength 600 nm is incident normal on it.

14. (a) Good quality sun-glasses made of polaroids are preferred over ordinary coloured glasses. Justifying your answer.

(b) Two polaroids P_1 and P_2 are placed in crossed positions. A third polaroid P_3 is kept between P_1 and P_2 such that pass axis of P_3 is parallel to that of P_1. How would the intensity of light (I_2) transmitted through P_2 vary as P_3 is rotated? Draw a plot of intensity 'I_2' Vs the angle 'θ', between pass axes of P_1 and P_3.

15. (a) Complete the following nuclear reactions :

(i) $^{208}_{84}Po \rightarrow {}^{204}_{82}Pb + ...$

(ii) $^{32}_{15}P \rightarrow {}^{32}_{16}S + ...$

(b) Write the basic process involved in nuclei responsible for (i) β^- and (ii) β^+ decay.

(c) Why is it found experimentally difficult to detect neutrinos?

16. Draw the energy band diagrams of (i) n-type and (ii) p-type semiconductor at temperature, T > 0K.

In the case n-type Si semiconductor, the donor energy level is slightly below the bottom of conduction band whereas in p-type semiconductor, the acceptor energy level is slightly above the top of the valence band. Explain, what role do these energy levels play in conduction and valence bands.

17. Draw a plot of transfer characteristic (V_0 vs V_i) and show which portion of the characteristic is used in amplification and why?

Draw the circuit diagram of base bias transistor amplifier in CE configuration and briefly explain its working.

18. Explain the following terms in relation to the use of internet :

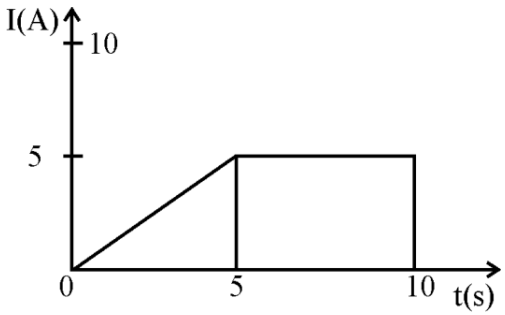
(i) Internet surfing

(ii) Social networking

(iii) E-mail

19. (a) Deduce the relation between current I flowing through a conductor and drift velocity $\vec{v}_d$ of the electrons.

(b) Figure shows a plot of current 'I' flowing through the cross-section of a wire versus the time 't'. Use the plot to find the charge flowing in 10s through the wire.



20. Draw a circuit diagram of a potentiometer. State its working principle. Derive the necessary formula to describe how it is used to compare the emf of the two cells.

OR

20. With the help of the circuit diagram, explain the working principle of meter bridge. How is it used to determine the unknown resistance of a given wire? Write the necessary precautions to minimize the error in the result.

21. (a) Why is the magnetic field radial in a moving coil galvanometer? Explain how it is achieved.

(b) A galvanometer of resistance 'G' can be converted into a voltmeter of range (0-V) volts by connecting a resistance 'R' in series with it. If this is to be converted to voltmeter of range 0 to V/2, how much resistance will be required?

22. A source of ac voltage $V = V_0 \sin \omega t$ is connected to a series combination of a resistor 'R' and a capacitor 'C'. Draw the phasor diagram and use it to obtain the expression for (i) impedance of the circuit and (ii) phase angle.

Section D

23. Immediately after school hour, as Bimla with her friends came out, they noticed that there was a sudden thunderstorm accompanied by the lightening. They could not find any suitable place for shelter. Dr. Kapoor who was passing thereby in his car noticed these children and offered them to come in their car. He even took care to drop them to the locality where they were staying. Bimla's parents, who were waiting, saw this and expressed their gratitude to Dr. Kapoor.

(1) What values did Dr. Kapoor and Bimla's parents display?

(2) Why is it considered safe to be inside a car especially during lightening and thunderstorm?

(3) Define the term 'dielectric strength'. What does this term signify?

Section E

24. (a) Define wavefront. How is it different from a ray?

(b) Depict the shape of a wavefront in each of the following cases :

(i) Light diverging from a point source.

(ii) Light emerging out of a convex lens when a point source is placed at its focus.

(iii) Using Huygen's construction of secondary wavelets, draw a diagram showing the passage of a plane wavefront from a denser into a rarer medium.

OR

24. (a) Draw a ray diagram showing image formation by a compound microscope. Obtain expression for total magnification when the image is formed at infinity.

(b) How does the resolving power of a compound microscope get affected, when

(i) focal length of the objective is decreased.

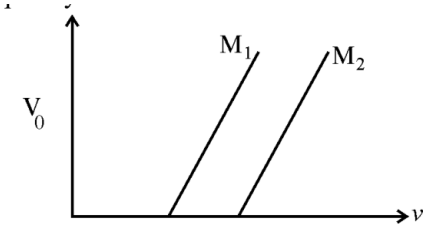
(ii) the wavelength of light is increased?

Give reasons to justify your answer.

25. (a) Write three observed features of photoelectric effect which cannot be explained by wave theory of light.

Explain how Einstein's photoelectric equation is used to describe these features satisfactorily.

(b) Figure shows a plot of stopping potential (V_0) with frequency (ν) of incident radiation for two photosensitive materials M_1 and M_2. Explain



(i) why the slope of both the lines is same?

(ii) for which material emitted electrons have greater kinetic energy for the same frequency of incident radiation?

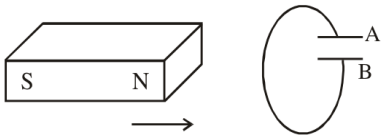
OR

25. (a) In Rutherford scattering experiment, draw the trajectory traced by α-particles in the coulomb field of target nucleus and explain how this led to estimate the size of the nucleus.

(b) Describe briefly how wave nature of moving electrons was established experimentally.

(c) Estimate the ratio of de-Broglie wavelengths associated with deuterons and α-particles when they are accelerated from rest through the same accelerating potential V.

26. (a) State Lenz's law. Use it to predict the polarity of the capacitor in the situation given below :



(b) A jet plane is travelling towards west at a speed of 1800 km/h.

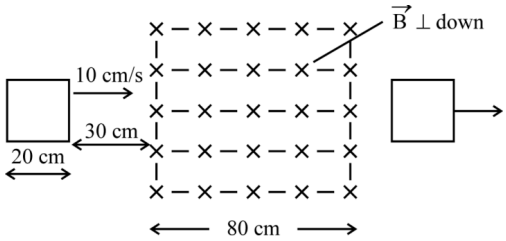
(i) Estimate voltage difference developed between the ends of the wing having a span of 25 m if the earth's magnetic field at the location has a magnitude of 5×10^{-4} T and dip angle is 30°.

(ii) How will the voltage developed be affected if the jet changes its direction from west to north?

OR

26. Define mutual inductance of a pair of coils and write on which factors does it depend.

A square loop of side 20 cm is initially kept 30 cm away from a region of uniform magnetic field of 0.1 T as shown in the figure. It is then moved towards the right with a velocity of 10 cm s^{-1} till it goes out of the field.



Plot a graph showing the variation of :

(i) magnetic flux (ϕ) through the loop with time (t).

(ii) induced emf (ε) in the loop with time t.

(iii) induced current in the loop if it has resistance of 0.1 Ω.

- End of Question Paper -