AMRITA VIDYALAYAM

AMRITA PRE BOARD EXAMINATION 1 - 2018 - '19

Class : XII **Marks : 70**

Time : 3 hrs

PHYSICS (042)

GENERAL INSTRUCTIONS:

1. *All questions are compulsory. There are 27 questions in total.*
2. *This question paper has four sections.*
3. *Section A contains 5 questions of 1 mark each, Section B contains 7 questions of 2 marks each, Section C contains 12 questions of 3 marks each, Section D contains 3 questions of 5 marks each.*
4. *There is no overall choice. However an internal choice has been provided in 2 questions of 1 mark, 2 questions of 2 marks, 3 questions of 3 marks and 3 questions of 5 marks each. You have to attempt only 1 of the choices in such questions.*
5. *You may use the following values of physical constants wherever necessary.*

$C = 3 \times 10^8$ m/s $\quad h = 6.63 \times 10^{-34}$ JS

$e = 1.6 \times 10^{-19}$C $\quad \mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^{2}N^{-1}m^{-2} $\quad m_e = 9.1 \times 10^{-31}$ kg

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

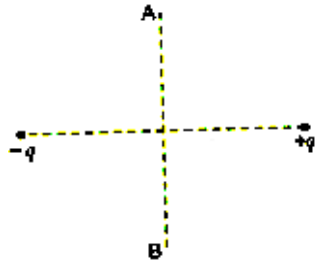
Mass of neutron = 1.675×10^{-27} kg $\quad$ Mass of proton = 1.673×10^{-27} kg

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

Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION - A

1. A charge q is moved from a point A above a dipole of dipole moment p, to a point B below the dipole in equatorial plane without acceleration. Find the work done in the process.

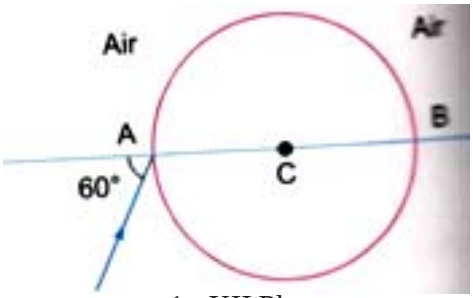


2. Two materials Si and Cu are cooled from 300K to 60K. What will be the effect on their resistivity?
3. The charging current for a capacitor is 0.25A. What is the displacement current across its plate?

OR

Name the current which can flow even in the absence of electric charge.

4. A ray of light falls on a transparent sphere parallel to the line AB as shown in the figure. Find the angle of refraction at A, if the refractive index of the material of the prism is $\sqrt{3}$.



5. The de Broglie wave length of a particle of kinetic energy K is λ. What will be the wavelength if the kinetic energy is K / 4?

OR

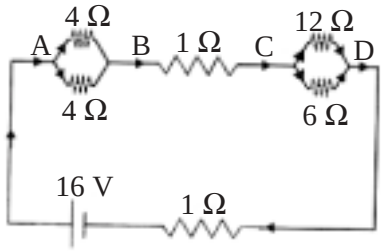
Does the stopping potential in photoelectric emission depend on
a) the intensity of the incident radiation?
b) the frequency of incident radiation in a photocell?

SECTION - B

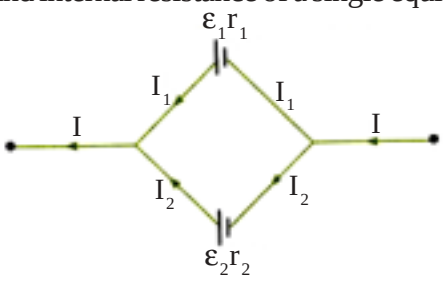
6. A 9 volt battery is connected in series with a resistor. The terminal voltage is found to be 8 volt. Current through the circuit is measured as 5 A. What is the internal resistance of the battery?

OR

A network of resistors is connected to a 16 volt battery of internal resistance 1 ohm, as shown in the following figure. Compute the equivalent resistance of the network.



7. Two cells of e.m.f's E_1 and E_2 and internal resistance r_1 and r_2 are connected in parallel. Obtain expression for the e.m.f and internal resistance of a single equivalent cell that can replace this combination.



8. A wheel with 8 metallic spokes, each 50 cm long is rotated with a speed 120 rev / min in a plane normal to the horizontal component of earth's magnetic field. The earth's magnetic field at the place is 0.4 G and the angle of dip is 60^0. Calculate the e.m.f induced between the axle and rim of the wheel. How will the value of e.m.f be affected if the number of spokes is increased?

9. Find the wavelength of the electromagnetic waves of frequency 4×10^9 Hz in free space. Give its two applications.

OR

The magnetic field in a plane electromagnetic wave is given by
$B_y = 8 \times 10^{-6} \text{ Sin } (2 \times 10^{11} t + 300 \pi x)$ T.
a) What is the wavelength of the wave?
b) Write expression for the electric field E.

10. Find the ratio of intensities of two points P and Q on a screen in Young's double slit experiment when waves from sources S_1 and S_2 have phase difference of
a) 0^0 and b) $\pi / 2$ respectively.

11. For an amplitude modulated wave, the maximum amplitude is found to be 10 volt while the minimum amplitude is found to be 2 volt. Determine the modulation index μ. What will be the value of μ, if the minimum amplitude is zero volt?

12. A TV transmission tower antenna is at a height of 20 m. How much range can it cover, if the receiving antenna is at a height of 25 m. (Given value of earth's radius to be 6400 kms)

SECTION - C

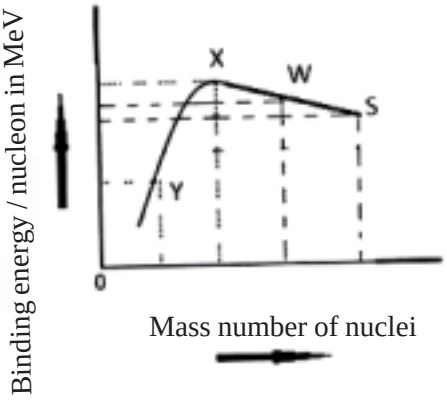
13. An electric dipole is held in a uniform electric field.
    a) Using suitable diagram show that it does not undergo any translator motion.
    b) Derive an expression for the torque acting on it and specify its direction.
    c) Derive an expression for the work done in rotating the dipole from angle θ_1 to θ_2 in a uniform electric field E.
14. Derive an expression for the energy stored in a parallel plate capacitor charged to a potential difference V. Hence derive an expression for the energy density of the capacitor.
15. A galvanometer of resistance R_g is converted to a voltmeter to measure up to V volts by connecting a resistance R_1 in series with the coil of the galvanometer. When a resistance R_2 is connected in series with it, then it can measure up to V / 2 volts. Find the resistance R_3 required to convert it to a voltmeter that can read up to 2V volts and also the resistance of the galvanometer in terms of R_1 and R_2.

    OR

    Name and define the magnetic element's of earth's magnetic field at a place. Derive an expression for the angle of dip in terms of the horizontal component and the resultant magnetic field of earth at a place.
16. Define self inductance of a solenoid. Write its S.I unit. Obtain the expression for the mutual inductance of two long coaxial solenoids S_1 and S_2 wound one over the other, each of length *l* and radius r_1 and r_2 and number of turns per length being n_1 and n_2, when a current I is set up in the outer solenoid S_2.
17. A sinusoidal voltage of peak value 10 volt is applied to a series LCR circuit in which resistance, capacitance and inductance have values of 10 ohm, 1 μ F and 1 H respectively. Find
    a) the peak voltage across the inductor at resonance.
    b) quality factor of the circuit.

    OR

    a) What is the principle of a transformer?
    b) Explain how laminating the core of the transformer helps to reduce eddy currents.
    c) Why is, the primary and secondary coils of a transformer are preferably wound on the same core?
18. Derive the expression for the refractive index of the material of the prism in terms of the angle of the prism and angle of minimum deviation by drawing a neat labelled diagram.
19. Draw a ray diagram to show the formation of image of an object placed between the optical centre and focus of a convex lens. Write the characteristics of the image so formed. Using this diagram derive the relation between object distance, image distance and focal length of the convex lens.
20. Write Einstein's photoelectric equation and mention which important features in photoelectric effect can be explained with the help of this equation. The maximum kinetic energy of the photoelectrons gets doubled when the wavelength of the incident radiation changes from λ_1 to λ_2. Derive an expression for the work function in terms of λ_1 and λ_2.
21. Using Rydberg's formula, calculate the longest wave length belonging to Lymann and Balmer series. In which region of the hydrogen spectrum do these transitions lie?
    (Given $R_H = 1.1 \times 10^7\ m^{-1}$)
22. Binding energy per nucleon versus mass number curve is as shown.
    $^{A}_{Z}S$, $^{A1}_{Z1}W$, $^{A2}_{Z2}X$ and $^{A3}_{Z3}Y$ are four nuclei indicated on the curve.



Based on the graph

a) Arrange X, W and S in the increasing order of their stability.

b) Write the relation between the relevant A and Z values for the following nuclear reaction.

$S \rightarrow X + W$

c) Explain why binding energy is low for heavy nuclei.

OR

22. How are protons, which are positively charged, held together inside the nucleus?

b) Explain the variation of potential energy of a pair of nucleons as a function of their separation.

c) State the significance of negative potential energy in this region.

23. a) How is a Zener diode fabricated?

b) What causes the setting up of high electric field even for small reverse bias voltage across the diode?

c) Describe with the help of a circuit diagram the working of Zener diode as voltage regulator.

24. A sinusoidal carrier wave of amplitude A_c and angular frequency ω_c is modulated in accordance with a sinusoidal information signal of amplitude A_m and angular frequency ω_m.

a) Show that the amplitude modulated signal contains three frequencies centred around ω_c.

b) Draw the frequency spectrum of the resulting modulated signal.

SECTION - D

25. Draw a schematic diagram of a cyclotron.

a) Explain briefly how it works and how it is used to accelerate the charged particles.

b) Show that the time period of ions in a cyclotron is independent of both the speed and radius of the circular path.

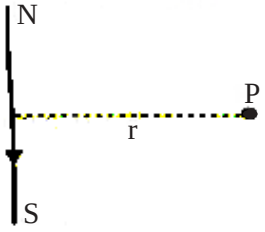
c) What is resonance condition? How is it helpful in the acceleration of charged particles?

OR

a) Derive an expression for the force between two long parallel current carrying conductors.

b) Using this expression define the S.I unit of current.

c) A long straight wire AB carries a current I. A proton P travels with a speed v, parallel to the wire at a distance d from it, in a direction opposite to the direction of current as shown in the figure.



What is the force experienced by the proton and what is its direction?

26. a) State Huygen's principle. Using this principle draw a diagram to show how a plane wave front incident at the interface of the two media gets refracted when it propagates from a rarer to denser medium. Hence verify Snell's law of refraction.

b) When monochromatic light travels from a rarer to denser medium, explain the following, giving reasons.

(i) Is the frequency of the reflected and refracted light are the same as that of the frequency of the incident light?

(ii) Does a decrease in speed imply a reduction in energy carried by the light wave?

OR

What are coherent sources of light? Two slits of Young's double slit experiment are illuminated by two different sodium light of same wave lengths.

a) Why is no interference pattern observed?

b) Obtain the condition for getting dark and bright fringes in Young's experiment. Hence write the expression for fringe width. If the set up were to be put up in a medium optically denser than air what effect would be thereon the observed fringe width. Give reason for your answer.

c) If s is the size of the source and d its distance from the plane of the slit, a the distance between the two cohearent sources, λ the wavelength of light used, what should be the criteria for the interference fringes to be seen?

27. With the help of a labelled circuit diagram, explain how an n-p-n transistor can be used as an amplifier in common emitter configuration. Write an expression for its voltage gain. Explain how the input and output voltages are out of phase by 180^0 for a common emitter amplifier.

The potential difference across the collector of a transistor used in common emitter mode is 1.5 volt, with the collector resistance of 3 k. ohm. Find the emitter current and the base current if the d.c gain of the transistor is 50.

OR

Draw the circuit diagram to determine the characteristics of an n-p-n transistor in common emitter configuration. Using the I - V characteristics, explain how the collector current changes with base current. How can output resistance and current amplification factor be determined from the I - V characteristics? Identify the equivalent gate for the following circuit and write its truth table.