COMMON PRE-BOARD EXAMINATION
SUBJECT: PHYSICS (042)
CLASS XII- SESSION 2022-23

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

General Instructions:

1. There are 35 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.
6. You may use the following values of physical constants wherever necessary

$c = 3 \times 10^{8}$ m/s
$h = 6.6 \times 10^{-34}$ J s
$e = 1.6\times 10^{-19}$ C
$\mu_0 = 4\pi\times 10^{-7}$ Tm A^{-1}
$\varepsilon_0 = 8.854 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$
$$\frac{1}{4\pi\varepsilon_0} = 9\times 10^{9}\ Nm^2C^{-2}$$
Mass of electron = 9.1×10^{-31} kg
Mass of neutron = 1.675×10^{-27} kg
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

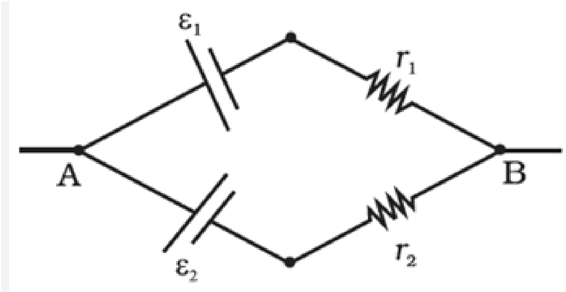
1. Two point charge *Q* and -2*Q* are placed at some distance apart. If the electric field at the location of *Q* is *E*, then the electric field at the location of -2*Q* will be

(a) –3E/2 (b) –2E
(c) –E (d) –E/2

2. If 125 water drops of equal radius and equal capacitance C, coalesce to form a single drop of capacitance C' the relation between C and C' is

(a) C' = C (b) C' = 125C
(c) C' = 5C (d) C' = 250C

3. Two batteries of emf ε_1 and ε_2 ($\varepsilon_2 > \varepsilon_1$) and internal resistances r_1 and r_2 respectively are connected in parallel as shown in figure :



(a) The equivalent emf ε eq of the two cells is $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$.

(b) The equivalent emf ε eq is smaller than ε_1.

(c) The εeq is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always.

(d) ε eq is independent of internal resistances r_1 and r_2.

4. Current sensitivity of a galvanometer can be increased by decreasing :

(a) Magnetic field B
(b) number of turns N
(c) Torsional constant K
(d) Area A

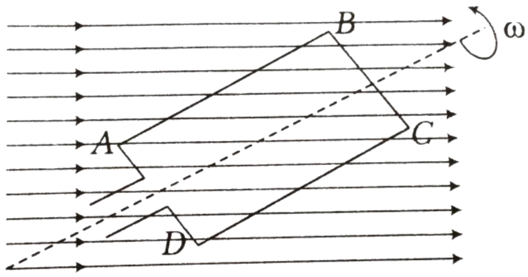
5. A current passing through a circular coil of two turns produces a magnetic field of 8 T at its centre. The coil is then rewound, so as to have four turns and current is passed through it is doubled. Now magnetic field at the centre of the coil will be

(a) 64 T
(b) 32 T
I
f
(c) 16 T
(d) 8 T

6. A diamagnetic substance is brought near north or south pole of a bar magnet, then it is

(a) attracted by the poles
(b) repelled by the poles
(c) attracted by the north pole and repelled by the south pole
(d) repelled by the north pole and attracted by the south pole

7. A rectangular coil ABCD is rotated anticlockwise with a uniform angular velocity about the axis shown in the figure. Initially, the axis of rotation of the coil as well as the magnetic field B was horizontal. The induced E.M.F. in the coil would be maximum when plane of the coil



(a) is horizontal.
(b) is at right angle to the magnetic field.
(c) makes an angle of 30^0 with the horizontal.
(d) makes an angle of 45^0 with the direction of magnetic field.

8. The magnetic flux through a circuit of resistance R changes by an amount Δϕ in a time Δt . The total electric charge Q that passes any point in the circuit during the time Δt is represented by

(a) $Q = \frac{\Delta\phi}{\Delta t}$
(b) $Q = \frac{\Delta\phi}{R}$
(c) $Q = R \cdot \frac{\Delta\phi}{\Delta t}$
(d) $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$

9. The power factor of series LCR circuit at resonance is

(a) 0.707
(b) 0
(c) 0.5
(d) 1

10. In an AC circuit, an alternating voltage $V = 200\sqrt{2}\, sin100t$ volt is connected to a capacitor of capacity 1μF. The rms value of current in the circuit is

(a) 20mA (b) 10mA

(c) 100mA (d) 200mA

11. Which of the following statements are correct?

A. X-rays are suitable for radar system and aircraft navigation.

B. Water molecules readily absorb infrared radiation and their thermal motion increases.

C. Microwaves are produced in Klystron valve

D. Gamma radiations generate due to electron transitions between upper and lower energy levels of heavy element when excited by electron bombardment

(a) Both A and B (b) Both B and C

(c) Both C and D (d) only C

12. A diffraction pattern is obtained by using a beam of red light. What happens, if the red light is replaced by blue light?

(a) no change

(b) diffraction bands disappear

(c) diffraction bands become broader and farther apart

(d) diffraction bands become narrower and crowded together

13. The energy E of a hydrogen atom with principal quantum no. n is given by $E = -13.6/n^2$ eV. The energy ejected when the electron jumps from n = 3 state to n = 2 state of hydrogen is approximately

(a) 0.85 eV (b) 1.5 eV

(c) 1.9 eV (d) 3.4 eV

14. Energy equivalent of 1 amu is

(a) 0.931 M eV (b) 9.31MeV

(c) 93.1 MeV (d) 931MeV

15. The work function for a metal surface is 4.14 eV. The threshold wavelength for this metal surface is:

(a) 4125 Å (b) 2062.5 Å

(c) 3000 Å (d) 6000 Å

16. **Assertion:** The resistivity of a semi-conductor increases with temperature.

Reason: The atoms of semi-conductor vibrate with larger amplitude as higher temperatures thereby increasing its resistivity.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

17. **Assertion:** When tiny circular obstacle is placed in the path of light from some distance, a bright spot is seen at the centre of the shadow of the obstacle.

Reason: Destructive interference occurs at the centre of the shadow.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

18. **Assertion:** Kinetic energy of photo electrons emitted by a photosensitive surface depends upon the frequency of incident photon.

Reason: The ejection of electrons from metallic surface is not possible with frequency of incident photon below the threshold frequency.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

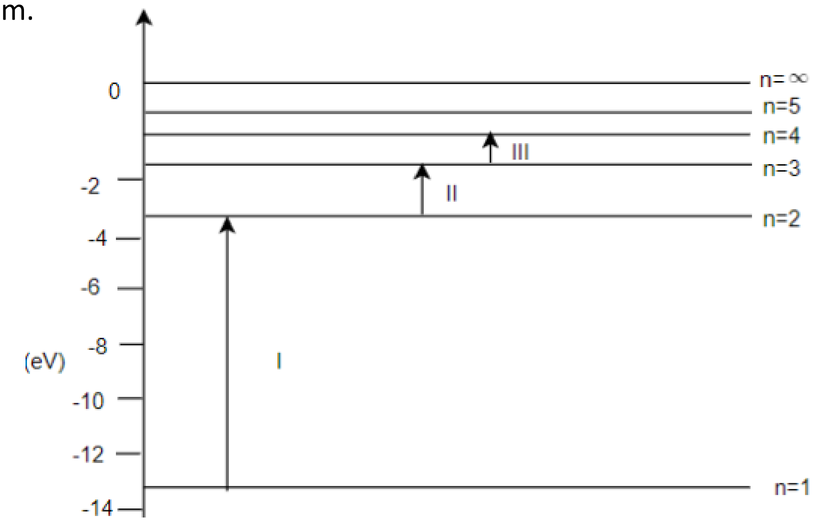
SECTION-B

19. Explain briefly how electromagnetic waves are produced by an oscillating charge. How is the frequency of electromagnetic waves produced related to that of the oscillating charge?

20. a) Define the term magnetic susceptibility and write its relation in terms of relative magnetic permeability.

b) Two magnetic materials A and B have relative magnetic permeabilities of 0.96 and 500. Identify the magnetic materials A and B

21. Photons, with a continuous range of frequencies, are made to pass through a sample of rarefied hydrogen. The transitions, shown here, indicate three of the spectral absorption lines in the continuous spectrum.



(a) Identify the spectral series of the hydrogen emission spectrum to which each of these three lines corresponds.

(b) Which of these lines corresponds to the absorption of radiation of maximum wavelength?

OR

When four hydrogen nuclei combine to form a helium nucleus, estimate the amount of energy in MeV released in this process of fusion (Neglect the masses of electrons and neutrinos)
Given: (i) mass of $_{1}^{1}H$ = 1.007825u (ii) mass of helium nucleus = 4.002603u, 1u = 931MeV/c^2

22. For a glass prism (μ = $\sqrt{3}$) the angle of minimum deviation is equal to the angle of the prism. Find the angle of the prism.

23. What happens when a forward bias is applied to a p -n junction?

OR

Draw energy band diagram of n -typed and p -typed semiconductor at temperature T > 0 K. Mark the donor and acceptor energy level with their energies.

24. Two plane monochomic waves propagating in the same direction with amplitudes *A* and 2A and differing in phase by $\pi/$ 3 superpose. Calculate the amplitude of the resultant wave.

25. Find the electric dipole moment electron and a proton which distance is 4.3 nm apart.

SECTION-C

26. Define magnetic field in terms of the force on a moving charge. Hence define one tesla.

OR

Two long straight parallel conductors carrying currents I_1 and I_2 are separated by a distance d. If the currents are flowing in the same direction, show how the magnetic field produced by one exerts an attractive force on the other. Obtain the expression for this force and hence define 1 ampere.

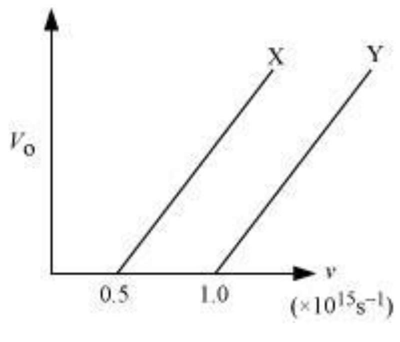
27. The current flowing in the two coils of self-inductance L_1 = 16 mH and L_2 = 12 mH are increasing at the same rate. If the power supplied to the two coils are equals, find the ratio of
    (a) induced voltage,
    (b) the currents and
    (c) the energies stored in the two coils at a given instant.

28. Derive the equation of instantaneous current in L-C-R circuit when $X_L > X_C$ or the circuit is inductive.

OR

a. Derive the transformer equation.
b. Name the factors responsible for decreasing the efficiency of a transformer.

29. The following graph shows the variation of stopping potential V_0 with the frequency (v) of the incident radiation for two photosensitive metals X and Y.



a. Which of the metals has larger threshold wavelength? Give reason.
b. Explain giving reason which metal gives out electrons having larger kinetic energy, for the same wavelength of the incident radiation.

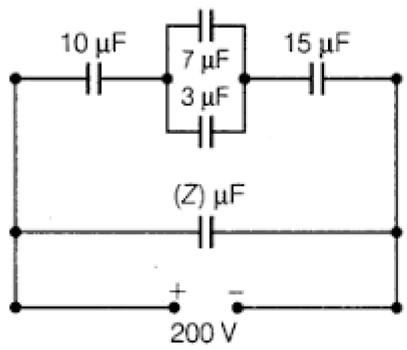
c. If the distance between the light source and metal X is halved, what will be the kinetic energy of electrons emitted due to this change? Give reason.

30. The ground state energy of hydrogen atom is -13.6 eV. If an electron makes a transition from an energy level - 0.85 eV to -3.4 eV, calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong?

SECTION-D

31. (i) Derive an expression for the capacitance of a parallel plate capacitor. If a compound dielectric medium of thickness t (t < d) is introduced between the plates of the capacitor, how will the capacitance of the capacitor change?

A system of capacitors, connected as shown , has a total energy of 160 mJ stored in it . Obtain the value of the equivalent capacitance of this system and the value of Z.



OR

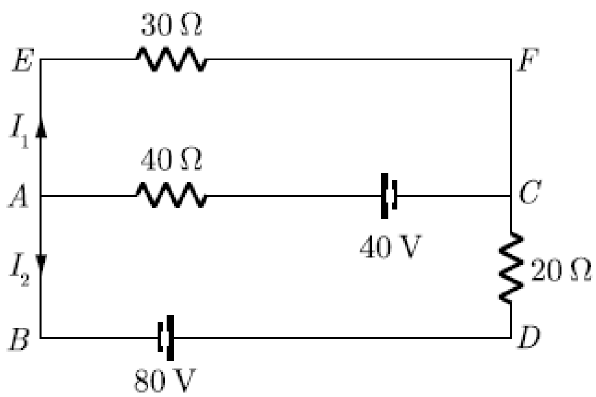
(a) Using Gauss' law, obtain expressions for the electric field (i) inside, and (ii) outside a positively charged spherical shell.

(b) Show graphically variation of the electric field as a function of the distance r from the centre of the sphere.

(c) A square plane sheet of side 10 cm is inclined at an angle of 30^0 with the direction of a uniform electric field of 200 NC^{-1}. Calculate the electric flux passing through the sheet.

32. (a) State Kirchhoff's rules.

(b) Using Kirchhoff's rules, calculate the current in the arm *AC* of the given circuit.



OR

(a) Define the term drift velocity.

(b) On the basis of electron drift, derive an expression for resistivity of an conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?

(c) Why alloys like constantan and manganin are used for making standard resistors?

33. (a) Sketch the refracted wavefront for the incident plane wavefront of light from a distant object passing through a convex lens.

(b) Using Huygens' principle, verify the laws of refraction when light from a denser medium is incident on a rarer medium.

(c) A monochromatic light of wavelength 500 nm incident on a glass slab. The refractive index of glass is 1·5. Estimate the speed and wavelength and frequency of the light inside the glass slab.

OR

(a) State the essential conditions for diffraction of light.

(b) Explain diffraction of light due to a narrow single slit and the formation of pattern of fringes on the screen.

(c) Find the relation for width of central maximum in terms of wavelength λ , width of slit *a* and separation between slit and screen *D*.

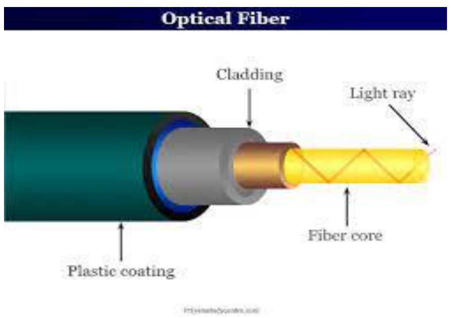
(d) If the width of the slit is made double the original width, how does it affect the size and intensity of the central band?

SECTION-E

Case Study :

Read the following paragraph and answer the questions.

34. Now-a-days optical fibres are extensively used for transmitting audio and video signals through long distances. Optical fibres too make use of the phenomenon of total internal reflection. Optical fibres are fabricated with high quality composite glass/quartz fibres. Each fibre consists of a core and cladding. The refractive index of the material of the core is higher than that of the cladding. When a signal in the form of light is directed at one end of the fibre at a suitable angle, it undergoes repeated total internal reflections along the length of the fibre and finally comes out at the other end. Since light undergoes total internal reflection at each stage, there is no appreciable loss in the intensity of the light signal. Optical fibres are lubricated such that light reflected at one side of inner surface strikes the other at an angle larger than the critical angle. Even if the fibre is bent, light can easily travel along its length. Thus, an optical fibre can be used to act as an optical pipe.



1. What is the condition for total internal reflection to occur?
2. What type of signal is used in fiber optics signal transmission?

3. Calculate the speed of light in a medium whose critical angle is 30^0

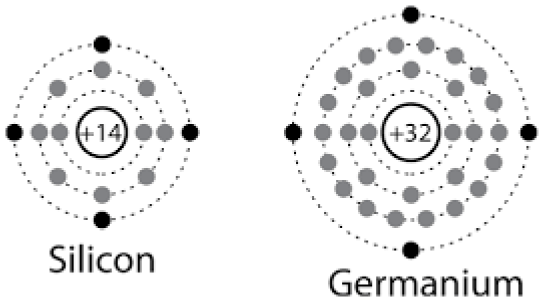
OR

3. A point source of monochromatic light 'S' is kept at the centre of the bottom of a cylinder of radius 15.0 cm. The cylinder contains water (refractive index 4/3) to a height of 7.0 cm. Draw the ray diagram and calculate the area of water surface through which the light emerges in air.

Case Study:

Read the following paragraph and answer the questions.

35. Anita was thinking that C, Si and Ge have same lattice structure, but C is insulator while Si and Ge intrinsic semiconductors. The four bonding electrons of C, Si and Ge distributed respectively in the second, third and fourth orbit. So, energy required to take out an electron from these atoms known as ionisation energy I_E will be least for Ge, followed by Si and highest for C. Hence number of free electrons for conduction in Ge and Si are significant while negligible small for C.



1. What are the intrinsic semiconductors?
2. What do you mean by 'minority carrier injection'?
3. Which is better silicon or germanium for making semiconductor devices? Why?

OR

3. If a pure silicon crystal has 5×10^{28} atoms $/m^3$. It is doped by 1 ppm concentration of pentavalent arsenic. If $n_i = 1.5 \times 10^{16}/m^3$, then calculate the number of electrons and holes.

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