Roll Number **SET A**

INDIAN SCHOOL MUSCAT

FINAL EXAMINATION

SUBJECT : PHYSICS

CLASS: XII Sub. Code: 042 Time Allotted: 3 Hrs.

04.02.2021 Max. Marks: 70

General Instructions:

1. **All questions are compulsory. There are 33 questions in all.**
2. **This question paper has five sections: Section A, Section B, Section C, Section D and section E.**
3. **Section A contains ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.**
4. **There is no overall choice. However, an internal choice is provided. You have to attempt only one of choices in such questions.**
5. **You may use the following values of physical constants wherever necessary.**

$c = 3 \text{ X } 10^{8}$ m/s , $h = 6.63 \text{ X } 10^{-34}$ Js , $e = 1.6 \text{ X } 10^{-19}$ C , $\mu_0 = 4\pi \text{ X } 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \text{ X } 10^{-12} C^2 N^{-1} m^{-2}$, $1/4\pi\varepsilon_0 = 9 \text{ X } 10^9 N m^2 C^{-2}$, $m_e = 9.1 \text{ X } 10^{-31}$ 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

All questions are compulsory. In case of internal choices, attempt any one of them.

1. Name the physical quantity having the unit Am^2. 1

2. How is the speed of electromagnetic wave in vacuum determined by electric and magnetic fields? 1

OR

Give one use of electromagnetic radiations obtained in nuclear disintegrations.

3. A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move in circular path with higher frequency? 1

4. Define the term self- inductance and write its SI unit. 1

OR

Mention any two energy losses in a transformer.

5. Write the relationship between the size of a nucleus and its mass number. 1

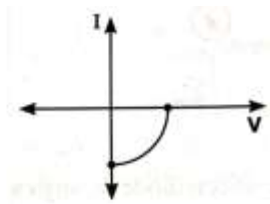
6. The photoelectric cut-off voltage in a certain experiment is 1.5 V. What is maximum kinetic energy of photoelectrons emitted? 1

7. What are isotopes? Give examples. 1

OR

Write any two characteristics properties of nuclear force.

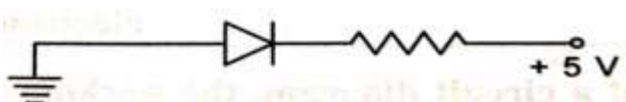
8. Name the junction diode whose I-V characteristics are drawn below. 1



OR

In full wave rectification, what is the output frequency if input frequency is 50 Hz.

9. In the following diagram, is the junction diode forward biased or reverse biased? 1



10. Which semiconductors are preferred to make LEDs and why? 1

For question numbers 11, 12, 13 and 14 two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true and R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is also false

11. Assertion (A): Electric field at the surface of a charged conductor is always normal to the surface at every point. 1

Reason (R): Electric field gives the magnitude and direction of electric force ($\vec{F}$) experienced by unit positive charge placed at any point.

12. Assertion (A): The net force on a dipole in a uniform electric field is zero. 1

Reason (R): Electric dipole moment is a vector directed from –q to +q.

13. Assertion (A): Within a glass slab, a double convex air bubble is formed. This air bubble behaves like a converging lens. 1

Reason (R): Refractive index of air is more than the refractive index of glass.

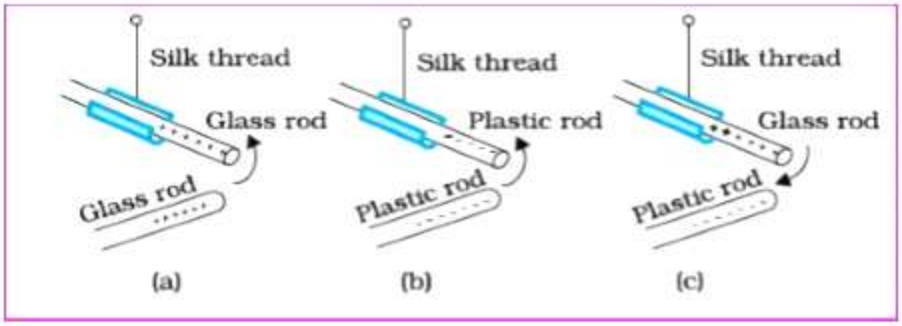
14. Assertion: The focal length of lens does not change when red light is replaced by blue light. 1

Reason: The focal length of lens does not depends on colour of light used.

SECTION-B

Questions 15 and 16 are Case Study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

15. When a glass rod is rubbed with silk, the rod acquires one kind of charge and the silk acquires the second kind of charge. This is true for any pair of objects that are rubbed to be electrified. Now if the electrified glass rod is brought in contact with silk, with which it was rubbed, they no longer attract each other. They also do not attract or repel other light objects as they did on being electrified. Thus, the charges acquired after rubbing are lost when the charged bodies are brought in contact. What can you conclude from these observations? It just tells us that unlike charges acquired by the objects neutralize or nullify each other's effect. Therefore, the charges were named as positive and negative by the American scientist Benjamin Franklin. We know that when we add a positive number to a negative number of the same magnitude, the sum is zero. This might have been the philosophy in naming the charges as positive and negative. By convention, the charge on glass rod or cat's fur is called positive and that on plastic rod or silk is termed negative. If an object possesses an electric charge, it is said to be electrified or charged. When it has no charge it is said to be electrically neutral. 4



(1) When you charge a balloon by rubbing it on your hair this is an example of what method of charging?

(a)Friction

(b)Conduction

(c)Grounding

(d)Induction

(2) Neutral atoms contain equal numbers of positive __ and negative __.

(a)Electrons and Protons

(b)Protons and Electrons

(c)Neutrons and Electrons

(d)Protons and Neutrons

(3) Which particle in an atom can you physically manipulate?

(a)protons

(b)electrons

(c)neutrons

(d)you can't manipulate any particle in an atom

(4) If a negatively charged rod touches a conductor, the conductor will be charged by what method?

(a) Friction

(b)Conduction

(c)Induction

(d)Convection

(5) The cause of charging is

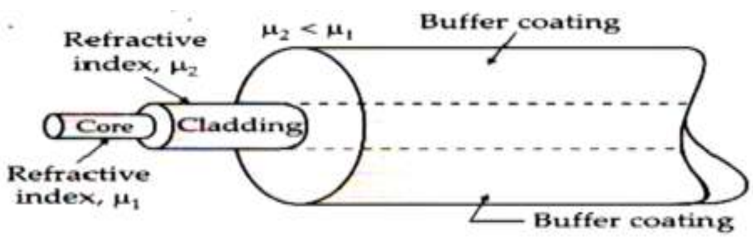
(a) the actual transfer of protons

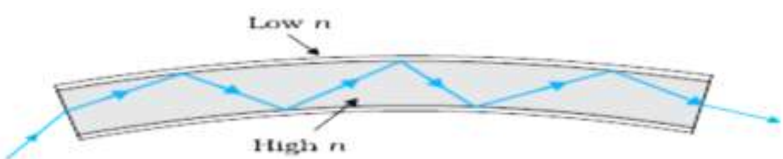
(b) the actual transfer of electrons

(c) the actual transfer of neutrons

(d) none of these

16. Optical fibres: 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 fabricated 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. 4





(1) Which of the following statement is not true.

a) Optical fibres is based on the principle of total internal reflection.

b) The refractive index of the material of the core is less than that of the cladding.

c) An optical fibre can be used to act as an optical pipe.

d) There is no appreciable loss in the intensity of the light signal while propagating through an optical fibre.

(2) What is the condition for total internal reflection to occur?

a) Angle of incidence must be equal to the critical angle.

b) Angle of incidence must be less than the critical angle.

c) Angle of incidence must be greater than the critical angle.

(d) None of the above.

(3) Which of the following is not an application of total internal reflection?

a) Mirage

b) Sparkling of diamond

c) Splitting of white light through a prism.

d) Totally reflecting prism.

(4) Optical fibres are used extensively to transmit

a) Optical Signal

b) current

c) Sound waves

d) None of the above

(5) In optical fibres, transmission of signal takes place with

(a) the speed of sound

(b) the speed of light

(c) less than speed of light

(d) more than speed of light

SECTION-C

All questions are compulsory. In case of internal choices, attempt anyone.

17. Two long and parallel straight wires carrying currents of 2A and 5A in the opposite directions are separated by a distance of 1 cm. Find the nature and magnitude of the magnetic force between them. 2

18. Why cannot two independent monochromatic sources of light produce sustained interference pattern. 2

OR

In a single slit diffraction experiment, the width of the slit is made double the original width. How does this affect the size and intensity of the central diffraction band? Explain.

19. Derive an expression for the energy stored in a capacitor. 2

OR

A 600 pF capacitor is charged by a 200 V supply. It is then disconnected from the supply and is connected to another uncharged 300 pF capacitor. Calculate how much electrostatic energy is lost in the process.

20. Three photo diodes D_1, D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2 eV and 3 eV respectively. Which of them will not be able to detect light of wavelength 600 nm? 2

21. State Lenz's law. Explain, by giving examples that Lenz's law is consequence of conservation of energy. 2

22. Using Huygen's wave theory, verify the law of reflection. 2

23. Draw energy band diagrams of a **n**-type and a **p**-type semiconductor at temperature **T > 0K**. Mark the donor and acceptor energy levels with their energies. 2

24. (i) Name the three elements of the Earth's magnetic field. 2

(ii) Where on the surface of Earth is the vertical component of the Earth's magnetic field is zero?

OR

A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip down at 60^0 with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.4 G. Determine the magnitude of the earth's magnetic field at the place.

25. (a) Write the necessary conditions for the phenomena of total internal reflection to occur. 2

(b) Write the relation between the refractive index and critical angle for given pair of optical media.

SECTION-D

All questions are compulsory. In case of internal choices, attempt anyone.

26. Explain the meaning of the term mutual inductance. Consider two concentric circular coils, one of radius $\mathbf{r_1}$and other of radius $\mathbf{r_2}$ ($\mathbf{r_1} > \mathbf{r_2}$) placed coaxially with centers coinciding with each other. Obtain the expression for the mutual inductance of the arrangement. 3

27. A cell of emf 'E' and internal resistance 'r' is connected across a variable resistor R. Plot a graph showing variation of terminal voltage 'V' of the cell versus the current 'I'. Using the plot, show how the emf of the cell and its internal resistance can be determined. 3

OR

A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit?

28. Using photon picture of light, show how Einstein's photoelectric equation can be established. 3

Write two features of photoelectric effect which cannot be explained by wave theory.

OR

State de-Broglie hypothesis.

A proton and **α-** particle are accelerated through same potential difference. Determine the ratio of their de-Broglie wavelengths.

29. Using Bohr's postulates, obtain the expression for the total energy of the electron in the stationary states of the hydrogen atom. 3

30. (a)Distinguish between nuclear fission and fusion. Show how in both these processes energy is released. 3

(b) Calculate the energy release in MeV in the deuterium-tritium fusion reaction:

$$^{2}_{1}\text{H} + ^{3}_{1}\text{H} \longrightarrow ^{4}_{2}\text{He} + n$$

Using the data:

$$m(^{2}_{1}\text{H}) = 2.014102\ u$$
$$m(^{3}_{1}\text{H}) = 3.016049\ u$$
$$m(^{4}_{2}\text{He}) = 4.002603\ u$$
$$m_n = 1.008665\ u$$
$$1u = 931.5\ \text{MeV}/c^2$$

SECTION-E

All questions are compulsory. In case of internal choices, attempt anyone.

31. (a)State Gauss's law in electrostatics. Find out the outward electric flux due to a point charge +q placed at the centre of a cube of side a. Why is it found to be independent of the size and shape of the surface enclosing it? Explain. 5

(b) Two large parallel thin metallic plates are placed close to each other. The plates have surface charge densities of opposite signs. Calculate the electric field intensity (i) in the outer region of the plates, and (ii) in the interior region between the plates.

OR

(a) Derive an expression for the electric field **E** due to a dipole of length **' 2a'** at a point distant **r** from the centre of the dipole on the axial line.

(b) Draw a graph of **E** versus **r** for **r >> a**.

(c) If this dipole were kept in a uniform external electric field $\mathbf{E_0}$, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in both the cases.

32. (a) Draw a ray diagram to show refraction of ray of monochromatic light passing through a glass prism. Deduce the expression for the refractive index of glass in terms of angle of prism and angle of minimum deviation. 5

(b) Draw a ray diagram showing the formation of image by a reflecting type telescope.

OR

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

(b) Describe any two characteristic features which distinguish between interference and diffraction phenomena.

33. A device X is connected across an ac source of voltage $\mathbf{V = V_0 \sin \omega t}$. The current through X is given as $\mathbf{I = I_0 \sin(\omega t + \pi/2)}$. 5

(a) Identify the device X and write the expression for its reactance.

(b) Draw graphs showing variation of the voltage and current with time over one cycle of ac, for X.

(c) How does the reactance of the device X vary with frequency of the ac? Show this variation graphically.

(d) Draw the phasor diagram for the device X.

OR

(a) State the principle of ac generator

(b) Explain with the help of a labelled diagram its working.

(c) The coil of an ac generator having **N** turns, each of area **A**, is rotated with constant angular velocity $\boldsymbol{\omega}$. Deduce the expression for the alternating emf generated in the coil.

End of the Question Paper