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SAMPLE QUESTION PAPER (SESSION: 2020-21)
SUBJECT PHYSICS (042)

Max. Marks: 70 **Time Allowed: 3 hours**

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 internal choice is provided. You have to attempt only one of the choices in such questions.

SECTION-A

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

1. What is the SI unit of magnetic moment?

2. How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced by red light? Give reason.

3. The ground state energy of hydrogen atom is -13.6 eV. What is K.E. of electron in this state?

4. Plot a graph showing the variation of photoelectric current versus intensity of light.

OR

Define the term "threshold frequency", in the context of photoelectric emission.

5. Name the factor which determines frequency of light emitted by LED.

6. Two nuclei have mass numbers in the ratio 3:9. What is the ratio of their nuclear densities?

OR

Name the process responsible for energy production in the sun.

7. Draw the V-I characteristics of solar cell.

8. What is the angle of dip at a place where horizontal and vertical components of earth's magnetic field are equal?

9. In which directions do the electric and magnetic field vectors oscillate in an electromagnetic wave propagating along the x-axis?

OR

Write the relation for the speed of electromagnetic waves in terms of the amplitudes of electric and magnetic fields.

10. When a p-n junction diode is forward biased, how will its barrier potential be affected?

OR

What is meant by depletion region in a junction diode?

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 but R is NOT the correct explanation of A

c) A is true but R is false
d) A is false and R is also false.

11. **Assertion(A):** if a convex lens made of material of refractive index 1.25 is kept in water of refractive index 1.33, it behaves as a diverging lens.
    Reason(R): focal length of the lens depends on its refractive index of the lens w.r.t. surrounding medium.
12. **Assertion(A):** Work done in moving a charge between two points in an electric field is independent of the path followed by the charge between these points.
    Reason(R): Electrostatic forces are non-conservative forces.
13. **Assertion(A):** A ray of light entering from glass to air suffers change in frequency.
    Reason(R): Velocity of light in glass is more than that in air.
14. **Assertion(A):** Electrons tend to move from a region of low potential to a region of higher potential.
    Reason(R): because an electron has a negative charge.

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 potential difference V is applied across the two ends of a conductor, the free electrons in the conductor experience a force and are accelerated towards the positive end of conductor. On their way, they suffer frequent collisions with the ions/atoms of the conductor and lose their gained kinetic energy and again get accelerated due to electric field and lose the gained kinetic energy in the next collision and so on. The average velocity with which the free electrons get drifted towards the positive end of the conductor under the effect of applied electric field is called drift velocity.
    i) The motion of electrons between two successive collisions (with the atoms/ions) in the presence of electric field follows:
        a) Straight line path
        b) Circular path
        c) Elliptical path
        d) Curved path
    ii) The drift velocity of the electrons depends on
        a) Dimensions of the conductor
        b) Number density of free electrons in the conductor
        c) Both a and b
        d) None of these.
    iii) When potential difference across a given copper wire is increased, drift velocity of free electrons
        a) Decreases
        b) Increases
        c) Remain same
        d) Get reduced to zero
    iv) Two wires of same material having radii in the ratio 1:2, carry currents in the ratio 4:1. The ratio of drift velocities of electrons in them is
        a) 2:1
        b) 1:1
        c) 1:4
        d) 16:1
    v) If the temperature of a conductor increases, the drift velocity of free electrons
        a) Remains same

b) Increases
c) Decreases
d) May increase or decrease.

16. A power generating station is located nearly 200 km away from the city. The electrical energy generated at station is transmitted over such a long distance in the form of alternating current (ac), raised to a high voltage using step-up transformer. At the receiving end in the city, the voltage is reduced to operate the devices by using step-down transformer.

i) Transformer works on the principle
   a) Self induction
   b) Mutual induction
   c) magnetic effect of the electrical current
   d) Both a and b

ii) A transformer can't be used to step up d.c. voltage because
   a) There is no need to change the dc voltage
   b) A dc circuit has more heat losses
   c) The rate of change of magnetic flux is zero for dc
   d) None of these.

iii) The core of transformer is laminated, so as to
   a) reduce i^2R losses in the coils
   b) increase the magnetic flux
   c) Increase the secondary voltage
   d) Reduce energy loss due to eddy currents

iv) For an ideal transformer, the quantity which is same for both the coils is
   a) Current in the coils
   b) Power in the coils
   c) Voltage across the coils
   d) Resistance of coils

v) An ideal transformer steps down 220 V to 110 V to operate device with an impedance of 100 ohm. The current drawn by primary coil of transformer is:
   a) 5.5 A
   b) 0.25 A
   c) 0.55 A
   d) 2.5 A

SECTION-C

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

17. Derive Snell's law on the basis of Huygen's wave theory when light is travelling from a denser to a rarer medium.

OR

Depict the shape of a wavefront in each of the following cases.
   i) Light diverging from point source.
   ii) Light emerging out of a convex lens when a point source is placed at its focus.

18. How is the mutual inductance of a pair of coils affected when
   (i) Separation between the coils is increased?
   (ii) a thin iron sheet is placed between the two coils, other factors remaining the same?
   Justify your answer in each case.

19. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier.

20. Two long straight wires carrying currents of 2 A and 5 A in the same direction are kept parallel, 10 cm apart from each other. Calculate the force acting between them and write its nature.

OR

Two coils P and Q of radius R and 2R respectively are lying in perpendicular planes having a common centre. Find the magnitude and direction of the resultant magnetic field at the common centre, if they carry the currents I and $\sqrt{3}\,I$ respectively.

21. 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? Explain.

22. (a) Why is a photodiode operated under reverse bias condition?

(b) Draw V-I characteristic curves of photodiode for incident light of intensities I_1 and I_2 ($I_1 > I_2$).

23. A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.

OR

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.

24. Under what conditions does the phenomenon of total internal reflection take place? Draw a ray diagram showing how a ray of light deviates by 90^0 after passing through a right-angled isosceles prism.

25. Obtain the conditions under which an electron does not suffer any deflection while passing through a magnetic field.

Two protons P and Q moving with the same speed pass through the magnetic fields $\overrightarrow{B_1}$ and $\overrightarrow{B_2}$ respectively at right angles to the field directions. If $|\overrightarrow{B_2}| > |\overrightarrow{B_1}|$, which of the two protons will describe the circular path of smaller radius? Explain.

SECTION-D

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

26. a) State two distinguishing features of nuclear force.

b) Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their separation. Mark the regions on the graph where the force is (i) attractive, and (ii) repulsive.

27. A) Define an equipotential surface. Draw equipotential surfaces:

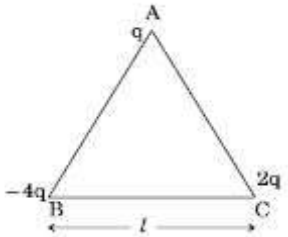
(i) in the case of a single point charge and

(ii) in a constant electric field in Z-direction.

b) Why the equipotential surfaces about a single charge are not equidistant?

OR

Three point charges q, – 4q and 2q are placed at the vertices of an equilateral triangle ABC of side *'l'* as shown in the figure.



i) Obtain the expression for the magnitude of the resultant electric force acting on the charge 2q.

ii) Find out the amount of the work done to separate the charges at infinite distance.

28. State Bohr's postulate to define stable orbits in hydrogen atom. How does de Broglie's hypothesis explain the stability of these orbits?

A hydrogen atom initially in the ground state absorbs a photon which excites it to the n = 3 level. Estimate the frequency of the photon.

29. Using photon picture of light, show how Einstein's photoelectric equation can be established. Write two features of photoelectric effect which cannot be explained by wave theory.

OR

a) Plot a graph to show the variation of stopping potential with frequency of incident radiation in relation to photoelectric effect.

b) Use Einstein's photoelectric equation to show how from this graph, (i) Threshold frequency, and (ii) Planck's constant can be determined.

30. i) A screen is placed at a distance of 100 cm from an object. The image of the object is formed on the screen by a convex lens for two different locations of the lens separated by 20 cm. Calculate the focal length of the lens used.

ii) A converging lens is kept coaxially in contact with a diverging lens - both the lenses being of equal focal length. What is the focal length of the combination?

SECTION-E

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

31. a) In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width.

b) The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 16:25. Find the ratio of the widths of the two slits.

OR

a) Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point.

b) In a compound microscope, an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eyepiece has a focal length of 5 cm and the final image is formed at the near point, estimate the magnifying power of the microscope.

32. a) Show that in an a.c. circuit containing a pure inductor, the voltage is ahead of current by $\pi/2$ in phase.

b) A horizontal straight wire of length L extending from east to west is falling with speed v at right angles to the horizontal component of Earth's magnetic field B.

(i) Write the expression for the instantaneous value of the e.m.f. induced in the wire.

(ii) What is the direction of the e.m.f.?

(iii) Which end of the wire is at the higher potential?

OR

a) State the principle of an AC generator and explain its working with the help of a labeled diagram. Obtain the expression for the emf induced in a coil having N turns each of cross-sectional area A, rotating with a constant angular speed ω in a magnetic field $\vec{B}$, directed perpendicular to the axis of rotation.

b) An airplane is flying horizontally from west to east with a velocity of 900 km/hour. Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of the Earth's magnetic field is 5×10^{-4} T and the angle of dip is 30^0.

33. a) Define electric flux. Write its SI unit.

b) Use Gauss's law to prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.

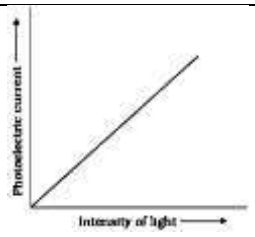
c) How is the field directed if the sheet is (i) positively charged (ii) negatively charged?

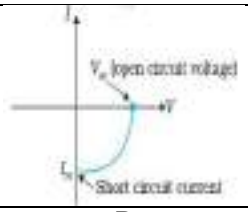
OR

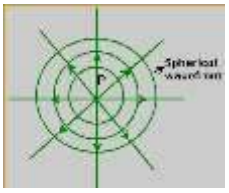
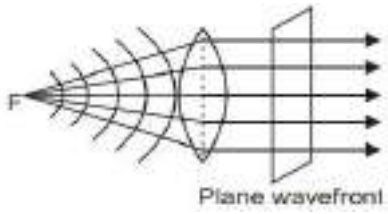
a) Derive an expression for the electric field at any point on the axial line of an electric dipole.

b) Two identical point charges, q each, are kept 2m apart in air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.

Class –XII PHYSICS (Theory)
SQP Marking Scheme 2020-21

Sr. No.	VALUE POINTS	Marks
1	Am^2	1
2	$we\ know, \delta \propto {}^{1}/_{\lambda}$ and $\lambda_r > \lambda_v$ $\therefore\ \delta_r < \delta_v$	1
3	K.E. = 13.6eV	1
4	 **OR** definition	1 1
5	frequency of light emitted by LED is related to the band gap of the semiconductor used in LED	1

6	1:1 **OR** Nuclear fusion	1 1
7	 	1
8	$\tan\delta = \frac{B_V}{B_H} = 1$ $\therefore \delta = 45^0$	1
9	Electric field: along y-axis Magnetic field: along z-axis **OR** $c = \frac{E_0}{B_0}$	½ + ½ 1
10	The potential barrier height reduces. **OR** Depletion region is the region around the p-n junction which has immobile ions and is devoid of free charge carriers.	1
11	a) Both A and R are true and R is the correct explanation of A	1
12	c) A is true but R is false	1
13	d) A is false and R is also false	1
14	a) Both A and R are true and R is the correct explanation of A	1
15	i) d) curved path ii) d) none of these iii) b) increases iv) d) 16:1 v) c) decreases (any 4 parts to be attempted)	4x1 = 4
16	i) b) mutual induction	4x1=4

	ii) c) the rate of change of magnetic flux is zero for dc iii) d) Reduce energy loss due to eddy currents iv) b) power in the coils v) c) 0.55 A (any 4 parts to be attempted)	
17	Diagram Derivation **OR** **(i)**  **(ii)**  	½ 1.5 1 1
18	(i) Mutual inductance decreases as flux passing through the coil decreases. (ii) Mutual inductance increases as $M \propto \mu$	1+1
19	Diagram of half wave rectifier Working	1+1
20	$F = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r}$ Given $I_1 = 2\ A;\ I_2 = 5\ A; r = 10\ cm = 0.1\ m$ Putting values F=10^{-5} N/m Nature: attractive **OR** Calculation of magnitude of magnetic field; ($B = \frac{\mu_0(\sqrt{7}I)}{4R}$) direction	½ ½ ½ ½ 1.5 ½
21	Size of central maximum is halved as central maximum width $\propto 1/a$ Intensity becomes 4 times as width is halved, area becomes 1/4th.	1 1
22	(a) Because the fractional change in reverse current is much greater than the fractional change in forward current. (b) V-I characteristics	1 1

23	Initial P.E.= ½ CV^2 Energy stored in combined system= ½ $C(V/2)^2$ +½ $C(V/2)^2$ Calculation Answer- 1:2 **OR** Graph Slope of the graph gives internal resistance of cell Intercept tells emf of the cell	½ 1 ½ 1 ½ ½
24	Conditions for TIR Ray diagram	½+½ 1
25	When electron moves either parallel or antiparallel to the magnetic field. Q will move along the circular path of smaller radius. As r = mv/qB; $r \propto 1/B$	 ½ ½ 1
26	a) Any two features b) Graph Marked regions	1 1 ½ + ½
27	a) Definition Diagrams b) Also $E = \frac{\lvert dV \rvert}{dr}$; E$\propto 1/dr$ As electric filed intensity due to a point charge is not constant, that's why separation between surfaces (dr) is also not same. **OR** (i) F=$2\sqrt{13}\frac{kq^2}{l^2}$ (ii) W=$10\frac{kq^2}{l}$	½ ½ + ½ 1.5 1.5 1.5
28	Statement Explanation of Bohr's 2nd postulate Calculation of frequency of photon	1 1 1
29	Derivation of Einstein's photoelectric equation. Two features **OR** a) Graph b) $eV_0 = h\nu - h\nu_0$ determination of ν_0 and h from graph using equation	2 1 1 1+1
30	i) using $f = \frac{D^2-x^2}{4D}$ ii) using $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$	1.5 1.5

31	a) Formation of dark and bright fringes; Diagram expression for fringe width b) Finding the ratio $(\frac{w_1}{w_2} = \frac{81}{1})$ **OR** a) Labelled ray diagram Expression for total magnification b) Calculating the magnifying power (m= -30)	1 ½ 2 1.5 1.5 2 1.5

32	a) Alternating voltage applied to inductor $V = V_0 \sin\omega t$ Deduce the relation $I = I_0 \sin(\omega t - \pi/2)$ b) (i) induced emf $e = B_H l v$ (ii) West to east (iii) East end **OR** (a)Principle of ac generator Well labelled diagram Brief working and emf expression c) $e = B_V l v$ Putting values e = 1.44 V	3 1 ½ ½ ½ 1 2 1.5
33	(a) Definition of electric flux; its SI unit (b) derivation of electric field due to uniformly charged infinite plane sheet. (c) (i) away from the sheet (ii) Towards the sheet **OR** a) Derivation of electric field at axial line of electric dipole b) For equilibrium, net force on each charge = 0. Using this we will get that the position of Q is at the midpoint of line joining the charges and its polarity is negative.	½+ ½ 3 ½ ½ 3 2