Class: XII Session: 2020-2021

Subject: Physics

Sample Question Paper (Theory)

Maximum Marks: 70 Marks 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.

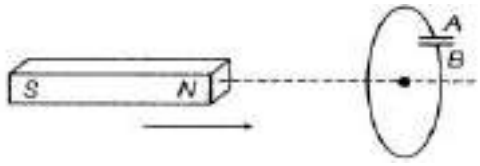
Section-A

1. What is the SI unit of absolute permeability of free space? (1)
2. To which part of electromagnetic spectrum does a wave of frequency 5×10^{19} Hz belong? (1)

OR

Welders wear special goggles or face mask with glass windows to protect their eyes from electromagnetic radiation. Name the radiation and write the range of their frequency.

3. Why should the spring/ suspension wire in a moving coil galvanometer have low torsional constant? (1)
4. In the given figure, a bar magnet is quickly moved towards a conducting loop having a capacitor. Predict the polarity of the plates A and B of the capacitor. (1)



OR

The current flowing through a pure inductance 2mH is, l =(15 cos 300t) A. What is the (i) rms and average value of current for a complete cycle?

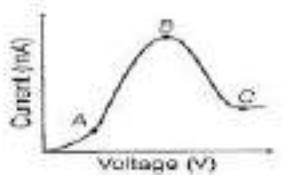
5. What is the ratio of radii of the orbits corresponding to first excited state and ground state, in a hydrogen atom? (1)
6. The stopping potential in an experiment on photoelectric effect is 1.5 V. What is the maximum kinetic energy of the photoelectrons emitted? (1)
7. Two nuclei have mass numbers in the ratio 1:2. What is the ratio of their nuclear densities? (1)

   OR

   Out of the two characteristics, the mass number A and the atomic number Z of a nucleus, which one does not change during nuclear decay?
8. What happens to the width of depletion layer of a p-n junction when it is (i) forward biased? (ii) reverse biased? (1)

   OR

   Why cannot we take one slab of p-type semiconductor and physically join it to another slab of n-type semiconductor to get p-n junction?
9. The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any over which the semiconductor has a negative resistance. (1)



10. At what temperature would an intrinsic semiconductor behave like a perfect insulator? (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 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):** A metallic shield in form of a hollow shell may be built to block an electric field.
    Reason(R): In a hollow spherical shield, the electric field is zero inside it at every point.

12. **Assertion(A):** If the distance between parallel plates of a capacitor is halved and dielectric constant is made three times, then the capacitor becomes 6 times.
    Reason(R): Capacity of the capacitor does not depend upon the nature of the material.

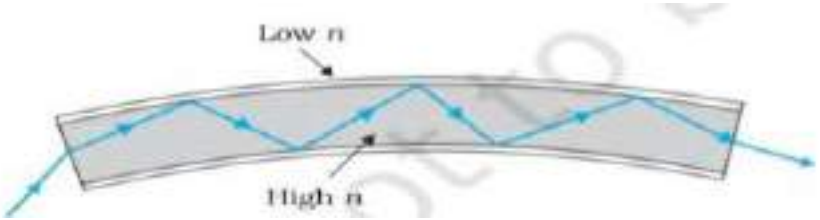
13. **Assertion(A):** Wavelength of light depends on refractive index of light.
Reason(R): Different colors travel with different speed in vacuum.

14. **Assertion(A):** Critical angle of light passing from glass to air is minimum for violet colour.
Reason(R): The wavelength of blue light is greater than the light of the other colors.

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. optical fibres are extensively used for transmitting audio and video signals through long distances. 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. 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.



(1) On which phenomena optical fibers works?
- (a) Diffraction
- (b) Polarization
- (c) dispersion of light
- (d) total internal reflection

(2) Which property of light remains same when it passes through optical fiber?
- (a) Intensity of light
- (b) wavelength of light
- (c) speed of light
- (d) frequency of light

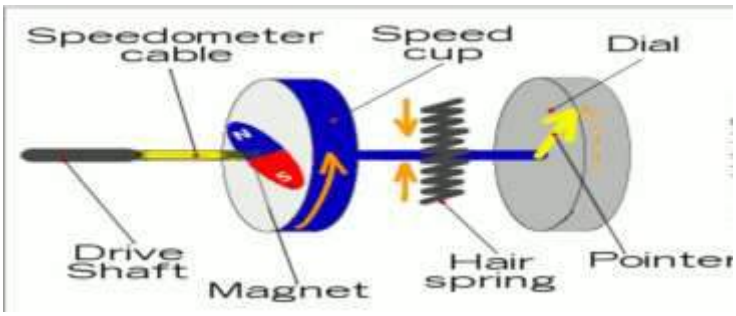
(3) Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$).
- (a) less than θ_2

(b) between θ_1 and θ_2
(c) greater than θ_2
(d) less than θ_1

(4) The outer concentric shell in fiber optic is called:
(a) cladding
(b) core
(c) coat
(d) mantle

(4) What is the relation between critical angle and refractive index?
(a) $\mu = \sin C$
(b) $\mu = 1/\sin C$
(c) $\mu = \cos C$
(d) $\mu = 1/\cos C$

16. In the speedometer, a small magnet is connected to the main shaft of the vehicle. According to the speed of the vehicle, it rotates. Due to the effects of the induced currents, the motion of the rotating is opposed and the pointer gets deflected through a certain angle. The pointer attached to the calibrated scale indicates the speed of the vehicle.



(1) Which type of currents induced in speedometer ?
(a) Eddy current
(b) Negative current
(c) Conventional current
(d) No current is induced.

(2) Identify the wrong statement:
(a) Eddy currents are produced in a steady magnetic field.
(b) Eddy current can be minimized by using laminated core.
(c) Induction furnace use eddy current to produce heat
(d) Eddy current can be used to produce braking force in moving train.

(3) Which material is filled between speed cup and magnet in speedometer?
(a) Air
(b) Oil
(c) Water
(d) Iron core

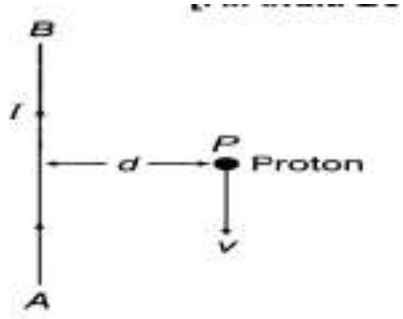
(4) In the case of a speedometer, the induced currents create .....
   (a) Drag force
   (b) Drag torque
   (c) Drag momentum
   (d) None of these

(5) What is the angle made by the plane of eddy currents with the plane of magnetic lines of force?
   (a) 0^0
   (b) 40^0
   (c) 90^0
   (d) 180^0

Section-C

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

17. **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 current as shown in the figure. What is the force experienced by the proton and what is its direction? (2)



18. Laser light of wavelength 640 nm incident on a pair of slits produces an interference pattern in which the bright fringes are separated by 7.2 mm. Calculate the wavelength of another source of light which produces interference fringes separated by 8.1 mm using same arrangement. (2)

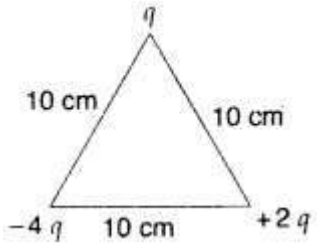
OR

Yellow light (λ = 6000Å) illuminates a single slit of width 1 x 10^{-4} m. Calculate the distance between the two dark lines on either side of the central maximum, when the diffraction pattern is viewed on a screen kept 1.5 m away from the slit;

19. Two point charges, $q_1 = 10 \times 10^{-8}$C, $q_2 = -2 \times 10^{-8}$C are separated by a distance of 60 cm in air. Find at what distance from the 1st charge, q_1 would the electric potential be zero. (2)

OR

Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown.



20. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier. (2)
21. A metallic rod of length L is rotated with angular frequency of ω with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring. (2)

22. (a) Write the conditions under which light sources can be said to be coherent.
(b) Why is it necessary to have coherent sources in order to produce an interference pattern? (2)

23. Draw energy band diagram of n-type and p-type semiconductor at temperature T > 0K. Mark the donor and acceptor energy level with their energies. (2)

24. Name the three elements required to specify the earth's magnetic field at a given place. Draw a labelled diagram to define these elements. Explain briefly how these elements are determining to find out the magnetic field at a given place on the surface of the earth. (2)

OR

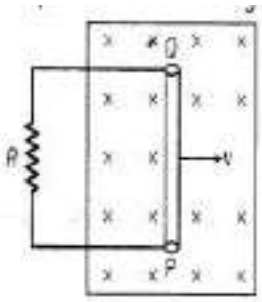
The horizontal component of the earth's magnetic field at a place equals to its vertical component . Find the value of the angle of dip at that place. What is the ratio of the horizontal component to the total magnetic field of the earth at that place?

25. A converging lens of refractive index 1.5 is kept in a liquid medium having same refractive index. What would be the focal length of the lens in this medium? (2)

Section-D

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

26. A conducting rod PQ, of length /, connected to a resistor R, is moved at a uniform speed v, normal to a uniform magnetic field B, as shown in the figure



(i)Deduce the expression for the emf induced in the conductor.
(ii) Find the force required to move the rod in the magnetic field.
(iii) Mark the direction of induced current in the conductor. (1+1+1)

27. A battery of emf 10 V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, find (i) the resistance of the resistor; (ii) the terminal voltage of the battery. (3)

OR

A battery of emf E and internal resistance r when connected across an external resistance of 12 ohm, produces a current of 0.5 A. When connected across a resistance of 25 ohm, it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell.

28. (i) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{3} W. Estimate the number of photons emitted per second on an average by the source.

(ii) Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface. (2+1)

OR

Figure shows variation of stopping potential (V_0) with the frequency (v) for two

photosensitive materials M_1 and M_2.

(a) Why is the slope same for both lines?

(b) For which material will the emitted electrons have greater kinetic energy for the incident radiation of the same frequency? Justify your answer.

29. How the size of a nucleus is experimentally determined? Write the relation between the radius and mass number of the nucleus. Show that the density of nucleus is independent of its mass number. (1+1+1)

30. Find the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its (a) second permitted energy level to the first permitted level and (b) the highest permitted energy level to the first permitted level. (3)

Section-E

31. (a) A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface. Using Gauss's law, derive an expression for an electric field at a point outside the shell.
(b) Draw a graph of electric field E(r) with distance r from the centre of the shell for $0 \leq r \leq \infty$. (3+2)

OR

(i) Derive the expression for electric field at a point on the equatorial line of an electric dipole.

(ii) Depict the orientation of the dipole in (a) stable,(b) unstable equilibrium in a uniform electric field

32. (a) Explain briefly, with the help of a labelled diagram, the basic principle of the working of an a.c. generator.
(b) In an a.c. generator, coil of N turns and area A is rotated at v revolutions per second in a uniform magnetic field B. Write the expression for the emf produced. (3+2)

OR

(a)Derive an expression for the impedance of a series LCR circuit connected to an AC supply of variable frequency.
(b) Plot a graph showing variation of current with the frequency of the applied voltage.
(c) Explain briefly how the phenomenon of resonance in the circuit can be used in the tuning mechanism of a radio or a TV set. (3+1+1)

33. (a) State Huygen's principle. Using this principle explain how a diffraction pattern is obtained on a screen due to a narrow slit on which a narrow beam coming from a monochromatic source of light is incident normally.
(b) Show that the angular width of the first diffraction fringe is half of that of the

central fringe.
(c) If a monochromatic source of light is replaced by white light, what change would you observe in the diffraction pattern? (3+1+1)

OR

(a)Draw the labelled ray diagram for the formation of image by a compound microscope.
(b) Derive the expression for the total magnification of a compound microscope . (3+2)

(c)Explain why both the objective and the eyepiece of a compound microscope must have short focal lengths

Class –XII

PHYSICS (Theory)

SQP Marking Scheme 2020-21

S.no.	Value points	Marks
1	Newton/Ampere^2(N/A^2)	1
2	Gamma Rays Or Ultraviolet (10^{15}Hz –10^{17} Hz)	1
3	To increase sensitivity of galvanometer	1
4	A – Positive B- Negative Or 15/√2A and zero	1
5	4:1	1
6	1.5eV	1
7	1:1 Or Mass no. does not change	1
8	(i) Decreased (ii) Increased Or Because continuous contact at atomic level will not possible	½+1/2
9	Part BC	1
10	0K	1
11	A	1

12	A	1
13	C	1
14	C	1
15	(1) D (2) A (3) C (4) B (5) B	
16	(1) A (2) A (3) A (4) B (5) C	
17	$F=(\mu_0/4\pi)(2IeV/d)$ Directed perpendicular to the straight conductor and away from it.	1+1
18	Formula of fringe width, Wavelength of second source = 720nm Or Formula of side of central maximal, 18mm	1+1
19	Correct formula, Distance from 1^{st} charge= 50cm Or Correct formula, work done= 2.303×10^{-8} J	1+1
20	Diagram, Working	1+1
21	Change in flux in 1 revolution =B(pie L^2), $e = \frac{1}{2}(BwL^2)$	1+1
22	Any two condition for coherent source, Because phase differences between the light waves from non- coherent source will change continuously.	1+1
23	Proper labelled diagram for n and p type semiconductor	1+1
24	Name of elements Labelled diagram Explanation Or Angle of dip= 45^0 Ratio: $1:\sqrt{2}$	½+1+1/2 or 1+1
25	Correct formula, Focal length = infinity	1+1
26	(i) e=Bvl (ii) $F=B^2l^2v/R$ (iii) Anticlock-wise	1 +1 +1

27	(i) 17 ohm (ii) 8.5V Or (i) 6.5V (ii) 1 ohm	1+1
28	Energy= 4×10^{-19} J No. Of photons= 5×10^{15} , Graph Or Because both slopes give Planck's constant, For material M_2 , explanation	1+1+1 Or 1+2
29	Explanation of determination of size of Nucleus, Relation , Proof	1+1+1
30	10.2 eV 13.6 eV 3:4	1+1+1
31	Derivation , Correct labelled graph Or Derivation Correct orientation for both equilibrium	3+2 Or 3+2
32	Principal, labelled diagram Expression of induced emf Or Derivation of impedance, Graph, Correct explanation	1+2+2 Or 3+1+1
33	Huygen's principal, Explanation of single slit experiment, Proof, Central maximum will be white and on either side of central maximum , there will be coloured fringes Or Labelled diagram, Derivation, For larger angular magnification and magnifying power	1+3+1 Or 2+2+1