SAMPLE QUESTION PAPER

BLUE PRINT

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

S. No.	Chapter	VSA/ AR/ Case Based (1 mark)	SA-I (2 marks)	SA-II (3 marks)	LA (5 marks)	Total
1.	Electrostatics	1(1)	2(4)	–	1(5)	**7(16)**
2.	Current Electricity	1(1)	1(2)	1(3)	–	
3.	Magnetic Effects of Current and Magnetism	1(1)	2(4)	2(6)	–	**8(17)**
4.	Electromagnetic Induction and Alternating Current	3(6)	–	–	–	
5.	Electromagnetic Waves	1(1)	–	1(3)	–	**8(18)**
6.	Optics	4(7)	1(2)	–	1(5)	
7.	Dual Nature of Radiation and Matter	1(1)	–	–	–	**6(12)**
8.	Atoms and Nuclei	2(2)	2(4)	–	1(5)	
9.	Electronic Devices	2(2)	1(2)	1(3)	–	**4(7)**
	Total	**16(22)**	**9(18)**	**5(15)**	**3(15)**	**33(70)**

Subject Code : 042

PHYSICS

Time allowed : 3 hours ***Maximum marks : 70***

(i) All questions are compulsory. There are 33 questions in all.

(ii) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(iii) 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.

(iv) 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. When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge Ze, how does its distance of closest approach from the nucleus depends on m.

2. The electric field at a distance $\frac{3R}{2}$ from the centre of a charged conducting spherical shell of radius R is E. What will be the electric field at a distance $\frac{R}{2}$ from the centre of the sphere.

OR

A hollow metal sphere of radius R is uniformly charged. What will be the electric field due to the sphere at a distance r from the centre?

3. An equiconvex lens has power P. It is cut into two symmetrical halves by a plane containing the principal axis. Find the power of one of the parts.

4. In Young's double slit experiment, the path difference between two interfering waves at a point on the screen is $\frac{5\lambda}{2}$, λ being wavelength of the light used. The n^{th} dark fringe will lie at this point. Find the value of n.

5. The primary of a transformer when connected to a dc battery of 10 volt draws a current of 1 mA. The number of turns of the primary and secondary windings are 50 and 100 respectively. Find the voltage in the secondary and the current drawn by the circuit in the secondary.

OR

An alternating voltage given by $V = 140 \sin 314t$ is connected across a pure resistor of 50 Ω. Find the rms current through the resistor.

6. Define magnetic susceptibility of a material.

7. If the momentum of an electron is changed by P, then the de-Broglie wavelength associated with it changes by 0.5%. Find the initial momentum of electron.

8. What is the equivalent energy of a 10 mg mass ?

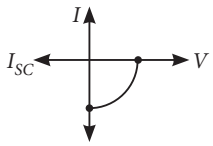
OR

Name the absorbing material used to control the reaction rate of neutrons in a nuclear reactor.

9. What should be added as an impurity into the silicon to produce n type semiconductor?

OR

Name the junction diode whose I-V characteristics are shown in figure, where V_{OC} is open circuit voltage and I_{SC} is short circuit current.



10. On what factors does the magnitude of the emf induced in the circuit due to magnetic flux depends.

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) : Higher is the refractive index of a medium or denser the medium, lesser is the velocity of light in that medium.

Reason (R) : Refractive index is inversely proportional to velocity.

12. Assertion (A) : A photocell is called an electric eye.

Reason (R) : When light is incident on some semiconductor its electrical resistance is reduced.

13. Assertion (A) : Heater wire must have high resistance and high melting point.

Reason (R) : If resistance is high, the electric conductivity will be less.

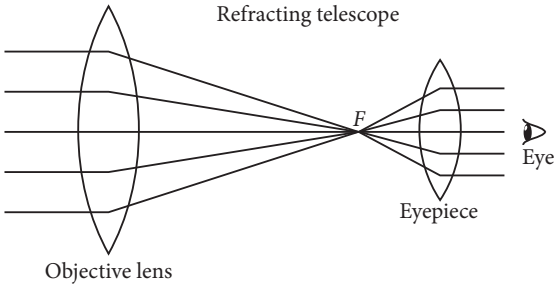
14. Assertion (A) : Light is a transverse wave but not an electromagnetic wave.

Reason (R) : Maxwell showed that speed of electromagnetic waves is related to the permittivity of the medium through which it travels.

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. Refracting telescopes work by using two lenses to focus the light and make it look like the object is closer to you than it really is. Both lenses are in a shape that's called 'convex'. Convex lenses work by bending light inwards (like in the diagram). This is what makes the image look smaller. Consider a telescope having an objective of focal length 50 cm and eyepiece of focal length 5 cm. The least distance of distinct vision is 25 cm. The telescope is focussed for distinct vision on a scale 200 cm away from the objective.



(i) An astronomical telescope has a large aperture to

(a) reduce spherical aberration (b) have high resolution

(c) increase span of observation (d) have low dispersion.

(ii) On what factors does magnifying power of a refracting telescope depend?

(a) Wavelength of light used. (b) Focal length of eyepiece.

(c) Focal length of objective. (d) Both (b) and (c).

(iii) Calculate the separation between the objective and eyepiece of the given telescope.

(a) 50.62 cm (b) 45.34 cm (c) 70.83 cm (d) 97.64 cm

(iv) Calculate the magnitude of magnification produced by the telescope.

(a) –1 (b) 1 (c) 2 (d) –2

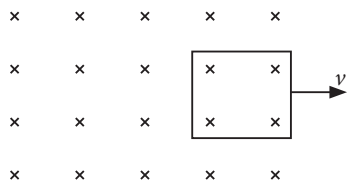
(v) You are given following three lenses. Which two lenses will you see as an eyepiece and as an objective to construct an astronomical telescope?

Lenses	Power	Aperture
L_1	3 D	8 cm
L_2	6 D	1 cm
L_3	10 D	1 cm

(a) L_3 as objective and L_1 as eyepiece. (b) L_1 as objective and L_3 as eyepiece.

(c) L_2 as objective and L_1 as eyepiece. (d) L_1 as objective and L_2 as eyepiece.

16. Any change in magnetic flux induces an emf. Opposing that change, this process is called induction. Motion is one of the major cause of induction. Charges moving in a magnetic field experiences a magnetic forces which moves opposite charges in opposite direction and produces an emf. Consider the given figure which shows a square loop having 100 turns, an area of 2.5×10^{-3} m^2 and a resistance of 100 Ω. The magnetic field has a magnitude $B = 0.40$ T.



(i) Find the emf induced in the left arm of the loop, if it is moved out of the magnetic field in 1.0 s with a constant speed.

(a) 0.1 V (b) 2 V (c) 1 V (d) 0.2 V

(ii) Find the current induced in the loop.

(a) 1.0×10^{-2} A (b) 2.0×10^{-2} A (c) 1.0×10^{-3} A (d) 2.0×10^{-3} A

(iii) Find the force acting on the left arm of the loop due to the external magnetic field.

(a) 2.0×10^{-3} N (b) 1.0×10^{-3} N (c) 1.5×10^{-2} N (d) 2.0×10^{-2} N

(iv) Find the work done in pulling the loop out of the field, slowly and uniformly in 1 s.

(a) 2.0×10^{-3} J (b) 1.0×10^{-4} J (c) 2.0×10^{-4} J (d) 1.0×10^{-3} J

(v) Lenz's law is a consequence of the law of conservation of

(a) charge (b) energy (c) induced emf (d) induced current

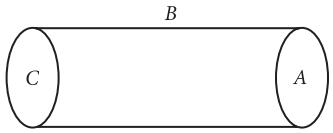
SECTION - C

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

17. Distinguish between the phenomena of nuclear fission and fusion.

Explain, using the graph for the B.E./A versus mass number (A), how the release in energy can be accounted for in the two processes.

18. A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in units of voltmeter associated with the curved surface B, find the flux linked with the plane surface A in units of V-m.



19. State two conditions for sustained interference of light to occur. Two coherent sources of light have their intensities in the ratio 4 : 9. Calculate the ratio of the intensity of maxima and minima of the interference pattern.

OR

In a single slit diffraction experiment, the width of the slit is decreased. How will the (i) size (ii) intensity of the central bright band be affected. Justify your answer.

20. Draw a graph showing the variation of current versus voltage in an electrolyte when an external resistance is also connected.

21. A semiconductor with a band gap of 2.5 eV is used to fabricate a *p-n* photodiode. Find the wavelength of signal detected by it.

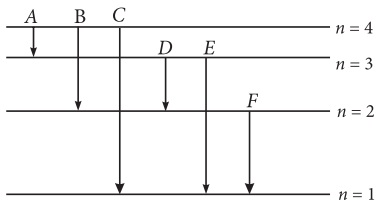
OR

The peak voltage in the output of a half wave diode rectifier fed with a sinusoidal signal without filter is 10 V. Find the *d.c.* component of the output voltage.

22. A parallel plate air capacitor has capacity C, distance of separation between plates is d and potential difference V is applied between the plates. What will be the force of attraction between the plates of the parallel plate air capacitor.

23. The work done in turning a magnet of magnetic moment M by an angle of 90° from the meridian, is n times the corresponding work done to turn it through an angle of 60°. Find the value of n.

24. The figure shows energy level diagram of hydrogen atom.



Which transition corresponds to the emission of radiation of maximum wavelength? Justify your answer.

25. Charge q is uniformly spread on a thin ring of radius R. The ring rotates about its axis with a uniform frequency f Hz. Find the magnitude of magnetic induction at the center of the ring.

OR

If a long hollow copper pipe carries a current, then find the magnetic field produced in it.

SECTION - D

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

26. How can a moving coil galvanometer be converted into an ammeter? To increase the current sensitivity of a moving coil galvanometer by 50% its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

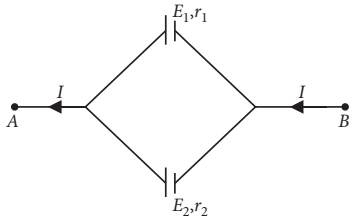
27. The electric field of an electromagnetic wave in free space is given by $\vec{E} = 10\cos(10^7 t + kx)\hat{j}$ V / m where t and x are in seconds and metres respectively. Find the value of wavelength and wave number.

OR

In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6 V m^{-1}.

Find the peak value of the magnetic field

28. Two cells of emf E_1, E_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure.



Deduce the expression for

(i) The equivalent emf of the combination

(ii) The equivalent resistance of the combination

(iii) The potential difference between the points A and B.

29. A non-conducting thin disc of radius R charged uniformly over one side with surface density σ rotates about its axis with an angular velocity ω. Find :

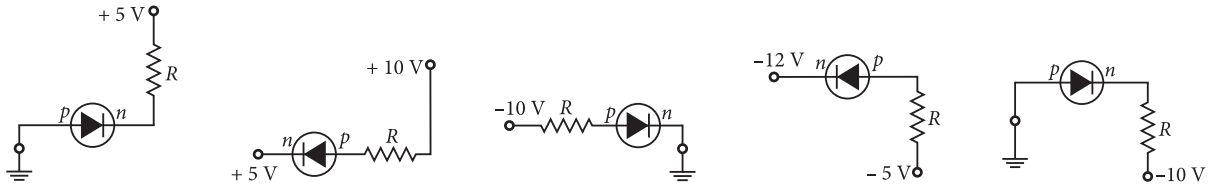
(i) the magnetic induction at the centre of the disc

(ii) the magnetic moment of the disc.

OR

Draw a labelled diagram of an a.c. generator. Explain briefly its principle and working.

30. In the given figures, which of the diodes are forward biased, and which are reverse biased and why?



SECTION - E

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

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

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

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

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

OR

(a) State the importance of coherent sources in the phenomenon of interference.

(b) In Young's double slit experiment to produce interference pattern, obtain the conditions for constructive and destructive interference.

(c) How does the fringe width get affected, if the entire experimental apparatus of Young's double slit experiment is immersed in water?

32. Explain, using suitable diagrams, the difference in the behaviour of a (i) conductor and (ii) dielectric in the presence of external electric field. Define the terms polarization of a dielectric and write its relation with susceptibility.

OR

Find out the expression for the potential energy of a system of three charges q_1, q_2 and q_3 located respectively at $\vec{r}_1, \vec{r}_2$ and $\vec{r}_3$ with respect to the common origin *O*.

33. In Rutherford scattering experiment, draw the trajectory traced by α-particles in the coulomb field of target nucleus and explain how this led to estimate the size of the nucleus. Write two important limitations of Rutherford nuclear model of the atom.

OR

Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number n_i) to the lower state, (n_f). When electron in hydrogen atom jumps from energy state $n_i = 4$ to $n_f = 3, 2, 1$. Identify the spectral series to which the emission lines belong.