KENDRIYA VIDYALAYA GACHIBOWLI, GPRA CAMPUS, HYD – 32
SAMPLE PAPER TEST 02 (2020-21)

SUBJECT: PHYSICS (043)

BLUE PRINT : CLASS XII

UNIT		VSA (1 mark)	Case Study Questions	SA - I (2 marks)	SA – II (3 marks)	LA (5 marks)	Total
I	**Electrostatics**	1(1)	--	**2(1)***	--	**5(1)***	**8(3)**
II	**Current Electricity**	1(1)	**4(1)#**	--	**3(1)***	--	**8(3)**
III	**Magnetic Effects of Current and Magnetism**	**1(1)*** 1(1)	--	**2(1)*** 2(1)	--	--	**5(3)**
IV	**Electromagnetic Induction & Alternating Currents**	2(2)	--	2(1)	3(1)	**5(1)***	**12(5)**
V	**Electromagnetic Waves**	2(2)	--	**2(1)***	--	--	**4(3)**
VI	**Optics**	1(1)	**4(1)#**	4(2)	--	**5(1)***	**14(5)**
VII	**Dual Nature of Radiation and Matter**	1(1)	--	--	**3(1)***	--	**4(2)**
VIII	**Atoms and Nuclei**	**1(1)*** 1(1)	--	--	6(2)	--	**8(4)**
IX	**Electronic Devices**	**1(1)*** 2(2)	--	4(2)	--	--	**7(5)**
	Total	**14(14)**	**8(2)**	**14(9)**	**15(5)**	**15(3)**	**70(33)**

Note: * - Internal Choice Questions and Yellow shaded with # - Case Study Question : attempt 4 questions out of 5 questions

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SUBJECT: PHYSICS **MAX. MARKS : 70**
CLASS : XII **DURATION : 3 HRS**

General Instruction:

(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.*
(v) *You may use the following values of physical constants wherever necessary :*

$c = 3\times10^{8}\, m/s, \quad h = 6.63\times10^{-34}\, Js, \quad e = 1.6\times10^{-19}\, C, \quad \mu_0 = 4\pi\times10^{-7}\, TmA^{-1},$

$\varepsilon_0 = 8.854\times10^{-12}\, C^2N^{-1}m^{-2}, \quad m_e = 9.1\times10^{-31}\, kg, \quad \frac{1}{4\pi\varepsilon_0} = 9\times10^{9}\, Nm^2C^{-2},$

Mass of neutron $= 1.675\times10^{-27}\, kg$, Mass of proton $= 1.673\times10^{-27}\, kg$,

Avogadro's number $= 6.023\times10^{23}$ per gram mole, Boltzmann constant $= 1.38\times10^{-23}\, JK^{-1}$

SECTION – A
Questions 1 to 14 carry 1 mark each.

1. What is the forbidden energy gap (in joule) for a germanium crystal?

2. What is the purpose of heavy water in nuclear reactors?

OR

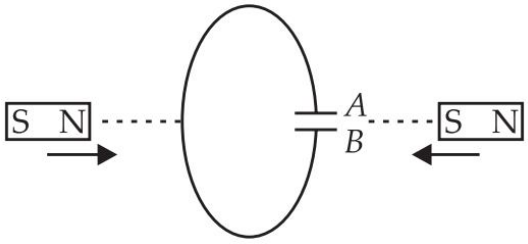
Compare the radii of two nuclei with mass numbers 1 and 27 respectively.

3. Define the term 'current sensitivity' of a moving coil galvanometer.

4. Plot a graph showing variation of induced e.m.f. with the rate of change of current flowing through a coil.

OR

Predict the polarity of the capacitor in the situation described below.



5. Two metals A and B have work functions 2 eV and 6 eV respectively. Which of the two metals have larger threshold frequency?

6. Give any one advantage of LEDs over conventional incandescent low power lamps.

7. What is the frequency of electromagnetic waves produced by oscillating charge of frequency λ?

OR

Name the part of electromagnetic spectrum whose wavelength lies in the range of 10^{-10} m. Give its one use.

8. Using the concept of force between two infinitely long parallel current carrying conductors, define one ampere of current.

9. Draw circuit diagram of a half wave rectifier.

OR

Draw I-V characteristic of a solar cell.

10. What is the Bohr's quantization condition for the angular momentum of an electron in the second orbit?

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 is kept in water its convergent power decreases.
Reason (R): Focal length of convex lens in water increases.

12. Assertion (A): In a cavity within a conductor, the electric field is zero.
Reason (R): Charges in a conductor reside only at its surface.

13. Assertion (A): The electromagnetic waves are transverse in nature.
Reason (R): Waves of wavelength 10 mm are radiowave and microwave.

14. Assertion (A): A copper sheet is placed in a magnetic field. If we pull it out of the field or push it into the field, we experience an opposing force.
Reason (R): According to Lenz's law eddy current produced in sheet opposes the motion of the sheet.

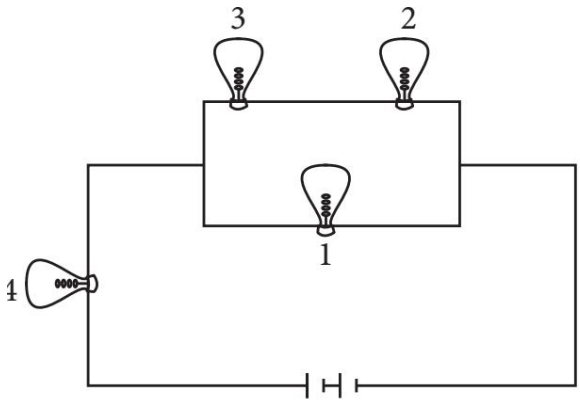
SECTION - B

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. In physics, an electric power measure of the rate of electrical energy transfer by an electric circuit per unit time. Denoted by P and measured using the SI unit of power is the watt or one joule per second. Electric power is commonly supplied by sources such as electric batteries and produced by electric generators.

The formula for electric power is given by P = VI
where, P is the power, V is the potential difference in the circuit, I is the electric current

Power can also be written as $P = I^2R$ and $P = V^2/R$
The above two expressions are got by using Ohms law, Where, Voltage, current, and resistance are related by the following relation
V = IR Where, R is the resistance in the circuit, V is the potential difference in the circuit, I is the electric current
The given figure shows four bulbs 1, 2, 3 and 4, consume same power. The resistance of bulb 1 is 36 Ω.



(i) What is the resistance of the bulb 3?
(a) 4 Ω (b) 9 Ω (c) 18 Ω (d) 12 Ω

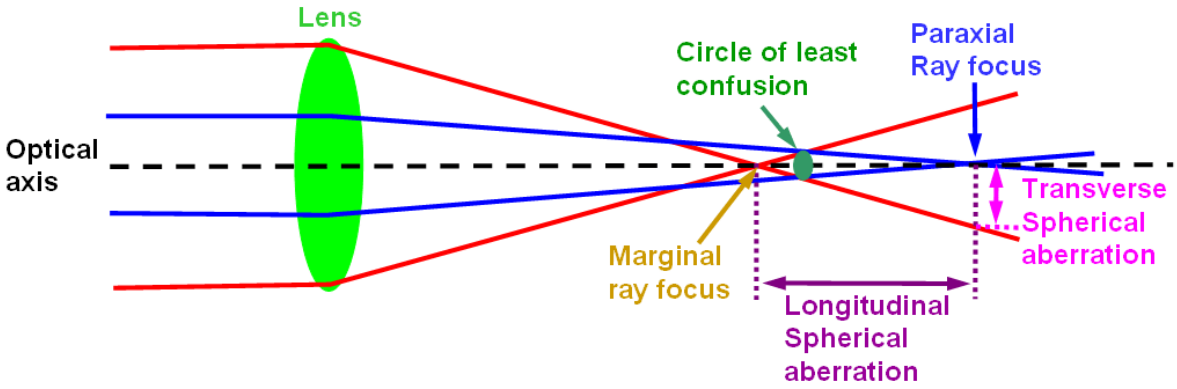
(ii) What is the resistance of bulb 4?
(a) 4 Ω (b) 8 Ω (c) 9 Ω (d) 18 Ω

(iii) If power of each bulb is 4 W, then the total current flowing through the circuit is
(a) 1 A (b) 2 A (c) 4 A (d) 12 A

(iv) What is the equivalent resistance of the circuit?
(a) 12 Ω (b) 8 Ω (c) 18 Ω (d) 16 Ω

(v) What is the voltage output of the battery, if the power of each bulb is 4 W?
(a) 16 V (b) 12V (c) 24V (d) 18V

16. Image of a white object is coloured and blurred because μ (hence f) of lens is different for different colours. This defect is called chromatic aberration. As $\mu_0 > \mu_r$, therefore, $f_r > f_v$. The difference $(f_r - f_v)$ is a measure of longitudinal chromatic aberration of the lens. Focal length for mean colour is $f = \sqrt{f_r \times f_v}$. Using lens maker formula, for mean colour of light, we have $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ where f is focal length of mean colour and m is the refractive index of mean colour.



(i) Focal length of a equiconvex lens of glass μ = 3/2 in air is 20 cm. The radius of curvature of each surface is
(a) 10 cm (b) –10 cm (c) 20 cm (d) –20 cm

(ii) Focal length of the lens in water would be
(a) 20 cm (b) 80 cm (c) –20 cm (d) –80 cm

(iii) If $\mu_v = 1.6$, $\mu_r = 1.5$, $R_1 = 20$ cm and $R_2 = -20$ cm, then the chromatic aberration of the lens would be
(a) 3 cm (b) 3.3 cm (c) –3 cm (d) –3.3 cm

(iv) A given convex lens of glass (μ = 3/2) can behave as concave when it is held in a medium of μ equal to
(a) 1 (b) 3/2 (c) 2/3 (d) 7/4

(v) Chromatic aberration of a lens can be corrected by
(a) providing different suitable curvature to its two surfaces
(b) proper polishing of its two surfaces
(c) Suitably combining it with another lens
(d) reducing its aperture.

SECTION – C

Questions 17 to 25 carry 2 marks each.

17. Answer the following questions:
(a) Name the e.m. waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.
(b) If the Earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain.

OR

What are the radio waves? How are these waves produced?

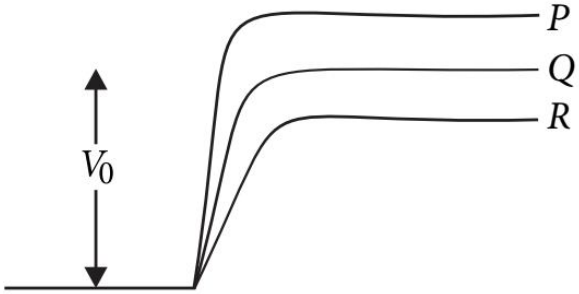
18. In what way is diffraction from each slit related to the interference pattern in a double-slit experiment?

19. Write the four important properties of the magnetic field lines due to a bar magnet.
Properties of magnets

OR

A conducting rod of length 2 m is placed on a horizontal table in north-south direction. It carries a current of 5 A from south to north. Find the direction and magnitude of the magnetic force acting on the rod. Given that the Earth's magnetic field at the place is 0.6×10^{-4} T and angle of dip is $\pi/6$.

20. In figure, V_0 is the potential barrier across a p-n junction, when no battery is connected across the junction. Which of P, Q and R corresponds to forward and reverse bias of junction?



21. Explain briefly how the phenomenon of total internal reflection is used in fibre optics.

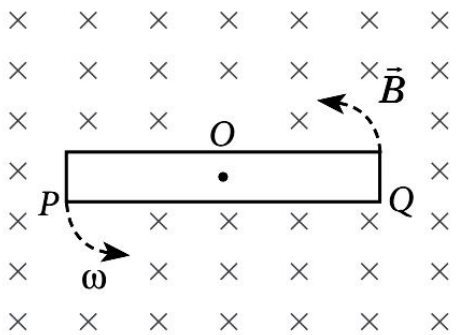
22. Show that the capacitance of a spherical conductor is $4\pi\varepsilon_0$ times the radius of the spherical conductor.

OR

Two charges 2 μC and –2 μC are placed at points A and B 6 cm apart.
(a) Identify an equipotential surface of the system.
(b) What is the direction of the electric field at every point on this surface?

23. A proton and a deuteron, each moving with velocity $\vec{v}$ enter simultaneously in the region of magnetic field $\vec{B}$ acting normal to the direction of velocity. Trace their trajectories establishing the relationship between the two.

24. A metallic rod PQ of length l is rotated with an angular velocity w about an axis passing through its midpoint (O) and perpendicular to the plane of the paper, in uniform magnetic field $\vec{B}$, as shown in the figure. What is the potential difference developed between the two ends of the rod, P and Q?



25. When an electric field is applied across a semiconductor what happens to electrons and holes?

SECTION – D

Questions 26 to 30 carry 3 marks each.

26. Define resistivity of a conductor. Plot a graph showing the variation of resistivity with temperature for a metallic conductor. How does one explain such a behaviour, using the mathematical expression of the resistivity of a material?

OR

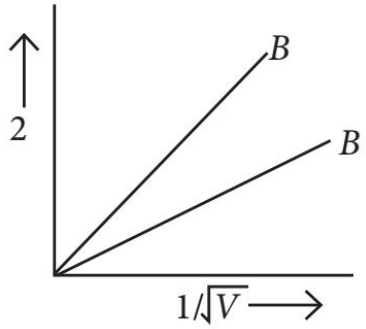
Derive an expression for the drift speed of electrons in a good conductor in terms of the relaxation time of electrons.

27. Write three characteristic properties of nuclear force.

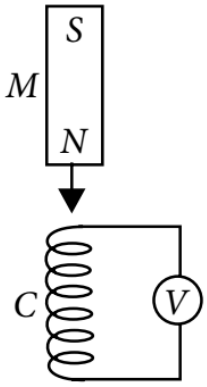
28. Radiations of frequency 10^{15} Hz are incident on two photosensitive surfaces A and B. Following observations are recorded. Surface A: No photo-emission takes place. Surface B: Photo-emission takes place but photo-electrons have zero energy. Explain the above observations on the basis of Einstein's photoelectric equation. How will the observation with surface B change when the wavelength of incident radiation is decreased?

OR

The two lines A and B shown in the graph represent the de-Broglie wavelength (λ) as a function of $1/\sqrt{V}$ (V is the accelerating potential) for two particles having the same charge. Which of the two represents the particle of heavier mass?



29. Figure shows a bar magnet M falling under gravity through an air cored coil C. Plot a graph showing variation of induced emf (e) with time (t). What does the area enclosed by the e-t curve depict?

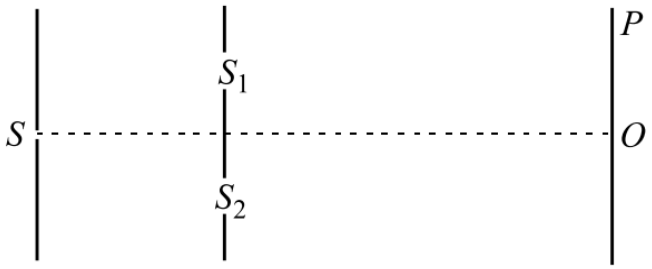


30. Using the relevant Bohr's postulates, derive the expression for the speed of the electron in the nth orbit.

SECTION – E

Questions 31 to 33 carry 5 marks each.

31. Figure shows an experiment setup similar to Young's double slit experiment to observe interference of light.



Here $SS_2 - SS_1 = \lambda/4$

Write the condition of (i) constructive, (ii) destructive interference at any point P in terms of path difference, $\Delta = S_2P - S_1P$

Does the central fringe observed in the above setup lie above or below O? Give reason in support of your answer. Yellow light of wavelength 6000Å produces fringes of width 0.8 mm in Young's double slit experiment. What will be the fringe width if the light source is replaced by another monochromatic source of wavelength 7500Å and separation between the slits is doubled?

OR

(a) What are coherent sources of light? State two conditions for two light sources to be coherent.

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

32. (a) A lamp is connected in series with a capacitor. Predict your observations for d.c. and a.c. connections. What happens in each case if the capacitance of the capacitor is reduced?

(b) A coil of 0.01 henry inductance and 1 ohm resistance is connected to 200 volt, 50 Hz ac supply. Find the impedance of the circuit and time lag between maximum alternating voltage and current.

OR

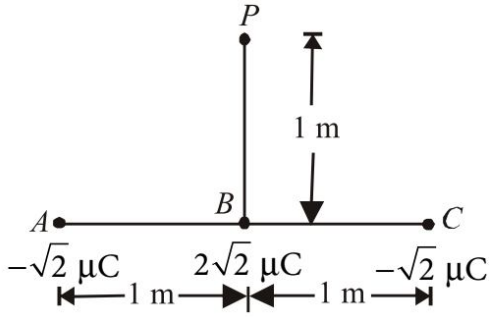
(a) In a series LCR circuit connected across an ac source of variable frequency, obtain the expression for its impedance and draw a plot showing its variation with frequency of the ac source.

(b) What is the phase difference between the voltages across inductor and the capacitor at resonance in the LCR circuit?

(c) When an inductor is connected to a 200 V dc voltage, a current of 1 A flows through it. When the same inductor is connected to a 200 V, 50 Hz ac source, only 0.5 A current flows. Explain, why? Also, calculate the self inductance of the inductor.

33. (a) Obtain the formula for the electric field due to a long thin wire of uniform linear charge density λ without using Gauss's law.

(b) Three charges $-\sqrt{2}\mu C$, $2\sqrt{2}\mu C$ and $-\sqrt{2}\mu C$ are arranged along a straight line as shown in the figure. Calculate the total field intensity due to all three charges at the point P.



OR

(a) A hollow charged conductor has a tiny hole cut into its surface. Show that the electric field in the hole is $\left(\frac{\sigma}{2\varepsilon_0}\right)\hat{n}$, where $\hat{n}$ is the unit vector in the outward normal direction, and σ is the surface charge density near the hole.

(b) The figure shows a charge + Q held on an insulating support S and enclosed by a hollow spherical conductor. O represents the centre of the spherical conductor and P is a point such that OP = x and SP = r. Find the electric field at point P.