KENDRIYA VIDYALAYA GACHIBOWLI, GPRA CAMPUS, HYD – 32
SAMPLE PAPER TEST 01 (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**	2(2)	--	**2(1)***	--	**5(1)***	**8(3)**
II	**Current Electricity**	--	**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**	1(1)	--	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**	**2(2)*** 1(1)	--	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 # - 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 $= 1.38\times10^{-23}\, JK^{-1}$

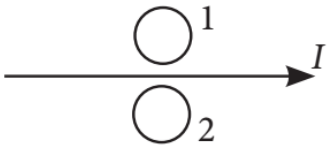
SECTION – A
Questions 1 to 14 carry 1 mark each.

1. Depict the direction of the magnetic field lines due to a circular current carrying loop.

2. From the information of energy bandgaps of diodes, how do you decide which can be light emitting diode?

3. The total energy of an electron in the first excited state of the hydrogen atom is about –3.4 eV.
(i) What is the kinetic energy of electron in this state?
(ii) What is the potential energy of electron in this state?

4. What is the direction of induced currents in metal rings 1 and 2 when current I in the wire is increasing steadily?



OR

A long straight current carrying wire passes normally through the centre of circular loop. If the current through the wire increases, will there be an induced emf in the loop? Justify.

5. An electron is moving along +ve x – axis in the presence of uniform magnetic field along +ve y – axis. What is the direction of the force acting on it?

6. Long distance radio broadcasts use short-wave bands. Why?

OR

Optical and radio telescopes are built on the ground but X-ray astronomy is possible only from satellites orbiting the earth. Why?

7. What is the effect on the velocity of the emitted photoelectrons if the wavelength of the incident light is decreased?

8. In a half wave rectifier circuit operating from 50 Hz mains frequency, what would be the fundamental frequency in the ripple?

9. Which physical quantity in a nuclear reaction is considered equivalent to the Q-value of the reaction?

OR

Give the relation between radius of a nucleus and mass number A?

10. A potential barrier of 0.3 V exists across a p-n junction. If the depletion region is 1 mm wide, what is the intensity of electric field in this region?

OR

When the voltage drop across a p-n junction diode is increased from 0.65 V to 0.70 V, the change in the diode current is 5 mA. Find the value of the dynamic resistance of the 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): A single lens produces a coloured image of an object illuminated by white light.
Reason (R): The refractive index of the material of lens is different for different wavelengths of light.

12. Assertion (A): If a dielectric is placed in external field then field inside dielectric will be less than applied field.
Reason (R): Electric field will induce dipole moment opposite to field direction.

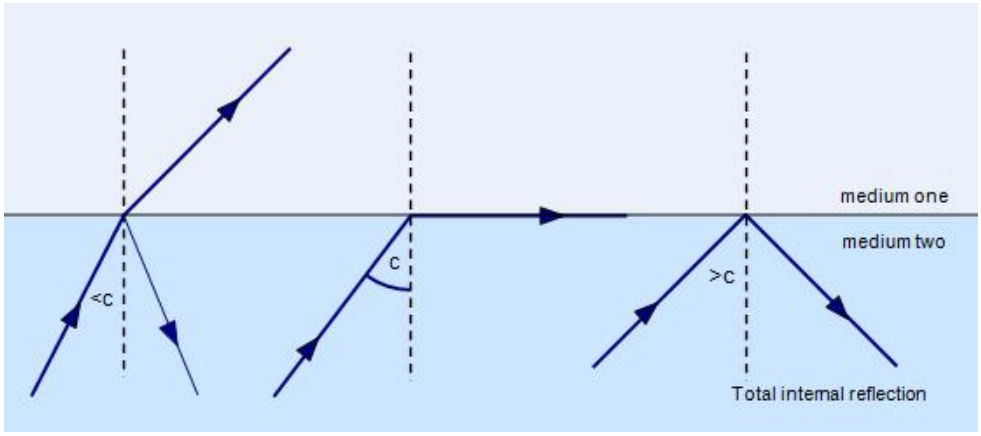
13. Assertion (A): When a charged particle moves in a circular path. It produces electromagnetic wave.
Reason (R): Charged particle has acceleration.

14. Assertion (A): Net electric field insider a conductor is zero.
Reason (R): Total positive charge equals to total negative charge in a charged conductor.

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. Total internal reflection is the phenomenon that involves the reflection of all the incident light off the boundary. Light must travel from denser to rarer medium and angle of incidence in denser medium must be greater than critical angle (C) for the pair of media in contact. For internal reflection we can show that $\mu = 1/\sin C$.



(i) Critical angle for glass air interface where μ of glass is 3/2 is
(a) 41.8° (b) 60° (c) 30° (d) 44.3°

(ii) Critical angle for water air interface is 48.6°. What is the refractive index of water?
(a) 1 (b) 3/2 (c) 4/3 (d) 3/4

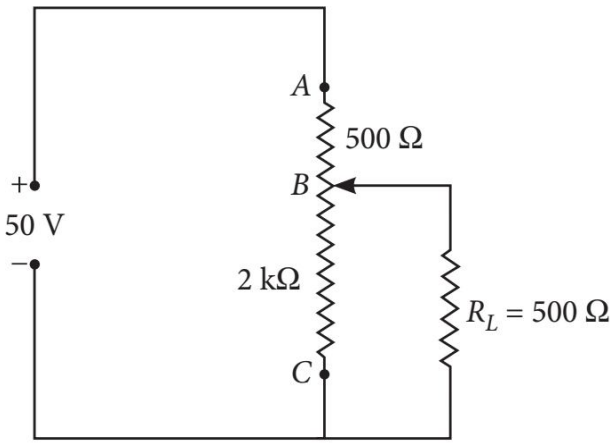
(iii) Critical angle for air water interface for violet colour is 49°. Its value for red colour would be
(a) 49° (b) 50° (c) 48° (d) 52°

(iv) A point source of light is held at a depth h below the surface of water. If C is critical angle of air-water interface, the diameter of circle of light coming from water surface would be
(a) 2 h tanC (b) h tanC (c) h sinC (d) h/sinC

(v) If the critical angle for total internal reflection from a medium to vaccum is 30°, then the velocity of light in the medium is,
(a) 3×10^8 m/s (b) 1.5×10^8 m/s (c) 6×10^8 m/s (d) 3×10^8 m/s

16. A rheostat is a variable resistor which is used to control the current flowing in a circuit. They are able to vary the resistance in a circuit without interruption. The construction is very similar to the construction of a potentiometers. It uses only two connections, even when 3 terminals (as in a potentiometer) are present. The first connection is made to one end of the resistive element and the other connection to the wiper (sliding contact). In contrast to potentiometers, rheostats have to carry a significant current. Therefore, they are mostly constructed as wire wound resistors. Resistive wire is wound around an insulating ceramic core and the wiper slides over the windings. Rheostats were often used as power control devices, for example to control light intensity (dimmer), speed of motors, heaters and ovens. As shown in figure, a variable rheostat

of 2 kW is used to control the potential difference across a 500 Ω load. Here, the source emf is 50 V and resistance AB is 500 Ω.



(i) The total resistance of the circuit is
(a) 500 Ω (b) 375 Ω (c) 875 Ω (d) 1500 Ω

(ii) The value of total current flowing through the circuit is
(a) 2.87 A (b) 0.057 A (c) 0.87 A (d) 0.677 A

(iii) The potential difference across the load is
(a) 21.43 V (b) 32.45 V (c) 17.62 V (d) 19.83 V

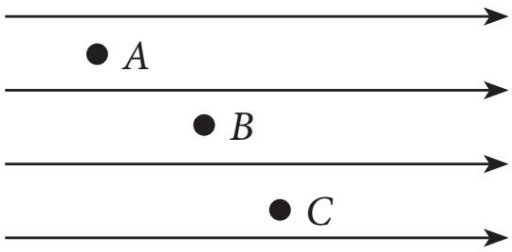
(iv) If the load is removed, the current across the rheostat is,
(a) 1/4 A (b) 1/20 A (c) 1/40 A (d) 40 A

(v) If the load is removed, what should be the resistance at BC to get 40 V between B and C?
(a) 500 Ω (b) 375 Ω (c) 1600 Ω (d) 1500 Ω

SECTION – C

Questions 17 to 25 carry 2 marks each.

17. Figure shows three points A, B and C in an uniform electric field. At which of the points the electric potential is maximum?



OR

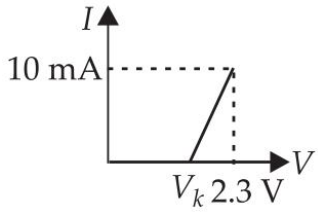
Is it possible to transfer all the charge from a conductor to another insulated conductor?

18. Interstellar space has an extremely weak magnetic field of the order of 10^{-12} T. Can such a weak field be of any significant consequence? Explain.

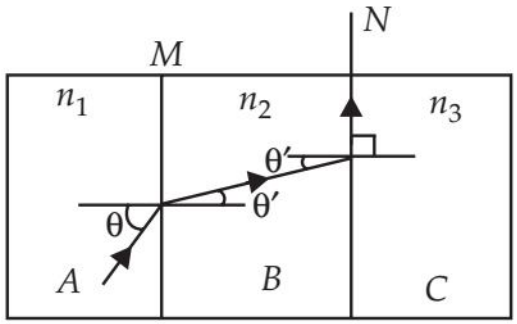
OR

Consider the plane S formed by the dipole axis and the axis of earth. Let P be point on the magnetic equator and in S. Let Q be the point of intersection of the geographical and magnetic equators. Obtain the declination and dip angles at P and Q.

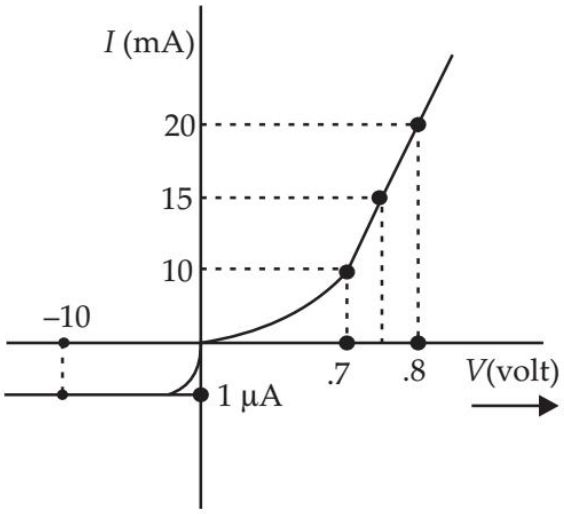
19. Find the resistance of a germanium junction diode whose V – I is shown in figure. (V_k = 0.3 V)



20. A, B and C are the parallel sided transparent media of refractive index n_1, n_2 and n_3 respectively. They are arranged as shown in the figure. A ray is incident at an angle q on the surface of separation of A and B is as shown in the figure. After the refraction into the medium B, the ray grazes the surface of separation of the media B and C. Find the value of sinθ.



21. The V-I characteristic of a diode is shown in the figure. Find the ratio of forward to reverse bias resistance.



22. A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30° with the direction of the motion of the particle. Draw the trajectory followed by the particle in the presence of the field and explain how the particle describes this path.

23. Starting from the expression for the energy W = ½ LI², stored in a solenoid of self-inductance L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length *l* of the solenoid having n number of turns per unit length. Hence, show that the energy density is given by $B^2/2\mu_0$.

24. Show, by giving a simple example, how e.m. waves carry energy and momentum.

OR

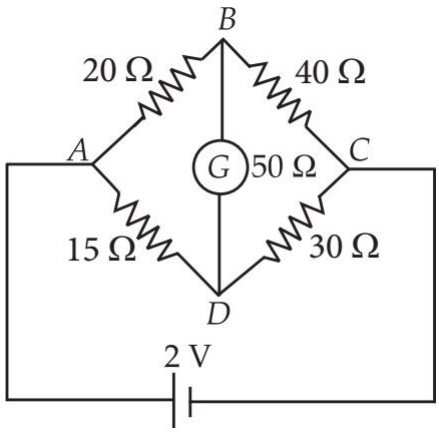
An e.m. wave is travelling in a medium with a velocity $\vec{v} = v\hat{i}$. Draw a sketch showing the propagation of the e.m. wave, indicating the direction of the oscillating electric and magnetic fields.

25. For a single slit of width 'a', the first minimum of the interference pattern of a monochromatic light of wavelength *l* occurs at an angle of λ/a. At the same angle of λ/a, we get a maximum for two narrow slits separated by a distance 'a'. Explain.

SECTION – D

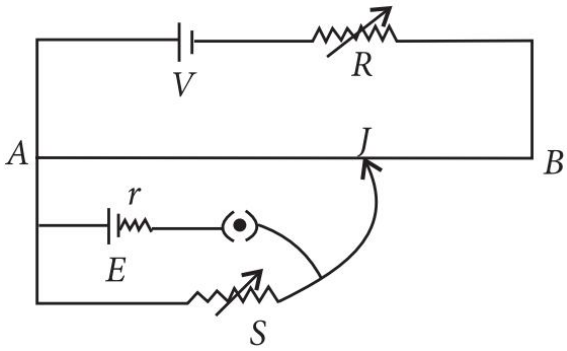
Questions 26 to 30 carry 3 marks each.

26. The given figure shows a network of resistances. Name the circuit so formed. What is the current flowing in the arm BD of this circuit? State the two laws used to find the current in different branches of this circuit.



OR

State working principle of potentiometer. Explain how the balance point shifts when value of resistor R increases in the circuit of potentiometer, given below.



27. $_{86}Rn^{222}$ is converted into $_{84}Po^{218}$ and $_{93}Np^{239}$ is converted into $_{94}Pu^{239}$. Name the particles emitted in each case and write down the corresponding equations.

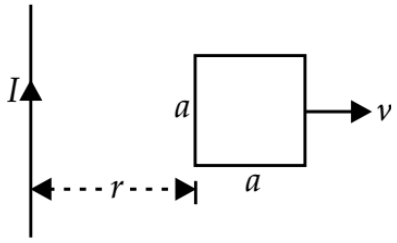
28. The work function for the following metals is given:
Na: 2.75 eV; K: 2.30 eV; Mo: 4.17 eV; Ni: 5.15 eV.
Which of these metals will not give photoelectric emission for a radiation of wavelength 3300 Å from a He-Cd laser placed 1 m away from the photocell? What happens if the laser is brought nearer and placed 50 cm away?

OR

Why should gases be insulators at ordinary pressures and start conducting at very low pressure?

29. Derive an expression for the total energy of the electron in hydrogen atom, using Rutherford's model of the atom. Also, explain the significance of total negative energy possessed by the electron?

30. Obtain an expression for the mutual inductance between a long straight wire and a square loop of side a as shown in figure.



SECTION – E

Questions 31 to 33 carry 5 marks each.

31. Use Huygen's principle to explain the formation of diffraction pattern due to a single slit illuminated by a monochromatic source of light.

OR

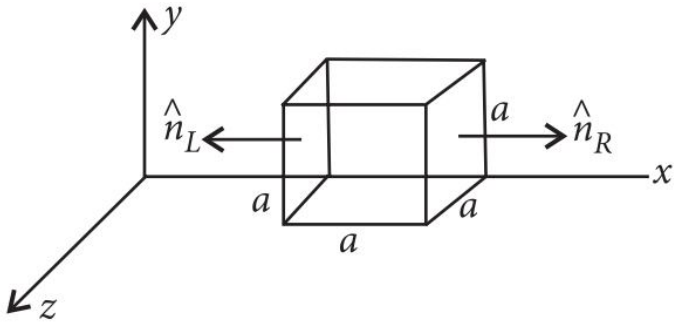
Using Huygens' principle, draw a diagram to show propagation of a wavefront originating from a monochromatic point source.

32. (a) An alternating voltage $V = V_m \sin \omega t$ applied to a series LCR circuit drives a current given by $i = i_m \sin(\omega t + \phi)$. Deduce an expression for the average power dissipated over a cycle.
(b) Determine the current and quality factor at resonance for a series LCR circuit with L = 1.00 mH, C = 1.00 nF and R =100 Ω connected to an ac source having peak voltage of 100 V.

OR

(a) Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write four sources of energy loss in this device.
(b) A small town with a demand of 1200 kW of electric power at 220 V is situated 20 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5 Ω per km. The town gets the power from the line through a 4000-220 V step-down transformer at a substation in the town. Estimate the line power loss in the form of heat.

33. (a) Using Gauss's law, derive expression for intensity of electric field at any point near the infinitely long straight uniformly charged wire.
(b) The electric field components in the following figure are $E_x = \alpha x$, $E_y = 0$, $Ez = 0$; in which α = 400 N/C m. Calculate (i) the electric flux through the cube, and (ii) the charge within the cube, assume that a = 0.1m.



OR

(a) Define electrostatic potential at a point. Write its SI unit. Three charges q_1, q_2 and q_3 are kept respectively at points A, B and C as shown in figure. Write the expression for electrostatic potential energy of the system.

(b) Depict the equipotential surfaces due to (i) an electric dipole (ii) two identical negative charges separated by a small distance.