KENDRIYA VIDYALAYA SANGATHAN, HYDERABAD REGION
SAMPLE PAPER – 03 (2017–18)

SUBJECT: PHYSICS (043)

<u>BLUE PRINT : CLASS XII</u>

	UNIT	VSA (1 mark)	SA - I (2 marks)	SA – II (3 marks)	VBQ (4 marks)	LA (5 marks)	Total
I	**Electrostatics**	1(1)	--	3(1)	--	5(1)	**9(3)**
II	**Current Electricity**	1(1)	2(1)	3(1)	--	--	**6(3)**
III	**Magnetic Effects of Current and Magnetism**	--	--	6(2)	--	--	**6(2)**
IV	**Electromagnetic Induction & Alternating Currents**	1(1)	--	--	4(1)	5(1)	**10(3)**
V	**Electromagnetic Waves**	--	--	3(1)	--	--	**3(1)**
VI	**Optics**	1(1)	2(1)	6(2)	--	5(1)	**14(5)**
VII	**Dual Nature of Radiation and Matter**	--	2(1)	3(1)	--	--	**5(2)**
VIII	**Atoms and Nuclei**	--	2(1)	3(1)	--	--	**5(2)**
IX	**Electronic Devices**	--	--	6(2)	--	--	**6(2)**
X	**Communication Systems**	1(1)	2(1)	3(1)	--	--	**6(3)**
	Total	**5(5)**	**10(5)**	**36(12)**	**4(1)**	**15(3)**	**70(26)**

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

General Instruction:
(i) ***All*** *questions are compulsory. There are **26** 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 **five** questions of **one** mark each, Section B contains **five** questions of **two** marks each, Section C contains **twelve** questions of **three** marks each, Section D contains one value based question of **four** marks and Section E contains **three** questions of **five** marks each.*
(iv) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
(v) You may use the following values of physical constants wherever necessary :

$$c = 3 \times 10^8 \, m/s, \quad h = 6.63 \times 10^{-34} \, Js, \quad e = 1.6 \times 10^{-19} \, C, \quad \mu_0 = 4\pi \times 10^{-7} \, TmA^{-1},$$

$$\varepsilon_0 = 8.854 \times 10^{-12} \, C^2 N^{-1} m^{-2}, \quad m_e = 9.1 \times 10^{-31} \, kg, \quad \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \, Nm^2 C^{-2},$$

Mass of neutron $= 1.675 \times 10^{-27} \, kg$,   Mass of proton $= 1.673 \times 10^{-27} \, kg$,

Avogadro's number $= 6.023 \times 10^{23}$ per gram mole,   Boltzmann constant $= 1.38 \times 10^{-23} \, JK^{-1}$

SECTION – A
Questions 1 to 5 carry 1 mark each.

1. Define the term 'quality factor' of resonance in series LCR circuit. What is its S.I. unit?

2. With the help of a block diagram, show the basic constituents of the communication system.

3. A point charge +Q is placed in the vicinity of a conducting surface. Trace the field lines between the charge and the conducting surface.

4. Why can't we see clearly through fog? Name the phenomenon responsible for it.

5. The plot of the variation of potential difference across a combination of three identical cells in series versus current is shown below. What is the emf and internal resistance of each cell?
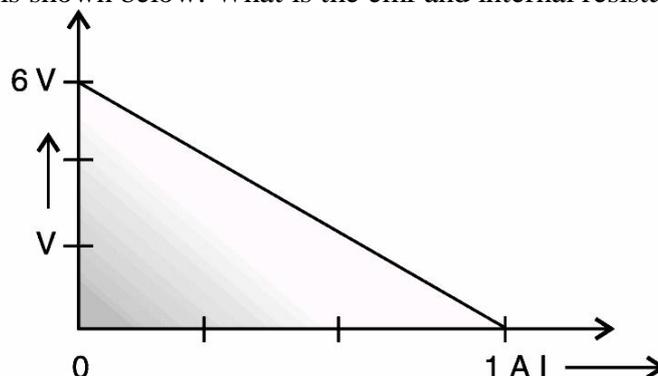
# SECTION – B
Questions 6 to 10 carry 2 marks each.

6. Distinguish between 'sky wave' and 'space wave' modes of propagation. Why is the sky wave mode of propagation restricted to frequencies upto 40 MHz ?

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7. A ray of light incident on an equilateral glass prism propagates parallel to the base line of the prism inside it. Find the angle of incidence of this ray. Given refractive index of material of glass prism is

OR

A biconvex lens of glass of refractive index 1·5 having focal length 20 cm is placed in a medium of refractive index 1·65. Find its focal length. What should be the value of the refractive index of the medium in which the lens should be placed so that it acts as a plane sheet of glass ?

8. Determine the value of the de Broglie wavelength associated with the electron orbiting in the ground state of hydrogen atom (Given $E_n = -(13\cdot6/n^2)$ eV and Bohr radius $r_o = 0\cdot53$ $\overset{o}{A}$). How will the de Broglie wavelength change when it is in the first excited state ?

9. The energy levels of a hypothetical atom are shown below. Which of the shown transitions will result in the emission of photon of wavelength 275nm.
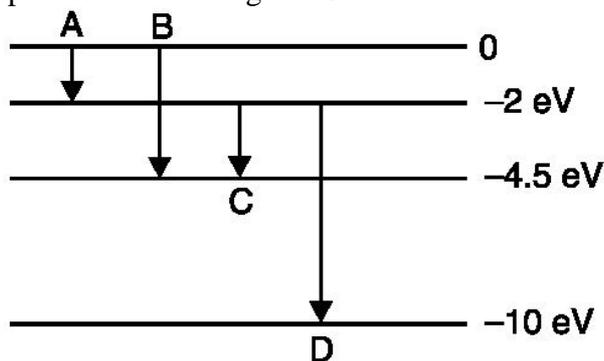
10. In the potentiometer circuit shown, the null point is at X. State with reason, where the balance point will be shifted when (a) resistance R is increased, keeping all other parameters unchanged; (b) resistance S is increased, keeping R constant.
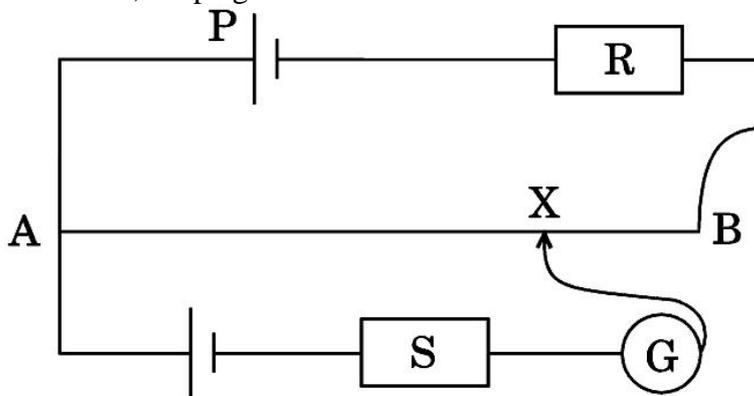
SECTION – C
Questions 11 to 22 carry 3 marks each.

11. Derive an expression for the electric field intensity at a point on the equatorial line of an electric dipole of dipole moment $\vec{p}$ and length 2a. What is the direction of this field?

12. (a) Define 'activity' of a radioactive substance.
(b) Two different radioactive elements with half lives T_1 and T_2 have N_1 and N_2 undecayed atoms respectively present at a given instant. Derive an expression for the ratio of their activities at this instant in terms of N_1 and N_2.

13. (a) Which one of the following electromagnetic radiations has least frequency : UV radiations, X-rays, Microwaves

(b) How do you show that electromagnetic waves carry energy and momentum ?

(c) Write the expression for the energy density of an electromagnetic wave propagating in free space.

14. Answer the following :

(a) In what way is diffraction from each slit related to the interference pattern in a double slit experiment ?

(b) When a tiny circular obstacle is placed in the path of light from a distant source, a bright spot is seen at the centre of the shadow of the obstacle. Explain, why.

(c) How does the resolving power of a microscope depend on (i) the wavelength of the light used and (ii) the medium used between the object and the objective lens ?

15. Define the term 'intensity of radiation' in photon picture of light.

Ultraviolet light of wavelength 2270 $\overset{o}{A}$ from 100 W mercury source irradiates a photo cell made of a given metal. If the stopping potential is – 1·3 V, estimate the work function of the metal. How would the photo cell respond to a high intensity (~ 105 Wm^{-2}) red light of wavelength 6300 $\overset{o}{A}$ produced by a laser ?

OR

Set up Einstein's photoelectric equation using the photon picture of electromagnetic radiation. Explain briefly how this equation accounts for all the observations in the photoelectric effect.

16. Draw the magnetic field lines distinguishing between diamagnetic and paramagnetic materials. Give a simple explanation to account for the difference in the magnetic behaviour of these materials.

17. Explain, with the help of suitable diagram, the two important processes that occur during the formation of p-n junction. Hence define the terms : depletion region and barrier potential.

18. How is a light emitting diode fabricated ? Briefly state its working. Write any two important advantages of LEDs over the conventional incandescent low power lamps.

19. Draw a block diagram of a simple modulator for obtaining amplitude modulated signal.

A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75% ?

20. (a) The light from a clear blue portion of the sky shows a rise and fall of intensity when viewed through a polaroid which is rotated. Describe, with the help of a suitable diagram, the basic phenomenon/process which occurs to explain this observation.

(b) Show how light reflected from a transparent medium gets polarised. Hence deduce Brewster's law.

21. (a) Show that the average power consumed in an inductor L connected to an a.c. source is zero.

(b) In a series LR circuit, $X_L = R$ and the power factor of the circuit is P1. When a capacitor with capacitance C such that $X_C = X_L$ is put in series, the power factor becomes P_2. Find out P_1 / P_2.

22. Define the electric resistivity of a conductor.

Plot a graph showing the variation of resistivity with temperature in the case of a (a) conductor, (b) semiconductor.

Briefly explain, how the difference in the behaviour of the two can be explained in terms of number density of charge carriers and relaxation time.

SECTION – D
Questions 23 carry 3 marks each.

23. Asha's uncle was advised by his doctor to have an MRI (magnetic resonance imaging) scan of his brain. Her uncle felt that it was too expensive and wanted to postpone it.

When Asha learnt about this, she took the help of her family and when she approached the doctor, he also offered a substantial discount. She thus convinced her uncle to undergo the test to enable the doctor to know the condition of his brain. The resulting information greatly helped his doctor to treat him properly.

Based on the above paragraph, answer the following questions :

(a) What according to you are the values displayed by Asha, her family and the doctor?

(b) What in your view could be the reason for MRI test to be so expensive ?

(c) Assuming that MRI test was performed using a magnetic field of 0·1 T, find the maximum and minimum values of the force that the magnetic field could exert on a proton (charge = 1·6 x 10^{-19} C) that was moving with a speed of 10^4 m/s.

SECTION – E
Questions 24 to 26 carry 5 marks each.

24. (a) Define a wavefront.

(b) Using Huygens' principle, draw the diagrams to show the nature of the wavefronts when an incident plane wavefront gets

    (i) reflected from a concave mirror,

    (ii) refracted from a convex lens.

(c) Draw a diagram showing the propagation of a plane wavefront from denser to a rarer medium and verify Snell's law of refraction.

OR

(a) A concave mirror produces a real and magnified image of an object kept in front of it. Draw a ray diagram to show the image formation and use it to derive the mirror equation.

(b) A beam of light converges at a point P. Now a lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is

(i) a convex lens of focal length 20 cm,

(ii) a concave lens of focal length 16 cm ?

25. (a) Derive the expression for the potential energy of an electric dipole of dipole moment $\vec{p}$ placed in a uniform electric field $\vec{E}$. Find out the orientation of the dipole when it is in (i) stable equilibrium, (ii) unstable equilibrium.

(b) Figure shows a configuration of the charge array of two dipoles.

Obtain the expression for the dependence of potential on r for r >> a for a point P on the axis of this array of charges.

OR

(a) Define electric flux. Write its S.I. unit.

(b) Using Gauss's law, obtain the electric flux due to a point charge 'q' enclosed in a cube of side 'a'.

(c) Show that the electric field due to a uniformly charged infinite plane sheet at any point distant x from it, is independent of x.

26. (a) Describe, with the help of a suitable diagram, how one can demonstrate that emf can be induced in a coil due to the change of magnetic flux. Hence state Faraday's law of electromagnetic induction.

(b) Two loops, one rectangular of dimensions 10 cm x 2·5 cm and second of square shape of side 5 cm are moved out of a uniform magnetic field $\vec{B}$ perpendicular to the planes of the loops with equal velocity v as is shown in the figure.

(i) In which case will the emf induced be more ?

(ii) In which case will the current flowing through the two loops be less ?

Justify your answer.
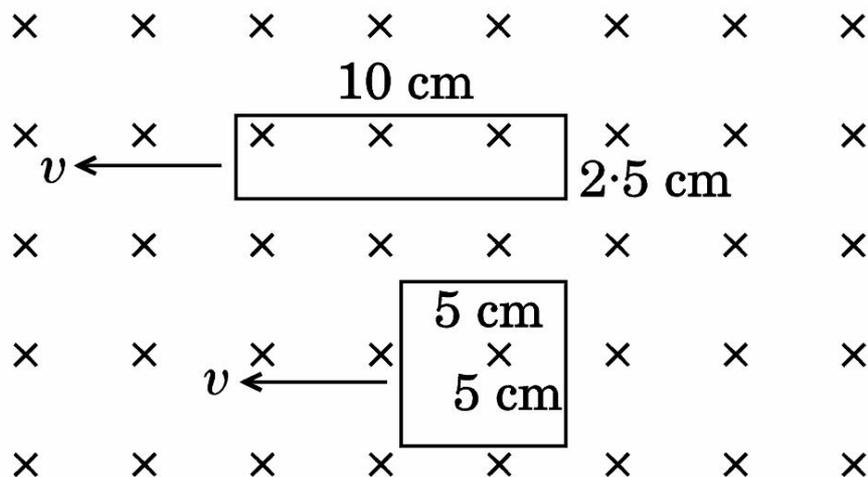
OR

(a) State the principle of an a.c. generator.

(b) Explain briefly, with the help of labelled diagram, its working and obtain the expression for the emf generated in the coil.

(c) Draw a schematic diagram showing the nature of the alternating emf generated by the rotating coil in the magnetic field during one cycle.