



# INDIAN SCHOOL MUSCAT

## SECOND PRE-BOARD EXAMINATION

### PHYSICS

CLASS: XII

Sub. Code: 042

Time Allotted: 3 Hrs.

03.02.2020

Max. Marks: 70

**General Instructions:**

- All questions are compulsory. There are 37 questions in all.
- This question paper has four sections: Section A, Section B, Section C and Section D.
- Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.
- There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- You may use the following values of physical constants where ever necessary.

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$$

$$c = 3 \times 10^8 \text{ m/s}$$

**SECTION A**

Directions (Q1-Q10) Select the most appropriate option from those given below each question

- When air is replaced by a medium of dielectric constant K, the force of attraction between two charges separated by a distance 'r' 1
  - Decreases K times
  - remains unchanged
  - increases K times
  - increases  $K^{-2}$  times
- When the distance between two charged particles is halved, the Coulomb force between them becomes 1
  - one-half
  - one-fourth
  - double
  - four times
- In the network of resistors shown in the adjoining figure, the equivalent resistance between A and B is 1



- 54 ohm
- 18 ohm
- 36 ohm
- 9 ohm

- 4 A 100W, 200V bulb is being operated at 160V, the power dissipation is 1  
 (a) 32W (b) 64W (c) 100W (d) 160W
- 5 The sensitivity of a moving coil galvanometer increases with the decrease in 1  
 (a) Number of turns (b) area of coil  
 (c) magnetic field (d) torsional constant
- 6 If the number of turns per unit length of the coil of a solenoid is doubled keeping other dimensions 1  
 same, then its self-inductance will be  
 (a) Halved (b) doubled  
 (c) four times (d) eight times
- 7 When ac source is connected across series R-L-C combination, maximum power loss will occur 1  
 provided  
 (a) current and voltage are in phase (b) Current from source is minimum  
 (c) Inductance is minimum (d) Capacitance is maximum
- 8 A light bulb and an open coil inductor are connected to an ac source. If an iron rod is inserted into 1  
 the interior of the inductor then  
 (a) The bulb glows brighter (b) The bulb glows dimmer  
 (c) The bulb glows on and off (d) The bulb glow is unaffected
- 9 If we want to produce electromagnetic waves of wavelength 500km by an oscillating charge; then 1  
 frequency of oscillating charge must be  
 (a) 600Hz (b) 500Hz (c) 167Hz (d) 15Hz

**OR**

Calculate the frequency of red light with a wavelength of  $4.2 \times 10^{-7} \text{m}$ .

- (a)  $7.14 \times 10^{14} \text{Hz}$  (b)  $7.34 \times 10^{14} \text{Hz}$   
 (c)  $7.64 \times 10^{14} \text{Hz}$  (d)  $7.94 \times 10^{14} \text{Hz}$

- 10 When trivalent impurity is mixed in a pure semiconductor, the conduction is mainly due to 1  
 (a) electrons (b) holes (c) protons (d) positive ions

Directions (Q11 –Q15) Fill in the blanks with appropriate answer.

- 11 When a coil carrying current is set with its plane perpendicular to the direction of magnetic field, 1  
 then torque on the coil is.....
- 12 S.I. unit of magnetic pole strength is ..... 1
- 13 The ability of a material to retain magnetism after removal of magnetizing field is called as 1  
 .....

- 14 The two properties of a material suitable for making a permanent magnet are .....and ..... 1
- 15 Two coils have mutual inductance of 1.5 Henry. If the current in the primary circuit is raised to 5A in one millisecond after closing the circuit, then the induced emf in secondary coil is \_\_\_\_\_ volt. 1

Directions (Q16 –Q20) Answer the following

- 16 Name the type of mirror used as rear view mirror in automobiles. 1
- 17 Name the type of wavefront emerging from a point source. 1
- 18 Name the phenomenon which shows the quantum nature of electromagnetic radiation. 1
- 19 Write the relationship between the size of a nucleus and its mass number (A). 1
- 20 What will be the output frequency of the signal in full wave rectification if the input frequency is 50Hz? 1

**OR**

What happens to the width of depletion layer of a p-n junction when it is (i) forward biased (ii) reverse biased?

### **SECTION B**

- 21 Using Ampere's circuital law, derive an expression for the magnetic field along the axis of a toroidal solenoid. 2

**OR**

(i) Define the term magnetic susceptibility and write its relation in terms of relative magnetic permeability.

(ii) Two magnetic materials A and B have relative magnetic permeabilities of 0.96 and 500. Identify the magnetic materials A and B.

- 22 Using Gauss's theorem obtain an expression for electric field intensity due to a uniformly charged spherical shell of radius R at a point (i) outside the shell and (ii) inside the shell. 2
- 23 (i) Why are connections between the resistors in a metre bridge made of thick copper strips? 2  
(ii) Which material is used for the metre bridge wire and why?
- 24 Draw a neat labelled ray diagram of a reflecting type telescope (Cassegrain). 2
- 25 With the help of a diagram show how light reflected from a transparent medium gets polarized and thereby derive Brewster's law. 2

- 26 Show that the radius of the orbit in hydrogen atom varies as  $n^2$ , where ' $n$ ' is the principal quantum number of the atom. 2

OR

Derive the expression for the law of radioactive decay of a given sample having initially  $N_0$  nuclei decaying to the number  $N$  present at any subsequent time  $t$ .

- 27 Give any two differences between an intrinsic semiconductor and a p-type semiconductor. 2

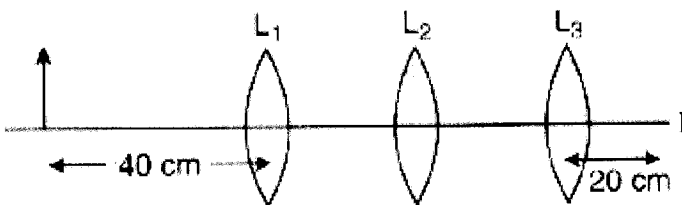
### SECTION C

- 28 (i) An infinitely long positively charged straight wire has a linear charge density  $\lambda \text{ Cm}^{-1}$ . An electron is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression for its kinetic energy. 3  
(ii) Plot a graph of the kinetic energy as a function of charge density.
- 29 (i) Show that the time period of ions in cyclotron is independent of both the speed of ion and radius of circular path. What is the significance of this property? 3  
(ii) A deuteron and a proton are accelerated by the cyclotron. Can both be accelerated with the same oscillator frequency. Give reason to justify your answer.
- 30 A wheel with 8 metallic spokes each 50cm long is rotated with a speed of 120rev/min in a plane normal to the horizontal component of Earth's magnetic field. The Earth's magnetic field at the plane is  $0.4 \times 10^{-4} \text{ T}$  and the angle of dip is  $60^\circ$ . Calculate the emf induced between the axle and the rim of the wheel. How will the value of emf be affected if the number of spokes were increased? 3

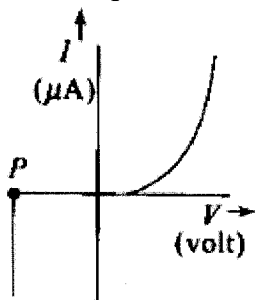
OR

A capacitor (C) and resistor (R) are connected in series with an ac source of voltage of frequency 50 Hz. The potential difference across C and R are respectively 120 V, 90 V and the current in the circuit is 3 A. Calculate

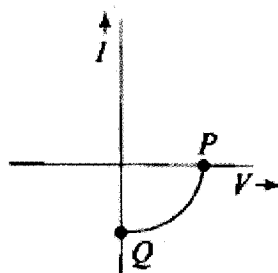
- (i) the impedance of the circuit  
(ii) the value of the inductance, which when connected in series will C and R will make the power factor of circuit unity .
- 31 (i) How are electromagnetic waves produced by oscillating charges? 3  
(ii) State clearly how a microwave oven works to heat up a food item containing water molecules.  
(iii) Why are microwaves found useful for the radar systems in aircraft navigation?
- 32 You are given three lenses  $L_1$ ,  $L_2$  and  $L_3$  each of focal length 20cm. An object is kept at 40cm in front of  $L_1$  as shown. The final real image is formed at the focus 'I' of  $L_3$ . Find the separations between  $L_1$ ,  $L_2$  and  $L_3$ . 3



- 33 (i) Draw a graph showing the variation of potential energy between a pair of nucleon as a function of their separation. Indicate the regions in which the nuclear force is (a) attractive (b) repulsive. 3
- (ii) Write two important conclusions which you can draw regarding the nature of the nuclear forces.
- 34 (i) Name the type of a diode whose characteristics are shown in figure (a) and (b). 3
- (ii) What does the point P in figure (a) represent?
- (iii) What does the points P and Q in figure (b) represent?



(a)



(b)

## SECTION D

- 35 (i) An electric dipole is held in a uniform electric field. Using suitable diagram show that it does not undergo any translatory motion and derive an expression for torque acting on it and specify its direction. 5
- (ii) What happens if the field is non-uniform?
- (iii) What would happen if the external field  $\vec{E}$  is increasing (a) parallel to  $\vec{p}$  and (ii) antiparallel to  $\vec{p}$ ?

OR

- (i) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. .
- (ii) On what factors does resistivity of a conductor depend?
- (iii) Why alloys like constantan and manganin are used for making standard resistors?
- 36 (i) With the help of a ray diagram, show the formation of image of a point object due to refraction of light at a spherical surface separating two media of refractive indices  $n_1$  and  $n_2$  ( $n_2 > n_1$ ). Using this diagram, derive the relation 5

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

- (ii) Write the sign conventions used.  
 (iii) What happens to the focal length of convex lens when it is immersed in water?

**OR**

- (i) In Young's double slit experiment, deduce the conditions for (a) constructive and (b) destructive interference at a point on the screen.  
 (ii) How does the fringe width of interference fringes change, when the whole apparatus of Young's experiment is kept in water (refractive index 4/3)?  
 (iii) Write two points of differences between the phenomena of interference and diffraction.

37

- (i) Plot a graph showing the variation of photoelectric current with intensity of light.  
 (ii) Using photon picture of light, show how Einstein's photoelectric equation can be established. Write two features of photoelectric effect which cannot be explained by wave theory.  
 (iii) A beam of monochromatic radiation is incident on a photosensitive surface. (a) Do the emitted photoelectrons have the same kinetic energy? (b) Does the kinetic energy of the emitted electrons depend on the intensity of incident radiation?

5

**OR**

- (i) Using Bohr's second postulate of quantization of orbital angular momentum show that the circumference of the electron in the  $n^{\text{th}}$  orbital state in hydrogen atom is 'n' times the de Broglie wavelength associated with it.  
 (ii) The electron in hydrogen atom is initially in the third excited state. What is the maximum number of spectral lines which can be emitted when it finally moves to the ground state?  
 (iii) In an experiment on  $\alpha$ -particle scattering by a thin foil of gold, draw a plot showing the number of particles scattered versus the scattering angle  $\theta$ .  
 (iv) Why is it that a very small fraction of the particles are scattered at  $\theta > 90^\circ$ ?

**End of the Question Paper**