CBSE (AI) EXAMINATION PAPER—2019

PHYSICS

CLASS—XII

Time allowed : 3 hrs. *Maximum Marks : 70*

GENERAL INSTRUCTIONS:

(*i*) ***All*** *questions are compulsory. There are* ***27*** *questions in all.*

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

(*iii*) *Section A contains* ***five*** *questions of* ***one*** *mark each. Section B contains* ***seven*** *questions of* ***two*** *marks each, Section C contains* ***twelve*** *questions of* ***three*** *marks each, Section D contains* ***three*** *questions of* ***five*** *marks each.*

(*iv*) *There is no overall choice. However, an internal choice(s) has been provided in* ***two*** *questions of* ***one*** *mark,* ***two*** *questions of* ***two*** *marks,* ***four*** *questions of* ***three*** *marks and* ***three*** *question of* ***five*** *marks weightage. You have to attempt only* ***one*** *of the choices in such questions.*

(*v*) *You may use the following values of physcial constants whenever necessary:*

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

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

$$e = 1.6 \times 10^{-19} \ C$$

$$\mu_0 = 4\pi \times 10^{-7} \ T\ m\ A^{-1}$$

$$\varepsilon_0 = 8.854 \times 10^{-12} \ C^2\ N^{-1}\ m^{-2}$$

$$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \ N\ m^2\ C^{-2}$$

$$\text{Mass of electron } (m_e) = 9.1 \times 10^{-31} \ kg$$

$$\text{Mass of neutron} = 1.675 \times 10^{-27} \ kg$$

$$\text{Mass of proton} = 1.673 \times 10^{-27} \ kg$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole}$$

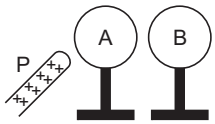
$$\text{Boltzmann constant} = 1.38 \times 10^{-23} \ JK^{-1}$$

Set–I

SECTION-A

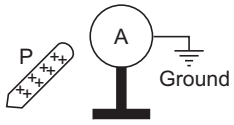
Question numbers 1 to 16 carry 1 mark each.

1. Two metallic spheres A and B kept on insulating stands are in contact with each other. A positively charged rod P is brought near the sphere A as shown in the figure. The two spheres are separated from each other, and the rod P is removed. What will be the nature of the charges on spheres A and B? **(1)**

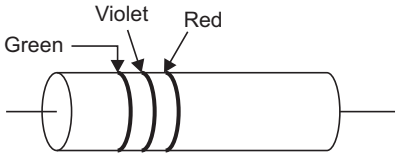


OR

A metal sphere is kept on an insulating stand. A negatively charged rod is brought near it, then the sphere earthed as shown. On removing the earthing, and taking the negatively charged rod away, what will be the nature of charge on the sphere? Give reason for your answer. **(1)**



2. A carbon resistor is shown in the figure. Using colour code, write the value of the resistance. **(1)**



3. State the condition under which a large magnification can be achieved in an astronomical telescope. **(1)**

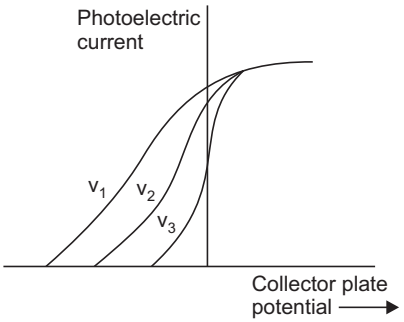
OR

How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light?

4. On the basis of the graphs shown in the figure, answer the following questions:

(*a*) Which physical parameter is kept constant for the three curves?

(*b*) Which is the highest frequency among v_1, v_2 and v_3? **(1)**



5. Define amplitude modulation in communication system. **(1)**

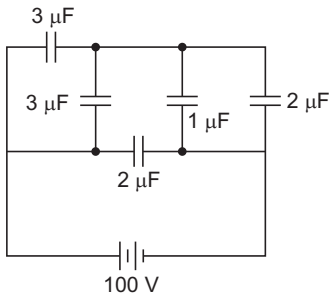
SECTION-B

6. Five point charges, each of charge + q are placed on five vertices of a regular hexagon of side 'l'. Find the magnitude of the resultant force on a charge – q placed at the centre of the hexagon. **(2)**

OR

A simple pendulum consists of a small sphere of mass m suspended by a thread of length l. The sphere carries a positive charge q. The pendulum is placed in a uniform electric field of strength E directed vertically downwards. Find the period of oscillation of the pendulum due to the electrostatic force acting on the sphere, neglecting the effect of the gravitational force. **(2)**

7. The figures shows a network of give capacitors connected to a 100 V supply. Calculate the total energy stored in the network. **(2)**



8. A 0.5 m long solenoid of 10 turns/cm has area of cross section 1 cm^2. Calculate the voltage induced across its ends if the current in the solenoid is changed from 1 A to 2 A in 0.1 s. **(2)**

OR

A small flat search coil of area 5 cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0.09 T and then quickly removed out of the field region. Calculate

(a) change of magnetic flux through the coil, and

(b) emf induced in the coil. **(2)**

9. For paraxial rays, show that the focal length of a spherical mirror is one-half of its radius of curvature. **(2)**

10. Obtain Bohr's quantisation condition for angular momentum of electron orbiting in n^{th} orbit in hydrogen atom on the basis of the wave picture of an electron using de Broglie hypothesis. **(2)**

11. Plot a graph showing the variation of undecayed nuclei N versus time t. From the graph, find out how one can determine the half-life and average life of the radioactive nuclei. **(2)**

12. (a) Write two distinguishing features of nuclear forces

(b) Complete the following nuclear reactions for α and β decay: **(2)**

(i) $^{238}_{92}U \longrightarrow ? + {}^{4}_{2}He + Q$ (ii) $^{22}_{11}Na \longrightarrow {}^{22}_{10}Ne + ? + \upsilon$

SECTION-C

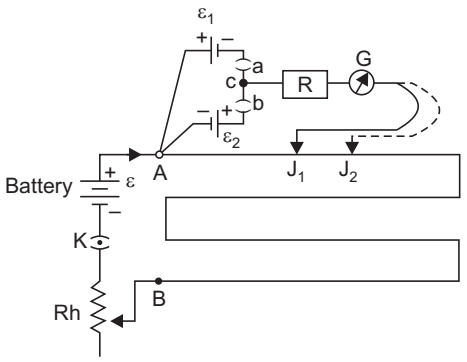
13. (a) Explain briefly, using a proper diagram, the difference in behaviour of a conductor and a dielectric in the presence of external electric field.

(b) Define the term polarization of a dielectric and write the expression for a linear isotropic dielectric in terms of electric field. **(3)**

14. Twelve wires each having a resistance of 3 Ω are connected to form a cubical network. A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of this network. Determine its equivalent and the current along each edge of the cube. **(3)**

15. A student uses the circuit diagram of a potentiometer as shown in the figures (a). For a steady current I passing through the potentiometer wire, he gets a null point for the cell ε_1 and not for ε_2. Give reason for this observation and suggest how this difficulty can be

resolved. (*b*) What is the function of resistance R used in the circuit? How will the change in its value affect the null point? (*c*) How can the sensitivity of the potentiometer be increased? **(3)**



16. (*a*) Show that the time period (T) of oscillations of a freely suspended magnetic dipole of magnetic moment (*m*) in a uniform magnetic field (B) is given by $T = 2\pi\sqrt{\frac{1}{mB}}$, where I is a moment of inertia of the magnetic dipole.

(*b*) Identify the following magnetic materials:

(*i*) A material having susceptibility (χ_m) = – 0.00015

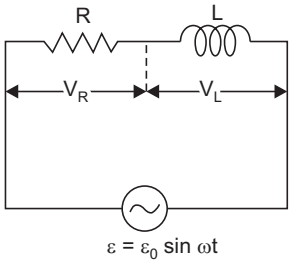
(*ii*) A material having susceptibility (χ_m) = 10^{-5}. **(3)**

17. (*a*) How are eddy currents generated in a conductor which is subjected to a magnetic field?

(*b*) Write two examples of their useful applications. **(3)**

(*c*) How can the disadvantages of eddy currents be minimized?

18. (*a*) An ac circuit as shown in the figures has an inductor of inductance L and a resistor of resistance R connected in series. Using the phasor diagram, explain why the voltage in the circuit will lead the current in phase.



(*b*) The potential difference across the resistor is 160 V and that across the inductor is 120 V. Find the effective value of the applied voltage. If the effective current in the circuit be 1.0 A, calculate the total impedance of the circuit.

(*c*) What will be the potential difference in the circuit when direct current is passed through the circuit? **(3)**

OR

An ac circuit consists of a series combination of circuit elements X and Y. The current is ahead of the voltage in phase by $\frac{\pi}{4}$. If element X is a pure resistor of 100 Ω,

(*a*) Name the circuit element Y.

(*b*) Calculate the rms value of current, if rms value of voltage is 141 V.

(*c*) What will happen if the ac source is replaced by a dc source? **(3)**

19. Name the radiation of the electromagnetic spectrum which is used for the following:

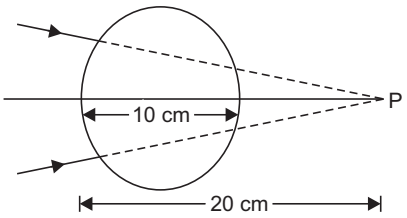
(a) Radar

(b) To photograph internal parts of human body

(c) For taking photographs of the sky during night and foggy conditions.

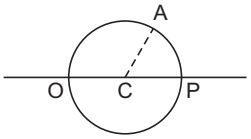
Give the frequency in each case. **(3)**

20. A converging beam of light travelling in air converges at a point P as shown in the figure. When a glass sphere of refractive index 1.5 is introduced in between the path of the beam, calculate the new position of the image. Also draw the ray diagram for the image formed.



OR

A converging 'O' marked on the surface of a glass sphere of diameter 20 cm is viewed through glass from the position directly opposite to the point O. If the refractive index of the glass 1.5, find the position of the image formed. Also, draw the ray diagram for the formation of the image. **(3)**



21. (a) Explain how an unpolarised light gets polarised when incident on the interface separating the two transparent media.

(b) Green light is incident at the polarising angle on a certain transparent medium. The angle of refraction is 30°. Find

(i) polarising angle, and

(ii) refractive index of the medium. **(3)**

22. (a) Plot a graph to show the variation of stopping potential with frequency of incident radiation in relation to photoelectric effect.

(b) Use Einstein's photoelectric equation to show how from this graph, (i) Threshold frequency, and (ii) Planck's constat can be determined. **(3)**

OR

(a) How does one explain the emission of electron from a photosensitive surface with the help of Einstein's photoelectric equation?

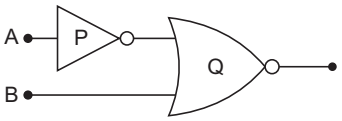
(b) Work function of aluminium is 4.2 eV. If two photons each of energy 2.5 eV are incident on its surface, will the emission of electrons take place? Justify your answer.

(c) The stopping potential in an experiment on photoelectric is 1.5 V. What is the maximum kinetic energy of the photoelectrons emitted? Calculate in Joules. **(3)**

23. (a) (i) Write the truth tables of the logic gates marked P and Q in the given circuit.

(ii) Write the truth table for the circuit.

(b) Why are NOR gates considered as universal gates? **(3)**



OR

(*a*) Explain how a potential barrier is developed in a *p-n* junction diode.

(*b*) Draw the circuit arrangement for studying the V-I characteristics of a *p-n* junction diode in reverse bias. Plot the V-I characteristics in this case. **(3)**

24. (*a*) What do you mean by bandwidth of a signal? Give its importance.

(*b*) Differentiate between Analog and Digital communication.

(*c*) Write the functions of transducer and repeaters. **(3)**

SECTION-D

25. (*a*) State and explain the law used to determine magnetic field at a point due to a current element. Derive the expression for the magnetic field die to a circular current carrying loop of radius *r* at its centre.

(*b*) A long wire with a small current element of length 1 cm is placed at the origin and carries a current of 10 A along the X-axis. Find out the magnitude and direction of the magnetic field due to the element on the Y-axis at a distance 0.5 m from it. **(5)**

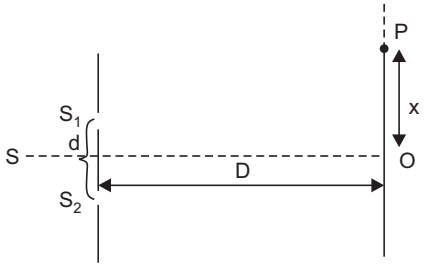
OR

(*a*) Derive the expression for the magnetic field due to a current carrying coil of radius *r* at a distance from the centre along the X-axis.

(*b*) A straight wire carrying current of 5A is bent into a semicircular arc of radius 2 cm as shown in the figure. Find the magnitude and direction of the magnetic field at the centre of the arc.

26. (*a*) Can the interference pattern be produced by two independent monochromatic sources of light? Explain.

(*b*) The intensity at the central maximum (O) in a Young's double slit experimental set-up shown in the figure is I_O. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P, would equal $\frac{I_O}{4}$.



(*c*) In Young's double slit experiment, the slits are separated by 0.5 mm and screen is placed 1.0 m away from the slit. It is found that the 5th bright fringe is at a distance of 4.13 mm from the 2nd dark fringe. Find the wavelength of the light used. **(5)**

OR

(*a*) Derive the relation a sin θ = λ for the first minimum of the diffraction pattern produced due to a single slit of width 'a' using light of wavelength λ.

(*b*) State with reason, how the linear width of central maximum will be affected if (*i*) monochromatic yellow light is replaced with red light, and (*ii*) distance between the slit and the screen is increased.

(*c*) Using the monochromatic light of same wavelength in the experimental set-up of the diffraction pattern as well as in the interference pattern where the slit separation is 1 mm, 10 interference fringes are found to be within the central maximum of the diffraction pattern. Determine the width of the single slit, if the screen is kept at the same distance from the slit in the two cases. **(5)**

27. (*a*) Draw a circuit diagram of an n-p-n transistor with emitter-base junction forward biased and base-collector junction reverse biased. Briefly describe its working.

Explain how a transistor in its active state exhibits a low resistance at its emitter-base junction and high resistance at its base-collection junction.

(*b*) Derive the expression for the voltage gain of a transistor amplifier in CE configuration in terms of the load resistance R_L, current gain β_a and input resistance.

Explain why input and output voltages are in opposite phase. **(5)**

OR

(*a*) Write the important considerations which are to be taken into account while fabricating a p-n junction diode to be used as a Light Emitting Diode (LED) what should be the order of band gap of an LED, if it is required emit it light in the visible range? Draw a circuit diagram and explain its action.

(*b*) Draw the V-I characteristics of an LED. State two advantages of LED lamps over conventional incandescent lamps. **(5)**

Questions are different from Set I.

Set–II

SECTION-A

1. Draw a plot of resistivity versus temperature for a typical semiconductor. **(1)**

2. Define the term attenuation in communication system. **(1)**

4. In photoelectric emission, when the frequency of incident radiation is doubled, will the maximum kinetic energy of photoelectrons also be doubled? Justify your answer. **(1)**

SECTION-B

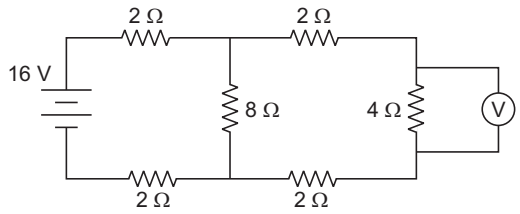
6. Show that the image formed by a convex mirror of an object is always virtual. **(2)**

7. Distinguish between nuclear fusion and nuclear fission. Given one example for each. **(2)**

8. An electron in a hydrogen atom in the second excited state jumps to the first and ground state of the atom. Find the ratio of the wavelengths emitted during this process. **(2)**

SECTION-C

13. In the circuit given below, find the voltmeter reading across a 4 Ω resistor. **(3)**



14. When a parallel plate capacitor is being charged by a dc battery, why does a galvanometer show a momentary deflection?

Obtain the expression for the displacement current and show how it is related to conduction current in a steady state. **(3)**

16. (*a*) Explain briefly, using a proper diagram, the difference in behaviour of a conductor and a dielectric in the presence of external electric field. **(3)**

(*b*) Define the term polarization of a dielectric and write the expression for a linear isotropic dielectric in terms of electric field. **(3)**

18. (*a*) Use Kirchhoff's rules to obtain the balance condition in Wheatstone bridge.

(*b*) Give one practical application that is based on this principle. **(3)**

21. Answer the following:

(*a*) Magnetic field lines can be entirely confined within the core of a toroid but not within a straight solenoid. Why?

(*b*) Does a bar magnet exert a torque on itself due to its own field? Justify your answer.

(*c*) When an electron revolves around a nucleus, obtain the expression for the magnetic moment associated with it. **(3)**

Questions are different from Set I and Set–II.

Set–III

SECTION-A

1. Define intensity of radiation based on photon picture of light. **(1)**

5. Write the function of receiver in communication system. **(1)**

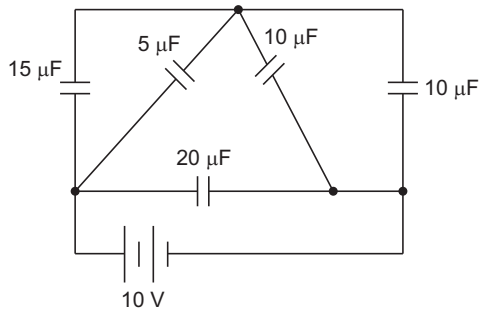
SECTION-B

7. (*a*) Which property of nuclear force explains the constancy of binding energy per nucleon $\left(\frac{BE}{A}\right)$ for nuclei in the range $20 < A < 170$? **(2)**

(*b*) Complete the following nuclear reactions:

(*i*) $^{32}_{15}P \longrightarrow {}^{A}_{Z}X + e^{-} + \bar{v}$ (*ii*) $^{12}_{6}C + {}^{12}_{6}C \longrightarrow {}^{A}_{Z}Y + {}^{4}_{2}He$

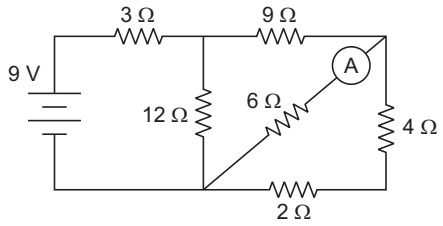
9. The figure shows a network of five capacitors connected to a 10 V battery. Calculate the charge acquired by 5 μF capacitor. **(2)**



11. In the case of a concave mirror of focal length f, when an object is kept between f and $2f$, show that its image is formed beyond $2f$. **(2)**

14. Write the image of the wavelength of the following electromagnetic radiations:
(a) Infrared rays (b) Ultraviolet rays (c) γ-rays **(3)**

17. In the circuit shown in the figure, find the value of the current shown in the ammeter A. **(3)**



19. (a) Obtain the expression for the current flowing through a conductor having number density of the electrons n, area of cross-section A in terms of the drift velocity v_d. **(3)**
(b) How does the resistivity of a semiconductor change with rise of temperature? Explain.

23. (a) What do you mean by bandwidth of a signal? Given its importance. **(3)**
(b) Differentiate between Analog and Digital communication.
(c) Write the functions of transducer and repeaters.

24. Define the dipole moment of a magnetic dipole. Write its S.I. unit. **(3)**
Obtain the expression for the torque acting on a magnetic dipole placed in an external uniform magnetic field. **(3)**