ROLL NO								

SET III

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FIRST PRE – BOARD SESSION 2020 – 21

SUBJECT – PHYSICS (THEORY)

Time allowed: **3 hours** Max. Marks: **70**

General Instructions:

(1) All questions are compulsory. There are 33 questions in all.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) Section A contains ten very short answer questions and four assertion reasoning MCQs of 1mark each, Section B has two case based questions of 4 marks each. Section C contains nine short answer questions of 2marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.

(4) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

- *You may use the following values of the physical constants wherever necessary:*

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

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

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

$\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

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

$\frac{1}{4\pi\varepsilon 0} = 9 \times 10^9$ Nm^{2}C^{-2}

Mass of electron = 9.1×10^{-31} kg

Mass of proton = 1.673×10^{-27} kg

Mass of neutron = 1.675×10^{-27} kg

Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION – A

Select the most appropriate option from the questions 1 to 10 given below.

1. Mark the wrong statement :-

(a) Equipotential surfaces never cross each other.

(b) For a uniformly charged non conducting sphere, the electric potential at the centre of the sphere is 1.5 times that at the surface.

(c) If potential in a certain region is non zero constant, then the electric field in that region will also be non zero constant.

(d) Inside a spherical charged shell, the electric field is zero but the electric potential is the same as that at the surface.

2. Length of a wire of resistance R Ω is increased to 10 times, so its resistance becomes 1000Ω, therefore R= (The volume of the wire remains same during increase in length)

(A) 0.01 Ω (B) 0.1Ω

(C) 1Ω (D) 10Ω

3. If in a moving coil galvanometer, a current I in its coil produces a deflection θ , then

(a) $I \alpha \theta$ (b) $I\alpha\theta^2$

(c) $I\alpha\theta^{-1}$ (d) $I \alpha \tan \theta$

4. If distance between two current- carrying wires is doubled, then force between them is

(a) Halved (b) doubled

(c) tripled (d) quadrupled

5. In a series LCR circuit, resistance R = 10 ohm and the impedance Z = 20ohm's. The phase difference between the current and the voltage is

(a) 30° (b) 45°

(c) 60° (d) 90°

6. When EM wave propagates through vacuum then-

(a) E-field leads B-field

(b) E-field lags B-field

(c) E-field and B-field are in the same phase

(d) Energy is stored only in E-field

7. In a Young's double slit experiment, the separation between the slits is 0.1 mm, the wavelength of light used is 600nm and the interference pattern is observed on a screen 1m away. Find the separation between bright fringes.

(a) 6.6 mm (b) 6.0 mm

(c) 6 m (d) 60 cm

8. The astronomical telescope consists of objective and eyepiece. The focal length of the objective is

(a) equal to that of the eyepiece.

(b) shorter than that of eyepiece.

(c) greater than that of eyepiece.

(d) five times shorter than that of eyepiece.

9. The cathode of a photoelectric cell is changed such that the work function changes from W_1 to W_2 ($W_2 > W_1$). if the current before and afterchange are I_1 and I_2, all other conditions remaining unchanged, then (assuming $hv > W_2$)

(a) $I_1 = I_2$ (b) $I_1 < I_2$

(c) $I_1 > I_2$ (d) $I_1 < I_2 < 2I$

10. Depletion layer in a p-n junction consists of -
    a. Electron
    b. Holes
    c. Positive and negative ion fixed in this position.
    d. Both holes and electron.

Directions:- In the following questions statement of assertion(A) is followed by a statement of reason (R) mark the correct choice as -

a) if both (A) and (R) are true and (R) is the correct explanation of(A)

b) if both (A) and (R) are true but (R) is not the correct explanation of (A)

c) if (A) is true but(R) is false

d) if both (A) and (R) are false

11 . Assertion(A):- Capacity of a parallel plate capacitor increases when distance between the plates is decreased
Reason(R):- Capacitance of capacitor is inversely proportional to distance between them.

12 . Assertion(A):- The focal length of an equiconvex lens placed in air is equal to radius of curvature of either face.
Reason(R):- For an equiconvex lens radius of curvature of both the faces is same.

13. Assertion(A):- That fringe closest on either side of the central bright fringe in case of interference pattern due to white light is red and the farthest appears blue.
Reason(R):- The interference patterns due to different component colours of white light overlap.

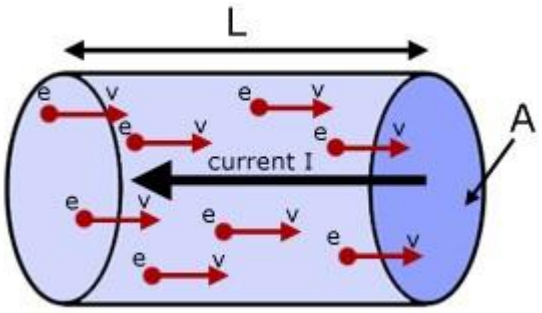
14. Assertion(A):- Nuclear force between neutron –neutron, proton- neutron and proton-Proton is approximately the same.
Reason(R):- The nuclear force does not depend on the electric charge.

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. A cylindrical copper conductor AB of length 'l' and area of cross section 'A' has a large number of free electrons which at room temperature move at random within the body of the conductor, like the molecules of a gas.The average thermal speed of the free electrons in random motion at room temperature is of the order of 10^5 m/s^{-1}. When a

potential difference 'V' is applied across the two ends of a given conductor, the free electrons in the conductor experience a force and are accelerated towards the positive end of the conductor. On their way they suffer frequent Collisions with the ion/atoms of the conductor and lose their gained kinetic energy. After each collision the free electrons are again accelerated due to electric field towards the positive end of the conductor and lose their gained kinetic energy in the next Collision with the Ion/atom of the conductor. The average speed of free electrons with which they drift towards the positive end of the conductor under the effect of applied electric field is called Drift velocity of the electron.



A) When the potential difference is applied across the two ends of the conductor then electric field exists-

(a) outside the conductor (b) inside the conductor

(c) both outside and inside the conductor (d) no where.

B) The motion of electrons in between two successive collisions with the atoms/ ion follows

a) straight path b) circular path

c) elliptical path d) curved path

C) The drift speed of the electrons depend on -

a) dimension of conductor

b) number density of free electron in the conductor

c) both (a) and (b)

d) none of these above

D) The current in the conductor is due to-

a) Thermal motion of free electrons

b) acceleration of the electrons towards the positive end of the conductor

c) Drifting of electrons towards positive end of the conductors

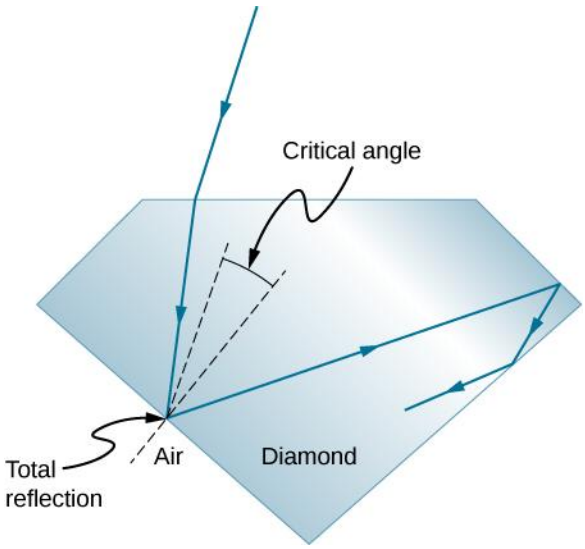
d) None of the above

E) Drift current is due to -

a) Applied electric field over a given distance
b) Random motion of electrons
c) Random motion of holes
d) Recombination of holes and electrons

16. **Sparking Brilliance of Diamond:**

The total internal reflection of the light is used in polishing diamonds to create a sparking brilliance. By polishing the diamond with specific cuts, it is adjusted the most of the light rays approaching the surface are incident with an angle of incidence more than critical angle. Hence, they suffer multiple reflections and ultimately come out of diamond from the top. This gives the diamond a sparking brilliance.



A) Light cannot easily escape a diamond without multiple internal reflections. This is because:

a) Its critical angle with reference to air is too large
b) Its critical angle with reference to air is too small
c) The diamond is transparent
d) Rays always enter at angle greater than critical angle

B) The critical angle for a diamond is 24.4o. Then its refractive index is-

a) 2.42 b) 0.413 c) 1 d) 1.4133.

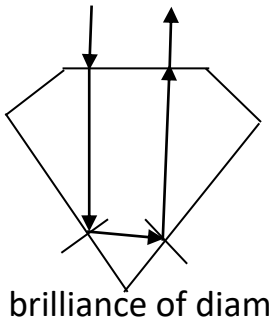
C) The basic reason for the extraordinary sparkle of suitably cut diamond is that

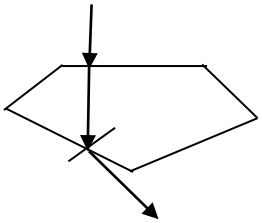
a) It has low refractive index
b) It has high transparency
c) It has high refractive index
d) It is very hard

D) A diamond is immersed in a liquid with a refractive index greater than water. Then the critical angle for total internal reflection will -

a) will depend on the nature of the liquid
b) decrease
c) remains the same
d) increase

E) The following diagram shows same diamond, cut in two different shapes.





The brilliance of diamond in the second diamond will be –

a) Less than the first
b) Greater than the first
c) Same as first
d) Will depend on the intensity of light

SECTION B

17. Deduce the condition for balance of Wheatstone's bridge network using Kirchhoff'slaws.
18. Rearrange the following electromagnetic radiations in the increasing order of their frequencies:
Microwaves; y-rays; Infra red rays; X-rays; Radio-waves and Ultra-violet rays.

OR

Answer the following questions:
(a) Name the em waves which are produced during radioactive decay of a nucleus. Write their frequency range.
(b) Welders wear special glass goggles while working. Why?

19. Why the photoelectrons emitted from a metal surface for a certain radiation have different energies even if work function of metal is a constant?

OR

Why is the density of the nucleus more than that of the atom?

20. Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photo sensitive materials having work function w_1 and w_2 ($w_1 > w_2$). On what factors does (i) slope (ii) intercept of the line depend?
21. Plot a graph showing variation of voltage v/s the current drawn from the cell. How can one get information from this plot about the emf of the cell and its internal resistance.

22. A neutron and an electron moving with equal velocities, enters uniform magnetic field perpendicular to the velocity. Trace their path in the field and justify your answer.
23. A small bulb is placed at the bottom of a water tank depth 80 cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 4/3.

OR

The focal length of an equi-convex lens is equal to the radius of curvature of either face. What is the value of refractive index of the material of the lens.

24. A hydrogen atom in the ground state is excited by an electron beam of 12.5 eV. Find out the maximum number of lines emitted by an atom from its excited state.
25. Explain why elemental semiconductor cannot be used to make visible LEDs.

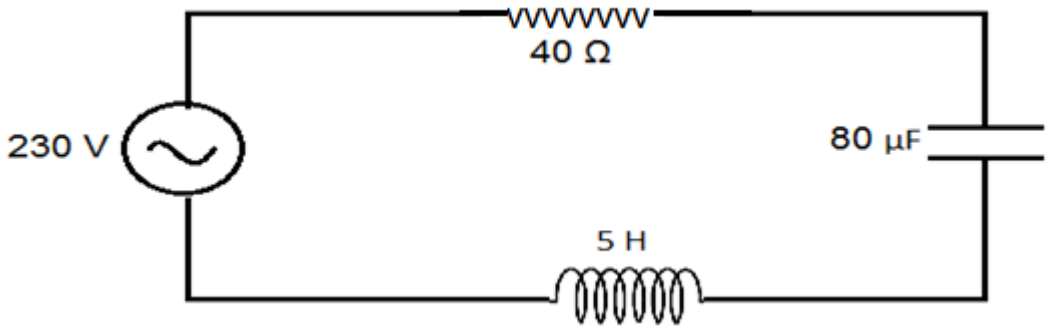
SECTION D

26. Draw electric field lines and equi potential surfaces in case of :-
(i) a positive point charge, (ii) an electric dipole, and (iii) two equal positive point charges.
27. Obtain the expression for the force per unit length of two parallel conductors carrying current and hence define one ampere.

OR

The figure shows a series LCR circuit connected to a variable frequency 230 V source.

(a) Determine the source frequency which derives the circuit in resonance.
(b) Calculate the impedance of the circuit and amplitude of current at resonance.
(c) Show that potential drop across L C combination is zero at resonance frequency.



28. What are elements of earth's magnetic field? Define them.
29. When an electron in Hydrogen atom jumps from 3rd excited state to the ground state, how would the de Broglie wavelength associated with the electron change. Justify your answer.

OR

Write Einstein photoelectric equation and point out any two characteristic properties of photons on which this equation is based?

30. (a) Explain with the help of a diagram how depletion region and potential barrier are formed in a junction diode.

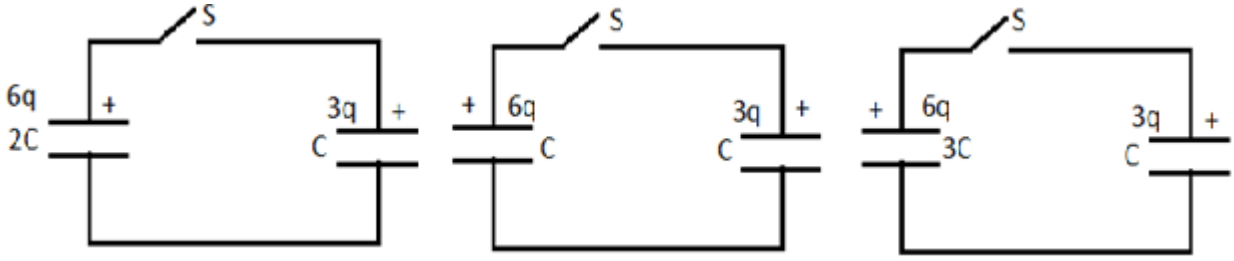
(c) If a small voltage is applied to a p-n junction diode. How will be barrier potential be affected when it is (i) Forward biased and (ii) Reverse biased.

OR

Draw circuit diagram of an illuminated photodiode in reverse bias. How is a photodiode used to measure the light intensity?

SECTION E

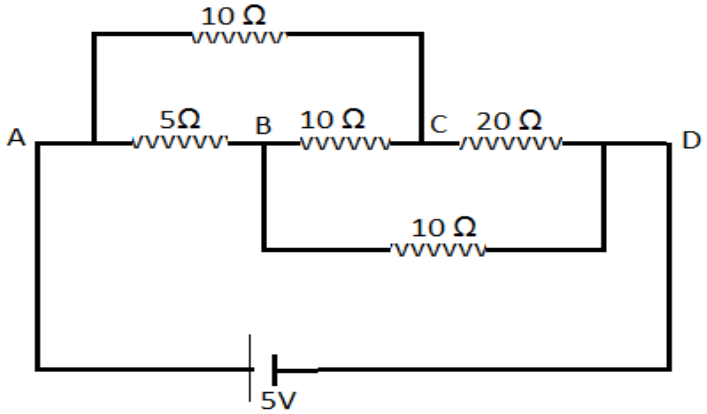
31. Derive an expression for energy stored in a parallel plate Capacitors C, charged to a potential difference V. Hence derive an expression for energy density of a capacitor. Three circuits each consisting of a switch 'S' and two capacitors, are initially charged, as shown in the figure. After the switch has been closed, in which circuit will the charge on the left hand side capacitor (i) increase, (ii) decrease and (iii) remain same? Give reason.



OR

Draw a circuit diagram showing balancing of Wheatstone bridge. Use Kirchhoff's rule to obtain the balance condition in terms of the resistances of four arms of Wheatstone bridge.

(i) Calculate the value of current drawn from a 5 V battery in the circuit as shown.



32. (i) Define mutual inductance and write its SI units.

(ii) Derive an expression for mutual inductance of two long co-axial solenoids of same length wound one over the other.

OR

(a) Describe briefly, with the help of a labelled diagram, the working of a step-up transformer.

(b) Write any two sources of energy loss in a transformer,

(c) A step-up transformer converts a low voltage into high voltage. Does it not violate the principle of conservation of energy? Explain.

33. Draw ray diagram showing the image formation in a compound microscope and label the parts. Derive the expression for magnification of a compound microscope.

OR

Draw ray diagram showing the image formation in a Astronomical Telescope and label theparts. Derive the expression for magnification of a Astronomical Telescope.