CBSE 2020
Grade 12
PHYSIC THEORY

Series HMJ/1

SET-3

Code No. 55/1/3

Candidates must write the code on the title page of the answer book.

Note:

(I) Please check that this paper contains 11 printed pages.

(II) Code number given on the right-hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) Please check that this question paper contains 10 questions.

(IV) Please write down the Serial Number of the question in the answer-book before attempting it.

(V) 15-minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

SECTION A

Note : Select the most appropriate option from those given below each question :

1. Photons of energies 1 eV and 2 eV are successively incident on a metallic surface of work function 0.5 eV. The ratio of kinetic energy of most energetic photoelectrons in the two cases will be 1
   (A) 1:2
   (B) 1:1
   (C) 1:3
   (D) 1:4

2. Which of the following statements is *not* correct according to Rutherford model ? 1
   (A) Most of the space inside an atom is empty

   (B) The electrons revolve around the nucleus under the influence of coulomb force acting on them

   (C) Most part of the mass of the atom and its positive charge are concentrated at its center.

   (D) The stability of atom was established by the model

3. The resolving power of a telescope can be increased by increasing 1

   (A) wavelength of light.

   (B) diameter of objective.

   (C) length of the tube.

   (D) focal length of eyepiece.

4. The magnetic dipole moment of a current carrying coil does

   not depend upon   1

   (A) number of turns of the coil.
   (B) cross-sectional area of the coil.
   (C) current flowing in the coil.
   (D) material of the turns of the coil.

5. For glass prism, the angle of minimum deviation will be

   smallest for the light of   1

   (A) red colour.

   (B) blue colour.

   (C) yellow colour.

   (D) green colour.

6. A biconvex lens of glass having refractive index 1.47 is

   immersed in a liquid. It becomes invisible and behaves as

   a plane glass refractive index of the liquid is   1

   (A) 1:47

   (B) 1.62

(C) 1.33

(D) 1.51

7. The resistance of a metal wire increases with increasing temperature on account of   1

   (A) decrease in free electron density

   (B) decrease in relaxation time.

   (C) increase in mean free path.

   (D) increase in the mass of electron.

8. An electric dipole placed in a non-uniform electric field can experience   1

   (A) a force but not a torque.

   (B) a torque but not a force.

   (C) always a force and a torque.

   (D) neither a force nor a torque

9. If the net electric flux through a closed surface is zero, Then we can infer   1

(A) no net charge is enclosed by the surface.

(B) uniform electric field exists within the surface.

(C) electric potential varies from point to point inside the surface.

(D) charge is present inside the surface.

10. Kirchhoff's first rule at a junction in an electrical conservation of   1

(A) energy

(B) charge

(C) momentum

(D) both energy and charge

Note : Fill in the blanks with appropriate answer :

11 A ray of light on passing through an equilateral glass prism, suffers a minimum deviation equal to the angle of the prism. The value of refractive index of the material of the prism is_____   1

12 According to Bohr's atomic model, the circumference of the electron orbit is always an_____multiple of de Broglie wavelength.   1

OR

In ß -decay, the parent and daughter nuclei have the same number of_____   1

13 The number of turns of a solenoid are doubled without changing its length and area of cross-section. The self-inductance of the solenoid will become _____ times
                    1

14. Laminated iron sheets are used to minimize _____ core of a transformer.   1

15. The magnetic field lines are _____ by a diamagnetic substance   1

16. why cannot we use Si and Ge fabrication of visible LEDs?   1

17 The variation of the stopping potential photosensitive surface the frequency (v) of the light incident on two different photosensitive surface M_1 and M_2 is shown in the figure. Identify the surface which has greater value of the work function   1
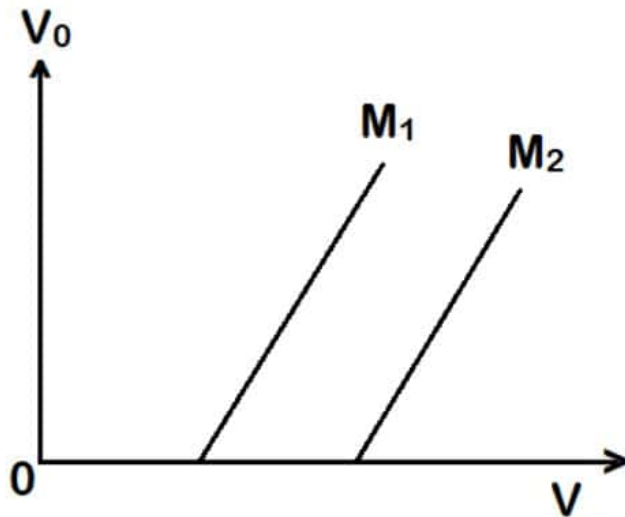
18. How does an increase in doping concentration affect the width of depletion layer of a p-n junction diode   1

19. The nuclear radius of $^{27}_{13}Al$ is 4.6 fermi. Find the nuclear radius of $^{64}_{29}Cu$ 1

OR

A proton and an electron have equal speed find the ratio of de Broglie Wavelengths associated with them   1

20. How is displacement current produced between the plates of a parallel plate capacitor during charging?

SECTION B

21 . Two long straight parallel wires A and B separated by a distance d, carry equal current I flowing in same direction as shown in the figure
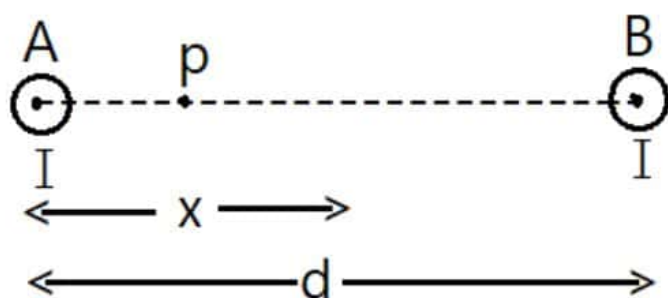
(a) Find the magnetic field at a point P situated between them at a distance x from one wire.

(b) Show graphically the variation of the magnetic field with distance x for $0 < x < d$ **2**

22. Using Bohr's atomic model, derive the expression for the radius of nth orbit of the revolving electron in a hydrogen atom.   **2**

OR

(a) Write two main observations of photoelectric effect experiment which could only be explained by Einstein's photoelectric equation.

(b) Draw graph variation of photocurrent with the anode potential of a

photocell   **2**

23. define wave front of a travelling wave. Using Huygens principle, obtain the law of refraction at a plane interface when light passes from a rarer to a denser medium   **2**

<div align="center">**OR**</div>

Using lens marker's formula ,derive the lens formula $\frac{1}{f}=\frac{1}{v}=\frac{1}{u}$ for a biconvex lens.   **2**

24. . Explain the principle of working of a meter bridge. Draw the circuit diagram for determination of an unknown resistance using it.   **2**

25. Explain the terms 'deletion layer, and 'potential barrier, in a p-n junction diode. How are the (a) width of depletion layer, and (b) value of potential; barrier affected when the p-n junction is forward biased ?   **2**

26. N small conducting liquid droplets, each of radius r, are charged to a potential V each, these droplets coalesce to form a single large drop without any charge leakage find the potential of the large drop   **2**

27. Define activity of a sample of a radioactive substance. The value of the disintegration constant of a radioactive substance is 0.0693 h$^{-1.}$ Find the time after which the activity of a sample of this substance reduces to one-half that of its present value.   **2**

SECTION-C

28. In a single slit diffraction experiment, light of wavelength λ

    Illuminates the slit of width 'a' and the ss observed on a screen.

(a) show the intensity diffraction in the pattern with the angular

    position θ

(b) how are the intensity and angular width of central maxima

    affected when

(i) width of slit is increased ,and

(ii) separation between slit and screen is decreased   **3**

29. with the help of a simple diagram, explain the working of a

    silicon solar cell, giving all three basic processes involved. Draw
    its I-V characteristics   **3**

30. A resistor R and an inductor L are connected in series to a source
    $V = V_o \, \omega \, . t$
    Find the
    (a) peak value of the voltage drops across R and across L,
    (b) phase difference between the applied voltage and current.
        Which of them is ahead ?   **3**

31. (a) Write the expression for the speed of light in a material
    medium of relative permittivity 6_r and relative magnetic
    permeability μ_r

(b) Write the wavelength range and name of the electromagnetic waves which are used in (i) radar systems for aircraft navigation and (ii) Earth satellites to observe the growth of the crops. **3**

32. (a) Two cells of emf E_1 and E_2 have their internal resistance and r_2, respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other

(b) In case the cell are identical, each of E= 5v and internal resistance r=2Ω calculate the voltage across the external resistance R= 10Ω **3**

33. (a) write an expression of magnetic moment associated with a current (I) carrying circular coil of radius r having N turns

(b) consider the above-mentioned coil places in YZ plane with its centre at the origin derive expression for the value of magnetic Field due it at point (x,0,0). **3**
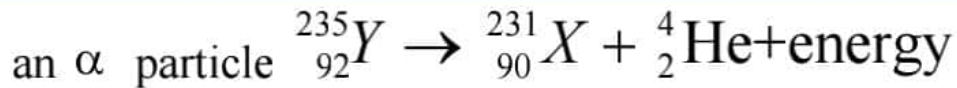
OR

(a) Define current sensitivity of a galvanometer. Write its Expression

(b) A galvanometer has resistance G and shows full scale deflection for current I_g.
(i) How can it be convened into an ammeter to measure current up to Io (Io > Ig) ?
(ii) What is the effective resistance of this ammeter ? **3**

34. the nucleus $^{235}_{92}Y$,initially at rest, decays into $^{231}_{90}X$ by emitting

an α particle $^{235}_{92}Y \rightarrow {}^{231}_{90}X + {}^{4}_{2}He + energy$

The binding energies per nucleon, the daughter nucleus and α-particle are 7.8 MeV, 7-835 MeV and 7.07 Mev, Respectively. Assuming the daughter nucleus to be formed in the unexcited state and neglecting its share in the energy of the reaction, find the speed of the emitted α- particle

(Mass of α- particle $= 6.68 \times 10^{-27}$ kg)   **3**

SECTION-D

35. (a) Derive the expression for the torque acting on the rectangular Current carrying coli of a galvanometer. Why is the magnetic field Made radial

    (b) An α-particle is accelerated through a potential difference of 10 kV and move along x-axis. It enters in a region of uniform magnetic Field $B = 2 \times 10^{-3}$ T acting along y-axis. Find the radius of its path. (Take mass of α - particle $= 6. \times 10^{-27}$ kg)   **5**

    OR

    (a) With the help of a labelled diagram, explain the working of a Step-up transformer. Give reasons to explain the following : (i) The core of the transformer is laminated (ii) Thick copper wire is used in windings.
    (b) A conducting rod PQ of length 20 cm and resistance 0.1 Ω rests on two smooth parallel rails of negligible resistance AA' and CC'. It

can slide on the rails and the arrangement is positioned between the poles of a permanent magnet producing uniform magnetic field B = 0.4 T. The rails, the rod and the magnetic field are in three mutually perpendicular directions as shown in the figure. If the ends A and C of the rails are short circuited, find the
(i) external force required to move the rod with uniform velocity v = 10 cm/s, and
(ii) power required to do so   5

X A   X   X
X ┌──────┬──────────── A'
X │   │
X │   ⊗ ├──→ v X
  │   B │
X │   │
X C └─────┴──────────── C'
   X   X
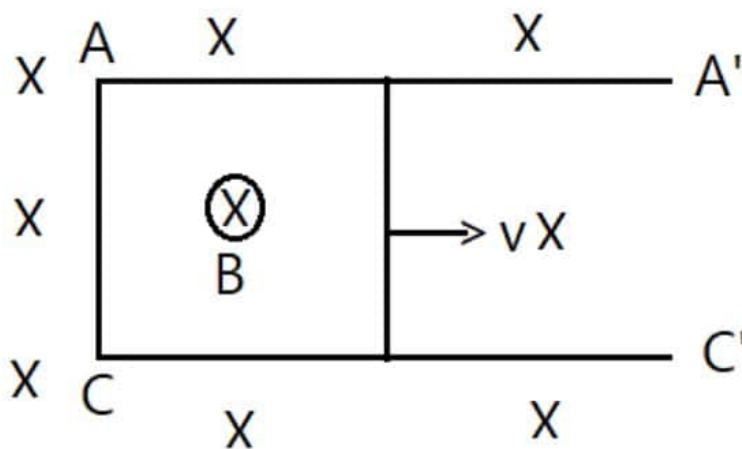
36. (a) Draw the ray diagram of an astronomical telescope when the final image is formed at infinity. Write the expression for the resolving power of the telescope.

(b) An astronomical telescope has an objective lens of focal

Length 20 m and eyepiece of focal length 1 cm

(i) Find the angular magnification of the telescope.
(ii) If this telescope is used to view of the Moon, find the diameter of the image formed by the objective lens. Given diameter of the Moon is 3.5×10^6 m and radius of lunar orbit 3.5×10^6 is 3.8×10^8 m.   5

OR

(a) An object is placed in front of a concave mirror it is observed
That a virtual image is formed. Draw the ray diagram to
show the image formation and hence derive the mirror
equation

(b) An object is placed 30 cm in front of a plano-convex
lens with its spherical surface of radius of curvature 20 cm.
If the refractive index of the material of. the lens is 1.5, find
the position and nature of the image formed   **5**

37.(a) Using Gauss law, derive expression for electric field due to a
spherical shell of uniform charge distribution a and radius R
at a point lying at a distance x from the centre of shell, such
that
(1) $0 < x < R$, and
(ii) $x > R$.
(b) An electric field is uniform and acts along + x direction in the
region of positive x. It is also uniform with the same
magnitude but acts in - x direction in the region of negative x.
The value of the field is $E = 200$ N/C for $x > 0$ and $E = -200$
N/C for $x < 0$. A right circular cylinder of length 20 cm and
radius 5 cm has its centre at the origin and its axis along the
x-axis so that one flat face is at $x = +10$ cm and the other is
at $x = -10$ cm. Find :
(i) The net outward flux through the cylinder.
(ii)The net charge present inside the cylinder. **5**

OR

(a) Find the expression for the potential energy of a system of two
point charges q_1 and q_2 located at $\vec{r_1}$ and $\vec{r_2}$ respectively in an

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external electric field . $\vec{E}$

(b) Draw equipotential surfaces due to an isolated point charge (— q) and depict the electric field lines.

(c) Three point charges $+1\mu C, -1\mu C$ and $2\mu C$ are initially infinite distance apart. Calculate the work done in assembling these charges at the vertices of an equilateral triangle of side 10 cm.

5