2021
PHYSICS

Total marks : 70   Time : 3 hours

General instructions:
i)   *Approximately 15 minutes is allotted to read the question paper and revise the answers.*
ii) *The question paper consists of 30 questions. All questions are compulsory.*
iii) *Marks are indicated against each question.*
iv) *Internal choice has been provided in some questions.*

N.B: Check that all pages of the question paper is complete as indicated on the top left side.

1. The core of a transformer is laminated so that   **1**
    (a) rusting of the core may be prevented
    (b) energy losses due to eddy currents may be minimised
    (c) ratio of voltage in primary and secondary may be increased
    (d) the weight of the transformer may be reduced.

2. Electromagnetic waves are produced by   **1**
    (a) a charge at rest   (b) accelerating charge
    (c) an electric field   (d) a magnetic field.

3. Two lenses of power +12D and −2D are combined together. What
    is their equivalent focal length?   **1**
    (a) 8.33 cm   (b) 10 cm
    (c) 14 cm   (d) 12.5 cm

4. Which among the following is the series of H – spectrum that lie in
    the UV region?   **1**
    (a) Paschen series   (b) Balmer series
    (c) Lyman series   (d) Brackett series.

5. Diode can work as   **1**
    (a) rectifier   (b) demodulator
    (c) modulator   (d) amplifier.

6. Write one possible cause of earth's magnetism.   **1**

7. A straight wire of mass 200g and length 1.5m carries a current of 2A.
    It is suspended in mid air by a uniform horizontal magnetic field $\vec{B}$.
    Find the magnitude of $\vec{B}$.   **1**

8.   Name any two factors on which the work function of a metal depends.   **1**

9.   What are isotopes?   **1**

10. Write the truth table of OR gate.   **1**

11. **a**. The electrostatic force on a small sphere of charge 0.4μC due to
         another small sphere of charge −0.8μC in air is 0.2N. What is the
         distance between the two spheres?
                          Or   **2**
     b. What is the force between two small charged spheres having charges
         of 2×10^{-7}C and 3×10^{-7}C placed 30 cm apart in air?

12. Derive the relation between drift velocity of free electron and electric
     current flowing through a conductor.   **2**

13. **a**. Define angle of magnetic inclination or dip at a place. Write the
         expression for earth's magnetic field.
                          Or   **2**
     b. Does every magnetic configuration necessarily have a north pole
         and a south pole? What about the field due to a toroid?

14. What are electromagnetic waves? Write any two properties of
     electromagnetic waves.   **2**

15. Explain the four spectral series of hydrogen atom.   **2**

16. **a.** Draw and label the block diagram of a generalized communication
         system.
                          Or   **2**
     b. What is meant by point-to-point and broadcast modes of
         communication? Give one example each.

17. Derive an expression for electric field 'E' on the axial line of an electric
     dipole.   **3**

18. **a**. State the Gauss's law in electrostatic and write its expression.
                          Or   **3**
     b. Explain the construction and working of a Vande Graff generator.

19. With the help of circuit diagram, explain the use of potentiometer for
     comparing the emf's of two cells.   **3**

20. Obtain the condition of a balanced Wheatstone bridge.   **3**

21. What is self induction? Deduce an expression for energy required to build up a circuit. **3**

22. **a**. A rectangular loop of size ($l \times$ b) carrying a steady current 'I' is placed in a uniform magnetic field $\vec{B}$. Prove that the torque ($\vec{\tau}$) acting on the loop is given by $\vec{\tau} = \vec{m} \times \vec{B}$, where $\vec{m}$ is the magnetic moment of loop.

    Or **3**

    b. Show that the alternating current lags behind the voltage by phase ($\frac{\pi}{2}$) in an A.C circuit containing inductor only. Draw a phasor diagram representing the relation between them.

23. State Brewster's law. Hence show that when a ray of light is incident at polarizing angle, the reflected ray is at right angle to the refracted ray. **3**

24. **a.** What focal length should the reading spectacles have for a person for whom the least distance of distinct vision is 50 cm? What is the nature of the lens?

    Or **3**

    b. An object of size 3.0 cm is placed 14 cm in front of a concave lens of focal length 21 cm. Find the position, nature and size of image.

25. **a.** What is photoelectric emission? State the laws of photoelectric effect.

    Or **3**

    b. What is a photocell? On what principle does a photocell work? Write any two applications of a photocell.

26. Derive an expression for the total energy of an electron according to Bohr's theory of hydrogen atom. **3**

27. A TV tower has height 'h'. Derive an expression for the maximum distance up to which the signal can be received from the antenna. What is the area and population covered by the signal? **3**

28. **a.** State Biot Savart's law. Use this law to obtain the expression for the magnetic field on the axis of a circular current loop.

    Or **5**

    b. With the help of a schematic diagram, explain the principle of a cyclotron. Hence, deduce the expression of cyclotron frequency.

29. **a.** Define angle of minimum deviation of a prism. Obtain an expression for the refractive index of the material of a prism and angle of minimum deviation.

Or   **5**

    b. What is a compound microscope? With the help of a ray diagram, derive the expression for total magnification of a compound microscope when image is formed at infinity.

30. **a**. What is a rectifier? Explain with a circuit diagram, the working principle and output-input wave formation of a full wave rectifier.

Or   **5**

    b. Explain with the help of a labelled circuit diagram, how a n-p-n transistor can be used as an amplifier. Also, explain how the input and output voltage signals are out of phase by $180°$.

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