2017

PHYSICS

(Theory)

Full Marks - 70

Pass Marks - 21

Time : Three Hours and *Fifteen Minutes

*(*15 minutes are given as extra time for reading questions)*

All questions are compulsory.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1 to 10 are 'Very Short Answer' type questions carrying 1 mark each.

1. State Coulomb's law in electrostatics.   1

2. If a wire is stretched to double of its length. What will be its new resistivity ?   1

3. Draw the magnetic field lines around a U-shaped magnet.   1

4. On what factors do the velocity of electromagnetic wave in vacuum depend ?   1

5. Under what condition, does a biconvex lens of glass having a certain refractive index act as a plane glass slab when immersed in a liquid ? 1

6. It is easier to remove an electron from sodium than from copper. Which has a higher value of threshold wavelength ? 1

7. What is the ratio of nuclear densities of two nuclei having ratio of mass number 1:4 ? 1

8. State the Radioactive Decay law. 1

9. What will happen if emitter as well as collector in a transistor are forward biased ? 1

10. Draw the I-V characteristics of LED.

Question Nos. *11 to 20* are *'Short Answer Type-II' questions carrying 2 marks each.*

11. An electric dipole consists of two charges +3 μC and –3 μC when held at 30° with respect to a uniform electric field of 10^4 NC^{-1} experiences a torque of 9×10^{-26} Nm. Calculate the length dipole. 2

12. The distance between the plates of a parallel plate capacitor is d. If a metal plate of thickness $\left(\dfrac{d}{2}\right)$ is inserted between the plates. What will be the effect on the capacitance ? 2

13.

$$6V, 2\Omega$$

X Y

$$4V, 8\Omega$$
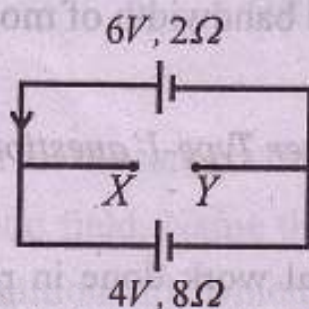
The figure shows a circuit with two cells in opposition to each other. One cell has an emf of $6V$ and internal resistance 2 *ohm* and the other has emf $4V$ and internal resistance of 8 *ohm*. Find the equivalent emf and internal resistance across terminals X and Y. 2

14. A solenoid contracts when a current passes through it. Give reason. 2

15. Give *four* causes of energy loss in a transformer. 2

16. Why should porcelain, glass or paper containers be used in a microwave oven ? Justify. 2

17. An object is placed at a distance $3m$ from an equiconvex lens and produces a real image at $2m$ from the lens. If the lens is cut into two equal symmetrical plano-convex lens and one of the plano-convex lens is removed, find the new position of image. 2

18. Obtain de Broglie equation for wavelength of matter waves. 2

19. Carbon, Silicon and Germanium all belong to the same group but carbon is not used as semiconductor. Explain why ? 2

20. Define amplitude modulation and bandwidth of modulated signal.   2

Question Nos. 21 to 27 are 'Short Answer Type-I' questions carrying 3 marks each.

21. Derive an expression for the total work done in rotating an electric dipole through an angle θ in a uniform electric field.   3

22. Using the Kirchhoff's laws, deduce the condition for balance in the Wheatstone bridge.   3

23. Prove Snell's law of refraction using Huygens' principle.   3

24. Give *three* points of difference between constructive and destructive interference.   3

25. State *three* limitations of Bohr's atomic model.   3

26. Give *three* distinguishing points between *n*-type and *p*-type semiconductors.   3

27. Explain the three main parts of a communication system.   3

Question Nos. 28 to 30 are 'Long Answer Type' questions carrying 5 marks each.

28. State Biot-Savart's law. Derive an expression for magnetic field at the centre of a circular coil of *n*-turns carrying current I.   2+3=5

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Derive an expression for the force acting on a current carrying conductor placed in a uniform magnetic field. Name the rule which gives the direction of the force. Write the conditions for which this force will have (1) maximum (2) minimum value. $3+1+1=5$

29. What is impedance of electric circuit ? Derive the relation for impedance of an a.c. LCR series circuit. $1+4=5$

OR

Derive an expression for the average power consumed in a.c. series LCR circuit. What is the power for (i) purely resistive circuit and (ii) purely capacitive circuit ? $4+1=5$

30. Draw a labelled ray diagram of a compound microscope showing the final image of an object formed at the least distance of distinct vision. Derive the expression of its magnifying power. $2+3=5$

OR

Draw a labelled ray diagram of an astronomical telescope showing the final image of a distant object formed at the least distance of distinct vision. Derive the expression of its magnifying power. $2+3=5$

31. Two wires A and B of the same material have lengths l and $2l$; and radii r and $r/2$ respectively, the ratio of their resistances is $\qquad$ 1

    (1) 1:2

    (2) 1:4

    (3) 1:8

    (4) 1:1

32. A wire loop that encloses an area of 15 cm^2 is perpendicular to a magnetic field of 0.1 T. If the field drops to 0.04 T in 0.2 s, the average emf induced in the loop is $\qquad$ 1

    (1) 0.3 mV

    (2) 4 mV

    (3) 0.45 mV

    (4) 4.5 mV

33. The de Broglie wavelength associated with an electron accelerated through potential difference of 100 V is $\qquad$ 1

    (1) 1.22 $\mathring{A}$

    (2) 12.2 $\mathring{A}$

    (3) $\sqrt{1.22}$ $\mathring{A}$

    (4) $\sqrt{12.2}$ $\mathring{A}$

34. The value of ionisation energy for a hydrogen atom is   1

    (1)   1.36 eV

    (2)   13.6 eV

    (3)   13.6 MeV

    (4)   13.6 J