

General Instructions

- (i) This question paper contains 30 questions. All questions are compulsory.
- (ii) It comprises 6 single-correct multiple-choice questions.
- (iii) Attempt every question; detailed solutions are provided in the companion solutions booklet.

1. A force of 80 newton acts between two point charges placed in air at a fixed distance. When the same charges are placed at the same distance in a dielectric medium, the force becomes 8 newton. The dielectric constant of the medium is:

- (A) 10
 - (B) zero
 - (C) 0.1
 - (D) 8
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2. In the resonance condition, the current drawn from the source by a parallel resonant (L-C) circuit is:

- (A) infinite
 - (B) zero
 - (C) fixed
 - (D) none of these
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3. In which region of the electromagnetic spectrum does the Lyman series of hydrogen lie?

- (A) Infrared
 - (B) Visible
 - (C) X-rays
 - (D) Ultraviolet
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4. When a convex lens is dipped in water, its focal length and nature become:

- (A) increased, convex lens
 - (B) decreased, convex lens
 - (C) increased, concave lens
 - (D) decreased, concave lens
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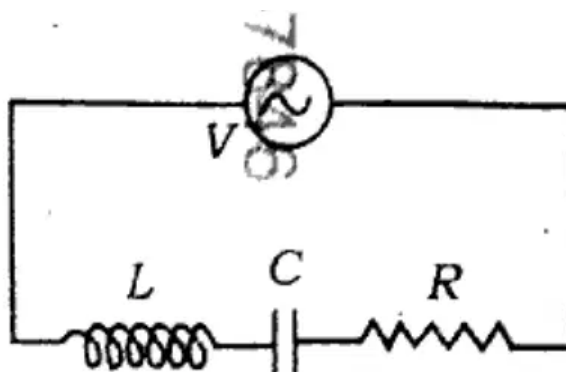
5. In a semiconductor, the energy gap between the valence band and the conduction band is nearly:

- (A) 5 eV
 - (B) 1 eV
 - (C) 15 eV
 - (D) zero
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6. The difference in the angular momenta of the electron between two successive orbits of a hydrogen atom is:

- (A) h/π
- (B) $h/2$
- (C) $h/2\pi$
- (D) $2h$

7.



An alternating current source is connected in the following figure (a series combination of an inductor L , a capacitor C and a resistor R across an AC source of rms voltage V). Determine the value of current flowing in the resistance R in the condition of resonance.

8. Calculate the de Broglie wavelength of a neutron of energy 12.8 MeV. (Given: mass of neutron $m_n = 1.67 \times 10^{-27}$ kg, $h = 6.6 \times 10^{-34}$ J s, 1 eV = 1.6×10^{-19} J.)

9. Write the definition of specific conductivity and its unit.

10. What is the difference between paramagnetic and diamagnetic materials?



11. What is the phenomenon of radioactivity?



12. What will be the focal length of a combination of a convex and a concave lens of the same focal length (placed in contact)?



13. Explain the meaning of power factor and wattless current in alternating current circuits.



14. The area of each plate of a parallel plate condenser is 100 cm^2 ; and the intensity of the electric field between the two plates is $100 \text{ newton/coulomb}$. How much charge is there on each plate? (Take $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$.)



15. Write the difference between isotopic, isobaric and isotonic nuclei. Give an example of each.



16. Explain the energy bands in solids.



17. What are electromagnetic waves? Explain two characteristics of these waves.



18. A convex lens of glass of focal length 15 cm is immersed in carbon disulphide. In this situation what will be the focal length and the nature of the lens? The refractive indices of glass and carbon disulphide (relative to air) are $\frac{3}{2}$ and $\frac{5}{3}$ respectively.

19. Explain the proton-neutron hypothesis in the structure of nucleus.

20. Explain the motion of a charged particle in a uniform magnetic field. Prove that the radius of the path of a charged particle moving perpendicular to a uniform magnetic field is proportional to the momentum of the particle.

21. Resistance of a wire is 16 ohm. By melting it, its length is stretched to half of its original length. What will be the resistance of the new wire?

22. Write Ohm's law. Deduce Ohm's law on the basis of drift velocity of electron.

23. An equiconcave lens of crown glass has to be formed. What should be the radii of the surfaces of the lens so that the power of the lens is -2.5 D ? The refractive index of crown glass is 1.65.

24. What do you mean by eddy current? How does it affect the energy losses? Write the uses of eddy current.

25. The wavelength of first line of Balmer series of hydrogen atom is $6563 \text{ \AA}$. Determine the wavelength of second line.

OR

What do you mean by polarization of light? How are unpolarized and plane polarized lights represented? Which nature of light waves is proved by polarization?

26. Deduce the formula of equivalent capacity of three condensers connected in parallel.

27. Obtain the formula for the magnetic field inside a current carrying solenoid with the help of Ampere's circuital law.

OR

Obtain the formula for moment of couple acting on a magnetic dipole in a magnetic field. Define magnetic dipole moment with the help of this.

28. How is the p-n junction diode used as a full wave rectifier? Explain its working process by making its simple circuit.

OR

What are de Broglie's matter-waves? The work function of potassium is 2.0 eV . When ultraviolet light of wavelength $3500 \text{ \AA}$ falls on the surface of potassium, calculate the maximum kinetic energy of the emitted photoelectrons in electron-volt.

29. By drawing ray-diagram, explain the formation of image by a compound microscope. Establish the formula for its magnifying power.

OR

What is meant by binding energy of nucleus? Draw the graph of binding energy per nucleon with respect to the mass number. Discuss fission and fusion reactions with the help of this curve.

30. Explain Biot-Savart law. Deduce the formula for magnetic field produced due to a straight current carrying conductor.

OR

An α -particle, accelerated with the potential difference of V volt strikes with a nucleus (atomic number = Z). If r be the nearest distance of closest approach to the nucleus then prove that $r = 14 \cdot 4 \frac{Z}{V} \text{ \AA}$.