1. An electric dipole placed at an angle \( \theta \) in a non-uniform electric field experiences
   a. force only    b. torque only    c. both force and torque    d. neither force nor torque
2. Torque on a dipole in a uniform electric field is maximum when angle between P and E is
   a. 0\(^\circ\)    b. 90\(^\circ\)    c. 45\(^\circ\)    d. 180\(^\circ\)
3. The unit of electric dipole moment is
   a. volt/metre (v/m)    b. Coulomb/metre (C/m)    c. volt.metre (Vm)    d. Coulomb.metre (Cm)
4. The electric field inside the plates of two oppositely charged plane sheets of charge density \( \sigma \) is
   a. \( \sigma / 2\varepsilon_0 \)    b. \( -\sigma / 2\varepsilon_0 \)    c. \( \sigma / \varepsilon_0 \)    d. zero
5. Electric potential energy (U) of two point charge is
   a. \( q_1q_2 / 4\pi\varepsilon_0 r^2 \)    b. \( q_1q_2 / 4\pi\varepsilon_0 r \)    c. PE \( \cos \theta \)    d. PE \( \sin \theta \)
6. Three capacitors of capacitances 2\( \mu \)F, 3\( \mu \)F and 4\( \mu \)F are connected in series the effective capacitance is
   a. 6\( \mu \)F    b. 11 / 6\( \mu \)F    c. 6 / 11\( \mu \)F    d. 1 / 6\( \mu \)F
7. The capacitance of a parallel plate capacitor increases from 5\( \mu \)F to 60\( \mu \)F when a dielectric is filled between the plates. The dielectric constant of dielectric is
   a. 65    b. 55    c. 12    d. 10
8. The number of electric lines of force originating from a charge of 1\( \mu \)C is
   a. 1.129 \times 10^5    b. 1.6 \times 10^{-19}    c. 6.25 \times 10^{18}    d. 8.85 \times 10^{12}
9. The equipotential surface are...... to the electric line of force.
   a. perpendicular    b. parallel    c. tangential    d. opposite
10. The work done in moving 500\( \mu \)C charge between two points on equipotential surface is
    a. zero    b. finite positive    c. finite negative    d. infinite
11. The work done in moving 50\( \mu \)C charge between two points on equipotential surface is
    a. zero    b. finite positive    c. finite negative    d. infinite
12. Electric field intensity is 400 V/m at a distance of 2m from a point charge. It will be 100 V/m at a distance of
    a. 50 cm    b. 4 cm    c. 4 m    d. 1.5 m
13. If a point lies at a distance \( x \) from the midpoint of the dipole, the electric potential at this point is proportional to
    a. \( 1 / x^2 \)    b. \( 1 / x^3 \)    c. \( 1 / x^4 \)    d. \( 1 / x^{3/2} \)
14. Which of the following quantities is a scalar?
    a. dipole moment    b. electric force    c. electric field    d. electric potential
15. The unit if relative permittivity is
    a. C^2N^{-1}m^{-2}    b. Nm^2C^{-2}    c. No unit    d. NC^2m^2
16. The unit of electric flux is
    a. Nm^2C^{-1}    b. Nm^2C^{-1}    c. Nm^2C    d. Nm^2C
I. ANSWER ANY EIGHT QUESTIONS : 

17. State Gauss’ law in electrostatics
18. Why is it safer to be inside a car than standing under a tree during lightning?
20. What is meant by electric polarisation?
21. What is a polar molecule? Give any two examples.
22. What is electrostatic induction? Mention its uses.
24. Explain the working of a microwave oven.
25. What do you mean by “Additive nature of charge”? Give an example.
26. Three capacitors each of capacitance 9µF are connected in series. What is the total capacitance of the combination?

III. ANSWER ANY THREE QUESTIONS :

27. Write the properties of electric lines of force.
28. Derive an expression for the torque experienced by an electric dipole when placed in a uniform electric field.
29. Explain how Gauss’s law is used to calculate the electric field due to an infinite charged plane sheet.
30. Three capacitors each of capacitance 9pF are connected in series.
   i. What is the total capacitance of the combination?  
   ii. What is the potential difference across each capacitor if the combination is connected to 120 V supply?

IV. ANSWER ANY TWO QUESTIONS :

31. What is an electric dipole? Derive an expression for the electric potential at a point due to an electric dipole. Discuss the special cases.
32. Derive an expression for electric field due to an electric field due to and electric dipole at a point along the equatorial line.
33. State the principle and explain the construction and working of van de Graaff generator.
1. According to Faraday’s law of electrolysis, when a current is passed, the mass of ions deposited at the cathode is independent of
   a. current  
   b. charge  
   c. time  
   d. resistance

2. The material through which electric charge can flow easily is
   a. quartz  
   b. mica  
   c. germanium  
   d. copper

3. The unit of conductivity is
   a. mho  
   b. ohm  
   c. ohm-m  
   d. mho-m^-1

4. If the resistance of a coil is 2 Ω at 0°C and = 0.004/°C, then its resistance at 100°C is
   a. 1.4 Ω  
   b. 0 Ω  
   c. 4 Ω  
   d. 2.8 Ω

5. Resistance of a metal wire of length 10 cm is 2 Ω. If the wire is stretched uniformly to 50 cm, the resistance is
   a. 25 Ω  
   b. 10 Ω  
   c. 5 Ω  
   d. 50 Ω

6. When n resistors of equal resistances (R) are connected in series, the effective resistance is
   a. n/R  
   b. R/n  
   c. 1/nR  
   d. nR

7. A copper wire has a resistance R. On doubling its length, left specific resistance
   a. will be doubled  
   b. will be halved  
   c. will become four the same  
   d. will remain the same

8. The colour code on a carbon resistor is red-red-black. The resistance of the resistor is
   a. 2.2 Ω  
   b. 22 Ω  
   c. 220 Ω  
   d. 2.2 kΩ

9. A cell of emf 2.2 V sends a current of 0.2 A through a resistance of 10 Ω. The internal resistance of the cell is
   a. 0.1 Ω  
   b. 1 Ω  
   c. 2Ω  
   d. 1.33 Ω

10. The electrical resistivity of a thin copper wire and a thick copper rod are respectively ρ₁ Ω-m and ρ₂ Ω-m. then
   a. ρ₁>ρ₂  
   b. ρ₂>ρ₁  
   c. ρ₁=ρ₂  
   d. ρ₂/ρ₁=∞

11. A charge of 60 C passes through an electric lamp in 2 minutes. Then the current in the lamp is
   a. 30A  
   b. 2 W  
   c. 0.5A  
   d. 5A

12. A toaster operating at 240 V has a resistance of 120. The power is
   a. 400 W  
   b. 2W  
   c. 480 W  
   d. 240 W

13. In the case of insulators, as the temperature decreases, the resistivity
   a. decreases  
   b. increases  
   c. remains constant  
   d. become zero

14. In the case of insulators, as the temperature increases, resistivity
   a. remains constant  
   b. increases  
   c. remains constant  
   d. becomes zero

15. The brown ring at one end of carbon resistor indicates a tolerance of
   a. 1 %  
   b. 2 %  
   c. 5 %  
   d. 10 %

16. The transition temperature of mercury is
   a. 4.2°C  
   b. 4.2 K  
   c. 2.4°C  
   d. 2.4K
II. ANSWER ANY EIGHT QUESTIONS : ( 8 X 3 = 24 )

17. What are the changes observed at transition temperature when the conductor becomes a super conductor?

18. Write any three applications of superconductors.

19. State Kirchoff’s current law and ( ii ) voltage law.

20. State Ohm’s law.

21. Distinguish between electro motive force and potential difference.

22. What are the applications of secondary cells?

23. Define electrical resistivity.

24. Why is copper wire is not suitable for a potentiometer?

25. The resistance of a platinum wire at 0°C is 4. What will be the resistance of the wire at 100°C if the temperature coefficient of resistance of platinum is 0.0038/°C?

26. An incandescent lamp is operated at 240 V and the current is 0.5A. What is the resistance of the lamp?

III. ANSWER ANY SEVEN QUESTIONS : ( 7 X 5 = .35 )

27. State and verify Faraday’s second law of electrolysis.

28. Obtain the condition for bridge balance in Wheatstone bridge.

29. List some application of super conductor.

30. Explain the action of a Daniel cell with diagram.

31. If two or more resistors are connected in parallel, derive an expression for the effective resistance.

32. Explain the action of lead - acid accumulator.

33. Define resistivity of a material. How are materials classified based on resistivity.

34. Explain the working of a Leclanche cell with diagram.

35. What is the drift velocity of an electron in a copper conductor having area 10 x 10⁻⁶m², carrying a current of 2A. Assume that there are 10 x 10²⁸ electrons / m³.

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I. CHOOSE THE CORRECT ANSWER : ( 16 X 1 = 16 )

1. Unit of Peltier coefficient is
   a. ohm  b. mho  c. volt  d. ampere

2. In a thermocouple, the temperature of the cold junction is 20°C the temperature of inversion is 520°C. the natural temperature is .................
   a. 500°C  b. 540°C  c. 270°C  d. 150°C

3. In which of the following pairs of metals of a thermocouple the e.m.f. is maximum ?
   a. Fe - Cu  b. Cu - Zn  c. Pt - Ag  d. Sb - Bi

4. For a given thermo couple, the netural temperature is
   a. maximum  b. minimum  c. Zero  d. a constant

5. Which of the following principles is used in an athermopite ?

6. In a circuit a voltmeter should be connected in
   a. series  b. parallel  c. series (or) parallel  d. none of the above

7. In a tangent galvanometer, for a constant current, the deflection is 30°. The plane of the coils is rotated through 90°. Now, for the same current, the deflection will be
   a. 30°  b. 60°  c. 90°  d. 0°

8. The unit of reduction factor of tangent galvanometer is
   a. no unit  b. tesla  c. ampere  d. ampere / degree

9. Magnetic induction due to an infinitely long straight conductor placed in a medium of permeability µ is
   a. \( \mu_0 I / 4\pi a \)  b. \( \mu_0 I / 2\pi a \)  c. \( \mu I / 4\pi a \)  d. \( \mu I / 2\pi a \)

10. The torque on a current carrying coil placed parallel to a magnetic field is
    a. zero  b. nBIA  c. nB I cos \( \theta \)  d. Infinite

11. Joule’s law of heating is
    a. \( H = I^2/Rt \)  a. \( H = V^2Rt \)  a. \( H = IR^2t \)  a. \( H = VIt \)

12. Of the following devices which has small resistance?
    a. Voltmeter  b. Ammeter of range 0 - 10A  c. Moving coil Galvanometer  d. Ammeter of range 0 - 1A

13. Nichrome is used as heating element because it has
    a. very low resistance  b. low melting point  c. high specific resistance  d. high conductivity

14. Two parallel wires carrying current in the opposite direction
    a. attract each other  b. repel each other  c. neither attract nor repel  d. either attract or repel

15. Fuse wire is an alloy of
    a. Lead and Tin  b. Tin and Copper  c. Lead and Iron

16. The period of revolution of a charged particle inside a cyclotron does not depend on
    a. the magnetic induction  b. the charge of the particle  c. the velocity of the particle  d. the mass of the particle
I. ANSWER ANY EIGHT QUESTIONS : ( 8 X 3 = 24 )
17. Define ampere in terms of force between two long parallel current carrying conductors.
18. Define Peltier coefficient and give its unit.
19. Mention the limitations of cyclotron
20. Why is nochrome used as a heating element?
21. How can we increase the current sensitivity of a galvanometer?
22. How is a galvanometer converted into (a) an ammeter (b) a voltmeter?
23. What is netural temperature of a thermocouple?
24. State Fleming’s left hand rule.

II. ANSWER ANY THREE QUESTIONS : ( 3 X 5 = 15 )
27. A moving coil galvanometer of resistance 20Ω products full scale deflection for a current of 50 mA. How you will convert the galvanometer into (i) an ammeter (ii) a voltmeter?
28. What are the special features of magnetic Lorentz force?
29. Explain the conversion of galvanometer into an ammeter.
30. A water heater is marked 1500 W, 220 V. If the voltage drops 180V. Calculate the power consumed by the heater.

IV. ANSWER ANY TWO QUESTIONS : ( 2 X 10 = 20 )
31. Deduce the relation for the magnetic induction at a point along the axis of a circular coil carrying current.
32. Explain in detail the principle, construction, working and limitations of a cyclotron with a diagram.
33. Deduce and expression for the force on a current carrying conductor placed in a magnetic field. Find the magnitude of the force.
I. CHOOSE THE CORRECT ANSWER : ( 16 X 1 = 16 )

1. Electromagnetic induction is not used in
   a. transformer    b. room heater    c. A.C. generator    d. choked coil

2. In an a.c. circuit, the current \( I = 10 \sin ( \omega t - \pi/2 ) \) lags behind the e.m.f. \( e = E_0 \sin ( \omega t + \pi/2 ) \) by
   a. 0    b. \( \pi/4 \)    c. \( \pi/2 \)    d. \( \pi \)

3. The effective value of alternating current is
   a. \( I_0/2 \)    b. \( I_0/2 \)    c. \( I_0 \)    d. \( 2I_0 \)

4. In an AC circuit with capacitor only, if the frequency of the signal is zero, then the capacitive reactance is
   a. infinity    b. zero    c. finite maximum    d. finite minimum

5. If the frequency of the a.c. is increased the reactance of the circuit consisting inductor alone
   a. increases    b. decrease    c. becomes zero    d. remains constant

6. For a.c. circuit, the value of capacitive reactance \( (X_c) \) is
   a. zero    b. infinity    c. \( \pi/2 \)    d. \( \pi \)

7. A DC of 5A produces the same heating effect as an AC of
   a. 50A rms current    b. 5A peak current    c. 5A rms current    d. \( 5\sqrt{2} \) A peak current

8. Which of the following devices does not allow d.c. to pass through ?
   a. resistor    b. capacitor    c. inductor    d. all the above

9. Transformer work on
   a. AC only    b. DC only    c. both AC and DC    d. AC more effectively than DC

10. In a LCR circuit, at the resonating frequency
    a. \( X_L > X_C \)    b. \( X_L < X_C \)    c. \( X_L = X_C \)    d. \( X_L = 0 \)

11. Len’s law is in accordance with the law of?
    a. conservation of energy    b. conservation of charge
    c. conservation of momentum    d. conservation of angular momentum

12. The generator rule is
    a. Fleming’s left hand rule    b. Fleming’s right hand rule
    b. Maxwell’s right hand corkscrew rule    d. Right hand palm rule

13. The average power consumed over one cycle in an a.c. circuit is
    a. \( E_{rms} I_{rms} \)    b. \( E_{rms} I_{rms} \cos \phi \)    c. \( E_{rms} I_{rms} \sin \phi \)    d. \( E_0 I_0 \cos \phi \)

14. Principle of a transformer is
    a. self inducance    b. mutual inducance    c. Farada’s law    d. lenz law

15. In a transformer, eddy current loss is minimized by using
    a. laminated core made of Mumetal    b. laminated core made of stelloy
    c. shell type core    d. thick copper wires

16. The self-inductance of a straight conductor’s
    a. zero    b. infinity    c. very large    d. very small
I. ANSWER ANY EIGHT QUESTIONS: (8 X 3 = 24)
18. State Lenz’s law in electromagnetic induction?
19. Define the unit (coefficient) of self induction.
20. State Fleming’s right hand rule.
21. Mention the methods of producing induced emf.
22. Define quality factor.
23. Why can a.d.c. ammeter not read a.c.?
24. A capacitor blocks d.c. but allows a.c. explain.
25. What are the difference between a stepup and step down transformer?
26. Calculate the mutual inductance between two coils when a current of 4A changing to 8 A in 0.5 s in one coil, induces an emf of 50.mV in the other coil.

III. ANSWER ANY THREE QUESTIONS: (3 X 5 = 15)
27. Explain how an e.m.f. can be induced by changing the area enclosed by the coil.
28. Give the applications of eddy currents.
29. Obtain the phase relation between current and voltage in an a.c. circuit with an inductor only (graph not necessary).
30. Air core solenoid having a diameter of 4cm and length 60cm is wound with 4000 turn. If a current of 5 A flows in the solenoid, calculate the energy stored in the solenoid.

IV. ANSWER ANY TWO QUESTIONS: (2 X 10 = 20)
31. Describe the principle, construction and working of a single phase a.c. generator.
32. Discuss with theory the method of inducting e.m.f. in a coil by changing its orientation with respect to the direction of the magnetic.
33. Explain the principle, construction and theory of a transformer (Diagram not necessary). Define its efficiency. Mention the energy losses.

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# Electromagnetic Waves and Waves Optics

## I. Choose the Correct Answer:

(16 x 1 = 16)

1. If the wavelength of the light is reduced to one-fourth, then the amount of scattering is
   - a. increased by 16 times
   - b. decreased by 16 times
   - c. increased by 256 times
   - d. decreased by 256 times

2. In Young’s experiment, the third bright band for wavelength of light 6000 Å coincides with the fourth bright band for another source in the same arrangement. The wavelength of the another source is
   - a. 4500 Å
   - b. 6000 Å
   - c. 5000 Å
   - d. 4000 Å

3. Electromagnetic waves are
   - a. transverse
   - b. longitudinal
   - c. may be longitudinal or transverse
   - d. neither longitudinal nor transverse

4. In an electromagnetic wave, the phase difference between electric field \( E \) and magnetic field \( B \) is
   - a. \( \pi/4 \)
   - b. \( \pi/2 \)
   - c. \( \pi \)
   - d. zero

5. A light of wavelength 6000 Å is incident normally on a grating 0.005 m wide with 2500 lines. Then the maximum order is
   - a. 3
   - b. 2
   - c. 1
   - d. 4

6. Atomic spectrum should be
   - a. pure line spectrum
   - b. emission band spectrum
   - c. absorption line spectrum
   - d. absorption band spectrum

7. In Raman’s effect, the spectral line with lower frequency than the incident frequency is
   - a. Stokes’ line
   - b. anti-Stokes’ line
   - c. Stokes’ and anti-Stokes’ lines
   - d. Rayleigh line

8. Refractive index of glass is 1.5. Time taken for light to pass through a glass plate of thickness 10 cm is
   - a. \( 2 \times 10^{-8} \) s
   - b. \( 2 \times 10^{-10} \) s
   - c. \( 5 \times 10^{-8} \) s
   - d. \( 5 \times 10^{-10} \) s

9. According to Brewster’s law
   - a. \( \mu = \tan i_p \)
   - b. \( i = \tan \mu \)
   - c. \( \mu = \tan i_p + \mu \)
   - d. \( \mu = \cot i_p \)

10. The refractive index of the medium, for the polarising angle 60° is
    - a. 1.732
    - b. 1.414
    - c. 1.5
    - d. 1.468

11. The transverse nature of light waves is demonstrated only by the phenomenon of
    - a. interference
    - b. diffraction
    - c. polarisation
    - d. reflecion

12. When a drop of water is introduced between the glass plate and planoconvex lens in Newton’s rings system, the rings system
    - a. contracts
    - b. expands
    - c. remains same
    - d. first expands, then contracts

13. In Newton’s ring experiment, the radii of the \( m^{th} \) and \( (m+4)^{th} \) dark rings are respectively \( \sqrt{m} \) mm and \( \sqrt{m+4} \) mm. What is the value of \( m \)?
    - a. 2
    - b. 4
    - c. 8
    - d. 10

14. The path difference between two monochromatic light waves of wavelength 4000 Å is \( 2 \times 10^{-7} \) m. The phase difference between them is
    - a. \( \pi \)
    - b. \( 2\pi \)
    - c. \( 3\pi/2 \)
    - d. \( \pi/2 \)

15. A nicol prism is based on the principle of ...
    - a. Refraction
    - b. Reflection
    - c. Double refraction
    - d. Diffraction

16. Which of the following is used to study crystal structure?
    - a. Microwave
    - b. Infrared rays
    - c. Ultraviolet rays
    - d. X-rays
I. ANSWER ANY EIGHT QUESTIONS :  

17. Why does the sky appear in colour ?
18. Define specific rotation.
19. What is Tyndall scattering ?
20. What are emission and absorption spectra ?
21. Define optic axis of a crystal.
22. State Huygen’s principle on wavefront.
23. Give the conditions for sustained interference.
24. What is fluorescence and phosphorescence ?
25. State Brewster’s law.
26. A light of wavelength 6000A falls normally on a thin air film. 6 dark fringes are seen between two points. Calculate the thickness of the air film.

II. ANSWER ANY THREE QUESTIONS : 

27. State and prove Brewster law.
28. Write a note on Nicol prism.
29. In Young’s experiment a light of frequency 6 x 1014Hz is used. Distance between the centres of adjacent fringes is 0.75 mm. Calculate the distance between the slits, if the screen is 1 m away.
30. Describe Newton’s rings experiment and derive the expression for radius of nth dark ring (or)
Explain the theory of Newton’s rings and deduce an expression for nth dark ring.

III. ANSWER ANY TWO QUESTIONS : 

31. Explain Raman scattering of light with the help of energy level diagram. What is Raman Effect?
32. What is known as interference? Derive an expression for bandwidth of interference fringes in Young’s double slit experiment.
33. Explain emission and absorption spectra.

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1. The cathode rays are
   a. stream of electrons  b. a stream of positive ions  
   c. a stream of uncharged particles  d. the same as canal rays 

2. According to Bohr’s postulates, which of the following quantities take discrete values ?
   a. Kinetic energy  b. Potential energy  c. Angular momentum  d. Momentum 

3. The minimum wavelength of X-rays produced in an X-ray tube at 1000kV is
   a. 0.012Å  b. 0.12Å  c. 1.24Å  d. 0.0012Å 

4. A coldidge tube operates at 24800V. The maximum frequency of X radiation emitted from coldidge tube is
   a. $6 \times 10^{18}$  b. $3 \times 10^{18}$  c. $6 \times 10^{8}$  d. $3 \times 10^{8}$ 

5. In hydrogen atom the ratio if the radii of the first three Bohr orbits is
   a. 1 : 1/2 : 1/3  b. 1 : 2 : 3  c. 1 : 4 : 9  d. 1 : 8 : 27 

6. According to Rutherford atom model, the spectral lines emitted by an atom is,
   a. line spectrum  b. continuous spectrum  c. continuous absorption spectrum  d. band spectrum 

7. X-ray is
   a. Phenomenon of conversion of kinetic energy into radiation  
   b. conversion of momentum  
   c. conversion of mass into energy  
   d. conversion of light energy into heat energy 

8. If R is Rydberg constant, the shortest wavelength of Paschen series is
   a. $R / 9$  b. $9 / R$  c. $16 / R$  d. $25 / R$ 

9. The direction of viscous force in Millikan’s oil drop experiment is
   a. always downwards  b. always upwards  c. opposite to the direction of motion of the oil drop  d. either upwards or downwards 

10. In Sommerfeld atom model, for a given value of n, the number of values l can take is
    a. n  b. n + 1  c. n - 1  d. 2n + 1 

11. The elliptical orbits of election in the atom were proposed by

12. Maser materials are
    a. diamagnetic ions  b. paramagnetic ions  c. ferromagnetic ions  d. non-magnetic ions 

13. In holography, whihc of the following is (are) recorded on the photographic film ?
    a. Frequency and amplitude  b. Phase and frequency  c. Phase and amplitude  d. Frequency only 

14. In hydrogen atom, which of the following transitions produces spectral line of maximum wavelength ?
    a. 2 --> 1  b. 4 --> 1  c. 6 --> 5  d. 5 --> 2 

15. In hydrogen atom, which of the following transitions produces spectral line of minimum wavelength ?
    a. 2 --> 1  b. 6 --> 2  c. 4 --> 3  d. 5 --> 2 

16. When an electric field is applied to an atom each of the spectral lines split into several lines. This effect is known as
17. State Moseley’s law. Write its equation?
18. What are the two important facts established by Laue experiment?
19. State the postulates of Bohr atom model.
20. Define ionisation potential.
21. What is hologram?
22. What are hard X-rays and soft X-rays?
23. Write the principle of Millikan’s oil drop experiment.
24. What are the characteristics of Laser?
25. Write any three medical application of laser.
26. Calculate the longest wavelength that can be analysed by a rock salt crystal of spacing \(d = 2.82 \, \text{Å}\) in the first order.

III. ANSWER ANY THREE QUESTIONS:

27. Write any five properties of cathode rays.
28. Explain the spectral series of hydrogen atom without diagram.
29. Prove that the energy of an electron for hydrogen atom in the nth orbit is
   \[ E_n = -\frac{m_e e^4}{8e^2 n^2 h^2} \]
30. State and obtain Bragg’s law.

IV. ANSWER ANY TWO QUESTIONS:

31. Draw a neat sketch of Ruby Laser. Explain it working with the help of energy level diagram.
32. How will you determine the wavelength of X-rays using Bragg spectrometer? Write any five properties of X-rays. (or)
   Derive Bragg’s law. Explain how Bragg’s spectrometer can be used to determine the wavelength of the X-rays.
33. State the principle and explain J.J. Thomson’s experiment in determining \(e/m\) of an electron.

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I. CHOOSE THE CORRECT ANSWER : ( 16 X 1 = 16 )

1. The photoelectric effect can be explained on the basis of ?
   a. corpuscular theory of light b. wave theory of light
c. electromagnetic theory of light d. quantum theory of light

2. The work function of a photo-electric material is 3.3eV. The threshold frequency will be equal to
   a. $8 \times 10^{14}$Hz b. $8 \times 10^{10}$Hz
c. $5 \times 10^{20}$Hz d. $4 \times 10^{14}$Hz

3. Einstein’s photoelectric equation is
   a. $W + hv = \frac{1}{2}mv_{max}^2$
   b. $\frac{1}{2}mv_{max}^2 = W$
c. $hv + \frac{1}{2}mv_{max}^2 = W$
d. $W + \frac{1}{2}mv_{max}^2 = W$

4. A photon of frequency $\gamma$ is incident on a metal surface of threshold frequency $\gamma_0$. The kinetic energy of the emitted photoelectron is
   a. $h (\gamma - \gamma_0)$ b. $h \gamma$
c. $h \gamma_0$ d. $h (\gamma + \gamma_0)$

5. The momentum of the electron having wavelength 2A is
   a. $3.3 \times 10^{24}$kgms$^{-1}$ b. $6.6 \times 10^{24}$kgms$^{-1}$
c. $3.3 \times 10^{-24}$kgms$^{-1}$ d. $6.6 \times 10^{-24}$kgms$^{-1}$

6. The value of stopping potential when the frequency of light is equal to the threshold frequency is
   a. maximum b. zero c. minimum d. infinity

7. When the momentum of a particle increases, its de Broglie wavelength
   a. increases b. decreases c. does not change d. infinity

8. The linear momentum of de Broglie wave is
   a. $n / c$ b. $h / \lambda$
c. $\lambda / h$ d. $c / n$

9. If the kinetic energy of the moving particle is E, then the de Broglie wavelength is,
   a. $\lambda = h / \sqrt{2mE}$ b. $\lambda = \sqrt{2mE} / h$
c. $\lambda = h \sqrt{2mE}$ d. $\lambda = h / E \sqrt{2m}$

10. An electron of mass $m$ and charge $e$ accelerated from rest through a potential of $v$, volt then its final velocity is
    a. $Ve / m$ b. $Ve / 2m$
c. $2Ve / m$ d. $2Ve / m$

11. The number of de Broglie waves of an electron in the $n^{th}$ orbit of an atom is
    a. $n$ b. $n - 1$
c. $n + 1$ d. $2n$

12. The stopping potential of metal surface is independent of
    a. frequency of incident radiation b. intensity of incident radiation
c. the nature of the metal surface d. velocity of the electrons emitted

13. According to the theory of relativity the length of a rod in motion
    a. is less than its rest length b. is same as its rest length
c. is more than its rest length d. may be more or less than or equal to rest length depending upon the speed of the rod

14. Electron microscope works on the principle of
    a. photoelectric effect b. particle nature of electron
c. wave nature of moving electron d. dual nature of matter

15. According to special theory of relativity the only constant in all frames is
    a. mass b. length c. time d. velocity of light

16. If 1 kg of a substance is fully converted into energy, then the energy produced is
    a. $9 \times 10^16$J b. $9 \times 10^{24}$J
c. $1J$ d. $3 \times 10^8$J
II. ANSWER ANY EIGHT QUESTIONS :  
17. What are the limitations of electron microscope ?  
18. What is the principle of electron microscope ?  
19. What is photoelectric effect.  
20. Write any three uses of photoelectric cells.  
21. Define stopping potential in photoelectric effect.  
22. What are inertial and non-inertial frames of reference ?  
23. State the postulates of special theory of relativity ?  
24. Define threshold frequency .  
25. According to classical mechanics, what is the concept of time ?  
26. What is the de Broglie wavelength of an electron of kinetic energy 120 eV ?

III. ANSWER ANY THREE QUESTIONS :  
27. Write any five applications of photoelectric cells.  
28. Derive an expression for de Broglie wave length of matter waves.  
29. Obtain Einstein’s photoelectric equation.  
30. Explain FitzGerald - Lorentz contraction with an example.  
31. Explain the wave mechanical concept of atom.  
32. Obtain Einstein’s mass-energy equivalence, E = mc².  
33. List the uses and limitations of an electron microscope.  
34. A proton is moving at a speed of 0.9 times the velocity of light. Find its kinetic energy in Joule and MeV.  
35. The work function of iron 4.7 eV. Calculate the cut-off frequency and the corresponding cut-off wavelength for this metal.
1. The ionization power is maximum for
   a. neutrons   b. $\alpha$- particles   c. $\gamma$- particles   d. $\beta$- particles
2. Which one of the following is not an electromagnetic wave?
   a. X-rays   b. $\gamma$- rays   c. U- rays   d. $\beta$- rays
3. The nuclei $^{13}$Al$^{27}$ and $^{14}$Si$^{28}$ are examples of
   a. isotopes   b. isobars   c. isotones   d. isomers
4. The nuclear radius of 4 Be$^8$ nucleus is
   a. $1.3 \times 10^{-15}$ m   b. $2.6 \times 10^{-15}$ m   c. $1.3 \times 10^{-13}$ m   d. $2.6 \times 10^{-13}$ m
5. The binding energy of 26 Fe$^{56}$ nucleus is
   a. 8.8 MeV   b. 88 MeV   c. 493 MeV   d. 41.3 MeV
6. The average energy released per fission is
   a. 200 eV   b. 200 MeV   c. 200 meV   d. 200 GeV
7. Anemia can be diagnosed by
   a. $^{13}$P$^{32}$   b. $^{15}$P$^{32}$   c. $^{26}$Fe$^{59}$   d. $^{15}$Na$^{24}$
8. Which of the following is used to detect the presence of blocks in blood vessels?
   a. $^{15}$P$^{31}$   b. $^{15}$P$^{32}$   c. $^{26}$Fe$^{59}$   d. $^{11}$Na$^{24}$
9. One amu is equal to
   a. 931 eV   b. mass of carbon atom   c. $1.66 \times 10^{-27}$ kg   d. mass of oxygen atom
10. The half-life period of a certain radioactive element with disintegration constant 0.0693 per day is
    a. 10 days   b. 14 days   c. 140 days   d. 1.4 days
11. The time taken by the radioactive element to reduce to 1/e times is
    a. half-life   b. mean life   c. half-life / 2   d. twice the mean life
12. The explosion of atom bomb is based on the principle of
    a. uncontrolled fission reaction   b. controlled fission reaction
    c. fusion reaction   d. thermonuclear reaction
13. Nuclear fission can be explained by
    a. shell model   b. liquid drop model   c. quark model   d. Bohr atom model
14. The ratio of nuclear density to the density of mercury is about
    a. $1.3 \times 10^{10}$   b. 1.3   c. $1.3 \times 10^{13}$   d. $1.3 \times 10^{4}$
15. The nuclear force is due to the continuous exchange of particles called
    a. leptons   b. meson   c. hyperons   d. photons
16. Which of the following particles is a lepton?
    a. Electron   b. Proton   c. Neutron   d. $\pi$-Meson
I. ANSWER ANY EIGHT QUESTIONS : (8 X 3 = 24)

17. What is pair production and annihilation of matter?
18. Define Curie.
19. Define roentgen.
20. What is meant by breeder reactor?
21. What are cosmic rays?
22. Write a note on Leptons.
23. What is the use of a control rod in the reactor? Mention any two control rods.
24. What is mass defect?
25. State the radioactive law of disintegration.
26. The half-life of radon is 3.8 days. Calculate its mean life.

III. ANSWER ANY THREE QUESTIONS : (3 X 5 = 15)

27. Explain how a cosmic ray shower is formed.
28. Give an account about atom bomb.
29. Give an explanation for the binding energy curve. (Graph not necessary)
30. Explain Soddy-Fajan's radioactive displacement laws.

IV. ANSWER ANY TWO QUESTIONS : (2 X 10 = 20)

31. Describe the principle and action of a Bainbridge mass spectrometer in determining the isotopic masses.
32. Explain the principle, construction and working of a GM (Geiger Muller) counter.
33. What are cosmic rays? Explain (i) the latitude effect (ii) the altitude effect of cosmic rays.

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I. CHOOSE THE CORRECT ANSWER: (16 X 1 = 16)

1. In an N-type semiconductor, there are
   a. immobile negative ions  b. revolving carriers
   b. immobile positive ions  d. active electrons

2. The reverse saturation current in a PN junction diode is only due to
   a. majority carriers  b. minority carriers  c. acceptor ions  d. donor ions

3. An oscillator is
   a. an amplifier with feedback  b. a converter of a.c. to d.c. energy
   c. nothing but an amplifier  d. an amplifier without feedback

4. Condition for oscillator is
   a. $A\beta = 0$  b. $A = \frac{1}{\beta}$  c. $A\beta = $  d. $A - \beta = 0$

5. In a Colpitts oscillator circuit
   a. capacitive feedback is used  b. tapped coil is used
   c. no tuned LC circuit is used  d. no capacitor is used

6. Improper biasing of a transistor circuit produces
   a. heavy loading of emitter current  b. distortion in the output signal
   c. excessive heat at collector terminal  d. faulty location of load time

7. The forbidden energy gap for silicon is of the order of?
   a. 0.7 eV  b. 0.4 eV  c. 1.1 eV  d. 10 eV

8. The forbidden energy gap for conductor is
   a. 0.7 eV  b. 1.1 eV  c. zero  d. 3 eV

9. According to the laws of Boolean algebra, the expression $(A + AB)$ is equal to
   a. $A$  b. $AB$  c. $B$  d. $A\overline{B}$

10. The Boolean expression $ABC$ can be simplified as
    a. $AB + C$  b. $A\overline{B}.\overline{C}$  c. $\overline{A}B + \overline{B}C + \overline{C}A$  d. $\overline{A} + \overline{B} + \overline{C}$

11. Since the input impedance of an ideal operational amplifier is infinite,
    a. its input current is zero  b. its output resistance is high
    c. its output voltage becomes independent of load resistance  d. it becomes a current controlled device

12. Of the following, the donor atoms are
    a. silicon and germanium  b. aluminium and gallium
    c. bismuth and arsenic  d. boron and indium

13. Avalanche breakdown is primarily dependent on the phenomenon of
    a. recombination  b. doping  c. ionisation  d. collision

14. In the forward bias characteristic curve, a diode appears as
    a. high resistance  b. a capacitor  c. an OFF switch  d. an ON switch

15. Of the following devices, which has small resistance?
    a. Voltmeter  b. Moving coil galvanometer
    c. Ammeter of range 0-1A  d. Ammeter of range 0-10A

16. Which of the following devices has a source of emf inside it?
    a. Voltmeter  b. Ammeter  c. Ohm meter  d. Rectifier
I. ANSWER ANY EIGHT QUESTIONS :  
17. What is Zener breakdown ?  
18. What is rectification ?  
19. State de Morgan’s theorems.  
20. What is an intrinsic semiconductor ? Give two examples.  
22. What is an integrated circuit ?  
23. What are universal gates ? Why are they called so ?  
24. Give the Barkhausen criteria for oscillations.  
25. Give the important parameters of an operational amplifier.  
26. What are the advantages of negative feedback ?  

III. ANSWER ANY THREE QUESTIONS :  
27. State and prove de Morgan’s theorems.  
28. Explain the working of a bridge rectifier with a neat circuit diagram.  
29. Explain the working of a half wave rectifier using diodes.  
30. With the circuit diagram, explain voltage divider biasing of an operational amplifier.  

IV. ANSWER ANY TWO QUESTIONS :  
31. Sketch the circuit of a colpitts oscillator and explain its working.  
32. What is rectification ? Explain the working of a bridge rectifier with diagram. Draw input and output signals.  
33. With circuit diagram, explain the working of an operational amplifier as a summing amplifier.

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I. CHOOSE THE CORRECT ANSWER : ( 16 X 1 = 16 )

1. The audio frequency range is
   a. 20Hz to 200000 Hz  
   b. 20 Hz to 2000 Hz  
   c. 20 Hz to 200000 Hz  
   d. 20 Hz to 20000Hz

2. The intermediate frequency of FM receivers is
   a. 455 KHz  
   b. 10.7MHz  
   c. 10.7KHz  
   d. 10.7GHz

3. High frequency waves follow
   a. the ground wave propagation  
   b. the line of sight direction  
   c. ionospheric propagation  
   d. the curvature of the earth

4. The radio waves after refraction from different part of ionosphere on reaching the earth are called as
   a. ground waves  
   b. sky waves  
   c. space waves  
   d. microwaves

5. The RF channel in a radio transmitter produces
   a. audio signals  
   b. high frequency carrier waves  
   c. both audio signal and high frequency carrier waves  
   d. low frequency carrier waves

6. In holography, which of the following are recorded on a photographic film ?
   a. Amplitude and frequency  
   b. Phase and frequency  
   c. Phase and amplitude  
   d. Amplitude, phase and frequency

7. In a FM transmitter which isolates the crystal oscillator from the phase modulator ?
   a. AF amplifier  
   b. Buffer amplifier  
   c. Power amplifier  
   d. Microphone

8. In television, blanking pulse is applied to
   a. horizontal plates  
   b. vertical plates  
   c. control grid  
   d. filament

9. Printed documents to be transmitted by fax are converted into electrical signals by the process of
   a. reflection  
   b. scanning  
   c. modulation  
   d. light variation

10. Digital signals are converted into analog signals using
    a. FAX  
    b. modern  
    c. cable  
    d. coaxial cable

11. In amplitude modulation, the bandwidth is
    a. equal to the signal frequency  
    b. twice the signal frequency  
    c. thrice the signal frequency  
    d. four times the signal frequency

12. The principle used in Fibre optical communication is
    a. refraction  
    b. total internal reflection  
    c. diffraction  
    d. polarisation

13. Vidicon camera tube works on the principle of
    a. photo conductivity  
    b. thermoelectric effect  
    c. thermionic emission  
    d. seeback effect

14. The purpose of dividing each frame into two fields so as to transmit 50 views of the picture per second is
    a. the fact that handling of higher frequencies is easier  
    b. that 50 Hz is the power line frequency in India  
    c. to avoid unwanted noises in the signals  
    d. to avoid flicker in the picture

15. In phase modulation
    a. only the phase of the carrier wave varies  
    b. only the frequency of the carrier wave varies  
    c. both the phase and the frequency of the carrier waves varies  
    d. there is no change in the frequency and phase of the carrier wave.

16. The first man-made satellite is
    a. Aryabhata  
    b. Spuntnik  
    c. Venera  
    d. Rohini
I. ANSWER ANY EIGHT QUESTIONS : ( 8 X3 = 24 )
17. Define modulation factor in Amplitude Modulation.
18. What is meant by skip distance ?
19. What is Fax ? Mention its use.
20. Mention the advantages of frequency Modulation.
21. What are the advantages of digital communication ?
22. Write any three applications of RADAR.
23. What are the demerits of satellite communication ?
24. What is interlaced scanning ?
25. What is the necessity of Modulation ?
26. Define directivity.

III. ANSWER ANY THREE QUESTIONS : ( 3 X 5 = 15 )
27. Mention the principle of RADAR and write its applications.
28. Write a short note on fibre optical communication and mention its advantages.
29. Explain with the help of block diagram, the function of FM radio transmitter.
30. Explain the function of an AM radio transmitter with use help of a block diagram.

IV. ANSWER ANY TWO QUESTIONS : ( 2 X 10 = 20 )
31. Make an analysis of amplitude modulated wave. Plot the frequency.
32. With the help of bloc diagram, explain the function of a monochrome TV receiver.
33. Explain the construction and working of a vidicon camera tube with neat diagram.