

## 1. Electrostatics

1. In a parallel plate capacitor the capacitance increases from  $16\mu\text{F}$  to  $80\mu\text{F}$  on introducing a dielectric medium between the plates. What is the dielectric constant of the medium ?

$$K = C_m/C_a = 80/16 = 5$$

2. The force between two point charges kept at a distance of  $r$  apart is  $F$ . If the same charges are kept in water at the same distance, how does the force between them change?

$$F_a/F_w = K, F_w/F_a = 1/K = 1/81$$

3. Under what conditions The electric field intensity due to two point charges be zero at a point in the line joining the two charges but the point should not be between the charges ?

The two charges should be of opposite charges and they should have different magnitudes.

4. How much work is done in moving a  $500\mu\text{C}$  of charge between two points on an equipotential surface at a potential of  $4\text{V}$ ?

Zero. Work done in moving a charge along an equipotential surface is zero.

5. Define dielectric field strength.

It is the maximum electric field strength a medium can withstand before break down.

6. Define equipotential surface. Can two equipotential surfaces intersect?

If all the points on a surface are at the same potential such a surface is equipotential surface. Two equipotential surfaces cannot intersect if they intersect, two electric field lines must intersect which is not possible.

7. If the plates of a parallel plate capacitor are connected to each other by a copper wire, what will happen?

The charge will flow from positive to negative plate and the capacitor will be discharged completely. So the energy stored is dissipated as heat energy.

8. The plates of a charged parallel plate capacitor are connected to a volt meter, what will be the effect of increasing the separation between the plates on the voltmeter reading?

Voltmeter reading increases.

9. A very thin metal plate of thickness  $t \ll d$  is kept in the middle of a parallel plate capacitor. What will be the effect on the capacitance of the system?

No change in the capacitance.

10. A  $12\text{pF}$  capacitor is connected to a  $50\text{V}$  supply. Calculate the electrostatic energy stored in the capacitor.

$$U = \frac{1}{2} CV^2 = 1.5 \times 10^{-8} \text{J}$$

## 2. Current Electricity

1. What will be the effect of the following on drift velocity of electrons in a metallic conductor i) heating the conductor ii) doubling the length of the conductor?

i) Decreases ii)  $v_d$  will reduce to half the original value.

2. On increasing the current drawn from the cell, how does the terminal pd across the cell change?

Decreases.

3. What is the effect of increasing electric field on the following i) drift velocity ii) mobility of electrons in a conductor?

i) increases ii) no change.

4. Which among the following is/ are vector(s)? electric current, electric field, current density, potential difference?

electric field, current density

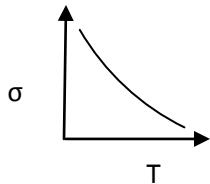
5. Write the expression to show the dependence of resistivity  $\rho$  on temperature.

$$\rho_t = \rho_0 (1 + \alpha (t - t_0))$$

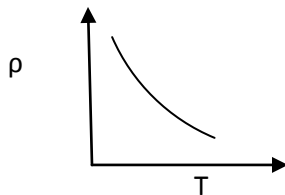
6. How does the conductivity of a i) good conductor ii) semiconductor change when the temperature increases?

i) decreases ii) increases.

7. Draw a graph to show the variation of conductivity  $\sigma$  of a conductor with temperature  $T$ .



8. Draw a graph to show the variation of resistivity  $\rho$  of i) a semiconductor ii) carbon with temperature  $T$ .



9. Why material of high resistivity is preferred for bridge wire in metre bridge & potentiometer?

To make it compact. Otherwise the bridge will be several metres in length.

10. Name the conservation laws obeyed by Kirchoff's I & II laws.

I law – law of conservation of charge, II law- law of conservation of energy.

### 3 .Magnetism & Magnetic effects of electric current

1. Where is the value of dip angle i) maximum ii) minimum ?

dip angle is  $90^\circ$  and maximum at poles. dip angle is  $0^\circ$  and minimum at equator.

2. Which among the following Aluminium, Bismuth, and Iron can become super conductor when cooled to a low temperature? Why?

Bismuth, as it is a diamagnet.

3. Arrange the following three a galvanometer, an ammeter and volt meter both made from identical galvanometers in increasing order of resistance?

ammeter, galvanometer, volt meter

4. A thin wire is made in the form of a loop of irregular shape. What will you observe when it is placed in a uniform magnetic field?

Its shape changes to circular. For a given perimeter a circle has more area. This is to increase the magnetic flux.

5. Which of the following a proton or a beta particle will describe the smallest circle when projected with same velocity perpendicular to the same magnetic field?

Beta particle as its mass is the least.

6. A charged particle enters in a uniform magnetic field at angles i)  $75^\circ$  ii)  $90^\circ$  predict the path travelled by them.

helical path, circular path

7. What is the value of magnetic field within a hollow sphere made of a ferromagnetic substance? Mention one application for it.

zero. It gives magnetic shield for any device to be protected from magnetic effects.

8. Which among the following antimony, aluminium, iron has Maximum value of magnetic susceptibility?

Iron.

9. What is the effect of increasing the number of turns of the coil in a galvanometer on i) current sensitivity ii) voltage sensitivity?

i) increases ii) no change

10. An electron beam projected along +ve X axis, experiences a force due to magnetic field along the +ve Y axis. What is the direction of the magnetic field?

Negative z direction.

#### 4 . Electromagnetic induction and Alternating current

1. Two identical loops, one of copper and another of constantan are removed from a magnetic field within the same interval, in which loop will the induced current be greater?

Copper wire as it is a conductor.

2. In an LR series circuit the pd across R is 60V and that along the inductor 80V what is the effective emf of the circuit?

100V

3. The power factor of an AC circuit is 0.5. What is the phase difference between the current and voltage?

$\pi/3$  rad

4. What is a choke coil? Mention its use.

Choke coil is a coil of high inductance and negligible resistance. It is used to control ac current with negligible power loss because power factor of choke coil is negligible. It is used to protect fluorescent lamps. If pure resistance is used in ac circuit, it will absorb the maximum power because power factor of resistor is maximum equal to 1.

5. The instantaneous current and voltage of an ac circuit are given by  $i = 10 \sin 314t$  A,

$v = 50 \sin 314t$  V. What is the power dissipation in the circuit?

Current is in phase with Voltage, therefore  $\cos \phi = 1$

Power  $P = \frac{1}{2} V_0 I_0 \cos \phi = \frac{1}{2} \times 50 \times 10 = 250$

6. The electric mains in a house is marked 220V, 50Hz. Write down the equation for instantaneous voltage.

$V = V_0 \sin \omega t$ ,  $V_0 = 220\sqrt{2}$

$V = 220\sqrt{2} \sin 2\pi \times 50t = 310 \sin 314t$

7. The frequency of ac is doubled, what happens to i) inductive reactance ii) capacitive reactance?

- i) inductive reactance  $X_L = 2\pi\nu L$ , it is doubled
- ii) capacitive reactance  $X_C = 1/2 \pi\nu C$ , it is halved

8. What is the origin of displacement current?

Displacement current is due to time varying electric flux  $I_d = \epsilon_0 \times d\phi_E / dt$ .

9. Which effect of electric current does not depend on direction of current flow?

Heating Effect

10. Mention 2 uses of eddy currents.

It is used in i) induction furnace ii) speedometer iii) brakes in electric train.

## 5 .Electromagnetic Waves & Communication Systems

1. Identify the following electromagnetic waves as per the wavelengths given below

- a)  $10^{-3}\text{nm}$  b)  $10^{-3}\text{m}$  c)  $1\text{nm}$ . Write one application for each of them.
- a) gamma radiation ,treatment of cancer .b) microwaves , RADAR for air craft navigation
- c) X rays, detection of fracture of bones , concealed contra band goods at air ports.

2. A plane electromagnetic wave travels in vacuum, along Y direction . Write down the ratio of magnitudes and ii)the direction , of its electric and magnetic field vectors.

i)  $E/B = c = 3 \times 10^8 \text{ m/s}$  ii) **E** along z direction, and **B** along x direction.

3.Name the following constituent radiations of electromagnetic spectrum which i) produce intense heating effect ii) is absorbed by ozone layer in the atmosphere.iii) used to study crystal structure. Write one application of each of them.

i) Infra red rays, used for taking photographs during fogs ii) UV rays , used to sterilize surgical instruments iii) X RAYS, used in detection of fracture of bones , concealed contra band goods at air ports

4.In a plane electromagnetic wave , the electric field oscillates with a frequency of  $2 \times 10^{10}\text{Hz}$  , and amplitude of electric field is  $40\text{V/m}$ , calculate its wavelength and amplitude of magnetic field.

$$\lambda = c/\nu = 1.5\text{cm} , B = 7.5 \times 10^{-6} \text{ T}$$

5. The Ozone layer on the top of stratosphere is crucial for human survival, why?

It absorbs the UV rays, and other low wavelength radiations which are harmful to living cells of human beings.

6. A radio can tune any station in the  $7.5\text{MHz}$  to  $12 \text{ MHz}$ . What is the corresponding wavelength band?

$$\lambda = c/\nu \quad \lambda_1 = 3 \times 10^8 / 7.5 \times 10^6 = 40\text{m} , \text{ similarly } \lambda_2 = 25\text{m}$$

7. Why the frequency of ground waves cannot exceed  $1.5\text{MHz}$  or  $1500 \text{ kHz}$  ?

ground waves are attenuated by earth's surface , the attenuation increases with frequency so the frequency of ground waves cannot exceed  $2\text{MHz}$ .

8. Name a component of electromagnetic waves which travels with same speed in any medium but blocked by bone.

X rays.

9. Why transponder should receive signal at one frequency and retransmit at another frequency?

It is to prevent cancellation of the signal by destructive interference with the retransmitted wave.

10. Why the value of modulation index cannot exceed 1?

It is to avoid the distortion of the signal.

## 6. Ray Optics & Wave Optics

1. The refractive index of a material is  $\sqrt{3}$ . What is the angle of refraction if un polarised light is

incident on the material at polarizing angle?

$$\mu = \tan i_p \quad \sqrt{3} = \tan i_p, \quad i_p = 60^\circ, \quad i_p + r = 90^\circ, \quad r = 30^\circ$$

2. Is dispersion possible in a hollow prism? Justify.

No. Because both the refracting sides act like two glass plates. So after refraction from both the plates the emergent ray is parallel to the incident ray.

3. The objective of telescope A has a diameter thrice that of the objective of telescope B. Compare the ratio of light gathered by A and B.

$$\text{Intensity} \propto d^2, \quad I_A/I_B = (d_A/d_B)^2 = 9:1$$

4. Two slits in Young's double slit experiment are illuminated by two different lamps emitting same wavelength. Will you observe interference pattern? Justify.

No. Even though wave lengths are equal, the lamps emit waves at different phase. so the sources are not coherent.

5. How does the resolving power of a compound microscope change when i) cedar wood oil is filled in the space between object and objective lens? ii) If yellow light is replaced by blue light for illumination?

$$R.P = 2\mu \sin \theta / 1.22 \lambda, \quad \text{i) as } \mu \text{ increases, R.P increases ii) as } \lambda \text{ decreases R.P increases}$$

6. Two telescopes have the same magnifying power, but the diameters of their apertures are different. Will there be a difference between the final images produced?

yes. The final image produced in a telescope with more aperture will be bright and finer details of the image can be seen as resolving power is more in it.

7. For which colour blue or red the focal length of a convex lens will be more? What will be your answer if the lens is concave?

The focal length is more for longer wavelength red in both convex and concave lenses.

8. An equi convex lens has a refractive index of 1.5. write its focal length in terms of radius of curvature.

$$R_1 = R_2 = R, \quad \text{for equi convex lens, } 1/f = (1.5 - 1) (1/R + 1/R) = 1/R, \quad \text{ie } f = R$$

9. What type of an air bubble inside water?

Diverging lens, as  $\mu_{\text{lens}} < \mu_{\text{medium}}$  from lens makers formula f will be negative.

10. State the essential condition required for diffraction to take place.

The width of the slit must be small or comparable with the wave length of light is used.

11. A convex lens of a material of refractive index  $\mu$  is placed in a transparent liquid. What would be the value of refractive index of the liquid more, less or equal to  $\mu$ ?

Equal to  $\mu$ . From lens makers formula.

12. Name the type of wave front from a i) line source ii) point source at infinite distance.

i) cylindrical wave front ii) plane wave front

13. Can sound waves be polarized? Justify.

No. Longitudinal waves cannot be polarised

14. To get a sharp image, which concave mirror you will prefer one with small aperture or large aperture?

The one with small aperture.

15. A concave mirror & a convex lens are held under water. What would be the change in their focal lengths?

In concave mirror no change but in convex lens focal length increases.

16. Mention advantages of total reflecting prism over mirrors or spherical metallic reflectors.

(i) The light is totally reflected so the image is bright. (ii) There is no tarnishing of reflecting surfaces.

17. What is the focal length and power of plane glass plate?

Focal length is infinite. Power is zero.

18. Why sunglasses have zero power even though their surfaces are curved?

Both the surfaces are curved in the same direction & the curvature is same for both the surfaces.

$$\text{Power } P = (\mu - 1) \left( \frac{1}{R} - \frac{1}{R} \right) = 0$$

19. A glass slab is placed over a page in which letters are printed in different colours. Which colour letter blue or red will be maximum raised?

Blue, as its wavelength is less.

20. Name the phenomenon of light which could not be explained by wave theory.

Photoelectric effect.

## 7. Dual Nature of Matter & Photoelectric Effect

1. Threshold wavelength of certain material is  $5000 \text{ \AA}$ . Will photoelectric emission take place when the material is illuminated by UV lamp of power  $8.3 \text{ W}$ ?

Yes, because  $\lambda$  of UV RAYS is less than  $5000 \text{ \AA}$ .

2. A source of light is placed at a distance  $r$  from a photoelectric cell. What would be the effect of doubling the distance  $r$  on i) photoelectric current, ii) cutoff potential?

Doubling the distance  $r$  will make the intensity  $\frac{1}{4}$  th i) photoelectric current also becomes  $\frac{1}{4}$  th

ii) no change in cut off potential as it is independent of intensity.

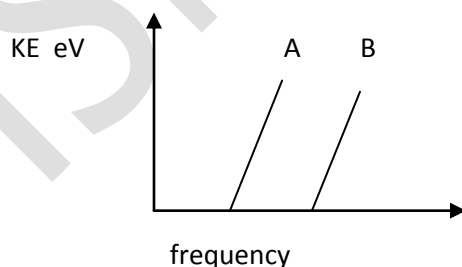
3. An electron and a proton have same kinetic energy which of them will have greater deBroglie wave length?

As the KE is same electron will have less momentum due to its less mass, so it will have greater deBroglie wavelength, as  $\lambda = h/p$ .

4. An electron and a proton have same momentum which of them will have greater deBroglie wave length?

Both will have same deBroglie wave length, as  $\lambda = h/p$ .

5. The graph shows the variation of kinetic energy of photoelectron emitted with the frequency of incident radiation for two photosensitive materials A and B. Find which of them will have i) more threshold wavelength ii) more work function iii) electrons emitted with more kinetic energy for same incident radiation of suitable frequency and intensity?



i) A ii) B iii) A

6. Two metals A and B have work functions  $2 \text{ eV}$  and  $4 \text{ eV}$  respectively, which metal has lower threshold wavelength?

B, since its work function and threshold frequency are more

## 8 . Atoms and Nuclei

- The radius of the first orbit of an electron in Hydrogen atom is  $0.53\text{\AA}$ . What is the radius of second orbit?  
 $r_2 = 4r_1$ ,  $r_2 = 4 \times 0.53\text{\AA} = 2.12\text{\AA}$ .
- Name the spectral series of Hydrogen in i) visible region ii) UV region  
 i) Balmer series ii) Lyman series
- What is the physical meaning of negative energy of an electron?  
 The electron is bound to the atom.
- How does n/p ratio of a nucleus change in  $\beta$  emission?  
 In negatron emission n/p ratio decreases. n/p ratio increases in positron emission.
- The half life of radium is 1600 years. After how many years the remaining sample will be 25% of its initial amount?  
 $N/N_0 = (\frac{1}{2})^n$ , where n is number of half lives here  $N/N_0 = (\frac{1}{2})^2$   $n = 2$ ,  
 total time =  $n \times \text{half life} = 2 \times 1600 = 3200$  years
- What type of spectrum is emitted by i)  $\alpha$  particle ii)  $\beta$  particle ?  
 i) line spectrum ii) continuous spectrum.
- Name a material which can be used as a moderator, coolant and neutron reflector.  
 heavy water ( $\text{D}_2\text{O}$ )
- Name the most stable nuclei. Which among the following Lithium & plutonium may undergo nuclear i) fission ii) fusion?  
 ${}_{26}\text{Fe}^{56}$ , i) Plutonium ii) Lithium
- Name any two quantities which are conserved in any Nuclear reaction.  
 atomic number and mass number are conserved.
- Which among the following U -238 , U-235 , Pu – 239 , U -233 undergo nuclear fission?  
 U-235 , Pu – 239 , U -233
- In which of the reaction, nuclear fission or nuclear fusion energy released per unit mass is greater?  
 nuclear fusion .
- Identify isotones among the following:  ${}_2\text{He}^4$ ,  ${}_2\text{He}^3$ ,  ${}_6\text{C}^{14}$ ,  ${}_7\text{N}^{14}$ ,  ${}_8\text{O}^{15}$ ,  ${}_8\text{O}^{16}$   
 ${}_6\text{C}^{14}$ ,  ${}_8\text{O}^{16}$
- What is the ratio of nuclear densities of two nuclei A and B having mass numbers in the ratio 1:3?  
 1: 1, Nuclear density is independent of mass number of the nuclei.
- The ground state energy of electron in hydrogen atom is -13.6eV. Calculate the kinetic and potential energy of electron in this state .  
 $E_k = -E = 13.6\text{eV}$ ,  $E_p = 2E = -27.2\text{eV}$
- Define K factor or multiplication factor in nuclear fission reaction. What is its importance?  
 It is the ratio of number of neutrons producing fission in a generation to the number of neutrons producing fission in previous generation.  
 If  $K > 1$ , the reaction is super critical as in atom bomb . If  $K = 1$ , the reaction is critical, as in a nuclear reactor. If  $K < 1$  the reaction is sub critical and the chain reaction may stop.

16. Mention uses of radio isotopes.

Co-60 –used in the treatment of cancer, I -131 -- used in the treatment of thyroid gland,

Na-24 – used to study about the functioning of heart, blockage in blood vessels, C-14- radio carbon dating ,to determine the age of fossils.

### 9. Solids & Semiconductor(ELectronic)devices

1 .Which of the following Boron or Aluminium will be preferred for doping a Silicon crystal to make it extrinsic semiconductor? Name the type of semiconductor thus obtained.

Aluminium, as its size is comparable with silicon atom. P – type semiconductor as Al is trivalent impurity.

2. What is the similarity between zener diode and photodiode. Mention one use for each of them.

Both work under reverse bias. Zener diode is used as a voltage regulator. Photo diode can be used in burglar alarms, Fire alarms, Automatic opening and closing of doors at the shopping malls.

3. Name two factors on which electrical conductivity of a pure semiconductor at a given temperature depends.

i) the width of forbidden band or energy gap ii) intrinsic charge concentration

4. Why base of a transistor must be thin and lightly doped?

So as to have least number of majority carriers recombining at base. This will increase the collector current.

5.What is the ratio of  $n_e$  to  $n_h$  in i) intrinsic ii) P- type iii) N – type semiconductors?

i )  $n_e / n_h = 1$  ii)  $n_e / n_h < 1$  iii)  $n_e / n_h > 1$

6.What is the phase difference between output and input in a transistor amplifier? What type of feedback is used in a transistor oscillator?

180°, Positive feedback.

7. Name the logic gate(s) obtained by using i) diodes ii) transistor.

i) OR gate , AND gate ii) NOT gate.

8. What are Universal Logic Gates? Why are they called so?

NAND and NOR gates .Because all the other basic gates like OR gate , AND gate and NOT gate can be made from NAND and NOR gates.

9. Mention advantages of LEDs over incandescent lamps.

i) Low operational voltage ii) long life iii) No warm up time is needed, so fast action.