Subject: - Applied Science- Physics (22211)

SYLLABUS

Chapter No.	Name of chapter	Marks With Option
1	ELECTRICITY AND CAPACITANCE	09
2	RADIOACTIVITY AND ULTRASONIC WAVES	14
3	PHOTO ELECTRICITY, X-RAYS AND LASER	12
	Total Marks :-	35

CLASS TEST - I
PAPER PATTERN
FOR ALL BRANCHES

COURSE:- APPLIED PHYSICS-ASE-P (22211)

PROGRAMME: - ELECTRICAL ENGINEERING.

Syllabus:-

Unit No.	Name of the Unit	Course Outcome (CO)
1	ELECTRICITY AND CAPACITANCE	211.1
2	ELECTRICITY,MAGNETISM AND SEMICONDUCTORS RADIOACTIVITY AND ULTRASONIC WAVES	211.2

Q.1	**Attempt all MCQ questions.** **First six questions 6*1= 6 Marks** **Last two questions 2*2= 4Marks**	**Course Outcome (CO)**
a)	Question on first chapter with four options	211.1
b)	Question on Second chapter with four options	211.2
c)	Question on first chapter with four options	211.1
d)	Question on second chapter with four options	211.2
e)	Question on first chapter with four options	211.1

f)	Question on first chapter with four options	211.1
g)	Question on first chapter with four options	211.1
h)	Question on second chapter with four options	211.2

CLASS TEST – II

PAPER PATTERN

COURSE:- APPLIED SCIENCE PHYSICS (22211)

PROGRAMME: - ELECTRICAL ENGINEERING

Syllabus: -

Unit No.	Name of the Unit	Course Outcome (CO)
2	ELECTRICITY,MAGNETISM AND SEMICONDUCTORS	CO-211.2
3	PHOTO ELECTRICITY, X-RAYS AND LASER	CO-211.3

COURSE OUTCOME (CO)

COURSE:- APPLIED SCIENCE- PHYSICS (22211)

PROGRAMME: - ELECTRICAL ENGINEERING

CO.NO	Course Outcome
CO-211.1	USE RELEVANT CAPACITORS IN ELECTRICAL CIRCUITS.
CO-211.2	USE EQUIPMENT / INSTRUMENTS BASED ON RADIOACTIVE AND ULTRASONIC PRINCIPLES.
CO-211.3	USE EQUIPMENT / INSTRUMENTS BASED ON PHOTOELECTRIC EFFECT, X-RAY AND LASER.

1. ELECTRICITY AND CAPACITANCE

MCQ Question

Total Marks-14

(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold.**

Electricity:

- **Electric current (I):**
  It is defined as rate of flow of charge is called as electric current.

$$\text{Current} = \frac{Charge}{Time}$$

$$I = \frac{Q}{t}$$

SI unit – Ampere (A)

- **Ohm's Law:**
  Statement- The current (I) flowing through a conductor is directly proportional to the potential difference (v) across its two ends,if its physical conditions remain the same.

OR

Statement-The Physical state of conductor (material,length,area and temperature) remaining the same ,the electric current flowing through a conductor is directly proportional to the potential difference across it.

$I \propto V$

$V \propto I$

$V = \text{constant} \times I$

$\mathbf{V = I\,R}$

- **Resistance(R):**

It is defined as opposition to the flow of electrons in a conductor is called as resistance.

OR

The resistance is the property of the material by virtue of which it opposes the flow of current.

SI Unit: Ohm (Ω)

$$R = \frac{V}{I}$$

- **Resistivity(ρ):**

It is defined as the resistance offered by the material of conductor having unit length and unit cross sectional area.

$$R \propto \frac{L}{A}$$

$$R = \text{constant} \times \frac{L}{A}$$

$$R = \rho \times \frac{L}{A}$$

$$\rho = \frac{R \times A}{L}$$

$$\text{SI unit - } \frac{\Omega m^2}{m} = \Omega m$$

- **Conductance(G):**

it is defined as the reciprocal of resistance SI unit-siemens(s)

conductivity: it is defined as the reciprocal of resistivity.

It is denoted by G.

SI unit -siemens (S)

$$G = \frac{1}{Resistance}$$

$$G = \frac{1}{R}$$

- **<u>Conductivity or specific conductance</u>(6):**

It is defined as reciprocal of resistivity.

OR

It is defined as reciprocal of specific resistance.

It is denoted by Sigma(6).

SI unit –siemens/meter (S/m)

$$6 = \frac{1}{Resistivity} \quad \textbf{OR} \quad 6 = \frac{1}{Specific\ Resistance}$$

$$6 = \frac{1}{\rho}$$

- **<u>CAPACITANCE</u> :**

Capacitance of a conductor is also defined as the charge required to increase its potential by unity

OR

Capacitance of a conductor is also defined as the ratio of charge to its potential difference.

SI unit of capacitance is farad (F).

$$C = \frac{Charge}{\text{potential differnce}}$$

$$C = \frac{Q}{V}$$

$$1\ \text{farad} = \frac{1\ coulomb}{1\ \text{volt}}$$

$$1\ \text{farad} = \frac{1\ C}{1\ \text{V}}$$

<u>Definition</u>: 1 farad- It is defined as the capacitance of a conductor, the potential of which is increased by 1 volt by a charge of 1 coulomb.

Q1. Capacitors which is also known as a condenser is an arrangement of two conductors separated by..................

(a) conductor | **(c) insulators**
(b) semiconductor | (d) silver

Q2. What is SI unit of EMF ?

(a) Coulomb | **(c) Volt**
(b) Coulomb/m | (d) Weber/m

Q3. Potential difference between two metal plates of capacitors is……………..strength of the charge 'Q' on conductor.

(a) directly proportional to | (c) not proportional to
(b) inversely proportional to | (d) equal to

Q4. The electric flux density is defined as the ………….per…………..measured at right angles to the direction of flux.

(a) Force, unit area | (c) Force, unit flux
(b) Flux, unit area | (d) unit area, coulombs

Q5. Capacitance or capacity of a conductor is defined as the...............

(a) ratio of potential to charge | (c) product of charge and potential
(b) sum of potential and charge | **(d) ratio of charge to potential**

Q6. Balancing condition of whetstones network with R_1, R_2, R_3 and R_4 in cyclic order is…………….

(a) $R_1/R_2 = R_3/R_4$ | (c) $R_1/R_4 = R_3/R_2$
(b) $R_1/R_2 = R_4/R_3$ | (d) $R_1R_2 = R_3R_4$

Q7. The maximum electric field that a dielectric medium can withstand without breakdown is called as.................

(a) Saturation field | (c) Utmost field
(b) dielectric strength | (d) optimized field

Q8. Capacitance of a capacitor is given by.................

(a) C=V/Q | (c) C=QV
(b) C=Q/V | (d) V=QC

Q9. The electric flux density is denoted by……………and measured in……………

(a) D, Coulomb-m | (c) D, Coulomb/m^2
(b) D, Coulomb/m | (d) D, Coulomb/m^3

Q10. Equivalent capacitance of series combination is given by.............

(a) $Cs=C_1 + C_2 + C_3$ | **(c) $1/Cs=1/C_1 +1/C_2 + 1/C_3$**
(b) $Cs=1/C_1 +1/C_2 + 1/C_3$ | (d) $1/Cs=1/C_1 \times C_2 \times C_3$

Q11.When number of capacitance are connected in parallel then effective capacitance............

(a) increase (c) remain same
(b) decreases (d) increases or decreases

Q12 The relation between charge and applied voltage across a capacitor is...............
(a) Q=C/V (c) Q=V/C
(b) Q=CV (d) $Q=V^2/C$

Q13.The value of relative permittivity for ….......... is assumed to be unity.
(a) Paper (c) Glass
(b) Air (d) Sand

Q14. E.M.F. of a cell is defined as potential difference between two terminal of the cell when.............
(a) the circuit is closed (c) high current is drawn
(b) the circuit is open (d) low resistance is connected

Q15.Principle of potentiometer is, fall of potential is…………….
(a) directly proportional to length of wire (b) inversely proportional to length of wire
(c) directly proportional to area of wire (d) inversely proportional to area of wire

Q16.If a battery of e.m.f. 10 V is connected across a resistance of 100 Ω and drop observed across a resistance is 9.8 V,then internal resistance of a cell will be....................
(a) 2 Ω (c)10 Ω
(b) 5 Ω (d) 20 Ω

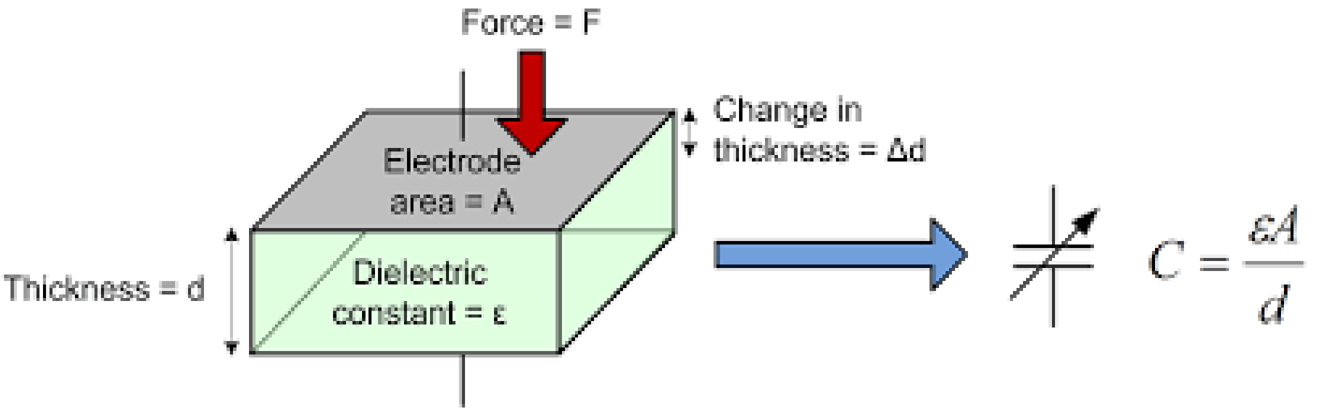
Q17.Kirchhoff's first law or junction rule states that in any network of conductors in an electrical circuits.................
(a) product of currents is zero (c) algebraic sum of potential is zero
(b) algebraic sum of current is zero (d) product of potential is zero

Q18. When number of capacitances are connected in series, then effective capacitance..................
(a) increases (c) remain same
(b) decreases (d) increases or decreases

Q19. If four capacitors of capacitance C are connected in parallel then its equivalent capacitance to will be ....
(a) 1 C (c) 3 C
(b) 2 C **(d) 4 C**

Capacity of a Parallel-Plate Condenser(Capacitor):

a capacitor is an arrangement of a two metal plates with a dielectric between them it is called as a parallel plate condenser.



A = Area of each metal plate

d = distance between two plate.

K= Dielectric constant of the medium between them.

+Q = charge given to A

-Q = charge induced on inner side of B.

V = potential difference between two electrodes.

Then,electric flux density D between the two plate is,

$D = \varepsilon_0 kE$…………………………………………………..(1)

Where E= electric intensity

ε_0 = permittivity of free space.

$D = \frac{\varphi}{A} = \frac{Q}{A}$……………………………………….(2)

φ= electric flux.

using equation (1) and (2) we get,

$$\frac{Q}{A} = \varepsilon_0 kE$$

But $E = \frac{V}{d}$

$$\frac{Q}{A} = \varepsilon_0 kE$$

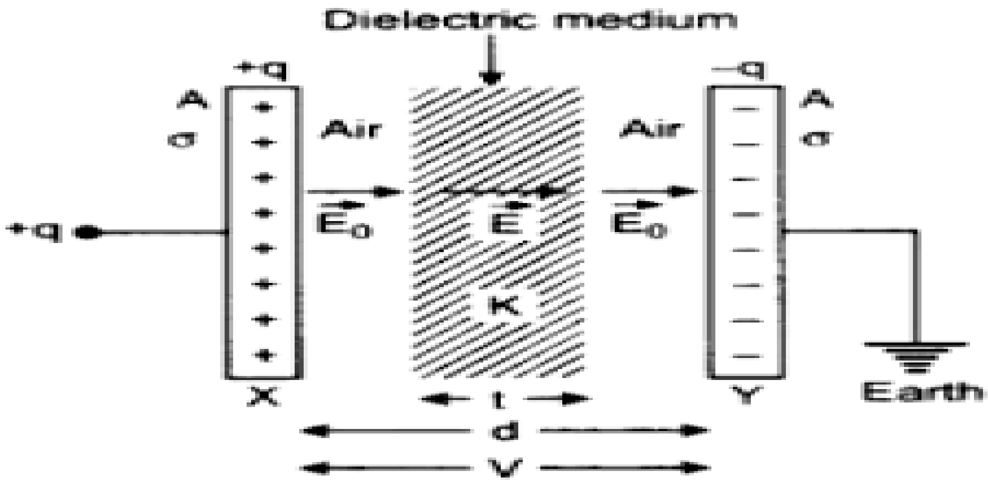
$$\frac{Q}{A} = \varepsilon_0 k\left(\frac{V}{d}\right)$$

$$\frac{Q}{V} = \frac{\varepsilon_0 kA}{d}$$

But $C = \frac{Q}{V}$

$$\mathbf{C = \frac{\varepsilon_0 kA}{d}}$$

<u>Effect of Dielectric on Capacitors(Capacitance)</u> :



A = Area of each metal plate as well as area of metal plate B.

d = distance between two metal plate.

K= Dielectric constant of the medium between them.

+Q = charge given to A

-Q = charge induced on inner side of B.

V_0 = potential difference between two electrodes.

E_0 = Electric field intensity.
We have,

$$D = \varepsilon_0 kE$$

$$D = \varepsilon_0 k E_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

But $D = \frac{Q}{A}$ and $E_0 = \frac{V_0}{d}$

These value Put in equation (1) we get,

$$D = \varepsilon_0 k E_0$$

$$\frac{Q}{A} = \varepsilon_0 k\left(\frac{V_0}{d}\right)$$ but k=1 for air

$$\frac{Q}{A} = \varepsilon_0\left(\frac{V_0}{d}\right)$$

$$\frac{Q}{V_0} = \varepsilon_0\left(\frac{A}{d}\right)$$ but $\frac{Q}{V_0} = C_0$

$$\boldsymbol{C_0 = \varepsilon_0\left(\frac{A}{d}\right)}$$

Q20.Capacitance of a capacitor with dielectric material k is ....capacitance of a capacitor without dielectric.

(a) k times more than (c) equal to
(b) k times less than (d) twice

Q21. The electric field between the conductors of capacitor is proportional to the..................

(a) current I (c) area A
(b) charge Q (d) distance d

Q22. Potential difference between two metal plates is defined as ....in bringing unit positive Charge from plate B to plate A against electric field.

(a) work done (b) force applied
(c) time taken (d) effort taken

Q23. Capacitor stores……………….

(a) large charge at lower potential (b) small charge at higher potential

(c) small charge at small potential (d) large charge at higher potential

Q24. Two condensers have equivalent capacitance of 8μF when connected in parallel and 2μF When connected in series. Then individual capacitance will be. ....

(a) 2μF, 4μF, (c) 1μF, 8μF
(b) 4μF, 4μF, (d) 1μF, 1μF

Q25.Capacity of a parallel plate condenser is given by………………

(a) $C= \varepsilon_0 kAd$ **(c) $C=\varepsilon_0 kA/d$**
(b) $C=kA/\varepsilon_0 d$ (d) $C=\varepsilon_0 kd/A$

Q26.Two condensers when connected in series and parallel have equivalent capacitances of 3 farad and 16 farad resp. what is the capacitance of each condenser?

(a) 12 farad and 4 farad (c) 12 farad and 6 farad
(b) 8 farad and 4 farad (d) 8 farad and 2 farad

Q27. If a capacitors of capacity 20μF is connected in across 10 V battery then charge drawn by a capacitor will be………………

(a) 50 μC **(c) 200 μC**
(b) 100 μC (d) 300 μC

Q28. KCL is used for obtaining the ……………in the given circuit.

(a) unknown current (c) unknown resistance
(b) unknown voltage (d) unknown capacitance

Q29.Energy of charged condenser is given by……………..

(a) $E=2CV^2$ **(c) $E=1/2CV^2$**
(b) $E=1/2V$ ((d) $E=1/2C^2 V$

Q30.If area of metal plate of capacitor with capacitance C is doubled then capacitance then capacitance will become……………..

(a) C (c) 3C
(b) 2C ((d) C/2

Q31. If distance between two metal plate of capacitor with capacitance C s halved then Capacitance will become……………..

(a) C (c) 3C
(b) 2C (d) C/2

Q32. A capacitor of capacitance C having air as a dielectric is dielectric is taken. Now dielectric Material of dielectric constant k=3 is introduced between two metal plates, then capacitance will become……………..

(a) C/3 (c) C/6
(b) 3C ((d) 6C

Q33. If area of parallel plate condenser is $1m^2$ and distance between plates is 0.1 mm then Capacitance of a condenser if its dielectric constant is 5 and $\varepsilon_{0=}$ 8.9 x 10-^{12} will be……………..

(a) 44.5 x 10^{-6} F (c) 44.5 x 10^{-9} F
(b) 44.5 F **(d) 44.5 x 10^{-12} F**

Q34. If two capacitors of capacitance 6μF each are connected in series, then its equivalent Capacitance will be……………..

(a) 1 μF
(b) 2 μF
(c) 3 μF
(d) 4 μF

Q35. If three capacitors of capacitance 9 μ F each are connected in series, then its equivalent Capacitance will be……………..

(a) 1 μ F
(b) 2 μF
(c) 3 μF
(d) 4 μF

Q36. If three capacitors of capacitance C each are connected in series, then its equivalent capacitance will be………………..

(a) C
(b) C/2
(c) C/3
(d) C/4

Q37. A 10 μF capacitors is connected to 10V battery. Electrostatics energy stored in the capacitors will be……………..

(a) 100×10^{-6} J
(b) 500×10^{-6} J
(c) 1000×10^{-6} J
(d) 250×10^{-6} J

Q38. If a battery of e.m.f. 10 V is connected across a resistance of 100 Ω and drop observed across a resistance is 9.8 V, then internal resistance of a cell will be....................

(a) 4 Ω
(b) 5 Ω
(c) 2 Ω
(d) 20 Ω

Q39. Kirchhoff's second law(loop rule) or junction rule states that in a closed loop of network of conductor, the alegebric sum of product of current and resistance of each part of closed loop is…………

(a) product of e.m.f in the circuit
(b) ratio of e.m.f is in the circuit
(c) algebraic sum of e.m.f in the circuit
(d) sum of current

Q 40. Capacitor of large capacitance holds…………

(a) small amount of charge at small potential
(b) large amount of charge at large potential
(c) large amount of charge at small potential
(d) small amount of charge at large potential

Q41. For a Capacitor to store large amount of charge without leakage, its capacitance should be high but…………..

(a) potential difference should be within breakdown limit
(b) potential difference should not be less than certain limit
(c) potential difference should be equal to certain limit
(d) none of these.

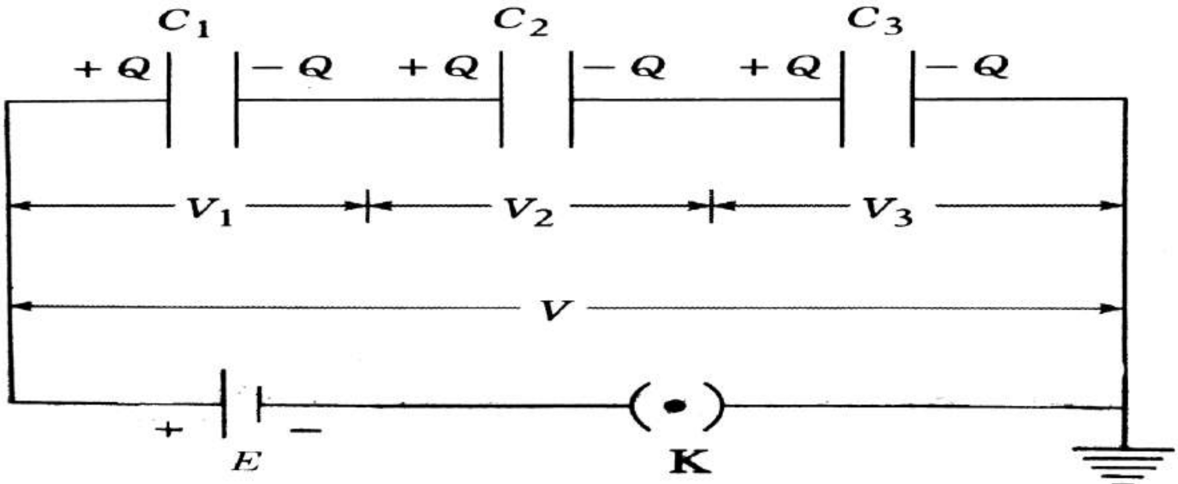
Q42. If area of parallel plate condenser is $3.21 m^2$ and distance between plates is 0.1 mm then Capacitance of a condenser if its dielectric constant is 7 and $\varepsilon_{0=}$ 8.9 x 10-^{12} will be……………..

(a) 1.99 x 10^{-6} F
(b) 1.99 F
(c) 1.99 x 10^{-9} F
(d) 1.99 x 10^{-12} F

Combination of Capacitors :

1. **Series Combination and Expression for Effective Capacitance:**
2. **Parallel Combination and Expression for Effective Capacitance:**

1.Series Combination and Expression for Effective Capacitance:



Capacitors in series

Consider three condenser of capacitance C1, C2 and C3 connected in series between the point A and B.

let V be the potential difference across the combination things the condenser are connected in series total charge on each condenser is the same but the potential V across the combination split into three parts V1, V2 and V3.

The value of V1, V2 and V3 depends upon the values of C1 ,C2 and C3 respectively.

V = $V_1 + V_2 + V_3$……………………………………………(1)

But C= $\frac{Q}{V}$

$V= \frac{Q}{C}$

$V_1 = \frac{Q}{C_1}$

$V_2 = \frac{Q}{C_2}$

$V_3 = \frac{Q}{C_3}$

And $V = \frac{Q}{C_s}$

Where C_s= equivalent capacitance of series combination.

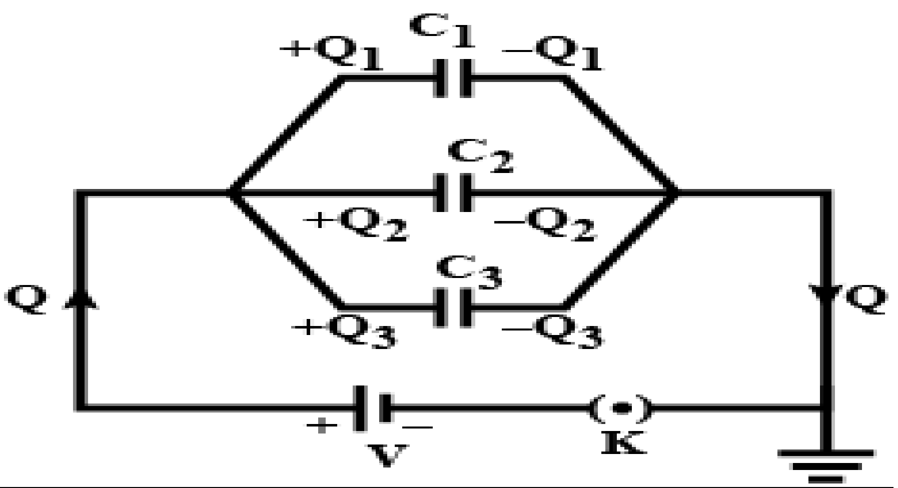
$$\frac{Q}{C_s} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$Q \times \frac{1}{C_s} = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right)$$

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

Law of condensers in series: Reciprocal of equivalent capacitance of the series combination equal to the sum of reciprocal of capacitance of the condensers in series.

2.Parallel Combination and Expression for Effective Capacitance:



Consider three condenser of capacitance C1, C2 and C3 connected in parallel between the point A and B.
let V be the potential difference across the combination.
Since the condenser are connected in Parallel, the potential across each condenser is same. But the total charge Q on each condenser is the same but the point A across the combination split into three parts Q1, Q2 and Q3.
The value of Q1, Q2 and Q3 depends upon the values of C1 ,C2 and C3 respectively.

$$Q = Q_1 + Q_2 + Q_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

But $Q_1 = C_1$V

$Q_2 = C_2$V

$Q_3 = C_3$V and Q $= C_p$V

Where C_P= equivalent capacitance of Parallel combination

$$C_pV = C_1V + C_2V + C_3V$$

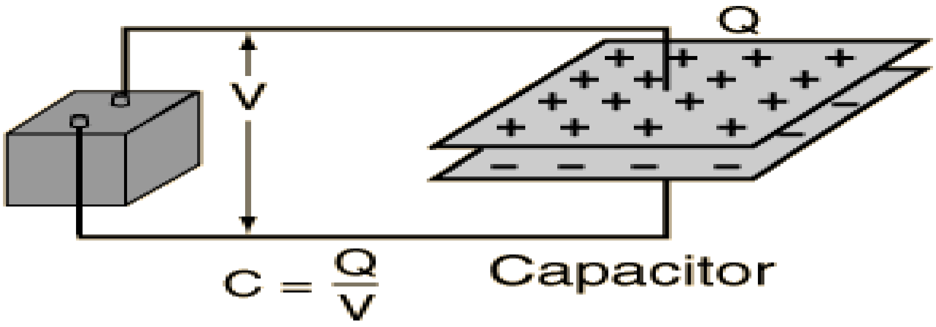
$$C_pV = V(C_1 + C_2 + C_3)$$

$$C_p = C_1 + C_2 + C_3$$

<u>Law of condensers in Parallel</u>: Reciprocal of equivalent capacitance of the parallel combination is equal to the sum of reciprocal of capacitance of the condensers in parallel.

- **<u>Energy stored in a Capacitor or Energy of a charged Condenser (capacitor)</u>:**

Potential difference between to plate is measured by the work done in carrying unit positive charge from one plate to other. Energy is measured by the total work done in charging the condenser. Let charge Q be given to a conductor gradually. Initially, the potential of a plate is zero after giving charge Q the potential is V.
Consider a two metal plate A and B which are not charged. Now consider a step-by-step charge transfer from the Bto the a at the end of this process, charge on A is + Q and charge on B is –Q. In transferring charge from plate be to plate a work will be done.
while charging a condenser some work is done. this work done is a stored in the condenser as the energy of condenser. consider a condenser is a charge gradually let Q be the total charge V is the total potential difference between the two plate and C is the capacity of a condenser.
Amount of a small work done is a carrying small charge dq is dw= dq x V.
Total work done is a charging the condenser is the addition of the small work done.
Thus total work done is a charging the condenser from Zero to Q is a given by,



This work done is stored in a condenser as energy E

$$W = \int_0^Q V'\,dq$$

or, $$W = \int_0^Q \frac{q'}{C}\,dq$$

or, $$W = \frac{1}{C}\int_0^Q q'\,dq \quad \text{or,} \quad W = \frac{1}{C}\left[\frac{q'^2}{2}\right]_0^Q$$

$\Rightarrow$ $$W = \frac{1}{2}\frac{Q^2}{C}$$

But , Q = CV

E= W $=\frac{1}{2}CV^2$

OR

E = W $=\frac{1}{2}$ QV

Q43. An electric charge of 3×10^{-3} μC is placed at a point in the medium of dielectric constant 1.08.Find its potential at a point 20 cm away from it. ……………..

(a) 125 volts (c) 197 volts
(b) 102 volts (d) 100 volts

Q44. A 50 pF capacitor is connected to 12 V battery. How much electrostatic energy is stored In the capacitor……………….

(a) 3000×10^{-6} J **(c) 3600×10^{-12} J**
(b) 3000×10^{-12} J (d) 1300×10^{-6} J

Q45. If a battery of EMF 12 V is connected across a resistance of 120 Ω and potential drop observed across a resistance is 11.8 V, calculate the internal resistance of a cell……………..

(a) 1.075 Ω **(c) 2.075 Ω**
(b) 6.075 Ω (d) 3.075 Ω

Q46. A capacity of a parallel - plate condenser with air as a dielectric is 20 pF. What would be its Capacity if mica sheet of dielectric constant 6 is introduced between two parallel plate.

(a) 1.200 pF (c) 1.2 pF
(b) 120 pF (d) 12000 pF

Q47. Three condensers of capacitance 6,12,and 16 μF are connected in series. A potential difference Of 220 volt is applied to the combination.How much charge will be drawn?

(a) 704 μC (c) 104 μC
(b) 804 μC (d) 504 μC

Q48. When a charge of a 0.05 μ C is given by to a conductor, its potential is raised to 100V find its capacitance…………..

(a) 1×10^{-10} F (c) 5×10^{-6} F
(b) 2×10^{-6} F **(d) 5×10^{-10} F**

Q49. The opposition offered by electrolyte to flow of charges from negative electrode to positive electrode of a cell through electrolyte is called as……………….

(a) external resistance **(c) internal resistance of a cell**
(b) external resistance (d) none of these

Q 50.Two condenser have an equivalent capacitance of 12 μF when connected in parallel and 2.25 μ F when connected in series. Calculate their individual capacitances…………….

(a) C_1=3 μF ,C_2=9 μF (c) C_1=4 μF ,C_2=8 μF
(b) C_1=2 μF ,C_2=4 μF (d) C_1=5 μF ,C_2=10 μF

…………………………………………………XXX………………………………….

2. ELECTRICITY, MAGNETISM AND SEMICONDUCTORS

MCQ Question

Total Marks-10

(Total number of Question=Marks*3=10*3=30)

Note: Correct answer is marked with **bold.**

Nuclear radiation:

Nuclear radiation refers to the particles and photons emitted during reactions that involve the nucleus of an atom. **Nuclear radiation** is also known as ionizing **radiation** or ionising **radiation**

- **Nuclear radiation-**Rutherford discovered α – radiations which are less penetrating and β– radiations which are more penetrating and later on Villard discovered, γ-radiations which are still more penetrating.

Types of radiation Nuclear:

Radiation arises from hundreds of different kinds of unstable atoms. The energy of each kind of radiation is measured in electron volts (eV). The principle kinds of ionizing radiation are:

Alpha particles:

1)Alpha (α) particles consist of two protons and two neutrons, and are positively charged.

2) α- rays are rays are deflected by electric and magnetic field small deflect towards negative electric plate shows that they are positively charged particle with larger inertia.

3)Speed ranges from $\frac{1th}{100}$ to $\frac{1th}{10}$ of speed of light.

4)They produce ionization in a gases.

5)They produce fluorescenes in substances like barium platino cyanide zinc sulphide.

6)They produce heating is a which stopped and cause burns on human body.

7)They affect photographic plate.

8)They are often very energetic, but because of their large size they cannot travel very far before they lose this energy.

9)They are stopped by a sheet of paper or skin and are only a potential health concern if they are ingested or inhaled.

10)The alpha particles' large size, relatively speaking, and high energy are key to understanding their health impacts. When inside the human body, alpha particles can cause damage to the cells and to DNA as their size makes it more likely that it will interact with matter. If the dose is too high for repairs to be made satisfactorily, there is a potential increase in the risk of getting cancer later in life.

<u>Examples of alpha emitters:</u> uranium-238, radon-222, plutonium-239.

Q1.The process of spontaneous emission of radiations from radioactive substance is known as…………….
(a) photoelectric emission
(b) thermo emission
(c) Radioactivity
(d) LASER

Q2.The process by which an unstable atomic nucleus losses energy by emitting radiations, such α, β, γ radiations is known as…………….
(a) photoelectric emission
(b) radioactivity
(c) thermoemission
(d) LASER

Q3.Which of the following is not an example of radioactivity substance…………
(a) Uranium
(b) Radium
(c) Thorium
(d) Calcium

Q4.Which of the following is not an example of radioactivity substance…………
(a) Polonium
(b) Boron
(c) Radon
(d) Actinium

Q5.All naturally occurring elements whose atomic numbers are greater than……….are radioactive.
(a) 12
(b) 32
(c) 52
(d) 82

Q6.Doulby ionized helium atoms are………..
(a) α particles
(b) β particles
(c) γ particles
(d) photons

Q7.Photons having higher frequency (energy) i.e. higher penetration power than X-ray are know as……

(a) radio waves
(b) microwaves
(c) γ rays
(d) infrared rays

Q8.Which of the following is not a property of radioactive radiations (α, β, γ)……….
(a) highly penetrating
(b) affect photographic plate
(c) produce scintillations on fluorescent screen
(d) produce elasticity

Q9.When radioactive element radiates radiation then it gets converted into new element which is……
(a) also radioactive
(b) not radioactive
(c) a compound
(d) a mixture

Q10.When radioactive element radiates radiation then it gets converted into new element which is also radioactive. This change is………..
(a) reversible
(b) irreversible
(c) stimulated
(d) none of these

Q11.The emission of radiation in radioactivity is………
(a) Stimulated
(b) spontaneous
(c) Reversible
(d) rechargeable

Q12.The emission of radiation from radioactive element is………process
(a) instantaneous
(b) short time
(c) not instantaneous i.e. prolonged
(d) momentary

Q13. α – rays are heavily charge particles with………
(a) one negative charge
(b) one positive charge
(c) two negative charges
(d) two positive charge

Q14. The mass of α – particles is……….
(a) 6.645×10^{-27} kg
(b) 6.645×10^{27} kg
(c) 2.2×10^{-10} kg
(d) 2.2×10^{10} kg

Q15. The charge of α – particles is……….
(a) 3.2×10^{19} C
(b) 3.2×10^{-19} C
(c) 3.2×10^{14} C
(d) 3.2×10^{-14}C

Q16. α – particles is represented as……….
(a) $_1He^2$
(b) $_1He^3$
(c) $_2He^4$
(d) $_2He^2$

Q17. α – rays are ……………particles
(a) negatively charged
(b) positively charged
(c) neutral
(d) none of these

Q18. Speed of α particles ranges from…………to…………..of speed of light
(a) 1^{th} /100, 1^{th} /10
(b) 10^{th}, 100^{th}
(c) 2,3
(d) 1/2 ,1/3

Q19. The spontaneous breaking up of the nucleus is known as…………..

(a) radioactive disintegration (c) Fusion
(b) radioactive integration (d) refusion

Q20. The radioactive disintegration ……………physical as well chemical condition i.e. pressure, temperature and chemical combination.
(a) directly proportional **(c) does not depend on**
(b) inversely proportional (d) depends on

- **Decay Constant (λ):**

It is defined as the ratio of amount of substance disintegrated in unit time to the amount of substance present is called as decay constant.

$$N = N_0 e^{-\lambda t}$$

But $t=1/\lambda$

$$N = N_0 e^{-\lambda(\frac{1}{\lambda})}$$

$$N = N_0 e^{-1}$$

$$N = \frac{N0}{e}$$

$$N = \frac{N0}{2.718}$$

$$\mathbf{N = 0.37\ N_0}$$

- **Half –Life Period (Time):**

It is defined as the time in which half of the radioactive substance is disintegrated is known as half life period(time).

If N_0 are the number of atoms present at any instant t=0 ,then the time in which $\frac{N0}{2}$ atoms are disintegrated is called half life period or half life time,

half life period is denoted by $T_{1/2}$

Hence $t = T_{1/2}$ when $N = \frac{N0}{2}$

We have,

$$N = N_0 e^{-\lambda t}$$

Put $t = T_{1/2}$ when $N = \frac{N0}{2}$

$\frac{N0}{2} = N_0 \, e^{-\lambda T1/2}$

$\frac{1}{2} = e^{-\lambda T1/2}$

$\frac{1}{2} = \frac{1}{e-\lambda T1/2}$

$2 = e^{\lambda T1/2}$

$Log_e 2 = \lambda \, T1/2$

$\frac{Loge2}{\lambda} = T_{1/2}$

$\mathbf{T_{1/2} = \frac{0.693}{\lambda}}$

e.g.Half life period of Uranium is 4.3×10^9 years & Radium is 1620 years
Half-life period of Radon is 3.8 days and polonium is 10^{-7} sec.

Q21. The ratio of amount of radioactive substance disintegrated in unit time to amount of substance present is called……

(a) Rutherford Constant
(b) radioactive decay constant
(c) Rutherford ratio
(d) soddy's constant

Q22.Piezo-electric effect is …………..

(a)reversible
(b) irreversible
(c) reversible under high pressure
(d) irreversible under high pressure

Q23. Ultrasonic are the sound waves having frequency…….**.**

(a)more than 20 kHz
(b) more than 20 Hz
(c) Less than 20 Hz
(d) less than 20 kHz

Q24.The relation between velocity, frequency and wavelength is……...

(a) n=vλ
(b) v=nλ
(c) v=n/λ
(d) v=λ/n

Q25.The maximum displacement of a particle (in S.H.M.) from its mean position is called as…………

(a) Frequency
(b) period
(c) Wavelength
(d) amplitude

Q26. If sound source or observer or both are moving away from each other then apparent frequency ……………. True frequency.

(a) is more than (c) is equal to
(b) is less than (d) is less than or equal to

Q27. The process of spontaneous emission of radiations from radioactive substance is known as…………

(a) photoelectric emission **(c) radioactivity**
(b) thermoemission (d) LASER

Q28. Radioactive disintegration equation is ……………

(a) $t=t_0e^{-\lambda N}$ **(c) $N=N_0e^{-\lambda t}$**
(b) $t=t_0e^{\lambda N}$ (d) $N=N_0e^{\lambda t}$

Q29.A tuning fork of frequency 512 Hz produces a wave of 65 cm, Velocity of sound in air will be………..

(a) 3.5 m/s (c) 396.4m/s
(b) 380.82 m/s **(d)332.8m/s**

Q30. Half-life period of radioactive substance given by $T_{1/2}$ is equal to…………….

(a) 0.693/ λ (c) λ / 2
(b) λ/0.693 (d) 2/ λ

Q31. An observer is moving away from siren of frequency 300Hz with a velocity of 150m/s. The Velocity of sound is 330 m/s.The frequency of sound heard by the observer will be..…………….

(a) 550 Hz (c) 175.5 Hz
(b) 150.25Hz (d) 190.9 Hz

Q32. Full form of SONAR is………..

(a) Sound for Navy and Army **(c) Sound Navigation and Ranging.**
(b) Sound Noticed by Radar (d) Sound of not activated range

Q33. The time taken by a particle to complete one oscillation is called as………of oscillation.

(a) frequency (c) Wavelength
(b) period (d) amplitude

Q34. Which of the following is not an application of ultrasonic?

(a) material analysis (c) SONAR
(b) detection of flaws of material (d) sonography

Q35. The normal healthy human ear can hear the sound waves of frequency……………..?

(a) less than 20Hz (b) 20Hz to 20 kHz

(c) more than 20 kHz
(d) more than 50 kHz

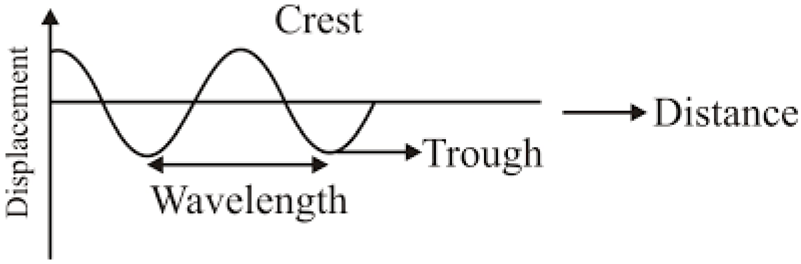
Q36. Which of the following is not a piezo-electric material?
(a) Quartz
(b) Rochelle salt
(c) Topaz
(d) Uranium

- **Relation between Velocity, Frequency and Time Period of wave:**

Relation between v,n and T:

$$\text{Velocity} = \frac{Distance\ covered}{Time\ taken}$$

$$V = \frac{\lambda}{T}$$



Frequency wavelength and wave velocity are related as follows:

Wave length is the distance travelled by the wave during the time a particle of the medium completes one vibration.

Therefore, if λ be the wavelength and T the time period then the wave travels a distance λ and time T

Hence,

Wave velocity =Time Distance

⇒v=Tλ

∴v=nλ [T1=frequency(ν)]

∴ Wave velocity= Frequency × Wavelength

$V = n\lambda$

The wave velocity in a medium remains constant under the same physical condition.

Q37. Which of the following is not a natural piezo-electric material?

(a) Quartz
(b) Rochelle salt
(c) Topaz
(d) Gallium phosphate

Q38. General formula for apparent frequency considering Doppler effect is…………

(a) n'=nX(V-Vo)/(V-Vs)
(b) n'= nX(V-V_0) X (V-Vs) X (V-Vs)
(c) n'=nX(V+Vo)/(V+Vs)
(d) n'=n(V_0-Vs)

Q39. The sound waves of frequency less than 20Hz are known as…………..

(a) infrasonic
(b) audible sound
(c) ultrasonic
(d) supersonics

Q40. A tuning fork vibrates with a frequency of 512 Hz. If the velocity of the wave is 330m/s distance travelled in 5 vibration will be…………..

(a) 581.8 Hz
(b) 3.2m
(c) 600.5 Hz
(d) 620.5Hz

Q41. A siren producing frequency of 400 Hz is moving towards observer with a velocity of 200 m/s and observer is moving towards siren with a velocity of 50 m/s. the frequency of sound heard by the observer will be…………..

(a) 555.5 Hz
(b) 575.5 Hz
(c) 249Hz
(d) 725.5Hz

Q42. Which of the following is not an application of ultrasonic?

(a) to detect and locate submarine object
(b) alcohol detector
(c) to break stones in kidney
(d) to determine depth of sea

Q43. Which of the following is an application of ultrasonic?

(a) to detect and locate submarine object
(b) All of these
(c) to break stones in kidney
(d) to determine depth of sea

Q44. If sound source or observer or both are moving away from each other then apparent frequency ……………. True frequency.

(a) is more than
(b) is less than
(c) is equal to
(d) is less than or equal to

Q45. Which of the following is not an application of Doppler effect?

(a)to calculate velocity of moving aeroplanes and submarines
(b)in estimating the speed of distant stars and planets
(C)to measure speed of cars on highway
(d)to detect flaws in aeroplanes

Q46. A siren pitch of 300 Hz is moving away from the stationary observer with a velocity of 100 m/s . the velocity of sound is 330m/s.find the sound heard by the observer.
(a) 849Hz (c) 649Hz
(b) 349Hz **(d) 230.2Hz**

Q47. A siren pitch of 400 Hz is moving away from the stationary observer with a velocity of 100 m/s . the velocity of sound is 50m/s.find the sound heard by the observer.
(a) 849Hz **(c) 660.86Hz**
(b) 349Hz (d) 249Hz

Q48. A siren pitch of 400 Hz is moving away from the stationary observer with a velocity of 50 m/s and observer is moving away from the siren with a velocity of 100m/s. the velocity of sound is 330m/s.find the sound heard by the observer will be……………………
(a) 180Hz (c) 220Hz
(b) 200Hz **(d) 242Hz**

Q49. Jacques and peirre Curie found that crystal like quartz develop electric charges across their faces when mechanical pressure is applied to it is called……………
(a) piezo-electric effect (c) pressure effect
(b)converse piezo-electric effect (d) electric effect

Q50. Longitudinal sound waves travel in the form of alternate …………..
(a) crest and trough (c) crest and compression
(b)compression and rarefaction (d) trough and rarefaction

…………………..………………xxxxxxx…………………………………………

3. PHOTO ELECTRICITY, X-RAYS AND LASERS

MCQ Question

Total Marks-11

(Total number of Question=Marks*3=11*3=33)

Note: Correct answer is marked with **bold.**

- **3.1 PHOTOELECTYCITY:**

When light of suitable frequency (wavelength)is incident on the metallic surface, electrons are emitted from the metal surface. As the effect takes place under the influence of light (photo), it is called as photoelectric effect and the emitted electrons are called as photoelectrons.

Light energy (photo) —— converted into ——→ Electric energy

Plank's Hypothesis (Plank's Quantum Theory)

- According to this theory, energy is not emitted and absorbed continuously, but in a discrete (intermitted) unit or packets (bundle). These energy packets are call as photons or quanta.
- The photons are electrically neutral and travel with speed of light i.e. radiation is considered as shower of photons.
- If υ is the frequency of light Photon the energy associated with the photon is directly proportional to υ.

  $E \propto \upsilon$, $E = \text{Constant} \times \upsilon$

  $E = h\upsilon$ where , h = planck's constant = 6.63×10^{-34} Js

- According to this theory, energy is always emitted or absorbed in integral multiple of $h\upsilon$ and not in fraction of $h\upsilon$.

E = h υ where n = integer = 1,2, ……

Q1. When light of suitable frequency is incident on metallic surface, then electrons are emitted from the metal surface, this effect is known as…..…………..

(a) thermoelectric effect
(b) photoelectric effect
(c) heating effect of electric current
(d) Seebeck effect

Q2. According to planck's theory, energy is not emitted and absorbed continuously, but in a discrete units or packets (bundle).These energy packet are called as…..…………..

(a) electrons
(b) protons
(c) photons(quanta)
(d) neutrons

Q3. Photons(quanta) are electrically…..…………..

(a) positive
(b) negative
(c) neutral
(d) none of these

Q4. Photons(quanta) travel with a speed…..…………..

(a) of sound
(b) of light
(c) less than sound
(d) less than light

Q5. Photons(quanta) is …..…………..

(a) indivisible entity
(b) divisibly entity
(c) electrically positive
(d) electrically positive

Q6. As per Einstein's theory of relativity …..…………..

(a) $E=m/c^2$
(b) $E=mc^2$
(c) E=mc
(d) E=m/c

Q7. The value of 'h' planck's constant have value …..…………..

(a) $3.36x10^{-34}$ Js
(b) $6.63x10^{34}$ Js
(c) $6.63x10\text{-}^{34}$ Js
(d) none of these

- ## Properties of photons (Characteristics)

- **The existence of photon:** The fact or state of existing. The photon is a indivisible entity. The existence of photon is same as existence of electron.
- **Non-electrical nature of photon:** Photons are electrically neutral i.e. photons cannot be deflected by electric field.
- **Non-magnetic nature of photon:** Photons cannot be deflected by magnetic field.

- Photon travel with speed of light i.e. $3x10^8$ m/s
- Photon do not ionize.
- **Mass and momentum of a photon:** Mass and energy are equivalent (Einstine's theory of relativity). The mass of photon is given by

$$m = \frac{E}{c^2} = \frac{h\upsilon}{c^2} = \frac{H}{C\lambda}$$

where m= Mass of photon, E = energy of photon
c = Speed of light, υ = Frequency of radiation
λ = Wavelength of radiation, h = Planck's constant

and momentum of photon is given by
Momentum = Mass x Velocity

$$= m \times c = \frac{h\upsilon}{c^2} \times c \quad \frac{h\upsilon}{c} = \frac{h}{\lambda}$$

- **Some important definitions**
- **Threshold frequency (υ_o):** Threshold frequency υ_o of a metal is the minimum frequency of the incident light at which emission just begins. υ_o changes from metal to metal.
- **Threshold wavelength (λo) :** Threshold wavelength λo of a metal is the maximum wavelength of incident light at which emission just begins.
- **Photoelectric work function (W_o) :** Photoelectric work function W_o of a metal is the minimum energy of incident photon required to detach the electron from the metal.
- **Stopping potential :** Stopping potential of photoelectric cell is the negative potential given to the cell at which photoelectric current becomes zero.

Q8. Photons …..…………..
(a) deflect by electric field
(b) deflect by magnetic field
(c) do not ionize
(d) ionize

Q9. Energy E associated with photon is given by……………..
(a) E=h/√
(b) h=E√
(c) E=h+√
(d) E=h√

Q10. Mass of photon is given by……………..
(a) m=h/cλ
(b) h=E√

(c) E=h+√
(d) E=h√

Q11. Einstein's photoelectric equation is given by……………..
(a) $1/2mv^2=h(\surd_0 - \surd)$
(b) $1/2mv^2=2h(\surd - \surd_0)$
(c) $1/2mv^2=h(\surd - \surd_0)$
(d) $1/2mv^2=h/(\surd - \surd_0)$

Q12. The amount of energy required to separate electron from atoms called as…………
(a) kinetic energy
(b) photo electric work function
(c) potential energy
(d) light energy

Q13. The value of photo electric work function W_0 depends on ……….
(a) nature of metal
(b) speed of photons
(c) medium
(d) area of metal plates

Q14. Threshold frequency $\surd_0$ of the metal is the ………. Frequency of the incident light at which………
(a) minimum, emission does not take place
(b) maximum, emission does not take place
(c) minimum, emission just begins
(d) maximum, emission just begins

Q15. The negative potential given to the photoelectric cell at which photoelectric current becomes Zero is called as…………
(a) photo potential
(b) light potential
(c) stopping potential
(d) Zero potential

Q16. The velocity of photoelectron is directly proportional to……………
(a) speed of photon
(b) intensity of light
(c) Frequency of light
(d) temperature of metal

Q17. Photoelectric current is directly proportional to…………….
(a) speed of photon
(b) energy of photon
(c) Frequency of light
(d) intensity of incident light

Q18. In Einsteins equation $½ mv^2 = h(\surd - \surd_0)$ if $\surd = \surd_0$ then …………….
(a) emission just begins
(b) emission takr place
(c) no emission
(d) rate of emission is high

Q19. In Einsteins equation $½ mv^2 = h(\surd - \surd_0)$ as √ increases **…………….……………..**
(a) K.E decreases
(b) velocity of photoelectron decreases
(c) velocity of photoelectron increases
(d) mass of photoelectron increase

Q20. As per principle of photoelectric cell ……………….….
(a) electrical energy is converted into light energy

(b) light energy is converted into electrical energy
(c) light energy is converted into kinetic energy
(d) light energy is converted into heat energy

Q21. Which of the following is not the application of photoelectric cell…………….
(a) Burglar alarm
(b) lux meter
(c) automatic street light controller
(d) to cure deseases like cancer

Q22. Which of the following is not the application of LDR ?
(a) used in security alarms
(b) used as smoke detector
(c) used in dental surgery
(d) street light controller

Q23. The energy of photoelectron is 2.4 ev its frequency will be………..
(a) 2.4×10^{14} Hz
(b) 5.79×10^{14} Hz
(c) 8×10^{14} Hz
(d) 9.59×10^{14} Hz

Q24. In most of the application of photoelectric cell,the property used is………..
(a) speed of photoelectron α frequency of light
(b) photoelectric current α frequency of light
(c) photoelectric current α intensity of light
(d) none of these

Q25. The principle of LDR is………..
(a) its resistance decreases as intensity of incident light increases.
(b) number of photoelectron increases with increase in intensity of light.
(c) its resistance increases with intensity of light
(d) its resistance increases with frequency of light

Q26. An accelerated electron emits a quantum of radiation with frequency 9×10^{19} cycle per second. Energy of photon will be………..
(a) 5.97×10^{-14} Hz
(b) 2.34×10^{-14} Hz
(c) 7.6×10^{-14} Hz
(d) 9.56×10^{-14} Hz

Q27. X –ray are the electromagnetic radiation of very short wavelength in the order of………..
(a) 10^{-10} to 10^{-11} m
(b) 10^{-2} to 10^{-3} m
(c) 10^{-5} to 10^{-6} m
(d) 10^{5} to 10^{6} m

Q28. When fast moving electron are suddenly stopped then………………
(a) laser are produced
(b) current are produced
(c) x-rays are produced
(d) none of these

Q29. In Coolidge tube . the target (T) material should have some properties . which of the following properties is not required? ………………

(a) target material should have high melting point
(b) target material should have high thermal conductivity.
(c) target material should have high atomic weight.
(d) target material have high ductility.

Q30. Which of the following is not property of LASER light……………?
(a) is coherent
(b) is monochromatic
(c) beam is extream intense
(d) high penetration power

Q31. Life time of hydrogen is………………
(a) 10^{-3} sec
(b) 10^{-8} sec
(c) 10^{3} sec
(d) ten years

Q32. An atom remains in excited state for very very small time (10^{-8} sec) and come to ground state Immediately. this state is known as……………………….
(a) short excited state
(b) temporary excited state
(c) metastable excited state
(d) ordinary excited state

Q33. The relaxation time for metastable state is ……………………….
(a) ten years
(b) 1 years
(c) 10^{2} to 10^{4} sec
(d) 10^{-6} to 10^{-3} sec

Q34. Which of the following is not an application of laser……………..
(a) used for engraving and embossing
(b) used for cutting and drilling metals
(c) used for chemical analysis
(d) used in computer printer

Q35. Making population of higher energy level more than that of ground state is called…………….
(a) population hiker
(b) population inversion
(c) crowd maker
(d) none of these

Q36. A system in which population inversion is achieved is called……………
(a) inverse system
(b) active system
(c) perfect system
(d) real system

Q37. The process of raising atoms from lower energy state to higher energy state is called….
(a) lifting
(b) hiking
(c) gaining
(d) pumping

Q38. Which of the following is not a pumping method in LASER ?
(a) capital pumping
(b) electrical pumping
(c) chemical pumping
(d) jet pumping

Q39. In the case of He-Ne laser pumping method used is…………..

(a) optical pumping
(b) electrical pumping
(c) inelastic atom-atom collision
(d) chemical pumping

Q40. Proper lasing action can be produced using……………

(a) one energy level laser system
(b) two energy level laser system
(c) three energy level laser system
(d) none of these

- ## Einstein's Photoelectric Equation

- According to quantum theory, radiation is considered as shower of particles called photons. Each photon carries energy E= hυ. These photons travel with speed of light. When radiation falls on the metal, these photons collide with the metal atoms.

- Energy of photon absorbed by the atom (hυ) is
  Used to detach the electron (W_o) and
  Given the electron in the form of kinetic energy,

  Thus,

$$h\upsilon = W_o + K.E.$$

$$h\upsilon = W_o + \frac{1}{2} mv^2$$

$$\boxed{\frac{1}{2} mv^2 = h\upsilon - W_o}$$

where W_o = photoelectric work function

$W_o = h\upsilon_o$

$$\frac{1}{2} mv^2 = h\upsilon - h\upsilon_o$$

$$\boxed{\frac{1}{2} mv^2 = h(\upsilon - \upsilon_o)}$$

This equation is Einstein's photoelectric equation

where, m = Mass of electron, v = Velocity of electron

h = Planck's constant, υ = Frequency of radiation

υ_o = Threshold frequency

Cases :

If $\upsilon < \upsilon_o$ ….. K.E.is negative ..... meaningless ….. no emission

If $\upsilon < \upsilon_o$ ….. K.E.is zero ….. emission just begins.

If $\upsilon < \upsilon_o$ ….. K.E.is positive ….. emission takes place.

Q41. The advantages of gas laser are…….

(a) high monochromaticity and stability frequency
(b) low monochromaticity and stability frequency
(c) high speed of laser
(d) low monochromaticity as well as high seed

Q42. In He-Ne laser, the tubs is filled with………

(a) 50% He and 50% Ne
(b) 90% He and 10% Ne
(c) 10% He and 90% Ne
(d) 60% He and 40% Ne

Q43. In He-Ne laser, actual lasing atoms are………

(a) Helium
(b) Neons
(c) Hydrogens
(d) Oxygens

Q44. Laser gain medium is a medium which can…….the power of light

(a) reduce
(b) subtract
(c) amplify
(d) decrease

Q45. X-rays travel with speed of light X-rays produce ionization in the gases……..

(a) True, True
(b) True, False
(c) False, True
(d) False, False

Q46. Which of the following is not an application of X-rays…………

(a) used to detect cracks in the body of aeroplane
(b) used to detect smuggling gold at airport
(c) used as sensor in atomization industry
(d) to detect cracks in the bridge

Q47. Which of the following is not an application of X-rays…………….

(a) used in speedometer of vehicle
(b) used to study crystal structure
(c) used in chemical analysis
(d) use to study structure of substances like rubber, plastic

- **<u>Photoelectric cell:</u>**

Principle : Light energy is converted into electrical energy.

- Photoelectric cell consists of (i) cathode K and (ii) anode A, enclosed in an evacuated glass bulb.
- The semi-cylindrical cathode coated with the photosensitive material forms the inner side. The anode is a rod of platinum kept along the axis of cathode. The cathode is connected to the negative terminal and anode is connected to the positive terminal of high tension battery through milliammeter.
- When light is allowed to fall on cathode, it emits photoelectrons. These electrons are attracted by the anode.
- The photoelectric current flows through the circuit and milliammeter shows a definition.

Fig Photo emissive cell

- **Types of Photoelectric Cell :**
  - **Photoemissive cell**
  - **Photoconductive cell**
  - **Photovoltaic cell**

- ## Applications of Photoelectric Cell
- When light falls on photocell, it becomes ON and when intensity of light increases. Then photoelectric current also increases. These characteristics play major role in most of the and applications.
- Photoelectric cell is used in lux-meter to measure the intensity of light. (Principle – Photoelectric current is directly proportional to the intensity of light)
- It is used for automatic control of traffic signals.
- It is used to switch on off automatically the street light.
- It is used on recording and reproduction of sound during shooting of a film.
- Photoelectric cell are used in television sets, fire alarms.
- Photoelectric cell is used in **Burglar alarms.**
- Photoelectric cell is used in exposure meter.
- It is used as Lux meter, to measure the intensity of light.

- ## Light Dependent Resistor (LDR) or Photoresistor
- It is a general purpose photoconductive cell. LDR is a type of semiconductor whose conductivity changes with the intensity of light.
- **LDR:**
- **Principal :** The electrical resistance of LDR decreases as the intensity of incident light increases.
- In semiconductor an energy gap exists between valence band and conduction band.
- When light is allowed to fall on this LDR (semiconductor), a photon is absorbed by the material and electron from valence band get excited and jump into the conduction band and hence conductivity of the material increases or resistivity of the material decreases.
- ## Applications of LDR
- LDR (photoconductive cell) is used
- in camera for exposure control
- in photocopy (xerox) machine – to control density of toner
- in security alarms
- as smoke detector
- automatic lighting control

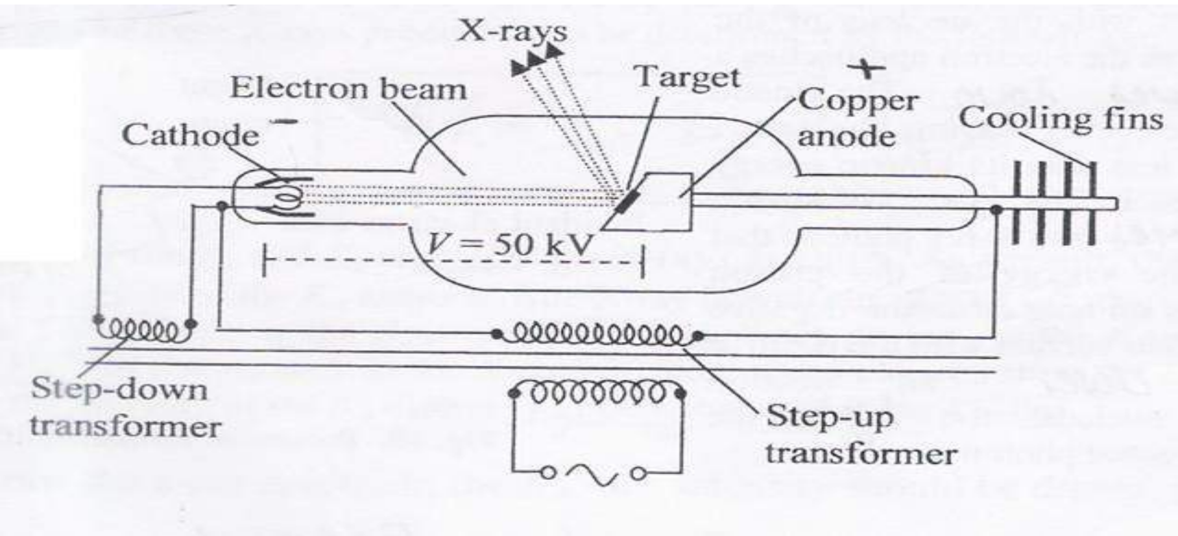
- street light control
- colorimetric test equipment
- automated rare view mirror

- **X-RAYS**
- **Production of X-Rays using Modern Coolidge X-Ray Tube**
- **Principle:** When fast moving electrons (e^-) are suddenly stopped then X-ray are produced

Four stages of production of X-rays :

Generate electrons → Accelerate electrons → Stop fast moving electrons → Cooling system to compensate heat produced

- The modern x-ray tube used for the production of x-rays is known as Coolidge tube. It consists of highly evacuated hard glass bulb with a cathode (filament) and anti-cathode or anode.



- The cathode i.e. metal filament is surrounded by molybdenum metal cylinder kept at negative potential to the filament. Hence, the electrons.
- The target T consist copper block in which a piece of tungsten or molybdenum is fitted. The anode should possess the following properties.
- **High meeting point:** So that it is not melted due to bombardment of fast moving electrons which produce large amount of heat.
- **High atomic weight:** To produce the hard x-rays.
- **High thermal conductivity:** To carry away the generated heat.
- The target is placed at an angle of 45^0 with the path of electrons beam.

- When the cathode (filament) is heated by an electric current, it produces electrons due to process known as *thermionic emissions.* This beam of electrons is then focused on the anode (target)
- **By controlling the filament current,** the thermionic emission of electrons and hence the **intensity of x-rays can be controlled.**
- The **penetrating power of x-rays** determines the quality of X-rays which can be **controlled by changing the voltage between cathode and anode.**
- The **X-rays** of **high penetrating power** and **higher frequency** are called **hard X-rays** and those with **low penetrating power** and low **frequency** are called **soft X-rays.**
- **The intensity of X-rays depends on filament current. Penetrating power of X-rays** depends upon the **potential difference (P.D.) between cathode and anode.**

- ## Properties of X-Rays
- They are electromagnetic waves of very short wavelength
- They travel with speed of light ($c=3x10^8 m/s$)
- X-ray affect photographic plates
- They produce fluorescence in many substances e.g. zinc sulphide
- They can be reflected or refracted under certain conditions.
- They are not deflected by magnetic or electric field.
- They have high penetrating power and hence can pass through many solids.
- They produce small amount of ionization in the gases through which they pass.
- They produce photoelectric effect.
- X rays kill some form of animal cells.
- X-rays (light rays) are invisible to Eyes.
- ## Application of X-Rays
- **Engineering Applications:**
- X-rays are used to detect cracks in the body of an aeroplane or motor car
- X-rays are used to detect manufacturing defect in rubber type or tennis ball in quality control.
- X-rays are used to detect flaws or cracks in metal jobs.
- They are used to distinguish real diamond from duplicate one.

- X-rays are used to detect smuggling gold at airport and dock (Ship) yard.
- They are used to detect cracks in the wall, bridge (civil engineering)
- X-rays radiography is used to check the quality of welded joints.

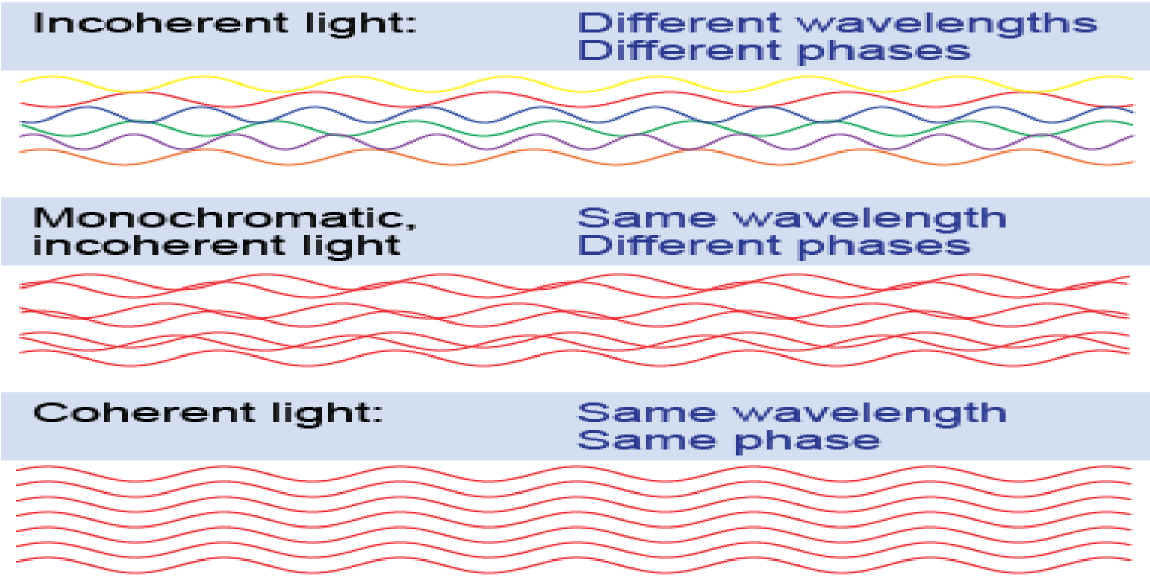
- **Medical Applications:**
- X-rays are used in surgery to detect bone fractures. The reason in penetration power of X-rays through muscle (skin) and bone is different.
- X-rays are used to cure skin diseases and destroy tumours.
- X-rays are used to cure diseases like cancer.
- X-rays are used to detect bullet's position inside the body

- **Scientific Applications:**
- X-rays are used to study structure of crystal (e.g. weather hexagonal, rhombus…) The structure of an alloy is studies with the help of diffraction of X-rays to determine the crystal from.
- They are used in chemical analysis and for determination of atomic number of chemical elements.
- X-rays are used for identification of chemical element present in the solution.
- X-rays are used to analysis of structure of organic molecules.

LASER

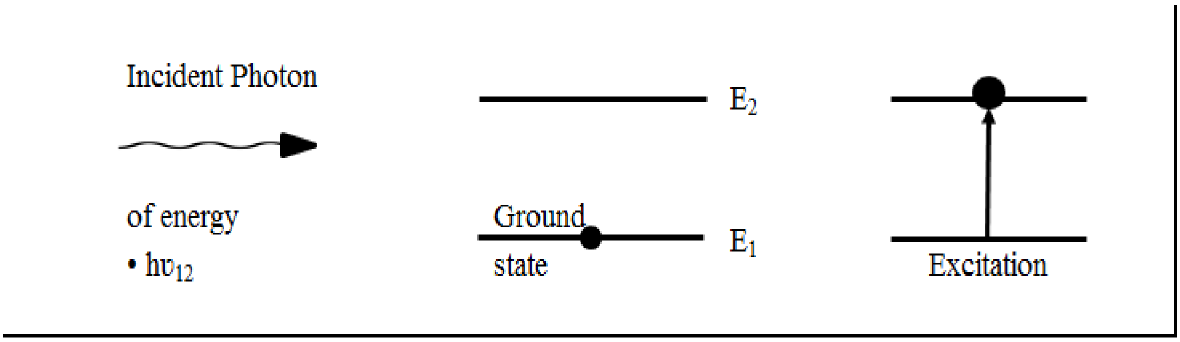
- ## Light Application by Stimulated Emission of Radiation (LASER)
- The term LASER stands for Light Application by Stimulated Emission of Radiation.
- **The light is coherent**: The light with the waves, all exactly in same phase.
- **The Light is monochromatic:** The light whose waves all have the same frequency or wavelength.
- **The light has unidirectionality**: The light produces sharp focus.
- **The beam is extremely intense:** The light has extreme brightness.

- In order to understand the concept properly observe the pictorial difference given below.



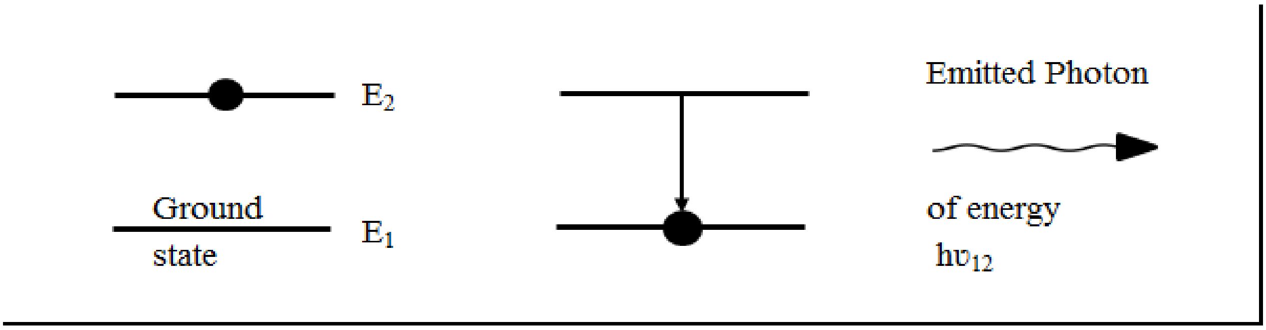
- **Absorption or Stimulated Absorption**
- When a photon of energy $h\upsilon = E_2 - E_1$ is incident on an atom, then the atom gets excited i.e. moves from lower energy level E_1 to higher energy level E_2.

- **Spontaneous Emission**
- *After completion of life time, the excited atom comes to ground (lower) energy state spontaneously (on its own accord) emitting a photon hυ. this is known as spontaneous emission.*

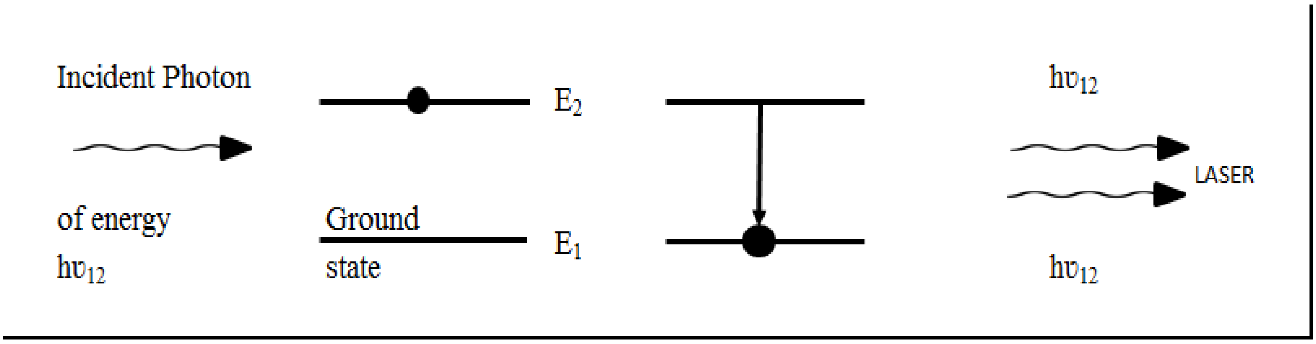


- The spontaneous emission depends on type of particle and type of transition, but is independent of outside circumstances.

- *Radiations which are emitted spontaneously are random in direction, random in phase.*



- **Stimulated Emission**
- When an atom is in excited state on before coming to ground (lower) state if the atom is triggered due to an action of incident Photon. T*he interaction between the excited atom an incident Photon can Trigger the excited atom make a transition to ground state.*



- **Metastable excited state**

Spontaneous emission	Stimulated emission
1. Excited atoms come to ground state on its own accord	1. Excited atoms come to ground state after interaction with incident photon.
2. Radiations are random in direction, phase and wavelengths.	2. Radiations are coherent, monochromatic and in same direction

- **Engineering Applications of Lasers**
- Lasers are used for **engraving** and **embossing** of printing plates e.g. number plate, name plate of company monogram of the company.
- Laser are used in **cutting, drilling** (peening) and **welding metal**.

- Laser are used in **holography**
- Laser are used in **computer printers**
- Laser are used for 3D (3-dimensional) laser scanner - analyse the real world object-collected data can be used to construct digital 3-dimensional (3D) models.
- Laser are used in control **heat treatment**.
- Laser through Optical Fiber is used to transfer data from one computer to other.
- Laser used to find flaws or defect in a material

Q48. LASER light is coherent means…………….

(a) all the waves have some frequency or wavelength

(b) all the waves are exactly in same phase

(c) all the waves are exactly opposite in phase

(d) all the waves carry some energy

Q49. Atom in the ground state absorbs energy of incident photon and get excited towards higher energy level. This process is known as……….

(a) spontaneous emission

(b) stimulated emission

(c) stimulated absorption

(d) photon collision

Q50. In He-Ne laser,the metastable stast of He and Ne where energy transfer through collision takes place are................

(a) 20.61 ev and 20.66 ev

(b) 18.7 ev and 20.66 ev

(c)20.66 ev and 18.7 ev

(d) 18.7 ev and 18.82ev

………………………………………XXX………………………………………..