Q&A

WORK BOOK CUM QUESTION BANK WITH ANSWERS

PHYSICS

CLASS - XII

SCHEDULED CASTES & SCHEDULED TRIBES
RESEARCH & TRAINING INSTITUTE (SCSTRTI)
ST & SC DEVELOPMENT DEPARTMENT
BHUBANESWAR

Work Book
cum
Question Bank with Answers

PHYSICS

CLASS-XII

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SCHEDULED CASTES & SCHEDULED TRIBES
RESEARCH & TRAINING INSTITUTE (SCSTRTI)
ST & SC DEVELOPMENT DEPARTMENT
BHUBANESWAR

2020

FOREWORD

An innovative education program has been initiated by ST & SC Development Department, Govt. of Odisha for the students appearing in +2 Science and Commerce examination pursuing studies in the ST & SC Development Department Schools (EMRS & HSS) to ensure quality education at +2 level.

In this regard it is to mention that an Academic Performance Monitoring Cell (APMC)has been set up in SCSTRTI to monitor the Training and Capacity Building of Teachers of SSD Higher Secondary Schools and Ekalabya Model Residential Schools (EMRS) to enhance quality education for better performance of the students appearing +2 Science and Commerce examination.This effort by APMC will certainly help the students to equip themselves for appropriate answering the question in the examination in an efficient manner.

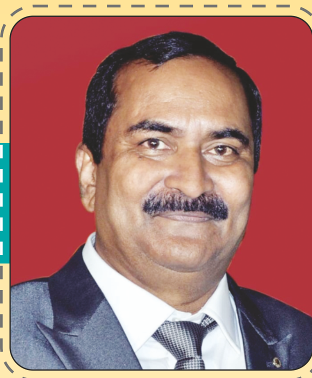
In order to materialize the effort, thebest ofsubject experts of the state have been roped into formulate self-contained and self-explanatory "Work book cumQuestions Bankwith Answers" as per the syllabi of CHSE,Odisha.They have tried to make the material as far as activity based and solution based as possible.This novel effort is first of its kind at +2 level in Odisha.

I would like to extend my thanks to Prof.(Dr.) A.B. Ota, Advisor-Cum-Director and Special Secretary, SCSTRTI and the team of Subject experts for their sincere effort for bringingout the study materials in quick time.

Hope, these study materials will be extremely useful for the students appearing the +2 examination in Science and Commerce of our SSD Schools.

Ranjana Chopra
Principal Secretary
ST & SC Development Department
Govt. of Odisha

PREFACE



The ST and SC Development Department, Government of Odisha, has initiated an innovative effort by setting up an Academic Performance Monitoring Cell (APMC) in Scheduled Castes and Scheduled Tribes Research and Training Institute (SCSTRTI) to monitor the Training and Capacity Building of teachers of SSD Higher Secondary Schools and Ekalavya Model Residential Schools (EMRS) and to ensure quality education of students studying at +2 level under the administrative control of the ST & SC Development Department. This innovative programme is intended to ensure quality education in the Higher Secondary Level of the schools of the ST & SC Development Department.

Since the introduction of +2 Science and +2 Commerce stream by the Council of Higher Secondary Education, Odisha, there was a great demand to cater to the needs of the students appearing the +2 Examination. But no organisation or institute has taken the initiative to fulfil the needs of the students appearing the +2 examination. Realizing the necessities and requirements of students to perform better and secure better marks in the examination and proper pattern of answering the question in a scientific way, the APMC under the banner of SCSTRTI has taken the initiative for the first time in Odisha to prepare Questions Banks in Physics, Chemistry, Botany, Zoology, Mathematics, IT, English & Odia of the Science Stream and all the disciplines of the Commerce stream in line with the Syllabus of the Council of Higher Secondary Education (CHSE).

These questions banks are first of this kind in Odisha, as per syllabi of CHSE and are self contained and self explanatory. The subject expert, who are the best in their respective subjects in the state have been roped in for the exercise. They have given their precious time to make the question banks as activity based and solution based as possible.

I take this opportunity to thank all the subject experts of different subjects for rendering help and assistance to prepare the question banks within a record time. I hope, this material will be extremely useful for the students preparing for the +2 examination in different subjects of Science & Commerce streams.

Prof. (Dr.) A.B. Ota
Advisor cum Director & Special Secretary
SCSTRTI, Govt. of Odisha

PHYSICS (2nd Year) Syllabus

Unit-I Electrostatics (22 Periods)

1. Electric charges and fields:

Electric charge and its quantization, conservation of charge, Coulomb's law, force between two point charges, force between multiple charges, superposition principle, Continuous change distribution.

Electric field due to a point charge, electric field lines, electric field due to a dipole at any point, torque on a dipole in uniform electric field.

Electric flux, Gauss's theorem (statement only) and its applications to find field due to uniformly charged infinite plane sheet, infinitely long straight wire and uniformly charged thin spherical shell (field inside and outside).

2. Electrostatic potential and capacitance:

Electric potential, potential difference, electric potential due to a point charge, potential due to a dipole, potential due to a system of charges. Equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field.

Conductors, insulators, free charges and bound charges inside a conductor, Dielectrics and electric polarization, capacitors and capacitance, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, combination of capacitors in series and in parallel energy sorted in a capacitor.

Unit-II Current Electricity: (20 Periods)

Electric current, drift velocity, mobility and their relation with electric current, Ohm's law, electrical resistance, conductance, resistivity, conductivity, effect of temperature on resistance, v ~ I characteristics (linear and non-linear), electrical energy and power, carbon resistors, colour code of carbon resistors, combinations of resistors in series and parallel.

EMF and potential difference, internal resistance of a cell, combination of cells in series and parallel, Kirchhoff's laws and simple applications. Wheatstone bridge and meter bridge. Potentiometer-Principle and its applications to measure potential difference and for comparing EMF of two cells; measurement of internal resistance of a cell.

Unit-III Magnetic effect of Current and magnetism: (22 Periods)

1. Moving charges and magnetism:

Concept of magnetic field, Oensted's experiment, Biot-Savart law and its application to find magnetic field on the axis and at the centre of a current carrying circular loop, Ampere's law and its application to infinitely long straight wire. Straight and toroidal solenoid (qualitative treatment only); Force on a moving charge in uniform magnetic and electric fields, Cyclotron.

Force on a current carrying conductor in a uniform magnetic field, force between two parallel current carrying conductors- definition of ampere, torque experienced by a current loop in uniform magnetic field, moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.

2. Magnetism and matter :

Current loop as a magnetic dipole and its magnetic dipole moment, magnetic dipole moment of a revolving electron, magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis, torque on a magnetic dipole (bar magnet) in a uniform magnetic field, bar magnet as an equivalent solenoid, magnetic field lines, earth's magnetic field and magnetic elements.

Para-, dia- and ferro- magnetic substances with examples, Electromagnets and factors affecting their strengths, permanent magnets.

Unit-IV Electromagnetic induction and Alternating current: (20 Periods)

1. Electromagnetic induction :

Faraday' laws of electromagnetic induction, induced EMF and current, Lenz's law, Eddy currents, self and mutual induction.

2. Alternating Current:

Alternating currents, peak and RMS value of alternating current / voltage, reactance and impedance, LC oscillation (qualitative idea only), LCR series circuit, resonance, power in AC circuits, wattles current, A.C. generator and transformer.

Unit-V Electromagnetic waves: (04 Periods)

Basic idea of displacement current, qualitative idea about characteristics of electromagnetic waves, their transverse nature.

Electromagnetic spectrum (radio waves, microwaves, infrared, visible, Ultra violet, X-ray and gamma rays), including elementary ideas about their uses.

Unit-VI Optics (25 Periods)

1. Ray optics and optical instruments:

Reflection of light, spherical mirrors, mirror formula, lateral and longitudinal magnification, refraction of light, refractive index, its relation with velocity of light (formula only) total internal reflection and its applications, optical fibre, Refraction at spherical surfaces, thin lens formula, lens makers formula, magnification, power of lenses, combination of two thin lenses in contact, combination of a lens and a mirror, refraction and dispersion of light through prism;

Scattering of light: blue colour of sky and reddish appearance of sun at sunset and sunrise. Optical instruments: microscopes and telescopes (reflecting and refracting) and their magnifying powers.

2. Waves Optics :

Wave front, Huygen's principle, reflection and refraction of plane wave at a plane surface using wavefronts, proof of laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width, coherent sources, sustained interference of light, diffraction due to a single slit, width of a central maximum, resolving power of microscope and astronomical telescope (qualitative idea), polarization, plane polarized light, Brewster's law, uses of plane polarized light and polaroids.

Unit-VII Dual nature of Radiation and matter: (08 Periods)

Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations, Einstein's photoelectric equation, particle nature of light.

Matter waves- wave nature of particles, de-Broglie relation, Davisson- Germer experiment, (only conclusions should be explained).

Unit-VIII Atoms and Nuclei (14 Periods)

1. Atoms:

Alpha- particle scattering experiment, Rutherford's model of atom, its limitations, Bohr model, energy levels, hydrogen spectrum.

2. Nuclei:

Atomic nucleus, its composition, size, nuclear mass, nature of nuclear force, mass defect, binding energy per nucleon and its variation with mass number, nuclear fission, fusion, Radioactivity, alpha, beta and gamma particles/ rays and their properties, radioactive decay law, half life and decay constant.

Unit-IX Semiconductor electrocnics: (15 Periods)

Energy bands in conductors, semiconductors and insulators (qualitative idea only), p-type, n- type semiconductors, semiconductor diode, V-I characteristics in forward and reverse bias, diode as a half and full wave rectifier (centre tap), efficiency (no derivation).

Special purpose p-n junction diodes: LED, photodiode, solar cell and Zener diode and their characteristics, Zener diode as a voltage regulator.

Junction transistor, transistor action, Characteristics of transistor, transistor as an amplifier (CE configuration), basic idea of analog and digital signals, Logic gates (OR, AND, NOT, NAND, and NOR)

Unit-X Communication System: (10 Periods)

Elements of a communication system (block diagram only), bandwidth of signals (speech, TV and digital data), bandwidth of transmission medium, propagation of electromagnetic waves in the atmosphere, sky and space wave propagation, satellite communication, Need for-modulation, qualitative idea about amplitude modulation and frequency modulation, advantages of frequency modulation over amplitude modulation, basic idea about internet, mobile telephony and global positioning system (GPS).

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QUESTION PATTERN OF CHSE

Theory	:	70 marks
Practical	:	30 marks
Total:		**50 marks**

Units	**Subjects**	**Marks**
Unit-I	Electrostatics	15
Unit-II	Current Electricity	
Unit-III	Magnetic Effects of Current and Magnetism	16
Unit-IV	Electromagnetic Induction and Alternating Currents	
Unit-V	Electromagnetic Waves	17
Unit-VI	Optics	
Unit-VII	Dual Nature of Radiation and Matter	10
Unit-VIII	Atoms and Nuclei	
Unit-IX	Semiconductor Electronics	12
Unit-X	Communication Systems	
	Total	**70**

QUESTION WISE BREAK UP

Type of Question	Mark per Question	Total No. of Question	Total Marks
VSA	1	14	14
SA-I	2	7	14
SA-II	3	7	21
LA	7	3	21
TOTAL			**70**

[VSA-Very Short Answer, Sa-Short Answer, A-Long Answer.]

CHSE QUESTION PAPERS WITH ANSWERS

2019 to 2017

2019 (A)

Time : 3 hours — ***Full Marks : 70***

The figures in the right hand margin indicate marks.
Answer all questions from Group-A and B
serially and continuously, and any three questions from Group-C
No electronic gadgets are allowed into the Examination Hall
Symbols used in the questions carry thier usual meanings.

Group - A

1. **Choose the correct answer out of the four probables given at the end of each bit: [1x7=7]**

(a) The magnitude of force experienced by an electron placed at a point in the electric field $\vec{E}$ is equal to its weight $m\vec{g}$. The magnitude of $\vec{E}$ is

(i) mge (ii) e/(mg)
(iii) mg/e (iv) mg/e^2

(b) A test charge q_0 is brought from infinity along the perpendicular bisector of an electric dipole. The work done on q_o by the electric field of the dipole is

(i) zero (ii) negative
(iii) positive (iv) proportional to q_0

(c) Which of the following is the correct relation among the SI units of capacitance, potential and charge ?

(i) F = CV (ii) $F = C^{-1}V$
(iii) $F = C^{-1}V^{-1}$ (iv) $F = CV^{-1}$

(d) The angle between $\vec{E}$ and $\vec{B}$ in an electromagnetic wave is

(i) 180^0 (ii) 120^0
(iii) 90^0 (iv) 45^0

(e) The distance between the plates of a parallel-plate capacitor of capacitance C is doubled. Its new capacitance will be

(i) 2C (ii) $\frac{1}{2}C$
(iii) C^2 (iv) 4C

(f) Monochromatic light of wavelength 600 nm enters from air into a glass medium of refractive index 1.5. The wavelength of refracted light inside the glass is

(i) 400 nm (ii) 600 nm
(iii) 700 nm (iv) 900 nm

(g) If the kinetic energy of a moving particle of mass m is E, then the de Broglie wavelength α is

(i) $h\sqrt{2mE}$ (ii) $\frac{hE}{\sqrt{2m}}$
(iii) $\frac{\sqrt{2mE}}{h}$ (iv) $\frac{h}{\sqrt{2mE}}$

2. **Answer each bit as directed : [1x7=7]**

(a) Two points in an electric field have a potential difference of 5 V. What is the amount of work done in moving a charge of 3 C from one point to be other ? (Write the answer only)

(b) The relation between weber and tesla is ______.

(c) What is the value of $\frac{1}{4\pi\varepsilon_0}$ in SI unit ? (Write the answer only)

(d) LED emits light when connected in ____.

(Fill in the blank using 'forward bias' or 'reversed bias')

(e) Photoelectric emission occurs when light of wavelength 6000 A falls on a metal. 4500 A falls on the same metal ?

(Write 'Yes' or 'No')

(f) A convex mirror is placed inside water. Will its focal length change ?

(Write 'Yes' or 'No')

(g) Which series of hydrogen spectrum lies in the visible region ?

Group - B

3. Answer any seven of the following bits: [2x7=14]

(a) Three resistance, each of $5\,\Omega$, are connected to form a triangle. Calculate the resistance between two ends of any arm.

(b) Calculate the dimensional formula of electric potential.

(c) Define eqipotential surface. Mention the angle between the equipotential surface and the lines of force on this surface.

(d) The refractive index of diamond is 2.419. Calculate the critical angle for light going from diamond to air.

(e) A biconvex lens is to be made from glass of refractive index 1.5, with both faces having same radius of curvature. Determine the focal length if this radius of curvature is 30 cm.

(f) Draw the V ~ I characteristic curves of a semiconductor diode for forward and reversed bias.

(g) State Faraday's laws of electromagnetic induction.

(h) A region in an electric field is specified by the following potential :

$$V(x) = \frac{a}{x} + b$$

where V is in volt and x is in meter. Find out the units of a and b.

(i) Determine the changes that take place in the atomic number and mass number of a radioactive nucleus after the emits an electron.

(j) Two identical capacitors are first joined in parallel and then in series. Find the ratio of their equivalent capacitance.

4. Answer any seven of the following bits : [3x=21]

(a) The mass numbers of nuclei of two elements A and B are respectively in the ratio 27 :1. If the radius of nucleus of B is 2.4 x 10^{-15}m, calculate the radius of nucleus of A.

(b) Write the expression for impedance in a series LCR circuit connected to an a.c. source and identify the symbols used. Write the expression for resonance frequency.

(c) Define half-life and mean life of a radioactive nucleus. State the relation between them.

(d) Define 'isotope' and 'isobar' and give one example of each.

(e) In Young's double-slit experiment, the fringe width is 0.1 mm when light of wavelength 600 nm is used. Calculate the fringe width when the entire apparatus is immersed in a medium of refractive index 4/3 by keeping the source of light in air.

(f) Write the circuit symbol and the truth table of a three-input AND gate.

(g) v_{21} and v_{31} are respectively the frequencies of the first and second lines of the Lyman series in hydrogen spectrum. If v_{32} is the frequency of the first line of Balmer series, establish the relation among v_{31}, v_{32} and v_{21}.

(h) Draw a neat circuit diagram of a half-wave rectifier using p-n junction diode. Draw the curves for input and output voltage.

(i) An object is placed 12 cm in front of a convex mirror of focal length 18 cm. Determine the position and nature of the image.

(j) Give the basic ideas of internet and global positioning system.

Group - C

Answer any three of the following questions:
[7x2=14]

5. State Biot and Savart law. Derive the expression for the magnetic field at any point on the axis of a circular current-carrying loop. Find its value at the centre of this loop. (2+4+1=7)

6. State and explain Kirchhoffs laws for an electrical network. Apply these to obtain the condition of balance for a Wheatstone's bridge. (2+5=7)

7. Discuss Huygen's principle. Prove the laws of reflection of light using this principle. (2+5=7)

8. What is photoelectric effect ? Frame Einstein's photoelectric equation. Discuss how it gives the concept of threshold frequency. [1+4+2=7]

9. What is modulation ? Discuss qualitatively about amplitude modulation and frequency modulation. Mention the advantages of frequency modulation over amplitude modulation. [1+4+2=7)

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ANSWERS - 2019 (A)

GROUP - A

1.(a) (iii) $\frac{mg}{e}$

(b) (i) Zero

(c) (iv) $F=CV^{-1}$

(d) (iii) 90^0

(e) (ii) $\frac{1}{2}C$

(f) (i) 400nm

(g) (iv) $\frac{h}{\sqrt{2mE}}$

2.(a) 15J

(b) Tesla $=\frac{\text{Weber}}{m^2}$

(c) $9 \times 10^9 \times N\,m^2\,C^{-2}$

(d) forward bias

(e) Yes

(f) No

(g) Balmer

GROUP - B

3.(a) Circuit diagram equivalent resistance $\frac{10}{3}\Omega$.

(b) $V = \frac{W}{q}$ Dimensional formula $M^1\ L^2\ T^{-3}\ A^{-1}$

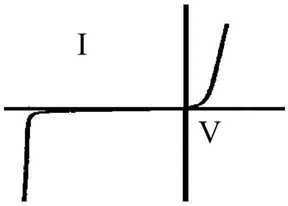
(c) Definition - all points on equipotential surface are of same potential. No work done in taking a charge from one point to another on the surface of equipotential points. angle - 90^0

(d) $\mu=\frac{1}{\sin C}$ $C = \text{Sin}-1\frac{1}{\mu} = 24.4^0$

(e) $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$ as $R_1=-R_2=R$

$\frac{1}{f}=0.5 \times \frac{2}{R}=0.5\frac{2}{30}=F=30CM$

(f) Reverse bias



Forward bias

(g) $e=\frac{-d\Phi}{dt}$

(h) a = Voltmeter b = Volt

(i) Atomic number changes by one.

(j) $\frac{C\,\text{Parallel}}{C\,\text{Series}}=\frac{2C}{C/2}=\frac{4}{1}$

4.(a) $\frac{R_A}{R_B}=\left(\frac{A_A}{A_B}\right)^{1/3}=\left[\frac{27}{1}\right]^{1/3}=3/1$

$R_A = 3 \times 2.4 \times 10^{-15} = 7.2 \times 10^{-15}\,A$

(b) $Z=\sqrt{R^2+\left(WL-\frac{1}{WC}\right)^2}$

R $\rightarrow$ Ohmic resistance

L $\rightarrow$ Inductance C - Capacitance

W $\rightarrow$ angular frequency.

$f=\frac{1}{2\pi}\frac{1}{\sqrt{LC}}$

(c) Time during which number of atoms are reduced to half the number exists initially is half life

$$T_{\frac{1}{2}N\rightarrow} \rightarrow \frac{No}{2}$$

$$\frac{\cancel{N}o}{2} = \cancel{N}o\ e^{-\lambda T_{1/2}}$$

$$Z = e^{+\lambda T_{1/2}}$$

$$T_{1/2} = \frac{1}{\lambda}\ 2.3026\ \log_{10^2}$$

Average life is the average life of all the atoms of radio active element.

$$Tav = \frac{\text{sum of lives of all atoms}}{\text{total no. of atoms}}$$

$$Tav = \frac{1}{\lambda}$$

$$T_{1/2} = Tav\ 2.3026\ \log_{10^2}$$

$$= 0.695\ x\ Tav$$

(d) Nuclei having same atomic number but different mass number - iso topes

$^{14}_{6}C$ $^{12}_{6}C$

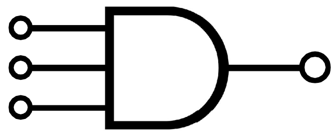
Nuclei having same mass number but different atomic number are iso bars

$^{3}_{1}H$, $^{3}_{2}He$

(e) $$\frac{\beta\,\text{medium}}{\beta\,\text{air}} = \frac{\lambda\,\text{med}\,\frac{D}{d}}{\lambda\,\text{air}\,\frac{D}{d}} = \frac{\lambda\,\text{med}}{\lambda\,\text{air}} = \frac{C_{med}}{C_{air}}$$

$$= \frac{c\,\text{med}}{c\,\text{air}} = \frac{1}{\mu} = \frac{3}{4}$$

$$\beta\,\text{med} = \frac{3}{4}\beta\,\text{air} = 0.075\text{mm}$$

(f) 

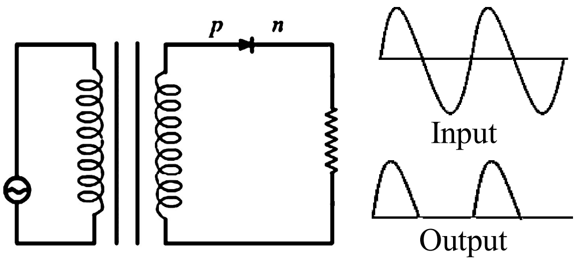
A.B.C = y

A	B	C	Y
0	0	0	0
1	0	0	0
0	1	0	0
0	0	1	0
0	1	1	0
1	1	0	0
1	0	1	0
1	1	1	1

(g) $$\upsilon_{21} = \frac{E_2 - E_1}{h} \quad \upsilon_{31} = \frac{E_3 - E_1}{h}$$

$$\upsilon_{32} = \frac{E_3 - E_2}{h}$$

$$\upsilon_{21} = \upsilon_{32} + \upsilon_{21}$$

(h) 

(i) $$\frac{1}{f} = \frac{1}{v} + \frac{1}{y} \quad f = -18\text{cm}\ u = 12\text{cm}$$

$$V = \frac{-36}{5} = -7.2\text{cm}$$

Virtual erect diminished

(j) Internet - Globally inter connected autonomous computer network GPS global positioning system is a space based navigation system which can provide the information of anevent (location and time of occurance) any where on or near the surface of earth.

Group - C

5. State Biot and Savart law. Derive the expression for the magnetic field at any point on the axis of a circular current-carrying loop. Find its value at the centre of this loop.

(Refer to Long Questions with Answer of the Question Bank)

6. State and explain Kirchhoffs laws for an electrical network. Apply these to obtain the condition of balance for a Wheatstone's bridge.

(Refer to Long Questions with Answer of the Question Bank)

7. Discuss Huygen's principle. Prove the laws of reflection of light using this principle.

(Refer to Long Questions with Answer of the Question Bank)

8. What is photoelectric effect ? Frame Einstein's photoelectric equation. Discuss how it gives the concept of threshold frequency.

(Refer to Long Questions with Answer of the Question Bank)

9. What is modulation ? Discuss qualitatively about amplitude modulation and frequency modulation. Mention the advantages of frequency modulation over amplitude modulation.

(Refer to Long Questions with Answer of the Question Bank)

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2018 (A)

Time- 3 hours ***Full Marks -70***

The figures in the right-hand margin indicate marks.

Answer all questions from Groups A and B serially and continously.

GROUP - A

1. Choose the correct answer out of the four probables given at the end of each bit : [1x7

(a) A parallel-plate capacitor. with air between the plates, has capacitance $3 \mu F$. If the capacitor is immersed in a liquid of dielectric constant 4.0, its capacitance will be

(i) $0.75 \mu F$ (ii) $1.5 \mu F$

(iii) $6 \mu F$ (iv) $12 \mu F$

(b) Due to the presence of a point charge at the centre of a spherical Gaussian surface of diameter a, 10^6 N m^2/C amount of electric flux passes through it. Keeping the point charge at the centre, the Gaussian surface is changed to a cubical Gaussian surface of side a. The flux through the new Gaussian surface will be

(i) $\sqrt{2}$ x 10^6 N m^2/C

(ii) $10^6/\sqrt{2}$ N m^2/C

(iii) $10^6/$ N m^2/C

(iv) $2\sqrt{2}$ x 10^6 N m^2/C

(c) The blue colour of the sky is due to which of the following Phenomena of light ?

(i) Interference (ii) Scattering

(iii) Diffraction (iv) Dispersion

(d) The power of a convex lens of focal length 20 cm in diopter unit is

(i) -10 (ii) -5

(iii) 5 (iv) 10

(e) Fraunhofer diffraction by a single slit is produced on a screen by using light of wavelength 600 nm. The width of the central maximum is l nm. If the wavelength of light is changed to 400 nm, the width of the central maximum will be

(i) 0.5 mm (ii) 0.66 mm

(iii) l mm (iv) 1.5mm

(f) Electromagnetic wave of wavelength 1500 nm lies in which region of the spectrum ?

(i) Radiowave (ii) Microwave

(iii) Infrared (iv) Ultraviolet

(g) The de Broglie wavelength of an electron moving with zi constant velocity is 0.367nm. The mass of proton is 1835 times that of an electron. The de Broglie wavelength of a proton moving with the same velocity will be

(i) 0.2 x 10^{-12}m (ii) 0.3 x 10^{-12}m

(ii) 0.4 x 10^{-12}m (iv) 0.5 x 10^{-12}m

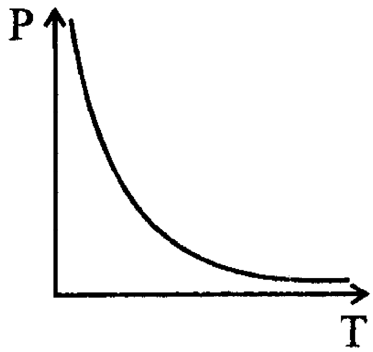
2. Answer each bit as directed. [l x 7

(a) A student said that a possible unit for electric field is J C^{-1} m^{-1}. Is this correct ? (Write 'Yes' or 'No')

(b) The electric potential at a point at a distance of 2m from a point of charge of $0.1 \mu C$ is 450 V. The electric field at this point will be ____ N/C. (Fill in the blank)

(c) The variation of registivity of a material with absolute temperature T is given by the following figure. The material is a ____ .

(Fill in the blank using 'conductor' or 'semiconductor')



(d) In an optical fibre, the propagation of light occurs due to which phenomenon ? (Write the answer only)

(e) The refractive index of a medium is When light travels from air to that medium, the Brewster angle will be i. (Fill in the blank)

(f) The susceptibility of a diamagnetic material is ________. (Fill in the blank using 'greater than zero'or 'less than zero')

(g) The magnetic field produced at the centre of a circular coil carrying a current is 0.005 T. Will the magnetic field change if both the number of turns and the current are doubled ? (write 'Yes' or 'No')

GROUP - B

3. Answer any seven of the following bits : [2 x 7

(a) A point charge of 3×10^{-9} C is released from rest in a uniform electric field and moves a distance of 5 cm after which its kinetic energy becomes 4.5×10^{-5} J.

Calculate the magnitude of the electric field.

(b) An electric charge Q is uniformly distributed around a thin metallic circular coil of single turn and of radius a. Find the expression for the electric potential at a point on its axis at a distance x from its centre.

(c) Distinguish between frequency and amplitude modulations.

(d) State four properties of nuclear force.

(e) Write the relation between nuclear mass defect and binding energy, and name the terms in it.

(f) Distinguish between nuclear fission and nuclear fusion.

(g) State the difference between P-type and N-type semiconductors.

(h) When a photon corresponding to the third line of Paschen series of hydrogen spectrum is emitted, detemine the change in angular momentum of the electron associated with the process.

(i) Use the lens equation $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ and prove that for a convex lens when the object is placed within the focal length, the image will be virtual.

(j) The work function of a photosensitive material is 2 eV. Calculate its threshold wavelength.

4. Answer any seven of the following bits: [3x7

(a) An electric charge Q is uniformly distributed around a semicircle of radius a. Calculate the electric potential at the centre of this semicircle.

(b) A 20 μF capacitor is charged to a potential difference of 1000 V. The terminals of this charged capacitor are then connected to those of an uncharged 5 μF capacitor, Calculate the final potential difference across each capacitor.

(c) Derive Coulomb's law from Gauss' law in electrostatics.

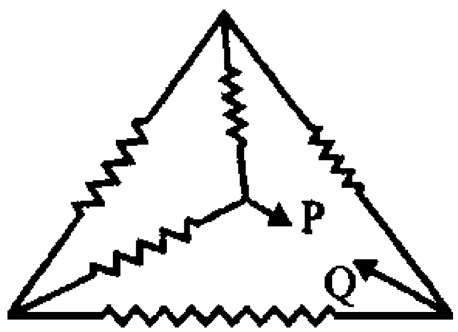
(d) Write the circuit symbol and the truth table of a three-input NOR gate.

(e) Two thin lenses are in contact with each other. One of these is concave lens of focal length 20 cm and the other is a convex lens of same focal length Determine the focal length of the combination and state how it behaves.

(f) A biconvex lens is to be made from glassof refractive index 1.55, with both faces having same radius of curvature. Determine this radius of curvature if the focal length is 20 cm.

(g) Show that the energy E (in eV) of a photon of wavelength λ in (in nm) is given by $E = \frac{1240}{\lambda}$

(h) Calculate the equivalent resistance between P and Q in the following circuit. Each resistance is of 10 Ω .



(i) Write three important properties of beta particles.

(j) On the basisof band theory, distinguish among insulator, semicounductor and conductor of electricity.

GROUP - C

Answer any three of the following questions :

5. State Ampere's. Apply it to determine the magnetic field at a point near an infinitely long straight wire carrying a current. [2+5

6. Describe Young's double-slit experiment and derive the expression for the fringe width. [3+4

7. With a neat circuit diagram, explain how p-n junction diode can be used as full-wave rectifer. [2+5

8. Explain Bohr's model for hydrogen atom and derive the expression for energy of the electron in the nth stationary state. [3+4

9. What is an electric dipole ? Derive an expression for the electric field intensity at a point on the axis of the dipole. [1+6

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ANSWERS - 2018 (A)

GROUP - A

1.(a) (iv) 12 μF ...[1

[Given $C = 3\,\mu F = 3 \times 10^{-6} F$., k = 4. From relation $C = C_o k$

$\Rightarrow C = 4 x 3 x 10^{-6} F = 12 x 1010 -^{-6} F = 12 \mu F]$

(b) (iii) [10^6 Nm^2/C will remain same, because electric flux depends on the amount of charge enclosed by the Gaussian surface, according to Gauss's law i.e., $\Phi = q/\epsilon_0$]

(c) (ii) Scattering ... [1

(d) (iii) 5 ... [1

$$\left[P = \frac{1}{f \text{ in metre}} = \frac{100}{f \text{ in cm}}\right]$$

$$\therefore P = \frac{100}{20} = 5\,\text{doptre} \quad \text{(Ans.)}$$

(e) (ii) 0.66 m.m.

[Given $\lambda_1 = 600 \text{ nm} = 6 \times 10^{-7} m$

$x_1 = 1mm = 10^{-3m}$.

and $\lambda_2 = 400 \text{ nm} = 4 \times 10^{-7} m$

From relation $x_1 = \frac{\lambda_1 D}{a}$

$$\Rightarrow \frac{D}{a} = \frac{x_1}{\lambda_1} = \frac{10^{-3}}{6 \times 10^{-7} m} \Rightarrow \frac{D}{a} = \frac{10^4}{6}$$

Now width of central maximum is

$$x_0 = \lambda_2 \frac{D}{a} = 4 \times 10^{-7} \times \frac{10^4}{6}$$

$= 0.66 \times 10^{-3} = 0.66mm$ (Ans.)

(f) (iii) Infrared ...[1

(g) (i) 0.2×10^{-12}m ...[1

[Given , $\lambda_e = 0.367 \times 10^{-9}$ m.

$\frac{m_p}{m_e} = 1835, m_p = 1835 \times m_e$.

$$\Rightarrow \lambda_p = \frac{h}{m_p \times V} = \frac{h}{1835 \times m_e \times V}$$

$$\Rightarrow \lambda_p = \frac{0.367 \times 10^{-9}}{1835}$$

$\Rightarrow \lambda_p = 0.2 \times 10^{-12} m]$ (Ans.)

2.(a) Yes

$$\left[JC^{-1}m^{-1} = \frac{J}{Cm} = \frac{N}{C}.\frac{m}{m} = \frac{N}{C}\right]$$

(b) 225

[Given

$r = 2m, q = 0.1 \times 10^{-6} C$ and $V = 450V$.

From relation,

$\Rightarrow E = \frac{9}{4} \times 10^2 = 2.25 \times 10^2 = 225\, N/C]$ (Ans.)

(c) Semiconductor ...[1

(d) Total Internal Reflection ...[1

(e) 60^0 or $\pi/3$ ...[1

[Given $\mu = \sqrt{3}$,

From relation, $\tan i_p = \mu$

$\Rightarrow i_p = \tan^{-1}(\sqrt{3}) = 60^0]$ (Ans)

(f) less than zero ...[1

(g) Yes ...[1

[Given B= 0.005 T.

From Relation, $B = \frac{\mu_0}{2}\frac{NI}{R}$

$N' = 2N$ and $I' = 2I]$

GROUP - B

3.(a) A point charge of 3 x 10^{-9} C is released from rest in a uniform electric field and moves a distance of 5cm after which its kinetic energy becomes 4.5 x 10^{-5}J.

Calculate the magnitude of the electric field.

Ans. Given,

$q = 3 \times 10^{-9} C$

$d = 5\,cm = 5 \times 10^{-2} m.$

$E_K = 4.5 \times 10^{-5} J$

From relation $_qEd = E_K$

...[1

$\Rightarrow E = \frac{E_k}{qd} = \frac{4.5 \times 10^{-5}}{3 \times 10^5 N/C}$

$\Rightarrow E = 3 \times 10^5 N/C$ (Ans.) ...[1

(b) An electric charge Q is uniformly distributed around a thin metallic circular coil of single turn and of radius a. Find the expression for the electric potential at a point on its axis at a distance x from its centre.

Ans. $V = K\frac{Q}{\sqrt{a^2 + x^2}}$ where, $K = \frac{1}{4\pi \in_0}$ ... [1

(c) Distinguish between frequency and amplitude modulations.

Ans. **Frequency Modulation** ... [1

(i) It is immune to noise.

(ii) Its effciency is high.

(iii) Channel bandwidth is large.

(iv) In this modulation amplitude is constant.

Amplitude Modulation ...[1

(i) AM reception is noisy.

(ii) Its efficiency is low.

(iii) Channel bandwidth is small.

(iv) In this modulation frequency remains constant.

(d) State four properties of nuclear force.

Ans. (i) It is very strong and attractive in nature.

(ii) It is a short range force i.e., 10^{-15}m.

(iii) It is charge independent.

(iv) It is spin dependent.

(v) It is a non-central force.

(e) Write the relation between nuclear mass defect and binding energy, and name the terms in it.

Ans. $E_B = \Delta m.C^2$ ... [1

Where $E_B =$ Binding Energy.

$\Delta m =$ Mass Defect.

and C = Velocity of light. ... [1

(f) Distinguish between nuclear fission and nuclear fusion.

Ans. **Nuclear fission**

(i) It is the process of splitting of heavier nucleus into smaller nuclei with release of huge amount of energy.

(ii) Example: Atom bomb ... [1

(iii) $_{92}U^{235} + _0n^1 \rightarrow _{56}Ba^{141} + _{36}Kr^{92} + 3_0n^1 + q$

Nuclear fusion

(i) It is the process of combine of lighter nuclei into heavier nucleus with release of huge amount of energy.

(ii) Example : Hydrogen bomb.

(iii) $4_1H^1 \rightarrow _2He^4 + 2_{+1}e^0 + q$ ... [1

(Any two distinction including definitions)

(g) State the difference between P-type and N-type semiconductors.

Ans. **N-type Semiconductor**

(i) It is produced by doping pentavalent impurity with tetravalent intrinsic semiconductor.

(ii) in this semiconductor majority carriers are electrons.

(iii) Here Arsenic or Antimony are doped with Germanium or Silicon. ...[1

P-type semiconductor

(i) It is produced by doping trivalent impurity with tetravalent intrinsic semiconductor.

(ii) In this senliconductpr majority carriers are holes.

(iii) Here lndium or Gallium are doped with Germanium or Sillicon ... [1

(Any two differences)

(h) When a photon corresponding to the third line of Paschen series of hydrogen spectrum is emitted, determine the change in angular momentum of the electron associated with the process.

Ans. In Paschen series electron jumps from 6th orbit to 3rd orbit.

So, $n_1 = 3$ and $n_2 = 6$ ... [1

$\therefore$ Change in Angular momentum

$$=(6-3)\frac{h}{2\pi}=\frac{3h}{2\pi}$$ ... [1

(i) Use the lens equation $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ and Prove that for a convex lens when the object is placed within the focal length, the image will be virtual.

Ans. Since $u < f$,

According to lens equation

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}\Rightarrow\frac{1}{v}=\frac{1}{f}-\frac{1}{u}$$

$\Rightarrow v$ is negative.

Negative image distance implies virtual image.

(j) The work function of a photosensitive material is 2ev. Calculate its threshold wavelength.

Ans. Given $\theta = 2eV$, $f = h\upsilon_0$

$$\Rightarrow 2 \text{x} 1.6 \text{x} 10^{-19} = h \text{x} \frac{C}{\lambda_0}$$

$$\Rightarrow\lambda_0=\frac{hC}{2\text{x}1.6\text{x}10^{-19}}=\frac{6.6\text{x}10^{-34}\text{x}3\text{x}10^{8}}{3.2\text{x}10^{-19}}$$ ... [1

$$\Rightarrow \lambda_0 = 6.2 \text{x} 10^{-7} \text{m (Ans.)}$$ ... [1

4.(a) An electric charge Q is uniformly distributed around a semicircle of radius a. Cal ulate the electric potential at the centre of this semicircle.

Ans. Then electric potential at the centre of the semi-circle is given by

$$V = K.\frac{Q}{a} = \frac{1}{4\pi \in_0}\frac{Q}{a}$$ ... [1

(b) A 20 μF capacitor is charged to a potential difference of 1000 V. The terminals of this charged capacitor are then connected to those of an uncharged 5 μF capacitor. Calculate the differential potential difference across each capacitor.

Ans. At steady state. P.D. across both the capacitor would be same and the charges would be redistributed.

So $C_1V_1 = C_1V + C_2V$ ... [1

$$\Rightarrow V = \frac{C_1V}{C_1+C_2} = \left(\frac{C_1}{C_1+C_2}\right)V_1$$

$$\Rightarrow V = \left(\frac{20}{25}\right)\text{x}1000 = 800V \text{ (Ans.)}$$ ... [1

(c) Derive Coulomb's law from Gauss's law in electrostatics.

Ans. It states taht the total electric flux through closed surface is equal to $\frac{1}{\in_0}$ times the net charge enclosed, by the surface, where $\in_0$ is the permittivity of vaccum or free space. ... [1

Mathematically, $\Phi = \frac{q}{\in_0}$

Coloumb's law : $\Rightarrow F = \frac{1}{4\pi \in_0}\frac{q_1 q_2}{r^2}$

Derivation :

Let us consider a spherical Gaussian surface is enclosing the charge 'q'.

Now consider an elementary Gaussian surface $d\vec{S}$. So electric flux is passing through it is given by

$$\Phi = \vec{E}.d\vec{S} \qquad ...(1)$$

Now, total electric flux is given by

$$d\Phi = \int E\,dS\ \cos\theta$$

($\because \vec{E}$ and $d\vec{S}$ are in same direction)

$$= \int E\,dS = E\int dS$$

$$\text{So } \Phi = E.4\pi r^2 \left(\because \int dS = 4\pi r^2\right) \qquad ...(2)$$

Where $4\pi r^2$ is surface area of spherical gaussian surface.

Where, r = radius of spherical surface. But according to Gauss' law.

$$\Phi = \frac{q}{\epsilon_0} \qquad ...(3)$$

Now comparing eqn (2) and (3) we get

$$\Rightarrow \frac{q}{\epsilon_0} = E,4\pi r^2 \Rightarrow E = \frac{1}{4\pi r^2}\cdot\frac{q}{r^2} \qquad ...(4)$$

Since electric field intensity at a point is given by

$$E = \frac{F}{q_0} \Rightarrow F = E.q_0$$

$$\Rightarrow F = \frac{1}{4\pi\epsilon_0}\frac{qq_0}{r^2} \qquad ...(5)\ [2$$

which is required expression.

(d) Write the circuit symbol and the truth table of a three-input NOR gate.

Ans.

A	B	C	$X = A+B+C$	$Y = \overline{A+B+C}$
0	0	0	0	1
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	1	0	1	0
1	1	1	1	0

(e) Two thin lenses are in contact with each other. One of these is concave lens of focal length 20cm and the other is a convex lens of same focal length. Determine the focal length of the combination and state how it behaves.

Ans. Given

$$F_{concave} = F_{convex} = 20cm = 2\,x\,10^{-1}m.$$

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{20} - \frac{1}{20} = 0 \qquad ...\ [1+1$$

$\Rightarrow F = \infty$, So, glass Plate. ... [1

(f) A biconvex lens is to be made from glass of refractive index 1.55, with both faces having same radius of curvature.

Determine this radius of curvature if the focal length is 20 cm.

Ans. Given, $\mu_g = 1.55$

both faces having same radius.

$$R_1 = R_2 = R$$

f = 20cm.

According to lens manner formula

$$P = \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \qquad ...\ [1$$

$$\frac{1}{20} = (1.55 - 1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

$$\Rightarrow \frac{1}{20} = 0.55\ x\ \frac{2}{R} \qquad ...\ [1$$

$$\Rightarrow R = 20\ x\ \frac{55}{100}\,x\,2 = 22cm\ \text{(Ans)} \qquad ...\ [1$$

(g) Show that the energy E (in eV) of a photon of wavelength λ in (in nm) is given by

$$E = \frac{1240}{\lambda}.$$

Ans. $E_{photon} = \frac{hC}{\lambda} = \frac{6.64\,x\,10^{-34}\ x\,3\,x\,10^{-8}}{\lambda}$ ... [1+1

$$E_{photon} = \frac{1240}{\lambda} \qquad ...\ [1$$

(h) Calculate the equivalent resistance between P and Q in the following circuit. Each resistance is of 10Ω.

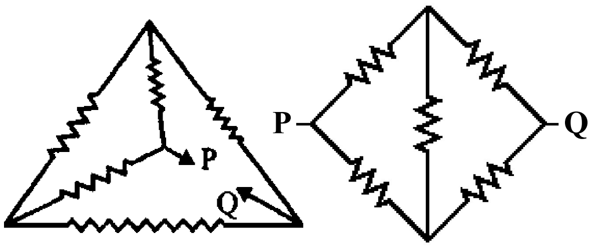
Ans. $\frac{P_A}{R_A} = \frac{Q_A}{S_A} = \frac{10}{10} = \frac{10}{10}$

So, resistance will be cancelled out due to lack of current.

$R_{1_s} = 10 + 10 = 20\Omega$

$R_{2_s} = 10 + 10 = 20\Omega$

$\Rightarrow R_P = 10\Omega$ (Ans.) ... [1



(i) Write three important properties of beta particles.

Ans. (a) β particles are material in nature.

(b) It is deflected by electric and magnetic fields.

(c) Its mass is 9.1 x 10^{-31}kg and charge is 1.6 x 10^{-19}C. ... [1 x 3

(j) On the basis of band theory, distinguish among insulator, semiconductor and conductor of electricity.

Ans. (a) Conductor - In terms of energy band, valence band and conduction band overlap each other. Band gap is negligible.

For example : Al, Cu, Ag, Fe, Ni etc.

(b) Semi conductor - In terms of energy band, the valence band is almost filled and conduction band is almost empty. Band gap is very small i.e. 1 ev ... [1

Example - Germanium, Silicon, Carbon.

(c) Insulators - In terms of energy band, the valence band is full while the conduction band is empty. Band gap is 1.5 eV.

GROUP -C

5. State Ampere's law. Apply it to determine the magnetic field at a point near an infmitely long straight wire carrying a current.

Ans. Refer to Long-Question Section

6. Describe Young's double-slit experiment and derive the expression for the fringe width.

Ans. Refer to Long-Question Section ?

7. With a near circuit diagram, explain how p-n junction diode can be used as full-wave rectifier.

Ans. Refer to Long-Question Section.

8. Explain Bohr's model for hydrogen atom and deive the expression for energy of the electron in the nth stationary state.

Ans. Refer to Long-Question Section

9. What is an electric dipole ? Derive an expression for the electric field intensity at a point on the axis of the dipole.

Ans. Refer to Long Question Section

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2017 (A)

Time- 3 hours *Full Marks -70*

The figures in the right-hand margin indicate marks.
Answer all questions from Groups A and B serially and continously.

GROUP - A

1. Choose the correct answer out of the four probables given at the end of each bit : [1x10

(a) The -ve and +ve charges of a dipole of moment $\vec{P}$ are placed respectively at pints $-\hat{i}a$ and $+\hat{i}a$. If $y >> a$, then the electric field intensity due to the dipole at the point located at $\hat{j}y$, is

(i) $\vec{P}/2\pi\in_0 y^3$ (ii) $-\vec{P}/2\pi\in_0 y^3$

(iii) $\vec{P}/4\pi\in_0 y^3$ (iv) $-\vec{P}/4\pi\in_0 y^3$

(b) The potential difference between the ends of a uniform conductor in a circuti is V. If J is the current density in the conductor and l and Aare its length and area of cross section respectively, then the resistivity ρ of its material is

(i) VlJ/A (ii) lJ/V

(iii) Vl/J (iv) V/lJ

(c) A rectangular wire loop with sides a and b carries current I in the anticlockwise sense and is placed in a uniform magnetic field $\vec{B}$ with its plane perpendicular to $\vec{B}$. Then the magnetic force on the loop is

(i) $I(\vec{a}\times\vec{B})$ (ii) $I(\vec{b}\times\vec{B})$

(iii) $I(\vec{a}\times\vec{b})\times\vec{B}$ (iv) Zero

(d) The average life of a radioactive sample is 2 years. Its half-life in years is

(i) 1 (ii) 1.347

(iii) 1.386 (iv) 1.693

(e) An a.c. source is connected to a pure capacitor. The capacitor is charged during the

(i) first and second quarters of the a.c.cycle.

(ii) first and third quarters of the a.c. cycle.

(iii) first and fourth quarters of the a.c. cycle.

(iv) second and fourth quarters of the a.c. cycle.

(f) Two transparent media A and B are separated by a plane boundary. The speeds of light are 2×10^{-8} m/s and 2.4×10^{-8} m/s respectively in A and B. Then the critical angle for a ray of light for these two media is

(i) $\sin^{-1} 0.833$ (ii) $\sin^{-1} 0.751$

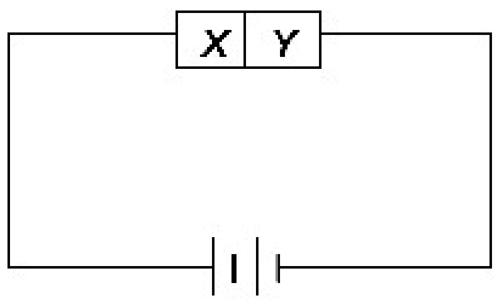
(iii) $\sin^{-1} 0.482$ (iv) $\sin^{-1} 0.406$

(g) The minimum distance between an object and its real image formed by a convex lens of focal length f is

(i) f (ii) 2f

(iii) 3f (iv) 4f

(h) In the given circuit diagram a junction diode x~y has been connected to a source of e.m.f. The semiconductors x and y have been made by doping germanium crystal with arsenic and indium respectively. Then which of the following statements regarding the diode is correct ?



(i) x is p-type and y is n-type semiconductor and the diode is reverse biased.

(ii) x is n-type and y is p-type semiconductor and the diode is reverse biased.

(iii) x is p-type and y is p-type semiconductor and the diode is forward biased.

(iv) x is n-type and y is p-type semiconductor and the diode is forward biased.

(i) An a.c. source given by $V = V_0 \sin \omega t$ is connected to a pure inductance *L* in a circuit. If I_0 is the peak value of the a.c., then the instantaneous power in the inductor is

(i) $V_0 I_0 \sin \omega t$ (ii) $V_0 I_0 / 2 \sin 2\omega t$

(iii) $-V_0 I_0 / 2 \sin 2\omega t$ (iv) $-V_0 I_0 \sin 2\omega t$

(j) The relationship between the transistor parameters α and β is

(i) $\alpha = 1 + \beta$ (ii) $\alpha = \frac{(1+\beta)}{\beta}$

(iii) $\beta = \frac{\alpha}{(1-\alpha)}$ (iv) $\beta = \frac{\alpha}{(1+\alpha)}$

2. Answer each bit as directed. [1x10

(a) y-particles are not affected by a magnetic field, but are affected by an electric field.

(write Yes or No)

(b) Two thin lenses of power 2D and 4D are kept in contact. What is the focal length of the combination in cm ?

(Write the answer only)

(c) Define mobility of the charge carriers in a conductor.

(d) Name the angle between the geographical meridian and the magnetic meridian of the earth.

(e) How much is the charge deposited on the capacitor of $10\,\mu F$ charged to a potential of 100v ?

(f) Which physical quantity is expressed in Tm/A ?

(g) The angular momentum of the electron in the second orbit of the hydrogen atom is $\underline{2h/\pi}$.

(h) A pure inductor is connected to an a.c. source given by

$\varepsilon = \varepsilon_0 \sin(100\pi t - \theta)$

The instantaneous power of the circuit will have a frequency of ______ H_Z.

(Fill in the blank)

(i) What is the ratio of the efficiency of a half-wave rectifier to that of a full-wave rectifier ?

(j) Satelite communication is brought about in ______ H_z frequency range.

(Fill in the blank using micro/nano/giga)

GROUP - B

3. Answer any ten of the following bits : [2x10

(a) Point charges $1\,\mu C$, $2\,\mu C$ AND $-3\,\mu C$ are at rest on the X-axis respectively at points x_1= 10cm, x_2= 20cm and x_3= 30cm. Calculate the potential due to the charges at the origin.

(b) The current in a resistor varies with time according to the equation.

$I=5A+2As^{-1}t$

Calculate how many coulomb pass through the cross section of the resistor in the time interval between t=2s and t= 5s.

(c) Explain Biot-Savart Law.

(d) Deduce the dimension of the resistivity of a material.

(e) A circular coil of 100 turns has radius 4cm. It is placed with its plane perpendicular to a magnetic field of 3T. if the the magnetic field reduces to I T in 0.2s, Calculate the e.m.f induced in the coil.

(f) Show that the SI unit of EB/μ_0 iw W/m^2.

(g) In Young's double-slit experiment, I_{max}:

I_{min}=49:9. Calculate the ratio of the intensities of the individual sources.

(h) Calculate the ratio of the longest to the shortest wavelengths of Balmer series of hydrogen spectra.

(i) Write the truth table and circuit symbol of a two-input NAND gate.

(j) Calculate *i* in the given circuit applying Kirchhoff's laws.

(k) The distances of the real image of an object and the object, from the focus of a concave mirror are respectively b and a . Find the focal length of the concave mirror are respectively b and a. Find the focal length of the concave mirror in terms of a and b.

(l) Explain the working principle of a step-up transformer.

4. Answer any three of the following bits : [3x3

(a) The wavelength of a photon is equal to the de Broglie wavelength of a particle moving with a velocity v. Find the ratio of the energy of the photon to the kinetic energy of the particle.

(b) Derive the relation between the electric field intensity and the potential gradient due to a point charge at a point in its field.

(c) The power dissipation is 20W when a combination of three equal resistors in series is connected to a source. Calculate the power dissipation when the three resistors are connected in parallel across the source.

(d) A galvanometer of resistance 100Ω gives full-scale deflection for a current of $10\mu A$. Find the resistance needed to convert it to an ammeter of range 1A.

(e) A plane mirror and a convex mirror are at a distances of 20cm and 25cm respectively from an object. Determine the focal length of the convex mirror if the images formed by both the mirrors are at the same location without parallax.

GROUP - C

5. Derive the expression for the capacity to a parallel-plate capacitor filled with a dielectric. **[7**

or

Define electric current density and Write its relation with the current. Derive the relation between current density and electric field intensity. [2+5

6. Explain What is the effective value of an a.c. and derive the expression for the same in terms of its peak value. **[2+5**

or

Explain in working of a p-n-p transistor with a neat circuit diagram. Discuss its input and output characteristics in common emitter configuration. **[2+2+3**

7. Deduce the lens maker's formula.

or

Establish Einstein's photoelectric equation. Discuss how it gives the concept of threshold frequency and stopping potential. **[2+3+2**

***

ANSWERS - 2017 (A)

GROUP - A

1.(a) (iv) $-\vec{p}/4\pi\varepsilon_0 y^3$

(b) (iv) V / *l* J

(c) (iv) zero

(d) (iii) 1.386

(e) (ii) first and third quarters of the a.c. cycle.

(f) (i) $\sin^{-1}0.833$

(g) (iv) 4*f*

(h) (ii) *x* is n-type and *y* is p-type semiconductor and the diode is reverse biased.

(i) (iii) $-V_0I_0\sin 2\omega t$

(j) (iii) $\beta = \dfrac{\alpha}{1-\alpha}$

2.(a) No

(b) $P=P_1+P_2$ and F=-50cm

(c) Mobility is defined as drift velocity per unit electric field intensity.

Matematically, $\mu = \dfrac{V_d}{E}$

(d) Declination/Variation.

(e) Q = CV=10 x 10^{-6} x 100=10^{-3} Coulomb.

(f) Magnetic Permeability (μ)

(g) Fourth orbit $100\Omega\left(L = \dfrac{nh}{2\pi}\right)$. Here n=4.

(h) $100H_z$ $(\because w = 2\pi n)$

(i) 1:2 or 0.5

(j) Giga Hertz (1 Giga Hertz = 109Hz)

GROUP - B

3. (a) Point charges 1μC, 2μC and −3μC are at rest on the Xaxis respectively at points x_1=10cm, x_2 = 20cm and x_3 = 30cm. Calculate the potential due to the charges at the origin.

Ans. $V = V_1 + V_2 + V_3$

$$\Rightarrow V = \frac{1}{4\pi\varepsilon_0}\left(\frac{1}{10}+\frac{1}{20}+\frac{-3}{30}\right)$$

$\Rightarrow 9x10_4$ volt

(b) The current in a resistor varies with time according to the equation

$I = 5A + 2As^{-1}t$

Calculate how many coulomb pass through the cross section of the resistor in the time interval between t = 2s and t = 5s.

Ans. $q = \int_2^5 (5+2t)dt$

$$= \int_2^5 5.dt \int_2^5 2t.dt$$

$$= 5[t]_2^5 + 2\left[\frac{t^2}{2}\right]_2^5$$

$$= 5[5-2] + 2\left[\frac{25}{2} - \frac{4}{2}\right]$$

$= 15 + 21 = 36$ (Coulomb) (Ans)

(c) Explain Biot-Savart law.

Ans. $dB = \dfrac{\mu_0}{4\pi} I.dl\sin\theta$

Where,

I = Current flowing through the conductor.

d*l* = elementary length.

r = distance of point of observation from the conductor.

Q = angle between direction of current and position vector of point of observation.

(d) Deduce the dimension of the resistivity of a material.

Ans. $\rho = R\dfrac{A}{l} = \left[ML^3T^{-3}A^{-2}\right] = (1, 3, -3, -2)$

(e) A circular coil of 100 turns has radius 4cm. It is placed with its plane perpendicular to a magnetic field of 3T. If the magnetic field reduces to 1 T in 0.2s, Calculate the e.m.f induced in the coil.

Ans. $\varepsilon = -\dfrac{d\theta}{dt} = -NA\left(\dfrac{B_2 - B_1}{dt}\right)$

$= -100 \text{ x } \pi \text{ x } (0.04)^2 \left[\dfrac{1-3}{0.2}\right]$

$= 1.6\pi = 1.6\text{x}3.141 = 5.0256$ volt.

(f) Show that the SI unit of EB/μ_0 is W/m^2.

Ans. $\dfrac{EB}{\mu_0} = \dfrac{W}{m^2}$

$\text{L.H.S.} = \dfrac{N}{C} \text{x} \dfrac{N}{\text{amp.m}} \text{ x} \dfrac{\text{amp}^2}{N} = \dfrac{\text{N.amp}}{\text{c.m}}$

$= \dfrac{N}{\text{sec.m}}\left(\because \dfrac{\text{amp}}{C} = \dfrac{1}{\text{sec}}\right)$

$\text{R.H.S.} = \dfrac{W}{m^2} = \dfrac{\text{Watt}}{m^2} = \dfrac{\text{N.m}}{\text{sec.m}^2}$

$= \dfrac{N}{\text{sec.m}}$

Hence, L.H.S = R.H.S (Proved)

(g) In Young's double slit experiment,

$I_{max} : I_{min}$ = 49 : 9.Calculate the ratio of the intensities of the individual sources.

Ans. $\dfrac{I_{max}}{I_{min}} = \left(\dfrac{a_1 + a_2}{a_1 - a_2}\right)^2$

$\Rightarrow \dfrac{I_1}{I_2} = \left(\dfrac{a_1}{a_2}\right)^2 = \dfrac{25}{4}$ (Ans)

(h) Calculate the ratio of the longest to the shortest wavelengths of Balmer series of hydrogen spectra.

Ans. $\dfrac{1}{\lambda} = R\left(\dfrac{1}{2^2} - \dfrac{1}{3^2}\right)$

$\dfrac{1}{\lambda_2} = R\left(\dfrac{1}{2^2} - \dfrac{1}{\infty}\right)$

$\Rightarrow \dfrac{\lambda_1}{\lambda_2} = \dfrac{9}{5} = \dfrac{\lambda\,\text{long}}{\lambda\,\text{short}}$

(i) Write the truth table and circuit symbol of a two input NAND gate.

Ans. (Symbol of NAND gate)

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

(Truth table)

(j) Calculate *i* in the given circuit applying Kirchhoff's laws.

Ans. Using Kirchhoff's law and second law,

$\Sigma I = 0$ and $\Sigma IR = \Sigma E$

$i = i_1 + i_2$

$\Rightarrow i_1 \text{ x } 6 - i_2 \text{ x} = 0$

$\Rightarrow i_1 \text{ x } 6 + i \text{ x } 2 = 6$

$\Rightarrow i_2 \text{ x} 12 + i \text{ x } 2 = 6$

$\Rightarrow i_1 = 1A$ (Ans.)

(k) The distances of the real image of an object and the object, from the focus of a concave mirror are respectively b and a. Find the focal length of the concave mirror in terms of a and b.

Ans. $\dfrac{1}{f+b} + \dfrac{1}{f+a} = \dfrac{1}{f}$

$\Rightarrow f = \sqrt{ab}$ (Ans.)

(l) Explain the working principle of a stepup transformer.

Ans. Step up transformer works on the principle of Mutual Induction.

$$\left(\frac{N_S}{N_P}\right)E_P, E_S > E_P$$

4.(a) The wavelength of a photon is equal to the de Broglie wavelength of a particle moving with a velocity v. Find the ratio of the energy of the photon to the kinetic energy of the particle.

Ans. $E_1 = \frac{hc}{\lambda}, \lambda = \frac{h}{mv}, E_2 = \frac{1}{2}mv^2$

$$\frac{E_1}{E_2} = \frac{2C}{\mu} = \frac{E_{photon}}{E_{particle}}$$

Where C = velocity of light.

$$\frac{E_1}{E_2} = \frac{hC}{\lambda} x \frac{2}{m\mu^2} = \frac{hc\,x\,m\mu}{h} x \frac{2}{m\mu^2} = \frac{2C}{\mu} \text{ (Ans)}$$

(b) Derive the relation between the electric field intensity and the potential gradient due to a point charge at a point in its field.

Ans. $E = \frac{dv}{dx}$

Electric field intensity is the negative of potential gradient.

(c) The power dissipation is 20w When a combination of three equal resistors in series is connected to a source. Calculate the power dissipation when the three resistors are connected in parallel across the source.

Ans. $P_1 = \frac{V^2}{3R}, P_2 = \frac{V^2}{R/3}$

Where R = Resistance of the conductor.

So $\frac{P_2}{P_1} = \frac{3V^2}{R} x \frac{3R}{v^2} = 9$

$\Rightarrow P_2 = 9 x P_1 = 9 x 20 = 180\text{watt}$ (Ans)

(d) A galvanometer of resistance 100Ω gives full-scale deflection for a current of $10\mu A$. Find the resistance needed to convert it to an ammeter of range 1A.

Ans. $S = \frac{I_g G}{I - I_g}$

Where I_g = Current galvanometer.

$$= \frac{100 x 10^{-6}}{1 - 10^{-6}} = 10^{-3}\Omega$$

(e) A plane mirror and a convex mirror are at a distances of 20cm and 25cm respectively from an object. Determine the focal length of the convex mirror if the images formed by both the mirrors are at the same location without parallax.

Ans. Given $u = 25cm, v = -15cm$

then, $f = \frac{uv}{u+v} = -37.5cm$ (Ans)

GROUP - C

5. Derive the expression for the capacity of a parallel-plate capacitor filled with a dielectric.

Ans. Refer to Long Question section.

or

Define electric current density and write its relation with the current. Derive the relation between current density and electric field intensity.

Ans. Refer to Long Question section (Group -C)

6. Explain what is the effective value of an a.c. and derive the expression for the same in terms of its peak value.

Ans. Refer to Long Question section (Group-C).

or

Explain th working of a p-n~p transistor with a neat circuit diagram Discuss its input and output characteristics in common-emitter configuration.

Refer to Long Question section (Group-C).

7. Deduce the lens maker's\formula.

Ans. Refer to Long Question section (Group-C).

or

Establish Einstein's photoelectric equation. Discuss how it gives the concept of threshold frequency and stopping potential.

Ans. Refer to Long Question section (Group-C).

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GROUP - A

OBJECTIVE TYPE QUESTIONS

1. Choose the correct answer out of the four probables given at the end of each bit :

1. The minimum electro static force between two changed particle separated by distance 1 M is

(a) 6.2×10^{-34}N (b) 2.3×10^{-28}N

(c) 1.02×10^{-26}N (d) 4.2×10^{-27}N

2. Electric field on the axis of a small electric di pole at a distance r is $\vec{E_1}$ and $\vec{E_2}$ at a distance 2r. on a line of perpendicular bisector from the centre of dipole then

(a) $\vec{E_2} = -\vec{E_1}/8$ (b) $-\vec{E_2} = \frac{-\vec{E_1}}{4}$

(c) $-\vec{E_2} = \frac{-\vec{E_1}}{16}$ (d) $\vec{E_2} = \vec{E_1}$

3. What is the type of electricity developed on a glass rod when it is rubbed with silk.

(a) Positive

(b) Negative

(c) May be Positive or Negative

(d) No electricity is developed

4. Value of $4\pi \in_0$ is

(a) 9×10^9 N M^2 C^{-2}

(b) $\frac{1}{9x10^9}$ $C^2M^{-2}N^{-1}$

(c) 1

(d) $3x10^9$ N M^2 C^{-2}

5. A uniform electric field is represented by a set of lines of force which are

(a) Converging (b) diverging

(c) Parallel (d) None of these

6. Electron volt is unit of

(a) Potential difference (b) Charge

(c) Energy (d) Momentum

7. Three charges each of +q are placed at the three vertices of an equilateral triangle if the distance of centroid from each vertex of triangle is r then the strength of electric field at the centroid is

(a) $\frac{q}{4\pi \in_0 r^2}$ (b) $\frac{3q}{4\pi \in_0 r}$

(c) $\frac{3q}{4\pi \in_0 r^2}$ (d) 1 zero

8. Work done in moving a unit positive change through a distance of x meter on an equipotential surface is

(a) x Joules (b) $\frac{1}{x}$ Joul

(c) Zero (d) x^2 Joul

9. Electric flux linked with a given plane surface is maximum if the angle between the electric lines of force and the surface is

(a) 0^0 (b) 45^0

(c) 90^0 (d) 135^0

10. An electric di pole in a uniform electric field is most stable, when the angle between dipole moment and field vector is

(a) 90^0 (b) 0^0

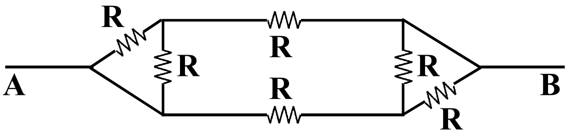
(c) 45^0 (d) 60^0

11. A cell develops the same power across two resistances R_1 and R_2 separately then the internal resistance of the cell is

(a) $R_1 + R_2$ (b) $\frac{R_1 + R_2}{2}$

(c) $\sqrt{R_1 R_2}$ (d) $\frac{\sqrt{R_1 R_2}}{2}$

12. Equivalent resistance between A and B is in the circuit is



(a) $\frac{3}{4}R$ (b) $\frac{5}{3}R$
(c) $\frac{7}{5}R$ (d) R

13. Two electric bulbs rated for the same voltage have powers of 200 w and 100 w respectively if their resistances are r_1 and r_2 respectively then
(a) $r_1 = 2r_2$ (b) $r_2 = 2r_1$
(c) $v_2 = 4r_1$ (d) $r_1 = 4r$

14. n identical light bulbs each designed to draw P power from certain voltage supply, are joined in series across that supply. The total power which they will draw is
(a) np (b) p
(c) p/n (d) p/n^2

15. An isolated charge is placed in homogeneous isotropic medium. The equipotential surface will be
(a) cylindrical (b) spherical
(c) elliptical (d) parabolic

16. A convex lens of power P is immersed in water. Its Power
(a) increases
(b) decreases
(c) remains unchanged
(d) increases for red colour

17. The focal length of convex lens is 30CM and the size of the image is quarter of the object, then the object distance is
(a) 30 CM (b) 60 CM
(c) 90 CM (d) 120CM

18. A ray of light incident on a 60^0 angled prism of refractive index $\sqrt{2}$, suffers minimum deviation. The angle of incidence is
(a) 70^0 (b) 0^0
(c) 45^0 (d) 60^0

19. The focal length of converging lens is measured for violet, green and red colours, f_v, f_g and for are the corresponding focal length then
(a) $f_v = f_g$ (b) fv > fr
(c) fv < fr (d) f_g > fr

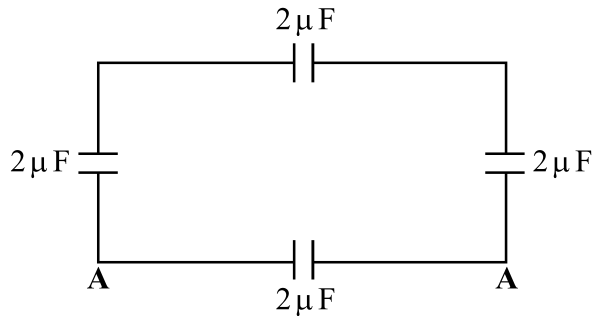
20. The angle of a prism is 30^0, The rays incident at an angle of 60^0 at one refracting face suffere a deviation of 30^0 then the angle of emergence is
(a) 0^0 (b) 30^0
(c) 60^0 (d) 90^0

21. The critical angle of a prism is 30^0. The velocity of light in the medium is
(a) 1.5×10^8m/sec
(b) 3×10^8m/sec
(c) 4.5×10^8 m/sec
(d) None of the above

22. A Prism is made up of material of refractive index V3. The angle of Prism is A^0. If the angle of minimum deviation is equal to A^0 then A is
(a) 30^0 (b) 45^0
(c) 75^0 (d) 60^0

23. Eight drops of mercury of equal redii and each possessing the same charge combine to form a big drop. The capacitance of this big drop as compared to that of each smaller drop is
(a) 2 times (b) 4 times
(c) 8 times (d) 16 times

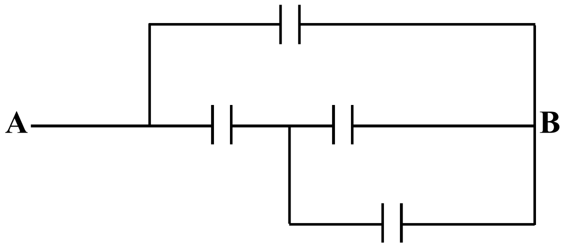
24. The equivalent capacitance between the points A and B in given circuit is



(a) $8\mu F$ (b) $\frac{8}{3}\mu F$

(c) $6\mu F$ (d) $2\mu F$

25. If individual capacitor has a capacity of $3\mu F$ the in the circuit the equivalent capacity between A and B is



(a) $\frac{3}{4}\mu F$ (b) $6\mu F$

(c) $3\mu F$ (d) $5\mu F$

26. A potential difference of 300 volts is applied to a combination of $2.0\mu F$ and $8.0\ \mu F$ capacitors connected in series. The charge on the capacitor will be

(a) 30 x 10^{-5} coulomb
(b) 48 x 10^{-5}C
(c) 60 x 10^{-5}C
(d) 24 x 10^{-5} coulomb

27. A parallel plate capacitor is made by taking n equally spaced plates connected alternatively. If the capacitance between any two successive plates is C. The capacitance of the equivalent system is

(a) c (b) nc

(c) (n-1) c (d) (n+1) c

28. At a frequency ω the reactance of a certain capacitor equals to that of a certain inductor. If the frequency is changed to 2ω then the ratio of reactance of the inductor to that of the capacitor is

(a) 4 : 1 (b) V2 : 1

(c) 1 : 2 V2 (d) 1 : 2

29. The current through an inductor of 1H is given by i=3t sin t the voltage across the inductor is

(a) 3 sint + 3 cost (b) 3 cost + t sint

(c) 3 sint + 3t cost (d) 3t cost + sint

30. The electric current is given by $i = 3t$
The rms current for the period $t = 0$ to $t = 1$sec is

(a) 3A (b) 9A

(c) $\sqrt{3}$A (d) $\frac{1}{3}$A

31. Two inductors L_1 and L_2 are connected in parallel and a time varying current flows with i_1 along L_1 and i_2 along L_2. The ratio of current $\frac{i_1}{i_2}$ is

(a) $\frac{L_1}{L_2}$ (b) $\frac{L2}{L1}$

(c) $\frac{L_1}{L_1 + L_2}$ (d) $\frac{L_2}{L_1 + L_2}$

32. Ratio of magnetic field at the centre of current carrying coil of radius R and at a distance of 3R on its axis.

(a) 10v2 (b) $2\sqrt{10}$

(c) $10\sqrt{10}$ (d) $\sqrt{10}$

33. A charged particle having charge q experience a force $\vec{F_1} = q(-\hat{J} + \hat{K})$ N in a magnetic field $\vec{B}$ When it has a velocity $\vec{V_1} = 1\hat{i}$ m/sec. The force becomes $\vec{F} = q(+\hat{z} - \hat{k})$N when the velocity is changed to $\vec{V_2} = 1\hat{j}$m/sec then the magnetic induction vector at that point is

(a) $(\hat{i} + \hat{J} + \hat{K})$T (b) $(-\hat{i} - \hat{J} + \hat{K})$T

(c) $(\hat{i} - \hat{J} - \hat{K})$T (d) $(\hat{i} + \hat{J} + \hat{K})$T

34. Magnetic field at a point due to an infinitely long straight conductor carrying current is

(a) $\frac{\mu_0 i}{4\pi r}$ (b) $\frac{1}{4\pi\mu_0}\frac{i}{r}$

(c) $\frac{2\mu_0 i}{4\pi r}$ (d) $\frac{2\mu_0 i}{2\pi r}$

35. A charge moves through a magnetic field with a certain velocity. Direction of force can be obtained by applying

(a) Ampere's law

(b) Fleming's right hand rule

(c) Rule of cross product of vectors

(d) Cork Screw rule

36. The wave front of a distant source of unknown shape is

(a) spherical (b) cylindrical

(c) plane (d) elliptical

37. Two coherent light beams of intensity I and 9I are superposed. The ratio of maximum intensity to minimum intensity is

(a) 4:1 (b) 9:1

(c) 10:8 (d) 1:4

38. If in Young's double slit experiment of light interference is performed in water which of the following is correct.

(a) fringe width will decrease

(b) fringe width will increase

(c) fringe width will remain same

(d) None of the above

39. The angle at which reflected light is totally polarised for reflected from air to glass of refractive index μ is

(a) $\mathrm{Sin}^{-1}\frac{1}{\mu}$ (b) $\mathrm{Sin}^{-1}\mu$

(c) $\mathrm{Tan}^{-1}\mu$ (d) $\mathrm{Tan}^{-1}\left(\frac{1}{\mu}\right)$

40. Resolving Power of Microscope depends on the wave length of the light as

(a) R.P. $\alpha\ \lambda$ (b) R.P. $\alpha\ \frac{1}{\lambda}$

(c) R.P. $\alpha\ \lambda^2$ (d) R.P. $\alpha\ \frac{1}{\lambda^2}$

41. When a certain metalic surface is illuminated by light of wavelength λ The stopping potential : is $3v_0$. If it is issuminated by a light of wave length 2λ stopping potential is v_0 (to be included after $3v_0$ upto the thresold). The thresold wavelength of the surface for photo electric effect is

(a) 6λ (b) $4\lambda/3$

(c) 4λ (d) 8λ

42. A metal surface is illuminated by a light of given intensity and frequency to cause photo emission. If the intensity of illuminatior is reduced to one fourth of its original value, then the maximum K.E of emitted photo electrons will become

(a) $\left(\frac{1}{16}\right)$th of original value

(b) unchanged

(c) twice the original value

(d) four times the original value

43. In the graph of $V \sim \frac{1}{\lambda}$ for a given photo cathode is

(a) Straight line (b) Parabola

(c) Circle (d) Eelipse

Where $V \rightarrow$ Stopping potential plotted along Y axis.

44. In which process the number of protons in the nucleus increase

(a) λ decay (b) β^+decay

(c) β^-decay (d) K capture

45. Let E_1 and E_2 be the binding energies of two nuclii A and B. It is observed that two nuclii of A combine together to form a nucleus B. This will be possible if
    (a) $E_1 > E_2$ (b) $E_2 > E_1$
    (c) $E_2 > 2E_1$ (d) $E_2 < 2E_1$

46. A radio active substance decays by 63% of initial value in 10 sec. It would have decayed by 50% of its initial value in
    (a) 6.93sec (b) 14sec
    (c) 1.4 sec (d) 2 secs

47. The ionisation energy of hydrogen atom is 13.6 ev. Energy corresponding to transition between 3rd and 4th orbit is
    (a) 3.4 ev (b) 1.51 ev
    (c) 0.85 ev (d) 0.66 ev

48. 1 amu is
    (a) 20 Mev (b) 45 Mev
    (c) 931 Mev (d) 100 Mev

49. If the radius of ${}_{13}Al^{27}$ nucleus is 3.6 fermi The radius of ${}_{53}Te^{125}$ will be nearly
    (a) 6 fermi (b) 8 fermi
    (c) 4 fermi (d) 5 fermi

50. If ${}_{92}U^{238}$ changes to ${}_{85}At^{210}$ by series of α and β decays the number of α and β decays undergone is
    (a) 7, 5 (b) 7, 7
    (c) 5, 7 (d) 7, 9

51. According to Bohr's theory of hydrogen atom, the product of the binding energy of electron in the n th orbit and its radius in n th orbit
    (a) is proportional n^2
    (b) is inversely proportional to n^2
    (c) It is independent of n
    (d) It is inversely proportional to n

52. The shortest wave length of the Brackett series of a hydrogen like atom of atomic number z is same as the shortest wave length of the Balmer series of hydrogen atom. The value of Z is
    (a) 2 (b) 3
    (c) 4 (d) 6

53. For Uranium nucleous now does its mass vary with volume.
    (a) $m \alpha V^{1/2}$ (b) $m \alpha V$
    (c) $m \alpha V^2$ (d) $m \alpha \frac{1}{V}$

54. The electron emitted in beta radiation originates from
    (a) inner orbit of atom
    (b) decay of a neutron in a nucleus
    (c) free electrons existing in nucleus
    (d) None of the above

55. An α Particle is accelerated through potential difference of 10^6v. The kinetic energy of α Particles will be
    (a) 1Mev (b) 2Mev
    (c) 4Mev (d) 8Mev

56. Electric potential at a point on equitorial line of an electric di pole is numerically
    (a) equal to its di pole moment
    (b) equal to its charge
    (c) Zero
    (d) None of the above

57. The medium between a parallel capacitor was air then it is replaced by oil. Then the capacitance
    (a) decreases
    (b) increases
    (c) remains same
    (d) first increases then decreses

58. The dimension of electric permittivity is
    (a) $M L^3T^4A^{-2}$ (b) $M^{-1}L^{-3}T^4A^2$
    (c) $M^{-1}L^3T^4A^2$ (d) $M^{-1}L^{-3}T^4A^{-2}$

59. The equivalent capacitance of two capacitors when joined in parallel is 16 μF and joined in series is 3 μF then the capacitance of capacitors are
    (a) 8 μF, 8 μF
    (b) 6 μF and 10 μF
    (c) 4 μF and 12 μF
    (d) 2 μF and 14 μF

60. The energy gap between the valace band and the conduction band for a material is 6 ev. The material is
    (a) insulator
    (b) metal
    (c) an intrinsic semi conductor
    (d) a super conductor

61. If no external voltage is applied across p - n junction there will be
    (a) no electric field across the junction
    (b) an electric field pointing from n type to p type across the junction
    (c) an electric field pointing from p type to n type across the junction
    (d) None of the above

62. If the forward voltage in a diode is increased the width of the depletion region.
    (a) increases (b) decreases
    (c) fluctuates (d) no change

63. A transistor is used in common emitter configuration. If $\alpha = 0.9$ and I_b changes by 2 μA Then change in collector current is
    (a) 1 μA (b) 10 μA
    (c) 18 μA (d) 30 μA

64. In short wave communication waves of which of the following frequencies will be reflected back by the ionospheric layer having electron density $10^{11} m^{-3}$?
    (a) 2.8 MHz (b) 10.2 MHz
    (c) 12.4 MHz (d) 18 MHz

65. The maximum distance upto which TV transmission from a TV tower of height h can be received is proportional to
    (a) $h^{\frac{1}{2}}$ (b) h
    (c) $h^{\frac{3}{2}}$ (d) h^2

66. The waves used by artificial satelites for communication purposes are
    (a) FM radio waves
    (b) A M radiowaves
    (c) Xrays
    (d) Microwaves

67. In the communication system amplitude modulation is used for broadcasing because
    (a) It is more noise immune than other modulation system.
    (b) It requires less transmitting power.
    (c) Its use avoids receiver complexity.
    (d) no other modulation system can give the necessary bandwidth for faithful transmission.

68. What is the modulation index if an audio signal of amplitude one half the carrier amplitude is used in amplitude modulation ?
    (a) 1 (b) 0
    (c) 1.5 (d) 0.5

69. The process of separating radio signal from the modulated wave is known as
    (a) amplification (b) modulation
    (c) demodulation (d) superposition

70. Long distance short wave radio broadcasing uses
    (a) groundwave
    (b) Skywave
    (c) direct wave or space wave
    (d) ion ospheric wave

71. Minimum number of satelites needed in GPS is
    (a) 2 (b) 1
    (c) 5 (d) 4

72. Video signals required for transmission of picture have a bandwidth of about

(a) 1 Hz (b) 1 KHz

(c) 4.2 MHz (d) 300 Hz

73. Modulation factor has unit of

(a) Volt

(b) no unit

(c) Hz

(d) None of the above

74. When inputs are zero each and output is zero for two input gate then the logic gate is

(a) NAND (b) AN

(c) NOR (d) OR

75. When light travels from glass to air there will be no change in its

(a) wavelength (b) frequency

(c) velocity (d) amplitude

76. The sign of the power of a convex lens is

(a) +ve

(b) -ve

(c) sign is not there

(d) None of the above

77. Two resistances are connected in the two gaps of a meterbridge. The balance point is 20CM from the zero end. A resistance of 15Ω is connected in series with the smaller of the two resistances, then the null point shifts to 40CM. The smaller of the two resistances has the value.

(a) 8Ω (b) 10Ω

(c) 12Ω (d) 9Ω

78. The resistances of two lamps are in the ratio 4:5 Their wattage will be in the ratio

(a) 4:5 (b) 5:4

(c) 16:25 (d) 25:16

79. 1 Killo watt hour is equal to

(a) 36×10^5J (b) 36 X 10^3J

(c) 10^3J (d) 10^6J

80. A Cell is balanced on 125 cm length of a potentio meter wire. On short circuiting the cell by a resistance of 2 ohm the balance point is obtained at 100CM. The internal resistance of the cell is

(a) 2Ω (b) LΩ

(c) O.S,Ω (d) 0.1Ω

81. A piece of wire of resistance R is stretched uniformly so that the length is doubled. The resistance of the stretched wire will be

(a) 2R (b) $R/4$

(c) $R/2$ (d) 4R

82. Two point charges repel each other with a force of 100 N. One of the charges is increased by 10% and other is decreased by 10%. The new force of repulsion at the same distance would be

(a) 100 N (b) 99 N

(c) 101 N (d) None of these

83. Five point charges each of value +q are place on five verticles of a regular hexagon of side L. The magnitude of force on a point charge of value -q coulomb placed at the centre of the hexagon is

(a) $\frac{1}{\pi \in_0}\left(\frac{q}{L}\right)^2$ (b) $\frac{2}{\pi \notin_0}\left(\frac{q}{L}\right)^2$

(c) $\frac{1}{2\pi \notin_0}\left(\frac{q}{L}\right)^2$ (d) $\frac{1}{4\pi \notin_0}\left(\frac{q}{L}\right)^2$

84. A and B are two points on the axis and the perpendicular bisector respectively of an electric di pole. A and B are far away from the di pole and at equal distances from it. The fields at A and B are

(a) $\vec{E}_A = \vec{E}_B$

(b) $\vec{E}_A = 2\vec{E}_B$

(c) $\vec{E}_A = -2\vec{E}_B$

(d) $\left|\vec{E}_B\right| = \frac{1}{2}\left|\vec{E}_A\right|$ and $\vec{E}_A$ is perpendicular to $\vec{E}_B$

85. At a point in space electric field points towards north. In the region surrounding this point, the rate of change of potential will be zero along

(a) east west (b) north
(c) south (d) north-south

86. An electric field is expressed as $\vec{E} = 2\hat{i} + 3\hat{j}$. Find the potential difference V_A-V_B between two points A and B whose position vectors are

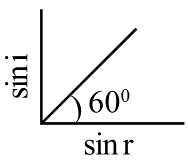
$r_A = \hat{i} = 2\hat{j}$ $r_B = 2\hat{i} + \hat{j} + 3\hat{k}$ is

(a) -1v (b) 1v
(c) 2v (d) 3v

87. Find the potential V of an electrostatic field $\vec{E} = a(\hat{i}\,y + \hat{J}\,x)$ Where a is constant

(a) axy + c (b) - axy + c
(c) axy (d) - axy

88. The graph between sin i and sin r is as in the figure where i is angle of incidence and r is angle of refraction. The velocity of light in first medium i s n times the velocity in second medium. Then the value of n is



(a) $\sqrt{3}$ (b) $\frac{1}{\sqrt{3}}$
(c) $\sqrt{3}/2$ (d) $\frac{2}{\sqrt{3}}$

89. Critical angle of glass is θ_1 that of water is θ_2. The critical angle for water and glass surface would be

${}^a\mu_g = 1.5$ ${}^a\mu_w = \frac{4}{3}$

(a) less than θ_1
(b) greater than θ_2
(c) less than θ_2
(d) between θ_1 and θ_2

90. The minimum orbital angular momentum of the electron in a hydrogen atom

(a) h (b) $h/2$
(c) h/λ (d) $\frac{h}{2\pi}$

91. The work function of metal is w and λ is wavelength of incident radiation. There is no emission of photo electrons when

(a) $\lambda > \frac{hc}{w}$ (b) $\lambda = \frac{hc}{w}$
(c) $\lambda < \frac{hc}{w}$ (d) non of the above

92. The K.E of photo electrons is E when the incident wavelength is $\lambda/2$ The K.E becomes 2E when incident wave length is $\lambda/3$ The work function of the metal is

(a) hc/λ (b) $2hc/\lambda$
(c) $3hc/\lambda$ (d) $\frac{hc}{3\lambda}$

93. An Ac voltage is

$E = 220(\sqrt{2})\cos 50\,\pi t$

How many times the current will become zero in 1 second

(a) 100 times (b) 30 times
(c) 50 times (d) 125 times

94. Power factor is one for

(a) Pure inductor
(b) Pure capacitor
(c) both capacitor and inductor
(d) Pure resistor

95. A Transformer steps up the voltage from 220v. to 11000volt. If the primary has 100 turns the secondary should have
 (a) 22000 turns (b) 5000 turns
 (c) 2000 turns (d) 11000 turns

96. The core of a transformer is laminated to
 (a) increase the output voltage
 (b) decrease the output voltage
 (c) reduce eddy current loss
 (d) reduce the magnetism in the core

97. LCR Circuit has L =8 henry C = 0.5 μ F
 R = 100 Ω in series. the resonant angular frequency is
 (a) 600 radian (b) 500 radian
 (c) 400 radian (d) 100 radian

98. When the current in a coil changes from 2A to 4A in 0.05 sec an emf of 8v is induced in the coil. The coefficient of self induction in the coil is
 (a) 0.1 H (b) 0.2 H
 (c) 0.5 H (d) 0.4 H

99. Which of following has the highest penetrating power ?
 (a) α particle (b) β -particle
 (c) r-ray photon (d) proton

100. When do two protons attract each other ? When
 (a) The distance between them is 10^{-10} M
 (b) The distance between them is 10^{-1}M
 (c) distance between them is ∞
 (d) distance between them is less than 10^{-15}M

101. In an electromagnetic wave the angle between electric and magnetic field vector is
 (a) 0^0 (b) 90^0
 (c) 45^0 (d) 120^0

102. For a transistor amplifier, the voltage gain
 (a) remains constant for all frequencies
 (b) is high at high and low frequencies and constant in middle frequency range
 (c) is low at high and low frequencies and constant in mid frequency range
 (d) None of the above.

103. The current gain for CE amplifier 59 and I_E = 6.0 mA then collector current is
 (a) 6 mA (b) 5 mA
 (c) 0.1 mA (d) 5.9 mA

104. In terms of Bohr radius a_0, the radius of the second Bohr orbit of hydrogen atom is
 (a) $4a_o$ (b) $8a_o$
 (c) $\sqrt{2}a_o$ (d) $2a_o$

105. If the kinetic energy of a free electron doubles its de-Broglie wave length changes by factor
 (a) ½ (b) 2
 (c) $\frac{1}{\sqrt{2}}$ (d) $\sqrt{2}$

***

2. *Answer each bit as directed.*

1. When ebonite is rubbed with fur the fur acquires ______ change. (Fill in the blanks)
2. The Smallest Unit of charge is that of ______. (Fill in the blanks)
3. Relative Permitivity has unit of force. (Correct the Sentence)
4. Coulomb force is a central force. (Answer Yes or No.)
5. A Coulomb is ______ times a stat coulomb. (Fill in the blanks)
6. Force experienced by a charge moving in an electric field depends on its velocity. (Correct if necessary)
7. An electric dipole placed in a non uniform electric field experiences <u>force</u>. (Correct the Sentence without changing the underlined word).
8. Two charges of $+1\,\mu C$ and $+5\,\mu C$ are placed 1CM apart the ratio of the coulomb force acting on each of them is ______. (Fill in the blanks)
9. The lines of force for uniform electric field are converging ones. (Correct the sentences)
10. 1 Volt = ______ Stat Volt. (Fill in the blanks)
11. Dimension of Capacitance is ______. (Fill in the blanks)
12. Filling the space in between with a dielectric the capacity of the condensor decreases by $\frac{1}{K}$ times. where K is dielectric constant. (Correct the sentence.)
13. Energy stored in capacitor varies as the sqaure of ______ on it. (Fill in the blanks)
14. Net energy stored in a combination of capacitors is independent of the way they are connected. (Correct the sentence if necessary)
15. Drift velocity is order of ______ s^{-1}. (Fill in the blanks)
16. Electric current flowing through a conductor is inversely proportional to the drift velocity. (Correct the statement if necessary)
17. How the drift velocity is related to mobility ? (Write the answer only)
18. Dimension of resistance is ______. (Fill in the blanks)
19. Temperature co-efficient of resistance for metals is negative ? (Yes or No)
20. Dimension of conductance is same as that of resistance. (Yes or No)
21. Direction of electric current through the internal resistance of a cell is from ______ to ______. (Fill in the blanks)
22. Kirchhoft's current law and voltage law are based on conservation of ______ and ______. (Fill in the blanks)
23. In order to convert a galvanometer to a voltmeter a low resistance is connected in series with the galvanometer coil. (True or False)
24. Filament of electric bulb is made up of ______. (Fill in the blanks)
25. The maximum power rating of 20w resistor is 2 Kilowatt. Can it be connected to a 220v. D.C. Supply ? (Yes or No)
26. The magnetic field due to straight conductor is ______ when the observation point lies along the length of the conductor. (Fill in the blanks)
27. Magnetic susceptibility of paramagnetic substance is directly proportional to the temperature ? (Yes or No)
28. Volt Meter is always connected in ______ with the circuit. (Fill in the blanks)
29. The range of voltmeter can be increased by reducing the resistance. (Correct the Statement)
30. Nature of Magnetic field in case of moving coil galvano meter is ______. (Fill in the blanks)

31. Force exerted by magnetic field on a moving charge is parallel to the magnetic field. (Correct the Sentence)

32. The dimension of $\frac{1}{\sqrt{LC}}$ is same as that of the velocity. (Correct the Sentence)

33. Ratio of dimension of the magnetic flux to that of electric flux is $L\,T^{-1}$. (Correct the Sentence)

34. Force on a charged particle moving in a magnetic field is maximum if the angle between $\vec{V}$ and $\vec{B}$ is ______. (Fill in the blanks)

35. Two Parallel straight conductor carrying currents and placed side by side attract if ______. (Complete the Sentence)

36. In an ammeter a low resistance is connected in series. (Whether the statement is true or not)

37. Susceptibility is positive and small for dimagnetic substance. (If necessary correct the Sentence)

38. The strength of the magnetic field due to a straight current carrying conductor is B at a distance r and field will be ______ at distance $r/2$. (Fill up the blanks)

39. Minimum size of plane mirror required to see full size image of the object is ______. (Fill up the blanks)

40. Focal length of plane mirror is infinity and its power is ______. (Fill up the blanks)

41. Intensity of light is directly proportional to ______. (Fill up the blanks)

42. Refractive index is ______ proportional to the sine of the critical angle. (Fill up the blanks)

43. Shining in diamond is due to ______. (Fill up the blanks)

44. Fringle width is the distance between any consecutive maxima and minima. (Correct the Sentence)

45. Phase difference = 2π x Path difference. (Correct the Sentence)

46. Watt x Volt = Ampere. (Correct the Sentence)

47. <u>Electric lines</u> of force are continuous and closed. (Change the underlined word to correct the sentences)

48. The speed of r ray in vaccum is equal $3 \times$ light velocity in vaccum. (Correct the Sentence)

49. Nuclear force is the weakest force. (Correct the Sentence)

50. In fission of 1kg of uranium releases more energy than in fusion of 1kg of hydrogen. (Correct the Sentence)

51. The energy liberated from sun is due to process of nuclear fission. (Correct the Sentence)

52. According to Huygen's principle light is form of particles. (Correct the Sentence)

53. Path difference for destructive interference is ______. (Fill up the blank)

54. Light wave is longitudinal. (Correct the sentence)

55. Polarisation phenomenon is common to both sound and light wave. (Yes or No)

56. For a parallel beam of monochromatic light of λ wavelength get diffracted by a single slit. If slit width is 'a' and D is distance of screen from the slit, the width of central maxima is ______. (Fill in the blank)

57. Polarisation of light proves ______ nature of light. (Fill in the blank)

58. Resolving power of telescope can be increased by increasing the wavelength. (Correct the statement if necessary)

59. Correct the underline angle :- The angle of incidence of light ray at a glass slab is <u>45^0</u> such that reflected ray and refracted ray will be at right angles to each other. $\sqrt{3}$ is the refractive index of glass.

60. Meanlife of radio active substance is 100s then half life time in minutes is ______. (Fill in the blanks)

61. The binding energy per nucleon is maximum for ______. (Fill in the blanks)

62. If alpha, beta, gamma rays carry same momentum beta ray has the longest wavelength. (Correct the Statement)

63. The nuclear force is charge dependent. (Correct the Statement)

64. The sharp peak in binding energy curve for Helium nucleus indicates that it is unstable. (Correct the Statement)

65. The ratio of minimum to maximum wavelength of Balmer series is ______. (Fill in the blanks)

66. The ground state energy of hydrogen is -13.6ev. The Kinetic energy of electron will be ______. (Fill in the blanks)

67. In case of a concave mirror the image always moves faster than the object. (State whether statements are True or False)

68. If an object is placed in front of diverging mirror at a distance equal to its focal length the height of the image is half that of object. (State whether statements are True or False)

69. The equation $\frac{\mu 2}{V}-\frac{\mu 1}{U}=\frac{\mu 2-\mu 1}{R}$ is applicable to a plane surface $R=\infty$. (State whether statements are True or False)

70. An air bubble inside water acts like a concave lens. (State whether statements are True or False)

71. The distance between a real object and its real image formed by a single lens cannot be more than 4f. (State whether statements are True or False)

72. Lyman series of hydrogen atom lies in the infra red region. (State whether statements are True or False)

73. Velocity of electron in an atom is dependent on its mass. (State whether statements are True or False)

74. Time period of revolution of an electron in the n^{th} orbit is directly proportional to n^2. (State whether statements are True or False)

75. A converging and diverging lens of equal focal length are placed coaxially in contact then the power of the combination is ∞.

76. Value of critical angle for a material of refractive index V2 is 60^0.

77. Sound wave can be polarised.

78. As the temperature rises the resistance of semiconductors ______. (Fill in the blanks).

79. The doping of an intrinsic semiconductor decreases the conductivity. (Correct the Statement)

80. For using a transistor as an amplifier the base emitter junction is ______ biased and base collector junction is ______ biased. (Fill in the blanks)

81. An output I is obtained in a NoR gate when either input terminals are at 0 state. (Correct if necessary)

82. The movement of charge carriers from a region of higher concentration to a region of lower concentration is ______ (diffusion or drift). (Choose the correct Answer)

83. The energy band in solids is an outcome of ______ (Pauli's exclusion principle, coulomb's law). (Fill in the blank with correct answer)

84. Two nuclie having mass number ratio is 1:4. What is the ratio of nuclear density ? (Write the answer only)

85. The conductivity of an intrinsic semiconductor is high or low ? (Write the answer only)

86. Conductivity of semiconductor varies lineraly with temperature. (True or False)

87. The semi conductors are ______ at absolute zero temperature (conductor, insulator). (Fill in the blanks)

88. The drift velocity of electrons are equal to that of holes. (Correct the Statement)

89. In a transistor if $V_{CE} >> V_{BE}$ Then Ic is independent of V_{CE}. (Correct the statement if necessary)

90. State the name of diode which is used as voltage regulator. (Write the answer only)

91. AND gate followed by ______ gate is equivalent to a NAND gate. (Fill in the blanks)

92. A 25 ohm galvanometer is shunted by 2.5 Ω wire. The part of the total current flows through the galvonometer is ______. (Fill in the blnaks)

93. Weber ampere per meter is equal to ______ . (Fill in the blanks)

94. The current loop placed in a uniform magnetic field experiences a torque which depends on the shape of loop. (Correct the statement if necessary)

95. A cylinder of radius R and length L is placed in a uniform electric field E parallel to cylinder axis. The total flux from the surface of the cylinder is ______. (Fill in the blanks)

96. The region surrounding an oscillating di pole has electric field only. (Correct the Statement)

97. The angles between the electric di pole moments and the electric fied at point on axial line and on equitorial line are ______ and ______. (Fill in the blanks)

98. A parallel capacitor has a capacitance of 50 μF in air and 100 μF in oil. The di electric constant of oil is ______. (Fill in the blanks)

99. A thin metal plate is insulated half way between the plates of a parallel plate capacitor of capacitance C in such a way that it is parallel to the two plates then the capacitance is ______. (Fill in the blanks)

100. The energy 4 μF capacitor charged to a potential difference of 100v is more than the energy gained by 4 μC charge moved through a potential difference of 200v. (Correct the sentence if necessary)

101. In the process of electrification by friction the principle of conservation of electric charge is violated. (Correct the sentence if necessary)

102. Lenz's law is a consequence of conservation of momentum. (Correct the sentence if necessary)

103. Henry is unit of magnetic field strength. (Correct the sentence if necessary)

104. A transformer steps up or steps down both ac and dc. (Correct the sentence if necessary)

105. The dimension of L/R is equal to that of length.

106. Dimension of $(\mu_0\varepsilon_0)^{\frac{1}{2}}$ is $L^{\frac{1}{2}}T^{-\frac{1}{2}}$.

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GROUP - A

ANSWERS

1. Choose the correct answer out of the four probables given at the end of each bit :

1. (b) 2.3×10^{-28}N
2. (c) $\overrightarrow{-E_2} = \frac{\overrightarrow{-E_1}}{16}$
3. (a) Positive
4. (b) $\frac{1}{9x10^9}\ C^2M^{-2}N^{-1}$
5. (c) Parallel
6. (c) Energy
7. (d) 1 zero
8. (c) Zero
9. (c) 90^0
10. (b) 0^0
11. (c) $\sqrt{R_1R_2}$
12. (a) $\frac{3}{4}R$
13. (b) $r_2 = 2r_1$
14. (c) p/n
15. (b) spherical
16. (b) decreases
17. (c) 90 CM
18. (c) 45^0
19. (c) fv < fr
20. (a) 0^0
21. (a) 1.5×10^8m/sec
22. (d) 60^0
23. (a) 2 times
24. (b) $\frac{8}{3}\mu F$
25. (d) $5\,\mu F$
26. (b) 48×10^{-5}C
27. (c) (n-1) c
28. (a) 4 : 1
29. (c) 3 sint + 3t cost
30. (a) 3A
31. (b) $\frac{L2}{L1}$
32. (c) $10\sqrt{10}$
33. (a) $\left(\hat{i}+\hat{J}+\hat{K}\right)T$
34. (c) $\frac{2\mu_0 i}{4\pi r}$
35. (c) Rule of cross product of vectors
36. (c) plane
37. (a) 4:1
38. (a) fringe width will decrease
39. (c) $Tan^{-1}\mu$
40. (b) R.P. $\alpha\ \frac{1}{\lambda}$
41. (c) 4λ
42. (b) unchanged
43. (a) Straight line
44. (d) K capture
45. (c) $E_2 > 2E_1$
46. (a) 6.93sec
47. (d) 0.66 ev

48. (c) 931 Mev
49. (a) 6 fermi
50. (b) 7, 7
51. (c) It is independent of n
52. (a) 2
53. (b) $m \propto V$
54. (b) decay of a neutron in a nucleus
55. (b) 2Mev
56. (c) Zero
57. (b) increases
58. (b) $M^{-1}L^{-3}T^{4}A^{2}$
59. (c) $4\mu F$ and $12\mu F$
60. (a) insulator
61. (b) an electric field pointing from n type to p type across the junction
62. (b) decreases
63. (c) $18\mu A$
64. (a) 2.8 MHz
65. (a) $h^{\frac{1}{2}}$
66. (d) Microwaves
67. (c) Its use avoids receiver complexity.
68. (d) 0.5
69. (c) demodulation
70. (c) direct wave or space wave
71. (d) 4
72. (c) 4.2 MHz
73. (b) no unit
74. (c) NOR
75. (b) frequency
76. (b) -ve
77. (d) 9Ω
78. (b) 5:4
79. (a) 36×10^{5}J
80. (c) O.S, Ω
81. (d) 4R
82. (b) 99 N
83. (d) $\frac{1}{4\pi \notin_0}\left(\frac{q}{L}\right)^2$
84. (c) $\vec{E}_A = -2\vec{E}_B$
85. (a) east west
86. (a) -1v
87. (b) - axy + c
88. (a) $\sqrt{3}$
89. (b) greater than θ_2
90. (d) $\frac{h}{2\pi}$
91. (a) $\lambda > \frac{hc}{w}$
92. (a) hc/λ
93. (c) 50 times
94. (d) Pure resistor
95. (b) 5000 turns
96. (c) reduce eddy current loss
97. (b) 500 radian
98. (b) 0.2 H
99. (c) r-ray photon
100. (d) distance between them is less than 10^{-15}M
101. (b) 90^{0}
102. (c) is low at high and low frequencies and constant in mid frequency range
103. (d) 5.9 mA
104. (a) $4a_o$
105. (c) $\frac{1}{\sqrt{2}}$

2. Answer each bit as directed.

1. Positive
2. electron
3. no unit
4. Yes
5. $3x10^9$
6. doesnot depend on the velocity.
7. It experience force in uniform field
8. 1:1
9. Parallel lines of force
10. $\frac{1}{300}$ Stat volt.
11. $\left[M^{-1}L^{-1}T^{4}A^{2}\right]$
12. It increases by K times
13. Charge or Potential
14. Sentence is correct
15. 1 MM/Sec.
16. $I \,\alpha\, V_d$
17. $\mu = \frac{V_d}{E}$
18. $\left[M^{1}L^{2}T^{-3}A^{-2}\right]$
19. No
20. No
21. from -ve to +ve terminal of cell
22. Charge and energy
23. False, high resistance
24. Tungsten
25. No
26. Zero
27. No $\chi \,\alpha\, \frac{1}{T}$
28. Parallel
29. by increasing the resistance
30. radial
31. Perpendicular
32. that of angular velocity.
33. $T\,L^{-1}$
34. 90^0
35. if current flows in same direction
36. false (in parallel)
37. Paramagnetic substance
38. 2B
39. 1/2 of the size of object
40. Zero
41. Square of amplitude
42. inversely proportional
43. total internal reflection
44. between two consecutive maxima.
45. $\frac{2\pi}{\lambda}$ x Path difference
46. Watt = Volt x ampere
47. Magnetic lines of force
48. Light velocity in vacuum
49. Strongest force
50. Less energy
51. by fusion process
52. Form of wave

53. $(2N+1)\frac{\lambda}{2}/(2n+1)\frac{\lambda}{2}$
54. Transverse
55. No only for light
56. $\frac{2D\lambda}{a}$
57. transverse nature of light
58. No
59. 60^0
60. 1.155 Minutes
61. Iron
62. all of them are having same wave length
63. Charge independent
64. Stable
65. 5:9
66. 13.6 ev.
67. - false for U>2f image moves slower
68. True $m = \frac{fo}{fo + x}$ and $x = fo$
69. True
70. True
71. True
72. False (U-V region)
73. Mass independent (False)
74. $T \alpha n^3$ False
75. False power is zero
76. $ic = 45^0$
77. False
78. Decrease
79. increases conductivity
80. Forward, reverse
81. When both terminals in 0 state
82. diffusion
83. Pauli's exculsion principle.
84. 1:1
85. Low
86. False
87. insulators
88. correct
89. Correct
90. Zener
91. NOT
92. $\frac{1}{11}$th Path
93. Newton
94. doesnot depend on the shape depends on I,B,A
95. Zero
96. electric and magnetic field both
97. 0^0 and 180^0
98. 2
99. C same as ther original
100. Statement is correct
101. Not violated
102. Conservation of energy
103. Henery is unit of mutual and self inductance
104. Only a.c
105. $Time^-$
106. $L^{-1}T$

***

GROUP - B

SHORT TYPE QUESTIONS

3. Answer the following bits. [2x7]

1. Compare gravitational force with electro static force of repulsion between two electrons separated by same distance,
   $G = 6.67 \times 10^{-11}$
   $Me = 9.1 \times 10^{-31}$ kq
   $e = 1.59 \times 10^{-19}$ coulomb.

2. Derive relation between volt, stat volt and abvolt with definitions.

3. A tennis ball painted with conducting material is suspended by silk thread in between two metalic plate. One of the plate is grounded other is connected to high voltage generator. What will happen to the ball ?

4. Coulomb force is central, conservative force, Justify.

5. What is supuposition principle for coulomb interaction ?

6. Two point charges $+5 \times 10^{-19}$c and $+20 \times 10^{-19c}$ are separated by distance of 2m. The electric field intensity will be zero at certain distance from 5×10^{-19}c. What is that distance ?

7. An electron of mass Me falls through a distance 'd' in a uniform electric field E. The direction of field is reversed and magnitude is same and a proton is allowed to fall through same distance. Find the ratio of times taken by electron to proton.

8. A concave mirror is held in water what should be change in its focal length ?

9. Can be absolute value of refractive index be less than unity ? What about relative refractive index ?

10. If a Plane glass slab is placed on letters of different colours. Which coloured letter appears more raised up why ?

11. A charged particle of mass m has an acceleration $\vec{a} = 2\hat{i} + x\hat{j}$ in a magnetic field $\vec{B} = 3\hat{j} - 2\hat{K}$. Find the value of x.

12. The focal length of an equiconvex lens is equal to the radius of convature of either face what is the refractive index of the lens material ?

13. If one uses x ray in a single slit diffraction experiment with slit width 0.6mm what will happen ?

14. Why sun appears reddish at time of Sunset ?

15. How does the resolving power of a telescope changes on increasing the diameter of the objective ?

16. What is displacement current ? Whether it produces magnetic field ? What is the dimension $\epsilon_0 \frac{d\theta_E}{dt}.\theta_E$ is electric flux

17. Out of microwave, ultra violet rays and infra red rays which radiation is most effective for photo electric emission from metalic surfaces.

18. Why micro waves are best for radar system ?

19. Differentiate between conduction current and displacement current.

20. Write the Lens maker's formula why is called so ?

21. What is the focal length and power of a rectangular glass slab ?

22. Why the power is reciprocal of focal length ?

23. Why white light disperse when passed through glass prism ?

24. Why empty test tube immersed in water appears shining ?

25. A converging lens of refractive index 1.5 is kept in a liquid of same μ value. What will be the focal length of lens ?

26. How the angle of minimum deviation will vary with different colours of light passing through a prism ?

27. What is the length of telescope in normal adjustment ?

28. An astronomical telescope set for normal adjustment has magnifying power 10. If f_0 is 1.2 What is fe ?

29. A convex lens is placed in contact with a plane mirror. A point object placed in the front along the axis of combination coincides with its image when placed at 20cm. What is the focal length of lens ?

30. A biconvex lens of $\mu = 1.25$ immersed in water of $\mu = 1.33$. How this lens will behave ?

31. If two thin convex lenses of focal length f_1 and f_2 are placed co-axially in contact. An object is placed beyond f of one lens. Draw the ray diagram to show the position of image.

32. Define wave front.

33. State Huygen's principle.

34. Give definition of plane of polarisation and plane of vibration.

35. For a single slit of width 'a' the first minimum occurs at an angle $\frac{\lambda}{2}$. At the same angle of $\frac{\lambda}{2}$ one gets max^m for two narrow slits separated by distance a. How ?

36. If polarising angle is 56^0 then what is the refracting angle ?

37. In a LCR Circuit voltage drop across L can be more than applied voltage justify.

38. Can we have resonance in LR and CR circuits ?

39. A sinusoidal alternating current of peak value Io passes through a resistance R. What will be the mean power output ?

40. A coil is placed in a constant magnetic field. The magnetic field is parallel to the coil. Find the emf induced in the coil if B is increasing.

41. Current in 10MH inductance increases uniformly from zero to I A in 0.01seconds. Find the direction and magnitude of self induced emf.

42. State Faraday's laws of electromagnetic induction.

43. The current in a coil of self inductance 2 henry is increasing according to $i = 2\sin t^2$. Find the amount of energy spent during the time current changes from 0 to 2A.

44. A region is having potential function $v = 2x^2+3y^2$

    Calculate the field at $x = 2, y = 2$

45. State and Explain Kirchhoff's 1st law.

46. Why an ammeter is connected in series with circuit ?

47. Define magnetic susceptibility.

48. State two properties of dimagnetic substance.

49. Write down relation between susceptibility and permeability.

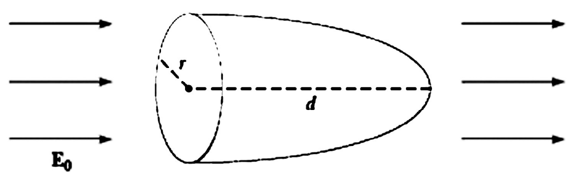
50. Why concave shaped pole pieces are used in moving coil galvanometer ?

51. Trace the trajectory of an electron starting from rest and moving in an electric field.

52. State fleming's left hand rule.

53. A charge $-q_1$ is revolving around a charge $+q_2$ in a circular path of radius r. Find the time period for $-q_1$ for each revolution.

54. Calculate the total electric flux through a parboloidal surface due to a uniform electricfield of magnitude E_0 in the direction in Fig.



55. The potential produced by a point charge is $V = \frac{KQ}{r}$. Use this information to determine the shape of equipotential surface ?

56. Two condensors of capacity $0.3\,\mu f$ and $0.6\,\mu f$ respectively are connected in series. The combination is connected across a potential 6 volts. Find the ratio of energies stored by the condensors.

57. No work is done in taking a positive charge from one point to other inside a positively charged metalic sphere while outside work is done. Justify.

58. A point charge q is placed at origin Let $\vec{E}_A$ and $\vec{E}_B$ be electric fields at points A (1,2,3) and B (1,1,-1) Find the angle between $\vec{E}_A$ and $\vec{E}_B$.

59. A steady current flows in a metalic conductor of non uniform cross section which of the quantities remain constant (i) current (ii) current density (iii) electric field (iv) drift velocity.

60. A potential difference v is applied to copper wire of diameter d and length L. How the electron drift velocity will vary by doubling V, L and d ?

61. The current in a simple series circuit is 5A when an additional resistance of 2 Ω is introduced the current is reduced to 4A . Assuming p.d. to be same in both cases ? What is the value of original resistance ?

62. Why does potential barrier is setup across PN junction ?

63. Can one interchange emitter and collector of a transistor ?

64. Give the circuit symbol and truth table for AND gate.

65. State the factors which controls the wavelength and intensity of light emitted by an LED.

66. The width of depletion layer is smaller or longer in zener diode compared to ordinary P.N. Junction diode ?

67. Draw the IV characteristics of an LED.

68. Why modulation is needed ?

69. Give the names of system, which uses sky wave and space wave propagation.

70. How many types of modulations are there ?

71. A carrier wave of peak voltage 20v is used to transmit a message signal, if modulation index is 80% then what is the peak voltage ?

72. A nucleus undergoes β decay how do its atomic number and mass number change ?

73. Why is there sudden increase in current in zener diode ?

74. Why in a transistors collector current is less than the emitter current ?

75. What is the truth table for NAND gate ?

76. What type of impurity should be added to germanium so that it will be a p type semiconductor ? Explain.

77. Which gates are called universal gates and why ?

78. Give symbolical representation of zener diode and explain its V - I characteristic.

79. Draw the circuit diagram of a PNP Transistor amplifier in CE Configurations.

80. If the output of a 2input NOR gate is fed as both inputs A and B to another NOR gate. Write down the truth table for all combination of A and B.

81. Describe the principle of a solar-cell.

82. Draw the characteristics curves of NPN Transistor in CE configuration.

83. A modulated carrier wave has maximum and minimum amplitudes 800m V and 200mv What is the percentage of modulation.

84. An audio signal is given by 15 sin2 π (100000t). Determine (i) percentage of modulation (ii) modulating signal carrier frequencies (iii) frequency spectrum of the modulated wave.

85. Which is better for high fidelity reception FM or AM ?

86. Why is ground wave transmission of signals restricted to a frequency of 1500KHz ?

87. Why high frequency carrier waves are needed for effective transmission of signals ?

88. Name four variables to determine.
    Accurate position in a GPS system.

89. What is WWW ?

90. What is bandwidth of speech signals ?

91. Two points at a give potential difference are joined by n wires of equal resistances Heat generated in wires when they are connected in series is related to heat generated in wires when they are connected parallel. What is the relation ?

92. Aproton has kinetic energy E = 100ev which is equal to that of a photon The wave length of photon is λ_2 and that of proton is λ_1. How the ratio λ_2/λ_1 is related to energy.

93. For photo electric effect with incident photon of wave length λ the stopping potential is V_0. How V_0 will vary with λ and $\frac{1}{\lambda}$.

94. A particle of mass M at rest decays into two particles of masses m_1 and m_2 having non zero velocities. Find the ratio of the de-Broglie wave lengths of both.

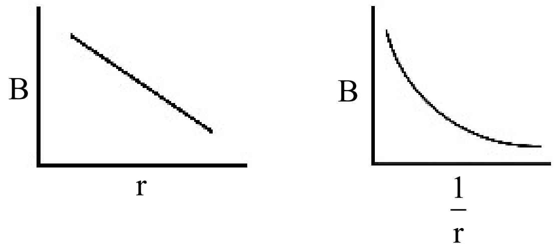
95. Interference pattern of beam of electrons is observed in Young's double slit experiment. If velocity of electrons increase how the fringe width be affected ?

96. In which series hydrogen spectrum the transition involves longest change of energy ?

97. Hydrogen atom is excited from ground state to another state with principal quantum number 4. Then how many number of spectral lines will be in emission spectra ?

98. If one has to apply Bohr model to a particle of mass m and charge q moving in a plane under the influence of a magnetic field B, then K. Energy of that particle in n+h level will be _______.

99. Write the expression for the magnetic induction B due to a long current carrying conductor at r and the plot of B with $\frac{1}{r}$ and r are



    Whether they are correct ?

100. Define ampere.

101. How eddy current can be minimised ?

102. In case of a.c circuit emf leads the current by phase of $\pi/3$, Then state the components of circuit.

103. An AC voltage source $E = 200\sqrt{2}$ Sin100t is connected to a circuit containing an ac ammeter and a capacitor of $C = 1\,\mu F$.

     What will be reading in ac ammeter ?

104. At resonance what is the phase difference between E and I in LCR circuit ?

105. A solenoid of length 1M has 6 layers of 1000 turn each if current in the solenoid is 2A. Then calculate the flux density.

***

4. *Answer the following bits.* *[3x7]*

1. A particle of mass M and change q is projected vertically upwards. A uniform $\vec{E}$ acts vertically down-words. So the graph between potential energy (both gravitational plus electrostatic) and height h will be of what type ?

2. The spherical charged conductor is of radius R. It is charged to potential of V volts. Express the electric field at a distance r> R from the centre of sphere in terms of V.

3. A square is held parallel to y-z plane in an electric field $\left[2\hat{i}+3\hat{j}+5\hat{k}\right]$. It is found that electric flux linked is $8Nm^2c^{-1}$. Calculate the length of the square.

4. When a di electric slab is introduced between two charges. The electric force decreases why ?

5. Express $\in_0$ in terms of Farad.

6. Find the radius of sphere that it may have a capacity of $0.1\ \mu F$. What inference is obtained to use unit of capacitance as microfarad ?

7. Two points A and B are situated at distance 3M and 5M from the origin of source of electrostatic field E

   $E=\frac{2}{X^2}$ What is the P.D between A and B

8. Three changes q, q - q, are placed at the vertical of an equilateral triangle of side a. Calculate the potential energy of the system.

9. An isolated parallel plate capacitor of plate area 'A'. Plate separation 'd' and capacitance C is found to loose charge slowly by conduction through the di electric which has resistivity. Find the resistance of di electric.

10. Two point changes 2q and 8q are placed at a distance r apart. Where should the third charge -q be placed between them so that the potential energy will be minimum.

11. A spherical changed conductor has surface charge density σ. $\vec{E}$ electric field on the surface and V is the potential. If the radius is halved and charge is same. Then find new values of the E and V are

12. A cell develops the same power across two resistance R_1 and R_2 separately. Find the internal resistance of the cell.

13. Two coils have combined resistance 8Ω when connected in series and 2Ω when connected parallel. What are their individual resistances.

14. 16 Cells each of internal resistance 0.5 ohm and e.m.f 1.5v each are used to send current through an external circuit of 2Ω resistance. Find the best model of grouping the cells and current through external circuit.

15. Define wave front. How it is different from ray ?

16. What will be the effect on fringe width of young's double slit experiment when source of light is white light ?

17. In a single slit diffraction experiment slit width is doubled. How the band width of central maxima is affected ?

18. Why astronomers prefer to use telescope with large objective diameter ?

19. Green light is incident at the polarising angle on a glass plate. The angle of refraction is 30^0. What is refractive index of glass ?

20. If a double slit experiment two coherent sources have intensities I and $I+\delta I$. Find the intensities at maxima and minima.

21. Define coherent sources.

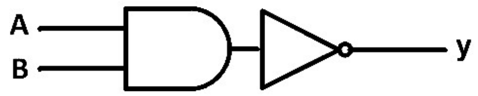
22. Distinguish between polarised and unpolarised light.

23. What part of intensity of an unpolarised light incident on a polarising sheet get transmitted ?

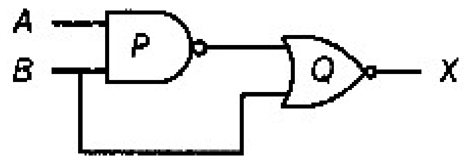
24. State characteristics of nuclear force.

25. Give examples of α decay and β decay.

26. Derive relation between half life and decay constant of radio active element.
27. State limitations of Rutherford model.
28. Find the ratio of the volume of atom and volume of nucleus approximately.
29. Establish relation between packing fraction, mass defect and binding energy.
30. Define Becquerel, Curie, and Rutherford establish relation among them.
31. Why fusion reaction is not possible in laboratory ?
32. How K capture is different from β^+ Decay ?
33. The count of α particle decreases from 28800 to 1800 in 48hours what will be its half life ?
34. With increasing quantum number n whether the energy difference between adjacent levels increase or decrease ?
35. Give the difference between intrinsic and extrinsic semi conductors.
36. What are holes ?
37. Draw circuit diagram and wave fronts of full wave rectifies.
38. Draw circuit diagram of zener as a voltage regulator.
39. Draw symbol of LED and I.V characteristic.
40. Give circuit diagram of C.E n-p-n transistor and input characteristics.
41. Draw CE n-p-n transistor circuit for amplification.
42. A common emitter n-p-n amplifier circuit has voltage drop of 0.8v over the Load resistance of resistance 800Ω. Vcc= 8volt. Find the collector current and collector emitter voltage and voltage gain where β = 25 and internal resistance of transistor is 200Ω
43. The current gain for common emitter amplifier is 59. If the emitter current is 6mA. Find the base current and collector current.
44. What happens when both the emitter and collector are reversed biased ?
45. Give the following diagram table of the logic gate.



46. Identify from the symbol the logic gates P and Q



and find x if A = 0 B = 0 A = 1 B = 1

47. The output of an OR gate is connected to both the inputs of a NOR gate. Write the truth table.
48. What is bandwidth of a signal ? What is its importance ? Give some examples.
49. Which type of modulation is better ?
50. What is difference between LAN and WAN.
51. Show that nuclear density is independent of the size of the nucleus.
52. If permittivity and permeability

$\in_0 = 8.85 \times 10^{-12} C^2N^{-1}M^{-2}$

$\mu_0 = 4\pi \times 10^{-7}$ T M A^{-1}

Find the velocity of electro magnetic wave.
53. A radio can tune to any station in 7.5 MHz to 12MH$_Z$ What is the corresponding wave length band ?
54. If electric field amplitude of em wave is 120 N/C, frequency is 50 MHz then what is amplitude of magnetic field ?
55. An object is placed at a distance of 40CM on the principal axis of a concave mirror of radius of cuvature 30CM. By how much does the image move if the object is shifted towards the mirror through 15CM.
56. When the distance of an object from a concave mirror is decreased from 15CM to 9CM. The image gets modified by 3 times magnified than the first one. Calculate the focal length of the mirror.

57. Calculate the speed of light in a medium whose critical angle is 30^0.

58. The radii of curvatues of a double convex lens are 15CM and 30CM refractive index is 1.5. Calculate the focal length.

59. Using Bohr's model derive expression of radius for nth orbit of an electron.

60. What is the minimum energy that must be given to hydrogen atom so that it emits an H_r in Balmer series If angular momentum is conserved what will be angular momentum of each photon ?

61. Derive how de-Broglie wavelength associated with electron orbiting in ground state will change when it jumps into first excited state ? E_{ground} = -13.6ev

62. If the atom ${}^{257}_{100}Fm$ follows the Bohr model and its radius is in 5th orbit is 'P' times the Bohr radius then find P.

63. Calculate the speed of electron orbiting in the nth orbit around nucleus.

64. If one hydrogen atom is excited and radius becomes 21.2×10^{-11}M. Then find what will be principal quantum number of that state ?

65. Show that the speed of an electron in the innermost orbit (n=1) for hydrogen atom is $1/137$ time the speed of light in vaccum.

66. Why an ammeter is connected in series with the circuit ?

67. Define magentic susceptiblity.

68. State two properties of dimagnetic and paramagnetic substance.

69. Derive relation between susceptibility and permeability.

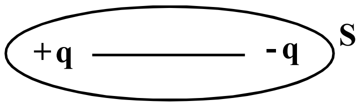
70. Why concave shaped pole pieces are used in moving coil galvanometer.

71. Trace the trajectory of an electron starting from rest and moving in an electric field.

72. State Fleming's left hand rule and right hand rule.

73. A charge $-q_1$ is revolving around $+q_2$ in a circular path. Find the time period for each revolution and obeys Bohr'r model.

74. Calculate the total electric flux through a surface 's' due to electric field of a dipole.



75. The potential produced by a point charge is $V = \dfrac{KQ}{r}$ use this information to find how the intensity of electric field depends upon the distance between two equipotential surfaces.

76. For a given medium polarising angle is 60^0. Find the critical angle.

77. An electron, α particle and proton have the same kinetic energy which of them has the shortest de-Broglie wave length.

78. Two convex lenses. A and B of an astronomical telescope having focal length 5CM and 20CM respectively and they are separated by 15CM which will be choosen to be objective what will be its magnification.

79. Sun glasses have curved surfaces but they donot have any power why ?

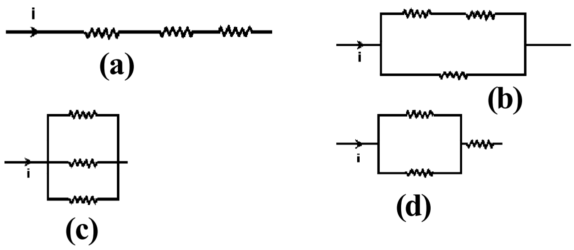
80. The distance of an object and its real image, measured from the focus of the concove mirror are 'a' and b respectively. Show that $f^2 = ab$

81. Show that light ray will pass through an equilateral glass prism ($\mu = 1.5$) the angle of incidence is greater than 30^0

82. What is the focal length of a combination of a convex lens of focal length 30 CM and concave lens of focal length 20 CM.

83. Deduce expression for fringe width in young's double slit experiment.

84. The resistances are of equal value are arranged in different combinations. Arrange them in increasing order of power dissipition.



85. In young's double slit experiment fringe width is 0.8mm when λ is 6000A^0, What will be the fringe width if λ is 7500 A^0 and separation of slits is doubled ?

86. What is the ratio of slit widths if the amplitude of light waves from them have a ratio of $\sqrt{2}:1$.

87. Two coherent sources have intensities ratio is 25:16 Find the ratio of intensities of maxima and minima after the interference.

88. The fraunhoffer diffraction from a single slit of width 1 μ.m is observed with λ=500nm Calculate the half angular width.

89. Why should have narrow sources to produce good interference fringes ?

90. Deduce the relation $\mu = \mathrm{Sin}\dfrac{\frac{\partial m + A}{2}}{\mathrm{Sin}\, A/2}$

91. A thin convex lens made from crown glass $((\mu = 1.5)$ has focal length f when it is measured in two different liquids of $\mu = \frac{4}{3}$ and $\frac{5}{3}$ its focal length changes to f_1 and f_2 respectively. How f_1 and f_2 are related to f.

92. State which phenomenon of light Shows the wave property of light and which shows the particle property.

93. How the power dissipition will be small for ac circuit without affecting E and I.

94. If the value of W increases how does the impendence changes in LCR circuit ?

95. What information is obtained from vector impedanced plot ?

96. $2K\omega$ Power is supplied to 100 turn primary of a transformer at 1000MA. The secondary gives 200 V so what will be number of turns in secondary ?

97. Prove that Irms = $\frac{I_0}{\sqrt{2}}$ and I_{av} for half cycle = $\frac{2I_0}{\pi}$.

98. Find the expression for work done in rotating a magnetic dipole in a magnetic field.

99. What is a paramagnetic substance ? How it is different from Ferromagnet ?

100. The resistance of galvanometer is 50Ω and the maximum current that can pass through it is 0.001A what resistance must be connected to it in series so that it can be converted to an ammeter of range 0.5A.

101. In case of dc source how a inductor circuit and a capacitor circuit behave ?

102. Derive expression for instantaneous current in a pure capacitor circuit.

103. What information is obtained from Davission - Germer experiment ?

104. Two radiations of photon energies 1ev and 2.5 ev illuminate a metal of work function 0.5ev Then what will be ratio of the maximum speeds of the emitted electrons.

105. Why the radio active nuclei are of high mass number ?

106. The potential is $v = x(y^2 - 4x^2)$ what is the value of E_z ?

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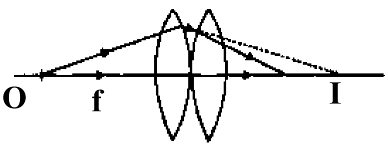
GROUP - B

ANSWERS

3. Answer the following bits. [2x7]

1. 4 X 10^{42} times stronger.
2. 1 volt $= \frac{1}{300}$ stat volt $= 10^8$ ab volt
3. It will oscillate .
4. Central as $\vec{F}(r) = f(r)\hat{r}$ conservative because work done by force is path independent.
5. Coulomb force between two charges is not affected by presence of other charges.
6. $2/3$ meter
7. $\sqrt{\frac{Me}{Mp}}\left(a = \frac{eE}{m}, h = \frac{1}{2}at^2\right)$
8. no change as no μ dependence
9. no but relative refractive index <1 (μ of water with respect to glass)
10. Red, $d = t(1 - \frac{1}{\mu})$
11. $\vec{F} \perp^r \vec{B}$ $\quad \vec{a} \perp^r \vec{B}$

    $\vec{a}.\vec{B} = 0 \quad x = 3$
12. μ=1.5 $\frac{1}{f} = (\mu - 1)\left[\frac{1}{R} - \left(-\frac{1}{R}\right)\right]$
13. no diffraction λ very small for x ray
14. Scattering
15. D decreases R.P decreases.
16. (a) related with flux change in electric field.
    (b) Yes
    (c) Current
17. U - V ray.
18. Short wavelength less diffracted.
19. (a) due to electron flow nonzero if E is constant.
    (b) Zero if E is steady.
20. $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ used for making glass lens.
21. $R = \infty$ and P = Zero
22. $\frac{1}{f}$ gives power of bending of light.
23. Due to different velocity for different colours.
24. Due to total internal reflection.
25. zero.
26. $\mu_v > \mu_r$ so deviation for violet is greater than that of red.
27. $f_0 + f_e$
28. $m = \frac{f_0}{f_e}$ f_e=0.12
29. 20CM
30. diverging.
31. 

32. Wave front is locus of points of same phase of disturbance.
33. Statement.
34. Plane containing direction of vibration and direction of wave propagation is Plane of vibration. Plane $\perp^r$ to direction of vibration and containing direction of $\vec{k}$ is plane of polarisation.
35. For single slit path diff $\lambda/2$ for first minimum and for double slit path diff is $\lambda \rightarrow$ For first maximum.
36. 34^0

37. depending on x_L, R and X_c it can be more.

38. No.

39. $\frac{Io^2R}{2}$

40. Zero

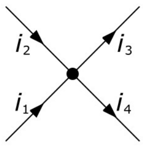
41. $-L\frac{dI}{dt}$

42. Statement

43. 4 Joules

44. $E = -i\frac{\partial v}{\partial x} - j\frac{\partial v}{\partial x} = -\hat{i}\ 4x - \hat{j}\ 6y = -8\hat{i} - 12\hat{j}$

45. statement figure.
sign convention
No charge accumulation



46. Entire current will pass through the ammeter.

47. Definition $= \frac{\text{intensity of magnetisation}}{\text{strength of magnetising field}}$

48. Susceptibility -ve, magnetisation is in opposite direction to magnetising field, it is repelled. It rests at $\perp^r$ to magnetic lines of force.

49. $\mu_0(1+k)$

50. To make field radial.

51. $X = \frac{1}{2}eEt^2$ so $x \sim t$ graph is parabolic

52. Statement.

53. $\frac{1}{4\pi\in_0}\frac{q_1q_2}{r^2} = \frac{mv^2}{r} \rightarrow$

centripetalforce = coulombforce.

$v^2 = \frac{1}{4\pi\in_0}\frac{q_1q_2}{r^2}$

$\left(\frac{2\pi r}{T}\right)^2 = \frac{1}{4\pi\in_0}\frac{q_1q_2}{r^2}$ So T can be known.

54. $E_0\pi r^2$

55. Spherical.

56. $\frac{E_1}{E_2} = \frac{C_2}{C_1} = 2$ As Energy $\alpha\frac{1}{c}$

57. no potential difference inside but P.D outside.

58. 90^0

59. I same $\vec{j}$ different

v_d same $\vec{E}$ same.

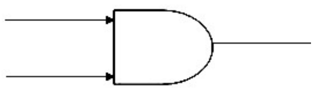
60. $\mu_d = \frac{e^v}{M_e}Z$ remains same.

61. 8Ω

62. Accumulation of -ve charge in P region +ve charge in N region.

63. No doping level is different

64.

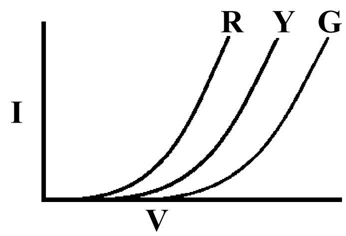


$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

65. Wave length, on nature of material, intensity, on amount of forward bias.

66. D layer small, junction field high.

67.



68. (1) To transmit low frequency wave to a distance place. (2) Protect wave form (3) To keep antenna height small.

69. Short broadcast - Skywave
TV - Space wave.

70. Frequency modulations amplitude and phase modulation.

71. $\frac{80}{100}x20 = 16v$

72. Mass number does not changes atomic number changes.

$n \rightarrow P + e^- + \bar{\upsilon}_e Z$ increases.

$p \rightarrow n + e^+ + \upsilon_e Z$ decreases.

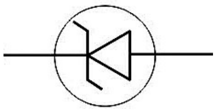
73. The P.D across junction in reverse bias tears of electrons form atoms, no. of electron increases .

74. $I_C + I_B = I_E$

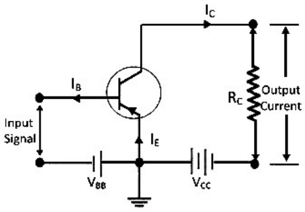
75. $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$

76. Tri valent atom.

77. NAND, NOR all other gates can be made out of them.

78.  Beyond the zener voltage.

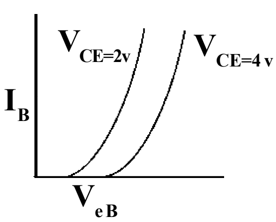
v remains constant with increase in I

79. 

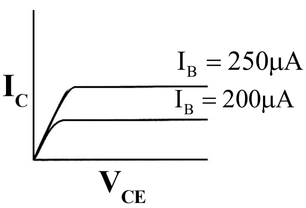
PNP Transistor

80. NOR gate $\begin{matrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 1 & 0 \end{matrix} \rightarrow \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$

81. Heat energy $\rightarrow$ electrical energy

82. 

Input Characteristic



Output Characteristic

83. $100x\dfrac{800-200}{800+200} = 60\,\%$

84. $\mu = \dfrac{15}{60}x100$ percentage of modulation 25%

$fc = 100000H_z$

$fm = 2000H_z$

$102K_z$ to $98\ H_z$

85. F.M., as large number of side bands.

86. High frequency, greater loss, highly damped.

87. To reduce length of antenna.

Increase power radiated

Convert wide band to narrow band signal.

88. (i) longitude

(ii) height

(iii) latitude

(iv) time error

89. World wide web.

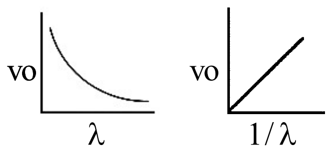
90. $3100H_z$ - $300H_z$

91. Heat in parallel connection = n^2 x Heat in series.

92. $\dfrac{\lambda_2}{\lambda_1}\ \alpha\ E^{\frac{1}{2}}\ \dfrac{\lambda_2}{\lambda_1}\ \alpha\ E^{\frac{1}{2}} \left(E = \dfrac{hc}{\lambda_2},\ X_1 = \dfrac{h}{\sqrt{2ME}}\right)$

93. $\dfrac{hc}{\lambda} = eV_o + W_o$

$vo = \dfrac{hc}{e}\left(\dfrac{1}{\lambda}\right) - \dfrac{Wo}{e}$



94. Momentum will be conserved

$\lambda_1 = \dfrac{h}{p_1},\ \lambda_2 = \dfrac{h}{p_2} \qquad P_1 = -p_2, \left|\dfrac{\lambda_1}{\lambda_2}\right| = 1$

95. $\beta = \frac{D\lambda}{d}$

V increases P increase $\lambda = \frac{h}{p}$

λ decreases

So β decreases.

96. Lyman series.

97. $\frac{n(n-1)}{2} = 6$

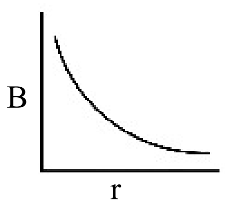
98. $m\,v\,r = \frac{nh}{2\pi)}$ $\frac{mv^2}{r} = qvB \rightarrow \frac{mv}{r} = qB$

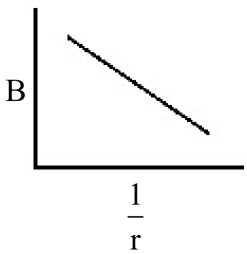
$m\,v\,r\,x\,\frac{mv}{r} = \frac{nh}{2\pi} qB = m^2v^2$

$K.E = \frac{1}{2}mv^2 = \frac{n\,h\,q\,B}{4\,\pi\,m}$

99. $B = \frac{\mu o\; i}{r}$

$B \sim r$





100. Definition

101. Using core in laminated form

102. Resistance, capacitance and inductance

103. 20MA $I = \frac{E}{R}$ $R = \frac{1}{WC}$

104. Zero as $WL = \frac{1}{WC}$

105. $l = 1m$ N = 6000

$n = \frac{N}{e} = 6000$

$i = 2A$

$B = \mu o\; ni$

4. ***Answer the following bits.*** ***[3x7]***

1. $mgh + qEh = y$

$y = (mg + qE)h$ st line passing through the origin.

2. $V = \frac{1}{4\pi\in_0}\frac{q}{R}$ $E(r) = \frac{q}{4\pi\in_0}\frac{1}{r^2}$

$E(r) = \frac{Rv}{r^2}$

3. $\left[2\hat{i} + 3\hat{j} + 5\hat{k}\right].\vec{A} = 2A = 8$

direction of area along x direction

so $2\hat{c}.\,\vec{A} = 2A$

$A = 4$

Side $= 2$

4. Introduction of dielectric change $\in$ value so the electric field changes.

5. $C = \frac{\text{charge}}{\text{potential}} = \frac{q}{\frac{q}{4\pi\in_0 r}} = 4\pi\in_0 r$

$\frac{\text{Farad}}{\text{Meter}} = 4\pi\in_0\; /\; r\; \in_0 = FM^{-1}$

6. $\rightarrow$ .9km if $1\mu F$ is used as practical unit so Farad is not a practical unit.

7. $E = \frac{-dv}{dx} dv = -EdxV_A - V_B - \int\frac{2}{x^2}dx \rightarrow .26$ volt

8. $= \frac{1}{4\pi\in_0}\left[\frac{q^2}{a} - \frac{q^2}{a} - \frac{q^2}{a}\right] = -\frac{1}{4\pi\in_0}\frac{q^2}{a}$

9. $c = \frac{\in A}{d}$ $A = \frac{cd}{\in}$ $R = \rho\frac{d}{A}$ $R = \frac{\rho d \in}{c\,d}$ $R = \frac{\rho\in}{c}$

10. $v = k\frac{16q^2}{r} - \frac{k2q^2}{x} - \frac{k8q^2}{r-x}$

V is minimum when $\frac{2q^2}{x} + \frac{8q^2}{r-x}$ is maximum

$\frac{2}{x} + \frac{8}{r-x} = z$ is maximum $\frac{dz}{dx} = 0$.

at $x = \frac{r}{3}$ at $x = \frac{r}{3}$ $= \frac{d^2z}{dx^2} = +ve$ so maximum

11. 4E and 2v

12. $I^2 R_1 = \left(\frac{E_1}{R_1+r}\right)^2 R_1 \quad = \left(\frac{E_1}{R_2+r}\right)^2 R^2$

$r = \sqrt{R_1 R_2}$

13. $r_1+r_2=8 \quad \frac{r_1 r_2}{r_1+r_2} = 2$

Solve $r_1 = r_2 = 4\Omega$

14. $mn = 16,\ R = \frac{nr}{M}, n = 4M$

$4M^2 = 16 \quad M = 2 \quad n = 8$

8 cells connected in series with 2 rows in parallel.

$i = \frac{16x1.5}{2x2+8x0.5} = \frac{24}{4+4} = 3A$

15. Statement figure, direction with some example. Wave front is the locus of particles in same phase. Ray is $\perp^r$ to wave front ray gives the direction of disturbance.

16. It will be blurred. There will be overlapping of fringes, central fringe white, closest fringe to central fringe is violet.

17. band width $\frac{2D\lambda}{a}$

$a' \to 2a$ band width $\frac{D\lambda}{a}$

18. To have more light to increase intensity.

19. $ip + r = 90'$

$r = .30 \quad ip = 60.$

$\text{Tan ip} = \mu \quad \text{Tan } 60^0 = \mu$

20. $\frac{I\max}{I\min} = \frac{\left(\frac{a_1}{a_2}+1\right)^2}{\left(\frac{a_1}{a_2}-1\right)^2} \quad \frac{a_1}{a_2} = \frac{\sqrt{I+\partial I}}{I}$

21. Coherent source - There is no phase difference or constant phase difference.

22. In unpolarised light it has electric field vector vibrations in all directions in a plane perpendicular to direction of propagation. If light wave vibrates only in one direction then this is polarised.

23. The intensity of transmitted light varies as the square of cosine of angle between the transmission direction and analyser.

$I = Io \cos^2 \theta$

24. Nuclear force short ranged, Non central very strong, charge independent, spin dependent, attractive.

25. ${}_Z X^A \to {}_{Z-2}Y^{A-4} + {}_2He^4$

${}_Z X^A \to {}_{Z-2}Y^{A-4} + {}_2He^4$

26. $N = No\, e^{-\lambda t} \left[\frac{dN}{dt} = -\lambda N, -\frac{dN}{dt} \alpha N\right]$

$\frac{N}{N_O} = e^{-\lambda t} \quad \frac{N_O}{2N_O} = e^{-\lambda t\ 1/2}$

$\frac{N_O}{2} = N_O\ e^{-\lambda t ½}\ \varsigma 0 \quad \lambda = \frac{1}{t_{½}} \log_e 2$

$t ½ = \frac{0.69^3}{\lambda}.$

27. Rutherford model could not explain why an electron being charged and getting accelerated should radiate energy that subsequently it will drop into the nucleus. Atomic structure will collapse which is not true.

28. Atomic radius is order of 10^{-10}M.

Nuclear radius is order of 10^{-15}M.

atomic volume $\approx 10^{-30}$

nuclear volume $\approx 10^{-45}$

So ratio is 10^{15} order

29. Packing fraction =

[mass of nucleons in free stage - mass of nucleons inside the nucleus] / A =

$\frac{\Delta M}{A}$ = Mass defect = Δ M

B.E = Δ MC^2m

30. Curie $\rightarrow$ Radio activity of a substance is 1 curie if its atoms disintegration is 3.7 x 10^{10} integrations per second.. This is the activity of 1g of radium. Rutherford is 10^6 disintegration/sec.

1curie = 3.7x10^4 Rutherford.

31. Fusion needs lot of energy to overcome the repulsion between two nuclei correponding Temp is very high, same as temp in the sun so this is not possible.

32. K capture is different because here electron is captured from interior energy level at atom.

33. N_1=28800 = $N_O e^{-\lambda t_1}$

N_2=1800 = $N_O e^{-\lambda t_2}$

$$\frac{28800}{1800} = e^{-\lambda t_1 + \lambda t_2}$$

$$16 = e^{-\lambda(t_2 - t_1)}$$

$$16 = e^{-\lambda 48}$$

$$\log 16 = -\lambda 48$$

$$\frac{1}{\log 16} = -\lambda 48 \quad \lambda = \frac{1}{\log 2^4 x 48} = \frac{1}{4 \log 2 \, x \, 48}$$

$$T_{1/2} = \frac{\log_e 2}{\lambda} = \qquad \frac{1}{\lambda} = 48x4 \log 2$$

34. $E_{n_1} \alpha \frac{1}{n_1^2}$ $\qquad E_{n_1} - E_{n2} = \frac{-1k}{n_1^2} + \frac{1}{n_2^2} k$

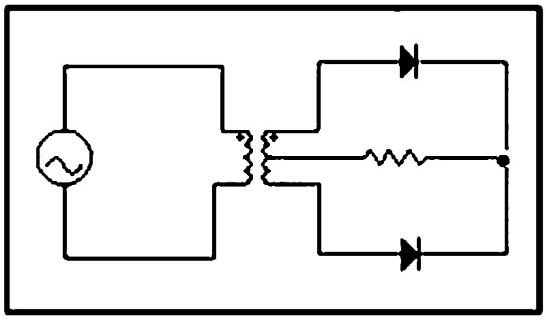
$E_{n_2} \alpha \frac{1}{n_2^2}$

35. Intrinsic - Pure, electrical conductivity low and temp dependent, number of electrons is equal to that of holes.

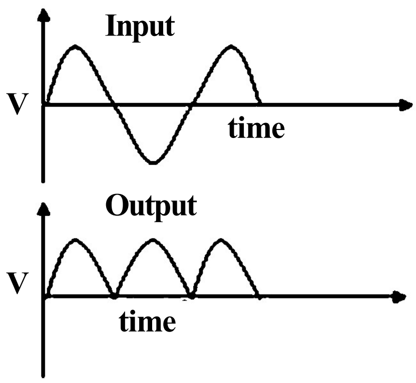
Extrinsic - impure, doped with penta or trivalent impurity. So carrier no is high. electron no high in n type, holes are high in p type. Electrical conductivity high, depends on temp as well as impurity concentration.

36. Vacancy created by the removal of electron from a covalent bond of semiconductor, same mass as the electron, associated with +ve charge.

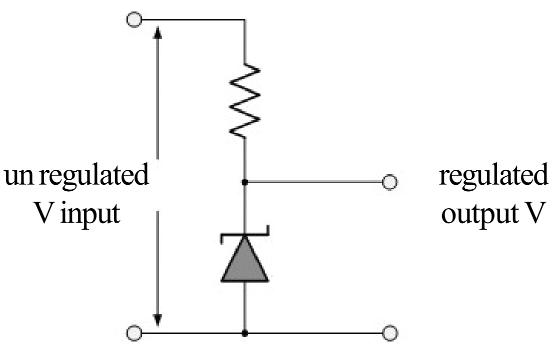
37.



Wave form

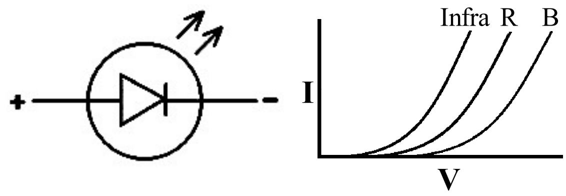


38.

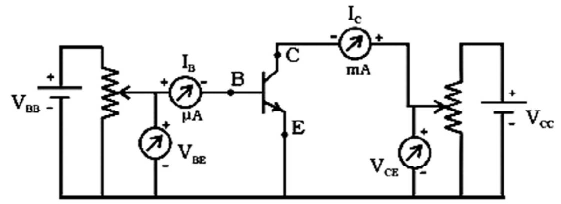


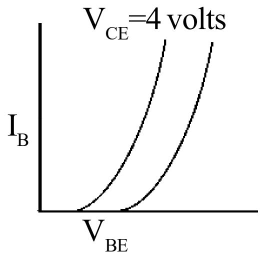
v input increases, potential drop increases, so the output voltage is stabilised.

39.

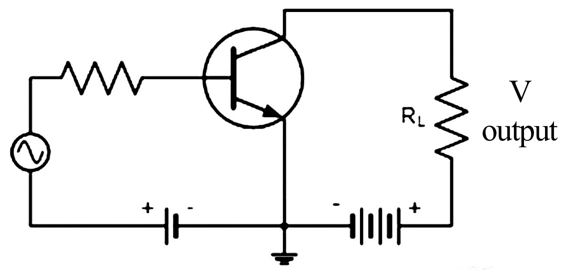


40.





41.



42. $I_C = \dfrac{0.8}{800} = 10^{-3}\,A$

$V_{CE} = V_{CC} - I_C RL = 8 - 0.8 = 7.2\ V$

$A_V = 25 \times \dfrac{800}{200} = 100$

43. $\alpha = \dfrac{\beta}{1+\beta} = \dfrac{59}{60}$

$I_C = \dfrac{59}{60} \quad I_E = \dfrac{59}{60} \times 6 = 5.9$

$I_B = 6 - 5.9 = 0.1$

44. No current flows this is cut-off bias condition.

45. NAND gate

0	0	1
0	1	1
1	0	1
1	1	0

46. NAND gate

0	0	1
0	1	1
1	0	1
1	1	0

47.

A	B	Y^1	$Y = \overline{Y^1 + Y^1}$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

48. The message signal in any communication system have different ranges of frequencies. The range over which frequencies in an information signal vary is called bandwidth. For telephonic transmission the band width is 3100MHz - 300Hz.

49. (1) F.M is efficient, less energy loss.

(2) Amplitude constant so less noise.

(3) Give high fidelity reception due to presence of large number of side bands.

50. Inter connection in local area is LAN (Local area network) with high total data rate of mbps (wide area network) WAN. with less data rate.

51. $V = \dfrac{4}{3}\pi r^3 = \dfrac{4}{3}\pi\ r_o^{\ 3} A$

M $\rightarrow$ Mass of nucleon

$\dfrac{\cancel{A}m}{\frac{4}{3}\pi\ r_o^{\ 3}\cancel{A}} = \dfrac{3M}{4\pi r_o^{\ 3}} = \text{Constant}$

52. $C=\dfrac{1}{\sqrt{\mu o \in_o}}=3x10^8 M/sec.$

53. frequency band 12MHz-7.5MHz=4.5MHz

$$\lambda=\frac{c}{f} \text{ so } \lambda_2-\lambda_1=\frac{c}{f_1}-\frac{c}{f_2}$$

54. $B_O=\dfrac{E_O}{C}$

55. $\dfrac{1}{V_1}+\dfrac{1}{U_1}=\dfrac{1}{f}$

$$\frac{1}{V_1}+\frac{1}{40}=\frac{1}{15} \quad \frac{1}{V_1}=\frac{5}{120}V_1=24$$

$$\frac{1}{V_2}+\frac{1}{U_2}=\frac{1}{f}$$

$$\frac{1}{V_2}+\frac{1}{25}=\frac{1}{15} \quad \frac{1}{V_2}=\frac{2}{75}\ V_2=37.5$$

$$37.5-24=13.5.$$

56. $\dfrac{1}{V_1}+\dfrac{1}{15}=\dfrac{1}{f} \qquad \dfrac{1}{V_2}+\dfrac{1}{9}=\dfrac{1}{f}$

$$\frac{1}{V_1}+\frac{1}{15}=\frac{1}{V_2}+\frac{1}{9}$$

$$\frac{V_2}{V_1}=3 \qquad \frac{1}{V_1}+\frac{1}{15}=\frac{1}{3V_1}+\frac{1}{9}$$

$$\frac{2}{3V_1}=\frac{2}{45} \qquad 3V_1=45 \qquad V_1=15$$

$$\frac{1}{15}+\frac{1}{15}=\frac{1}{f} \qquad f=\frac{15}{2}=7.5$$

57. $\mu=\dfrac{1}{\sin c}=\dfrac{1}{\sin 30}=2=\dfrac{C}{V}$

$$V=\frac{C}{2}$$

58. $\dfrac{1}{f}=(\mu-1)\left(\dfrac{1}{R_1}+\dfrac{1}{R_2}\right)$

$$=.5\left(\frac{1}{15}+\frac{1}{30}\right)=.5x\frac{1}{10}$$

59. $\dfrac{MV^2}{r_n}=\dfrac{KZe^2}{r_n^{\ 2}}$

$$r_n=\frac{kze^2}{mv^2}= \quad L=mvr=\frac{nh}{2\pi}r=\frac{nh}{\pi 2\pi mv}$$

$$\frac{kze^2}{mv^2}=\frac{nh}{2\pi mv} \quad V=\frac{2\pi KZe^2}{nh}$$

$$r=\frac{n^2h^2}{4\pi^2 mkze^2}$$

60. For Hr $n_2=n_1+3$

$$\frac{1}{\lambda}=R\left[\frac{25-4}{100}\right]$$

$$\nu=\frac{2\pi^2K^2Me^4}{h^3}\ \frac{21}{100}$$

$$h\nu^2=\frac{2\pi 2K^2Me^4}{h^2}\ x\frac{21}{100}$$

61. Eground = -13.6 ev E_1=-3.4

$$=\frac{.h}{\sqrt{2mE}} \quad \lambda_1-\lambda_2$$

$$=\frac{h}{\sqrt{2m(3.4)1}}-\frac{h}{\sqrt{2m(13.6)}}$$

62. $r_o=\dfrac{h^2}{4\pi^2 mke^2} \qquad r_n=\dfrac{n^2h^2}{4\pi^2 mkze^2}$

$$r_5=\frac{25h^2}{4\pi^2 mK100e^2}=Pr_o$$

$$P=\frac{1}{4}.$$

63. $V = \dfrac{2\pi K Z e^2}{n h}$

64. $r_o = \dfrac{h^2}{4\pi^2 m k e^2} = 5.29 x 10^{-11}$

$r_n = \dfrac{n^2 h^2}{4\pi^2 m k e^2} = 21.2 x 10^{-11}$ So $n^2 = 4$ n=2

65. $V = \dfrac{2\pi K Z e^2}{n h}$ for $z = 1$ $v = \dfrac{2\pi K e^2 c}{nh c}$

$v \ \alpha \ \dfrac{c}{n}$ $v = \alpha \ \dfrac{c}{n}$

$\alpha = \dfrac{2\pi K Z e^2}{c h} = \dfrac{1}{137}$

66. Ammeter is of low resistance so it will not affect the main current.

67. $A = \dfrac{\text{Intensity}}{\text{Magneticfield}} = \chi$

68. $\chi = -ve$, repelled from magnetic field (for dia)

$\chi = +ve$ small, attracted (for para)

69. $\mu = \mu_0(1+k)$ (derivation)

70. To make magnetic field radial. So there will be intense magnetic field at the centre.

71. Force = E e

$S = Ut + \dfrac{1}{2}at^2 = \dfrac{1}{2}at^2$ as $U = 0$

$S = \dfrac{1}{2} \dfrac{Ee}{m} t^2$

equation to a parabola.

72. Statements

73. $\dfrac{Kq_1q_2}{r^2} = \dfrac{mv^2}{r}$

$V = \dfrac{2\pi q_1 q_2}{h}$

$r = \dfrac{h^2}{4\pi^2 m k q_1 q_2}$

$T = \dfrac{2\pi r}{v}$

74. $\left(\dfrac{+q}{E_0} \dfrac{-q}{E_{60}}\right) = \text{Flux} = 0$ and $E \ \alpha \ \dfrac{1}{dr}$

75. $v \ \alpha \ \dfrac{1}{r}$ So equipotential surfaces will be spherical.

76. $\text{Tan} 60 = \mu = \dfrac{1}{\sin c}$

77. For particle possesing same

K.E $\lambda \ \alpha \ \dfrac{1}{m}$ So $\lambda e >> \lambda p > \lambda_\alpha$

78. Lens of longer focal length as objective

$M = \dfrac{f_o}{f_e} = \dfrac{20}{5} = 4$

79. Both the surfaces have same curvature.

$R_1 = R_2$

$P = (\mu - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) = 0$

80. $f = \dfrac{u v}{u + v}$

$-f = \dfrac{\{-(f+a)\}\{-(f+b)\}}{-f - a - f - b}$

$f = \dfrac{f^2 + (a+b)f + ab}{2f + a + b}$

$2f^2 + (a+\cancel{b})f = f^2 + (a+\cancel{b})f + ab$

$f^2 = ab$

81. $\mu = \dfrac{\sin i}{\sin r}$ $\text{Sin}\, r = \dfrac{\sin i}{\mu}$

$\text{Sin}\, r = \dfrac{\sin 30}{\mu} = \dfrac{1}{2} \text{ x } 1.5 = \dfrac{1}{3} = 0.33$

$r = \sin^{-1} 0.33 = 19^0$

So the angle of incidence at the second face A - $19^0 = 60^0 - 19^0 = 41^0$

Which is just less than critical angle 42^0 for glass - air interface if i<30 r>i_c So there will be internal reflection.

82. $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \quad = \frac{1}{30} - \frac{1}{20} = \frac{1}{60}$

f = -60 combination is a diverging lens.

83. Path diff

$$= \left[\left[d^2 + \left(x + \frac{d}{2}\right)^2\right]\right]^{1/2} - \left[\left[d^2 + \left(x - \frac{d}{2}\right)^2\right]\right] = \frac{2\ x\ d}{2D}$$

Phase diff $\frac{2\ x\ d}{2D} x \frac{2\pi}{\lambda} = \frac{xd}{D} x \frac{2\pi}{\lambda}$

$\frac{xd}{D} = n\lambda$ the bright fringe

$\frac{xd}{D} = (2n+1)\lambda_{1_2}$ the dark fringe

So fringe width $\frac{Dx}{d} = x_1 - x_2$

84. Current same R different

(a) $R = 3r$ (b) $R = \frac{2r}{3}$

(c) $R = \frac{r}{3}$ (d) $R = \frac{3r}{2}$

so c < b < d < a

85. $\beta_1 = \frac{D\lambda}{d} \quad 0.8mm = \frac{D\,X\,600^0}{d}$

$\frac{D}{d} = \frac{0.8mm}{6000A^0}$

$\beta_2 = \frac{DX7500}{2d} = \frac{0.8mm}{6000A^0} X \frac{7500\cancel{A}}{2} = .5MA$

86. $\frac{W_1}{W_2} = \frac{T_1}{I_2} = \frac{a_1^2}{a_2^2} = \frac{2}{1}$

87. $\frac{a_1}{a_2} = \sqrt{\frac{25}{16}} \quad = \frac{5}{4}$

$$\frac{Im\,ax}{Im\,in} = \frac{\left(\frac{5}{4}+1\right)^2}{\left(\frac{5}{4}-1\right)^2} = 81:1$$

88. $\sin\theta = \frac{\lambda}{a} = \frac{500\ x\ 10^{-9}}{1\ x10^{-6}} = 0.5$

$\theta = 30^0$

89. Broad source comprices of many narrow sources so the fringes from each source will over lap and fringes will be blurred.

90. Derivation of formula.

91. $\frac{1}{f_1} = \left(\frac{3/2}{4/3} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{f_2} = \left(\frac{3/2}{5/3} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{f} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$f_1 = 4f \quad f_2 = -5f$

92. Interference shows the wave property because the fringes are obtained due to super position of primary wavefronts. Photo electric effect shows the particle nature of light couristing of photons. So photons of suitable energy ejects electrons.

93. Power dissipation will be small depending upon the factor d $\omega = E_V I_v$ Cosθ if Cosθ is small that means θ is large θ depends on $\omega L - \frac{1}{\omega C}$ $\omega L - \frac{1}{\omega c}$ will be large $\frac{1}{\omega c}$ is small c is large, high capacitor used in the circuit will control the power loss.

94. $\left[R^2+\left(WL-\frac{1}{WC}\right)^2\right]^{1/2}$ = Impedance.

Impedance first decreases comes to minimum at $WL-\frac{1}{WC}$ then increases.

95. It gives idea about phase difference between emf and current and power factor.

96. E_pI_p = Power

$E_p x 1000 x 10^{-3} = 2000$

$E_P = \frac{2000}{1000} \times 10^{-3} = 2 x 10^3$

$\frac{200}{2000} = \frac{ns}{200}$ ns = 20

97. Heat $dH = i^2 R\,dt$

$H = \int i^2Rdt = \int I_0^2 \sin^2 wt\,Rdt$

$= \frac{Io^2R\,T}{2} = I^2_{rms}R\,T$

So $I_{rms} = \frac{I_0}{V_2}$

$I_{av} = \frac{\int_O^{T/2} I_O \text{ son wtdt}}{T/2}$

$I_{av}\,{}^T/_2 = \frac{2I_O}{w}$

So $I_{av} = \frac{2I_O}{\pi}$

98. $\int Z\,do = \int M\,B\,Sin\theta d\theta$

$(\vec{Z}\ \vec{M} x \vec{B}) = M\,B(\cos\theta_1 - \cos\theta_2)$

99. It is a magnetic substance whose susceptibility is +ve but small. Ferro magnets have earge +ve susceptibility.

Permeability is just greater than 1 susceptibility $\alpha\ \frac{1}{Temp}$

100. $ig = 0.001A$ I=0.5A

$shunt = \frac{50 x 0.001}{0.5-0.001} = \frac{50 x 0.001}{0.499}$

101. In d.c $w = 0$ so no impedance in L circuit WL=0 for capacitor impedence is ∞ so dc current does not pass through a capcitor.

102. $E = E_0 \sin wt$ $q = E_0 c \sin wt$

$i = \frac{dq}{dt} = cwE_0 \cos wt = \frac{E_0}{\frac{\perp}{wc}} \sin\left(wt + \pi/2\right)$

103. It confirms the wave nature of electron.

104. $\frac{1}{2}mv_1{}^2 = 1 - 0.5$ $\frac{1}{2} mv_2{}^2 = 2.5 - .5$

$v_1{}^2/v_1{}^2 = \frac{0.5}{2} = \frac{1}{4}$ $\frac{v_1}{v_2} = 1/2$

105. More number of protons so unstable.

106. Zero

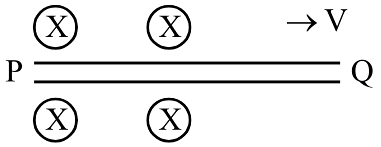
***

GROUP - C

LONG QUESTIONS

1. Define electric field intensity at a point and write its dimension. State Gauss law in electro statics and express it in its mathematical form. Derive coulomb's law.

2. Force on a conductor carrying current and placed in a magnetic field.



3. Force between two parallel conductors and definition of ampere.

4. Torque on a current loop placed in a magnetic field.

5. Moving coil galvanometer - construction and working principle.

6. State Lenz's Law and discuss how it states law of conservation of energy. Lenz's law states that direction of induced emf is such that it tends to oppose the very cause which produces it.

7. What is self induction ? Define co-efficient of self inductance.

8. Define an electric dipole, Deduce an expression for the magnitude of $\vec{E}$ due to dipole at any point.

9. What is Lorentz force ? What is work done by Lorentz force ?

10. State Biot-Savart's law and find the magnetic field due to straight current carrying conductor.

11. Field due to solenoid :- (at a point on the axis) A solenoid consists of long cylindrical coil wound over a hollow insulating cylinder.

12. State Biot Savart's law Find B for circular current carrying conductor.

13. Derive expression for electric field due to an infinite non conducting flat sheet of charge.

14. Show that line integral of electrostatic field is independent of path followed.

15. Grouping of capacitors.

16. Expression for drift velocity, current and mobility and their relations in a conductor.

17. Define a capacitor and capacitance and derive expressions for capacitance of a parallel plate capacitor in air and when a dielectric slab is introduced.

18. Expression for energy density of capacitor (parallel plate)

19. State and explain Kirchhoff's law for an electrical network and application to wheat stone bridge.

20. Huygen's Principle

    Statement- Wave front at any instant is locus of all the particles in the medium which are disturbed at the same instant of time and are in same phase of vibration.

    Construction figure →

21. Photo electric effect - Explain photo-electric equation.
22. Explain Modulation.
23. What are nuclear force explain their important properties.
24. What is binding energy ? Explain the binding energy curve ?
25. Explain properties of α, B, r rays.
26. Soddy Fazan's displacement law.
27. Define Current gains and establish relation between them.
28. Draw common emitter characteristics of npn transistor with circuit diagram.
29. Diffraction at single slit :-
30. What considerations led de-Broglie to suggest that material particles can have wave properties ? Derive de-Broglie wave equation.
31. What is Lens makers formula Derive it for double convex lens.
32. Derive Lens makers formula for double concave lens.
33. Discuss the phenomenon of refraction through a prison. Derive an expression for refractive index.
34. What is the deviation through a small angle prism.
35. Derive relation between object distance, image distance and focal length for thin lens (convex) real image .
36. Derivation of relation between u, v, f for concave lens.
37. Derive relation between U,V,f incase of virtual image in convex lens.
38. Define magnetic intensity at a point in a magnetic field and deduce an expression for magnetic intensity at a point on the end on position of a bar magnet.
39. Magnetic intensity due to a bar magnet on a point on equitorial line or broad side on position.
40. Describe the construction of a transformer and its working principle.
41. Derive expression for power in an A.C. Circuit.
42. State laws of photo electric emission and explain experimental findings.
43. State the mirror formula for the concave mirror and derive.
44. Derive Mirror equation for concave mirror for virtual image.
45. Derive Mirror formula for convex mirror.
46. State Ampere's law. Apply it to determine the magnetic field near an infinitely long straight current carrying wire.

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GROUP - C

ANSWERS

1. $\text{Def}^n \rightarrow$ Electric field intensity at a point is the force experienced by unit positive charge placed at that point. The direction of field intensity is given by the direction of motion of the unit positive charge if it is free to do so

$\vec{f}(r) \rightarrow$ Force at a point $\vec{r}$ on a test charge q_o

Then intensity $\text{Def}^n \rightarrow \vec{E}(r) = \underset{q_0 \rightarrow 0}{\text{lt}} \dfrac{\vec{F}(\vec{r})}{q_0}$

$q_0 \rightarrow 0$ implies that it doesnot disturb the existing field

Dimension $\dfrac{M\ L\ T^{-2}}{A\ T} = M L A^{-1} T^{-3}$

Statement of Gauss law.

For any distribution of charges The total electric flux linked with a closed surface is $\dfrac{1}{\in_0}$ times the total charge enclosed by the surface mathematically $\oint \vec{E}.\vec{ds} = \Sigma \dfrac{qi}{\in_0}$

Where $\vec{E}$ is field intensity.

$\vec{ds} \rightarrow$ ava element.

$\in_0 \rightarrow$ permittivity.

$\Sigma qi \rightarrow$ Total charge enclosed by the surface.

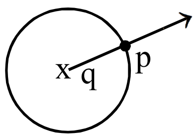
coulomb's law $\rightarrow$

$P \rightarrow$ Point at distance $\vec{r}$ from the cahrge q.

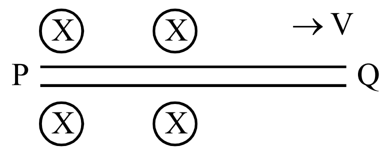
Draw the gaussian surface around +q which is a sphere of radius r

$\oint \vec{E}\,\vec{ds} = |\vec{E}| x\, 4\pi r^2 = \dfrac{q}{\in_0} \quad |E| = \dfrac{q}{4\pi \in_0 r^2}$

so force on q_0 is $\dfrac{q}{4\pi \in_0 r^2}$



2. Force on a conductor carrying current and placed in a magnetic field.



$\vec{B} \rightarrow$ magnetic field $\perp^r$ to plane of paper into the plane.

$PQ \rightarrow$ conductor

$i \rightarrow$ Current flowing through P Q from P to Q

So charge flows through the conductor

$\vec{V} \rightarrow$ Velocity

$d\vec{F} = dq(\vec{V} x \vec{B})$

$\vec{V} = \dfrac{dl}{dt} \quad d\vec{F} = \dfrac{dq}{dt}(\vec{dl} x \vec{B})$

$= i\,(\vec{dl} x \vec{B})$

$\text{current} = \dfrac{dq}{dt}$

$\vec{F} = \int \vec{dF} = \int i\vec{dl} x \vec{B} = i\vec{l} x \vec{B}$

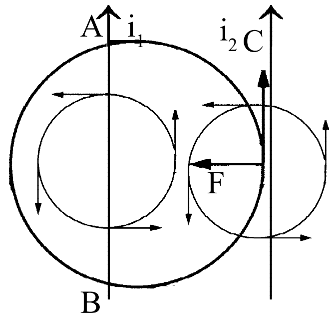
$|F| = i\ \ l\,B \sin\theta$

$\theta \rightarrow$ angle between *l* and B. direction is according to Flemings left hand rule. If first finger of left hand points towards $\vec{B}$ central finger point the direction of current then thumb points the direction of force when three fingers are stretched at right angles to each other. but otherwise the direction of force is $\perp^r$ to plane containing *l* and B.

for $\theta = 90$ .F = i*l*b

$\theta = 0 \quad F = 0$

3. Let A B and C D be two parallel conductors carrying current I_1 and I_2



The direction of $\vec{B}$ is tangent to the lines of force.

Force on C D due to $\vec{B}$ created by current in A B is $\frac{I_2 l \mu_0 I_1}{2\pi r}$

as $\vec{B} = \frac{\mu_o I_1}{2\pi r}$

Similarly force on AB due to $\vec{B}$ created by current in CD

$\vec{B} = \frac{\mu o I_2}{2\pi r}$

$\vec{F} = I_1 \frac{\mu o I_2}{2\pi r} l$

Where $l \to$ length r is separation

$\text{Force}/\text{Length} = \frac{\vec{F}}{l} = \frac{l_1 I_2 \mu o}{2\pi r}$

When current flowing in same direction l is $\perp^r$ to plane of paper away from the reader then $\vec{l} \times \vec{B} =$ Force is towards the conductor. So they attract for unlike current. Force is away from conductor so they repell. Unit of electric current

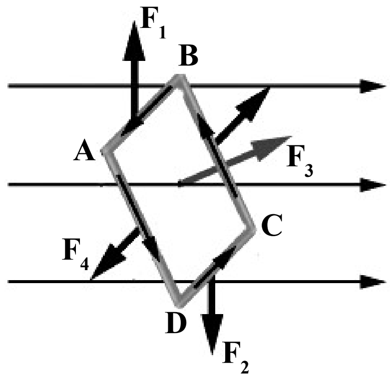
if $i_1 = i_2 = i = 1$

$r = 1M \quad l = 1M$

$F = \frac{\mu o}{2\pi} \quad = 2 \times 10^{-7} N$

So unit of current is 1 ampere when it flows through two parallel conductors of unit length separated by unit distance and each experiences a force of $2 \times 10^{-7} N$.

4. ABCD is a rectangular current carrying loop placed in a magnetic field $\vec{B}$.



l - length b- breadth

$F_1 = i\,\vec{b} \times \vec{B} \to$ vertically up for A B

$F_2 = -i\,\vec{b} \times \vec{B} \to$ vertically down for CD

$F_3 = -i\,\dot{l} \times \vec{P} \to$ into the paper

$F_4 = -i\,\dot{l} \times \vec{B} \to$ out of the paper.

F_1 and F_2 cancells their effect (same line of action, opposite)

F_3 and F_4 form a couple so the loop rotates.

Torque $= i\dot{l} \times \vec{B} \;\; b\cos\theta$

$= i\,A\,B\cos\theta$

$A = l\,b \to$ area

θ is angle that the side makes with lines of force.

$\theta = 0 \;\; i = i\;AB$

$\theta = 90 \;\; i = 0$ if $n \to$ number of turns

$\vec{i} = i\,n\,AB\cos\theta$

$90 - \theta \to$ angle that $\vec{A}$ makes with $\vec{B}$

So $\vec{i} = n\,i\,\vec{A} \times \vec{B}$

5. Principle $\to$ loop carrying current placed in a magnetic field experiences torque.

Construction $\to$

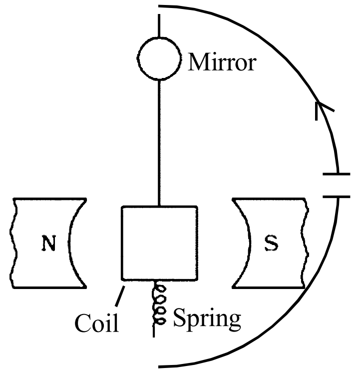
Coil C having large number of turns of thin copper wire, soft iron core in side the coil. Suspended from a Torsion head by phospher bronze wire inside cylindrical pole pieces of horse shoe magnet.

M mirror connected to coil on the top and a spring is connected to coil at the bottom.

Working $\rightarrow$ Torque on the coil is = i

$i = n\,Bi\;\;A\cos\theta$

number of turns $\rightarrow$ n



B $\rightarrow$ magnetic induction

i $\rightarrow$ current

A $\rightarrow$ Area of loop

θ $\rightarrow$ angle between coil and $\vec{B}$

For radial field $\vec{A},\vec{B}$ are parallel.

$i = n\,Bi\;\;A$

When current passes through the coil, coil gets deflected so there is twist in suspension wire and a restroring torque is produced.

C $\rightarrow$ couple per unit twist.

Moment $\rightarrow$ C θ $\quad\theta$ angle of twist

$C\,\theta = n\,Bi\;\;A$

$$i = \frac{c}{n\,B\,A}\theta$$

$i = k\;\theta\;\;K = \dfrac{c}{n\,B\,A}$ constant for a fixed arranged.

$i\,\alpha\,\theta$

Reduction factor is the current required to produce unit deflection in galvanometer

$i = k \quad$ When $\theta = 1$

Deflection is measured by lamp and scale arrangement.

6. Through a coil current is passed and direction is noted in galvanometer and direction of current form one side of the coil is noted. Say this is anti clock wise. A magnet with North pole pointing to coil is moved and the direction of induced current is noted in the coil from same side if the current is anticlockwise the polarity of magnetic field developed is north. So north polarity opposes the north pole of magnet.

   Conservation of energy suggests that energy can neither be created nor destroyed. Sum total remains constant. It can just be converted from one type to to other type. The direction of induced emf opposes the cause. Hence the agent which moves the magnet has to overcome the opposition so he has to do some work. This work is mechanical energy which is getting converted into electrical energy. So energy conservation law is not violated.

7. Self induction of a circuit is defined as the property of circuit by virtue of which it tends to oppose a change in current as an induced emf is set up when current charges so as per Lenz's law any change in current is opposed.

   Co-efficient of self inductance of a circuit is defined as the magnetic flux linked with the circuit when unit current passes through it

   $\Phi\,\alpha\,I$ as flux α current

   $\Phi = LI$

   $\Phi = L$ When I = 1

   $$\frac{d\Phi}{dt} = L\frac{dI}{dt}$$

   Faraday's law = $E = -\dfrac{d\Phi}{dt} = -L\dfrac{dI}{dt}$

   So $L = E$ When $\dfrac{dI}{dt} = 1$

   Self inductance is equal to induced emf. When rate of charge of current is one.

   Unit of L = 1 Henery When

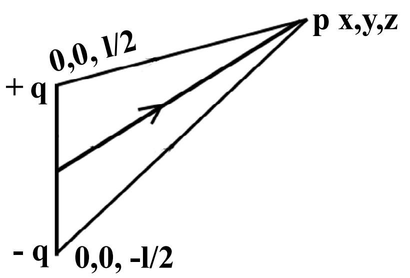
   $E = 1\text{Volt}$ and $\dfrac{dI}{dt} = 1A/\sec$

   1 Henry = $IVSA^{-1}$.

8. An electric dipole consists of combination of two equal and opposite charges situated very close to each other. The magnitude of charges tend to infinity and separation distance tends to zero. but the dipole momement (product of charge and separation length) is finite.

$\overline{-q\ 2l\ +q}$

Field $\vec{E}$ determination $\rightarrow$



dipole position along τ axis

+q at $\left(0,0,\frac{l}{2}\right)$-q at $\left(0,0,-\frac{l}{2}\right)$

P(x,g, τ) is the point of observation.

$$\overrightarrow{AP}=\left[\hat{i}x+\hat{j}y+\hat{k}z-\frac{l}{2}\hat{k}\right]$$

$$\overrightarrow{BP}=\left[\hat{i}x+\hat{j}y+\hat{k}z-\left(-\frac{l}{2}\right)\hat{k}\right]$$

$$\left|\overrightarrow{AP}\right|=\left[X^2+y^2+\left(z-\frac{l}{2}\right)^2\right]^{\frac{1}{2}}$$

$$\left|\overrightarrow{BP}\right|=\left[X^2+y^2+\left(z+\frac{l}{2}\right)^2\right]^{\frac{1}{2}}$$

$$E\left(\vec{r}\right)=\frac{1}{4\pi\in_0}\left[q\frac{\overrightarrow{AP}}{\left|\overrightarrow{AP}\right|^{3/2}}-q\frac{\overrightarrow{BP}}{\left|\overrightarrow{BP}\right|^{3/2}}\right]$$

for small ℓ value $\left|\overrightarrow{AP}\right|-\frac{3}{2}=\left[\left|\vec{r}\right|^2-lz\right]^{-\frac{3}{2}}$

$$\left[\left|\overrightarrow{BP}\right|\right]^{-\frac{3}{2}}=\left[\left|\vec{r}\right|^2+lz\right]^{-\frac{3}{2}}$$

$$E_x\left(\vec{r}\right)=\frac{1}{4\pi\in_0}\left[\frac{q}{r^3}\left(1+3\frac{lz}{2r^2}\right)-\frac{q}{r^3}\left(1-3\frac{lz}{2r^2}\right)\right]x$$

$$=\frac{1}{4\pi\in_0}\ \frac{p}{r^5}\ 3\,x\,z$$

$$E_z\left(\vec{r}\right)=\frac{1}{4\pi\in_0}\ \frac{p}{r^5}\ 3yz$$

$$E_z\left(r\right)=\frac{1}{4\pi\in_0}\ \frac{p}{r^5}\ \left(3z^2-r^2\right)$$

where P = ql $\rightarrow$ dipole Moment.

$$E\left(\vec{r}\right)=\frac{1}{4\pi\in_0}\frac{\left|\vec{p}\right|}{r^5}\left[3xz\hat{i}+3yz\hat{j}+3\left(z^2-r^2\right)\hat{k}\right]$$

if P on axial point P is in z director
x, y = 0 z = r

$$E\left(\vec{r}\right)=\frac{1}{4\pi\in_0}\ \frac{\left|\vec{p}\right|}{r^5}\left(3z^2-r^2\right)\hat{k}$$

$$=\frac{2\left|\vec{p}\right|}{4\pi\in_0 r^3}\ \hat{k}\quad \text{along +ve z axis}$$

P on equitorial line. z = 0

$$\vec{E}\left(\vec{r}\right)=\frac{1}{4\pi\in_0}\ \frac{\left|\vec{p}\right|}{\left|r^5\right|}\left(-r^2\right)\hat{k}=\frac{-\left|P\right|}{4\pi\in_0\left|\vec{r}\right|3}$$

along -ve z axis.

$$\left|E\right|\ \alpha\ \frac{1}{r^3}$$

Individual cases may be answered from first Principle.

9. When a charged body passed through electric and magnetic field it experiences a force which is called Lorentz force.

$\vec{E}$ $\rightarrow$ electric field $\vec{B}$ $\rightarrow$ magnetic field.

$\vec{F}_e=q\vec{E}$, q charge of the body.

$\vec{F}_B=q\vec{V}\,x\,\vec{B}$ where $\vec{V}$ is the velocity of the body.

Total $\vec{F} =$ Lorentz force

$$\vec{F} = q\vec{E} + q\vec{V} \times \vec{B}$$

Work done by Lorentz force

$$\vec{dl} = \vec{V}\,dt$$

$$dw = \vec{F}.\vec{dl} = q\vec{E}.\vec{V}dt + dtq\left(\vec{V} \times \vec{B}\right)\vec{V}$$

$$= q\vec{E}.\vec{V}dt$$

as $\left(\vec{V} \times \vec{B}\right)\vec{V} = 0$

$$\frac{dw}{dt} = \vec{F_e}.\vec{V}$$

Only electrical force does work.

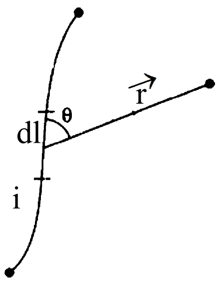
10. Biot-savart's law states that magnetic field at a point due to a current carrying conductor of length dl is dB. Then

$dB \;\alpha\; dl$

$dB \;\alpha\; i$

$dB \;\alpha\; \frac{1}{r^2}$

$dB \;\alpha\; \sin\theta$



$dl \rightarrow$ Current element.

$i \rightarrow$ Current

r is the distance between the observation point and the current element θ angle between $\vec{r}$ and $\vec{dl}$

$$dB \;\alpha \frac{idl\sin\theta}{r^2}$$

$$dB = \frac{K\,idl\sin\theta}{r^2}$$

k is the proportionality constant.

$$\vec{dB} = k\;i\;\frac{\vec{dl} \times \vec{r}}{\left|\vec{r}\right|^3}$$

Perpendicular to Plane containing dl and r

$$K = \frac{\mu_0}{4\pi}$$

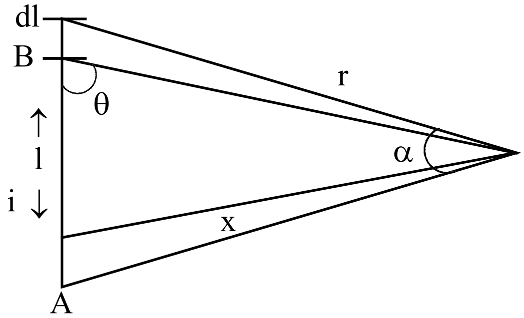
$\theta = 0$

$dB = 0$

$\theta = 90^0$

$dB \rightarrow max^m$

$\vec{B}$ due to straight current carrying coductor-



so $\left|\vec{dB}\right| = \frac{\mu_0}{4\pi}\;\frac{dl\;\sin\theta}{r^2}$

In the triangle OPB

$$\sin\theta = \cos\theta, \frac{x}{r} = \cos\alpha.\frac{l}{x} = \tan\alpha, \frac{1}{r} = \frac{\cos\alpha}{x}$$

$$dl = xd\alpha\sec^2\alpha$$

$$\left|\vec{dB}\right| = \frac{\mu_0 i}{4\pi}\;\frac{xd\alpha\;\cos\alpha\;\sec^2\alpha}{x^2/\cos^2\alpha}$$

$$\left|\vec{dB}\right| = \frac{\mu_0 i}{4\pi x}\;\cos\alpha\;d\alpha$$

$$\left|\vec{B}\right| = \frac{\mu_0 i}{4\pi x}\int\cos\alpha\;d\alpha$$

$$\left|\vec{B}\right| = \frac{\mu_0 i}{4\pi x}\int_{\theta_1}^{\theta_2}\cos\alpha\;d\alpha$$

but if the conductor is very long.

$$= \frac{\mu_0 i}{4\pi x}\left(\sin\theta_2 - \sin\theta_1\right)$$

$$\theta_2 \rightarrow \frac{\pi}{2}\;\text{so}\;\theta_1 \rightarrow \frac{\pi}{2}$$

$\left|\vec{B}\right| = \frac{\mu_0 i}{2\pi x}$ direction $\perp^r$ to plane containing $\vec{r}$ and $\vec{L}$.

11. Field due to solenoid :- (at a point on the axis)
A solenoid consists of long cylindrical coil wound over a hollow insulating cylinder.

$N \rightarrow$ Total no. of turns

$l \rightarrow$ length of solenoid

$a \rightarrow$ radius of solenoid

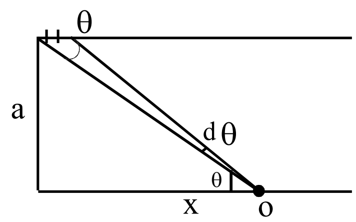
$i \rightarrow$ Current flowing

$o \rightarrow$ Observation point

$dx \rightarrow$ small length element

$\vec{r} \rightarrow$ distance of 0 from the length element.

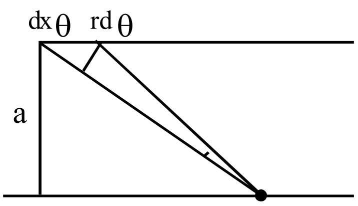
$$r = \sqrt{a^2 + x^2}$$



Field due to circular coil at dx on a point on the axis.

$$dB = \frac{\mu_0}{2} \frac{N}{l} dx \frac{i\, a^2}{\left[a^2 + x^2\right]^{3/2}}$$

$$\frac{a}{r} = \sin\theta = \frac{rd\theta}{dx}$$



$$dx = \frac{rd\theta}{\sin\theta}$$

$$dB = \mu_0 \frac{N}{e} i\, a^2 \frac{rd\theta}{\sin\theta} \frac{1}{r^3}$$

$$\frac{a}{r} = \sin\theta$$

$$dB = \frac{\mu_0\, N}{e} i\, a^2 \frac{d\theta}{\sin\theta} \frac{\sin^2\theta}{a^2}$$

$$= \frac{\mu_0\, N\, i}{e} i\, \left(d\theta \sin\theta\right)$$

$$B = \frac{\mu_0\, N i}{2\ \ l} \left[\cos\theta_1 - \cos\theta_2\right]$$

if cylinder is very long.

$$\theta_1 = 0 \quad \theta_2 = 180^0$$

$$B = \frac{\mu_0 N i}{2\ \ l}$$

12. (1) Statement of Biot and Savart law.

(2) Mathematical expression in scalar as well as vector form (specific cases at different angles)

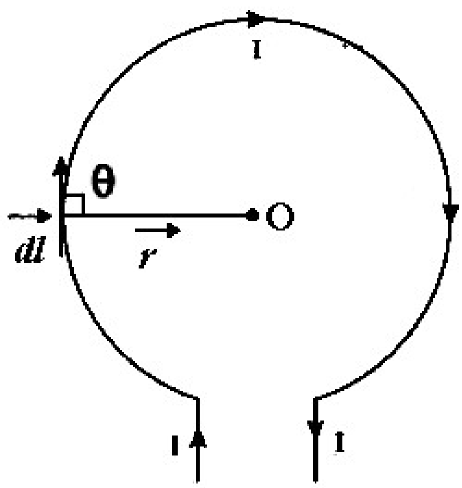
(3) Direction of $\vec{B}$ should be specified with unit.

(4) Figure for Biot savart's law.

(5) Circuit for circular current carrying conductor.

(6) Field calculation on the axis special case at centre.

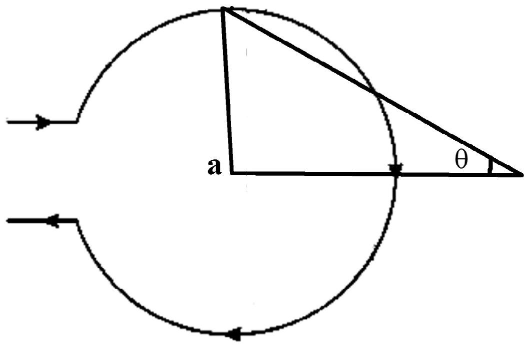
(7) Both magnitude and direction should be specified.



$$dB\ \alpha\ dl, dB\ \alpha\ i, dB\ \alpha\ \sin\theta\ \ dB\ \alpha\ \frac{1}{r^2}$$

$$dB = K \frac{idl\sin\theta}{r^2} \quad \overrightarrow{dB} = \frac{\mu_0}{4\pi} \frac{i\vec{dl} \times \vec{r}}{\left|\vec{r}\right|^3}$$

$$\theta = 0 \quad dB = 0 \quad \theta = 90^0 \quad dB = \max^m$$



$$\vec{B} = \int_0^B dB \sin\theta$$

$dB\cos\theta$ teams cancell due to symmetry.

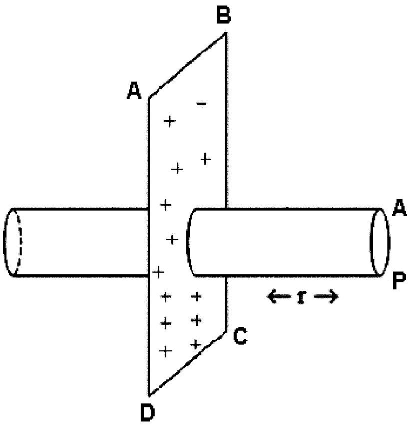
$$= \frac{\mu_0 N i}{4\pi} I \frac{dl}{r^2} \sin\theta$$

$$= \frac{\mu_0}{2} \frac{N i\, a^2}{\left(a^2 + x^2\right)^{3/2}}$$

At the centre $x = 0$

$$\vec{B} = \frac{\mu_0}{2} \frac{N i\, a^2}{a^3} = \frac{\mu_0}{2} \frac{N i}{a}$$

13.



A B C D non conducting flat sheet.

$\sigma \rightarrow$ surface charge density.

P point of observation at a distance $\vec{r}$

Draw a gaussian surface around P of length 2r and A as cross sectional area as in figure.

Due to symmetry $\vec{E}$ 11^{l} to curved surface so

$\perp^{r}$ to flat surfaces

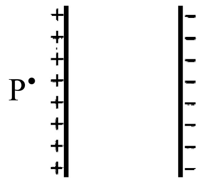
$$\vec{E}.\vec{ds} = 2\ E\ A = \frac{\sigma A}{\epsilon_0} \quad E = \frac{\sigma A}{2\epsilon_0}$$

Probable questions

(a) Field due to conducting sheet.

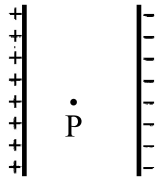
(b) Field due to two plane parallel and oppositly charged sheets. (Point inside and point outside).

Point Outside



$$\frac{\sigma}{2\epsilon_0} - \frac{\sigma}{2\epsilon_0} = 0$$

Point Inside



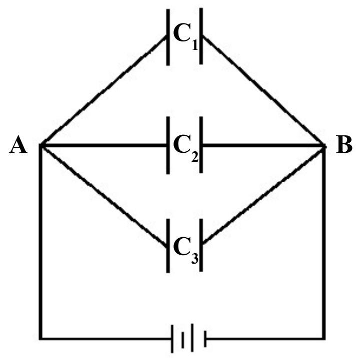
$$\frac{\sigma}{2\epsilon_0} + \frac{\sigma}{2\epsilon_0} = \frac{\sigma}{2\epsilon_0}$$

14. Define $\rightarrow \vec{E}$ then $\int_A^B \vec{E}.\vec{dl} = \frac{q}{4\pi\epsilon_0} \int \frac{\hat{r}}{r^2}.\vec{dr}$

$$= \frac{q}{4\pi\epsilon_0} \int \frac{dr}{r^2} = \frac{q}{4\pi\epsilon_0}\left(\frac{1}{r_A} - \frac{1}{r_B}\right)$$

depends only on end points. So path independent.

15. Capacitors in parallel



v across all capacitors same in parallel.

$$C_1 = \frac{q_1}{v} \quad C_2 = \frac{q_2}{v} \quad ....$$

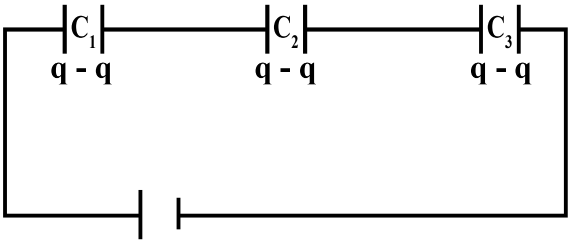
$$v = \frac{q_1}{c_1} = \frac{q_2}{c_2} = \frac{q_3}{c_3} .... = \frac{Q}{C}$$

$Q = CV = q_1 + q_2 + q_3....$

$= C_1V + C_2V + C_3V -.$

$C = c_1 + c_2 + c_3$

In series charge is same



Charge is same.

$V = v_1 + v_2 + v_3....$

$$v = \frac{q_1}{c_1} = \frac{q_2}{c_2} = \frac{q_3}{c_3}.... = \frac{Q}{C}$$

$$\frac{1}{c} = \frac{1}{c_1} + \frac{1}{c_2} + \frac{1}{c_3}$$

16. In conductor all electrons move half hazzardly

$$\text{average velocity } = 0 = \frac{\overrightarrow{U_1} + \overrightarrow{U_2} + ... + \overrightarrow{U_n}}{N} = 0$$

So no net transfer of charge

$$\vec{E} = \text{applied field} = \frac{\text{P.D}}{\text{Length}} = \frac{-V}{l}$$

$1 \rightarrow$ length of conductor

$$\vec{F} \text{ on electron } -e.\vec{E} = \frac{-e\,v}{l}$$

$$\text{accl}^n = +\frac{e\,v}{ml} = \frac{\vec{F}}{\text{mass}}$$

$\tau \rightarrow$ relaxation time or average time between two consecutive collisions of electron.

$\overrightarrow{V_1} \rightarrow \overrightarrow{U_1} + \overrightarrow{a\tau_1}$

$\overrightarrow{U_1} =$ initial velocity one electron. τ_1 its relaxation time

$\overrightarrow{V_1} \rightarrow$ velocity gained in τ_1

$(V_1 + V_2 + V_3 + ...V_n)/N$

average or drift velocity in presence of $\vec{E} = \vartheta$

$$\frac{U_1 + U_2 + U_3 + ...U_n}{N}$$

$$+\frac{\vec{a}}{N}(\tau_1 + \tau_2 + \tau_3 ... + \tau_n)$$

$= 0 + \vec{a}\,\tau$

$\vec{\vartheta} = \vec{a}\tau =$ acceleration x τ.

17. A capacitor is adevice which stores charge. The capacity of conductor is also defined as the charge required to raise it through a unit potential. The capacitance $\rightarrow c = q/_V$

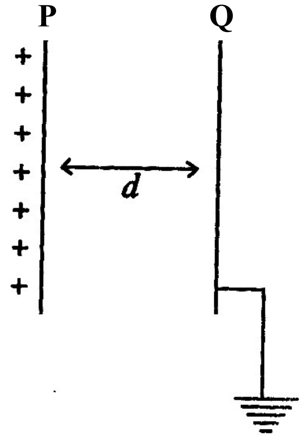
The capacity of a conductor is said to be capacitance. The unit of capacitance is 1 farad if 1 coloumb charge is sufficient to raise its potential through 1volt.

When $Q = 1$ coloumb V= 1 volt

C = 1 farad

Dimension of C= $M^{-1}\ L^{-2}\ T^4\ A^2$

A parallel plate capacitor consists of two parallel plate conductors held parallel to each other at a distance. One plate is charged other is grounded.



$d \rightarrow$ distance of separation

$p \rightarrow$ +vely charged.

Thus Q will have -ve charge induced +ve charge will flow to ground.

$A \rightarrow$ Area of the plate

$6 \rightarrow$ surface charge density.

At point $\vec{r}$ inside two plates

$|\vec{E}| = \frac{6}{2 \in_0}$ for P Plate

$\frac{6}{2 \in_0}$ for Q plate

both are in same direction.

$\vec{E} = \frac{6}{2\in_0} + \frac{6}{2\in_0} = \frac{6}{\in_0}$

$dv \to$ p.d between the points $\vec{r}$ and $\vec{r} + \vec{dr}$.

$\int dv = \int_0^d E\, dr = \frac{6}{\in_0} d$

$V = \frac{6}{\in_0} d \quad Q = 6\ A$

$C = \frac{6A}{6/\in_0\ d} = \frac{A \in_0}{d}$

$C\ \alpha\ \frac{1}{d} \quad C\ \alpha\ A$

Capacitance calculation for parallel plate capacitor if there is conducting medium of thickness t.

Inside the conducting material

$\vec{E} = 0$

$\vec{E}$ is only in $(d-t)$

$V = E_0(d-t)$

$E_0 = \frac{6}{\in_0} = \frac{q}{A\in_0}$

$v = \frac{q}{A\in_0}(d-t)$

$c = \frac{q \quad A\in_0}{q(d-t)} = \frac{A\in_0}{d-t}$

if there is dielectric medium of thickness

Let E_0 be field in air

E- field in dielectric

t- thickness of dielectric

V in air = $E_0(d-t)$

V in dielectric = E t

$= \frac{E}{E_0} = \frac{1}{K} \quad E = \frac{E_0}{K}$

$v = E_0\left(d - t + \frac{t}{k}\right)$

$C = \frac{q}{v} = \frac{q}{E_0\left(d - t + \frac{t}{k}\right)}$

$C = \frac{q}{\frac{6}{\in_0}(d - t + t/k)}$

$C = \frac{6\ A}{\frac{6}{\in_0}(d - t + t/k)}$

$C = \frac{A\in_0}{(d - t + t/k)}$

if t = d

$C = \frac{A\in_0 k}{d} = kC_o$

18. Expression for energy density of capacitor (parallel plate)

Capacitance $C = \frac{\in_0 A}{d}$

$E = \frac{6}{\in_0} \quad 6 = E \in_0$

$Q = A\ 6 = A E \in_0 \quad C = \frac{q}{v}$

Energy stored in a capacitor

$w = \int_0^w dw = \int_O^Q v\, dq = \int_o^\theta \frac{q}{c} dq = \frac{\theta^2}{2c}$

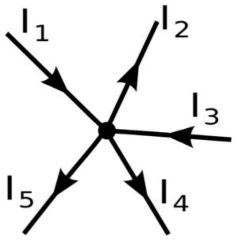
$\theta = cv \quad w = \frac{1}{2} C\ V^2$

w for parallel plate capacitor = $\frac{1}{2}\ \frac{(6A)^2}{\in_0 A}$

$w = \frac{1}{2}\ \frac{A^2 \in_0^2 E^2}{\in_0 \frac{A}{d}} = \frac{1}{2} \in_0 E^2 Ad$ so $\frac{w}{\text{volume}}$

$= 1/2 \in_0 E^2$

19. Statements - 1st law - Algebraic sum of currents meeting at a point is zero.



$\sum i = 0$

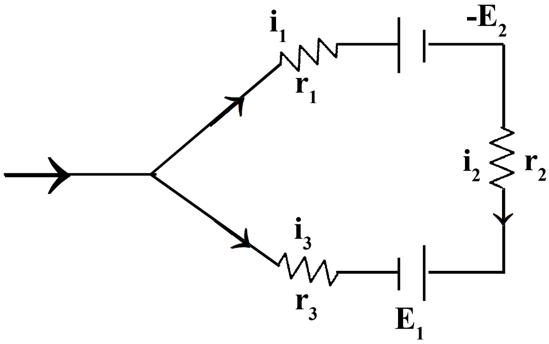
$i_1 + i_2 + i_3 - i_4 - i_5 = 0$

This is current law.

Currents approaching are +ve currents leaving are -ve.

Conclusion at any point $\rightarrow$ no charge accumulation.

Voltage law - 2nd law - In a closed circuit the algebraic sum of emf is equal to algebraic sum of the product of resistance and current flowing through them



Sign convention $\rightarrow$

(1) Current flow from -ve to +ve in the cell then emf +ve in direction of current.

(2) ir is -ve in direction of current.

So $i_1 r_1 + E_2 - i_2 r_2 - E_1 + i_3 r_3 = 0$

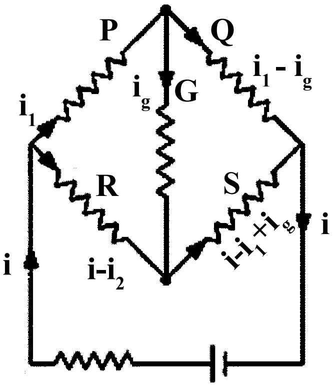
$\sum ir = \sum E$

Wheat stone bridge

$i_1 p + i_g G - (i - i_1) R = 0$

$(i_1 - i_g) Q - i_g G - (i - i_1 + i_g) S = 0$

if $i_g = 0$



P,Q,R,S are resistances. G galvanometer resistance for balanced bridge.

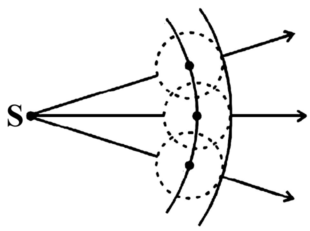
$\frac{i_1}{i_1 - i_1} = \frac{R}{P}$

$\frac{i_1}{i_1 - i_1} = \frac{S}{Q}$

So $R/P = \frac{S}{Q}$

$P/Q = \frac{R}{S}$

20. Statement- Wave front at any instant is locus of all the particles in the medium which are disturbed at the same instant of time and are in same phase of vibration.



Source at the centre so the surface of sphere with centre at the source serves as a primary wave front.

(1) Every point on primary wave front is source of secondary disturbance and constructing spheres around every point the surfaces stand for secondary wave front. Tangent envelop of this spheres gives rise to a new wavefront.

Strokes law - statement-

I= intensity α $(1+\cos\theta)$

$\theta \rightarrow$ angle between normal and central line.

for backward wave $\theta = -\pi$

$I = 0$ So no back wave front.

21. Emission of electrons due to incident e.m wave of suitable wavelength on the metalic surface is photo electric effect.

Einstein theory$\rightarrow$ Energy of em wave of frequency υ

$E = h\upsilon$ incident on Metal.

electron are bound - Energy necessary to eject electron is = $W_O \rightarrow$ Work function, characteristic of the metal.

$h\upsilon - W_O$ = energy gained by electron

$$h\upsilon - W_O = \frac{1}{2} M V_{max}^2$$

if $W_O = h\upsilon_0$ $\upsilon_0 \rightarrow$ thresold frequency

$$h(\upsilon - \upsilon_0) = \frac{1}{2} M V_{max}^2$$

E instein's photo electric equaton

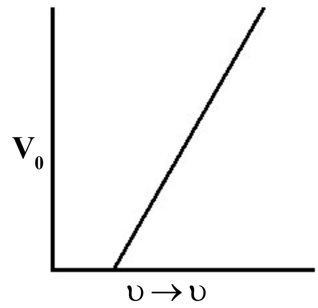
If potential necessary to stop the electron is V_0 Then $eV_0 = \frac{1}{2} M V_{max}^2$

$$ev_0 = h\upsilon - W_O$$

$$ev_0 = h(\upsilon - \upsilon_0)$$

$$v_0 = \frac{h}{e}\upsilon - \frac{W_O}{e}$$

$v_0 = A\upsilon - B$ A and B are constant.



Plot of stopping potential and frequency.

22. Modulation$\rightarrow$ Process of super imposing the signal to be transmitted on other wave of higher frequency called carrier waves. So transmission to distance places will be easier (high speed less absorption, control of antenna height)

Types of Mdulation -

Amplitude, frequency, phase. Differentiate these modulations.

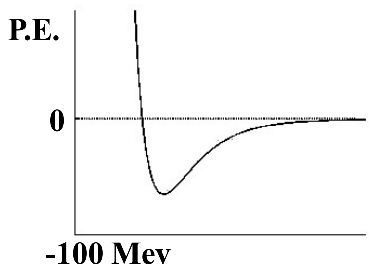
23. Nuclear force is the strong attractive interaction between the necleons in side the nucleous.

Properties -

(a) Strongest interaction 10^{+39} times larger than gravitational interaction.

(b) Short range within distance of fermi

(c)



distance between nucleous in formi.

P.E minimum at 0.8fm

repulsive for r < 0.8fm.

4fm > r > 0.8fm attractive

r > 4fm force is repulsive

(d) Charge independent n~n force=p~p force = p ~n force.
but p ~ p coulomb repulsion is less than attraction.

(e) nuclear force shows a saturation effect.

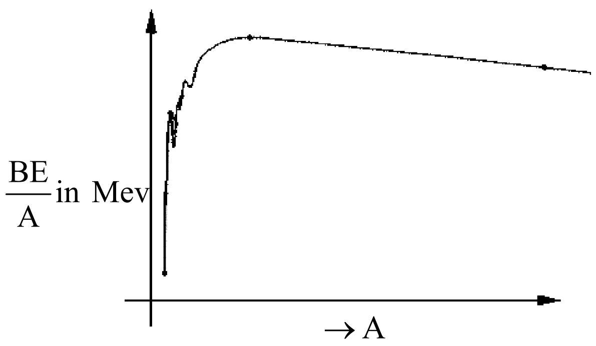
(f) spin dependent force and is greater for parallel spin allignment.

(g) non central force does not act along the line joining the nucleons.

(h) It arises out of exchange of Pions.

24. Energy required to break up a nucleus into its constituents and separate them to infinite distance.

$$B.E. = \left[ZM_P + (A-Z)M_N - M_{nuclear}\right]^{C^2}$$



Informations from the curve.

(1) ${}^4_2He$, ${}^{12}_6C$, ${}^{16}_8O$ are having less B.E, higher stability.

(2) for ${}^1_1H$, ${}^2_1H$, ${}^3_1H$ B.E is less.

(3) Max^m $B-E$ is 8.5 mev.

${}^{56}_{26}Fe$ has Max^m value.

(4) A increases B.E decreases due to presence of large no. of protons. So unstable nulei

(5) Heavier nucleus get under fission to have stable nuclei.

(6) Light nuclei combine to give stable nuclei under fusion process.

25. Explain properties of α, B, r rays.

α	β	**r**
+ve charged	-ve charged	no charge
deflected by E M field	deflected by E M field	no deflection
${}_2He^4$ (+2e charge)	-e charge	no charge
velocity $\frac{c}{10}$	99% of c	C
range - 2.7cm	high	very high
affects photographic plate	same	same
less penetrating power	higher	very high
less ionising power	higher	highest

26. Soddy Fazan's displacement law.

(1) The algebraic sum of charges before distintegration is same as that after disintegration.

(2) Sum of mass number also remains invariant.

(a) α particle emission changes atomic number, it decreases by 2 and mass number decreases by 4.

(b) β emission causes atomic number increases by 1 but mass number same.

(c) γ emission causes no charge.

27. AC current gain in common base is defined as ratio of small change in collector current to small change in emmitter current with constant collector base voltage.

$$\alpha = \frac{\Delta I_C}{\Delta I_E}\Big|V_{CB} \text{ Constant}$$

Common emmitter current gain is defined as ratio of small change in collector current to small change in base current for V_{CE} Constant.

$$\beta = \frac{\Delta I_C}{\Delta I_B}\Big|V_{CE}\ \text{Constant}$$

$$I_E = I_B + I_C$$

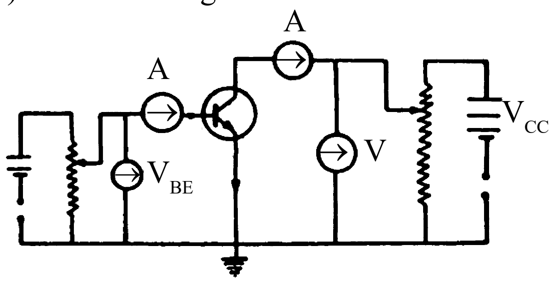
$$\frac{\Delta I_E}{\Delta E_C} = \frac{\Delta I_B}{\Delta I_C} + 1$$

$$\frac{1}{\alpha} = \frac{1}{\beta} + 1$$

$$\alpha = \frac{\beta}{1+\beta}$$

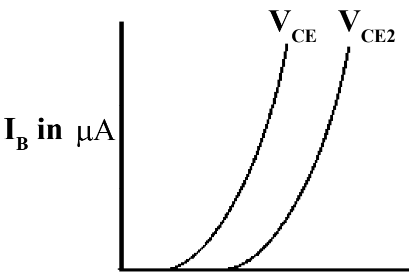
$$\beta = \frac{\alpha}{1-\alpha}$$

28. (a) Circuit Diagram



Emitter is grounded and it is common terminal. emitter - base junction is forward biased emitter collector is reversed biased.

V_{BE}, V_{CC} are measured by high resistance voltmeters I_B is in μA and Ic in m A



V_{BE} in volts (Input characteristics)

$I_B \sim V_{BE}$ Curve at constant V_{CE}

V_{BE} less I_B less.

$V_{BE} >$ barrier voltage, I_B increases rapidly.

$I_B << I_c$

When V_{CE} increases V_{CB} increases.

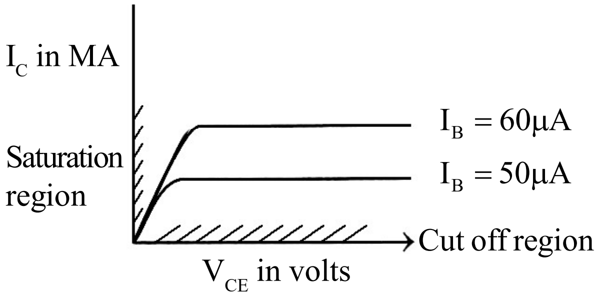
Its effect on I_B is negligible.

So curves are identical.

Input resistance $\gamma_i = \frac{\Delta V_{BE}}{\Delta I_B}\Big|V_{CE} = \text{Constant}$

= slope of tangent to $I_B \sim V_{BE}$ curve at any point.

Out put characteristic



Out put characteristics

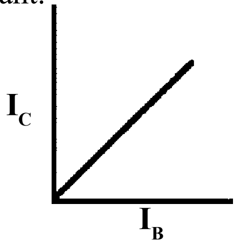
$I_c \sim V_{CE}$ curve at constant I_B

V_{CE} changes from 0 to .5 volt I_c increases rapidly increase in I_c is upto knee voltage

$V_{CE} > V_{BE}$ (collector base junction is reversed)

I_c varies slowly, nearly constant for increasing V_{CE}. So for larger value of I_B larger is I_c for given V_{CE}, so output resistance is high. Larger value of I_B Larger is I_c for given V_{CE} for $V_{CE} < V_{BE}$. I_c is independent of I_B. The shaded region below is cutoff region non shaded region is active region. Output resistance $\gamma_o = \frac{\Delta V_{CE}}{\Delta I_C}\Big|I_B$ constant

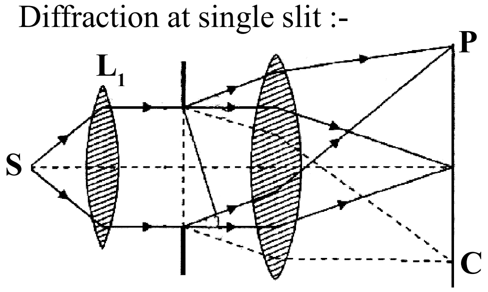
Transfer characteristics $\rightarrow I_c \sim I_B$ curve at V_{CE} constant.



$$B_{ac} = \frac{\Delta I_C}{\Delta I_B}\Big|V_{CE} = \text{Constant}$$

$$B_{dc} = \frac{I_C}{I_B}$$

29. Diffraction at single slit :-



Source at focus of L_1 So parallel rays incident on single slit. There will be secondary wavefronts. Secondary wave lets will super impose to give diffraction. The second lens will focus the diffraction pattern on the screen which is at its focal plane.

All the secondary wavelets going straight across the slit are focused at central point of the screen. The wavelets which are symmetric around the centre also constructively interfere to give central maxima.

$\theta \rightarrow$ angle of diffraction for wavelets of same phase to focused at point P with different phases. Path difference between wavelets from two extreme ends of slit reaching at

P is $= a \sin\theta$
$a \rightarrow$ slit width
P is such that $a \sin\theta = \lambda$
For symmetric points on the both side the path difference will be $\lambda/2$.
So they will interfere destructively.

$a \sin\theta_1 = \lambda \rightarrow$ dark

$a \sin\theta_2 = 2\lambda \rightarrow$ dark

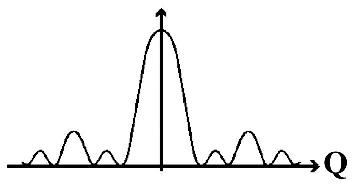
$a \sin\theta_n = n\lambda \rightarrow$ nth dark fring

but if P is such that

$$a \sin\theta_1 = \frac{3\lambda}{2}$$

slit is divisible into 3 parts. Wavelets from two parts will interfere destructively but third part will contribute to intensity intensity, will be less.

$a \sin\theta n^1 = (2n+1)\lambda/2 \rightarrow$ condition for secondary maxima.



The intensities are in ratio. $1 : \frac{1}{21} : \frac{1}{61} : \frac{1}{211}$

30. de-Broglie was inspired by the idea of Einstein's mass energy relation and equivalence of mass and energy. He also considered that nature loves symmetry. As radiation has dual property similarly material particle will have dual property.

The waves associated with material particles in motion are called matter or de-Broglie waves and corresponding wavelength is de-Broglie wavelength.

$E = h\upsilon$ (Planck's theory)

$E = MC^2$

$h\upsilon = mc^2$ $\upsilon \rightarrow$ frequency $= \frac{C}{\lambda}$

$C \rightarrow$ Velocity, λ wavelength

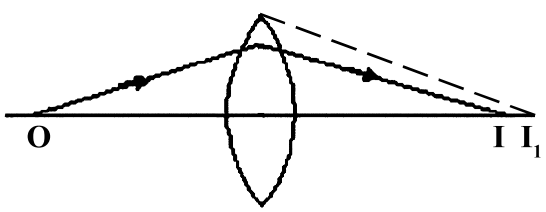
$$\lambda = \frac{h}{mc} = \lambda = \frac{h}{p}$$

31. This formula gives relation between the focal length, refractive index and radii of curvature.

Sign convention - all distances are measured from the centre of the lens. Measurement in direction of incident ray is +ve opposite to that is -ve. The lens is small, thin object is point object placed on axis. The rays are paraxial.

$\mu_1 \rightarrow$ R.I of air or any medium.

$\mu_2 \rightarrow$ R.I of material of the lens.



For first surface $\frac{\mu_2}{v_1} - \frac{\mu_1}{U} = \frac{\mu_2 - \mu_1}{R_1}$

$V_1 = OI_1$

For second surface

$$\frac{\mu_1}{v} - \frac{\mu_2}{v_1} = \frac{\mu_1 - \mu_2}{R_2}$$

$$\frac{\mu_1}{v} - \frac{\mu_1}{U} = \frac{\mu_2 - \mu}{R_1} + \frac{\mu_1 - \mu_2}{R_2}$$

$$\frac{1}{V} - \frac{1}{U} = \frac{\mu_2 - \mu_1}{\mu_1}\left[\frac{1}{R_1} - \frac{1}{R_2}\right] = \frac{1}{f}$$

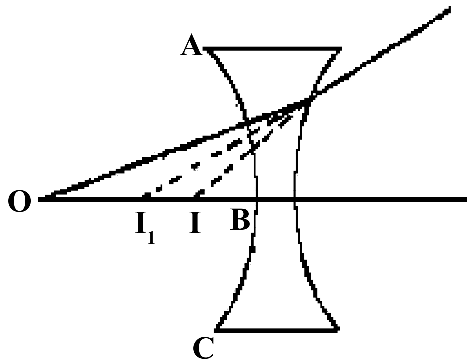
32. Derive Lens makers formula for double concave lens.

$$\frac{1}{f} = \frac{\mu_2 - \mu_1}{\mu_1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

For A B C surface i_1 is the image and I is the final image.

$$\frac{\mu_2}{v} - \frac{\mu_1}{U} = \frac{\mu_2 - \mu_1}{R_1}$$

for second surface

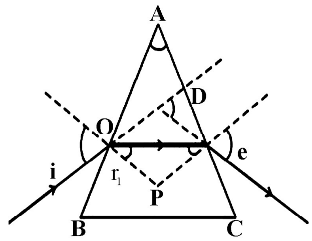


$$\frac{\mu_1}{v} - \frac{\mu_2}{V_1} = \frac{\mu_1 - \mu_2}{R_2}$$

$$\frac{\mu_1}{V} - \frac{\mu_1}{U} = \mu_2 - \mu_1\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{V} - \frac{1}{U} = \frac{\mu_2 - \mu_1}{\mu_1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \frac{1}{f}$$

33. Discuss the phenomenon of refraction through a prison. Derive an expression for refractive index.



ABC Parincipal section of equilateral triangle prism.

i- angle of incidence $e \rightarrow$ angle of emergency

$r^1 \rightarrow$ angle of refraction for first surface.

$r^{11} \rightarrow$ angle of incidence for second surface.

$A \rightarrow$ angle of prism.

Angle of deviation D is the angle through which the incident ray has been deviated.

In quadrilatual ΔOPD

$\angle A + \angle P = 180^0$

$r^1 + \angle r^{11} + P = 180$ In ΔOPD

$\angle r^1 + \angle r^{11} = \angle A$

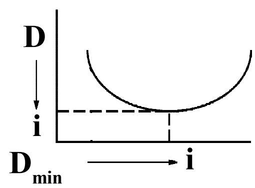
$D = i - r + e - r^1$

$D = i + e - A$

$A + D = i + e$

Variation of D with i

D decreases with increase in i comes to a minimum value and then increases with increase in i



Minimum value of deviation is minimum deviation. When D is minimum.

$e = i, \ A + D \min = 2i$

$r^1 - r^{11}$ So $r^1 = A/2$

$$\frac{\sin i}{\sin r^1} = \frac{\frac{\sin A + Dm}{2}}{\sin A/2} = \mu$$

34. $\mu = \dfrac{\sin i}{\sin r}$ for i small and

r small $\mu = \dfrac{i}{r}$ for first surface

$i' = \mu r^1$ for second surface

$D = i + i' - A = \mu r + \mu r^1 - A$

$= \mu(r + r') - A \;\; = \mu A - A$

$= (\mu - 1)\,A$ So deviation depends on μ value and hence on colour of light.

35. Derive relation between object distance, image distance and focal length for thin lens (convex) real image.
OB $\rightarrow$ object distance
O B$'$ $\rightarrow$ image distance
ABO and $A'B'O$ are similar

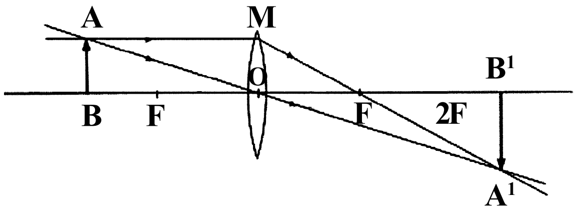
$\dfrac{A'B'}{AB} = \dfrac{OB'}{OB}$ $\Delta MO, F\Delta A'B'F \leftarrow$ are similar

$\dfrac{OM}{A'B'} = \dfrac{FO}{FB'}$ OM = AB

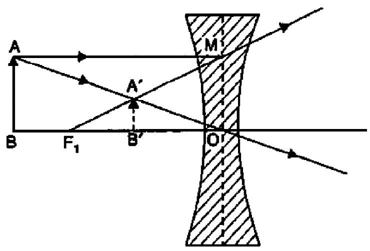
$\dfrac{A'B'}{AB} = \dfrac{FB'}{FO} = \dfrac{OB'}{OB} = \dfrac{OB' - OF}{FO}$

$OB = -U \quad OB' = +V \quad OF = f$

$\dfrac{V}{-U} = \dfrac{V - f}{f} \;\; \rightarrow \dfrac{1}{f} = \dfrac{1}{r} - \dfrac{1}{v}$



36. Derivation of relation between u, v, f for concave lens.



AB $\rightarrow$ object
$A'B'$ $\rightarrow$ image

ΔABO similar to $\Delta A'B'O$

$\dfrac{A'B'}{AB} = \dfrac{B'O}{BO}$, $\Delta A'BF$

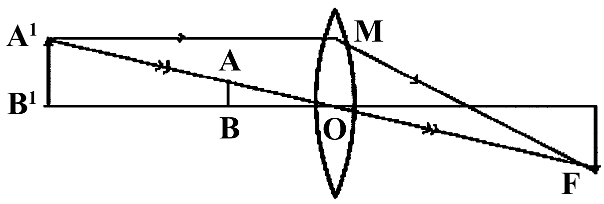
and Δ MOF are similar

$\dfrac{A'B'}{Mo} = \dfrac{FB'}{FO} \quad \dfrac{B'O}{BO} = \dfrac{FB'}{FO}$

$\dfrac{-V}{-U} = \dfrac{-f + v}{-f}$

$\dfrac{1}{f} = \dfrac{1}{v} - \dfrac{1}{U}$

37. Derive relation between U,V,f incase of virtual image in convex lens.



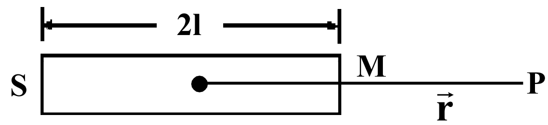
Triangle $A'B'O$ A B O similar
$\Delta A'B'F$ and MOF are similar

$\dfrac{A'B'}{AB} = \dfrac{B'O}{BO} \quad \dfrac{A'B'}{MO} = \dfrac{B'F}{OF}$

$\dfrac{-V}{-U} = \dfrac{-v + f}{f}$

$\dfrac{1}{f} = \dfrac{1}{v} - \dfrac{1}{U}$

38. Define magnetic intensity at a point in a magnetic field and deduce an expression for magnetic intensity at a point on the end on position of a bar magnet.



Magnetic at a point intensity is the force experienced by a unit north pole placed at that point.

Bar magnet length $\rightarrow 2l$

$M \rightarrow$ Pole strength

$\vec{r} \rightarrow$ distance of point from the centre

$2lm \rightarrow$ Magnetic moment force due to north pole

$$F_1 = \frac{\mu_0}{4\pi}\frac{M}{NP^2} \rightarrow \text{repulsive}$$

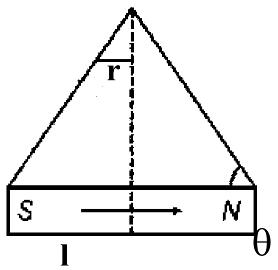
$$F_2 = \frac{\mu_0}{4\pi}\frac{M}{SP^2} \rightarrow \text{attractive}$$

$$F = \frac{\mu_0}{4\pi}M\left[\frac{1}{(r-l)^2} - \frac{1}{(r+l)^2}\right]$$

$$= \frac{\mu_0}{4\pi}M\frac{4lr}{\left(r^2-l^2\right)^2} = \frac{\mu_0}{4\pi}\frac{2M}{r^3} \text{ for } l << r$$

in direction of NP.

39. Magnetic intensity due to a bar magnet on a point on equitorial line or broad side on position.



$M \rightarrow$ Pole strength 2l - length M =2lm magnetic moment

$$F_1 = \frac{\mu_0}{4\pi}\frac{M}{r^2+l^2}$$

$$F_2 = \frac{\mu_0}{4\pi}\frac{M}{r^2+l^2}$$

$F_1 =$ Cos θ and F_2 Cos θ will add up

$F_{.1}$ Sin θ and F_2 Sin θ will cancell.

$$F = \frac{2\mu_0}{4\pi}\frac{M}{r^2+l^2}\cos\theta$$

$$= \frac{2\mu_0}{4\pi}\frac{M}{r^2+l^2}\frac{l}{\left(r^2+l^2\right)^{1/2}}$$

$$= \frac{\mu_0}{4\pi}\frac{M}{\left(r^2+l^2\right)^{3/2}} = \frac{\mu_0}{4\pi}\frac{M}{r^3} \text{ for } r>>>l$$

in direcrtion opposite to the magnetic moment.

40. It consists of two coils

(a) Primary (b) Secondary

They are wound around over soft iron core which are in form of laminas and properly insulated to avoid eddy current. A. C Source is connected to free end of Primary output is taken from secondary. Due to a.c source, there is change of magnetic field so magnetic field induces e.m.f in secondary.

$$E = -\frac{d\Phi}{dt}$$

$n_p \rightarrow$ no. of turns in Primary.

$n_s \rightarrow$ no. of turns in Secondary.

$$E_p = -n_p\frac{d\Phi}{dt}$$

$$E_s = -n_s\frac{d\Phi}{dt}$$

$$\frac{E_P}{E_s} = \frac{n_p}{n_s} \quad \frac{E_s}{E_p} = \frac{ns}{E_p}$$

Step up $n_s > n_p$ So $E_s > E_p$ $I_s < I_p$

Step down $n_s < n_p$ So $E_s < E_p$ $I_s > I_p$

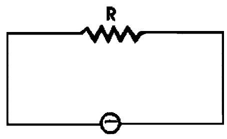
Under no loss of energy.

41. Derive expression for power in an A.C. Circuit.

(a) Circuit containing pure resistance.

$E = E_0$ sinwt

$I = I_0$ sinwt



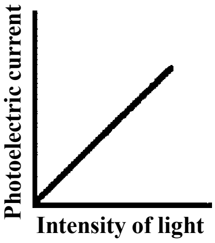
$$P = \frac{dW}{dt} = E_0 I_0 \;\; \text{Sinwt Sinwt}$$

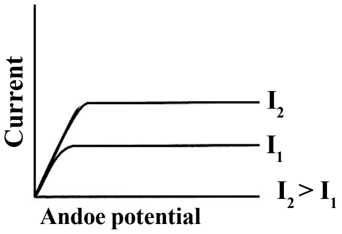
$$dW = E_0 I_0 \sin^2 wt\ dt$$

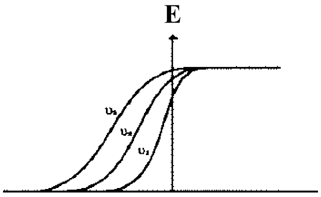
$$W = E_0 I_0 \int \sin^2 wt\, dt = \frac{E_0 I_0}{2}$$

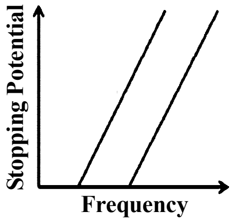
$$= \frac{E_0 I_0}{2} = \frac{I_0}{\sqrt{2}}\frac{E_0}{\sqrt{2}}$$

42. Photo electric emission
   (a) instantaneous
   (b) for a fixed υ I_{photo} α Intensity.
   (c) For a given metal there exists a cutoff υ below which there will be no emission.
   (d) Stopping potential α frequency. Explain experimental set up.









$$h\nu - h\nu_0 = \frac{1}{2} MV^2_{max}$$

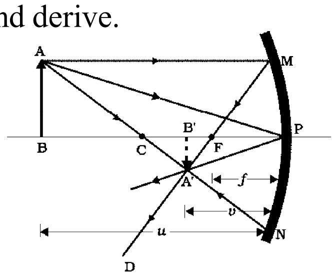
$$\nu_3 > \nu_2 > \nu_1$$

$$ev_0 = h\upsilon - wo$$

$$v_0 = \frac{h\upsilon}{e} - \frac{wo}{e}$$

Slope h/e gives the value of h. Explain all the curves

43. State the mirror formula for the concave mirror and derive.



AB - object, AM II^e to axis reflected rat passes through F.

$\angle APC = \angle CPA'$

$\angle i = \angle r$

$BP = -U,\ B'P = -V,\ FP = f,\ CP = -2f$

$\Delta A'B'C \ \ \Delta ABC$ Similar $\Delta A'B'P,\ \ \Delta ABP$

Similarly

$$\frac{A'B'}{AB} = \frac{CB'}{CB} = \frac{-R+V}{-U+R} = \frac{-V}{-U}$$

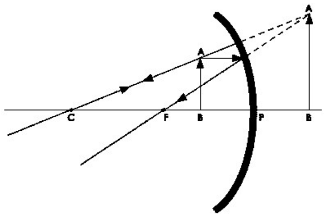
$$\frac{1}{U} + \frac{1}{V} = \frac{2}{R}$$

44. Derive Mirror equation for concave mirror for virtual image.

$BP = -U,\ PB' = V,\ FP = -f,\ CP = -2f$

$\Delta\ ABC\ \ \Delta\ A'B'C'$ are similar.

$\Delta\ MPF\ \ \Delta\ A'BF$ are similar.



$$\frac{-R+U}{-R+V} = \frac{-f}{-f+V}$$

$$\frac{1}{U} + \frac{1}{V} = \frac{2}{f}$$

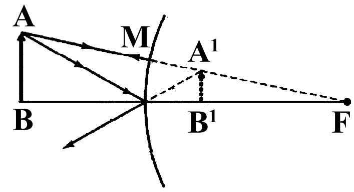
45. Derive Mirror formula for convex mirror

$\Delta\ APB\ \ \Delta\ A'PB'$ are similar

$\Delta\ MPF\ \ \Delta\ A'BF$ are similar

$$\frac{A'B'}{AB} = \frac{PB'}{PB} = \frac{A'B'}{MP} = \frac{B'F}{PF} = \frac{PF - FB'}{PF}$$

$PB' = +V\ \ PB = -U\ \ PF = f$

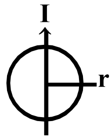


$$\frac{V}{-U} = \frac{f-v}{f}$$

$$\frac{1}{V} + \frac{1}{U} = \frac{1}{f}.$$

46. Line integral of magnetic field over a closed path $\oint \vec{B}.\vec{dl}$ is equal to μo times the net current crossing the area enclosed by that path

$$\oint \vec{B}.\vec{dl} = \mu oI$$



Draw the ampere loop of a circle around the straight conductor. Whose radius is the distance of the point.

$\vec{B}$ is tangent to the cirlce.

So $\oint \vec{B}.\vec{dl} = \oint \vec{B_{ll}}.\vec{dl} = B2\pi r = \mu oI$

$B = \dfrac{MoI}{2\pi r}$ direction of B is counter clock wise.

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