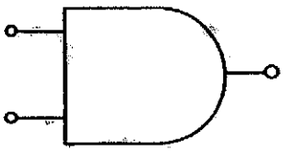
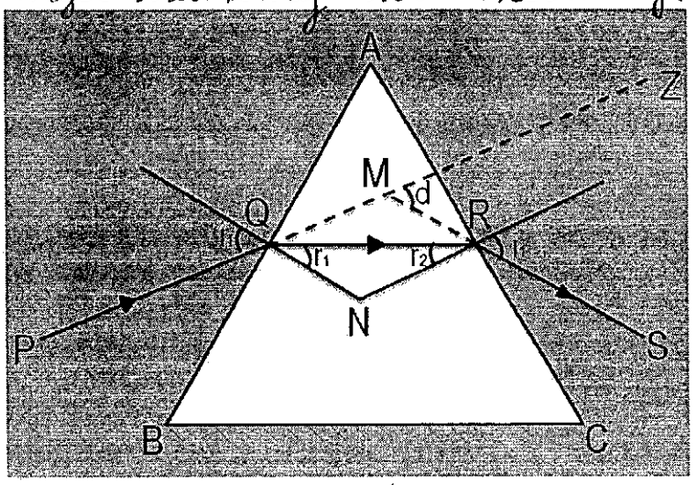
650 sets

KARNATAKA STATE PRE-UNIVERSITY EDUCATION BOARD

II PUC EXAMINATION MARCH – 2012

SCHEME OF VALUATION -- PHYSICS (33)

	PART-A	
1	**Define critical angle of a pair of medium.**	
Ans	Critical angle is a particular angle of incidence in denser medium for which the angle of refraction is 90^0 **OR** refracted ray grazes the surface of separation.	1
2	**How is velocity of light in free space related to permittivity and permeability of the free space?**	
Ans	$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ OR in words	1
3	**What is a plane polarised light?**	
Ans	The light in which vibrations are confined / restricted to a single plane	1
4	**Who proposed quantum theory of light?**	1
Ans	Max Planck OR Plank	
5	**Give the S.I unit of dielectric strength.**	
Ans	$V\ m^{-1}$ **OR** $N\ C^{-1}$	1
6	**What is the least quantity of the magnitude of the charge that can be given to or removed from a body**	
Ans	$\pm 1.6 \times 10^{-19}$ C	1

7	**What is the colour of the third band of a coded resistor of resistance 2.3 X 10^2 Ω ?**	
Ans	Brown	1
8	**What is the principle behind the working of a transformer?**	
Ans	Mutual induction.	1
9	**Identify the particle P in the following nuclear reaction** $$X_Z^A \rightarrow Y_{Z+1}^A + e_{-1}^0 + P$$	1
Ans	Anti neutrino	
10	**Write the circuit symbol of AND gate.**	
Ans		1
	PART-B	
11	**Draw the ray diagram to show the refraction of light through a prism.**	
Ans	Angle marking not necessary.  OR, Dispersion of composite beam of light through prism - diagram	2

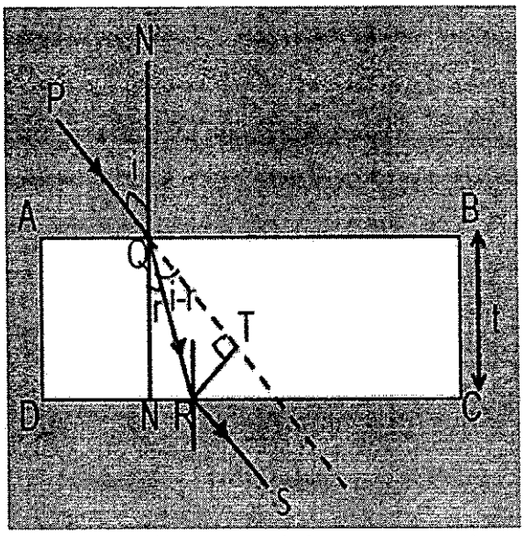
12	**Give the condition for constructive and destructive interference in terms of path difference between interfering waves.**	
Ans	$\delta = n\lambda$ Where n = 0,1,2,3,..... constructive interference	1
	$\delta = (2n+1)\frac{\lambda}{2}$ Where n = 0,1,2,3,...	
	$\delta = (2n-1)\frac{\lambda}{2}$ where n = 1,2,3,.....destructive interference	1
	Where λ is wavelength of light.	
13	**Distinguish between Fresnel and Fraunhoffer diffraction**	
Ans		

Fresnel diffraction	Fraunhoffer diffraction	
The distance of the source and the screen from the slit is finite	The distance of the source and the screen from the slit is infinite	1
Incident wave front is spherical or cylindrical;	Incident wave front is plane	1
Incident waves are divergent and diffracted waves are convergent	Incident waves are parallel and diffracted waves are parallel	1

Any 2

14	**Define the limit of resolution of a microscope. Give the expression for it.**	
Ans	The limit of resolution of a microscope is defined as the ***minimum*** linear separation (distance) between two point objects for which they are ***just*** resolved OR ***just*** separated in the image.	1
	$dx = \frac{\lambda}{2n\sin\Theta}$	1
15	**What is the effect of the presence of a dielectric medium on** **(i)capacitance of a parallel plate capacitor** **(ii) electrostatic force between two charges ?**	
Ans	(i) capacitance increases	1
	(ii)force decreases	1

16	**Give the expression for the magnetic moment of the current loop. Explain the symbols used.**	
Ans	$\vec{M} = I\vec{A}$ OR $\vec{\mu} = I\vec{A}$ [Note: Vector form not required] Where M = μ = magnetic moment I = strength of the current A = area of the loop	1 1
17	**Write the expression for the force between two parallel current carrying conductors. What is the nature of the force between two parallel conductors carrying current in the same direction ?**	
Ans	$\mathbf{F = \frac{\mu_0 I_1 I_2}{2\pi r} L}$ **or** $F = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r}L$ OR $\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi r}$ Attraction or attractive	1 1
18	**A galvanometer of resistance 100Ω gives full scale deflection for 10×10^{-3} A. Calculate the value of high resistance to be connected in series to convert it to a voltmeter of range 10 V.**	
Ans	$R = \frac{V}{I_g} - G$ $R = \frac{10}{10 \times 10^{-3}} - 100 = 900\,\Omega$ with or without unit	1 1
19	**State Faraday's laws of electromagnetic induction.**	
Ans	**I law**: Whenever there is a change in the magnetic flux linked with the coil or circuit an emf is induced in it, which exists as long as the change in magnetic flux takes place. **II law**: The magnitude of induced emf is directly proportional to the rate of change of magnetic flux linked with it.	1 1
20	**What type of spectrum is produced by oil flame? What are Fraunhoffer lines?**	
Ans	Continuous emission spectrum The dark lines in the solar spectrum OR sun light spectrum	1 1

21	**What are matter waves? Write the expression for de-Broglie wavelength of the particle in motion.**	
Ans	The waves associated with moving material particles	1
	$\lambda = \frac{h}{mv} = \frac{h}{p}$	1
22	**Mention two properties of LASERS**	
Ans	1. Highly intense 2. Highly coherent 3. Monochromatic 4. Unidirectional	1 1 1 1 Any 2
	PART-C	
23	**Derive the expression for the lateral shift produced by a parallel sided glass slab when a ray of light is incident obliquely on it.**	
Ans		1
	ABCD=Principal section of a glass slab PQ = incident ray QR = refracted ray RS = emergent ray NN`= normal RT = lateral shift BC = t = thickness of the slab i = angle of incidence r = angle of refraction	
	No figure / Wrong figure / wrong labelling [Zero mark]	

$$\text{From } \Delta QTR, \sin(i-r) = \frac{RT}{QR}$$ 1

$$\text{From } \Delta QNR, \cos r = \frac{QN}{QR}$$ 1

$$\text{Lateral Shift } RT = QR\sin(i-r) \ \& \ QR = \frac{QM}{\cos r}$$ 1

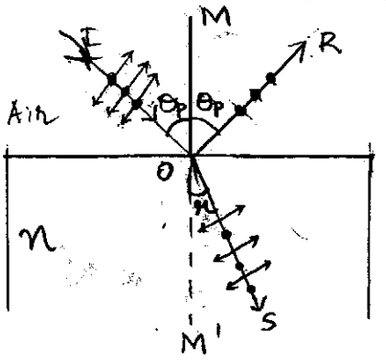
$$L_s = \frac{QM}{\cos r}\sin(i-r) = \frac{t}{\cos r}\sin(i-r)$$ 1

24.

Using Brewster's law show that the reflected and refracted rays are mutually perpendicular to each other when a ray of light is incident at polarising angle.

Ans

[In the diagram, there is no need to mention vibration]



1

From Brewster's law **$n = \tan\theta_p$** 1

$$n = \frac{\sin\theta_p}{\cos\theta_p} = \frac{\sin\theta_p}{\sin(90-\theta_p)} \quad \ldots\ldots\ldots(1)$$

From Snell's law $n = \frac{\sin i}{\sin r} = \frac{\sin\theta_p}{\sin r}$ .....(2) 1

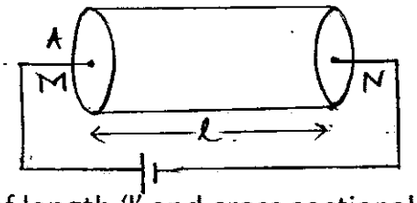
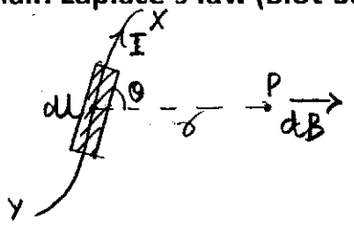
Equating (1) & (2) we get $\sin(90^0 - \theta_p) = \sin r$

$$90^0 - \theta_p = r$$

$$\theta_p + r = 90^0$$ 1

But MOM' = 180^0,

Hence the **reflected and refracted rays are perpendicular.** 1

25	**Obtain the expression for electric current in a conductor in terms of drift velocity of the electron. Define resistivity of the material of the conductor.**	
Ans	[Diagram not required] 	
	Consider a conductor of length 'l' and cross sectional area 'A' . Let n = number of free electrons per unit volume e=charge of electron	
	Total charge available for conduction **Q=nAel**	1
	If t= time taken by the free electrons to travel a distance 'l' then	
	Drift velocity $V_d = l/t$ **or** $t = l/V_d$	1
	We know that $I=Q/t$	1
	$$I = \frac{neAl}{l/v_d} = neAV_d$$	1
	Resistivity: It is defined as the the resistance offered by the given material of wire of unit area of cross-section and unit length	1
26	**State and explain Laplace's law (Biot-Savart's) law.**	
Ans		
	The magnitude of magnetic field near a current carrying conductor is	
	*directly proportional to the strength of the current **(I)**	1
	*directly proportional to the length of the current element **(dl)**	1
	*directly proportional to the sine of the angle between the current element and the line joining the point P to the mid-point of the current element	1
	*inversely proportional to the square of the distance between the point P and the mid-point of the current element.	1
	$$dB = \frac{\mu_0}{4\pi}\frac{I\,dl\sin\theta}{r^2}$$	1

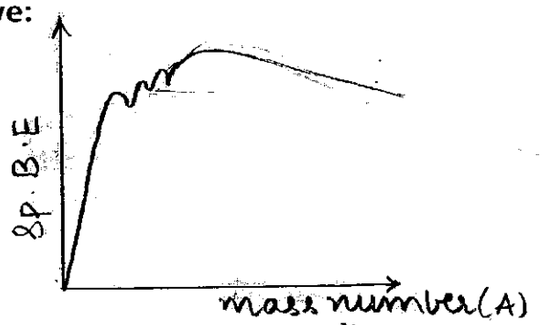
Note:- If diagram is not drawn, explain θ and r

27.	**Using Bohr's postulates arrive at the expression for the radius of n^{th} stationary orbit of the electron of hydrogen like atom.**	
Ans	Consider an electron of mass 'm' and charge 'e' be revolving with a speed 'v' around the nucleus of charge +Ze, in n^{th} stationary orbit of radius 'r' The necessary **centripetal force** is provided by **the electrostatic force of attraction** between the electron and the nucleus.	1
	$$\frac{mv^2}{r} = \frac{Ze^2}{4\pi\epsilon_0 r^2}$$	1
	$$mv^2r = \frac{Ze^2}{4\pi\epsilon_0} \quad \text{..... (1)}$$	
	From Bohr's postulates we know $mvr = \frac{nh}{2\pi}$	1
	Squaring we get $m^2v^2r^2 = \frac{n^2h^2}{4\pi^2}$ **.....(2)**	
	Dividing equation (2) by (1) we get	
	$$\frac{m^2v^2r^2}{mv^2r} = \frac{n^2h^2}{4\pi^2}\frac{4\pi\varepsilon_0}{Ze^2}$$	1
	$$r = \frac{\varepsilon_0 n^2h^2}{\pi mZe^2}$$	1
28	**Explain the terms 'mass defect' and 'binding energy'. How are they related? Draw binding energy curve.**	
Ans	**Mass defect**: It is the difference between the sum of the masses of the nucleons/constituents of the nucleus and the nuclear mass.	1
	Binding energy : The minimum energy required to break the nucleus into its constituent nucleons/particles	1
	[Note-Any other alternate correct answer]	

Binding energy = $(\Delta m)\, C^2$ or binding energy= $(\Delta m)931$MeV 1

Binding energy is equivalent to mass defect

Binding energy curve: 2



29 **Using radioactive decay law derive $N=N_0 e^{-\lambda t}$ where symbols have usual meaning.**

Ans Let N_0 be the initial number of radioactive atoms present in the sample at t=0, Let N be the number of atoms at any instant of time 't'

From decay law we have $\frac{dN}{dt} \propto N$ 1

$$\frac{dN}{dt} = -\lambda N$$ Where λ=decay constant

$$\frac{dN}{N} = -\lambda\, dt$$

Integrating we get $\int \frac{dN}{N} = \int -\lambda\, dt$

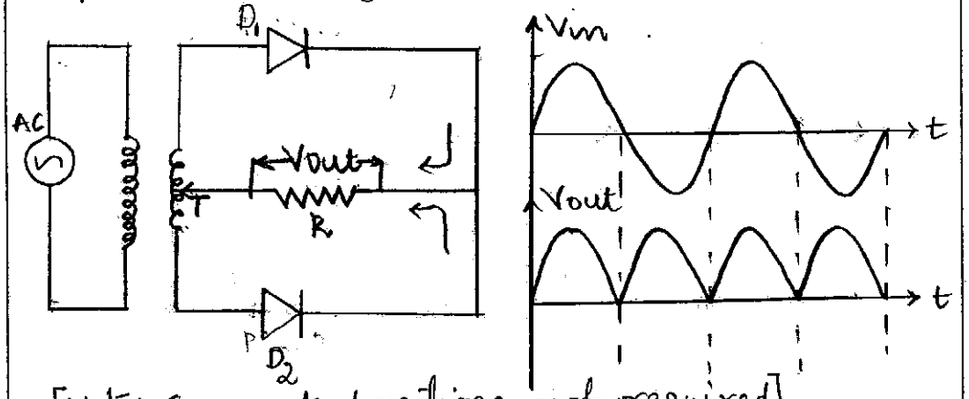
$\log_e N = -\lambda t + C$ .....(1) 1

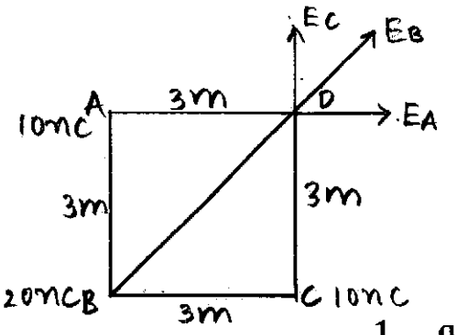
When t=0, $N=N_0$ $\log_e N_0 = C$ .....(2) 1

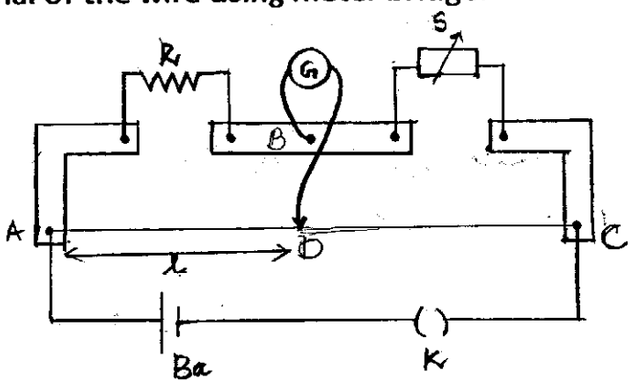
Substituting (2) in (1) we get $\log_e N = -\lambda t + \log_e N_0$ 1

$\log_e (N/N_0) = -\lambda t$ $\frac{N}{N_0} = e^{-\lambda t}$

$$N = N_0 e^{-\lambda t}$$ 1

30	**what is rectification? Explain the working of p-n junction diode as a full wave rectifier by drawing a suitable circuit diagram. Draw the input and output wave forms.**	
Ans	The process of converting a.c. to d.c. is called rectification	1
		1 - Diagram 1 – waveform
	[Note: Current directions not required]	
	The circuit connections are made as shown in the circuit diagram. During positive half cycle of the input signal diode D_1 is forward biased and hence conducts, where as diode D_2 is reverse biased and hence does not conduct.	1
	During negative half cycle of the input signal, diode D_1 is reverse biased and diode D_2 is forward biased. Hence D_2 conducts. Hence the output is as shown in the diagram.	1
31	**Radius of curvature of an equi convex lens is 0.2 m. Its refractive index is 1.5, calculate its focal length. if two such lenses are kept separated with common principal axis by a distance of 0.2 m, what will be effective focal length of the combination.**	
Ans	$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$	1
	$$\frac{1}{f} = (1.5-1)\left(\frac{1}{0.2} + \frac{1}{0.2}\right)$$	1
	$$f = 0.2m$$	1
	$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$	1
	$$f = 0.2m$$	1

32	**Point charges of 10 nC , 20 nC and 10 nC are kept at the corners A,B, C of a square ABCD of side 3 m Calculate the magnitude of the resultant electric intensity at D**	
Ans	 Electric intensity $\mathbf{E} = \frac{1}{4\pi\epsilon_0}\frac{q}{d^2}$	1
	Here $E_A = E_C = 9 \times 10^9 \times 10 \times 10^{-9} / 9 = 10\ NC^{-1}$	1
	$E_B = \frac{9\ X\ 10^9\ X\ 20\ X\ 10^{-9}}{(3\sqrt{2})^2} = 10$	1
	Resultant of E_A & E_C is $(\sqrt{2}X\ E_A) = 10\sqrt{2}$ E_B is along $\sqrt{2}X\ E_A$	1
	Resultant electric intensity at D is equal to $(\sqrt{2}X\ E_A) + E_B = 10 + 10\sqrt{2} = 24.14\ NC^{-1}$	1
33	**A resistor of 100Ω, inductance 0f 1H and a capacitor of capacitance 10.13 X 10^{-6}F are in series. This combination is connected to an A.C source of 200 V, 50 Hz. Find the current in the circuit and the p.d across the resistor.**	
Ans	$\mathbf{I_{rms}} = \frac{\mathbf{V_{rms}}}{\sqrt{\mathbf{R}^2 + (\mathbf{X_L} - \mathbf{X_C})^2}}$	1

	$X_L = 2\pi fL =$ **314.2 Ω**	1
	$X_C = 1/2\pi fC =$ **314.2 Ω**	1
	$I_{rms} = 200/100 =$ **2A**	1
	$V_R = I\,R = 2 \times 100 =$ **200 V**	1
34	**Calculate the energy released in the following nuclear reaction and hence calculate the energy released when 235 gram . of uranium-235 undergoes fission.** $\mathbf{U_{92}^{235} + n_0^1 \rightarrow Kr_{36}^{92} + Ba_{56}^{141} + 3n_0^1}$ **Rest masses of U^{235} , Ba^{141} , Kr^{92} and neutron are 235.04390 amu,140.91390 amu, 91.89730 amu and 1.00867 amu respectively. Avogadro number = 6.023 X 10^{23}**	
Ans	Sum of the masses of the reactants = 236.05257 amu	1
	Sum of the masses of the products = 235.83721 amu	1
	Mass converted to energy per fission = 0.21536 amu	1
	Energy released per fission = 0.21536 X 931 = 200.50016 MeV **OR** 200.5 X 1.6 X 10^{-13} = 3.208 X 10^{-11} J	1
	Energy released when 235 gram of U^{235} undergoes fission =200.5 X 6.023 X10^{23} = 1.2076 X 10^{26} M eV **or** 1.932 X 10^{13} J	1
35	**Explain the experiment to determine the resistivity of the material of the wire using meter bridge.**	
Ans		1

Formula $\rho = \frac{\pi d^2 R}{4L}$ $R = \frac{Sl}{(1-l)}$

Where ρ = resistivity in Ω-m 1

d=diameter of the wire in m

R= resistance of the given wire in Ω

L = length of the given wire in m

Procedure:

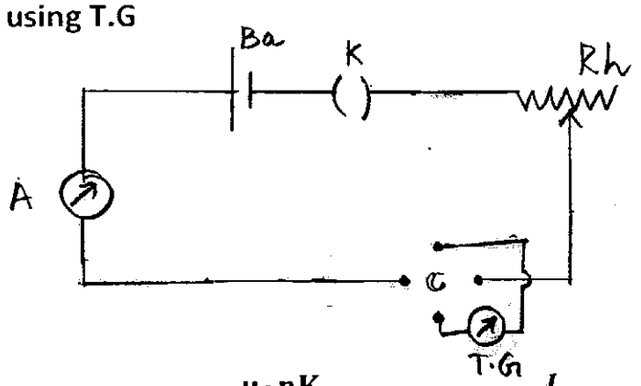
- Circuit connections are made as shown in the circuit diagram
- Suitable resistance 's' is unplugged in the standard resistance box
- Circuit is checked for opposite deflections by placing the slider at the ends of the wire A & C
- The slider is moved on the wire from end A to C till the galvanometer shows zero deflection
- The balancing length 'l' is measured, the resistance of the wire is calculated using the formula $R = \frac{Sl}{(1-l)}$
- Experiment is repeated for different values of S and average R is found
- The length 'L' of the given wire is measured and the resistivity is calculated using the formula $\rho = \frac{\pi d^2 R}{4L}$ 2

Tr no	Resistance S in ohm	Balancing length 'l' in m	(1-l) in m	$R = \frac{Sl}{(1-l)}$

1

36 Ans

Explain the experiment to determine the reduction factor (K) and B_H using T.G



1

Formula. $B_H = \frac{\mu_0 nK}{2r}$ & $K = \frac{I}{tan\theta}$ 1

Procedure:

- Initial adjustments of the T.G are made and the plane of the coil is kept in the magnetic meridian
- The circuit connections are made as shown in the circuit diagram
- The rheostat is adjusted for suitable current I such that the deflections are in between 30^0 & 60^0
- The current I and the corresponding deflections in T.G θ_1 and θ_2 are noted.
- The direction of the current is reversed using commutator key and the corresponding deflections θ_3 and θ_4 are noted The average deflection θ is calculated and the reduction factor is determined using the formula $K = \frac{I}{\tan\theta}$
- The experiment is repeated for different values of I and the mean value of K is noted
- Value of B_H is calculated using the formula $B_H = \frac{\mu_0 nK}{2r}$ 2

Number of turns in T.G = n=
Radius of the T.G coil = r

Tr no	Current I A	Deflection θ in degree					$K = \frac{I}{\tan\theta}$
		θ_1	θ_2	θ_3	θ_4	meanθ	

1

37 **Using the following data calculate the refractive index of the material of the convex lens.**
Radii of curvature of both the surfaces are 0.2 m
Data recorded in the shift method to determine the focal length of the convex lens are as follows.

Tr no	D	S
1	0.82 m	0.128 m
2	0.9 m	0.3 m

Ans

$$f = \frac{D^2 - S^2}{4D}$$ 1

$$f = \frac{D^2 - S^2}{4D} = \frac{0.82^2 - 0.128^2}{4 X 0.82} = 0.2 \text{ m}$$

$$f = \frac{D^2 - S^2}{4D} = \frac{0.9^2 - 0.3^2}{4 X 0.9} = 0.2 \text{ m}$$ 1

$$f_{av} = 0.2 \text{ m}$$

$$n = 1 + \frac{1}{f}\frac{R_1 R_2}{(R_1 + R_2)}$$ 1

$$n = 1 + \frac{1}{0.2}\frac{0.2X0.2}{(0.2+0.2)}$$ 1

n=1.5 1

38 **Following readings were obtained in the experiment to determine self inductance of a coil. Using it, calculate self inductance of the coil.**
Frequency of A.C = 50 Hz

D.C. part

Tr no	V	I
1	0.5 V	0.1 A
2	0.6 V	0.12 A

Ans

A.C part

Tr no	V	I
1	1.0 V	0.1 A
2	1.6 V	0.16 A

$$R = \frac{V}{I} = \frac{0.5}{0.1} = 5\Omega$$

$$R = \frac{V}{I} = \frac{0.6}{0.12} = 5\Omega$$

$\mathbf{R_{av} = 5\Omega}$ 1

$$Z = \frac{V}{I} = \frac{1.0}{0.1} = 10\Omega$$

$$Z = \frac{V}{I} = \frac{1.6}{0.16} = 10\Omega$$

$\mathbf{Z_{av} = 10\Omega}$ 1

$$L = \frac{\sqrt{Z^2 - R^2}}{2\pi f}$$ 1

$$L = \frac{\sqrt{10^2 - 5^2}}{2X3.142\,X50} = \frac{8.660}{314.2}$$ 1

$$\boldsymbol{L = 0.0276\ H}$$ 1

39 **(a) In Young's double slit experiment, fringes of certain width are produced on the screen kept at a certain distance from the slits. When the screen is moved away from the slits by 0.1 m , fringe width increases by 6 X 10^{-5} m. The separation between the slits is 1 X 10^{-3} m. Calculate the wavelength of light used**

$$\beta = \frac{\lambda D}{d}$$ 1

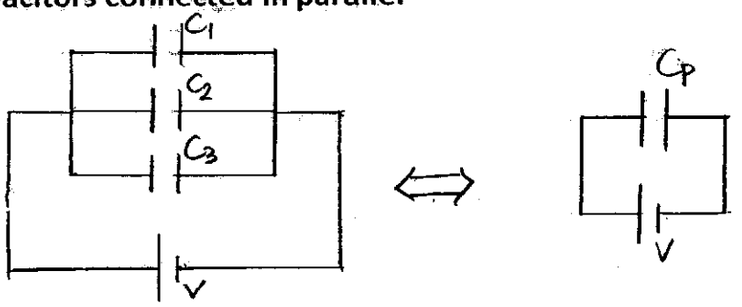
$$\boldsymbol{\beta = \frac{\lambda D}{1\,X\,10^{-3}}} \qquad \text{.....(1)}$$

$$\beta + (6\,X10^{-5}) = \frac{\lambda(D+0.1)}{1\,X\,10^{-3}} \quad \text{.....(2)}$$ 1

equation (2) – (1) $\rightarrow 6\,X\,10^{-5} = \frac{0.1\cdot\lambda}{1X10^{-3}}$ 1

$$\lambda = 6\,X\,10^{-7}\,m$$ 1

b) Obtain the expression for the effective capacitance of three capacitors connected in parallel



1

Let C_1, C_2 & C_3 be the three capacitors connected in parallel.
Let Q_1, Q_2 & Q_3 be the charges stored in them respectively.
Let 'V 'be the potential difference across each.

We know that $Q = Q_1 + Q_2 + Q_3$ 1

$$Q = C_1V + C_2V + C_3V \quad \text{.....(1)}$$

Let C_p be the effective capacitance $Q=C_p V$ .....(2) 1

From (1) & (2) $C_pV = C_1V + C_2V + C_3V$

$$\mathbf{C_p = C_1 + C_2 + C_3}$$ 1

(c) What are gels and emulsions?

Gels are the colloidal states in which liquid is the dispersed phase and solid is dispersion medium. 1

Emulsion is a colloidal state in which both the dispersed phase and the dispersion medium are liquids. 1

40 **(a) When the frequency of the incident light on a photo sensitive metal is changed from 7.6 X 10^{14} Hz to 6 X 10^{14} Hz the value of stopping potential changes by 0.66 V. Calculate Planck's constant**

Ans

Note:- Any form of Einstein's P.E. Equation can be considered)

$$h\nu = h\nu_0 + eV_s$$ 1

$$h \text{ X } 7.6 \text{ X } 10^{14} = h\,\nu_0 + 1.6 \text{ X } 10^{-19}\, V_1$$

$$h \text{ X } 6 \text{ X } 10^{14} = h\,\nu_0 + 1.6 \text{ X } 10^{-19}\, V_2$$ 1

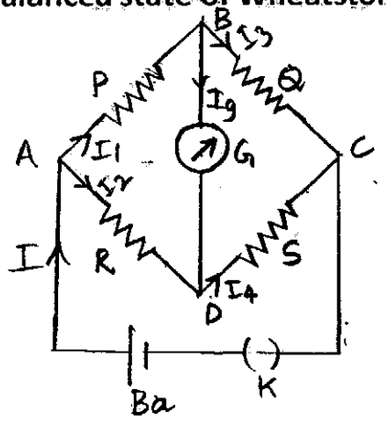
subtracting the above two equations we get

$$h\,(1.6 \text{ X } 10^{14}) = 1.6 \text{ X } 10^{-19}\,(V_1 - V_2)$$ 1

here $(V_1 - V_2) = 0.66$ given, simplifying we get

h = 6.6.X 10^{-34} Js 1

(b) Derive the condition for the balanced state of Wheatstone's network, using Kirchhoff's law.



1

P, Q ,S & R are the four resistances connected in cyclic order to form a wheatstone's network. 'G' is the galvanometer resistance. The currents are as shown in the diagram.

At node B, from K.C.L $\mathbf{I_1 - I_3 - I_g = 0}$ .....**(1)**

at node D, $\mathbf{I_2 - I_4 + I_g = 0}$ .....**(2)**

Applying K.V.L to the mesh ABDA

$$\mathbf{I_1 P + I_g G - I_2 R = 0}$$ .....**(3)**

Similarly, for the mesh BCDB,

$$I_3Q - I_4S - I_gG = 0 \quad \text{.....(4)}$$ 1.

For the balanced condition of the wheat stone's network $I_g=0$ 1

From equations (1) & (2) we get

$$I_1 = I_3 \quad I_2 = I_4 \text{ and } I_1P = I_2R \quad \text{.....(5)}$$

$$I_3Q = I_4S \quad \text{.....(6)}$$

Dividing (5) by (6) we get $\frac{P}{Q} = \frac{R}{S}$ 1

(c) What are coherent scattering and incoherent scattering?

Coherent scattering: If the frequency/ wavelength of the scattered light is **same** as that of the incident light, it is called coherent scattering. 1

Incoherent scattering: If the frequency/ wavelength of the scattered light is **different** from that of the incident light, it is called incoherent scattering. 1

NOTE: **Any other alternate correct method should be considered**

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