DESIGN OF THE QUESTION PAPER

PHYSICS - CLASS XII

Time : 3 hours **Maximum Marks : 70**

The weightage of the distribution of marks over different dimensions of the question paper shall be as follows.

A. Weightage to content/subject units

Unit.	Marks
Electrostatics	08
Current Electricity	07
Magnetic Effect of Current and Magnetism	08
Electromagnetic Induction and Alternating current	08
Electromagnetic Waves	03
Optics	14
Dual Nature of Radiation and Matter	04
Atoms and Nuclei	06
Electronic Devices	07
Communication Systems	05
Total	**70**

B. Weightage to form of questions

S.No. Form of Questions	Marks for each Question	No. of Questions	Total Marks
1. Long Answer Type (LA)	5	3	15
2. Short Answer SA (I)	3	9	27
3. Short Answer SA (II)	2	10	20
4. Very short Answer (VSA)	1	08	08
Total		**30**	**70**

C. Scheme of Options

1. There will be no overall choice.

2. Internal choice (either/or type), on a very selective basis, has been given in five questions. This internal choice is given in any one question of 2 marks, any one question of 3 marks and all three questions of 5 marks weightage.

D. A weightage, of around15 marks, has been assigned to numericals.

E. Weightage to difficulty level of questions

S.No.	**Estimated difficulty level**	**Marks Allotted**
1.	Easy	15 %
2.	Average	70 %
3.	Difficult	15 %

PHYSICS BLUE-PRINT- III

	UNIT	VSA (1 Mark)	SA I (2 Marks)	SA II (3 Marks)	LA (5 Marks)	TOTAL
1.	Electrostatics	1 (1)	4 (2)	3 (1)	—	8 (4)
2.	Current Electricity	—	2 (1)	—	5 (1)	7 (2)
3.	Magnetic effect of current and magnetism	1 (1)	4 (2)	3 (1)	—	8 (4)
4.	Electromagnetic induction and Alternating current	1 (1)	2 (1)	—	5 (1)	8 (3)
5.	Electromagnetic waves	1 (1)	2 (1)	—	—	3 (2)
6.	Optics	1 (1)	2 (1)	6 (2)	5 (1)	14 (5)
7.	Dual Nature of Radiation and Matter	1 (1)	—	3 (1)	—	4 (2)
8.	Atoms and Nuclei	—	—	6 (2)	—	6 (2)
9.	Electronic Devices	—	4 (2)	3 (1)	—	7 (3)
10.	Communication system	2 (2)	—	3 (1)	—	5 (3)
	Total	**8 (8)**	**20 (10)**	**27 (9)**	**15 (3)**	**70 (30)**

SAMPLE PAPER – III
PHYSICS (THEORY)
Class XII

Time: 3hours **M.M.: 70**

General Instruction:

(i) All questions are compulsory

(ii) There are 30 questions in total. Questions 1 to 8 are very short answer type and carry one mark each.

(iii) Questions 9 to18 carry two marks each, questions 19 to 27 carry three marks each and questions 28 to 30 carry five marks each.

(iv) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the questions of five marks. You have to attempt only one of the given choices in such questions.

(v) Use of calculators is not permitted. You may, however, use log tables if necessary.

You may use the following values of physical constants wherever necessary:

$c = 3 \times 10^8\ ms^{-1}$

$h = 6.63 \times 10^{-34} Js$

$e = 1.6 \times 10^{-19}\ C$

$\mu_o = 4\Pi \times 10^{-7}\ TmA^{-1}$

$$\frac{1}{4\Pi\varepsilon_o} = 9 \times 10^9 \frac{Nm^2}{C^2}$$

1. Let the wavelengths of the electromagnetic waves used quite often for

   (i) killing germs in household water purifiers.

   (ii) remote sensing

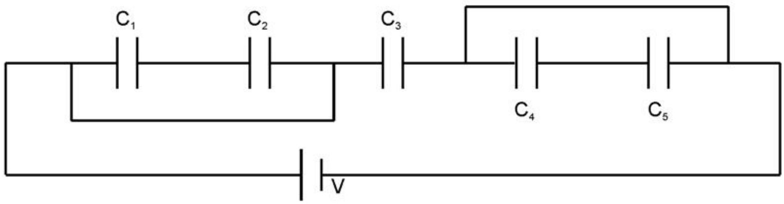
   (iii) treatment of cancer

   be labelled as λ_1, λ_2 and λ_3. Arrange λ_1, λ_2 and λ_3 in increasing order.

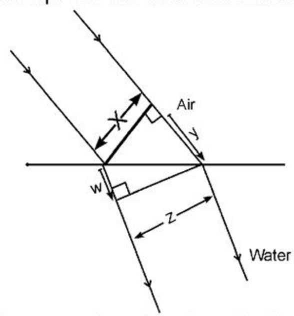
2. The motion of a copper plate is damped when it is allowed to oscillate between the pole pieces of a magnet. State the cause of this damping.

3. Two circular loops, of radii r and 2r, have currents I and I/2 flowing through them in clockwise and anticlockwise sense respectively. If their equivalent magnetic moments are $\vec{M_1}$ and $\vec{M_2}$ respectively, state the relation between $\vec{M_1}$ and $\vec{M_2}$.

4. What is the equivalent capacitance, C, of the five capacitors, connected as shown ?



5. A plane wave front, of width X, is incident on an air-water interface and the corresponding refracted wavefront has a width Z as shown. Express the refractive index of air with respect to water, in terms of the dimension shown.



6. A device X can convert one form of energy into another. Another device Y can be regarded as a combination of a transmitter and a receiver. Name the devices X and Y.

7. The maximum velocity of electrons, emitted from a metal surface of negligible work function, is 'V' , when frequency of light falling on it is 'f '. What will be the maximum velocity when the incident light frequency is made '4f ' ?

8. An audio signal of frequency υ_a is to be transimitted as an electromagnetic wave

(i) directly as such,

(ii) through its use as the modulating signal on a carrier wave of frequency υ_c.

State the ratio of the size of the transmitting antenna, that can properly sense the time variation of the signal, in terms of υ_a and υ_c.

9. A plane electromagnetic wave, of angular frequency ω, is propagating with velocity c the along the Z-axis. Write the vector equations, of oscillating electric and magnetic fields, and show these fields diagramatically .

10. Justify that the electrostatic potential is constant throughout the volume of a charged conductor and has the same value on its surface as inside it.

OR

A capacitor is charged with a battery and then its plate separation is increased without disconnecting the battery. What will be the change in

(a) charge stored in the capacitor?

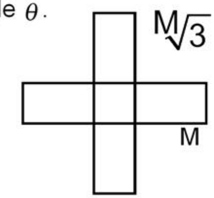
(b) energy stored in the capacitor?

(c) potential difference across the plates of the capacitor ?

(d) electric field between the plates of the capacitor?

11. Draw the current versus potential difference characteristics for a cell. How can the internal resistance of the cell be determined from this graph?

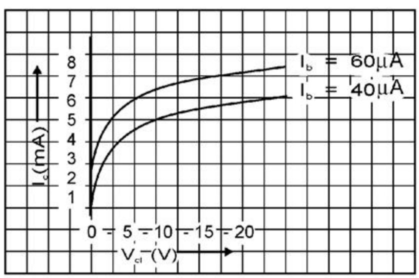
12. Two magnets of magnetic moments M and $M\sqrt{3}$ are joined to form a cross. The combination is suspended in a uniform magnetic field B. The magnetic moment M now makes an angle of θ with the field direction. Find the value of angle θ.



13. A luminiscent object is placed at a depth 'd' in a (optically) denser medium of refractive index 'μ'. Prove that radius r, of the base of the cone of light, from the object, that can emerge out from the surface, is

$$r = \frac{d}{\sqrt{\mu^2 - 1}}$$

14. A certain n - p - n transistor has the common emitter output characteristics as shown



(a) find the emitter current at V_{cc} = 10V and I_b = 60 μA.

(b) find β at this point.

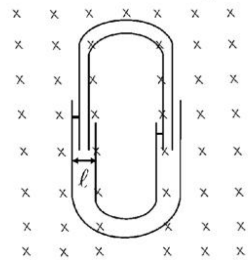
15. Using Gauss law establish that the magnitude of electric field intensity, at a point, due to an infinite plane sheet, with uniform charge density σ is independent of the distance of the field point.

OR

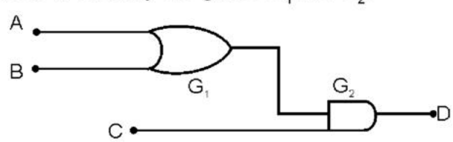
Define an electric field line. Draw the pattern of the field lines around a system of two equal positive charges separated by a distance.

16. An average induced emf of 0.4V appears in a coil when the current in it is changed from 10A in one direction to 10 A in opposite direction in 0.40 second. Find the coefficient of self induction of the coil.

17. A conducting U tube can slide inside another U tube maintaing electrical contact between the tubes. The magnetic field is perpendicular to the plane of paper and is directed inward. Each tube moves towards the other at a constant speed V. Find the magnitude of induced emf across the ends of the tubes in terms of magnetic field B, velocity v and width of the tube.

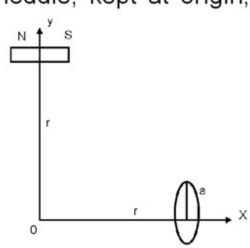


18. For the given combination of gates, Find the values of outputs Y_1 and Y_2 in the table given below. Identify the gates G_1 and G_2.

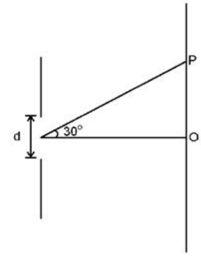


A	B	C	D
O	O	O	Y_1
1	1	O	Y_2

19. A small magnet, of magnetic moment M, is placed at a distance r from the origin O with its axis parallel to x-axis as shown. A small coil, of one turn, is placed on the x-axis, at the same distance from the origin, with the axis of the coil coinciding with x-axis. For what value of current in the coil does a small magnetic neddle, kept at origin, remains undeflected? What is the direction of current in the coil?



20. A slit of width 'd' is illuminated by white light. For what value of 'd' is the first minimum, for red light of λ = 650 nm, located at point P ? For what value of the wave length of light will the first diffraction maxima also fall at P?



21. A charged particle, of charge 2 μ C and mass 10 milligram, moving with a velocity of 1000 m/s entres a uniform electric field of strength 10^3 NC^{-1} directed perpendicular to its direction of motion. Find the velocity, and displacement, of the particle after 10s.

22. What reasoning led de- Broglie to put forward the concept of matter waves? The wavelength, λ, of a photon, and the de - Broglie wave length associated with a particle of mass 'm', has the same value, say λ. Show that the energy of photon is $\frac{2\lambda mc}{h}$ times the kinetic energy of the particle.

23. The ground state energy of hydrogen atom is – 13.6 eV.

(i) What are the potential and kinetic energy of an electron in the 3^{rd} excited state?

(ii) If the electron jumps to the ground state from the third excited state, calculate the frequency of photon emitted.

24. Give reason for each of the following observations :

(i) The resultant intensity at any point on the screen varies between zero and four times the intensity, due to one slit, in Young's double slit experiment.

(ii) A few coloured fringes, around a central white region, are observed on the screen, when the source of monochromatic light is replaced by white light in Young's double slit experiment.

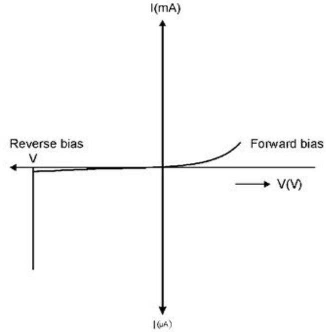
(iii) The intensity of light transmitted by a polaroid is half the intensity of the light incident on it.

25. The figure below shows the V – I characteristics of a semiconductor device.

(i) Identify the semiconductor device used here.

(ii) Draw the circuit diagram to obtain the given charactersitics of this diode.

(iii) Briefly explain how this device is used as a voltage regulator.



(b)

26. If nuclei, with lower binding energy per nucleon, transform to nuclei with greater binding energy per nucleon, would the reaction be exothermic or endothermic? Justify your answer and write two examples to support your answer.

27. Complete the following block diagram depicting the essential elements of a basic communication system.

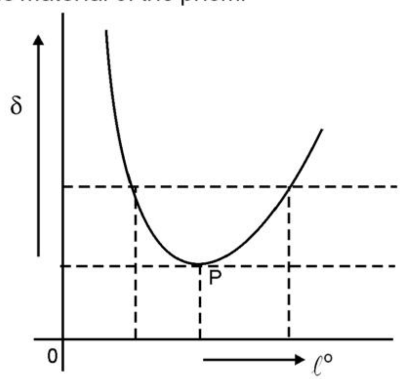
Name the two basic modes of communication. Which of these modes is used for telephonic communication?

OR

Is it necessary for the transmitting antenna and the receiving antenna to be of the same height for line of sight communication? Find an expression for maximum line of sight distance d_m between these two antennas of heights h_T and h_R.

28. A plot, between the angle of deviation (δ) and angle of incidence (i), for a triangular prism is shown below.

Explain why any given value of 'δ' corresponds to two values of angle of incidence? State the significance of point 'P' on the graph. Use this information to derive an expression for refractive index of the material of the prism.

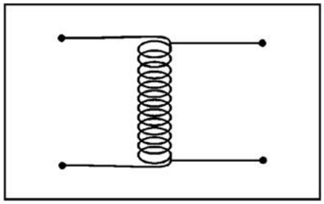


OR

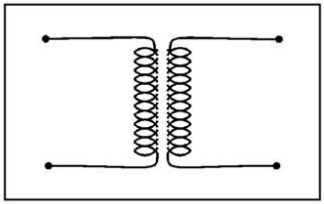
A thin lens, made of a material of refractive index μ, has a focal length 'f'. If the lens is placed in a transparent medium of refractive index 'n' (n<μ), obtain an expression for the change in the focal length of the lens. Use the result to show that the focal length of a lens of the glass ($\mu = \mu_g$) becomes $\frac{\mu_w(\mu_g - 1)}{(\mu_g - \mu_w)}$ times its focal length in air, when it is placed in water ($\mu = \mu_w$).

What happens when n > μ. Explain using appropriate ray diagram.

29. (a) Out of the two arrangements, given below, for winding of primary and secondary coil in a transformer, which arrangement do you think will have higher efficiency and why?



(a)



(b)

(b) Show that, in an ideal transformer, when the voltage is stepped up by a certain factor, the current gets stepped down by the same factor.

(c) State any two causes of energy loss in a transformer.

OR

(a) In a series LCR ac circuit, is the applied instantaneous voltage equal to the algebric sum of the instantaneous voltages across the series elements of the circuit? Is the same true for r.m.s. voltages?

(b) Prove that in a series LCR circuit, the power dissipated depends not only on the voltage and current but also on the cosine of the phase angle ϕ between these two.

30. Is current density a vector or a scalar quantity? Deduce the relation between current density and potential difference across a current carrying conductor of length l, area of cross-section A, and number density of free electrons n. How does the current density, in a conductor vary with

(a) increase in potential gradient?

(b) increase in temperature?

(c) increase in length?

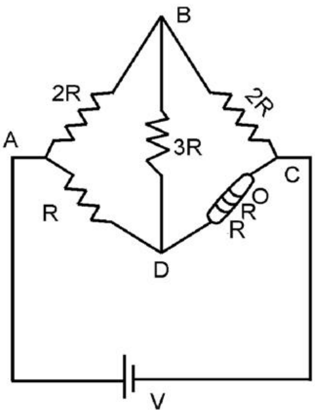
(d) increase in area of cross-section?

(Assume that the other factors remain constant in each case.)

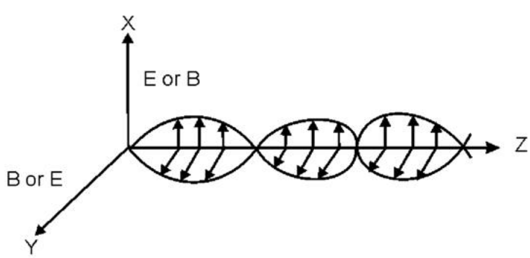
OR

Write the condition of balance in a Wheatstone bridge. In the given Wheatstone bridge, the current in the resistor 3R, is zero. Find the value of R, if the carbon resistor, connected in one arm of the bridge, has the colour sequence of red, red and orange.

The resistances, of BC and CD arms, are now interchanged and another carbon resistance is connected in place of R so that the current through the arm BD is again zero. Write the sequence of colour bands of this carbon resistor. Also find the value of current through it.



SAMPLE PAPER - III
MARKING SCHEME
PHYSICS (THEORY)
Class XII

Q No.	Value point / expected points	Marks	Total
1.	$\lambda_3 < \lambda_1 < \lambda_2$	1	1
2.	eddy currents	1	1
3.	$\vec{M_1} = -\frac{1}{2}\vec{M_2}$	1	1
4.	$C = C_3$	1	1
5.	${}_{w}^{a}\mu = \frac{\sin r}{\sin i} = \frac{w}{y}$	$\frac{1}{2}+\frac{1}{2}$	1
6.	(a) Transducer (b) Repeater	$\frac{1}{2}+\frac{1}{2}$	1
7.	2ϑ	1	1
8.	υ_c / υ_a	1	1
9.	$\vec{E} = E_o \sin\omega t\, \hat{i}$	½	
	$\vec{B} = B_o \sin\omega t\, \hat{j}$	½	
	OR	OR	
	$\vec{E} = E_o \sin \omega t\, \hat{j}$	½	
	$\vec{B} = B_o \sin \omega t\, \hat{i}$	½	
		1	2

10. Since electric field inside the conductor is zero and has no tangential component on the surface, no work is done in moving a small test charge within the conductor or on its surface. 1

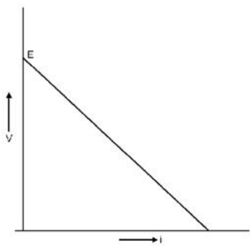
This means that, there is no potential difference between any two points inside or on the surface of the conductor. Hence the potential is constant through out the volume of the conductor and has the same value on its surface. 1 2

OR

(a) decreases (b) decreases ½+½

(c) remains same (d) decreases ½+½ 2

11.



1

Since V = E - ir, the internal resistance equals the negative of the slope of this graph 1 2

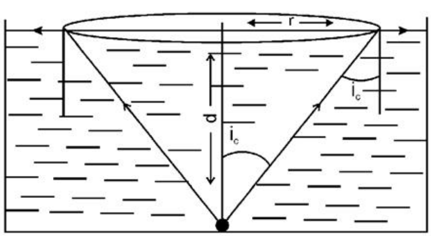
12. $MB \sin\theta = \sqrt{3}\, MB \sin(90^\circ - \theta)$ 1

$= \sqrt{3}\, MB \cos\theta$

$\Rightarrow \tan\theta = \sqrt{3}$

i.e $\theta = 60^\circ$ 1 2

13.



For total internal reflection

$\sin i_c = \frac{1}{\mu}$ ½

also, from the figure,

$\tan i_c = \frac{r}{d}$ ½

	$\therefore \frac{\sin i_c}{\sqrt{1-\sin^2 i_c}} = \frac{r}{d}$	½	
	$\therefore r = \frac{d}{\sqrt{\mu^2 - 1}}$	½	2
14.	(a) For $V_{cc} = 10$ V and $I_b = 60$ μA		
	$I_c = 6$ mA	1	
	$I_e = I_c + I_b = 6\text{mA} + 60\,\mu\text{A} = 6.06$ mA		
	(b) $\beta = \frac{I_c}{I_b} = \frac{6\text{mA}}{6\mu\text{A}} = 1000$	1	2
15.	Statement of Gauss law	½	
	Diagram	½	2
	Derivation	1	
	OR		
	Definition of field lines	1	
	Diagram	1	2
16.	$\frac{dI}{dt} = \frac{I_2 - I_1}{at} = \frac{-10 - 10}{40} = \frac{-20}{40}$	½	
	$= -50\ \text{As}^{-1}$	½	
	$E = -L\frac{dI}{dt}$	½	
	$0.4 = -L\ (-50)$		
	$L = \frac{0.4}{50}$		
	$= 0.008$H	½	2
	$= 8$mH		
17.	Relative velocity		
	$= v - (-v) = 2v$	1	
	$\therefore E = B\ell(2v)$		
	$= 2vB\ell$	1	2

18. $G_1 \rightarrow$ OR $\qquad G_2 \rightarrow$ AND $\qquad \frac{1}{2}+\frac{1}{2}$ $\qquad$ 2

$Y_1 = O \qquad Y_2 = O$ $\qquad$ 1

19. This happens when magnetic field of bar magnet is equal and opposite to the magnetic field of coil $\Rightarrow |\vec{B}_m| = |\vec{B}_c|$ $\qquad$ 1

$$\frac{\mu_o M}{4\pi r^3} = \frac{\mu_o I a^2}{2r^3} \qquad 1$$

$$\Rightarrow I = \frac{2M}{4\pi a^2} \qquad ½ \qquad 3$$

Current is in anticlockwise sense, as seen from the origin. $\qquad$ ½

20. At first minimum n=1

d sin 30º = n λ $\qquad$ ½

or $\frac{d}{2} = 1 \text{x} \; 650 \text{ nm}$

or $d = 1300 \text{ nm}$ $\qquad$ 1

For 1st maxima to lie at P:

$$d \sin \theta = \frac{3}{2}\lambda^1 \qquad ½$$

$$\text{or } \lambda^1 = \frac{2d\sin\theta}{3} = \frac{2\text{x}1300 \text{ x } \sin 30^o}{3} \text{ nm}$$

= 433.3 nm $\qquad$ 1 $\qquad$ 3

21. The velocity of the particle, normal to the direction of field,

$\vartheta_x = 1000\text{ms}^{-1}$, is constant. $\qquad$ ½

The velocity of the particle, along the direction of field,
after 10s, is given by

$$\vartheta_y = u_y + a_y$$

$$= 0 + \frac{qE_y}{m}t$$

$$= \frac{2\text{x}10^{-6}\text{x}10^3\text{x}10}{10\text{x}10^{-6}} = 2000\text{ms}^{-1} \qquad ½$$

The net velocity after 10s

$\vartheta = \sqrt{\vartheta_x^2 + \vartheta_y^2}$

$= \sqrt{(1000)^2 + (2000)^2}$ m s^{-1}

$= 1000\sqrt{5}$ m s^{-1} ½

Displacement, along the x-axis, after 10s

X=1000 x 10m = 10000 m

Displacement along y - axis (in the direction of field) after 10s, ½

$y = U_y t + \frac{1}{2} a_y t^2$

$= (0)t + \frac{1}{2} \frac{qE_y}{m} t^2$

$= \frac{1}{2} x \frac{2x10^{-6} x 10^3}{10x10} x\ (10)^2$

$= 10000$ m ½

Net displacement

$r = \sqrt{x^2 + y^2}$

$= \sqrt{(10000)^2 + (10000)^2}$

$= 10000\sqrt{2}$ m ½ 3

22. de-Broglie put forward the bold hypothesis that moving particles of matter should display wave-like properties under suitable conditions. He reasoned that nature was symmetrical and that the two basic physical entities, matter and energy, must have symmetrical character. If radiation shows a dual nature, so should matter. 1

$K = \frac{p^2}{2m}$ and $p = \frac{h}{\lambda}$ ½

$\therefore K = \frac{h^2}{2m\lambda^2}$ ½

Also $E_{photon} = \frac{hc}{\lambda}$ ½

$\therefore \frac{K}{E} = \frac{h}{2mc\lambda}$

$\therefore E_{photon} = \left(\frac{2\lambda\, mc}{h}\right)K$ ½ 3

23. $E_n = \frac{-13.6}{n^2} eV$ ½

For third excited state, n=4

$\therefore E_4 = \frac{-13.6}{16} eV = -0.85 eV$

$\therefore$ KE= 0.85eV ½

and PE = 2E = -1.7eV ½

$\Delta E = E_4 - E_1 = \left[-0.85 - (-13.6)\right] eV$

= 12.75 eV ½

and $\nu = \frac{\Delta E}{h} = \frac{12.75 x 1.6 x 10^{-19}}{6.63 x 10^{-34}} \simeq 3 x 10^{15} Hz$ 1 3

24. (i) The resultant intensity, at any point on the screen, is given by

$I = 4 I_o \cos^2 \frac{\phi}{2}$

For constructive interference:

$\varphi = 0, 2\pi, 4\pi$ and so on

For destructive interference:

$\phi = \pi,\ 3\pi,\ 5\pi$ and so on

$\Rightarrow$ I = 0 for minimum intersity,

and $I = 4I_o$ for maximum intensity 1

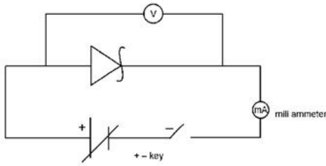
Thus, intensity varies between zero and four times the intensity, due to each slit, in Young's double slit experiment.

(ii) The interference pattern due to different colours of white light overlap incoherently. The central bright fringes for different colours are at the same position. Therefore the central fringe is white and the fringes closest, on either side of central white fringe, are red and the farthest will appear blue. After a few fringes no clear fringe pattern is seen. 1

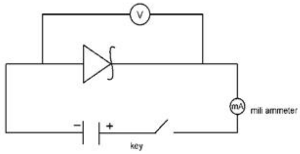
(iii) A polaroid consists of a long chain of molecules aligned in a particular direction. The electric vector (associated with the propagating light wave) along the direction of the aligned molecules get absorbed. Thus, if the light, from an ordinary source, pases through a polaroid, it is observed that its transmitted intensity gets reduced by half. 1 3

25 . (i) Zener diode ½

(ii) Circuit diagram in forward bias and reverse bias

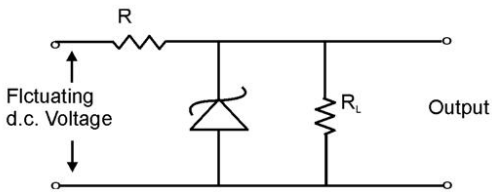


½



½

(iii)



½

If the input voltage increases, the current through R and Zener diode also increases. This increases voltage drop across R without any change of voltage across the Zener diode. 1 3

26. Greater the binding energy, less is the total mass of a bounded system, such as a nucleus. Consequently, if a nucleus, with less binding energy per nucleon, transforms to nuclei with greater binding energy per nucleon, there will be a net energy release. Reaction will be exothermic. 1

For example in case of fission, when a heavy nucleus decays into two or more intermediate mass fragments or in fusion, when light nuclei fuse into a heavier single nucleus, energy is released 2 3

27. 1

Two basic modes of transmission are (i) point-to-point and

(ii) broad cast mode. $\frac{1}{2}+\frac{1}{2}$

Point-to-point mode is used for Telephonic communication. 1 3

OR

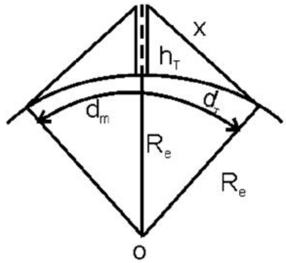
No, it is not necessary to have the same height. ½

For transmitting antenna of height h_T $(h_T + R_e)^2 = x^2 + Re^2$

$\because$ $h_r << Re$ $\therefore$ $x = d_T$

or

$(h_T + R_e)^2 = d_T^2 + R_e^2$ ½



$h_T^2 + R_e^2 + 2h_TR_e$

$= d_T^2 + R_e^2$

(h_T^2 is negligible) ½

$\Rightarrow d_T = \sqrt{2R_e\ h_T}$

d_T is also called the radio horizon of the transmiting antenna. ½

The maximum line-of-sight distance d_m between the two antennae is

$d_m = \sqrt{2R_eh_T} + \sqrt{2R_eh_R}$ 1 3

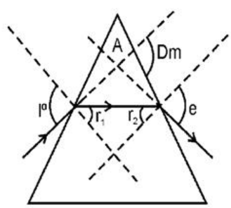
where h_R is the height of the receiving antenna.

28. In general, any given value of δ, except for i = e, corresponds to two values i and e This, in fact, is expected from the symmetry of i and e as δ = i + e -A, i.e, δ remains the same if i and e are interchanged. 1

Point P is the point of minimum deviation. This is related to the fact that the path of the ray, as shown in figure, can be traced back, resulting in the same angle of deviation. At the minimum deviation D_m, the refracted ray inside the prism becomes parallel to the base. 1

For $\delta = D_m$, $i = e \Rightarrow r_1 = r_2$ 1

or 2r = A or r = $A/2$



In the same way

$D_m = 2i - A$ or $i = \dfrac{A+D_m}{2}$ 1

$\therefore$ The refractive index of the prism is

$\mu = \dfrac{\sin(A + D_m)/2}{\sin A/2}$ 1 5

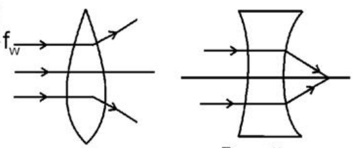
OR

Derivation of

$$\Delta f = \frac{R_1R_2}{R_2 - R_1}\left[\frac{n}{\mu - n} - \frac{1}{(\mu - 1)}\right]$$ 2

Proof of

$$f_w = \frac{\mu_w(\mu_g - l)}{\mu_g - \mu_w} f_w$$ 1



For n>μ Convex lens

For n >μ Concave lens 1

1 5

Explanation

29. Arrangment (a): because leakage of flux is minimum (almost zero.) 1

For an ideal transformer–Input power = output power

$$\Rightarrow \frac{E_S}{E_P} = \frac{I_P}{I_S}$$ 2

∴ when E_S increases, I_S decrease in the same ratio

Any two correct causes 2 5

OR

(a) Yes, $V = V_L + V_C + V_R$ for instantaneous values

It is not true for r.m.s values. For r.m.s value $V = \sqrt{(V_L \sim V_C)^2 + V_R^2}$ 2

This is due to phase relations between the different voltages.

(b) Proof of : $P_{AV} = E_{rms}\ I_{rms}\ \cos\phi$ 3 5

30. Yes, current density is a vector quantity ½

∴ $I = neAV_d$

∴ Current density ½

$$\frac{I}{A} = neV_d = ne\frac{eE}{m}\tau$$ 1

or

$$J = \frac{ne^2V}{ml}.\tau = \left(\frac{ne^2\tau}{m}\right)\frac{V}{\ell}$$ 1

(a) increases

(b) decreases

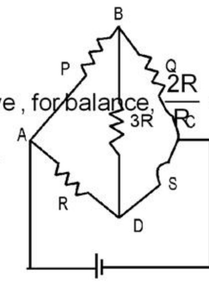
(c) decreases

(d) remains same ½ x 4 = 2 5

OR

The balance condition is–

$P/Q = R/S$ or $P/R = Q/S$ ½

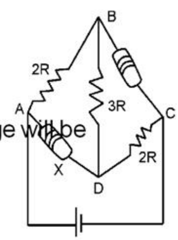


In the given Wheatstone bridge, we have , for balance, $\frac{2R}{R} = \frac{2R}{S}$ ½

$\therefore R = S =$ resistance of carbon resistor

$= 22x10^3 \Omega$

$= 22\ k\ \Omega$ 1



When the resistances are intercharged, the bridge will be a balanced one if

$$\frac{2R}{X} = \frac{22x10^3}{2x22x10^3} = \frac{1}{2}$$

$\therefore X = 4R = 88k\Omega$ ½

$\therefore$ The sequence of colours will be grey, grey and orange. 1

Also equivalent resistance,of the balanced wheatstone bridge, is given by

$$\frac{1}{R_{eq}} = \frac{1}{3R} + \frac{1}{6R} = \frac{2+1}{6R}$$

$\therefore R_{eq} = 2R$ ½

$\therefore$ Current through the (new) carbon resistor $= \frac{1}{3} x \frac{V}{2R}$

$= \frac{V}{6R}$ 1 5