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	8	08
Total		**30**	**70**

C. Scheme of Options

1. There will be no overall choice.
2. Internal choices (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 around 15 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- I

	UNIT	VSA (1Mark)	SA I (2 Marks)	SA II (3 Marks)	LA (5 Marks)	TOTAL
1.	Electrostatics	1 (1)	2 (1)	—	5 (1)	8 (3)
2.	Current Electricity	1 (1)	—	6 (2)	—	7 (3)
3.	Magnatic effect of current, and magnetism	1 (1)	2 (1)	—	5 (1)	8 (3)
4.	Electromagnetic induction and Alternating current	—	2(1)	6 (2)	—	8 (3)
5.	EM 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	2 (2)	2 (1)	—	—	4 (3)
8.	Atoms and Nuclei	1 (1)	2 (1)	3 (1)	—	6 (3)
9.	Electronic Devices	—	4 (2)	3 (1)	—	7 (3)
10.	Communication systems	—	2 (1)	3 (1)	—	5 (2)
	Total	**8 (8)**	**20 (10)**	**27 (9)**	**15 (3)**	**70 (30)**

SAMPLE PAPER – I
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 questions and carry one mark each.

(iii) Questions 9 to 18 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 three questions of five marks each. You have to attempt only one of the given choice in such questions.

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

(vi) You may use the following values of physical constants wherever necessary.

$c = 3 \times 10^8$ m/s

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

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

$\mu_o = 4\pi x 10^{-7} TmA^{-1}$

$$\frac{1}{4\pi \in_\circ} = 9x10^9 \frac{Nm^2}{C^2}$$

1. A ray of light, incident on an equilateral glass prism $\left(\mu_{glass} = \sqrt{3}\right)$ moves parallel to the base of the prism, inside it.

   What is the angle of incidence for this ray?

2. A capacitor, of capacitance C, is being charged up by connecting it across a d.c voltage source of voltage V. How do the conduction and displacement currents, in this set up compare with each other

   (a) during the charging up process?

   (b) after the capacitor gets fully charged?

3. Two electrically charged particles, having charges of different magnitude, when placed at a distance 'd' from each other, experience a force of attraction 'F'. These two particles are put in contact and again placed at the same distance from each other.

   What is the nature of new force between them?

   Is the magnitude of the force of interaction between them now more or less than F?

4. A resistance R is connected across a cell, of Emf E, and internal resistance r. A potentionter now measures the p.d, between the terminals of the cell, as V. State the expression for 'r' in terms of E, V and R.

5. Show, on a graph, the nature of variation, of the (associated) de-Broglie wavelength (λ_B), with the accelerating potential (V), for an electron initially at rest.

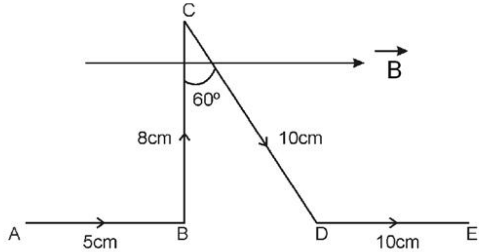
6. The mean life of a radioactive sample is T_m. What is the time in which 50% of this sample would get decayed?

7. A narrow stream, of protons and deuterons, having the same momentum values, enter a region of a uniform magnetic field directed perpendicular to their common direction of motion. What would be the ratio of the radii of the circular paths, described by the protons and deuterons?

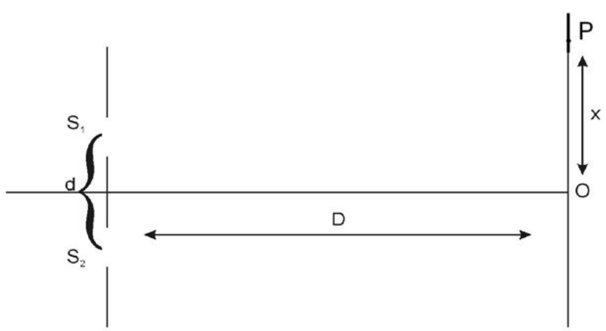
8. A proton, and an alpha particle, both initially at rest, are (suitably) accelerated so as to have the same kinetic energy. What is the ratio of their de - Broglie wavelengths?

9. Find the amount of work done in rotating an electric dipole, of dipole moment 3×10^{-8} Cm, from its position of stable equilibrium, to the position of unstable equilibrium, in a uniform electric field of intensity 10^4 N/C

10. Find the magnitude of the force on each segment of the wire shown below, if a magnetic field of 0.30 T, is applied parallel to AB and DE. Take the value of the current, flowing in the wire, as1 ampere.



11. The intensity, at the central maxima (O) in a Young's double slit set up is I_O. If the distance OP equals one third of the fringe width of the pattern, show that the intensity, at point P., would equal $I_o/4$.



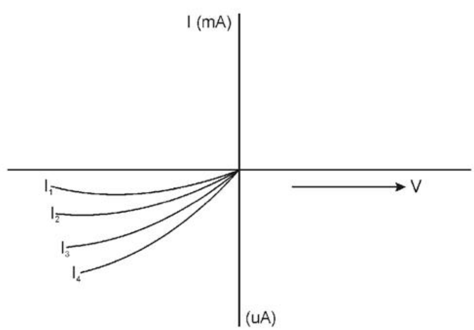
12. An electric heater is connected , turn by turn, to a d.c and a.c sources of equal voltages. Will the rate of heat production be same in the two cases? Explain.

13. Two students A and B prepare the following table about the electromagnetic waves. Rewrite this table in its corrected form.

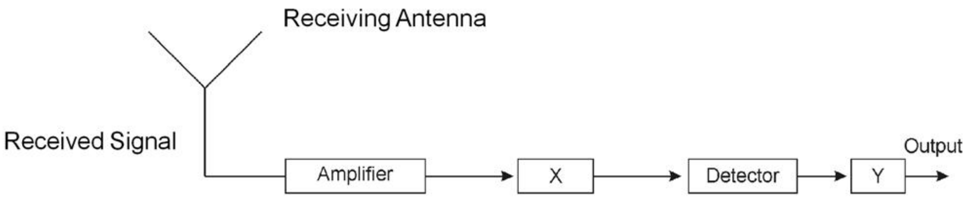
	Direction of			Peak Value of	
Student	Electric field	Magnetic field	Propagation	Electric field	Magnetic field
A	Along X-axis	Along X-axis	Along Y-axis	E	B=cE
B	Along Y-axis	Along Z-axis	Along X-axis	E=cB	B

14. Light, of wavelength 2000 A°, falls on a metal surface of work function 4.2 eV. What is the kinetic energy (in eV) of (i) the fastest and (ii) the slowest photo electrons emitted from the surface?

15. Why is a photodiode operated in reverse bias mode? Figure shows reverse bias current, under different illumination intensities I_1, I_2, I_3 and I_4, for a given photodiode. Arrange the intensities I_1, I_2, I_3 and I_4, in decreasing order of magnitude.



16. Block diagram of a receiver is as shown :-



Identify X andY.

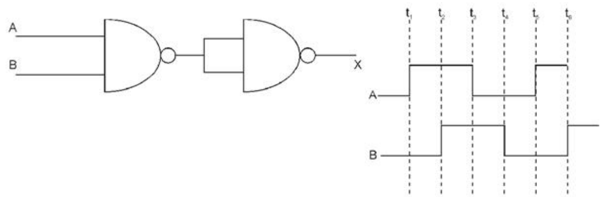
State their function.

17. Name the physical quantity whose S.I Unit is becquerel (Bq): How is this quantity related to (i) disintegration constant, (ii) half life, and (iii) mean life of the radioactive element.

OR

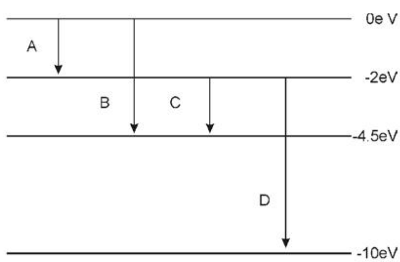
Write the equations for the two types of β-decay. Why is it very difficult to detect the neutrino?

18. Draw the output wave form at X, using the given inputs A,B for the logic circuit shown below. Also identify the (equivalent) gate.



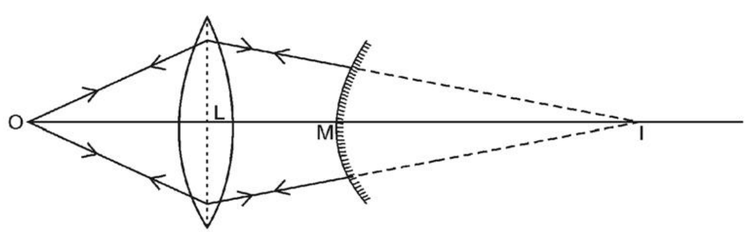
19. A resistor of resistance 400Ω, and a capacitor of reactance 200Ω, are connected in series to a 220V, 50Hz. a.c source. If the current in the circuit is 0.49 ampere find the (i) voltage across the resistor and capacitor (ii) value of inductance required so that voltage and current are in phase.

20. The energy levels of a hypothetical atom are as shown below. Which of the shown transitions will result in the emission of a photon of wavelength 275 nm?

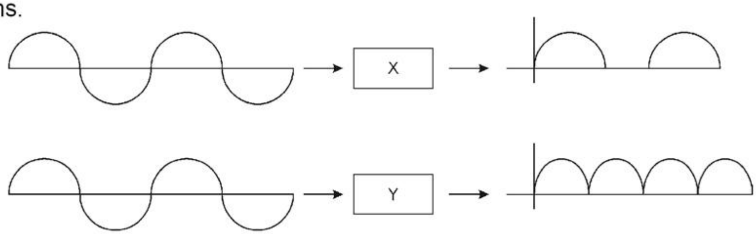


Which of these transition corresponds to emission of radiation of (i) maximum and (ii) minimum wavelength?

21. An object is placed at a distance of 15cm from a convex lens of focal length 10cm. On the other side of the lens, a convex mirror is placed such that its distance, from the lens, equals the focal length of the lens. The image formed by this combination is observed to coincide with the object itself. Find the focal length of the convex mirror.



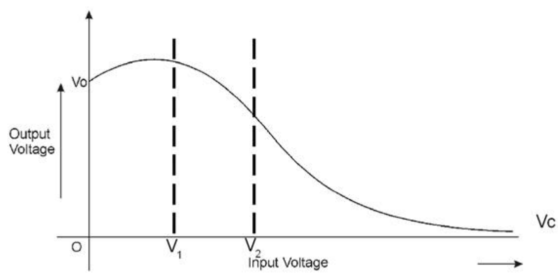
22. An a.c. signal is fed into two circuits X and Y and the corresponding output in the two cases have the waveforms shown below. Name the circuits X and Y. Also draw their detailed circuit diagrams.



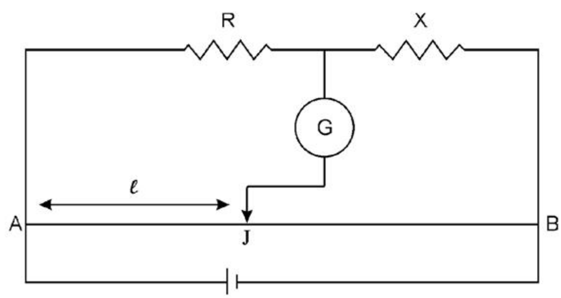
OR

The transfer characteristic of a base - biased transistor in CE configuration is as shown. Name the region corresponding to the values (i) 0 to V_1 (ii) V_1 to V_2 (iii) greater than V_2 of the input voltage applied to the transistor.

Identify the voltage range that should not be used if the transistor has to work as a switch. What is the practical use of transistor, when it is operated in this voltage range? Name the source that results in a higher energy of the output of a transistor operated in this range?

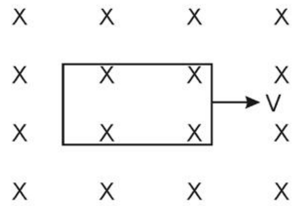


23. In the meter bridge experiment, a student observed a balance point at the point J, where AJ=l. Draw the equivalent Wheat stone Bridge circuit diagram for this set up.

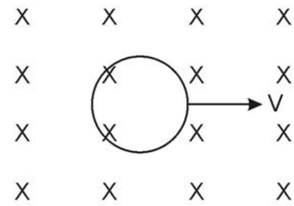


The values of R and X are both doubled and then interchanged. What would be the new position of the balance point? If, in this set up, the galvanometer and battery are interchanged at the balance point position, how will the balance point get affected ?

24. A rectangular loop and a circular loop are moving out of a magnetic field to a field free region with a constant velocity. It is given that the field is normal to the plane of both the loops.



(a)



(b)

Draw the expected shape of the graphs, showing the variation of the flux, with time, in both the cases.

What is the cause of the difference in the shape of the two graphs?

25. Two convex lenses, of equal focal length, but of aperture A_1 and A_2 ($A_2 < A_1$), are used as the objective lenses in two astronomical telescopes having identical eyepieces.

Compare the ratio of their (i) resolving power (ii) (normal) magnifying power and (iii) intensity of images formed by them. Which one of the two telescopes should be preferred? Why?

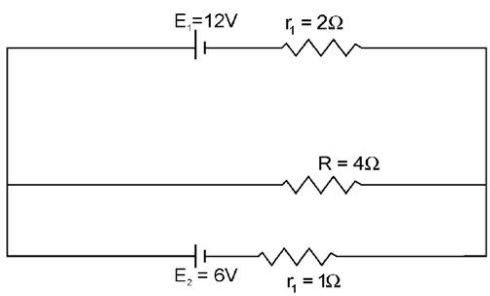
26. Give reasons for the following:-

(i) For ground wave transmission, size of antenna (ℓ) should be comparable to wave-length of signal i.e $\ell \simeq \lambda/4$

(ii) Audio Signals, converted into an emwave, are not directly transmitted as such.

(iii) The amplitude of modulating signal is kept less than the amplitude of carrier wave.

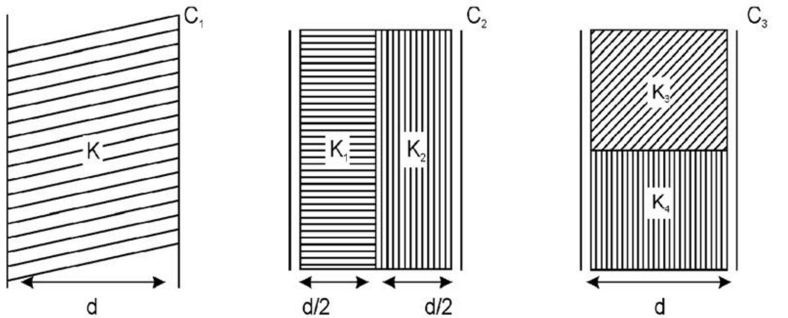
27. Find the potential difference across each cell and the rate of energy dissipation in R



28. State the principle of a machine that can build up high voltages of the order of a few million volts. Also explain the construction and working of this machine.

OR

Three identical parallel plate (air) capacitors C_1, C_2 C_3 have capacitances C each. The space between their plates is now filled with dielectrics as shown. If all the three capacitors, still have equal capacitances, obtain the relation between the dielectric constants K, K_1, K_2, K_3 and K_4.



29. (a) A plane wave front approaches a plane surface separating two media. If medium one is (optically) denser and medium two is (optically) rarer, construct the refracted wave front using Huygens's principle.

Hence prove Snell's law.

(b) Draw the shape of the refracted wave front when a plane wave front is incident on (i) prism and (ii) convex mirror. Give a brief explanation for the construction.

OR

(a) State the essential condition for the diffraction of light to take place.

A parallel beam of monochromatic light falls normally on a narrow slit and light coming out of the slit is obtained on the screen. Derive an expression for the angular width of the central bright maxima obtained on the screen.

(b) 'Diffraction defines the limit of the ray optics'. Give a brief explanation of this statement.

30. (a) How does a paramagnetic material behave in the presence of an external magnetic field? Explain with the help of an appropriate diagram.

(b) What happens when the temperature of a paramagnetic sample is lowered?

(c) To which of the two - a polar dielectric or a non-polar dielectric - does a paramagnetic material correspond? Justify your answer.

OR

(a) A magnetic dipole is placed in a uniform magnetic field with its axis tilted with respect to its position of stable equilibrium. Deduce an expression for the time period of (small amplitude) oscillation of this magnetic dipola about an axis, passing through its centre and perpendicular to its plane.

(b) If this bar magnet is replaced by a combination of two similar bar magnets, placed over each other, how will the time period vary?

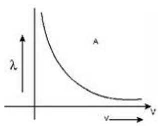
SAMPLE PAPER - I

MARKING SCHEME

(THEORY)

PHYSICS

Class XII

Q. No.	Value point / Expected Answer	Marks	Total
1.	60°	1	1
2.	(a) equal (b) equal	½ + ½	1
3.	repel, with a force of magnitude less than F	½ +½	1
4.	$r = \left(\frac{E}{V} - 1\right)R$	1	1
5.		1	1
6.	Time needed = Half life = $0.693T_m$	1	1
7.	1:1	1	1
8.	2:1	1	1
9.	$w = pE(1 - \cos\theta)$	½	
	$\theta = 180^o$	½	
	W = pE (- (-1))		
	= 2pE		
	$= 2 x 3.2 x 10^{-8} x 10^4 J$	½	
	$= 6.4 x 10^{-4} J$		
	= 0.64 mJ	½	2
10.	AB and DE are II to the magnetic field		
	$F = 0 \; (F = IB\ell \sin\theta)$	½ + ½	
	$F_{BC} = I\ell_{BC} B \sin 90^o$	½	
	= 0.024N		
	$F_{CB} = I\ell_{CD} B \sin 30^o$	½	2
	= 0.015 N		

11. $x = \frac{1}{3}\beta$ (given)

$\Rightarrow x = \frac{\lambda D}{3d}$ ½

$\Delta p = \frac{xd}{D}$

$\Rightarrow \Delta\Phi = \frac{2\pi\Delta p}{\lambda} = \frac{2\pi}{3}$ ½

$I = I_o \cos^2 \frac{\Phi}{2}$ ½

$= I_o \cos^2\left(\frac{2\pi}{3}\right) = I_o / 4$ ½ 2

12. The element of the heater is a coil having inductance L and resistance R. Hence,for a. c, its effective resistance (impedance) $\left(= \sqrt{R^2 + (\omega L)^2}\right)$ will be greater than its resistance R for d.c ½ ½

Hence rate of heat production, for the same voltage, for a.c will be less. 1 2

13. Correction for student 'A'

Electric field	Magnetic field	Peak Value of Electric Field	Peak Value of Magnetic Field
Along X-axis or Along Z-axis	Along Z-axis or Along X-axis	E	$B = \frac{E}{c}$

1

No Correction for student B 1 2

14. $E_{photon} = \Phi_o + \frac{1}{2}mV^2_{max} \rightarrow$ for fastest electron

$\frac{1}{2}mV^2_{max} = \frac{hc}{\lambda} - \Phi_o$ ½

$$= \left[\frac{6.63 x 10^{-34} x 3 x 10^{8}}{2000 x 10^{-10} x 1.6 x 10^{-19}} - 4.2 \right] eV$$ ½

= 1.99 eV ½

The K.E of the slowest emitted electron is zero ½ 2

15. Fractional change, due to the photo effects, on the minority carrier dominated reverse bias current, is more easily measurable than the fractional change in the forward bias current. 1

$I_4 > I_3 > I_2 > I_1$ 1 2

16. X = IF Stage ½

Y = Amplifier ½

IF Stage - Carrier frequency is usually changed to a (standard) lower frequency ½

Amplifier - The detected signal may not be strong enough to be made use of and is hence required to be amplified. ½ 2

17. Activity or decay rate ½

$R = \lambda N$ | where λ is the decay constant ½

$R = \left(\frac{0.693}{T_{1/2}} \right) N$ | $T_{1/2}$ is the half life ½

$R = \left(\frac{1}{T_m} \right) N$ | T_m is the mean life ½ 2

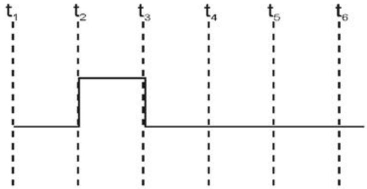
OR

β^- decay $\;{}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{o}_{-1}e + \bar{\nu}$ ½

β^+ decay $\;{}^{A}_{Z}X \rightarrow {}^{A}_{Z-1}Y + {}^{o}_{+1}e + \nu$ ½

Neutrino is an uncharged particle which interacts very weakly with matter and hence escapes undetected. 1 2

18.



1   2

AND Gate   1

19. (i) $V_R = I R$

$= 0.49 \times 400 V = 196\ V$ ½

$V_C = IX_C$

$= 0.49 \times 200 V = 98V$ ½

(ii) V and I are in phase

$$\Rightarrow \omega L = \frac{1}{\omega C}$$

$$\Rightarrow L = \frac{1}{\omega^2 C}$$ 1

$= 0.64H$ 1   3

20. $$E = \frac{hc}{\lambda}$$ ½

$$E = \left[\frac{6.63X10^{-34} X3X10^{8}}{275X10^{-9} X1.6X10^{-19}}\right] eV = 4.5eV$$ 1

Therefore transition B corresponds to

the emission of a photon of λ =275nm   ½

Transition A emits maximum wavelength   ½

Transition D emits minimum wavelength   ½   3

21. The image of the combination

coincides with the object itself

This implies that 'I' is the centre

of curvature of the convex mirror   ½

$\Rightarrow$ focal length of mirror

$$f_m = \frac{MI}{2}$$ ½

For lens $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ ½

u = -15 cm

f = +10 cm ½

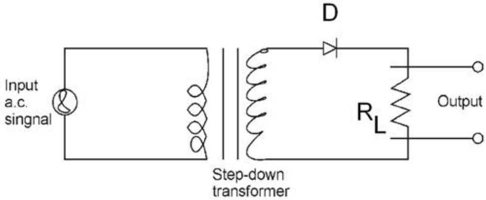
$\Rightarrow$ v = 30cm

$\Rightarrow$ MI = (30-10)cm =20cm ½

$f_m = \frac{MI}{2} = \frac{20}{2} = 10cm$ ½ 3

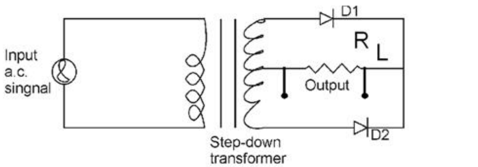
22. X - Half wave rectifier ½

Y - Full wave rectifier ½



1

Circuit diagram of
Half wave rectifier



1

Circuit diagram of
Full wave rectifier 3

OR

(i) O to V_1 Cut off region ½

(ii) V_1 to V_2 Active region ½

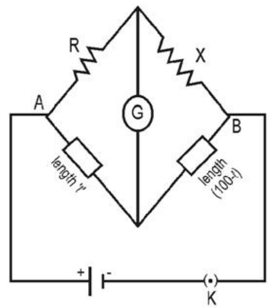
(iii) greater than V_2 Saturation region

For transistor to work as a switch, it should not remain in active region, i.e., from V_1 to V_2 ½

Transistor works as an amplifier in the active region (V_1 to V_2) ½

The energy, for the higher a.c power at
the output is supplied by the biasing battery. 1 3

23.



1

After doubling R and X, and interchanging, let the new balance point be at length ℓ^1. We then have

$$\frac{2X}{2R} = \frac{\ell^1}{\left(100 - \ell^1\right)}$$ ½

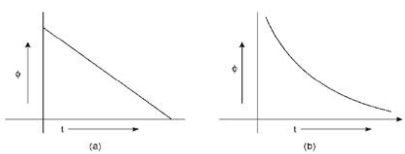
Also $\frac{R}{X} = \frac{\ell}{100 - \ell}$ ½

It fellows that

$\ell^1 = \left(100 - \ell\right)$ ½

No there will be no change in the balance point position. ½ 3

24.



1+1

In case of circular loop the rate of change of area during its passage out of the field, is not a constant 1 3

25. $R.P = \frac{a}{1.22\lambda} \Rightarrow \frac{(R.P)_1}{(R.P)_2} = \frac{A_1}{A_2}$ ½

$M.P = \frac{f_o}{f_e}$ (normal adjustment)

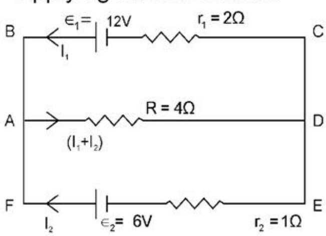
= 1:1 ½

$\frac{I_1}{I_2} = \left(\frac{A_1}{A_2}\right) > 1$ ½

The telescope with objective of aperture A_1 should ½
be prefered for viewing as this would ½
(i) give a better resolution. ½
(ii) have a higher light gathering power of telescope. ½ 3

26. (i) When the size of the antenna is comparable to wave length of the signal the time variation of the signal is properly sensed by the antenna 1
(ii) An e.m. wave, of audio signal frequency, would have a very high wavelength. It would, therefore, need an antenna, whose size would be practically unattainable. 1
(iii) The amplitude of modulating signal is kept less than the amplitude of carrier wave to avoid distortion. 1 3

27. Applying Kirchoff's Laws



For closed loop ABCDA

$12 = 4(I_1+I_2) + 2I_1$

$= 6I_1 + 4I_2$ (i) ½

For closed loop ADEFA

$6 = 4(I_1+I_2) + I_2$

$= 4I_1 + 5I_2$ (ii) ½

Solving (i) & (ii)

$I_1 = \frac{18}{7}$ A and $I_2 = \frac{-6}{7}$ A

p.d across R = V= (I_1+I_2) R

$= \left(\frac{18-6}{7}\right) x 4 \text{ volt} = \frac{48}{7} \text{volt}$ ½ p.d across each cell = p.d across R ½

Energy dissipated in R = 4Ω

$$= (I_1 + I_2)^2 R = \left(\frac{12}{7}\right)^2 \text{x}4\text{J}$$

$$= \frac{576\text{J}}{49} = 11.75\ \text{J}$$ 1

28. The machine is the Van de - Graff generator ½

Principle of Vande graff generator 1½

construction 1

working 2

OR

New Capacitance of $C_1 = \frac{k\varepsilon_o A}{d}$ ½

New Capacitance of C_2

= Series Combination of two Capacitors ½

$$= \frac{\varepsilon_o A}{d}\left(\frac{2k_1k_2}{k_1+k_2}\right)$$ 1½

New Capacitance of C_3

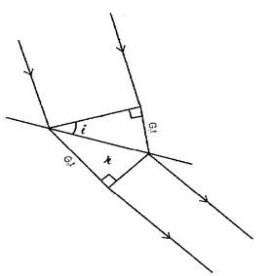
= Parallel Combination of two Capacitors ½

$$\frac{\varepsilon_o A}{d}\left(\frac{k_3+k_4}{2}\right)$$ 1½

$$\therefore K = \frac{2k_1k_2}{k_1+k_2}$$

$$= \frac{k_3+k_4}{2}$$ ½ 5

29. (a) Construction of refracted wave front



1

$\sin r = \frac{c_1 t}{\text{base}}$ ½

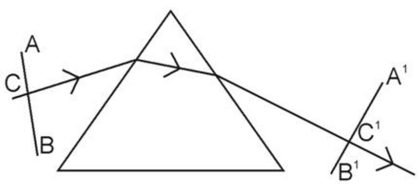
$\sin i = \frac{c_2 t}{\text{base}}$ ½

$\frac{\sin i}{\sin r} = \frac{c_1}{c_2}$ ½

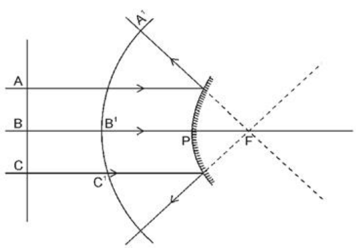
or

${}_r^d\mu = \frac{c_1}{c_2}$ ½

(b)



½



½

Explanation - time taken by any disturbance to travel from incident wave front to the refracted wave front is same 1

5

OR

Essential Condition for diffraction - size of aperture / obstacle comparable to the wave length of light 1

Derivation of angular width of central maxima = $\left(\frac{\lambda}{a}\right)$ 2

Explanation of the limit

$\lambda \rightarrow o$ for ray optics to be valid 2 5

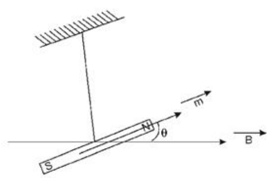
30. (a) Explanation of parallel alingment
of atomic dipoles. Net dipole moment
non - zero 2½

(b) As the temprature is lowered,
the magnetisation increases until
it reaches the saturation value at
which point all the dipoles are
perfectly alinged with the field 1

(c) Paramagnetic material correspond to a
polar dielectric. ½
This is because the atoms/molecules of such
a material have non-zero magnetic moment.
A similar statement holds for a polar dielectric
where the atoms/molecules of the material,
have a non-zero dipole moment. 1 5

OR

(a)



$\sin\theta \simeq \theta$

$\therefore \tau = m B \sin\theta \simeq m\ B\ \sin\theta$

This torque is in the nature of a restoring torque ½

Hence equation of motion, for the oscillatory
motion, of the magnet is

$$I\frac{d^2\theta}{dt^2} \simeq -mB\theta$$ ½

This is the equaion of a S.H.M

$$\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$$

where $\omega^2 = \frac{mB}{I}$ ½

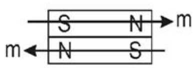
Hence the time period of oscillaiton of the magnet,

is given by

$$T = \frac{2\pi}{\omega}$$

$$= 2\pi\sqrt{\frac{I}{mB}}$$ 1

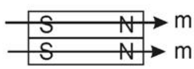
(b)



m_{net}=o, I_{net}= 2I ½

½

$\Rightarrow T \rightarrow \infty$



m_{net}= 2m, ½

I_{net}= 2I

$\Rightarrow$ T will remain same ½ 5