CUET Physics Solved Paper-2022

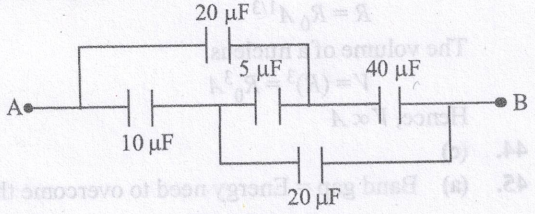
Held on 06 August 2022

1. Electric field at the surface, of a conducting shell of radius 'r' is measured as X.
Electric field at a distance 3r from the centre of the shell is

(a) $\frac{X}{3}$ (b) $\frac{X}{6}$

(c) $\frac{X}{9}$ (d) X

2. The equivalent capacitance between the points A and B in the network given below is



(a) 20 μF (b) 20/3 μF

(c) 40/3 μF (d) 10 μF

3. A charge + 10 μC is placed at (0 mm, 0 mm) Another charge – 5 μC is moved from (3 mm, 0 mm) to (0 mm, 3 mm). Work done by the external agency is

(a) 0 J (b) –150 J

(c) +150 J (d) –300 J

4. In a meter bridge, null point is found at a distance of 20 cm from the end A, then the resistance of 10 Ω is replaced by another resistance of 20 Ω the null

(a) 20 cm (b) 30 cm

(c) 15 cm (d) 40 cm

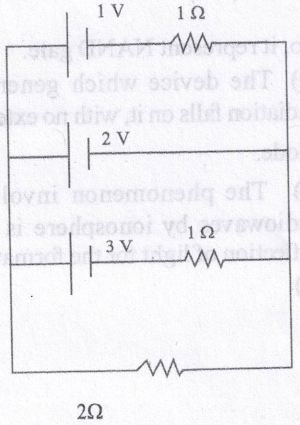
5. Changing current though IV, cell and through 2 Ω resistor respectively is

(a) 2A, 1A

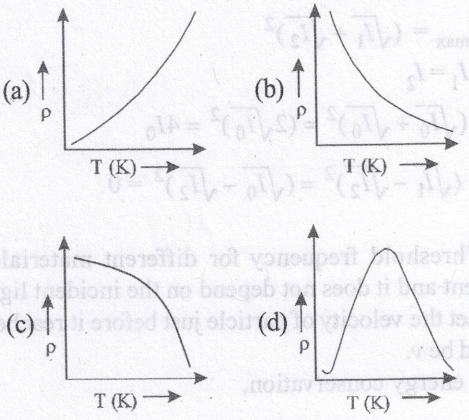
(b) 1A, 2A

(c) 2A, 2A

(d) 1A, 1A



6. Correct temperature dependence of Resistivity of copper (ρ) is shown by



7. The mobility of charge carriers increases with

(a) Increase in average collision time interval

(b) Increase in the electric field

(c) Increase in the mass of the charge carriers

(d) Decrease in the charge of the mobile carriers

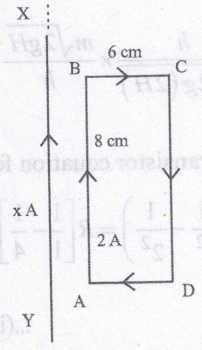
8. Consider an infinitely long conductor *XY* carrying current (*x*) A. A rectangular loop carrying current 2 A is placed parallel to it in the same plane. The two conductors are found to exert a force of 1.8×10^{-5} N/M. Find the value of *x*.

(a) 0.6 A

(b) 3×10^2 A

(c) 3 A

(d) 3×10^{-2} A



9. The first particle accelerator of India (37" cyclotron) was established in the year 1953. Whose vision was behind this project?

(a) Dr. C.V. Raman

(b) Dr. Meghnad Saha

(c) Dr. Jagdish Chandra Bose

(d) Dr. Homi Jahangir Bhabha

10. Match **List-I** with **List-II**

	List - I		List - II
A	Ammeter is made	I.	By connecting a high resistance in series with moving coil Galvanometer
B.	Voltmeter is made	II.	Increases the strength of magnetic field
C.	Soft ion core in moving coil galvanometer	III.	Increases torque produced in coil
D.	Radial field in moving coil galvanometer	IV.	By connecting a low resistance in parallel with moving coil Galvanometer

Choose the correct answer from the options givenbelow:
(a) A-IV, B-III, C-I, D-II
(b) A-II, B-III, C-IV, D-I
(c) A-I, B-II, C-III, D-IV
(d) A-IV, B-I, C-II, D-III

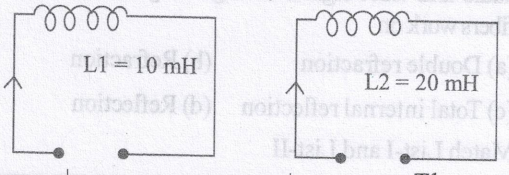
11. Gauss law in magnetism signifies that
(a) Magnetic lines of force can pass through a closed surface
(b) Net flux through closed surface is zero, monopole does not exist
(c) Net flux is always μ_0 times the net charge enclosed
(d) There always exist a monopole

12. A. At the magnetic pole of earth; angle of dip is 90° and $B_H = 0$.
B. At the magnetic pole of earth; angle of dip is zero and $B_v = 0$.
C. At the magnetic equator of the earth; angle of dip is 90° and $B_H = 0$.
D. At the magnetic equator of the earth; angle of dip is zero and $B_v = 0$.
Choose the correct answer from the options given below:
(a) A and B only (b) B and D only
(c) C and D only (d) A and D only

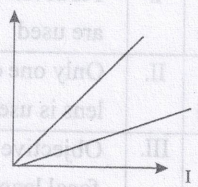
13. Faraday's law in integral form is μ_0
(The symbols have their usual meaning)
(a) $\text{E.ds} = \frac{Q}{\varepsilon_0}$ (b) $\int \text{E.d}l = \frac{-d\phi}{dt}$
(c) $\int \text{B.ds} = 0$ (d) $\int \text{B.d}l = \mu_0\left(i_c + \varepsilon_0 \frac{d\phi}{dt}\right)$

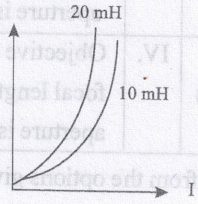
14. Four different pairs of physical quantities are given below. Pair having same dimensions will be?
(a) Magnetic flux and magnetic moment
(b) Magnetisation and magnetic intensity
(c) Magnetic field and magnetic permeability
(d) Magnetisation and Magnetic field

15. Consider two inductor circuits. Assume that the current is increasing with time equally in both the circuits.



The correct graph for energy stored in inductor with current is

(a)


(b)


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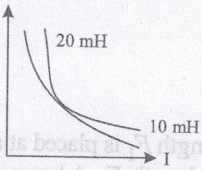

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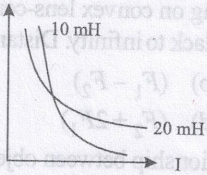


16. When a 100 V dc is applied across a solenoid, a current of 1 A flows in it. When a 100 V, 50 Hz ac is applied across the same solenoid, the current drops to 0.5 A. The inductance of the solenoid is
(a) 0.55 H (b) 0.86 H (c) 1 H (d) 0.93 H

17. A current of 5 A is flowing at 220 V in the primary coil of a transformer. If the voltage produced in the secondary coil is 2200 V and 50% of power is lost, then the current in the secondary coil will be
(a) 0.25 A (b) 0.5 A (c) 2.5 A (d) 5 A

18. Electric field in plane electromagnetic wave is given by-
$Ey = 5 \times 10^{-7} \sin(0.25 \times 10^3 x + 2.5 \times 10^{11} t)$
The magnetic field associated with it is
(a) $B_x = 0.5 \times 10^{-7} \sin(0.25 \times 10^3 x + 2.5 \times 10^{11} t)$
(b) $B_x = 1.66 \times 10^{-15} \sin(0.25 \times 10^3 x + 2.5 \times 10^{11} t)$
(c) $B_x = 9 \times 10^{-7} \sin(0.25 \times 10^3 x + 2.5 \times 10^{11} t)$
(d) $B_x = 3.6 \times 10^{-15} \cos(0.25 \times 10^3 x + 2.5 \times 10^{11} t)$

19. Nowadays optical fibers are extensively used for transmitting audio and video signals through long distances. The optical fibers work on

(a) Double refraction (b) Refraction

(c) Total internal reflection (d) Reflection

20. Match List-I and List-II

	List - I		List - I
A	Simple microscope	I.	Parabolic mirrors are used
B.	Compound microscope	II.	Only one convex lens is used
C.	Telescope (reflecting)	III.	Objective of large focal length and aperture is used
D.	Telescope (refracting)	IV.	Objective of small focal length and aperture is used

Choose the correct answer from the options given below:

(a) A-III, B-II, C-I, D-IV

(b) A-II, B-III, C-IV, D-I

(c) A-I, B-III, C-II, D-IV

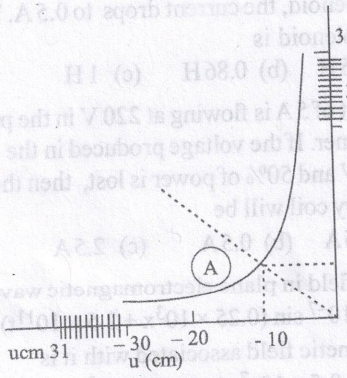
(d) A-II, B-IV, C-I, D-III

21. A convex mirror of focal length F_1 is placed at a distance d from a convex lens of focal length F_2. A beam of light rays coming from infinity falling on convex lens-convex mirror combination and returns black to infinity. Distance d is

(a) $(F_1 + F_2)$ (b) $(F_1 - F_2)$

(c) $(F_2 - 2F_1)$ (d) $(F_2 + 2F_1)$

22. The graph shows the relationship between object distance (u) and image distance (v) for an equiconvex lens. The focal length of the lens is



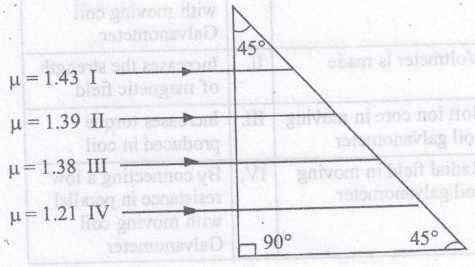
(a) 0.5 cm (b) 0.05 cm

(c) 5.00 cm (d) 5.5 cm

23. A short pulse of white light is incident from air to a glass slab at normal incidence, after travelling through the slab, the first colour to emerge is

(a) Blue (b) Green (c) Violet (d) Red

24.



There are four light rays incident on a right angled prism. The refractive index of prism material for the rays are 1.43,1.39, 1.38, 1.21 respectively. The ray that suffers total internal reflection is

(a) I (b) II (c) III (d) IV

25. A hollow double concave lens is made of very thin transparent material. It can be filled with air or either of the two liquids L_1 or L_2 having refractive indices n_1 and n_2 respectively ($n_2 > n_1 > 1$). The lens will diverge a parallel beam of light if it is filled with

(a) Air inside and placed in air

(b) Air inside and immersed in L_1

(c) L_1 inside and immersed in L_2

(d) L_2 inside and immersed in L_1

26. A star is seen using a telescope whose objective lens has a diameter of 250 cm. The wavelength of light coming form the star is 500 nm. The limit of resolution of telescope is

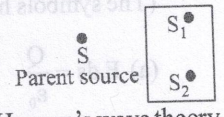
(a) 1.2×10^{-7} radians (b) 2.4×10^{-7} radians

(c) 1.5×10^{-7} radians (d) 3.9×10^{-7} radians

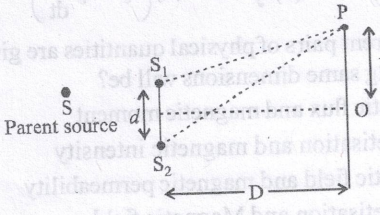
Passage: (Q. No. 27-31)

Read the information given below to answer

In Young's double slit experiment as hown in figure, interference of light waves were observed on the screen. Thomas Young made two pinholes S_1 and S_2 (very close to each other) on an opaque screen in front of parent source S



S_1 and S_2 behaved as coherent sources, and produced interference patten on the screen which has alternate bright fringe and dark fringes. This experiment proved Huygen's wave theory of Light.



27. In YDSE experiment position of bright fringes and dark fringes is given by

(a) $x_n = n\frac{\lambda D}{d}$ $n = 0, \pm1, \pm2$ __

$x_n = \left(n + \frac{1}{2}\right)\frac{\lambda D}{d}$ $n = 0, \pm1, \pm2$ __

(b) $x_n = n\frac{\lambda d}{D}$ $n = \pm1, \pm2$ __

$x_n = \left(n - \frac{1}{2}\right)\frac{\lambda D}{d}$ $n = \pm1, \pm2$ __

(c) $x_n = n\lambda$ $n = 0, \pm1, \pm2$ __

$x_n = \left(n + \frac{1}{2}\right)\lambda$ $n = 0, \pm1, \pm2$ __

(d) $x_n = n\frac{\lambda}{d}$ $n = \pm1, \pm2$ __

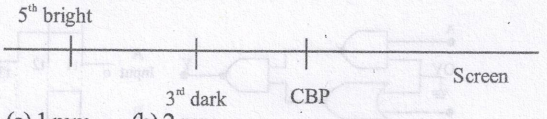
$x_n = \left(n + \frac{1}{2}\right)\frac{\lambda}{d}$ $n = \pm1, \pm2$ __

28. Path difference between the, waves meeting at point P is given by

(a) $\frac{xD}{d}$ (b) $\frac{xd}{D}$

(c) $\frac{2xD}{d}$ (d) $\frac{1xd}{2D}$

29. In YDSE 20th bright fringe is obtained 20 mm distance from central bright point. The distance between the 5th bright fringe and 3rd dark fringe is



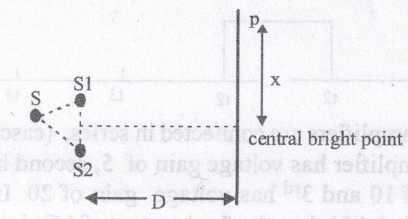
(a) 1 mm (b) 2 mm
(c) 2.5 mm (d) 8 mm

30. In YDSE the distance between two consecutive bright fringes is given by 3 mm. What would be the fringe width if YDSE is performed in a medium of refractive index 1.2?

(a) 3 mm (b) 1.5 mm
(c) 2.5 mm (d) 0.5 mm

31. In YDSE as shown, the path difference $SS_1 - SS_2 = \frac{\lambda}{3}$.

This causes the shift in position of central bright point. The new position of central bright point is



(a) $-\frac{\lambda D}{d}$ (b) $-2\frac{\lambda D}{d}$

(c) $-3\frac{\lambda D}{d}$ (d) $-\frac{1}{3}\frac{\lambda D}{d}$

32. If λ_e, λ_p and λ_α, be the de-Broglie wavelength of electron, proton and A-particle, respectively, then

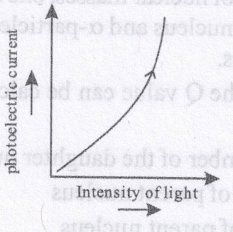
(a) $\lambda_p < \lambda_\alpha < \lambda_e$
(b) $\lambda_e < \lambda_\alpha < \lambda_p$
(c) $\lambda_e < \lambda_p < \lambda_\alpha$
(d) $\lambda_\alpha < \lambda_p < \lambda_e$

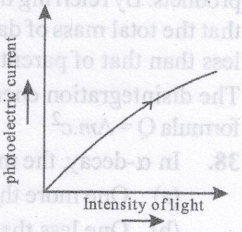
33. An electron is accelerated to potential V. If mass of electron is $m = 9.1 \times 10^{-31}$ kg its charge is $e = 1.6 \times 10^{-19}$ C, then de-Broglie wavelength of electron is

(a) $\lambda = \frac{125}{\sqrt{V}}$ nm (b) $\lambda = \frac{1.227}{\sqrt{V}}$ nm

(c) $\lambda = \frac{eh}{\sqrt{2mV}}$ nm (d) $\lambda = \frac{3.6}{\sqrt{V}}$ nm

34. Keeping the frequency of the incident radiation and the accelerating potential fixed, the intensity of light is varied and the resulting photoelectric current is measured each time by the graph

(a)


(b)


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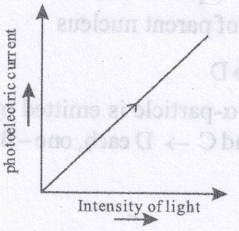

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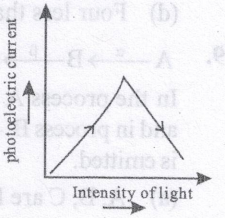


35. The study of hydrogen atom spectrum has mainly five series. Choose the correct sequence of these series in increasing order of their shortest wavelength.

A. Lyman Series
B. Pfund Series
C. Paschen Series
D. Bracket Series
E. Balmer Series

Choose the correct answer from the options given below:

(a) B, A, D, C, E (b) B, C, D, E, A
(c) A, E, C, D, B (d) A, C, E, B, D

36. The Bohr model for the spectra of a H-atom
A. Will not be applicable: to hydrogen in the molecular form
B. Will not be applicable as it is for a He-atom
C. Is valid only at room temperature
D. Predicts continuous as well as discrete spectral lines
Choose the correct answer from the options given below:
(a) A, B only (b) A, B, C only
(c) A, B, D only (d) B, C, D only

37. Two nuclei have mass number in the ratio 1:27, then the ratio of their radii and densities should be respectively
(a) 1 : 1 and 1 : 3 (b) 1 : 9 and 1 : 1
(c) 1 : 3 and 1 : 1 (d) 1 : 1 and 1 : 9

Passage: (Q. No. 38-41)

Read the information given below to answer

In α-decay, the mass number of daughter nucleus is four less than that of decaying nucleus (parent nucleus). While atomic number decreases by two. In general, α-decay of parent nucleus $+2^{He}$

${}^{A}_{Z}X$ results in daughter nucleus ${}^{A-4}_{Z-2}Y$

${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + 2^{He^4}$

From Einstein's mass energy equivalence relation and energy conservation, it is clear that this spontaneous decay is possible only when mass of decay products is less than the mass of the products. By referring the table of nuclear masses, one can check that the total mass of daughter nucleus and α-particle is indeed less than that of parent nucleus.

The disintegration energy or the Q value can be calculated by formula $Q = \Delta m.c^2$

38. In α-decay, the mass number of the daughter nucleus is
(a) One more than that of parent nucleus
(b) One less than that of parent nucleus
(c) Two more than that of parent nucleus
(d) Four less than that of parent nucleus

39. $A \xrightarrow{\alpha} B \xrightarrow{\beta} C \xrightarrow{\beta} D$

In the process A → B, α-particle is emitted by nucleus and in process B → C and C → D each, one – ß – particle is emitted.
(a) A, B, C are Isobars
(b) B, C, D are Isobars
(c) A, B, C are Isobars
(d) A, B, C, D all are Isotopes

40. α-particle is :
(a) Nucleus of Hydrogen atom
(b) Hydrogen atom
(c) Nucleus of Helium atom
(d) Helium atom

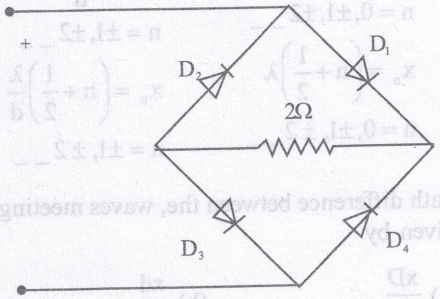
41. During the α-decay process, the mass of all decay product is
(a) Equal to the mass of initial nucleus
(b) Less than the mass of initial nucleus
(c) Equal to the mass of α-particle
(d) Greater than the mass of initial nucleus

42. An α-decay process is given by

${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$

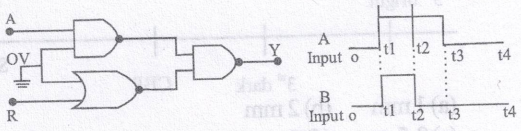
If mass of nuclei X, Y and He are m_x, m_y and m_{He} respectively, then Q-value is given by
(a) $(m_x - m_y - m_{He})c^2$ (b) $(m_y + m_{He} - m_x)c^2$
(c) $(m_x + m_y - m_{He})c^2$ (d) $(m_x - m_y + m_{He})c^2$

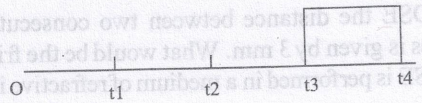
43. In the circuit diagram D_1, D_2, D_3 and D_4 are diodes. Choose the correct answer from the options given below



(a) D_1 and D_2 are forward biased
(b) D_1 and D_3 are forward biased
(c) D_2 and D_4 are forward biased
(d) All diodes are forward biased

44. Sketch the output λ for the circuit shown below for two inputs.



(a)


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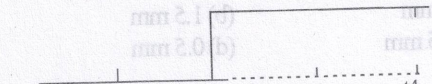

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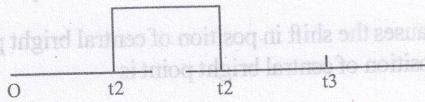

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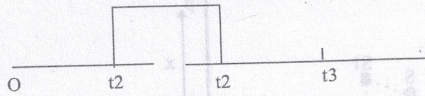


45. Three amplifiers are connected in series, (cascaded). The first amplifier has voltage gain of 5, second has voltage gain of 10 and 3rd has voltage gain of 20. If the Input signal is 0.1 V, then the final output of AC signal will be
(a) 5 V (b) 25 V (c) 100 V (d) 50 V

46. Ratio of free electron density to hole density of a p-type semiconductor is
(a) Equal to one
(b) Less than one
(c) Greater than one
(d) Can be less than or greater than one depending upon semiconductor material.

47. Which of the following statement is correct?
A. In conductors., the valence and conduction bonds overlap
B. Substances with energy gap of the order of 2 eV are insulators
C. The resistivity of a semiconductor increases with increase in temperature
D. The depletion layer in the *pn*-junction region is caused by draft of electrons
Choose the correct answer from the options below
(a) A only (b) B only
(c) C only (d) A, B, D only

48. The I-V characteristics of an operating photodiode are drawn in
(a) First quadrant (b) Second quadrant
(c) Third quadrant (d) Fourth quadrant

49. Frequencies in the UHF range normally propagate by means of
(a) Ground waves (b) Sky waves
(c) Surface waves (d) Space waves

50. Power radiated by an antenna is directly proportional to (l – length of antenna, λ – wavelength of electromagnetic wave)
(a) $\left(\frac{l}{\lambda}\right)^2$ (b) $\frac{l}{\lambda}$ (c) $\left(\frac{\lambda}{l}\right)^2$ (d) $\frac{\lambda}{l}$

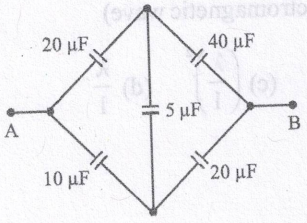
Hints & Explanations

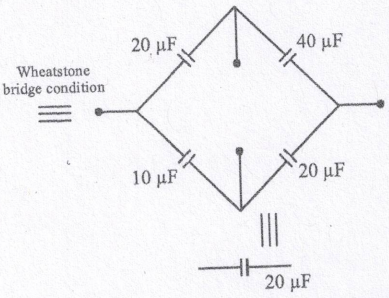
1. **(c)** $E_{surface} = X = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

$E_{3r} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(3r)^2}$; So, $\frac{X}{E_{3r}} = 9$

$\Rightarrow E_{3r} = \frac{X}{9}$

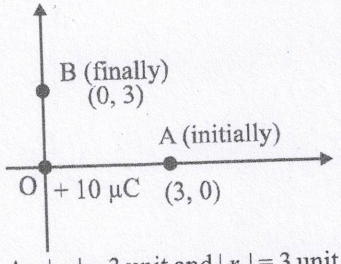
2. **(a)** We can redraw the circuit as





3. **(a)** Work done = Charge × Potential difference

$$= -5\mu C \times \frac{1}{4\pi\varepsilon_0} \times 10\mu C\left(\frac{1}{|r_f|} - \frac{1}{|r_i|}\right)$$



As, $|r_f| = 3$ unit and $|r_i| = 3$ unit

So, work done = 0.

4. **(d)** As null point length,

$l \propto$ resistance

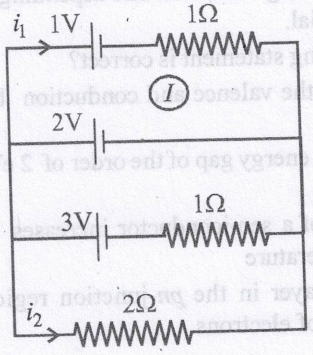
$\therefore$ when 10 Ω is replaced by its double 20 Ω.

Then, null point becomes double i.e., 40 cm.

5. **(d)** In loop (*I*), by KVL

$2 = 1 + i_1 \times 1$

$\Rightarrow i_1 = 1$ A

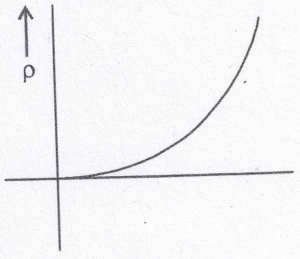


And,

Voltage across, 2 Ω = 2 volt

So, current through (i_2) 2 Ω $= \frac{2}{2} = 1$ A

6. **(a)** In conductors, resistivity increases exponentially with increase in temperature only in option (a), this is happening. So, (a) is correct answer.



At absolute zero, ' ρ ' is zero (superconductivity)

7. **(a)** Mobility of charge carrier is given as

$\mu = \frac{V_d}{E} = \frac{eJ}{m}$

So, $\mu \propto J$

$\mu \propto \frac{1}{m}$

Thus, (a) is correct and (b), (c) and (d) is incorrect.

8. **(None)** As we can see there is no information regarding distance between were *XY* and *AB*, which is essential for calculating force.

So, data is insufficient.

9. **(b)** Dr. Meghnand Saha's vision was behind the project of cyclotron in India.

10. **(d)** Ammeter is made by connecting a low valued resistance parallel to galvanometer.

So, A → IV.

Voltmeter is made by connecting a high valued resistance in series with galvanometer.

So, B → I.

On introduction of soft iron core to galvanometer, magnetic field strength of magnet is increased.

So, C → I.

Radial field in moving coil galvanometer makes magnetic field parallel to plane of coil and due to such magnetic field 'J' is maximum.

So, D → III.

11. **(b)** According to Gauss law in magnetism,

$$\oint_S \vec{B}.\vec{ds} = 0.$$

So, net flux through closed surface is zero and monopoles does not exist.

12. **(d)** At equator, the magnetic field lines becomes parallel to surface to earth.

So, angle of dip = 0

and, $B_H = B_{net}$, $B_V = 0$

At pole, the magnetic field lines become perpendicular to surface of earth.

So, angle of dip = 90°

and, $B_H = 0$, $B_V = B_{net}$

13. **(b)** By Faraday's law of EMI,

$$\text{Induced EMF, } \varepsilon = -\frac{d\phi}{dt} \Rightarrow \oint \vec{E}.\vec{d\ell} = -\frac{d\phi}{dt}$$

14. **(b)** We define, $H = \frac{B}{\mu_0}$ as magnetic intensity and its unit is A/m.

And, magnetic moment

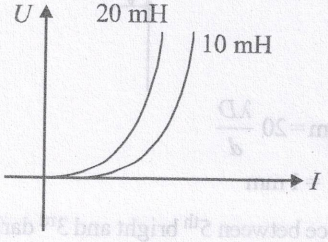
$$= \frac{\text{magnetic dipole moment}}{\text{volume}}$$

and its unit is also A/m.

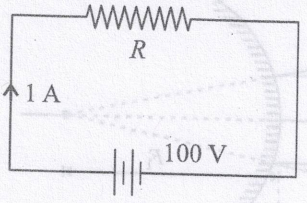
15. **(b)** As $U = \frac{1}{2}Li^2$

$$\Rightarrow U \propto i^2$$

So, graph will be parabola symmetric about U axis.



16. **(a)** When 100 V dc is applied, inductor will be replaced by a wire. So, circuit will look like this



$$\text{Here, } R = \frac{100}{1} = 100\,\Omega$$

When 100 V, 50 Hz ac is applied, we will have

$$R_{net} = \sqrt{X_L^2 + R^2}$$

$$\text{So, } 0.5 = \frac{100}{\sqrt{X_L^2 + 100^2}} \Rightarrow \sqrt{X_L^2 + 100^2} = 200$$

$$\Rightarrow X_L^2 = 200^2 - 100^2 \Rightarrow X_L^2 = 100 \times 300$$

$$\Rightarrow (2\pi \times 50)^2 \times L^2 = 30000$$

$$\Rightarrow L = 0.55\text{H}$$

17. **(a)** We have, efficiency $= \frac{1}{2}$

$$\Rightarrow \frac{P_0}{P_i} = \frac{1}{2} \Rightarrow \frac{V_0 I_0}{V_i I_i} = \frac{1}{2} \Rightarrow \frac{2200}{220} \times \frac{I_0}{5} = \frac{1}{2}$$

$$\Rightarrow I_0 = \frac{1}{4}\text{ A} = 0.25\text{ A}$$

18. **(b)** We have,

$$B_0 = \frac{E_0}{C} = \frac{5 \times 10^{-7}}{3 \times 10^8} = 1.67 \times 10^{-15}\text{ T}$$

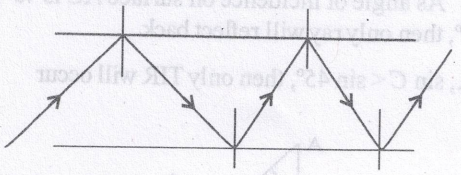
E and B should be perpendicular to each other and also perpendicular to direction of propagation.

i.e., $\hat{C} \times \hat{E} = \hat{B}$

$$\Rightarrow \hat{B} = -\hat{i} \times \hat{j} \Rightarrow \hat{B} = -\hat{k}$$

So, $\vec{B} = 1.67 \times 10^{-15} \sin(0.25 \times 10^3 x + 2.5 \times 10^{11} t)(-\hat{k})$

19. **(c)** Optical fibers use the principle of total internal reflection for transmitting audio and video signals through long distances.

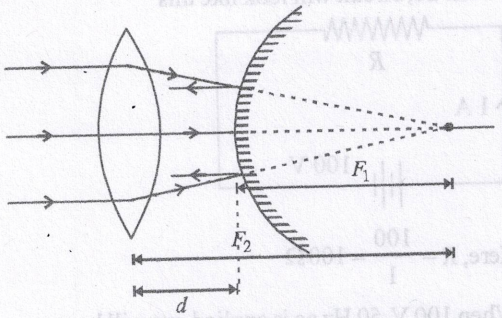


20. **(d)** The correct matching will be

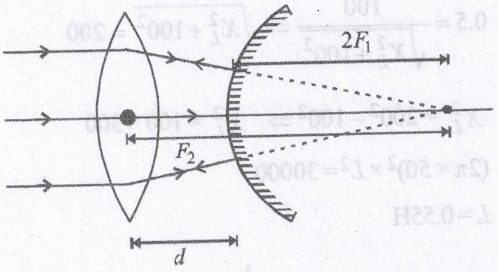
A – (II), B – (IV), C – (I), D – (III)

So, correct option is (d).

21. (c) **Case I:**



Case II: Here, we will have $d = F_2 - F_1$. But as there is no such option like this, we will see another case.



Here, $d = F_2 - 2F_1$ for ray to return back to infinty.

22. (c) By lens formula,

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

From graph, when $u = -10$ cm, $v = +10$ cm

So, $\frac{1}{10} - \frac{1}{-10} = \frac{1}{f}$

$\Rightarrow \frac{2}{10} = \frac{1}{f} \Rightarrow f = 5$ cm

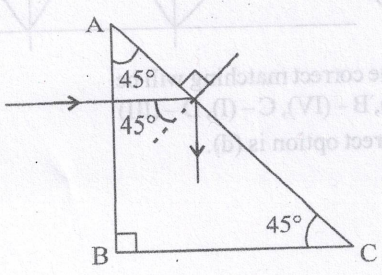
23. (d) We know that,

$V = f\lambda \Rightarrow V \propto \lambda \quad [\because f = \text{const.}]$

Thus, the first colour to emerge will be red, as largest wavelength will have fastest speed.

24. (a) As angle of incidence on surface AC is 45°, so if $C <$ 45°, then only ray will reflect back.

i.e., $\sin C < \sin 45°$, then only TIR will occur



i.e., if $\sin C < \frac{1}{\sqrt{2}}$

i.e., if $\frac{1}{\mu} < \frac{1}{\sqrt{2}} \Rightarrow \mu > \sqrt{2} \Rightarrow \mu > 1.414$

Now, only ray (I) have refractive index greater 1.414. So, only ray I will undergo *TIR*.

25. (d) By lensmaker formula,

$$\frac{1}{f} = ({}^{g}\mu_m - 1)\left(\frac{2}{R}\right) = \left(\frac{\mu_g}{\mu_m} - 1\right)\left(\frac{2}{R}\right)$$

Clearly, if $\mu_m < \mu_g$, then $\frac{1}{f}$ will be negative.

i.e., then power will be negative.

i.e., ray of light will diverge.

So, L_2 should be inside and L_1 should be outside (because $\mu_{L_2} > \mu_{L_1}$) to diverge the parallel ray.

26. (b) For telescope, limit of resolution is given by

$$d\theta = \frac{1.22\lambda}{D} \quad d\theta = \frac{1.22 \times 500 \times 10^{-9}}{2.5} = 2.4 \times 10^{-7} \text{ radian}$$

27. (a) Linear position for n^{th} bright fringe is given by

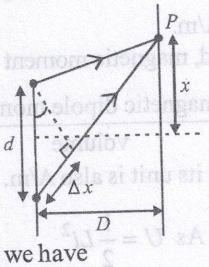
$$x_n = \frac{n\lambda D}{d},\ n = 0, \pm 1, \pm 2, \ldots$$

Linear position for n^{th} dark fringe is given by

$$x_n = \frac{\left(n + \frac{1}{2}\right)\lambda D}{d},\ n = 0, \pm 1, \pm 2, \ldots.$$

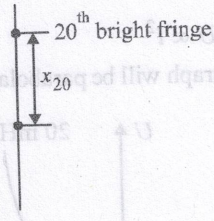
28. (b) We know that

$$x = \frac{\Delta x D}{d} \Rightarrow \Delta x = \frac{xd}{D}$$



29. (c) For 20th bright fringe, we have

$$x_{20} = 20\frac{\lambda D}{d}$$



$\Rightarrow 20\text{ mm} = 20\frac{\lambda D}{d}$

$\Rightarrow \frac{\lambda D}{d} = 1\text{ mm}$

So, distance between 5th bright and 3rd dark fringe is given as

$$\Delta x = 5\frac{\lambda D}{d} - \left(2 + \frac{1}{2}\right)\frac{\lambda D}{d} \left[\begin{array}{l}\text{for } 5^{\text{th}} \text{ bright fringe, } n = 5 \\ \text{for } 3^{\text{rd}} \text{ dark fringe, } n = 2\end{array}\right]$$

$$= \frac{\lambda D}{d}\left(5 - 2 - \frac{1}{2}\right) = \frac{\lambda D}{d} \times \frac{5}{2} = \frac{5}{2} \times 1\text{ mm} = 2.5\text{ mm}$$

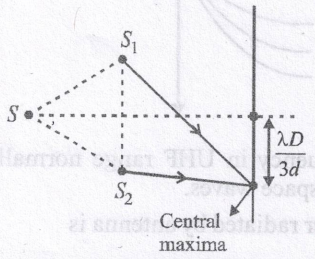
30. **(c)** We have, fringe width $(\beta) = \frac{\lambda D}{\mu d}$

In air, $\beta_{air} = \frac{\lambda D}{d}$ In medium, $\beta_{med} = \frac{\lambda D}{1.2d}$

So, $\frac{\beta_{med}}{\beta_{air}} = \frac{1}{1.2}$

$\Rightarrow \beta_{med} = \frac{\beta_{air}}{1.2} = \frac{3 \text{ mm}}{1.2} = 2.5 \text{ mm}$

31. **(d)** Here, path difference $= \Delta x + \frac{\lambda}{3}$, where $\Delta x = \frac{xd}{D}$



For central maxima, path difference = 0

$0 = \Delta x + \frac{\lambda}{3} \Rightarrow \Delta x = -\frac{\lambda}{3} \frac{xd}{D} = -\frac{\lambda}{3}$

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

So, central maxima will shift by $\left(\frac{\lambda D}{3d}\right)$ distance downward.

32. **(d)** We have

$\lambda = \frac{h}{\sqrt{2mq\Delta V}}$ or, $\lambda \propto \frac{1}{\sqrt{mq}}$

As, $(\sqrt{mq})_e = \sqrt{m_e e}$, $(\sqrt{mq})_p = \sqrt{1836 m_e e}$

and $(\sqrt{mq})_\alpha = \sqrt{4m_p \times 2e}$

$= \sqrt{4 \times 1836 m_e \times 2e}$

So, $\sqrt{(mq)_e} < (\sqrt{mq})_p < (\sqrt{mq})_\alpha$

$\Rightarrow \lambda_e > \lambda_p > \lambda_\alpha$

33. **(b)** We have,

$\lambda = \frac{h}{\sqrt{2mqV}} = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19} \times V}}$

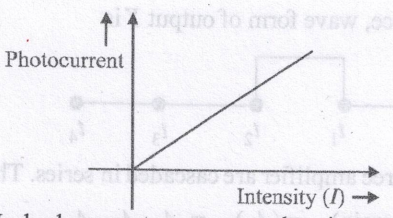
$= \frac{1.227}{\sqrt{V}} \times 10^{-9} \text{m} = \frac{1.227}{\sqrt{V}} \text{nm}$

34. **(c)** Photocurrent increases linearly with increase in intensity because

$I \uparrow\uparrow \Rightarrow \frac{\text{no. of photons}}{\text{time}} \uparrow\uparrow \Rightarrow \frac{\text{no. of photoelectrons}}{\text{time}} \uparrow\uparrow$

$\Downarrow$

Photocurrent $\uparrow\uparrow$



35. **(c)** In hydrogen atoms, spectral series corresponds to

(a) Lyman Series ——— Ultraviolet
(b) Balmer Series ——— Visible
(c) Paschen Series ——— Infra-red
(d) Brackett Series ——— Infra-red
(e) Pfund Series ——— For Infra-red

36. **(a)** The Bohr model of atom is applicable to '*H*' or '*H*' like atoms. So, (a) and (b) are correct.
As it is valid at nearly all temperature.
So, (c) is incorrect.
It cannot predicts continuous spectral line.
So, (d) is incorrect.

37. **(c)** Radius of nuclei is given as

$R = R_0 A^{1/3}$

$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} \Rightarrow \frac{R_1}{R_2} = \left(\frac{1}{27}\right)^{1/3} = \frac{1}{3}$

and, nuclear density is independent of mass number.

So, $\frac{\rho_1}{\rho_2} = \frac{1}{1}$

38. **(d)** We have,

$${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}_2He^4$$

So, mass of daughter nucleusis 4 less than parent nucleus.

39. **(b)** For β-decay only atomic number changes whereas mass number remain same. So, B, C, D are isobars.

40. **(c)** 'α' particle is basically doubly positive charge helium ion. So, it is simply a helium nuclei.

41. **(b)** This decay is spontaneous and spontaneous decay is possible only when mass of decay product is less than the mass of the products.

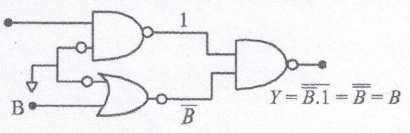
42. **(a)** $Q_{Value} = \Delta m\, c^2$

$\Rightarrow Q = (m_X - m_Y - m_{He})c^-$

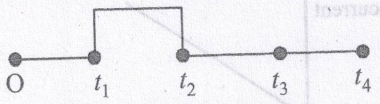
For ${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$

43. **(b)** For forward biasing, +ve terminal of battery is connected to *p*-side and –ve terminals of battery is connected to *n*-side.
So, D_1 and D_3 must be forward biased.

44. **(c)**



Hence, wave form of output Y is



45. **(c)** If three amplifier are cascaded in series. Then,

$(\text{Voltage gain})_{net} = (A_V)_{net} = A_{v_1} \cdot A_{v_2} \cdot A_{v_3}$

$= 5 \times 10 \times 20 = 1000$

So, final output $= (A_V)_{net} \times$ Input

$= 1000 \times 0.1 = 100\ \text{V}$

46. **(b)** In p-type semiconductor,

$n_n > n_e$

$\Rightarrow \frac{n_e}{n_h} < 1$

47. **(a)** In conductor, valence band and conduction band overlap. So, (a) is correct.

For insulators, band gap > 3 eV.

So, (b) is incorrect.

For semiconductor,

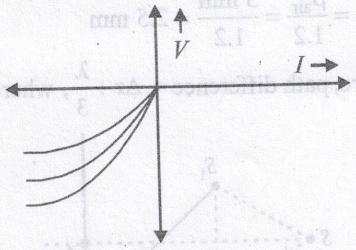
$$\rho \propto \frac{1}{T}.$$

So, (c) is incorrect.

The depletion layer is formed due to diffusion of holes from p to n side and electron from n to p side.

So, (d) is incorrect.

48. **(c)** Photodiodes are operated in reverse bias and has $I-V$ characteristic in IIIrd quadrant as shown in figure below.



49. **(d)** Frequency in UHF range normally propagate by means of space waves.

50. **(a)** Power radiated by antenna is

$$P_r = \frac{160\pi^2 \ell_0^2 \ell^2}{\lambda^2}$$

$$P_r \propto \frac{\ell^2}{\lambda^2}$$