06/08/2022
Slot-2

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Answers & Solutions

Time : 45 min. *for* M.M. : 200

CUET UG-2022

(Physics)

IMPORTANT INSTRUCTIONS:

1. The test is of 45 Minutes duration.
2. The test contains 50 Questions out of which 40 questions need to be attempted.
3. Marking Scheme of the test:
   a. Correct answer or the most appropriate answer: Five marks (+5)
   b. Any incorrect option marked will be given minus one mark (–1).
   c. Unanswered/Marked for Review will be given no mark (0).

Choose the correct answer :

Question ID: 702841

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

Answer (C)

Sol. Optical fibres work on the principle of total internal reflection.

Question ID: 702842

If λ_e, λ_p and λ_α, be the de-Broglie wavelength of electron, proton and α-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) $\lambda_\alpha < \lambda_p < \lambda_e$

Answer (C)

Sol. Considering that the question indicates if the particles have same speed or K.E or accelerating potential. (Although not mentioned in question)

$$\lambda = \frac{h}{mv} \text{ or } \lambda = \frac{h}{\sqrt{2mq(KE)}} \text{ or } \lambda = \frac{h}{\sqrt{2mqV}}$$

In all of the above possibilities

either $\lambda \propto \frac{1}{m}$ or $\lambda \propto \frac{1}{\sqrt{mq}}$

And $m_e < m_p < m_\alpha$ or

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

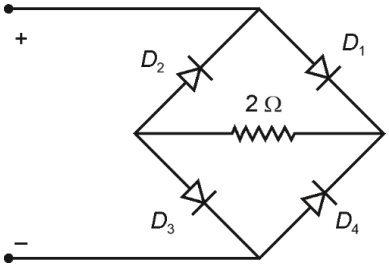
$\therefore$ It can be clearly stated that

$\lambda_\alpha > \lambda_p > \lambda_\alpha$

Question ID: 702843

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

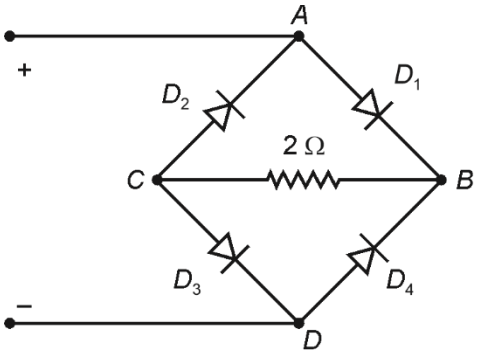
(B) D_1 and D_3 are forward biased

(C) D_2 and D_4 are forward biased

(D) All diodes are forward biased

Answer (B)

Sol.



From the above circuit it is clear that

$V_A > V_B$ $\therefore$ D_1 is forward biased

$V_A > V_C$ $\therefore$ D_2 is reverse biased

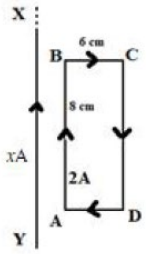
$V_C > V_D$ $\therefore$ D_3 is forward biased

$V_B > V_D$ $\therefore$ D_4 is reverse biased

Hence only D_1 and D_3 are forward biased

Question ID: 702844

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

Answer (Bonus)

Sol. As distance between wire XY and AB is not given which is required to calculate force. Data is insufficient.

Question ID: 702845

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

Answer (B)

Sol. According to Gauss' law in magnetism

Magnetic flux $(\phi_B)_{\text{Closed surface}} = 0$

This implies net magnetic pole strength inside any closed surface is always zero.

Hence, it clearly suggests that a magnetic monopole cannot exist.

Question ID: 702846

Frequencies in the UHF range normally propagate by means of

(A) Ground waves (B) Sky waves

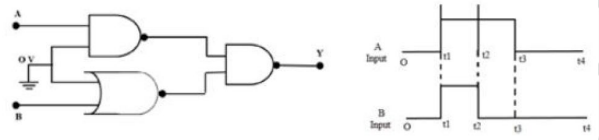
(C) Surface waves (D) Space waves

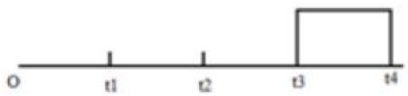
Answer (D)

Sol. The ultra high frequencies (UHF) used for communication and broadcasting normally propagate by means of space waves.

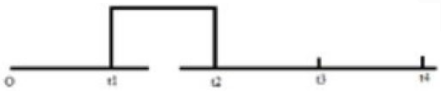
Question ID: 702847

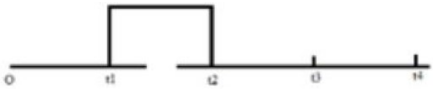
Sketch the output λ for the circuit shown below for two inputs.



(A) 

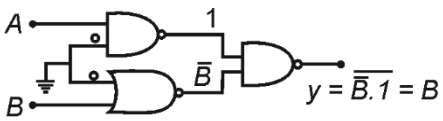
(B) 

(C) 

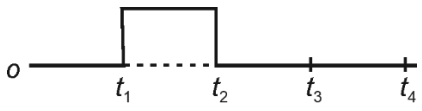
(D) 

Answer (C)

Sol.



Hence wave form of output Y is



Question ID: 702848

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

Answer (C)

Sol. Spectral series in hydrogen atoms corresponds to

A. Lyman Series – Ultraviolet

E. Balmer Series – Visible

C. Paschen Series – Infra-red

D. Bracket Series – Infra-red

B. Pfund Series – Far infra-red

This is the correct sequence of increasing order of their wavelength.

Hence sequence should be: A, E, C, D, B

Question ID: 702849

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

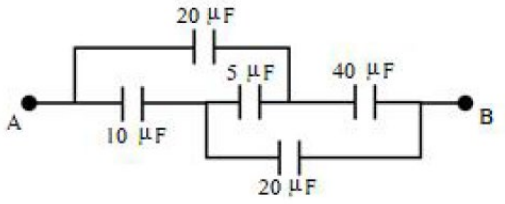
(D) Dr. Homi Jahangir Bhabha

Answer (B)

Sol. Dr. Meghnad Saha's vision was behind the project of cyclotron in India.

Question ID: 7028410

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



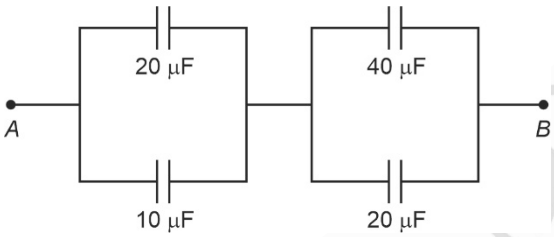
(A) 20 μF (B) 20/3 μF

(C) 40/3 μF (D) 10 μF

Answer (A)

Sol. The given circuit is a balanced Wheatstone bridge of capacitors (5 μF is the bridge capacitor)

Thus, the circuit can be modified as



$$C_{net} = \left(\frac{1}{30}+\frac{1}{60}\right)^{-1} = \left(\frac{1}{20}\right)^{-1} = 20\ \mu F$$

Question ID: 7028411

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

Answer (B)

Sol. We know,

$$\lambda = \frac{h}{p} \text{ and } p = \sqrt{2mqV}$$

$$\therefore \quad \lambda = \frac{h}{\sqrt{2mqV}}$$

For an electron, $\frac{12.27}{\sqrt{V}}$ Å

or $\frac{1.227}{\sqrt{V}}$nm

Question ID: 7028412

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

Answer (D)

Sol. At magnetic equator of Earth, the magnetic field lines become parallel to surface of earth.

$\therefore$ Angle of dip = 0°

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

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

$\therefore$ Angle of dip = 90°

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

Question ID: 7028413

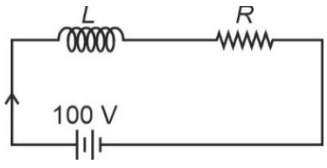
When a 100 V dc is applied across a solenoid, a current of 1 A flows in it. When a 100 V, 50 Hz ac is applied across the same solenoid, the current drops to 0.5 A. The inductance of the solenoid is

(A) 0.55 H (B) 0.86 H

(C) 1 H (D) 0.93 H

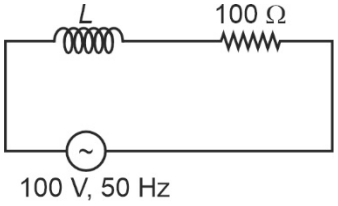
Answer (A)

Sol. **For DC circuit:**



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

For A.C. circuit:



Here, $Z = \frac{V}{I} = \frac{100}{0.5} = \sqrt{(\omega L)^2 + (100)^2}$

$Z = 200 = \sqrt{(100\pi L)^2 + (100)^2}$

$200 = 100\sqrt{\pi^2 L^2 + 1}$

$4 = \pi^2 L^2 + 1$

$\frac{\sqrt{3}}{\pi} = L$

$\Rightarrow \quad L = 0.55$ H

Question ID: 7028414

Faraday's law in integral form is

μ_0

(The symbols have their usual meaning)

(A) $E.ds = \frac{Q}{\varepsilon_0}$

(B) $\int E.dl = \frac{-d\phi}{dt}$

(C) $\int B.ds = 0$

(D) $\int B.dl = \mu_0\left(i_c + \varepsilon_0 \frac{d\phi}{dt}\right)$

Answer (B)

Sol. According to Faraday Law

Induced emf $\varepsilon = -\frac{d\phi}{dt}$

And $\varepsilon = \int \vec{E} \cdot \overrightarrow{dl}$

$\therefore \quad \int E \cdot dl = -\frac{d\phi}{dt}$

Question ID:7028415

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

Answer (B)

Sol. Limit of resolution of telescope, $d\theta = \frac{1.22\lambda}{D}$

$d\theta = \frac{1.22 \times 500 \times 10^{-9}}{250 \times 10^{-2}}$

$d\theta = 2.4 \times 10^{-7}$ radians

Question ID:7028416

Match List I and List II

	List-I		List-II
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

Answer (D)

Sol. In simple microscope : only one convex lens is used

In compound microscope : Objective has small focal length and aperture

In reflecting type telescope : Parabolic mirrors are used

In refracting type telescope : Objective has large focal length and aperture

Question ID:7028417

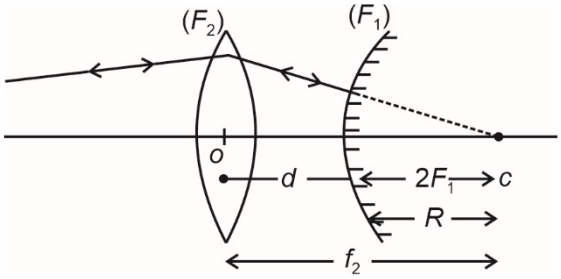
A convex mirror of focal length F_1 is placed at a distance d from a convex lens of focal length F_2. A beam of light rays coming from infinity falling on convex lens-convex mirror combination and returns black to infinity. Distance d is

(A) $(F_1 + F_2)$ (B) $(F_1 - F_2)$

(C) $(F_2 - 2F_1)$ (D) $(F_2 + 2F_1)$

Answer (C)

Sol. The situation can be presented in a ray diagram as shown



Clearly $\boxed{d = F_2 - 2F_1}$

Question ID:7028418

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

Answer (C)

Sol. We know, Radius of Nucleus $R \propto A^{1/3}$

Where A is mass number

$$\therefore \quad \frac{R_1}{R_2} = \left(\frac{1}{27}\right)^{\frac{1}{3}} = \frac{1}{3} = 1:3$$

While nuclear density is same for all nuclei

$$\therefore \quad \frac{\rho_1}{\rho_2} = 1:1$$

Question ID:7028419

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

Answer (D)

Sol. We know, $\frac{P}{Q} = \frac{R}{X}$ and

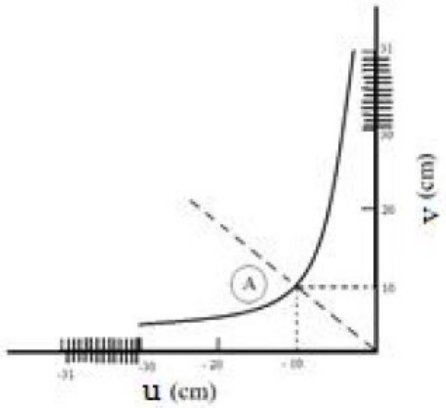
null point length, $l \propto$ resistance

$\therefore$ when 10 Ω is replaced by 20Ω (double)

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

Question ID:7028420

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

Answer (C)

Sol. From the graph it can be extracted that for the given convex lens

u = – 10 cm

v = 10 cm

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

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

$\therefore f$ = – 5 cm

$\therefore$ focal length = 5.00 cm

Question ID: 7028421

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

Answer (C)

Sol. We know, output voltage = (Voltage gain) (Input voltage)

V_{out} = (5) (10) (20) [0.1]

$\boxed{V_{out} = 100 \text{ V}}$

Question ID: 7028422

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.

Answer (B)

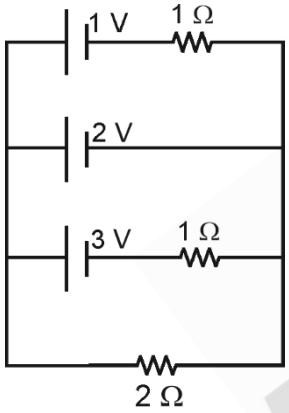
Sol. In *p*-type semiconductors

$n_h > n_e$

$\therefore \quad \frac{n_e}{n_h} < 1$

Question ID: 7028423

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

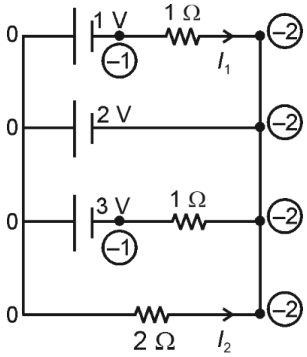


(A) 2A, 1A (B) 1A, 2A

(C) 2A, 2A (D) 1A, 1A

Answer (D)

Sol. In the given circuit potential at various points can be presented as



Clearly, $I_1 = \frac{-1-(-2)}{1} = 1\text{ A}$

And $I_2 = \frac{0-(-2)}{1} = 1\text{ A}$

Question ID: 7028424

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

Answer (A)

Sol. * In conductors, the valence and conduction bands overlap

* (E_g) for insulators > 3 eV

* Resistivity (ρ) of semiconductor $\propto \frac{1}{\text{Temperature}}$

* Depletion layer in pn junction diode is formed due to diffusion of electrons and holes into each others region

Thus, only statement (A) is correct

Question ID: 7028425

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

Answer (C)

Sol. We know, $E \propto \frac{1}{r^2}$ (for a shell)

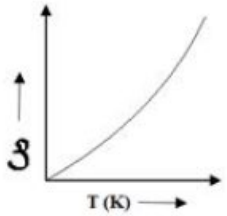
$\therefore \quad \frac{E_1}{E_2} = \frac{r_2^2}{r_1^2}$

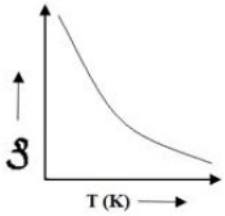
$\frac{X}{E_2} = \frac{(3r)^2}{(r)^2}$

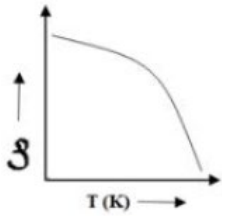
$\boxed{\therefore \; E_2 = \frac{X}{9}}$

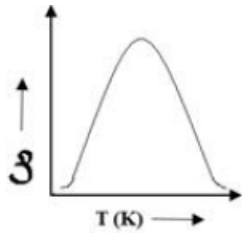
Question ID: 7028426

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

(A) 

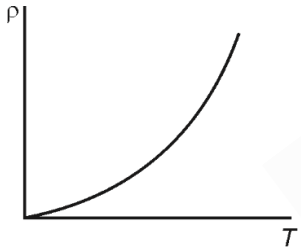
(B) 

(C) 

(D) 

Answer (A)

Sol. For pure metals the resistivity increases with increase in temperature (although non-linearly)



$\therefore$ for copper (metal)

At absolute zero 'ρ' is zero (superconductor)

Question ID: 7028427

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

Answer (D)

Sol. We know,

$v = f\lambda \quad \Rightarrow \quad v \propto \lambda \quad [\because f = \text{constant}]$

Thus the first colour to emerge will have longest wavelength *i.e.* Red.

Question ID: 7028428

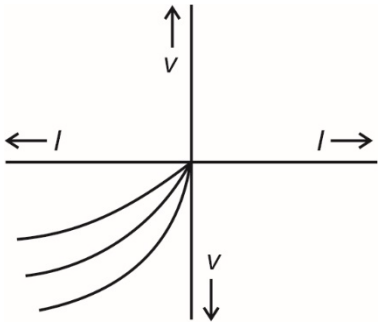
The I-V characteristics of an operating photodiode are drawn in

(A) First quadrant (B) Second quadrant

(C) Third quadrant (D) Fourth quadrant

Answer (C)

Sol. Photodiodes are operated in reverse bias and have I-V characteristics in third quadrant.



Question ID: 7028429

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

Answer (A)

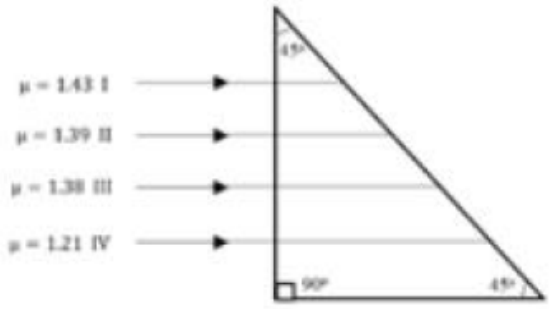
Sol. We know,

$$\text{Mobility } \mu = \frac{v_d}{E} = \frac{\left(\frac{eE}{m}\right)\tau}{E}$$

$$\therefore \quad \mu = \left(\frac{e}{m}\right)\tau$$

The mobility of charge carriers depends on average relaxation (collision) time.

Question ID: 7028430



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

Answer (A)

Sol. We know,

$$\sin i_c = \frac{1}{\mu}$$

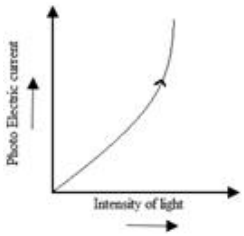
If $i_c = 45°$ then, $\mu = 1.414$

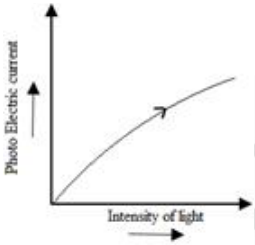
$\therefore$ Light with refractive index more than 1.41 will suffer total internal reflection while less than 1.41 will refract through opposite face.

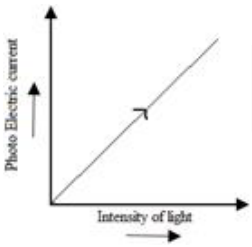
Thus, only I (μ = 1.43) will suffer Total Internal Reflection.

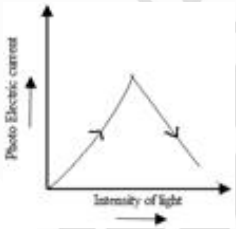
Question ID: 7028431

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) 

(C) 

(D) 

Answer (C)

Sol. We know,

Increasing intensity of incident radiation increases the number of photons striking the metal surface resulting in increase of ejected photoelectrons and hence photocurrent increases with increase in intensity of incident radiation.

Question ID: 7028432

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) $B_x = 3.6 \times 10^{-15} \cos (0.25 \times 10^3 x + 2.5 \times 10^{11} t)$

Answer (B)

Sol. We know,

$$\frac{E_0}{B_0} = c$$

$$\therefore \quad B_0 = \frac{5 \times 10^{-7}}{3 \times 10^8} = 1.66 \times 10^{-15}$$

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

$B_z = 1.66 \times 10^{-15} \sin (0.25 \times 10^3 x + 10^{11} t)$

Question ID: 7028433

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

Answer (A)

Sol. Efficiency $= \frac{P_{out}}{P_{in}} = \frac{V_0 I_0}{V_{in} I_{in}}$

$$\frac{50}{100} = \frac{(2200)(I_0)}{(220)(5)}$$

$$\left(\frac{1}{2}\right)\left(\frac{5}{10}\right) = I_0$$

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

Question ID: 7028434

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

Answer (B)

Sol. Unit of the given quantities are:-

Magnetic flux = Tm^2

Magnetic moment = Am^2

Magnetisation = A/m

Magnetic intensity = A/m

Magnetic permeability = T m/A

Thus only magnetisation and magnetic intensity have same dimensions.

Question ID: 7028435

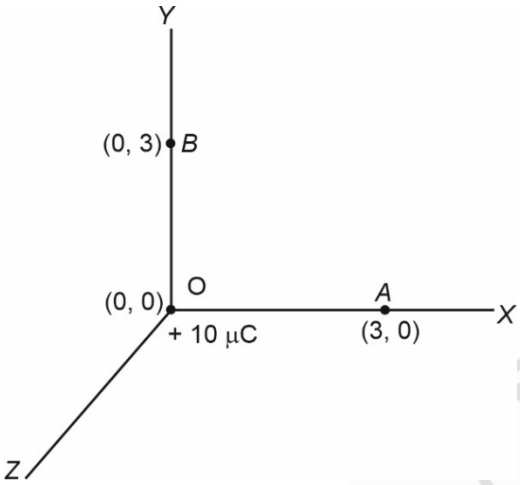
A charge + 10 μC is placed at (0 mm, 0 mm) Another charge –5 μC is moved from (3 mm, 0 mm) to (0 mm, 3 mm). Work done by the external agency is

(A) 0 J (B) –150 J

(C) + 150 J (D) –300 J

Answer (A)

Sol. Here, $OA = OB$



$\therefore \quad V_A = V_B$

Than $\Delta V = V_A - V_B = 0$

Hence, $W = q(\Delta v) = 0$

Question ID: 7028436

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) $\frac{\lambda}{l}$

Answer (A)

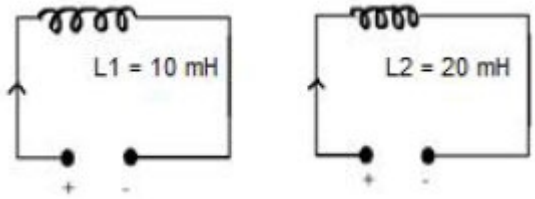
Sol. Power radiated by antenna is

$$P_r = \frac{160\pi^2 I_0^2 l^2}{\lambda^2}$$

Then, $P_r \propto \left(\frac{l}{\lambda}\right)^2$

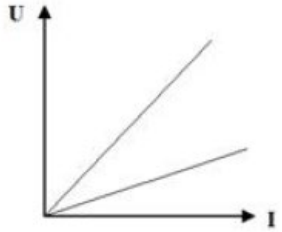
Question ID: 7028437

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

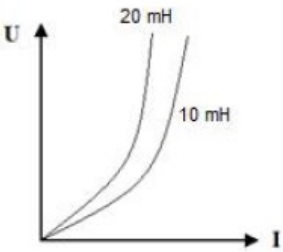


The correct graph for energy stored in inductor with current is

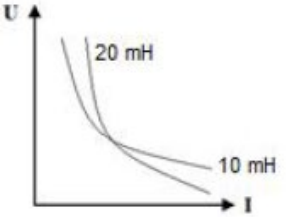
(A)



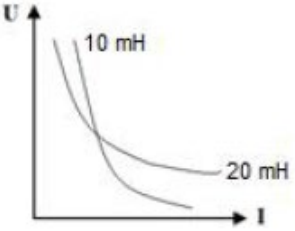
(B)



(C)



(D)



Answer (B)

Sol. We know,

Energy stored in an Inductor $U = \frac{1}{2}LI^2$

Thus $U \propto I^2 \rightarrow$ quadratic function

Hence, upward parabolic curve

Question ID: 7028438

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 given below:

(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

Answer (D)

Sol.

- Ammeter is made by connecting a shunt resistance of low value with the galvanometer coil.
- Voltmeter is made by connecting a high resistance in series with galvanometer coil.
- Soft iron core in MCG increases permeability and thus strength of magnetic field
- Radial field in MCG increases torque produced in the coil.

Question ID: 7028439

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

Answer (A)

Sol. The Bohr model of atom is applicable to atoms only and not to molecules. Also not applicable as it is for 'He'.

It is specifically designed for 'H' or 'H' like atoms only although its valid at all temperatures but it could not predict the continuous as well as discrete spectral lines.

Thus only statement (A) and (B) are correct.

Question ID: 7028440

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

Answer (D)

Sol.

For diverging the parallel beam, the liquid (medium) inside the lens should have less refractive index than the outer medium

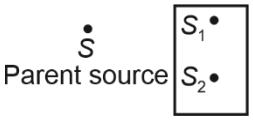
Hence, $n_2 > n_1$

$\therefore$ Liquid inside is L_1 and liquid outside is L_2.

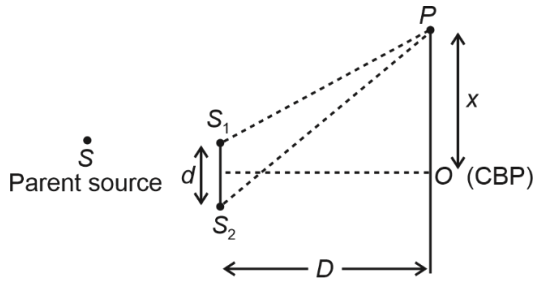
Passage:

Read the information given below to answer

In Young's double slit experiment as shown 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.



Question ID: 7028441

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) $x_n = n\frac{\lambda}{d}$

$n = \pm1, \pm2$ _ _

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

$n = \pm1, \pm2$ _ _

Answer (A)

Sol. In YDSE,

For bright fringes

$\phi_n = 2n\pi$

$\therefore \quad \Delta x_n = \frac{\lambda}{2\pi}(\phi_n)$

Hence, $\Delta x_n = \underline{n}\lambda$

For dark fringes

$\phi'_n = \frac{(2n+1)\pi}{2}$

$\therefore \quad \Delta x'_n = \frac{\lambda}{2\pi}(\phi'_n)$

$\Delta x'_n = \left(n + \frac{1}{2}\right)\lambda$

Position of fringes $y = \frac{\Delta x D}{d}$

$\therefore$ For bright fringes $y_n = \frac{n\lambda D}{d}$

and for dark fringes $y'_n = \left(n + \frac{1}{2}\right)\frac{\lambda D}{d}$

Question ID: 7028442

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) $\frac{1xd}{2D}$

Answer (B)

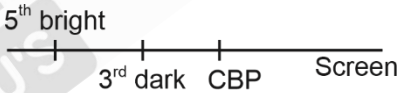
Sol. We know, position $x = \frac{\Delta x d}{d}$

where Δx is path difference

$\therefore \quad \Delta x = \frac{xd}{D}$

Question ID: 7028443

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

Answer (C)

Sol. It is given that, 20th bright fringe is 20 mm from centre

$\therefore \quad 20\left(\frac{\lambda D}{d}\right) = 20\text{ mm}$

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

Now, $\underset{\text{(Fifth bright)}}{y_5} - \underset{\text{(Third dark)}}{y'_3} = \frac{5\lambda D}{d} - \frac{5\lambda D}{2d}$

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

Question ID: 7028444

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

Answer (C)

Sol. We know,

Distance between two consecutive bright fringes is equal to width of a fringe (Dark or Bright)

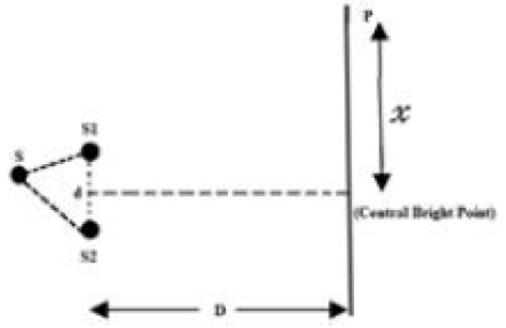
$\therefore$ Fringe width β = 3 mm

If system is immersed in a medium

then $\beta_{new} = \frac{\beta}{\mu} = \frac{3}{1.22} = 2.5$ mm

Question ID: 7028445

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

Answer (D)

Sol. We know path difference $S_2P - S_1P = \frac{Vnd}{D} + \frac{\lambda}{3}$

For maxima path difference = $n\lambda$

$\therefore \quad \frac{y_n d}{D} + \frac{\lambda}{3} = n\lambda$

$\frac{y_n d}{D} = n\lambda - \frac{\lambda}{3}$

For central bright fringe n = 0

$\therefore \quad \frac{y_0 d}{D} = -\frac{\lambda}{3}$

$y_0 = -\frac{\lambda D}{3d}$

Passage:

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 $Q = \Delta m \cdot c^2$

Question ID: 7028446

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

Answer (D)

Sol. We know α-particle is Helium Nucleus : ${}^{4}_{2}He$

Thus mass of daughter Nuclei after α-decay is four less than parent Nuclei

Question ID: 7028447

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

In the process $A \rightarrow B$, α particle is emitted by nucleus and in process $B \rightarrow C$ and $C \rightarrow D$ each, one – β – 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

Answer (B)

Sol. We know, β decay changes atomic number only while mass number remains same thus the outcome of β-decay gives 'Isobars'. Hence, B, C and D are 'Isobars'

Question ID: 7028448

α particle is :

(A) Nucleus of Hydrogen atom

(B) Hydrogen atom

(C) Nucleus of Helium atom

(D) Helium atom

Answer (C)

Sol. α-particle is Helium Nucleus : ${}^{4}_{2}He$

Question ID: 7028449

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

Answer (B)

Sol. During α-decay :

$${}^{A}_{Z}X \xrightarrow{\alpha-\text{decay}} {}^{A-4}_{Z-2}Y$$

Thus mass of product is always less than initial nucleus.

Question ID: 7028450

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) $(m_x - m_y + m_{He})c^2$

Answer (A)

Sol. Q value = mass energy of [Initial nuclei – Final product nucleus]

$\therefore$ Mass energy = Δmc^2

$\therefore$ $Q = [m_x - (m_y + m_{He})]c^2$

❑ ❑ ❑