30/08/2022

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: 702941

Which of the following characteristics of electron determines the current in a conductor?

(A) Drift velocity alone

(B) Thermal velocity alone

(C) Both drift and thermal velocity

(D) Neither drift nor thermal velocity

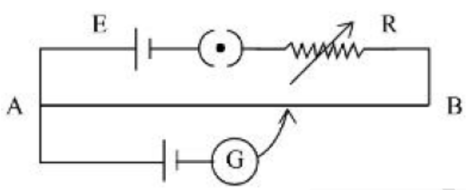
Answer (A)

Sol. The current $I = neAv_d$, where v_d is drift velocity.

$\therefore$ The drift velocity of electron determines the current in a conductor.

Question ID: 702942

AB is a potentiometer wire. If the value of *R* is increased, then in which direction will the balance point shift?



(A) Towards *A*

(B) Towards *B*

(C) No change

(D) Will remain fixed at the mid of wire *AB*

Answer (B)

Sol. As the resistance is increased, the value of potential gradient decreases. Hence to balance the cell now the balance point would shift towards *B* as larger resistance of potentiometer wire would be needed to obtain balance point.

Question ID: 702943

Match List I with List II

	LIST I (Devices)		LIST II (Principles)
A.	Principles	I.	Wheatstone Bridge
B.	Moving coil galvanometer	II.	Potential Gradient
C.	Transformer	III.	Mutual Induction
D.	Meter bridge	IV.	Radial Magnetic field

Choose the correct answer from the options given below:

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

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

Answer (B)

Sol. Moving coil galvanometer utilizes radial magnetic field.

Transformer utilizes the principle of mutual induction.

Meter bridge utilizes the principle of Wheatstone bridge.

B-IV, C-III, D-I

(A) option given in column-I is ambiguous)

Best Ans is A-II, B-IV, C-III, D-I

Question ID: 702944

Nichrome wire of length 10 m is used to make a heating coil. This coil consumes power of 160 W when there is a potential difference of 40 V across it. Find the diameter of this wire. Resistivity of Nichrome is 10^{-6} Ω m.

(A) 1.128 mm (B) 0.564 mm

(C) 0.10 mm (D) 1.128×10^4 m

Answer (A)

Sol. Electric power is given by

$$P = \frac{V^2}{R} \Rightarrow P = 160\text{ W, V} = 40\text{ V} \Rightarrow R = 10\ \Omega$$

$$\text{Also, } R = \frac{\rho l}{A} \Rightarrow 10 = \frac{10^{-6} \times 10}{A} \Rightarrow A = 10^{-6}\text{ m}^2$$

$$\Rightarrow \pi r^2 = 10^{-6} \Rightarrow r^2 = \frac{10^{-6}}{\pi}$$

$\Rightarrow$ $r = 0.564 \times 10^{-3}$

$\Rightarrow$ diameter, $d = 2r = 1.128 \times 10^{-3} = 1.128$ mm

Question ID: 702945

The resistance of two branch parallel circuit is 18 Ω. Of the resistance of one branch is 24 Ω. What is the resistance of other branch?

(A) 72 Ω (B) 6 Ω

(C) 36 Ω (D) 48 Ω

Answer (A)

Sol. For parallel combination, $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$

$$\Rightarrow \frac{1}{18} = \frac{1}{R_1} + \frac{1}{24} \Rightarrow \frac{1}{R_1} = \frac{1}{18} - \frac{1}{24}$$

$$\Rightarrow \frac{1}{R_1} = \frac{6}{18 \times 24} \Rightarrow R_1 = \frac{18 \times 24}{6} = 72\ \Omega$$

Question ID: 702946

Light of wavelength 180 nm ejects photoelectrons from a plate of metal whose work function is 2 eV. If a uniform magnetic field of 5 × 10^{-5} Wb/m^2 is applied parallel to the plate, the radius of the path followed by the electrons ejected normally from the plate with maximum energy is

(A) 0.15 m (B) 0.015 m

(C) 1.5 m (D) 0.5 m

Answer (A)

Sol. $K_{max} = \frac{hC}{\lambda} - \phi_0 \Rightarrow K_{max} = \frac{12,400}{1800} - 2$

$\Rightarrow K_{max} = 6.88 - 2 = 4.88$ eV

Also, $r = \sqrt{\frac{2mK.E}{qB}} \Rightarrow r\sqrt{\frac{2\times m\times K.E}{q^2B^2}}$

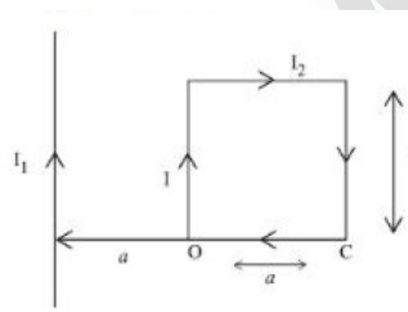
$\Rightarrow r = \sqrt{\frac{2\times 9.1\times 10^{-31}\times 4.88\times 1.6\times 10^{-19}}{1.6\times 10^{-19}\times 1.6\times 10^{-19}\times 25\times 10^{-10}}}$

$\Rightarrow r = \sqrt{\frac{2\times 9.1\times 4.88}{1.6\times 25}\times 10^{-2}}$

$= \sqrt{\frac{88.816}{40}}\times\frac{1}{10} = \frac{1.49}{10} = 0.149 \text{ m} \simeq 0.15 \text{ m}$

Question ID: 702947

A current carrying square loop is placed near an infinitely long current carrying wire as shown in figure. The torque acting on the loop is:



(A) $\frac{\mu_0}{2\pi}\left(\frac{I_1 I_2 a}{2}\right)$

(B) $\frac{\mu_0 I_1 I_2 a}{2\pi}$

(C) $\frac{\mu_0 I_1 I_2}{2\pi}\log(2)$

(D) Zero

Answer (D)

Sol. Torque acting on loop, $\vec{\tau} = \vec{M}\times\vec{B}$, where $\vec{M}$ is the magnetic moment and $\vec{B}$ is the external magnetic field.

$|\tau| = MB\sin\theta$

Since θ = 0° $\Rightarrow \tau$ = 0, where θ is the angle between the magnetic moment and external magnetic field.

Question ID: 702948

If magnetic monopoles existed, how would the Gauss's law in magnetism be modified?

(A) $\oint_S \vec{B}\cdot d\vec{s} = \mu_0 I$; where I is the current enclosed by S.

(B) $\oint_S \vec{B}\cdot d\vec{s} = \mu_0 q_m$; where q_m is monopole magnetic charge enclosed by S.

(C) $\oint_S \vec{B}\cdot d\vec{l} = \mu_0 q_m$; where q_m is monopole magnetic charge enclosed by S.

(D) $\oint_S \vec{B}\cdot d\vec{s} = \frac{q_m}{\mu_0}$; where q_m is monopole magnetic charge enclosed by S.

Answer (B)

Sol. If magnetic monopole existed, the Gauss's law in magnetism would be modified in the following manner:

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 (q_m)$$

where q_m = monopole magnetic charge enclosed by closed surface S.

Question ID: 702949

With regard to ferromagnetic materials, which of the following statement is true?

(A) Hard ferromagnetic materials are used in permanent magnets because they have large hysteresis area

(B) Soft ferromagnetic materials are used in permanent magnets because they large hysteresis area

(C) Soft materials have smaller area of hysteresis and therefore used in permanent magnets

(D) Hard materials have smaller areas of hysteresis and therefore are used in permanent magnets

Answer (A)

Sol. The ferromagnetic material which retain magnetisation for a long period of time are called hard magnetic material or hard ferromagnets.

They are used for permanent magnets as they have large hysteresis area which gives high retentivity and high coercivity which is ideal for permanent magnet material.

Question ID: 7029410

As a current is set up in a moving coil galvanometer, then arrange the following in sequential order.

A. Pointer attached with the coil starts rotating.

B. Pointer stops moving due to equilibrium between restoring torque and torque of coil.

C. The spring creates a restoring torque $\tau_c = k_\phi$.

D. Pointer reads a calibrated value.

E. The coil of the meter experience torque τ = NIAB and starts rotating.

Choose the correct answer from the options given below:

(A) E, C, A, D, B (B) E, A, C, B, D

(C) E, D, B, A, C (D) E, C, A, B, D

Answer (B)

Sol. Following is the correct sequence.

The coil of the meter experience torque, τ = NIAB and starts rotating.

Pointer attached with coil starts rotating.

The spring creates a restoring torque, $\tau_c = k_\phi$.

Pointer stops moving due to equilibrium between restoring torque and torque of coil.

Pointer reads a calibrated value.

Question ID: 7029411

The magnitude of the magnetic field at the center of a current carrying circular coil is directly proportional to

(A) Permeability of free space and inversely proportional to current and radius of the coil.

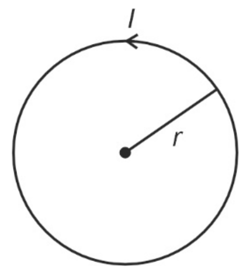
(B) Permeability of free space and current and inversely proportional to radius of the coil

(C) Current and inversely proportional to permeability of free space and radius of the coil

(D) Current and radius of the coil and inversely proportional to permeability of free space

Answer (B)

Sol. Magnitude of magnetic field at the centre of current carrying circular coil $= \frac{\mu_0 I}{2r}$.



Question ID: 7029412

According to the general formulae for electric and magnetic fields for em waves $E_x = E_0\sin(kz - \omega t)$ and $B_y = B_0\sin(kz - \omega t)$; what will be the value of B_0 if E_0 = 6.3 V/m.

(A) 2.1×10^{8} T (B) 2.1×10^{-8} T

(C) 1.89×10^{-7} T (D) 1.89×10^{7} T

Answer (B)

Sol. In any electromagnetic wave

$E_0 = CB_0$ (C is speed of light)

$$B_0 = \frac{E_0}{C_0}$$

$$B_0 = \frac{E_0}{C} = \frac{6.3}{3\times10^8}$$

$= 2.1 \times 10^{-8}$ T

Question ID: 7029413

Arrange the following types of electromagnetic waves in the increasing order of their frequencies.

A. Gamma rays

B. Radio waves

C. Visible light

D. Ultraviolet rays

Choose the correct answer from the options given below:

(A) A < D < C < B (B) D < C < A < B

(C) B < C < D < A (D) C < D < B < A

Answer (C)

Sol. Electromagnetic waves in increasing order of their frequency.

Radio waves < Visible light < UV rays < γ-rays

B < C < D < A

Question ID: 7029414

Interference of light corresponds to conservation of energy because

A. All fringes are of equal width.

B. All bright fringes are of same intensity and the dark fringes are of same intensity.

C. All fringes are separated by equal distance.

D. Energy is transferred from dark fringe to bright fringe.

Choose the correct answer from the options given below:

(A) A and C only (B) B and D only

(C) C and D only (D) A and B only

Answer (B)

Sol. In case of constructive interference, intensity becomes maximum & bright fringes are formed on the screen having same intensities whereas in destructive interference, intensity being minimum dark fringes are formed on screen. This implies that in interference intensity of light is redistributed from dark to bright fringe.

Question ID: 7029415

Which of the following does not depend on the total internal reflection of light?

(A) Mirage (B) Endoscopy

(C) Prism binoculars (D) Terrestrial Telescope

Answer (D)

Sol. Working of terrestrial telescope doesn't depend on total internal reflection of light, while mirage formation, endoscopy & prism binoculars based on total internal reflection.

Question ID: 7029416

If the focal length of objective lens is increased, the magnifying power of

(A) Microscope will increase & telescope will decrease

(B) Microscope will decrease & telescope will increase

(C) Both will increase

(D) Both will decrease

Answer (B)

Sol. For microscope,

Magnifying power = $= \dfrac{LD}{f_o f_e}$

Hence, $MP \propto \dfrac{1}{f_o}$

For telescope

Magnifying power = $\dfrac{f_o}{f_e}$

Hence, $MP \propto f_o$

Question ID: 7029417

A wavefront is defined as a surface of

(A) Constant speed

(B) Constant phase

(C) Constant wavelength

(D) Constant amplitude

Answer (B)

Sol. A wavefront is defined as a surface over which the phase of wave is constant.

In a particular wavefront, at a given moment of time, all particles of the medium are undergoing the same phase.

Question ID: 7029418

A small telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5 cm. If this telescope is used to view a 100 m tall tower 3 km away, what is the height of the final image of the tower if it is formed at 25 cm?

(A) 25 cm (B) 30 cm

(C) 24 cm (D) 36 cm

Answer (B)

Sol. $(\text{M.P.}) = \dfrac{-f_o}{f_e}\left[1+\dfrac{f_e}{D}\right]$

$$\text{M.P.} = \frac{-150}{5}\left[1+\frac{5}{25}\right]$$

$$= -30\left[\frac{6}{5}\right] = -36$$

$$m = \frac{\tan\beta}{\tan\alpha}$$

$$\tan\alpha = \frac{H}{u} = \frac{100}{3000} = \frac{1}{30} \qquad [\because u = 3\text{ km}]$$

$$\tan\beta = \frac{-36}{30} = \frac{H'}{D} \Rightarrow H' = \frac{36\times 25}{305} = +30\text{ cm}$$

Question ID: 7029419

The power of a convex lens of focal length 20 cm in dioptre unit is

(A) 0.5 (B) 0.05

(C) 5 (D) 2.5

Answer (C)

Sol. f = 20 cm

= 0.2 m

Power of lens is given by

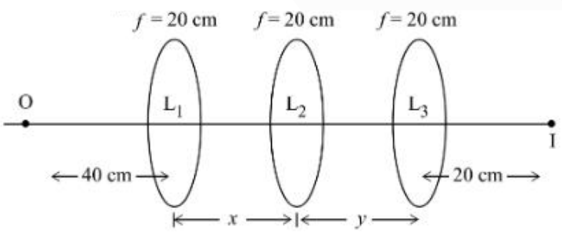
$$P = \frac{1}{f}$$

$$P = \frac{1}{20\text{ cm}} = \frac{1}{20 \times 10^{-2}} \text{ dioptre}$$

$\therefore$ P = 5 D

Question ID: 7029420

Three convex lens each of focal length 20 cm. are placed co-axially as shown in the figure. Object 'O' is placed in front of a lens L_1 at distance of 40 cm and final image by L_3 is framed at 20 cm from it, then distances x and y in the figure are



(A) x = 60 cm, y = 60 cm

(B) x = 60 cm, y = any value

(C) x = any value, y = 60 cm

(D) x = 40 cm, y = any value

Answer (B)

Sol. $f_1 = f_2 = f_3$ = 20 cm

$$\frac{1}{f_1} = \frac{1}{v_1} - \frac{1}{u_1}$$

v_1 = 40 cm

Image by L_3 is formed at focus

$\therefore$ object for L_3 is at ∞.

$\therefore$ Image formed by L_2 is at ∞ u_2 = 20 cm

Object for L_2 is placed at 20 cm left form L_2 which is 40 cm right L_1

$\therefore$ x = 40 + 20 = 60 cm

L_2 makes image at ∞

$\therefore$ any distance between L_2 and L_3 will make object for L_3 as ∞.

$\therefore$ y = any value.

Question ID: 7029421

A plano-convex lens acts like a concave mirror of focal length 28 cm when its plane surface is silvered and like a concave mirror of focal length 10 cm when its curved surface is silvered. The refractive index of the material of the lens is

(A) 1.50 (B) 1.55

(C) 1.60 (D) 1.65

Answer (B)

Sol. **Case-1:** The plane surface of plano-convex lens is silvered

$\Rightarrow$ $f_m = \infty,\ f_e = \frac{R}{\mu - 1}$, $R \to$ radius of curvature of curved surface

$$\frac{1}{f_{eq}} = \frac{-2}{f_e} + \frac{1}{\infty}$$

$$\Rightarrow f_{eq} = \frac{-R}{2(\mu-1)} \text{ and } \frac{-R}{2(\mu-1)} = -28 \qquad \text{…(i)}$$

Case-2: The spherical surface of plano-convex lens is silvered

$$f_e = \frac{R}{\mu-1},\ f_m = \frac{-R}{2},\ \frac{1}{f_{eq}} = \frac{-2(\mu-1)}{R} - \frac{-2}{R} = \frac{-2\mu}{R}$$

$$\Rightarrow f_{eq} = \frac{-R}{2\mu} \text{ and } \frac{-R}{2\mu} = -10 \qquad \text{¼(ii)}$$

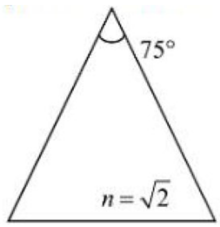
Dividing (i) and (ii)

$$= \frac{\frac{R}{2(\mu-1)}}{\frac{R}{2\mu}} = \frac{28}{10} \Rightarrow \frac{\mu}{\mu-1} = \frac{14}{5} \Rightarrow 5\mu = 14\mu - 14$$

$$14 = 9\mu \Rightarrow \mu = \frac{14}{9} = 1.55$$

Question ID: 7029422

Maximum angle of deviation of a prism having refractive index $\sqrt{2}$ and angle of prism 75° will be

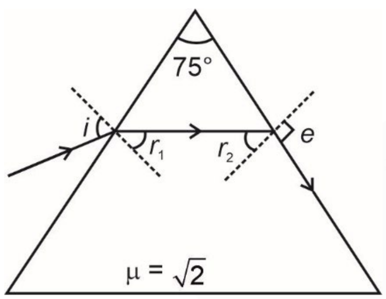


(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{8}$

Answer (A)

Sol. For grazing emergence e = 90°



For Snell's law $\frac{\sin r_2}{\sin e} = \frac{1}{\sqrt{2}}$

$\Rightarrow$ r_2 = 45°

$\Rightarrow$ $r_1 + r_2$ = 75° $\Rightarrow$ r_1 = 30°

Now $\frac{\sin i}{\sin r_1} = \sqrt{2}$

$\sin i = \frac{1}{2} \times \sqrt{2}$ $\Rightarrow$ i = 45°

As $i + e = A + \delta$

δ = 45° + 90° – 75° = 60°

$\delta = \frac{\pi}{3}$

Question ID: 7029423

A proton, electron and an α particle are accelerated with same potential. Arrange their de-Broglies wavelengths in ascending order.

A. Wavelength of proton = (λ_p)

B. Wavelength of electron = (λ_e)

C. Wavelength of particle = (λ_α)

Choose the correct answer from the options given below:

(A) $\lambda_\alpha < \lambda_p < \lambda_e$ (B) $\lambda_e < \lambda_\alpha < \lambda_p$

(C) $\lambda_e < \lambda_p < \lambda_\alpha$ (D) $\lambda_p < \lambda_\alpha < \lambda_e$

Answer (A)

Sol. De-Broglie wavelength of a changed. Particle moving in an electric field is given by:

$$i = \frac{h}{\sqrt{2mqV}}$$

$m_\alpha > m_p > m_e$

$\lambda_\alpha < \lambda_p < \lambda_e$

Question ID: 7029424

The threshold frequency of a photoelectric metal is ν_0. If light of frequency $2\nu_0$ is incident on the surface of that metal, maximum velocity of emitted electrons is v. What will be the maximum velocity of emitted electrons if light of frequency $4\nu_0$ is incident on the same metal surface.

(A) $4v$ (B) $\sqrt{3}v$

(C) $2v$ (D) $\sqrt{2}v$

Answer (B)

Sol. By Einstein photoelectric equation

$\phi = \phi_0 + K.E_{max}$

$$h2\nu_0 = h\nu_0 + \frac{1}{2}mv^2$$

$$\frac{1}{2}mv^2 = h\nu_0 \qquad \ldots(i)$$

$$4h\nu_0 = h\nu_0 + \frac{1}{2}mv_1^2$$

$$\frac{1}{2}mv_1^2 = 3h\nu_0 \qquad \ldots(ii)$$

On putting the value of $h\nu_0$ from equation (i)

$$\frac{1}{2}mv_1^2 = 3\frac{1}{2}mv^2$$

$$v_1 = \sqrt{3}v$$

Question ID: 7029425

When a metallic surface is illuminated with radiation of wavelength λ the stopping potentials is V. If the same surface is illuminated with radiation of wavelength 2λ the stopping potential is $\frac{V}{4}$, the threshold wave length for metallic surface is

(A) 4λ (B) 5λ

(C) $\frac{5}{2}\lambda$ (D) 3λ

Answer (D)

Sol. By Einstein's photoelectric equation

$\phi = \phi_0 + eV_0$

$$\frac{hc}{\lambda} = \phi_0 + eV \quad \ldots(i)$$

$$\frac{hc}{2\lambda} = \phi_0 + \frac{eV}{4} \quad \ldots(ii)$$

On putting the value of eV form equation (i) in equation (ii)

$$\frac{hc}{2\lambda} = \phi_0 + \frac{1}{4}\left(\frac{hc}{\lambda} - \phi_0\right)$$

$$\frac{hc}{4\lambda} = \frac{3\phi_0}{4}$$

$$\frac{hc}{4\lambda} = \frac{3}{4}\frac{\mu c}{\lambda_1} \quad \Rightarrow \lambda_1 = 3\lambda$$

Question ID: 7029426

According to Bohr's postulates, the quantity that shows discrete values is

(A) Linear momentum (B) Angular momentum

(C) Kinetic Energy (D) Potential Energy

Answer (B)

Sol. Angular momentum (L) $= \frac{nh}{2\pi}$

Where n is positive integer

Question ID: 7029427

The expression for the frequency of radiation emitted when a hydrogen atom de-excites from level n to level $(n-1)$, for a large value of n become

(A) $\frac{me^4}{8\varepsilon_0^2 h^3} \times \frac{1}{n^2}$ (B) $\frac{me^4}{4\varepsilon_0^2 h^3} \times \frac{1}{n}$

(C) $\frac{me^4}{4\varepsilon_0^2 h^3} \times \frac{1}{n^3}$ (D) $\frac{me^4}{8\varepsilon_0^2 h^3} \times \frac{1}{\frac{2}{n^3}}$

Answer (C)

Sol. The total energy of electron in n^{th} orbit

$$E_n = \frac{-me^4z^2}{8\varepsilon_0^2 h^2 n^2}$$

$$\Delta E = \frac{me^4z^2}{8\varepsilon_0^2 h^2}\left[\frac{1}{n^2} - \frac{1}{(n-1)^2}\right]$$

$$\Delta E = \frac{me^4z^2}{8\varepsilon_0^2 h^2}\left[\frac{(n-1)^2 - n^2}{n^2(n-1)^2}\right]$$

$$\Delta E = \frac{me^4z^2}{8\varepsilon_0^2 h^2}\left[\frac{2n-1}{n^2(n-1)^2}\right]$$

$$\Delta E = \frac{me^4z^2}{8\varepsilon_0^2 h^2}\left[\frac{2n\left(1-\frac{1}{2n}\right)}{h^4\left(1-\frac{1}{h}\right)^2}\right]$$

$$\Delta E = \frac{me^4z^2}{4\varepsilon_0 h^2 n^3}$$

$$\nu = \frac{me^4z^2}{4\varepsilon_0 h^2 n^3}$$

Question ID: 7029428

If the minimum wavelength corresponding the Paschen series of hydrogen spectra is 820 nm then that corresponding to the Balmer series would be.

(A) 1640 nm (B) 364.4 nm

(C) 528.4 nm (D) 298.2 nm

Answer (B)

Sol. Wavelength of radiation emitted in hydrogen spectra

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

For Paschen $n_1 = 3$, $n_2 \geq 4$

for λ min $n_1 = 3$, $n_2 = \infty$

$$\frac{1}{\lambda_1} = \frac{R}{9}$$

For Balmer $n_1 = 2$, $n_2 \geq 3$

For λ_{min} $n_1 = 2$, $n = \infty$

$$\frac{1}{\lambda_2} = \frac{R}{4}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{4}{9}$$

$$\lambda_2 = \frac{4}{9} \times \lambda_1$$

$$= \frac{4}{9} \times 820$$

≈ 364.4 nm

Question ID: 7029429

Statement I: Volume of the nucleus is proportional to a where A is mass number.

Statement II: Density of nucleus is independent of mass number A.

In the light of the: above statements, choose the correct answer from the options given below:

(A) Both Statement I and Statement II are true

(B) Both Statement I and Statement II are false

(C) Statement I is correct but Statement II is false

(D) Statement I is incorrect but Statement II is true

Answer (A)

Sol. Radius of nucleus $R = R_0 A^{1/3}$

$\Rightarrow$ Volume $\propto R^3$

$\Rightarrow$ $V \propto A$

Density of nucleus

$$(\rho) = \frac{m}{\text{Volume}} = \frac{MA}{KA} = \frac{M}{K} = \text{constant}$$

Question ID: 7029430

The half-life of a radioactive material undergoing β-decay is 12.5 years. What fraction the material remains undecayed after 25 years?

(A) $\frac{1}{4}$ (B) $\frac{1}{2}$

(C) $\frac{3}{4}$ (D) $\frac{1}{8}$

Answer (A)

Sol. $N = \frac{N_0}{2^n}$

Here N is number of remaining nuclei

N_0 is the number initial nuclei

n is the number of half life

$$n = \frac{25}{T_{1/2}} = \frac{25}{12.5}$$

= 2

$$\frac{N}{N_0} = \frac{1}{2^2} = \frac{1}{4}$$

Question ID: 7029431

Kinetic energy of the emitted α-particle in the α– decay of $^{226}_{88}Ra$ will be =

$$m\left(^{226}_{88}Ra\right) = 226.02540 \text{ u}$$

$$m\left(^{4}_{2}He\right) = 4.002603 \text{ u}$$

$$m\left(^{222}_{86}Rn\right) = 222.01750 \text{ u}$$

(A) 6.937 MeV (B) 4.85 MeV

(C) 0.087 MeV (D) 2.87 MeV

Answer (B)

Sol. Δm = (226.02540 – 4.002603 – 222.01750) u

Δm = 0.005297 u

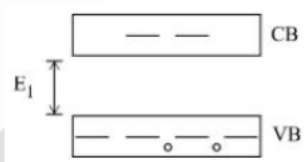
$$Q = (0.005297\,\text{u}) \times \left(931.5\frac{\text{MeV}}{\text{u}}\right)$$

= 4.9341555 MeV

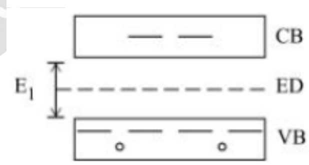
Hence nearby option is (B) 4.85 MeV

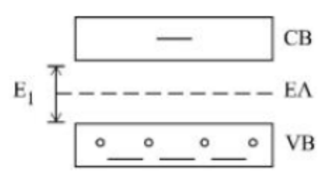
Question ID: 7029432

Which of the following corresponds. to an intrinsic semiconductor at T = 0 K?

(A)


(B)

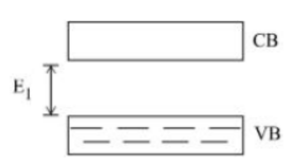

(C)


(D)


Answer (B)

Sol. At 0 K temperature, conduction band is completely empty and valance band is completely filled *i.e* no free electrons in conduction band and no holes in valance band.

Therefore, Best energy-band diagram of semiconductor is



Question ID: 7029433

Select the correct statement explaining the function of Rectifier.

(A) It converts DC Signal to AC signal

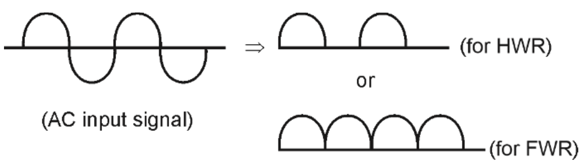
(B) It converts AC Signal to unidirectional pulsating signal

(C) It increases the level of DC Signal

(D) It decrease the level of Ac Signal

Answer (B)

Sol. Rectifier converts AC signal to unidirectional pulsating signal (AC)



Question ID: 7029434

A photodiode is fabricated with band gap of 3 eV. It can detect

(A) Visible light (B) Microwave

(C) Infrared radiation (D) Ultra Voilet radiation

Answer (A, D*)

Sol. For detection of light by photodiode $E \leq \frac{hc}{\lambda}$

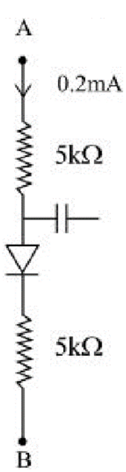
$$3\,\text{eV} \leq \frac{12400}{\lambda}$$

$$\lambda \leq \frac{12400}{3} \Rightarrow \lambda \leq 4130\ \text{Å}$$

The photodiode can detect the light lying in visible region (partially) and of ultraviolet region.

Question ID: 7029435

In the circuit shown in figure, if the diode forward voltage drop is 0.3 V. the voltage difference between A and B is.

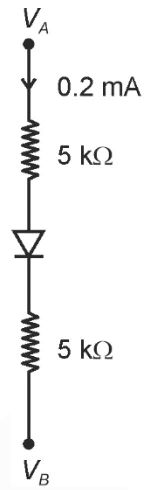


(A) 1.3 V (B) 2.3 V

(C) 0 (D) 0.7 V

Answer (B)

Sol. From Kirchhoff's voltage law



$$V_A - 0.2 \times 10^{-3} \times 5 \times 10^3 - 0.3$$

$$- 0.2 \times 10^{-3} \times 5 \times 10^3 = V_B$$

$$V_A - V_B = 1 + 0.3 + 1 = 2.3\text{ V}$$

Question ID: 7029436

Given below are two statements:

Statement I: In light emitting diodes, energy is released in the form of photons when minority carriers recombine with majority carriers near the junction.

Statement II: Light emitting diodes are fabricated using heavily doped p-n junction which emits spontaneous radiation under forward biased condition.

In the light of above statements, choose the correct answer from the options given below:

(A) Both Statement I and Statement II are true

(B) Both Statement I and Statement II are false

(C) Statement I is correct but Statement II is false

(D) Statement I is incorrect but Statement II is true

Answer (A)

Sol. Statement I: LED emit photon when at the junction boundary on either side of the junction excess minority carriers are there which recombine with majority carriers near the junctions.

Statement II: LED is a heavily doped P-N junction which under forward bias emits spontaneous radiation.

Hence option (A) Both statement (I) and (II) are true.

Question ID: 7029437

Some wireless communications are given as following. Select the correct arrangement of them into their increasing order of frequencies from low to high band range.

A. Satellite communication

B. Sky wave communication

C. A.M. Broad Cast

D. F.M. Broad Cast

Choose the correct answer from the options given below:

(A) $C \rightarrow A \rightarrow D \rightarrow B$

(B) $C \rightarrow D \rightarrow A \rightarrow B$

(C) $C \rightarrow B \rightarrow A \rightarrow D$

(D) $C \rightarrow B \rightarrow D \rightarrow A$

Answer (D)

Sol.

Services	Frequency Band
For AM Broadcast	(540 – 1600) kHz
Sky wave propagation	~ (3 – 30) MHz
FM Broadcast	(88 – 108) MHz
Satellite communication	In GHz range

Hence correct order (increasing order) of frequencies are $C \rightarrow B \rightarrow D \rightarrow A$

Question ID: 7029438

A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of modulating signal in order to have a modulation index of 75%?

(A) 3 V (B) 6 V

(C) 9 V (D) 12 V

Answer (C)

Sol. Modulation Index = $\dfrac{V_m}{V_c}$

$$\frac{75}{100} = \frac{V_m}{12}$$

$V_m = 9$ V

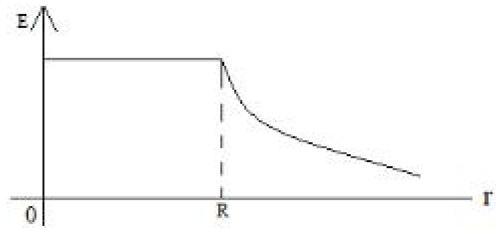
Option (C) is correct.

Question ID: 7029439

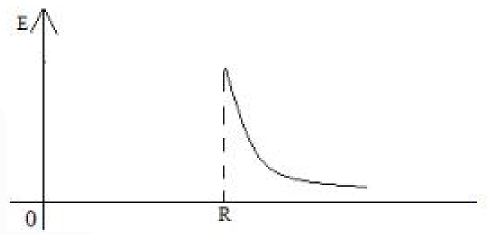
The variation of electric field with the distance from centre due to solid uniformly charged spherical conductor is correctly represented by

(Given R = Radius of spherical conductor)

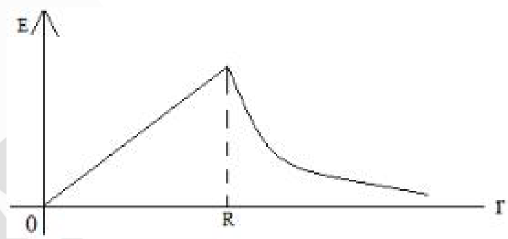
(A)



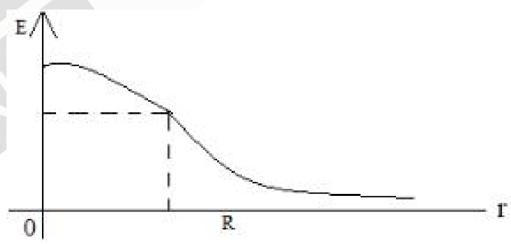
(B)



(C)



(D)

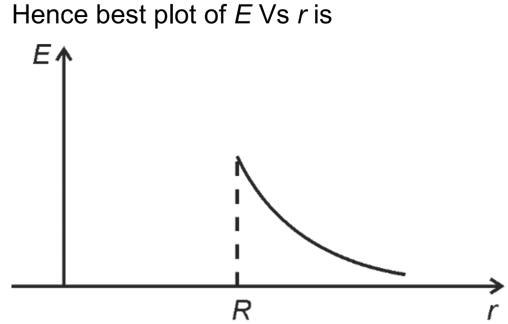


Answer (B)

Sol. Electric field due to uniformly charged spherical conductor is given as

$$E = \begin{cases} 0 & \text{for} \quad r < R \\ \dfrac{Q}{4\pi\varepsilon_0 r^2} & \text{for} \quad r \geq R \end{cases}$$

Hence best plot of E Vs r is



Question ID: 7029440

An LCR series circuit containing resistance R_1, inductance L_1 and capacitance C_1 gives resonance at the same frequency f as a second similar combination R_2, L_2 and C_2. If the two circuits are connected in series, then the frequency of the combined circuit is.

(A) $2f$ (B) $4f$

(C) f (D) $\frac{1}{2}f$

Answer (C)

Sol. Equivalent capacitance in series = $\frac{C_1C_2}{C_1+C_2}$

Equivalent inductance in series = $L_1 + L_2$

Frequency of combined circuit $\omega = \sqrt{\frac{1}{LC}}$

$$= \sqrt{\frac{C_1+C_2}{C_1C_2(L_1+L_2)}}$$

$$= \sqrt{\frac{C_1+C_2}{L_1C_1C_2+L_2C_1C_2}}$$

As frequency of individual circuit is same $L_1C_1 = L_2C_2$.

$$\omega = \sqrt{\frac{C_1+C_2}{L_1C_1C_2+L_1C_1C_1}}$$

$$= \sqrt{\frac{C_1+C_2}{L_1C_1(C_1+C_2)}}$$

$$= \sqrt{\frac{1}{L_1C_1}}$$

$\omega = \omega$ of individual circuit.

So, frequency is also same

(C) is correct ans.

Passage:

A hydroelectric power plant situated at a distance of 20 km from a town. Whose energy demand is 100 MW at 240 V. At hydro electric power plant, the water pressure head is at a height of 400 m and the water flow available is 100 m^3/s. Electrical energy generated in power plant is transmitted to the town with the use of transformers voltage output of the Ac. generator at power plant is stepped up and is there transmitted over long distances to an sub-station near the consumers in town. Sub-stations and utility poles steps down the voltage finally the 240 V which finally reaches the houses.

Question ID: 7029441

In the efficiency of turbine is 70% the electric power generated in plant is (Take g = 10 m/s^2)

(A) 280 kW

(B) 280 MW

(C) 400 kW

(D) 400 MW

Answer (B)

Sol. Gravitational power generated

$$P_{\text{grav}} = \rho\left(\frac{dV}{dt}\right)gh$$

$$P_{\text{grav}} = 1000(100)(10)(400)$$

P_{grav} = 400 MW

But, efficiency is $\eta = \frac{\text{Power output}}{\text{Power input}} = \frac{P_{\text{electric}}}{P_{\text{grav}}}$

$$\therefore\ P_{\text{electric}} = 70\left(\frac{400}{100}\right)\text{MW}$$

P_{electric} = 280 MW

Question ID: 7029442

Resistance of the two wires transmitting the power is 1 Ω/km. If the 50,000–5000 V step down transformer is used at a sub-station in town, the power loss in transmission line in the form of heat is

(A) 160 mW (B) 160 W

(C) 160 kW (D) 160 MW

Answer (D)

Sol. Here net resistance of power line $R = 1\frac{\Omega}{\text{km}} \times 40$ km

$= 40\ \Omega$

Current in line $I = \frac{P}{V} = \frac{100\times10^6}{50{,}000}$

$I = 2 \times 10^3$ A

$\therefore$ Power loss in line $P_{\text{loss}} = I^2R$

$P_{\text{loss}} = (2 \times 10^3)^2(40)$

$= 160 \times 10^6$ W

P_{loss} = 160 MW

Question ID: 7029443

Arrange the cause of energy loss in power transmission from power plant to end user in their sequential order:

A. Hysterisis in step-down transformer

B. Hysterisis in step-up transformer

C. Resistance of copper windings in step-down transformer

D. Resistance of copper windings in step-up transformer

E. Resistance of wire connecting powerplant and sub-station.

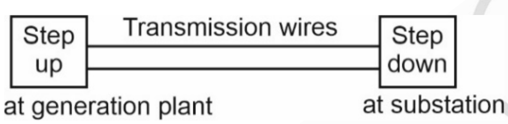
Choose the correct answer from the options given below:

(A) B, D, E, A, C (B) B, C, E, A, D

(C) C, A, E, D, B (D) D, B, E, C, A

Answer (D)

Sol. Transmission of power follows the path



Thus, power loss follows the following sequence

(1) Copper loss at step up transformer (D)

(2) Hysterisis loss in step up transformer (B)

(3) Loss in resistance of connecting wires between power plant and substation (E)

(4) Copper loss at step down transformer (C)

(5) Hysterisis loss in step down transformer (A)

Question ID: 7029444

Which amongst the following is not responsible for energy loss in transformer due to heat?

(A) Flux leakage

(B) Resistance of the windings

(C) Eddy currents

(D) Hysterisis

Answer (A)

Sol. In transformers

Although energy is lost due to flux leakage

But this energy is not lost in the form of heat like in resistance, eddy current or hysteresis loss.

This loss merely accounts for loss due to inefficient coupling of primary and secondary coils.

Question ID: 7029445

In ideal transformer back emf (e_p) in primary coil is equal to the applied voltage (V_p) across primary coil. If this were not so then.

(A) Primary current would be zero

(B) Secondary current would be zero

(C) Primary current would be infinite

(D) Secondary current would be infinite

Answer (C)

Sol. In any coil, applied AC voltage causes current to flow

Which induces a back emf

Thus applied voltage generates a current that gets limited by back emf

If this were not so, there is nothing to impede or block the current and thus primary current will become infinite.

Question ID: 7029446

Passage:

A capacitor is a system of two conductors separated by an insulating medium. Capacitance of this systems is determined purely geometrically, by the shapes, size and relative position of the conductors. The medium between the two conductor can be air or a dielectric. The way the dielectric is inserted accordingly by capacitance changes. Electric energy is stored in the capacitors. The capacitor can be connected in series or in parallel in an electric circuit.

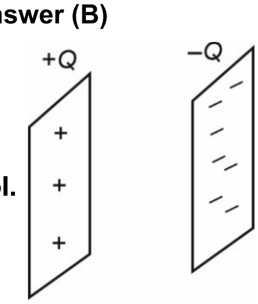
The plates of a parallel plate capacitor with area of each plater A and change Q attract each other with a force.

(A) $\frac{Q^2}{A\varepsilon_0}$ (B) $\frac{Q^2}{2A\varepsilon_0}$

(C) $\frac{2Q^2}{\varepsilon_0 A}$ (D) $\frac{Q^2}{4\varepsilon_0 A}$

Answer (B)

Sol.



Force between plates of a parallel plate capacitor is

$F = QE$

$$F = Q\left(\frac{\sigma}{2\varepsilon_0}\right) \qquad \left[\because E = \frac{\sigma}{2\varepsilon_0}\right]$$

$$F = \frac{Q^2}{2A\varepsilon_0} \qquad \left[\sigma = \frac{Q}{A}\right]$$

Question ID: 7029447

Energy stored in between the plates of a parallel plate capacitor of plate area A, separated by distance d is.

(A) $\frac{1}{2}\varepsilon_0 E^2 Ad$ (B) $\frac{1}{2}\varepsilon_0 E^2 \frac{A}{d}$

(C) $\frac{\frac{1}{2}\varepsilon_0 E^2}{Ad}$ (D) $\frac{1}{2}\varepsilon_0 E^2$

Answer (A)

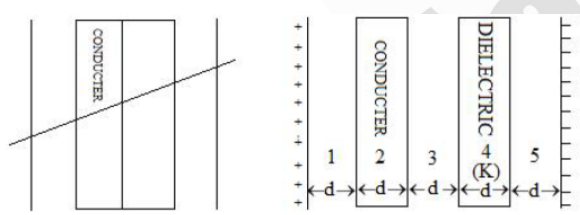
Sol. Energy stored in a parallel plate capacitor per unit volume

$$u = \frac{U}{V} = \frac{1}{2}\varepsilon_0 E^2$$

$$\therefore \quad U = \frac{1}{2}\varepsilon_0 E^2 (\text{volume})$$

$$U = \frac{1}{2}\varepsilon_0 E^2 Ad$$

Question ID: 7029448



A dielectric slab and a conducting slab of thickness d is inserted inside the charged capacitor plates. k is the dielectric constant. The electric field in the regions 2, 3, 4 are.

(A) $\frac{\sigma}{\varepsilon_0}, \frac{\sigma}{k\varepsilon_0}$ (B) $\frac{\sigma}{\varepsilon_0}, \frac{\sigma}{\varepsilon_0}, \frac{\sigma}{k\varepsilon_0}$

(C) $\frac{\sigma}{\varepsilon_0}$, zero, $\frac{\sigma}{k\varepsilon_0}$ (D) zero, zero, $\frac{\sigma}{k\varepsilon_0}$

Answer (C*)

Sol. We known

Electric field inside a conductor is zero.

And, if electric field in free space is E_0

Then electric field in dielectric (having dielectric constant K) $= \frac{E_0}{K}$

$\therefore$ For region (2) $\rightarrow E_2$ = Zero

For region (3) $\rightarrow E_3 = \frac{\sigma}{\varepsilon_0}$

For region (4) $\rightarrow E_4 = \frac{\sigma}{K\varepsilon_0}$

Note: Values of electric field given in option 'C' are not in order in the space 2, 3, 4 respectively.

Question ID: 7029449

An electrical technician required a capacitance of 2 μF. in a circuit across a potential difference of 1 kV. A large no of 1 μF capacitors are available to him each of which can withstand a potential difference of not more than 300 V. The minimum number of capacitor required for the arrangement will be.

(A) 18 (B) 24

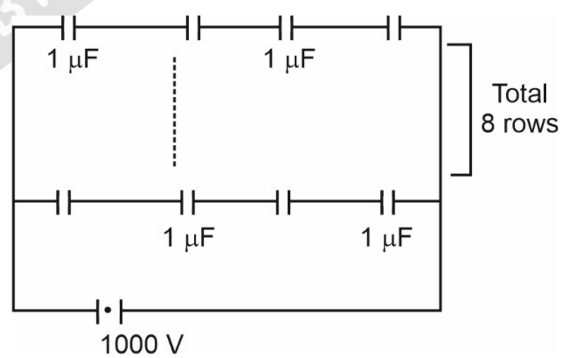
(C) 32 (D) 36

Answer (C)

Sol. Here C_{net} = 2 μF

Applied voltage = 1000 V

The circuit can be arranged as



Voltage on each capacitor = 250 V

And, capacitance of each branch = $\frac{1}{4}$ μF

$$\therefore \quad C_{net} = \left(\frac{1}{4}\right)8 = 2\ \mu\text{F}$$

So, total 8 rows are required

Thus minimum 32 capacitors are required for this setup

Question ID: 7029450

Given below are two statements.

Statement I: Equivalent capacitance of a series combination of three capacitors will always be greater than any individual capacitance connected in series.

Statement II: When a series combination of three capacitors is connected across a voltage source, magnitude of charge stored on each plate of all the three capacitors is the same.

In the light of the above statements, choose the **correct** answer from the options given below:

(A) Both statement I and statement II are true

(B) Both statement I and statement II are false

(C) Statement I is correct but statement II is false

(D) Statement I is incorrect but statement II is true

Answer (D)

Sol. In series combination,

Net capacitance < Capacitance of any individual capacitor.

But,

In series combination charge stored on each capacitor is same

$\therefore$ Statement I is incorrect

While statement II is correct

❑ ❑ ❑