JEE-Main-29-07-2022-Shift-1 (Memory Based)

Physics

Question: Position of a particle x at time t are related as $t=\sqrt{2x+4}$. The velocity of the particle at $t=4s$ is equal to (in S.I. units)

Options:

(a) 4

(b) 2

(c) 1

(d) 5

Answer: (a)

Solution:

$$t=\sqrt{2x+4} \Rightarrow x=\frac{1}{2}\left(t^2-4\right)$$

$$\Rightarrow \frac{dx}{dt}=v=t$$

At $t=4s, v=4m/s$

Question: Two rods of identical lengths and cross-sectional area are connected in series. If σ_1 and σ_2 is the thermal conductivity of material of two rods then equivalent conductivity of combination is equal to

Options:

(a) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

(b) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

(c) $\frac{\sigma_1\sigma_2}{\sigma_1-\sigma_2}$

(d) $\frac{2\sigma_1\sigma_2}{\sigma_1-\sigma_2}$

Answer: (a)

Solution:

$$R_1=\frac{L}{\sigma_1 A}, R_2=\frac{L}{\sigma_2 A}$$

$R_{net} = R_1 + R_2 = \frac{L}{A}\left(\frac{1}{\sigma_1} + \frac{1}{\sigma_2}\right)$

Must be equivalent to $R_{net} = R_1 + R_2 = \frac{2L}{\sigma A}$

So, $\frac{2L}{\sigma A} = \frac{L}{A}\left(\frac{1}{\sigma_1} + \frac{1}{\sigma_2}\right)$

$\sigma = \frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

Question: A travelling microscope has vernier scale with 9MSD = 10 VSD. If one main scale division (MSD) is equal to 1 mm, then least count of travelling microscope is

Options:

(a) 0.005 m

(b) 0.002 m

(c) 0.0001 m

(d) 0.0005 m

Answer: (c)

Solution:

Least count, $LC = 1MSD - 1VSD$

$\Rightarrow LC = 1MSD - \frac{9}{10}MSD$

$\Rightarrow LC = \frac{1}{10}MSD = \frac{1}{10} \times 0.001m$

$\Rightarrow LC = 0.0001m$

Question: Find the ratio of energy of electron when it transitions from second to first energy state in comparison to highest state to first energy state of hydrogen atom

Options:

(a) $\frac{1}{4}$

(b) $\frac{5}{36}$

(c) $\frac{8}{9}$

(d) $\frac{3}{4}$

Answer: (d)

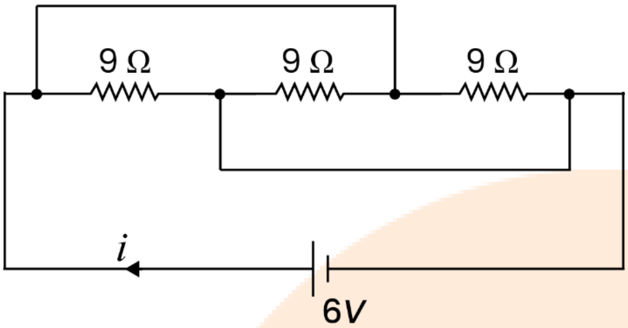
Solution:

Energy of photon is given as $E = h\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

So, $\dfrac{(hv)_{2\to1}}{(hv)_{\infty\to1}} = \dfrac{\left(\dfrac{1}{1^2}-\dfrac{1}{2^2}\right)}{\left(\dfrac{1}{1^2}-\dfrac{1}{\infty^2}\right)} = \dfrac{\left(\dfrac{3}{4}\right)}{1}$

Ratio $= 3:4$

Question: The value of current (in A) as shown is _____.



Options:
(a) 2A
(b) 3A
(c) 4A
(d) 5A
Answer: (a)
Solution:
All the resistance are in parallel.
$\Rightarrow R_{net} = 3\Omega$

$\Rightarrow i = \dfrac{V}{R_{net}} = \dfrac{6}{3} = 2A$

Question: Find the value of electric field at depletion layer in p-n junction if width is $6\times10^{-6}\,m$ and potential difference is 0.6 V, is ______ $\times10^{5}V/m$
Options:
(a) 2×10^{-5} V/m
(b) 6×10^{-6} V/m
(c) 1×10^{5} V/m
(d) 3×10^{6} V/m
Answer: (c)
Solution:
$AV = E.D$

$E = \dfrac{(0.6)}{6\times10^{-6}}$

$E = 1\times10^{5}V/m$

Question: A projectile with kinetic energy E at point of projection is projected at angle 45°. Its kinetic energy at top most point is equal to

Options:

(a) $\frac{E}{2}$

(b) $\frac{3E}{2}$

(c) $\frac{E}{4}$

(d) $\frac{E}{3}$

Answer: (a)

Solution:

$$\Rightarrow K.E_i = \frac{1}{2}mv^2 = E$$

Speed at highest point $v'; v\cos 45° = \frac{v}{\sqrt{2}}$

$$\Rightarrow K.E_f = \frac{1}{2}mv'^2 = \frac{1}{4}mv^2$$

$$K.E_f = \frac{E}{2}$$

Question: A particle thrown at angle 45° with horizontal with speed u has its range equal to R. At what angle should it be thrown with same speed for its range to be half of its initial value.

Options:

(a) 60°

(b) 30°

(c) 15°

(d) 70°

Answer: (c)

Solution:

$$\Rightarrow R = \frac{u^2 \sin(2\times 45°)}{g} = \frac{u^2}{g}$$

For range $\frac{R}{2}$

$$\Rightarrow \frac{u^2}{2g} = \frac{u^2 \sin 2\theta}{g}$$

$$\sin 2\theta = \frac{1}{2}$$

$$\Rightarrow \theta = 15°$$

Question: A cart is moving down a smooth incline of inclination α. What is the time period of a bob hanging from the roof of the cart with a light string?

Options:

(a) $2\pi\sqrt{\frac{l}{g\cos\alpha}}$

(b) $2\pi\sqrt{\frac{l}{g}}$

(c) $2\pi\sqrt{\frac{l}{g\sin\alpha}}$

(d) $2\pi\sqrt{\frac{l}{g\cot\alpha}}$

Answer: (a)

Solution:

$$g_{eff} = g\cos\alpha$$

$$T = 2\pi\sqrt{\frac{l}{g\cos\alpha}}$$

Question: If one mole of monoatomic gas and three moles of diatomic gas are mixed, then the molar heat at constant volume is $\alpha^2 R/4$. The value of α is ----------

Options:

(a) 2

(b) 3

(c) 5

(d) 1

Answer: (b)

Solution:

$$C_{V_{mix}} = \frac{\left(n_1 CV_1 + n_2 C_{V_2}\right)}{n_1 + n_2}$$

$$C_{V_{mix}} = \frac{\left(1\times\frac{3}{2}R + 3\times\frac{5}{2}R\right)}{1+3}$$

$$C_{V_{mix}} = \frac{9}{4}R \qquad \text{So, } \alpha = 3$$

Question: A wire of length 314 cm is made into a circular coil. Find its magnetic moment (in Am^2 if I = 14 A. $(\pi = 3.14)$

Options:

(a) 10 Am^2

(b) 8 Am^2

(c) 6 Am^2

(d) 11 Am^2
Answer: (d)
Solution:

$$\mu = i\pi r^2$$

$$\mu = i\pi\left(\frac{l}{2\pi}\right)^2$$

$$\mu = 14\times\pi\left(\frac{3.14}{2\times 3.14}\right)^2$$

$$\mu = 11\,Am^2$$

Question: Assertion: Potential is constant on surface & inside of conductor.
Reason: E is perpendicular to surface of conductor.
Options:
(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(b) If both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) If assertion is true, but reason is false.
(d) If both the assertion and reason are false.
Answer: (a)
Solution:
Since E=0, therefore the potential V inside the surface is constant. Because there is no potential difference between any two points inside the conductor, the electrostatic potential is constant throughout the volume of the conductor.