JEE-Main-25-06-2022-Shift-2 (Memory Based)

Physics

Question: If f is the degree of freedom, then $\frac{C_P}{C_V}$ for Ideal gas is

Options:

(a) $\gamma = 1+\frac{2}{f}$

(b) $\gamma = 1+\frac{4}{f}$

(c) $\gamma = 1+\frac{6}{f}$

(d) None of these

Answer: (a)

Solution:

We have

$C_V = \frac{f}{2}R$ and $C_P - C_V = R$

$C_P - \frac{f}{2}R = R$

$C_P = R + \frac{f}{2}R$

$C_P = R\left(1+\frac{f}{2}\right)$

Hence,

$\gamma = \frac{C_P}{C_V} = \frac{R\left(1+\frac{f}{2}\right)}{R\frac{f}{2}} = 1+\frac{2}{f}$

$\gamma = 1+\frac{2}{f}$

Question: The graph of $ln\left(\frac{A}{A_0}\right)$ with time is

Options:

(a) $-\lambda t$

(b) λt

(c) λt^2

(d) $\lambda^2 t^2$

Answer: (a)

Solution:

We know

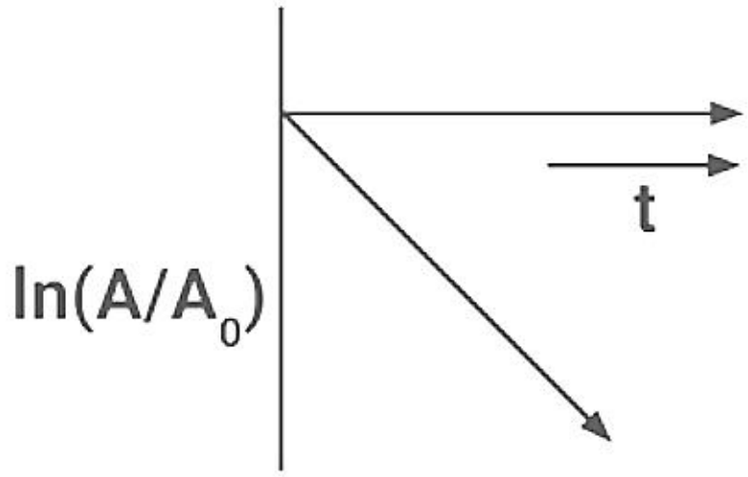
$$A = A_0 e^{-\lambda t}$$

$$\frac{A}{A_0} = e^{-\lambda t}$$

Taking log both the sides

$$\ln\left(\frac{A}{A_0}\right) = \ln\left(e^{-\lambda t}\right)$$

$$\ln\left(\frac{A}{A_0}\right) = -\lambda t$$



Question: A parallel plate capacitor has a distance of d between the plates. Now a metal sheet of thickness $\frac{d}{2}$ is inserted in between. The ratios of new to dd capacitance is?

Options:

(a) 3 : 2

(b) 4 : 7

(c) 2 : 1

(d) 1 : 2

Answer: (c)

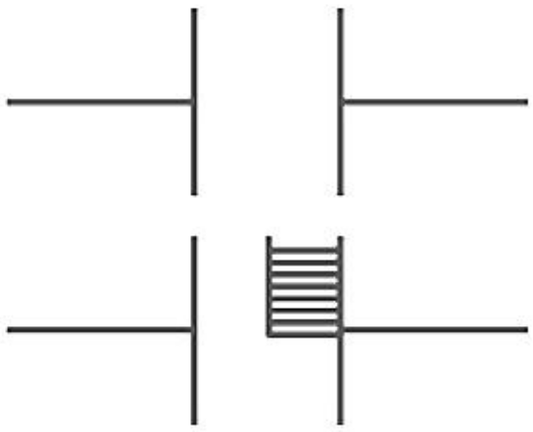
Solution:

$$C_0 = \frac{\varepsilon_0 A}{d}$$

$$C_1 = \frac{\varepsilon_0 A}{d/2}$$

$$C_1 = 2C$$

$$\frac{C_1}{C} = 2$$



Question: R = Radius of nucleus, R_0 = Nuclear constant and A = Mass No. of Nuclic, then graph of θ / $\ell n\left(\frac{R}{R_0}\right)$ with / ℓnA is

Options:

(a) $\frac{1}{2}\ell A$

(b) $\frac{1}{3}\ell A$

(c) $\frac{1}{8}\ell A$

(d) None of these

Answer: (b)

Solution:

We know,

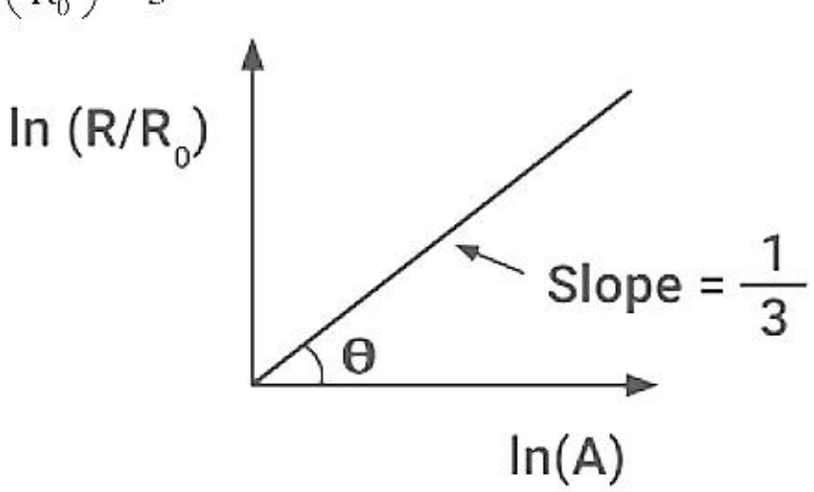
$R = R_0 A^{1/3}$

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

Taking log both the sides

$\ell n\left(\frac{R}{R_0}\right) = \ell n\left(A^{1/3}\right)$

$\ell n\left(\frac{R}{R_0}\right) = \frac{1}{3}\ell A$



Question: Two satellites revolve around a planet, with radius 3200 km and 800 km what is their ratio of orbital speeds?

Options:

(a) 2 : 3
(b) 2 : 1
(c) 3 : 2
(d) 1 : 2
Answer: (d)
Solution:

$$v = \sqrt{\frac{GM}{r}}$$

$$\frac{v_1}{v_2} = \sqrt{\frac{800}{3200}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

Question: Find MOI of following
(A) Solid sphere about diameter
(B) DISC about axis $\perp$ to plane and passing through center.
(C) HOLLOW cylinder about it axis
(D) RING about axis $\perp$ to plane and passing through center
Options:

(a) $A = \frac{1}{2}mR^2$, $B = mR^2$, $C = \frac{mR^2}{2}$, $D = \frac{2}{5}mR^2$

(b) $A = mR^2$, $B = mR^2$, $C = \frac{mR^2}{2}$, $D = \frac{2}{5}mR^2$

(c) $A = \frac{2}{5}mR^2$, $B = \frac{mR^2}{2}$, $C = mR^2$, $D = mR^2$

(d) None of these
Answer: (c)
Solution:

(A) Moment of inertial solid sphere about its diameter $= \frac{2}{5}mR^2$

(B) Moment of inertia of disc about an axis perpendicular to the plane and passing through the center $= \frac{mR^2}{2}$

(C) Moment of inertia of hollow cylinder about its axis $= mR^2$

(D) Moment of inertia of ring about an axis perpendicular to the plane R passing through center $= mR^2$

Question: If electron, Deutron and Proton and alpha particle are accelerated from rest same $p \cdot d$, then find the descending order of wavelengths
Options:

(a) $\lambda_D > \lambda_e > \lambda_\alpha > \lambda_p$

(b) $\lambda_e > \lambda_p > \lambda_D > \lambda_\alpha$

(c) $\lambda_p > \lambda_e > \lambda_\alpha > \lambda_D$

(d) None of these
Answer: (b)

Solution:

$$E = \frac{hc}{\lambda}$$

$$qV = \frac{hv}{\lambda}$$

$$\lambda = \frac{hc}{qV}$$

$v \rightarrow$ constant, $hv \rightarrow$ constant

$$\tau \propto \frac{1}{9}$$

So the sequence in decreasing order of wavelengths

Question: If the metal has threshold frequency of 5×10^{14} Hz then find out the work function of the metal

Options:

(a) 2.06 ev

(b) 3 ev

(c) 4.04 ev

(d) 3.25 ev

Answer: (a)

Solution:

Work function $(\phi) = hv_0$

$$= \frac{6.67\times10^{-34}\times5\times10^{4}}{1.6\times10^{-19}} ev$$

$$= 2.06ev$$

Question: If $X_a = at + bt^2$ and $X_b = at^2 + bt$ then at what time their velocities will be equal?

Options:

(a) $t = \frac{2(a+b)}{a+b}$

(b) $t = \frac{2(a+b)}{2a+3b}$

(c) $t = \frac{a+b}{2(a+b)}$

(d) none of these

Answer: (c)

Solution:

$X_a = at + bt^2 \Rightarrow V_a = a + 2bt$

$X_b = at^2 - bt \Rightarrow V_b = 2at - b$

Δ / θ

$V_a = V_b$

$a + 2bt = 2at - b$

$$a+b=(2a-2b)t$$

$$t=\frac{a+b}{2(a+b)}$$

Question: A cube of surface area 24 cm^2, heated by $10°C$ which has coefficient of linear expansion of 5×10^{-4}. Then the change in volume is?

Options:

(a) 0.02 cc

(b) 0.12 cc

(c) 0.01 cc

(d) 0.11 cc

Answer: (b)

Solution:

$\Delta V = V\times 3\alpha\Delta T$

$=\theta\times10^{-6}\times3\times5\times10^{-4}\times10$

$=120\times10^{-10+1}$

$=120\times10^{-9}$

$=0.12\times11^{-6}$

$=0.12cc$

Question: The magnetic field at centre of solenoid is B_0. When no. of turns is halved & current is doubled, what is the new field?

Options:

(a) $2B_0$

(b) B_0

(c) $B_0/2$

(d) $3B_0$

Answer: (b)

Solution:

Initially

$B_0=\mu_0 n_1 i_1$

No. of turns is now halved,

&current is doubled.

$\therefore B'=\mu_0 n_1(2).\frac{i_1}{2}$

$=\mu_0 n_2 i_1=B_0$

Question: If velocity of E.M wave is 2 x 10^8 ms^{-1} in a medium where $\mu_r=1$, then find $\in_r$?

Options:

(a) $\frac{9}{4}$

(b) $\frac{8}{5}$

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

(d) $\frac{9}{2}$

Answer: (a)

Solution:

$$\frac{v}{c}=\frac{1}{\sqrt{\mu_r \in_r}}$$

$$\Rightarrow \in_r=\frac{c^2}{v^2\mu_r}=\frac{\left(3\times10^8\right)^2}{\left(2\times10^8\right)^2\times1}=\frac{9}{4}$$

Question: Two cells of same *emf* have internal resistance r_1 & r_2 are in series with load R. If potential difference across the 2nd cell is zero, R= ?

Options:

(a) $R=\left|r_1-r_2\right|$

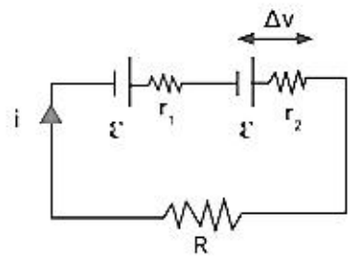
(b) $R=\left|r_2+r_1\right|$

(c) $R=\left|r_1+r_2\right|$

(d) $R=\left|r_2-r_1\right|$

Answer: (d)

Solution:



$$i=\frac{2\varepsilon}{R+r_1+r_2}$$

$$\Delta v=\varepsilon-ir_2$$

$$0=\varepsilon-\frac{2\varepsilon}{R+r_1+r_2}r_2$$

$$1=\frac{2r_2}{R+r_1+r_2}$$

$$R+r_1+r_2=2r_2$$

$$R=\left|r_2-r_1\right|$$

Question: Assertion: Two balls are projected such mat may have same range R & have maximum heights H_1& H_2 respectively man $R = H\sqrt{H_1 H_2}$

Reason: $H_1 = \frac{u^2 \sin^2 \theta}{2g}$

$H_2 = \frac{u^2 \cos^2 \theta}{2g}$

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:

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

Range is same For $\theta \& (90° - \theta)$

Height $H_1 = \frac{u^2 \sin^2 \theta}{2g}$

For $(90 - \theta), H_2 = \frac{u^2 \cos^2 \theta}{2g}$

$\sqrt{H_1 H_2} = \frac{u^2 \sin\theta \cos\theta}{2g}$

$4\sqrt{H_1 H_2} = \frac{2u^2 \sin\theta \cos\theta}{g} = \frac{u^2 \sin 2\varepsilon}{g}$

$= R$

Question: For a particle moving in XY plane in UCM speed v and radius r, the acceleration vector at any (r, θ) is?

Options:

(a) $-\cos\theta\hat{i} + \sin\theta\hat{j}$

(b) $-\cos\theta\hat{i} - \sin\theta\hat{j}$

(c) $+\cos\theta\hat{i} - \sin\theta\hat{j}$

(d) $\cos\theta\hat{i}+\sin\theta\hat{j}$

Answer: (b)

Solution:

Position vector at any instant 't'

$\vec{r}=R\cos\theta\hat{i}+R\sin\theta\hat{j}$

$\therefore\dot{v}=-R\omega\sin\theta\hat{i}+R\omega\cos\theta\hat{j}$

$\&\vec{a}=-R\omega^2\cos\theta\hat{i}-R\omega^2\sin\theta\hat{j}$

Since $v=\omega R$ in UCM

$\vec{a}=\frac{v^2}{R}\left(-\cos\theta\hat{i}-\sin\theta\hat{j}\right)$

Question: 27 drops each of 22 volts each combined together to form abig drop, its potential is

Answer: (198)

Solution:

$27\times\frac{4\pi r^3}{3}=\frac{4}{3}\pi R^3$

$R=3r$

$22=\frac{KQ}{r}$

$V=k\times\frac{27Q}{R}$

$=k\times\frac{27Q}{3r}$

$=9\frac{KQ}{r}=9\times22$

$V=198$ Volts

Question: If $\frac{I_1}{I_2}=\frac{1}{4}$ then $\frac{I_{max}+I_{min}}{I_{max}-I_{min}}=\frac{5}{x}$ fine value x?

Answer: (4)

Solution:

$$\frac{I_1}{I_2}=\frac{1}{4}\Rightarrow I_2=4I_1$$

$$\frac{I_{max}}{I_{min}}=\frac{\left(\sqrt{I_1}+\sqrt{I_2}\right)^2}{\left(\sqrt{I_1}-\sqrt{I_2}\right)^2}$$

$$=\frac{\left(\sqrt{I_1}+\sqrt{4I_1}\right)^2}{\left(\sqrt{I_1}-\sqrt{4I_1}\right)^2}=\frac{9}{1}$$

$$\Rightarrow I_{max}=9I_{min}$$

$$\therefore \frac{I_{max}+I_{min}}{I_{max}-I_{min}}=\frac{9+1}{9-1}=\frac{10}{8}$$

$$=5/4$$

$$\therefore x=4$$

Question: when temperature is increased the susceptibility of para and ferro materials will?

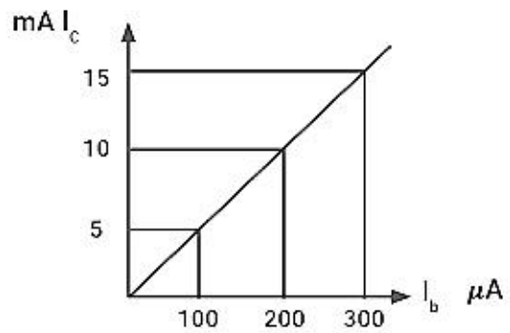
Answer: ($x\propto\frac{1}{T-T_C}$)

Solution:

Para: $x\propto\frac{1}{T}$

Ferro turns to para after curie's temp. and then $x\propto\frac{1}{T-T_C}$

Question: Current electricity characteristics of npn transistor is given as below. If input resistance is 60 Ohm, Output resistance is 200 Ohm find voltage gain



Answer: (500/3)

Solution:

From graph,

$I_C=15\text{mA}$

$I_B=300\mu A$

$R_i=60\Omega$

$R_0=200\Omega$

$$\therefore A_v = \frac{I_C R_0}{I_B R_i} = \frac{15\times10^{-3}\times200}{300\times10^{-6}\times60}$$

$$= \frac{500}{3}$$