JEE-Main-27-06-2022-Shift-1 (Memory Based)

Physics

Question: A particle starts from mean position at t = 0 and at t = 3 sec its displacement is half the amplitude of particle. Find time period.

Options:

(a) 25 sec

(b) 30 sec

(c) 36 sec

(d) 24 sec

Answer: (c)

Solution:

$y = A\sin\omega t$

At $t = 3$ sec,

$\frac{A}{2} = A\sin 3\omega$

$\Rightarrow \sin 3\omega = \frac{1}{2}$

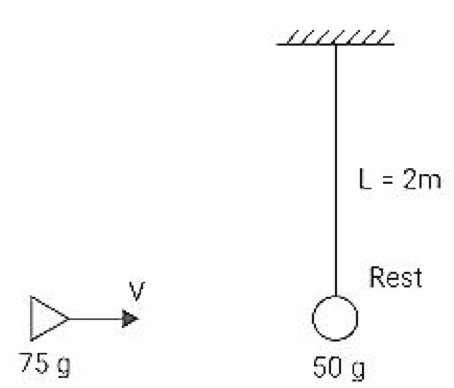
$3\omega = \frac{\pi}{6}$

$\omega = \frac{\pi}{18}$

$\frac{2\pi}{T} = \frac{\pi}{18}$

T = 36 sec

Question: A bullet of mass 75 g moving mM velocity v strikes a bob of mass 50 g as shown



If bullet emerges out from bob with velocity $\frac{v}{3}$ and bob just completes vertical circular motion. Find the velocity v of bullet.

Options:

(a) 10 m/s

(b) 7 m/s

(c) 12 m/s

(d) 5 m/s

Answer: (a)

Solution:

$$75\times10^{-3}\times v=50\times10^{-3}\times v^{1}+75\times10^{-3}\times\frac{v}{3}$$

$$75\times10^{3}v=50\times10^{-3}\times\sqrt{5rg}\times75\times10^{-3}\frac{v}{3}$$

A to Q

r = 2m

g = 10 m/s^2

$$75\times10^{-3}\times v=50\times10^{-3}\sqrt{5\times2\times10}+75\times10^{-3}\times\frac{v}{3}$$

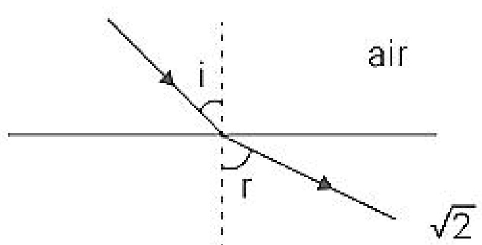
$$75\times10^{-3}\left(2\frac{v}{3}\right)=50\times10^{-3}\times10$$

$$15\times10^{-3}\times v=15^{\circ}\times10^{-2}$$

$$v=\frac{10^{-2}}{10^{-3}}$$

v = 10 m/s

Question: Find angle of incidence. Find angle of refraction is twice of angle of incidence.



Options:

(a) $\cos^{-1}\left(\frac{2}{1\sqrt{2}}\right)$

(b) $\sin^{-1}\left(\frac{1}{2\sqrt{2}}\right)$

(c) $\cos^{-1}\left(\frac{1}{2\sqrt{2}}\right)$

(d) $\sin^{-1}\left(\frac{2}{2\sqrt{1}}\right)$

Answer: (c)

Solution:

Snell's law

$$1 \times \sin i = \sqrt{2}\sin(2i)$$

$$\sin i = \sqrt{2}(2\sin i \cos i)$$

$$\cos i = \frac{1}{2\sqrt{2}}$$

$$\boxed{i = \cos^{-1}\left(\frac{1}{2\sqrt{2}}\right)}$$

Question: If susceptibility of a material is 99, the magnetic permeability is?

Options:

(a) $5\pi \times 10^{-5}$

(b) $7\pi \times 10^{-5}$

(c) $4\pi \times 10^{-5}$

(d) $2\pi \times 10^{-5}$

Answer: (c)

Solution:

$$\mu_R = 1 + x$$

$$\frac{\mu_m}{\mu_0} = 1 + 99$$

$$\mu_m = 100 \times 4\pi \times 10^{-7}$$

$$\mu_m = 4\pi \times 10^{-5}$$

Question: If sources is at rest and observer is a approaching the source with $\frac{1}{5}m$ of velocity of sound. Find percentage change in frequency received by observer

Options:

(a) 25%

(b) 15%

(c) 30%

(d) 20%

Answer: (d)

Solution:

$$f' = f\left(\frac{v + v_0}{v - v_s}\right)$$

$$\text{Here}, v_0 = \frac{v}{5} \ \& \ v_s = 0$$

$$f' = f\left(\frac{v + v/s}{v}\right) = \frac{6}{5}f$$

$\therefore$ Change in frequency

$$f' - f = \left(\frac{6}{5} - 1\right) f$$

$$= \frac{1}{5} f = 20\%$$

Question: A body of mass m and density d_1 falls in a liquid of density d_2 and viscosity n. Find the terminal speed?

Options:

(a) $d_1 - d_2$

(b) $d_2 - d_1$

(c) $d_1 + d_1$

(d)) $d_2 + d_1$

Answer: (a)

Solution:

$$v_t = \frac{2}{9} \frac{r^2 g}{n} (d_1 - d_2)$$

$$m = \frac{4}{3} \pi r^3 . d_1$$

$$\therefore r^3 = \frac{3m}{4\pi d_1}$$

$$\therefore v_t = \frac{2g}{9n} \left(\frac{3m}{4\pi d_1}\right)^{2/3} (d_1 - d_2)$$

Question: Force on a charge between plates of a capacitor is 10 N. What will be the force if one of the plate is removed?

Options:

(a) 2 N

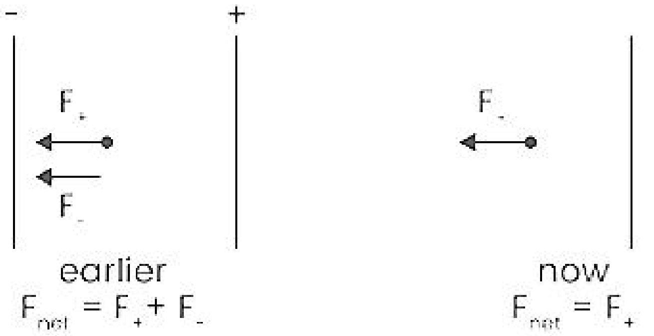
(b) 5 N

(c) 7 N

(d) 4 N

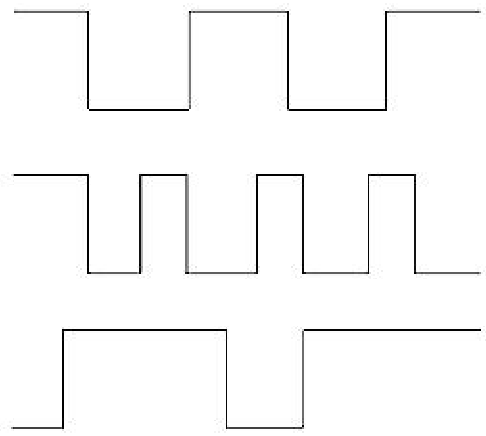
Answer: (b)

Solution:



$$\therefore \text{ New force } = \frac{1}{2} \text{old force} = \frac{1}{2} \times 10 = 5N$$

Question: Identify the logic gate for the following output inputs A and B



Options:

(a) AND gate

(b) NOR gate

(c) NAND gate

(d) XOR gate

Answer: (c)

Solution:

From the given diagram, we get

A	B	Output
1	1	0
0	0	1
0	1	1
1	0	1

This gives us a NAND gate.

Question: Find the dimensions of self inductance

Options:

(a) $\left[L^1M^2T^{-2}A^{-2}\right]$

(b) $\left[L^1M^1T^{-4}A^{-2}\right]$

(c) $\left[L^2M^1T^{-2}A^{-2}\right]$

(d) $\left[L^3M^1T^{-2}A^3\right]$

Answer: (c)

Solution:

$$e = L\frac{dI}{dt} \therefore L = \frac{edt}{dI} \therefore L = \frac{edt}{dI} = \frac{W}{q}\frac{dt}{dI}$$

$$= \frac{\left[L^2M^1T^{-2}\right]}{A\times T}\times\frac{T}{A}$$

[self inductance] $\left[L^2M^1T^{-2}A^{-2}\right]$

Question: Hydrogen in the ground state absorbs 10.2 ev. Find change in angular momentum.

Options:

(a) $\frac{h}{5\pi}$

(b) $\frac{h}{4\pi}$

(c) $\frac{h}{2\pi}$

(d) $\frac{h}{1\pi}$

Answer: (c)

Solution:

change in energy = 10.2 ev

i.e. transition is from n = 1 to n = 2

$\therefore$ change in momentum $= \frac{h}{2\pi}$

Question: Find the ratio of De Broglie wavelength of an α particle and carbon 12 for the same K.E.

Options:

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

(b) $\frac{\sqrt{6}}{1}$

(c) $\frac{\sqrt{2}}{1}$

(d) $\frac{\sqrt{3}}{1}$

Answer: (d)

Solution:

$$\lambda = \frac{h}{\sqrt{2mk}}$$

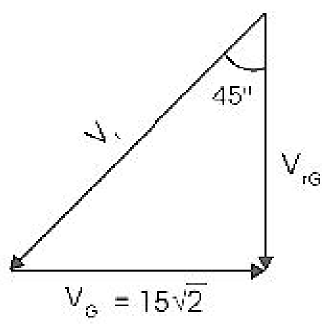
$$\lambda_\alpha = \frac{h}{\sqrt{2m_\alpha k_\alpha}}$$

$$\lambda_{c_{12}} = \frac{h}{\sqrt{2m_{c_{12}} k_{c_{12}}}}$$

$$\therefore \frac{\lambda_\alpha}{\lambda_{\alpha_{12}}} = \sqrt{\frac{m_{c_{12}}}{m_\alpha}} = \sqrt{\frac{12}{4}} = \frac{\sqrt{3}}{1}$$

Question: If rain falls vertically on girl when girl starts running with velocity of $15\sqrt{2}$, while standing she holds her umbrella at angle of 45° with vertical. Find the velocity of rain?

Options:
(a) 40 m/s
(b) 80 m/s
(c) 60 m/s
(d) 30 m/s
Answer: (b)
Solution:



From diagram

$$\sin 45° = \frac{v_g}{v_r}$$

$$v_r = \frac{15\sqrt{2}}{\sin 45°}$$

$$v_r = 80\, m/s$$

Question: Ball is projected with 20 m/s from horizontal at an angle α. After 10 sec, it makes an angle β with horizontal then find relation between α and β
Options:

(a) $1 - \frac{200}{10\sin\alpha}$

(b) $1 - \frac{300}{20\sin\alpha}$

(c) $1 + \frac{100}{30\sin\alpha}$

(d) $1 - \frac{100}{20\sin\alpha}$

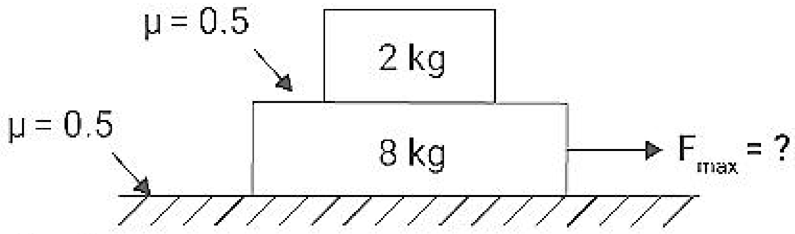
Answer: (d)
Solution:

$$\tan\alpha = \frac{u_y}{u_x} \ \tan\beta = \frac{v_y}{v_x}$$

$$u_x = v_x \text{ and } v_y = u_y - gt = u_y - 100$$

$$\frac{\tan\beta}{\tan\alpha} = \frac{u_y - 100}{u_y} = 1 - \frac{100}{20\sin\alpha}$$

Question: Find Maximin force So that 100 m blocks move Together.



Options:

(a) 78 N

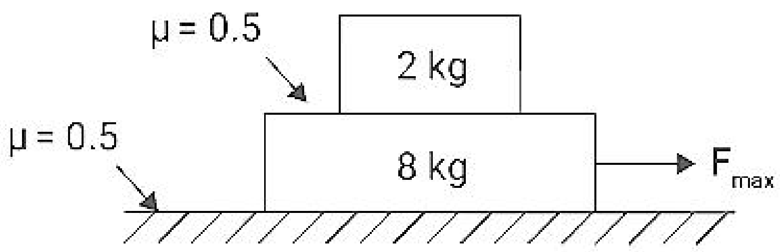
(b) 88 N

(c) 98 N

(d) 68 N

Answer: (c)

Solution:



for bath the block moving together

$a = \mu g$

So,

$a = 0.5 \times 9.8$

$a = 49 \text{m} / s^2$

Now Considering 2kgt 8kg as one body & drawing FBD.

$F_{max} - \mu_2 N = ma$

$F_{max} - 0.5 \times 10 \times 9.8 = 10 \times 4.9$

$F_{max} - 49 = 49$

$F_{max} = 98 N$

Question: S-1Gravitation law holds good for any objects in universe.

S-2 Wt. of body at center of earth is 0.

Options:

(a) 1

(b) 0

(c) 3

(d) 5

Answer: (b)

Solution:

Both statements are correct.

$g' = g\left(1 - \frac{d}{R_e}\right)$; at center

$d = R_e$

$g' = 0$

Question: For a Carnot engine, source temperature $527^\circ C$ and sink at $200k$. If $12 kJ$ of work is done then heat absorbed is?

Options:

(a) 16 KJ

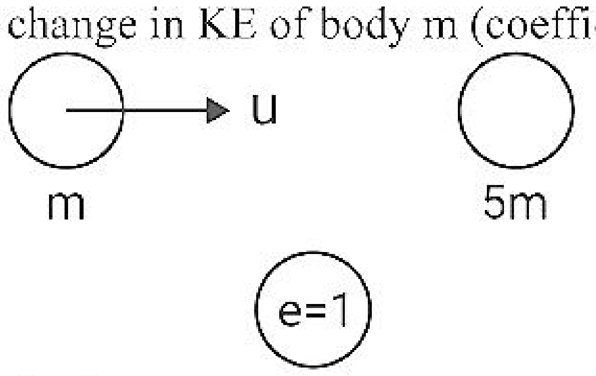
(b) 13 KJ
(c) 15 KJ
(d) 19 KJ
Answer: (b)
Solution:

$$n = 1 - \frac{T_C}{T_H} = \frac{W}{Q_a}$$
$$\therefore 1 - \frac{200}{800} = \frac{12}{Q_A}$$
$$\therefore \frac{3}{4} = \frac{12}{Q_A}$$
$$\therefore Q_A = 16\text{KJ}$$

Question: A Transmitter Antenna has Height 49 m & Receiver Antenna has height 25 m. Find maximum distance through which signal con be Transmitted.
Options:
(a) 32.54
(b) 23.35
(c) 42.93
(d) 51.23
Answer: (c)
Solution:

$$= \sqrt{2RG_T} + \sqrt{2RG_R}$$
$$= \sqrt{2 \times 6400 \times 10^3 \times 49} + \sqrt{2 \times 6400 \times 10^3 \times 25}$$
$$= 42.93 \times 10^3 \text{ m}$$
$$= 42.93\text{km}$$

Question: If bodies with masses m and 5 m collide as shown in the figure, then find out \% change in KE of body m (coefficient of restitution e =1)



Options:
(a) 32.65%
(b) 74.93%
(c) 43.85%
(d) 55.56%
Answer: (d)
Solution:

$$mu_1 + m_2u_2 = m_1v_1 + m_2v_2$$
$$mu + 5m \times 0 = mv_1 + 5mv_2 \ldots(1)$$

Again,

$$e = 1 = \frac{V_2 - V_1}{u_1 - u_2}$$

$$1 = \frac{v_2 - v_1}{4 - 0}$$

$$v_2 - v_1 = u$$

$$v_2 = u + v_1 \ldots(1)$$

$$mu = mv_1 + 5m(u + v_1)$$

$$mu = mv_1 + 5mu + 5mv_1 - 4mu = 6mv_1$$

$$v_1 = -\frac{2}{3}u$$

So,

$$k_i = \frac{1}{2}mu^2$$

$$k_f = \frac{1}{2}mv_1^2$$

$$= \frac{1}{2}m\left(-\frac{2}{3}4\right)^2$$

$$= \frac{1}{2} \times \frac{4}{9}m4^2$$

$$= \frac{4}{9}k_i$$

So % Change in $k\varepsilon$

$$\frac{K_f - K_i}{K_r} \times 100 = \frac{\frac{4}{9}K_i - K_1^1}{K_i} \times 100$$

$$= \frac{-5}{9} \times 100$$

$$= \frac{-500}{9}$$

$$= -55.56\%$$

If decreases by 55.56%

Question: A body of mars m density d_1 falls on liquid of density d_2 and attains terminal velocity. Find viscous force.

Options:

(a) $mg\left[1 - \frac{d_2}{d_1}\right]$

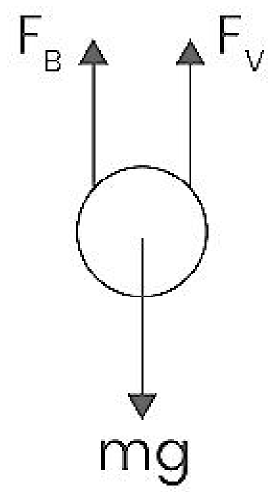
(b) $mg\left[1 + \frac{d_2}{d_1}\right]$

(c) $mg\left[1 < \frac{d_2}{d_1}\right]$

(d) $mg\left[1 > \frac{d_2}{d_1}\right]$

Answer: (a)

Solution:



After attaining terminal velocity $F_{net} = 0$

$$mg = F_B + F_V$$

$$mg = \left(\frac{m}{d_1}\right) d_2 g + F_v$$

$$F_v = mg\left[1 - \frac{d_2}{d_1}\right]$$

Question: Find λ of emitted photon for transition in $L_i + 2$ from 3rd orbit to 1st orbit.

Options:

(a) 1.13×10^{-8} m

(b) 1.12×10^{-8} m

(c) 1.14×10^{-8} m

(d) 1.10×10^{-8} m

Answer: (c)

Solution:

$$\lambda = 1.14 \times 10^{-8} \text{ m}$$

$$\frac{1}{\lambda} = Rz^2\left[\frac{1}{n_f^2} - \frac{1}{n_i^2}\right]$$

$$\frac{1}{\lambda} = R(3)^2\left[\frac{1}{1^2} - \frac{1}{3^2}\right]$$

$$\frac{1}{\lambda} = 9R\left[\frac{9-1}{9}\right]$$

$$\frac{1}{\lambda} = 9R \times \frac{8}{9}$$

$$\lambda = \frac{1}{8R} = 0.114 \times 10^{-7}$$

$$\lambda = 1.14 \times 10^{-8} \text{ m}$$

Question: In YDSE $D = 0.8\,\text{m}\,d = 0.6\,\text{mm}$ First dark band is formed in front of the slit. $\lambda = ?$

Options:

(a) 450 nm

(b) 750 nm

(c) 650 nm

(d) 350 nm

Answer: (a)

Solution:

$$y_{\text{dard}} = \frac{d}{2}$$

$$\text{odd } \frac{\lambda 0}{2d} = \frac{d}{2}$$

$$\therefore \lambda = \frac{d^2}{0} = \frac{\left(6\times10^{-4}\right)^2}{0.8} = \frac{36\times10^{-8}}{8\times10^{-1}}$$

$$= 4.5\times10^{-7}\text{ m}$$

$$= 450\,\text{nm}$$

Question: An infinite solid cylinder has radius 4 mm & current density is $4\times10^{6}\,\text{Am}^{-2}$. Find current in Region $\frac{R}{2}$ to R

Options:

(a) 150.79

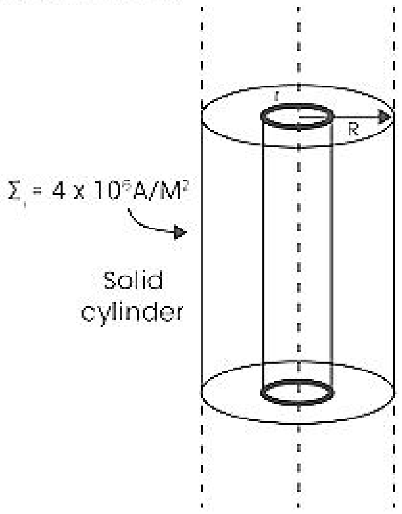
(b) 168.87

(c) 140.67

(d) 130.32

Answer: (a)

Solution:



$$O_i = \frac{i}{A} = 4\times10^6 \text{ A / M}^2$$

$$(dV)_{cylinder} = 2\pi r dr \cdot l$$

$$di = \int ri \cdot \left(\frac{dV}{l}\right)$$

$$\int_0^i di = \int_{R/2}^{R} 4\times10^6 2\pi r dr \cdot l$$

$$\left(\frac{i}{l}\right) = \theta\pi \times 10^6 \int_{R/2}^{R} r \cdot dr$$

$$\left(\frac{i}{l}\right) = \theta\pi \times 10^6 \times \left|\frac{R^2}{2}\right|_{R/2}^{R}$$

$$= \theta\pi \times 10^6 \times \left(\frac{R^2}{4} - \frac{R^2}{8}\right)$$

$$= \frac{\theta\pi \times 10^6}{\theta}\left(\frac{2R^2 - R^2}{1}\right)$$

$$= \frac{\theta\pi \times 10^6}{\theta} \times R^2$$

$$\left(\frac{i}{l}\right) = \frac{\theta\pi \times 10^6}{\theta} \times \left(4\times10^{-3}\right)^2$$

$$= 150.79\, A$$

Question: Find fraction of current passing through galvanometer.

Given $R_g = 720$ and $R_s = 80$

Options:

(a) 0.3

(b) 0.2

(c) 0.1

(d) 0.0

Answer: (c)

Solution:

$$I = I_g + I_s$$

$$I = \frac{I_g}{I} + \frac{I_s}{I}$$

$$= \frac{I_g}{I} + \frac{I_g R_g}{R_s I}$$

$$1 = \frac{I_g}{I}\left(1 + \frac{R_g}{R_s}\right)$$

$$1 = \frac{I_g}{I}\left(1 + \frac{72}{8}\right)$$

$$1 = \frac{I_g}{I}(9 + 1)$$

$$\Rightarrow \frac{I_g}{I} = \frac{1}{10}$$

Question: Match the correct column

	Colum I		Colum II
(a)	X rays	(p)	sterilize
(b)	IR rays	(q)	study cubic lattice
(c)	UV rays	(r)	greenhouse effect

Options:
(a) (a) r, (b) q, (c) p
(b) (a) q, (b) r, (c) p
(c) (a) r, (b) p, (c) q
(d) (a) q, (b) p, (c) r
Answer: (b)
Solution:
X rays - study cubic lattice
IR rays – Green House Effect
UV rays - sterilize
equipment

Question: 2 block the mass 10 kg and 30 kg coordinate (0,0) and at (x, 0) A block of 10 kg is moved a distance of 6 cm towards 30 kg Find the distance moved by Mass of 30 kg
Options:
(a) -3cm
(b) -4cm
(c) -2cm
(d) -1cm
Answer: (c)
Solution:
We know

$$x_{com} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$$

also

$$dx_{com} = \frac{m_1 dx_1 + m_2 dr_2}{m_1 + m_2}$$

Now to keep com at sane position (i.e. $dx_{com}=0$)

$$0 = m_1(dx_1) + m_2 dx_2 \ldots(1)$$

A to d

$$m_1 = 10kg, \quad m_2 = 80\,kg$$

$$dx_1 = 6\,cm, \quad dx_2 = ?$$

From eq (1)

$$0 = 10(6) + 30(dx_2)$$

$$dx_2 = -\frac{60}{30}$$

$$dx_2 = -2\,cm$$

So the m_2 mass will be moved 2cm towards 10kg mass

Question: The current flowing through on ac circuit is given by I =5 \sin (120 at)A. How long will the current take to reach the peak value starting from O

Options:

(a) 1 / 60 S

(b) 605

(c) 1 / 1205

(d) 1 / 240 S

Answer: (d)

Solution:

$i = 5\sin(120\pi t)$

A to Q

$5 = 5\sin(120\pi t)$

$\sin(120\pi t) = 1$

$\sin(120\pi t) = \sin\frac{\pi}{2}$

$120\pi t = \frac{\pi}{2}$

$t = \frac{1}{240}s$