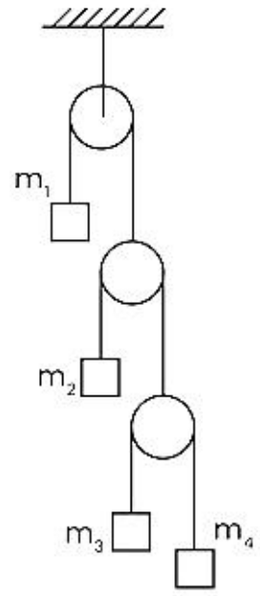
JEE-Main-26-06-2022-Shift-2 (Memory Based)

Physics

Question: Find the relation between $a_1\ a_2\ a_3\ a_4$

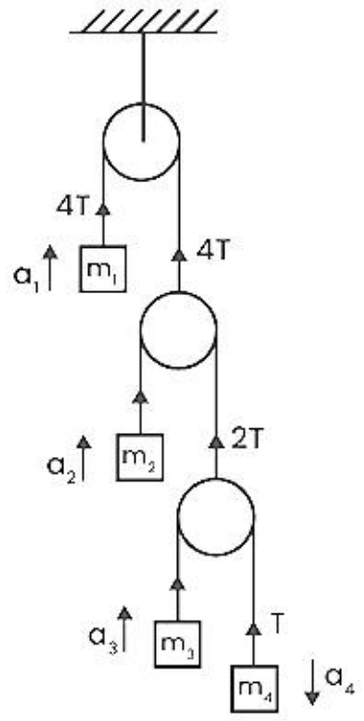


Options:

(a) 3
(b) 2
(c) 1
(d) 0

Answer: (d)

Solution:



$$4a_1 + 2a_2 + a_3 - a_4 = 0$$

Question: What is the expression of Reynold's number?

Options:

(a) 3
(b) 2
(c) 1
(d) 0
Answer:
Solution:

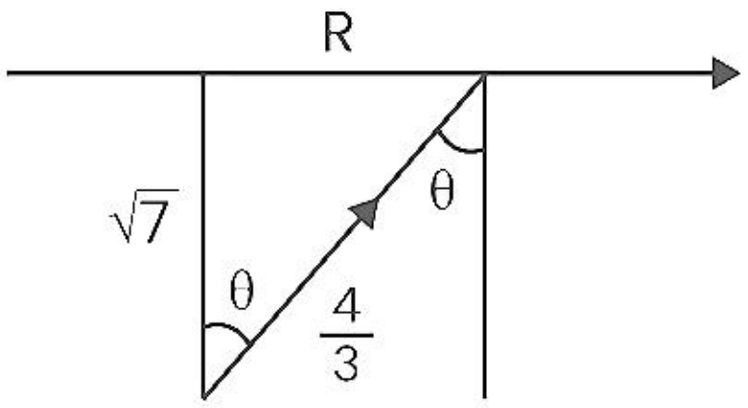
$$Re = \frac{\rho u L}{\mu}$$

Re = reynolds number
ρ = density of the fluid
u = flow speed
L = characteristic linear dimension
μ = dynamic viscosity of the fluid

Question: A bulb is placed at depth $\sqrt{7}$ from the surface in water of $\mu = 4/3$ .The area through which light comes out is $\pi x \text{ m}^2$ find x

Options:

(a) 11
(b) 9
(c) 7
(d) 3
Answer: (b)
Solution:



$$\frac{4}{3}\sin\theta = 1\sin 90^{\circ}$$

$$\sin\theta = \frac{3}{4}$$

$$\frac{R}{\sqrt{7}} = \tan\theta = \frac{\sin\theta}{\sqrt{1-\sin^2\theta}}$$

$$= \frac{3/4}{\sqrt{1-9/16}} = \frac{3/4}{\sqrt{7}/4} = \frac{3}{\sqrt{7}}$$

$R = 3m$

∴ Area through which light comes out $= \pi(3)^2 = 9\pi \text{m}^2$

$\therefore x = 9$

Qucstion: 20 tuning forks are arranged in increasing order of frequency such that every tuning fork produces 4 beats with previous one. If frequency of last tuning fork is double the first, then the frequency of first tuning fork is?

Options:

(a) 46
(b) 56
(c) 76
(d) 86
Answer:

Solution:
20 tuning forks =19 intervals

Each produces a beat of

4 $\therefore N_0$ of beats producod
$= 19 \times 4 = 76$

If first tuning fork has freq. f then acc.to qn. last one has frequency. 2 f.

$|2f - f| = 76$
$\therefore f = 76\,\text{Hz}$

Question: Temp of cold reservoir was 324k and heat given by the hot reservoir was 300J and heat given to the sink was 180 find the temp of hot reservoir.

Options:

(a) 540
(b) 335
(c) 232
(d) 457
Answer: 540

Solution:
$\frac{Q_H}{Q_L} = \frac{T_H}{T_L}$
$\frac{300}{180} = \frac{T_H}{324}$
$\Rightarrow T_H = 540\,\text{K}$

Qucstion: Find the ratio of rotational kinetic energy to the total kinetic energy of a rolling solid sphere?

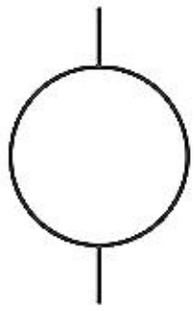
Options:

(a) 7/5
(b) 2/5
(c) 2/7

(d) 5/7

Answer: (c)

Solution:



Let m be the mass, r the radius of the sphere and let v and ω be the linear and angular velocities in rolling down.

Thus total kinetic energy = linear kinetic energy + rotational kinetic energy

$$= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

where I is the moment of inertia ie, $I = \frac{2}{5}mr^2$

Hence, total kinetic energy $= \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right)\frac{v^2}{r^2}$

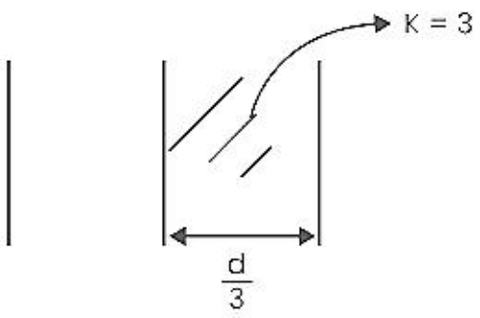
$$\frac{1}{2}mv^2 + \frac{1}{5}mv^2$$

$$\frac{7}{10}mv^2$$

So, the ratio $= \frac{\text{Rotational } KE}{\text{Total } KE}$

$$= \frac{\frac{1}{5}mv^2}{\frac{7}{10}mv^2} = 2:7$$

Question: If C is capacity of empty capacitor, then what's capacity of



Options:

(a) 2/3

(b) 3/5

(c) 2/6

(d) 3/2

Answer: (d)

Solution:

For partially filled capacitor

$$C = \frac{\varepsilon_0 A}{[d - t + t/k]}$$

Here $t = \frac{d}{2}$ and $k = 3$

$$\therefore C = \frac{\varepsilon_0 A}{\left[d - \frac{d}{2} + \frac{d}{6}\right]} = \frac{\varepsilon_0 A}{2/3d}$$

$$= \frac{3}{2}\varepsilon_0 \frac{A}{d} = \frac{3}{2}C$$

Question: Find the impulse given to the ball when batsman hits the ball of mass 0.5kg in the direction of the bowler with the same speed bowler throws it at him which is 15m/s.

Answer:

Solution:

Impulse = Change in momentum

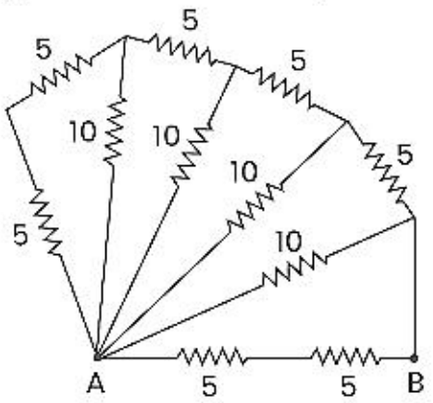
$|I| = |\Delta p| = mv_f - mv_i$

Here vel. only changes direction

$\therefore |\Delta p| = 2mV = 2(0.5)(15)$

$= 15\,\text{N} - 5$

Question: Find equivalent resistance across AB.



Options:

(a) 3.33 Ω

(b) 15 Ω

(c) 5 Ω

(d) 10 Ω

Answer: (a)

Solution:

$R' = 5 + 5 = 10\Omega$

$R'' = \frac{10 \times 10}{10 + 10} = 5\Omega$

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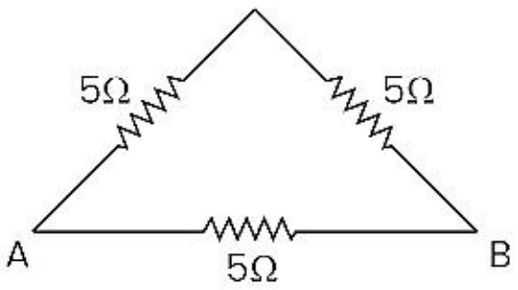
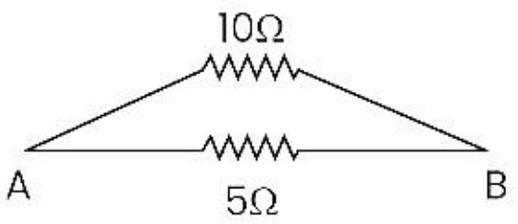




$$R_{AB} = \frac{10 \times 5}{10 + 5} = \frac{50}{15} = 3.33\Omega$$

Question: Dimensional formula of mutual inductance is

Options:

(a) $MLT^{-2}A^{-2}$

(b) $ML^{3}T^{-2}A^{-2}$

(c) $ML^{2}T^{-2}A^{-2}$

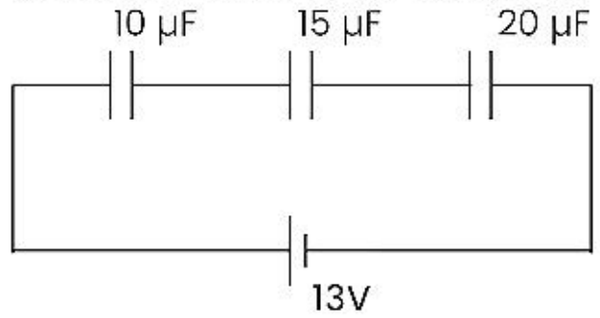
(d) $MLT^{-3}A^{-1}$

Answer: (c)

Solution:

Dimensional formula for mutual inductance is $ML^{2}T^{-2}A^{-2}$.

Question: What is the charge on 15 μF Capacitor



Options:

(a) 30 μC

(b) 60 μC

(c) 39 μC

(d) 45 μC

Answer: (b)

Solution:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{10} + \frac{1}{15} + \frac{1}{20}$$

$$\frac{1}{C_{eq}} = \frac{6+4+3}{60}$$

$$C_{eq} = \frac{60}{13}\mu F$$

Charge will be same on each capacitor in series.

$$Q = \frac{60}{13} \times 13 = 60\mu C$$

Question: A body vertically projected at t = 0 sec and another body is project at t = 2 sec with same initial velocity 50 m/s, then At what time t = _____ sec, they meet.

Options:

(a) 12

(b) 4

(c) 6

(d) 8

Answer: (c)

Solution:

$$y_1 = 50t - \frac{1}{2} \times 10 \times t^2$$

$$y_2 = 50(t-2) - \frac{1}{2} \times 10 \times (t-2)^2$$

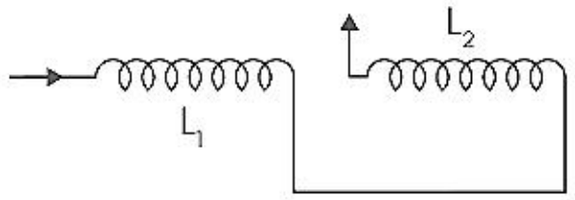
At $y_1 = y_2$ bodies will meet

$$50t - 5t^2 = 50t - 100 - 5(t^2 + 4 - 4t)$$

$$20t - 20 - 100 = 0$$

t = 6 sec.

Question: The equivalent relation for given circuit will be



Options:

(a) $\frac{1}{L_1} + \frac{1}{L_2}$

(b) $L_1 + L_2 - 2M$

(c) $L_1 + L_2 + 2M$

(d) $L_1 + L_2 + M$

Answer: (c)

Solution:

For inductors in series

$L_{eq} = L_1 + L_2$

Due to mutual inductance

$L_{eq} = L_1 + L_2 + 2M$

Question: 64 small balls each of radius 2 cm having surface charge density $5\mu C/m^2$ each merge and form a bigger sphere. Find the ratio of surface charge density of bigger sphere by small sphere

Options:

(a) 4 : 1

(b) 8 : 1

(c) 16 : 1

(d) 64 : 1

Answer: (a)

Solution:

$\sigma_{small} = 5\mu C / m^2$

$Q_{total} = 64 \times 5 \times 4 \times \pi (2 \times 10^{-2})^2 \mu C$

Let radius of bigger sphere is R then

$\frac{4}{3}\pi R^3 = 64 \times \frac{4}{3} \times \pi \times (2)^3$

$R = 4 \times 2 = 8 \text{ cm}$

$A = 4 \times \pi \times (8 \times 10^{-2})^2$

$\sigma_{Big} = \frac{64 \times 5 \times 4 \times \pi (2 \times 10^{-2})^2}{4 \times \pi (8 \times 10^{-2})^2}$

$\sigma_{Big} = \frac{64 \times 5 \times 4 \times 10^{-4}}{64 \times 10^{-4}} = 20\mu C / m^2$

$\frac{\sigma_{Big}}{\sigma_{small}} = \frac{20}{5} = 4$

Question: The energy of emitted photoelectrons from a metal is 0.9 eV and energy of incident photon is 3.1 eV then the work function of a metal is

Options:

(a) 4.0 eV

(b) 2.2 eV

(c) 3.0 eV

(d) 3.1 eV

Answer: (b)

Solution:

$E = \phi + KE_{Max}$

$\phi = 3.1 - 0.9$

$\phi = 2.2 \text{ eV}$

Question: Apparent wavelength is 670.7 nm and the original wavelength is 670 nm. Find the Relative speed of planet .

Options:

(a) 2.12×10^5 m/s

(b) 3.13×10^5 m/s

(c) 4.14×10^5 m/s

(d) 6.0×10^5 m/s

Answer: (b)

Solution:

We know that $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$

$$\frac{670.7 - 670}{670} = \frac{v}{3 \times 10^8}$$

$$\Rightarrow v = \frac{0.7}{670} \times 3 \times 10^8 = 3.13 \times 10^5 \, m/s$$

Question: Arrange wavelengths of gamma, X Rays, Visible & Microwave in ascending order.

Options:

(a) Gamma < X Rays < Visible < Microwave

(b) Gamma > X Rays > Visible > Microwave

(c) Gamma > Visible > X Rays > Microwave

(d) Microwave < Gamma < X Rays < Visible

Answer: (a)

Solution: