NDA-CDS 1 2025

GS

LIVE

PHYSICS

GRAVITATION & HYDROSTATICS MCQ

NAVJYOTI SIR

SSBCrack EXAMS

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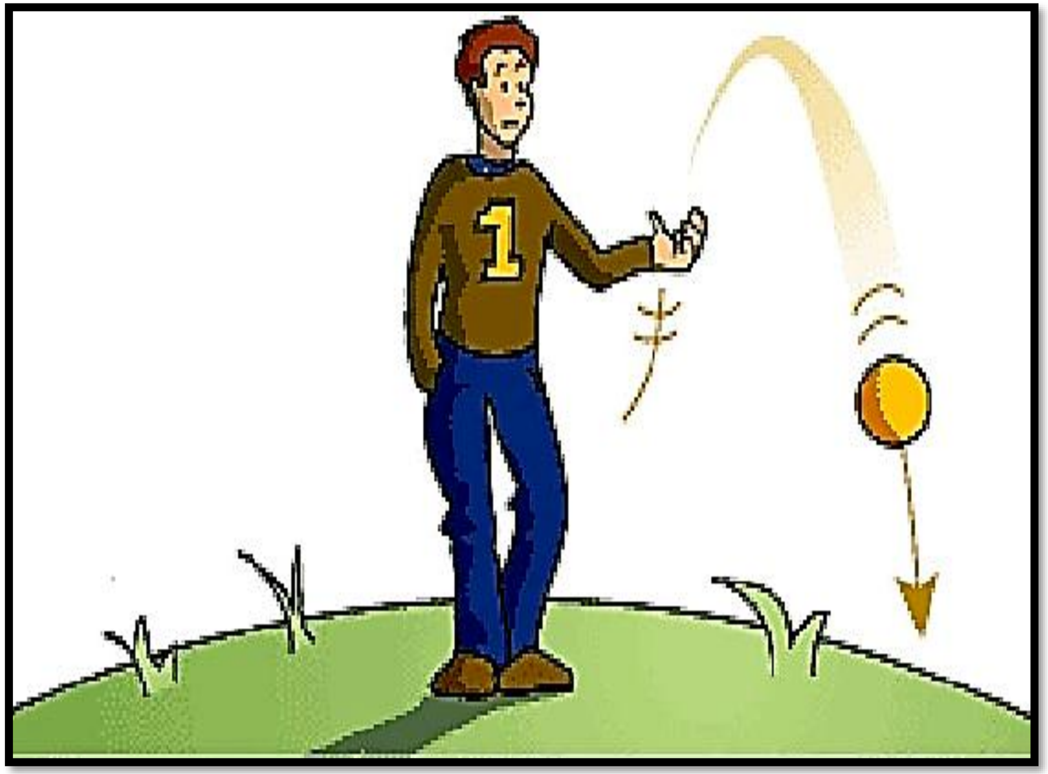
GRAVITATION AND HYDROSTATICS - MCQs



The SI unit of specific gravity (relative density) is

ratio of weights ≡ ratio of densities

A. gcm^{-3}

B. kgm^{-3}

C. No units ✓

D. None of the Above

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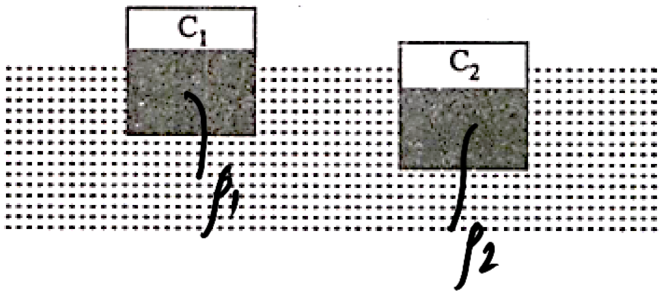
Shown in the figure are two hollow cubes C_1 and C_2 of negligible mass partially filled (depicted by darkened area) with liquids of densities ρ_1 and ρ_2, respectively, floating in water (density ρ_W). The relationship between ρ_1, ρ_2 and ρ_W is



(a) $\rho_2 < \rho_W < \rho_1$

(b) $\rho_2 < \rho_1 < \rho_W$

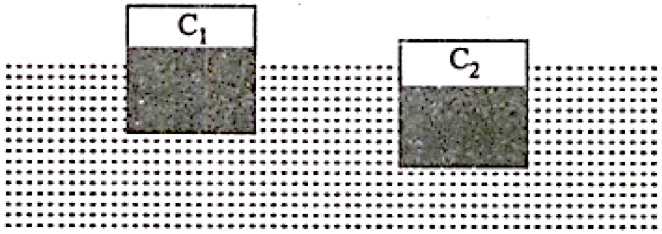
(c) $\rho_1 < \rho_2 < \rho_W$

(d) $\rho_1 < \rho_W < \rho_2$

$\rho_W > \rho_2 > \rho_1$

↳ more an object is inside the fluid, more its density is.

Shown in the figure are two hollow cubes C_1 and C_2 of negligible mass partially filled (depicted by darkened area) with liquids of densities ρ_1 and ρ_2, respectively, floating in water (density ρ_W). The relationship between ρ_1, ρ_2 and ρ_W is



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(d) $\rho_1 < \rho_W < \rho_2$

Answer: (C)

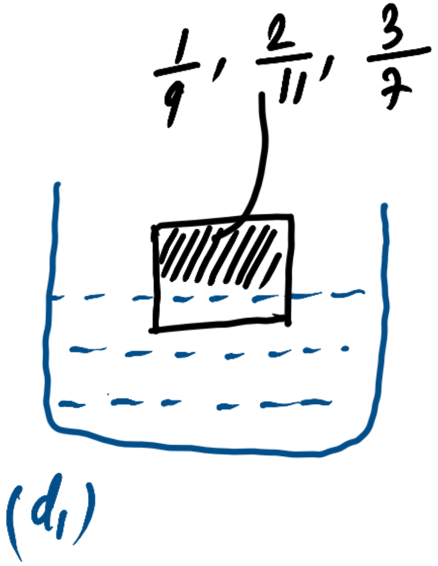
An object is put one by one in three liquids having different densities. The object floats with $\frac{1}{9}$, $\frac{2}{11}$ and $\frac{3}{7}$ parts of their volumes outside the liquid surface in liquids of densities d_1, d_2 and $d_3$respectively. Which of the following statement is correct?

(a) $d_1 > d_2 > d_3$

(b) $d_1 > d_2 < d_3$

(c) $d_1 < d_2 > d_3$

(d) $d_1 < d_2 < d_3$



$\frac{1}{9}$ $\frac{2}{11}$ $\frac{3}{7}$

$\frac{11\times 7}{9\times 11\times 7}$ $\frac{2\times 9\times 7}{11\times 9\times 7}$ $\frac{9\times 11\times 3}{7\times 11\times 9}$

d_1: 77, d_2: 126, d_3: 297

$d_3 < d_2 < d_1$

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(OR)

$\frac{1}{9}$ → 0.11, $\frac{2}{11}$ → 0.18, $\frac{3}{7}$ → 0.4 (volumes outside the liquid surface)

~(0.89) — (0.82) — (0.60) — (volume inside " " ")

density ∝ volume inside

$d_1 > d_2 > d_3$

An object is put one by one in three liquids having different densities. The object floats with $\frac{1}{9}, \frac{2}{11}$ and $\frac{3}{7}$ parts of their volumes outside the liquid surface in liquids of densities d_1, d_2 and $d_3$respectively. Which of the following statement is correct?

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(b) $d_1 > d_2 < d_3$

(c) $d_1 < d_2 > d_3$

(d) $d_1 < d_2 < d_3$

Answer: (A)

The working of Hydraulic Breaks and Lifts is based on

A. Archimedes Principle

B. Law of Floatation

C. Bernoulli's Principle

D. Pascal's Law

$$P_1 = P_2 \quad (\text{Pascal's law})$$

$$F_{large} = \left(\frac{F_{small}}{A_{small}}\right) F_{large}$$

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An object is made of two equal parts by volume; one part has density ρ_0 and the other part has density $2\rho_0$. What is the average density of the object?

(a) $3\rho_0$

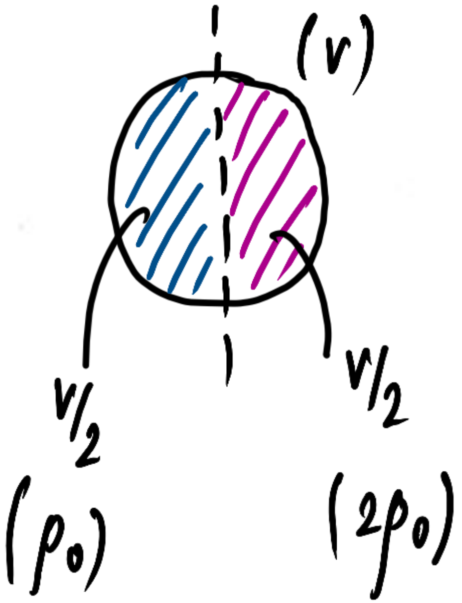
(b) $\frac{3}{2}\rho_0$

(c) ρ_0

(d) $\frac{1}{2}\rho_0$

$$\frac{\text{Total Mass}}{\text{Total Volume}} = \frac{\left(\rho_0 \frac{V}{2}\right) + \left(2\rho_0 \frac{V}{2}\right)}{V} = \frac{V}{V}\left(\frac{\rho_0}{2} + \rho_0\right)$$

$$\rho_{avg.} = \frac{3\rho_0}{2}$$



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(b) $\frac{3}{2}\rho_0$

(c) ρ_0

(d) $\frac{1}{2}\rho_0$

Answer: (B)

If an object mass on the Moon surface is 40 kg then what will be the mass of the same object on the Earth's surface ?

A. 40 kg ✓

B. 20 kg

C. 6.66 kg

D. 10 kg

Mass is an independent physical quantity.
(fundamental quantity)

If an object mass on the Moon surface is 40 kg then what will be the mass of the same object on the Earth's surface ?

A. **40 kg**

B. 20 kg

C. 6.66 kg

D. 10 kg

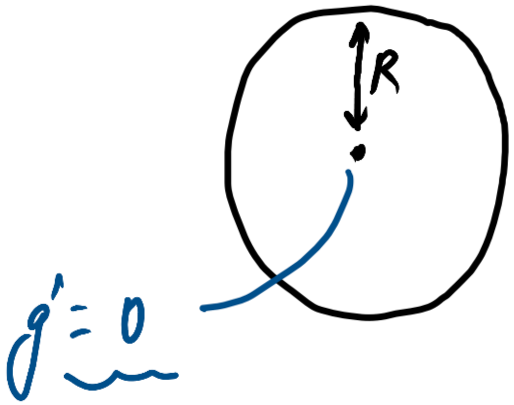
The weight of an object at the centre of the earth of radius R is

A. Zero ✓

B. Infinite

C. R times the weight at the surface of the Earth

D. $1/R^2$ times the weight at surface of Earth



$$g' = g\left(1 - \frac{d}{R}\right)$$

$$d = R \Rightarrow g' = g\left(1 - \frac{R}{R}\right) = g(1-1) = g(0) = 0$$

The weight of an object at the centre of the earth of radius R is

A. **Zero**

B. Infinite

C. R times the weight at the surface of the Earth

D. $1/R^2$ times the weight at surface of Earth

Law of gravitation gives the gravitational force between

A. The earth and a point mass only

B. The earth and sun only

C. Any two bodies having some mass

D. Two charged bodies only

Law of gravitation gives the gravitational force between

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In the relation $F = GMm / d^2$, the quantity G is

A. Depends on the value of g at the place of observation

B. Is used only when the earth is one of the two masses

C. Is greatest at the surface of earth

D. Is universally constant

G ⟶ Universal Gravitational constant

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The time period of a 1 m long pendulum approximates to

(a) 6 s

(b) 4 s

(c) 2 s

(d) 1 s

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

$$T \approx 2\sqrt{l} \quad \text{(approximate)}$$

$$T = 2\sqrt{1} = 2\,s$$

The time period of a 1 m long pendulum approximates to

(a) 6 s

(b) 4 s

(c) 2 s

(d) 1 s

Answer: (C)

All objects experience a buoyancy when they are immersed in a fluid. Buoyancy is

(a) a downward force

(b) a downward pressure

(c) an upward force

(d) an upward pressure

Buoyancy – also called upthrust

up → direction

thrust (Force)

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Answer: (C)

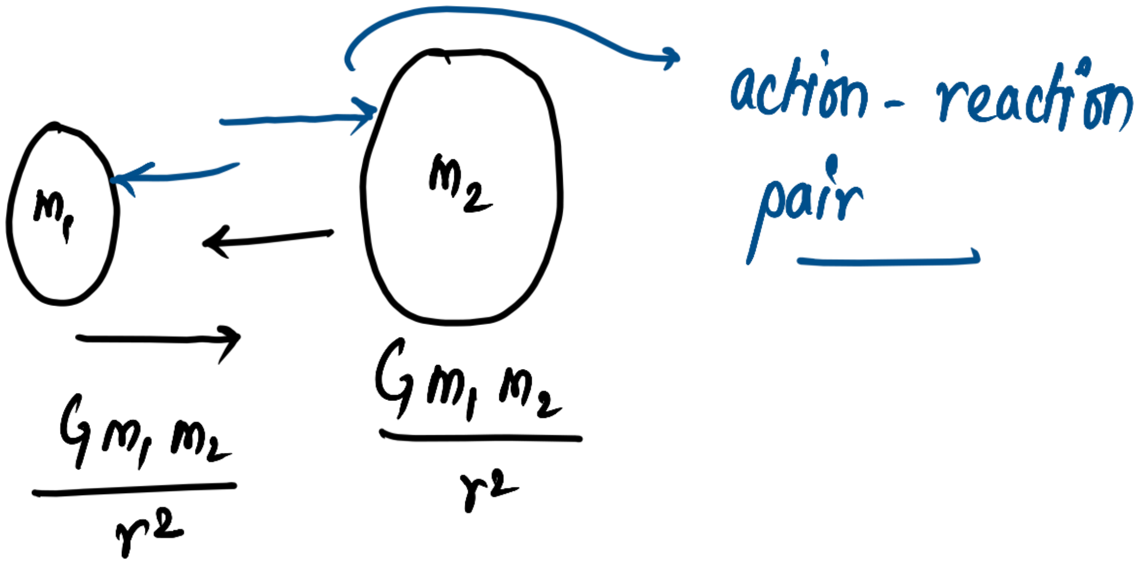
An apple falls from a tree because of gravitational attraction between the Earth and the Apple. If F1 is the magnitude of the Force exerted by the Earth on the apple and F2 is the magnitude of Force exerted by the Apple on the Earth , then

A. F1 > F2

B. F1 < F2

C. F1 = F2 ✓

D. Can't say



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Two planets orbit the Sun in circular orbits, with their radius of orbit as $R_1 = R$ and $R_2 = 4R$. Ratio of their periods (T_1/T_2) around the Sun will be

(a) 1/16

(b) 1/8

(c) 1/4

(d) 1/2

Kepler's 3rd law,

$$T^2 \propto R^3$$

$$\frac{T_1^2}{T_2^2} = \frac{R_1^3}{R_2^3}$$

$$\left(\frac{T_1}{T_2}\right)^2 = \left(\frac{R}{4R}\right)^3$$

$$\left(\frac{T_1}{T_2}\right)^2 = \frac{1}{64}$$

$$\frac{T_1}{T_2} = \frac{1}{8}$$

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(a) 1/16

(b) 1/8

(c) 1/4

(d) 1/2

Answer: (B)

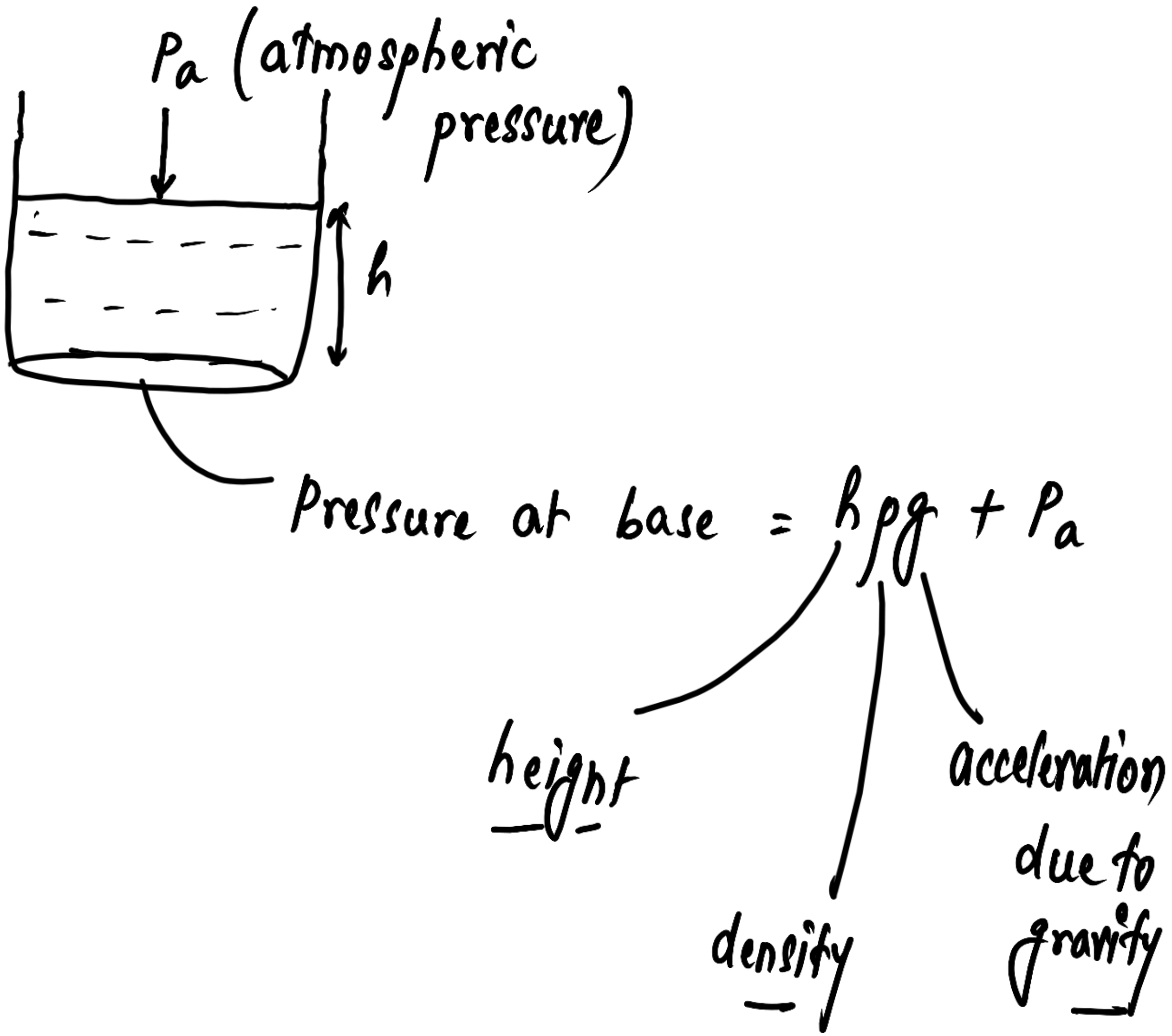
A liquid is kept in a glass beaker. Which one of the following statements is correct regarding the pressure exerted by the liquid column at the base of the beaker?

(a) The pressure depends on the area of the base of the beaker ✗

(b) The pressure depends on the height of liquid column ✓

(c) The pressure does not depend on the density of the liquid

(d) The pressure neither depends on the area of the base of the beaker nor on the height of liquid column



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Answer: (B)

A planet has a mass M_1 and radius R_1. The value of acceleration due to gravity on its surface is g_1. There is another planet 2, whose mass and radius both are two times that of the first planet. Which one of the following is the acceleration due to gravity on the surface of planet 2?

(a) g_1

(b) $2g_1$

(c) $g_1/2$

(d) $g_1/4$

Planet 1	Planet 2
M_1	$2M_1$
R_1	$2R_1$
(g_1)	

$$g_1 = \frac{GM_1}{R_1^2}$$

$$g_2 = \frac{G(2M_1)}{(2R_1)^2}$$

$$g_2 = \frac{2GM_1}{4R_1^2}$$

$$= \frac{GM_1}{2R_1^2} = \frac{1}{2}\left(\frac{GM_1}{R_1^2}\right)$$

$$\frac{1}{2}(g_1)$$

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Answer: (C)

Whether an object will float or sink in a liquid, depends on

(a) mass of the object only

(b) mass of the object and density of liquid only

(c) difference in the densities of the object and liquid

(d) mass and shape of the object only

Weight → density of object

Buoyant force → density of liquid

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(b) mass of the object and density of liquid only

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(d) mass and shape of the object only

Answer: (C)

Which one of the following statements about gravitational force is NOT correct ?

(a) It is experienced by all bodies in the universe → (As every body in universe has mass)

(b) It is a dominant force between celestial bodies (as masses are very large

↓

Gravitational force is quite evident.

(c) It is a negligible force for atoms

(d) It is same for all pairs of bodies in our universe ✓

Which one of the following statements about gravitational force is NOT correct ?

(a) It is experienced by all bodies in the universe

(b) It is a dominant force between celestial bodies

(c) It is a negligible force for atoms

(d) It is same for all pairs of bodies in our universe

Answer: (D)

Suppose there are two planets, 1 and 2, having the same density but their radii are R_1 and R_2 respectively, where $R_1 > R_2$. The accelerations due to gravity on the surface of these planets are related as

(a) $g_1 > g_2$

(b) $g_1 < g_2$

(c) $g_1 = g_2$

(d) Can't say anything

$$g = \frac{GM}{R^2}$$ → M = density × volume

$$g = \frac{G(\rho V)}{R^2}$$

$$g_1 = \frac{G\left(\rho \frac{4}{3}\pi R_1^3\right)}{R_1^2} = \frac{4}{3}\pi G\rho R_1$$

$$g_2 = \frac{4}{3}\pi G\rho (R_2)$$

$g_1 > g_2$ (as $R_1 > R_2$)

Suppose there are two planets, 1 and 2, having the same density but their radii are R_1 and R_2 respectively, where $R_1 > R_2$. The accelerations due to gravity on the surface of these planets are related as

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(c) $g_1 = g_2$

(d) Can't say anything

Answer: (A)

The force of attraction between two unit point masses separated by a unit distance is called

A. Gravitational potential

B. Acceleration due to gravity

C. Gravitational field

D. Universal gravitational constant

$$F = \frac{G m_1 m_2}{r^2}$$

$m_1 = 1\,kg$; $m_2 = 1\,kg$; $r = 1\,m$

$$F = \frac{G(1)(1)}{(1)^2} \Rightarrow F = G$$

The force of attraction between two unit point masses separated by a unit distance is called

A. Gravitational potential

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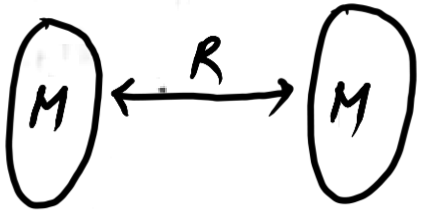
Two bodies of mass M each are placed R distance apart. In another system, two bodies of mass 2M each are placed $\frac{R}{2}$ distance apart. If F be the gravitational force between the bodies in the first system, then the gravitational force between the bodies in the second system will be

(a) 16 F

(b) 1 F

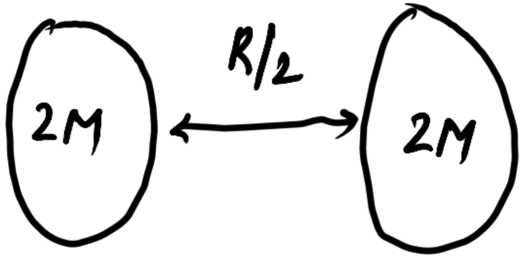
(c) 4 F

(d) None of the above



$$F = \frac{G(M)(M)}{R^2}$$

$$F = \frac{GM^2}{R^2}$$



$$F = \frac{G(2M)(2M)}{\left(\frac{R}{2}\right)^2}$$

$$F = \frac{4GM^2}{\left(\frac{R^2}{4}\right)} = \frac{4 \times 4\, GM^2}{R^2}$$

$$= 16F$$

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(d) None of the above

Answer: (A)

A pendulum clock is lifted to a height where the gravitational acceleration has a certain value g. Another pendulum clock of same length but of double the mass of the bob is lifted to another height where the gravitational acceleration is g/2. The time period of the second pendulum would be :

(in terms of period T of the first pendulum)

(a) $\sqrt{2}\,T$

(b) $\frac{1}{\sqrt{2}}T$

(c) $2\sqrt{2}\,T$

(d) T

$\sqrt{ab} = \sqrt{a} \times \sqrt{b}$

First pendulum

g ; length $= l$

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

Second pendulum

$\frac{g}{2}$; length $= l$

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

$= 2\pi\sqrt{2}\left(\sqrt{\frac{l}{g}}\right)$

$\sqrt{2}\left(2\pi\sqrt{\frac{l}{g}}\right) = \sqrt{2}\,T$

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(d) T

Answer: (A)

An astronaut whose weight on the Earth is 600 N experiences weightlessness on International Space Station orbiting around the Earth. It means that

feels to be floating,

(a) acceleration of the astronaut is zero

(b) normal reaction of the space-station floor on the astronaut is zero

(c) gravitational pull of earth on the astronaut is zero ✗

(d) space station applies a centrifugal force on the astronaut ✗

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(c) gravitational pull of earth on the astronaut is zero

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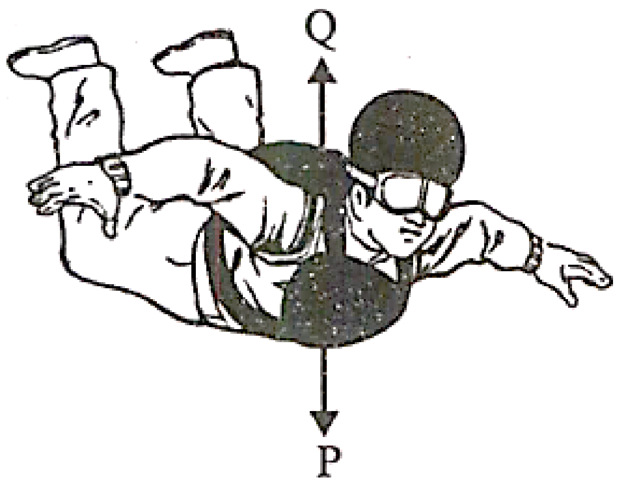
Answer: (B)

The figure given below shows the direction of the two forces P and Q acting on a skydiver :



Which one among the following statements is correct about the two forces ?

(a) Force P is caused by the gravity and force Q is caused by the friction

(b) When the force P is bigger than the force Q, the speed of the skydiver remains the same ✗

(c) After the parachute opens, force P remains the same while force Q increases ✓

(d) After the parachute opens, force P decreases while force Q increases

$P = Q$, $a = 0$, v = constant → terminal velocity

Q → force of drag (air resistance)

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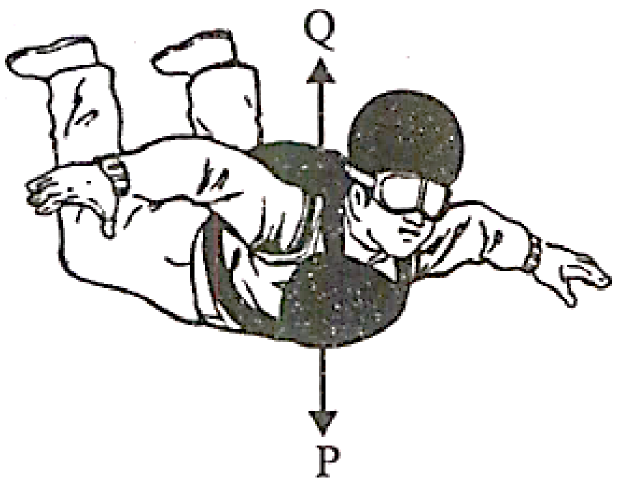

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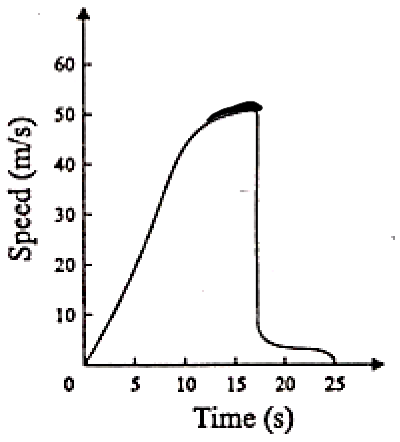
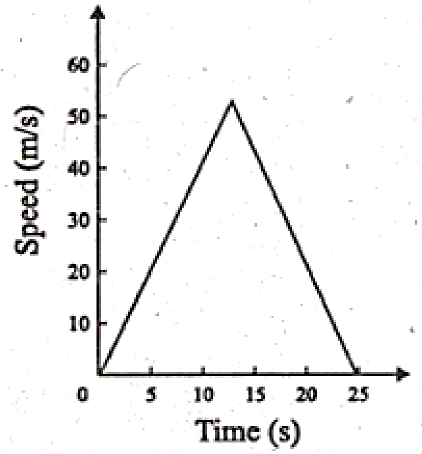
Answer: (C)

Which one among the following diagrams may correctly represent the motion of a skydiver during a jump ?

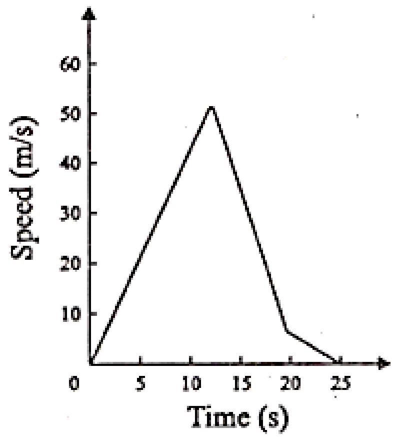
(a)



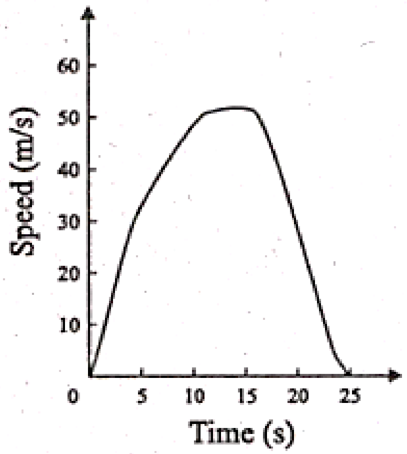
(c)



(b)



(d)



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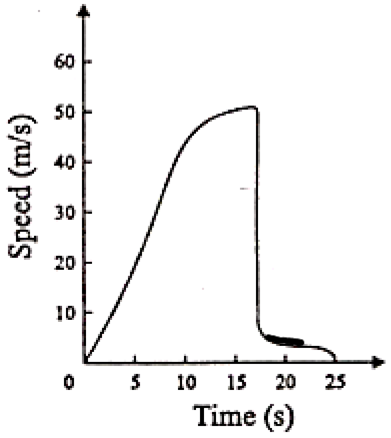
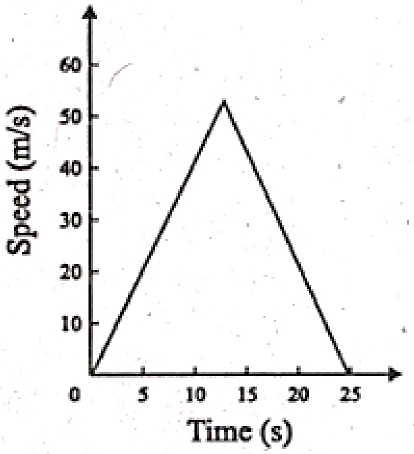
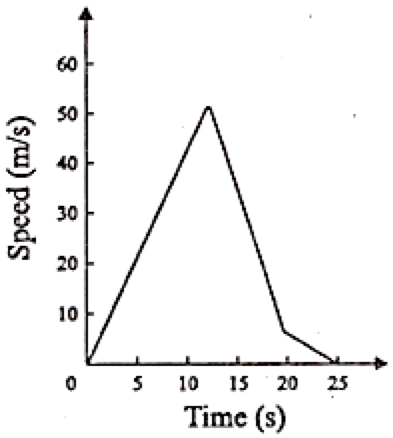


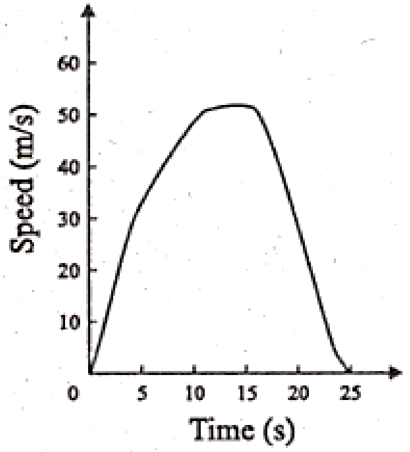
(c)

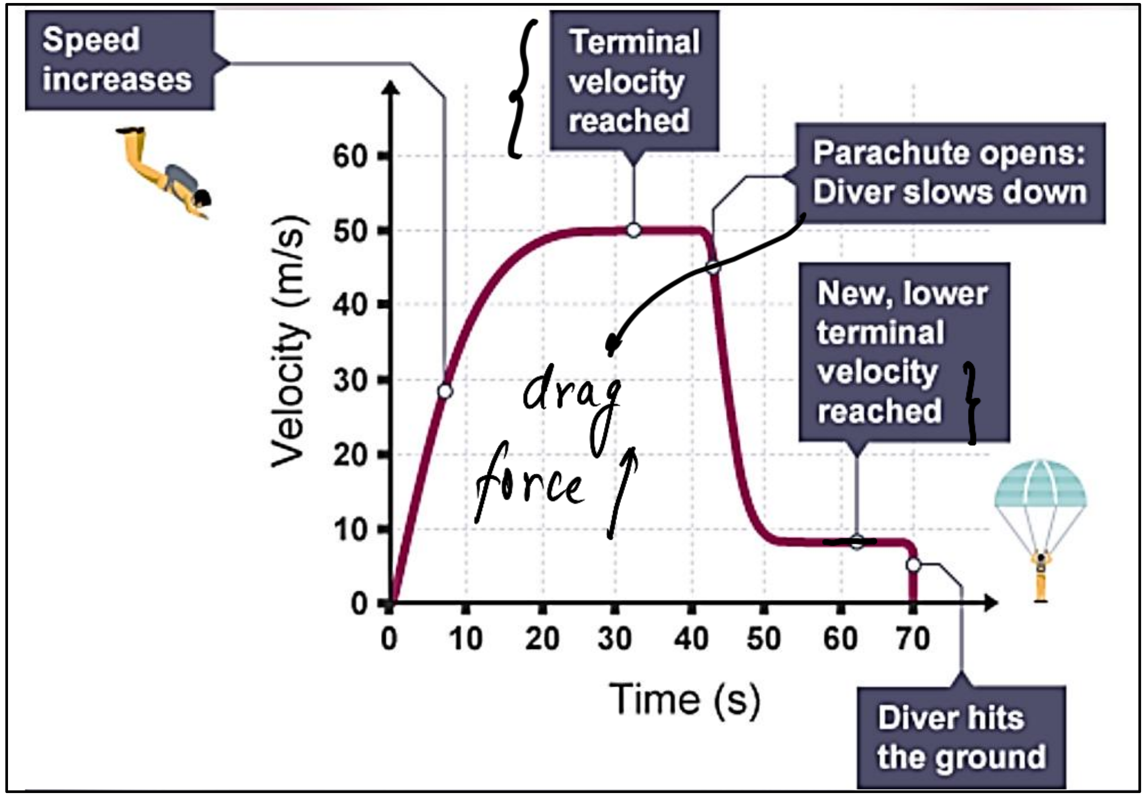


(b)



(d)





Answer: (A)

The masses of two planets are in the ratio of 1 : 7. The ratio between their diameters is 2 : 1. The ratio of forces which they exert on each other is

(a) 1 : 7

(b) 7 : 1

(c) 1 : 1

(d) 2 : 1

$F_1 = F_2$ (action - reaction pair)

Ratio = 1 : 1

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(a) 1 : 7

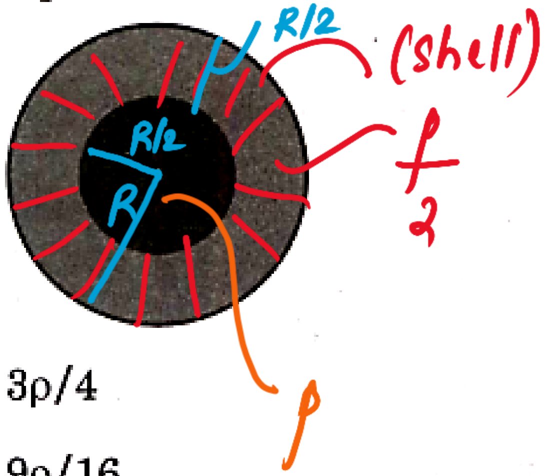
(b) 7 : 1

(c) 1 : 1

(d) 2 : 1

Answer: (C)

A spherical shell of outer radius R and inner radius R/2 contains a solid sphere of radius R/2 (see figure). The density of the material of the solid sphere is ρ and that of the shell is ρ/2. What is the average mass density of the larger sphere thus formed ?



(a) 3ρ/4

(b) 9ρ/16

(c) 7ρ/8

(d) 5ρ/8

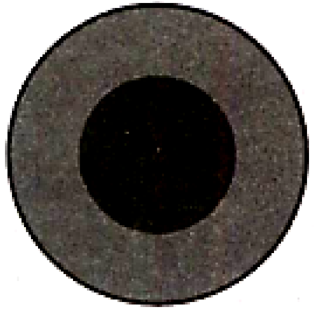
$$\rho_{avg} = \frac{\text{Mass of shell} + \text{Mass of solid sphere}}{\text{Volume of shell} + \text{Volume of sphere}}$$

$$= \frac{\frac{\rho}{2}\left(\frac{4}{3}\pi R^3 - \frac{4}{3}\pi\left(\frac{R}{2}\right)^3\right) + \rho\left(\frac{4}{3}\pi\left(\frac{R}{2}\right)^3\right)}{\left(\frac{4}{3}\pi R^3 - \frac{4}{3}\pi\left(\frac{R}{2}\right)^3\right) + \frac{4}{3}\pi\left(\frac{R}{2}\right)^3}$$

$$= \frac{\frac{4}{3}\pi R^3\left(\frac{\rho}{2} - \frac{\rho}{16} + \frac{\rho}{8}\right)}{\frac{4}{3}\pi R^3} = \frac{8\rho - \rho + 2\rho}{16}$$

$$\frac{9\rho}{16}$$

A spherical shell of outer radius R and inner radius R/2 contains a solid sphere of radius R/2 (see figure). The density of the material of the solid sphere is ρ and that of the shell is $\rho/2$. What is the average mass density of the larger sphere thus formed ?



(a) $3\rho/4$

(b) $9\rho/16$

(c) $7\rho/8$

(d) $5\rho/8$

Answer: (B)

Escape speed from the Earth is close to 11·2 km s^{-1}. On another planet whose radius is half of the Earth's radius and whose mass density is four times that of the Earth, the escape speed in km s^{-1} will be close to :

(a) 11·2

(b) 15·8

(c) 5·6

(d) 7·9

escape speed,

$$v_e = \sqrt{2gR}$$

$$v_e = \sqrt{2\left(\frac{GM}{R^2}\right)R} = \sqrt{\frac{2GM}{R}} = \sqrt{2G} \times \sqrt{\frac{M}{R}}$$

$$v_e = \sqrt{2G} \times \sqrt{\frac{\frac{4}{3}\pi R^3(\rho)}{R}} = \sqrt{2G} \times \sqrt{\frac{4}{3}\pi} \times \sqrt{R^2\rho}$$

$$= \sqrt{2G} \times \sqrt{\frac{4}{3}\pi} \times R\sqrt{\rho}$$

C

for another planet, escape speed, $v_e = C \times \frac{R}{2} \times \sqrt{4\rho} = \frac{R}{2} \times 2\sqrt{\rho}$

$V_e = c \times R\sqrt{\rho}$ = escape speed of earth

$= 11.2 \text{ kms}^{-1}$

Escape speed from the Earth is close to 11·2 km s^{-1}. On another planet whose radius is half of the Earth's radius and whose mass density is four times that of the Earth, the escape speed in km s^{-1} will be close to :

(a) 11·2

(b) 15·8

(c) 5·6

(d) 7·9

Answer: (A)

Which one of the following statements regarding simple pendulum is correct ?

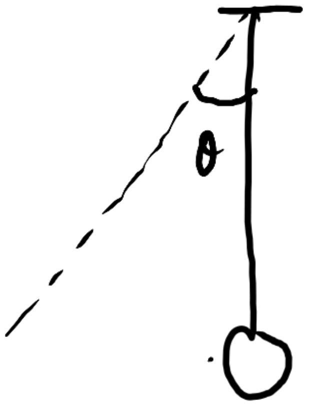
Simple pendulum has a time period independent of amplitude :

(a) only for small amplitudes because then the net force on its bob is independent of its displacement.

(b) for any amplitude because the net force on the bob is always proportional to its displacement.

(c) for any amplitude because the net force on the bob is independent of its displacement.

(d) only for small amplitudes because then the net force on its bob is proportional to its displacement.



Net force $\propto$ displacement $\Rightarrow T = 2\pi\sqrt{\frac{l}{g}}$

↳ Restoring force, (for small amplitudes only)

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(a) only for small amplitudes because then the net force on its bob is independent of its displacement.

(b) for any amplitude because the net force on the bob is always proportional to its displacement.

(c) for any amplitude because the net force on the bob is independent of its displacement.

(d) only for small amplitudes because then the net force on its bob is proportional to its displacement.

Answer: (D)

Density of water is

(a) maximum at 0°C
(b) minimum at 0°C
(c) maximum at 4°C
(d) minimum at – 4°C

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(d) minimum at – 4°C

1.0×10^3 kg m^{-3} / 1.0 g cm^{-3}

Answer: (C)

A container is first filled with water and then the entire water is replaced by mercury. Mercury has a density of $13.6 \times 10^3 \text{ kgm}^{-3}$. If X is the weight of the water and Y is the weight of the mercury, then

(a) $X = Y$
(b) $X = 13.6\,Y$
(c) $Y = 13.6X$
(d) None of the above

$X = m_w g$ $Y = m_m g$

$X = \rho_w V g$ $Y = \rho_m V g$

$X = Vg$ $Y = 13.6\,Vg$ (V – equal volumes of both water and mercury)

$Y = 13.6\,X$

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(b) $X = 13.6\,Y$
(c) $Y = 13.6X$
(d) None of the above

Answer: (C)

A person stands on his two feet over a surface and experiences a pressure p. Now, the person stands on only one foot. He would experience a pressure of magnitude

(a) $4p$ (b) p

(c) $\frac{1}{2}p$ (d) $2p$

$$p = \frac{F}{A}$$

If $A\downarrow \Rightarrow p\uparrow$ for same F.

$$p_2 = \frac{F}{\left(\frac{A}{2}\right)} = 2\left(\frac{F}{A}\right) = 2p$$

A person stands on his two feet over a surface and experiences a pressure p. Now, the person stands on only one foot. He would experience a pressure of magnitude

(a) $4p$ (b) p

(c) $\frac{1}{2}p$ (d) $2p$

Answer: (D)

A deep sea diver may hurt his ear drum during diving because of

(a) lack of oxygen
(b) high atmospheric pressure
(c) high water pressure
(d) All of the above

$p = h\rho g$

$h\uparrow \Rightarrow p\uparrow$

A deep sea diver may hurt his ear drum during diving because of

(a) lack of oxygen
(b) high atmospheric pressure
(c) high water pressure
(d) All of the above

Answer: (C)

The densities of three liquids are D, $2D$ and $3D$. What will be the density of the resulting mixture, if equal volumes of the three liquids are mixed?

(a) $6D$ (b) $1.4D$ (c) $2D$ (d) $3D$

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Answer: (C)

When a solid object is immersed in water, then there is a loss in its weight. This loss is

(a) equal to the weight of the water displaced

(b) less than the weight of the water displaced

(c) greater than the weight of the water displaced

(d) not related to the weight of the water displaced

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(c) greater than the weight of the water displaced

(d) not related to the weight of the water displaced

Answer: (A)

For a steel boat floating on a lake, the weight of the water displaced by the boat is

(a) less than the weight of the boat
(b) more than the weight of the boat
(c) equal to the weight of the part of the boat which is below the water level of the lake
(d) equal to the weight of the boat

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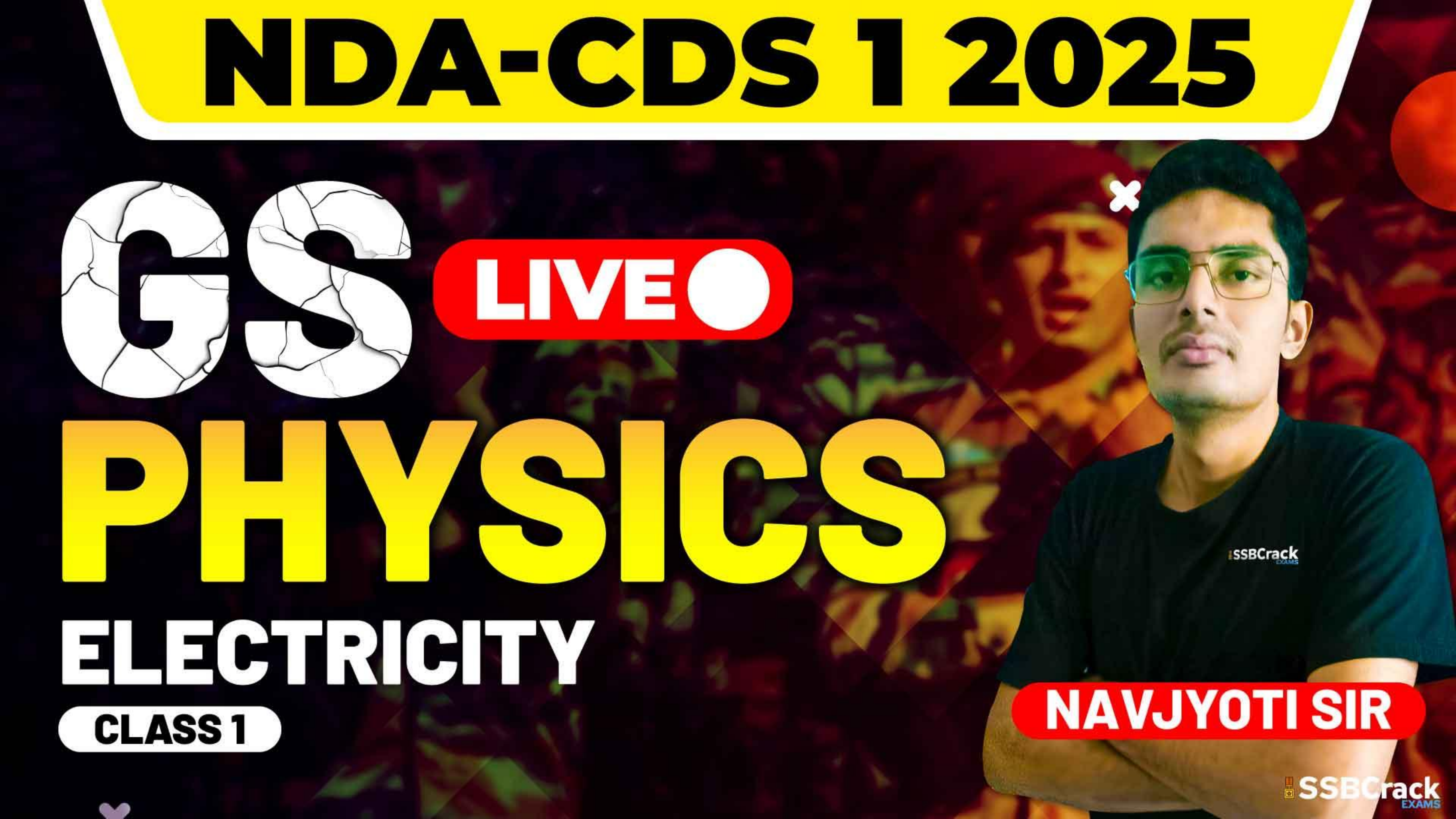
Answer: (C)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CLASS 1
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