PHYSICS

BOOKS - DISHA PHYSICS (HINGLISH)

CENTRE OF MASS

Physics

1. In the HCI molecule, the separation between the nuclei of the two atoms is about $1.27Å(1Å = 10^{-10}m)$. Find the approximate location of the c.m of the molecule, given that a chlorine atom is about 35.5 times as massive as a hydrogen atom and nearly all the mass of an atom is concentrated in its nucleus ?

A. 1 Å

B. 2.5 Å

C. 1.24 Å

D. 1.5Å

Answer:

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2. A 2 kg body and a 3 kg body are moving along the x-axis. At a particular instant the 2 kg body has a velocity of $3ms^{-1}$ and the 3 kg body has the velocity of $2ms^{-1}$. The velocity of the centre of mass at that instant is

A. $5ms^{-1}$

B. $1ms^{-1}$

C. 0

D. None of these

Answer:

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3. The distance between the carbon atom and the oxygen atom in a carbon monoxide molecule is 1.1Å. Given, mass of carbon atom is 12 a.m.u. and mass of oxygen atom is 16 a.m.u., calculate the position of the centre of mass of the carbon monoxide molecule

A. 6.3 Å from the carbon atom

B. 1 Å from the oxygen atom

C. 0.63Å from the carbon atom

D. 0.12Å from the oxygen atom

Answer:

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4. The velocities of three particles of masses 20g, 30g and 50g are $10\hat{i}, 10\hat{j}$ and $10\hat{k}$ respectively. The velocity of the centre of mass of the three particles is

A. $2\hat{i} + 3\hat{j} + 5\hat{k}$

B. $10\left(\hat{i} + \hat{j} + \hat{k}\right)$

C. $20\hat{i} + 30\hat{j} + 5\hat{k}$

D. $2\hat{i} + 30\hat{j} + 50\hat{k}$

Answer:

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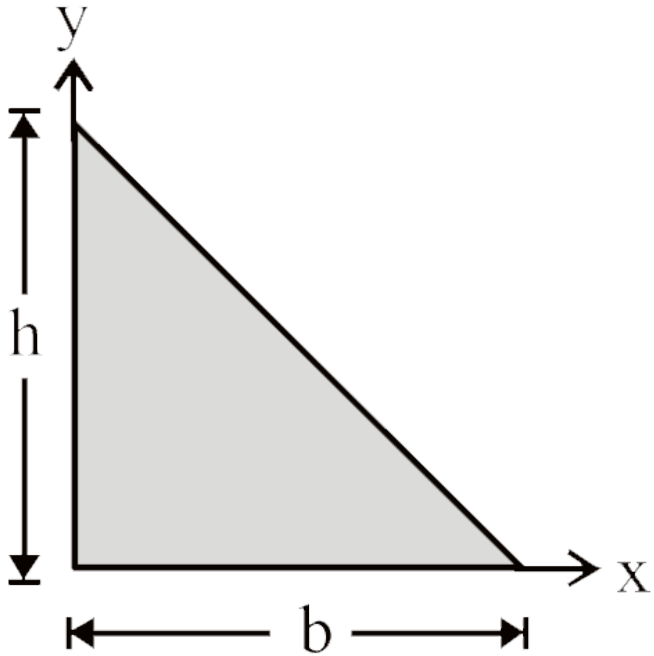
5. The centre of mass of a triangle shown in figure has coordinates



A. $x = \frac{h}{2}, y = \frac{b}{2}$

B. $x = \frac{b}{2}, y = \frac{h}{2}$

C. $x = \frac{b}{3}, y = \frac{h}{3}$

D. $x = \frac{h}{3}, y = \frac{b}{3}$

Answer:

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6. Two bodies of masses 2 kg and 4 kg are moving with velocities 2 m/s and 10 m/s respectively along same direction. Then the velocity of their centre of mass will be

A. $8.1m/s$

B. $7.3m/s$

C. $6.4m/s$

D. $5.3m/s$

Answer:

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7. Four particles of masses m, 2m, 3m and 4m are arranged at the corners of a parallelogram with each side equal to a and one of the angle between two adjacent sides is 60°. The parallelogram lies in the x-y plane with mass m at the origin and 4 m on the x-axis. The centre of mass of the arrangement will be located at

A. $\left(\frac{\sqrt{3}}{2}a, 0.95a\right)$

B. $\left(0.95a, \frac{\sqrt{3}}{2}a\right)$

C. $\left(\frac{3a}{4}, \frac{a}{2}\right)$

D. $\left(\frac{a}{2}, \frac{3a}{4}\right)$

Answer:

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8. Three identical metal balls each of radius r are placed touching each other on a horizontal surface such that an equilateral triangle is formed, when the center of three balls are joined. The center of mass of system is located at the

A. Horizontal surface

B. Centre of one of the balls

C. Line joining centres of any two balls

D. Point of intersection of the medians

Answer:

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9. 2 bodies of different masses of 2 kg and 4 kg are moving with velocities $20m / s$ and 10 m//s towards each other due to mutual gravitational attraction. What is the velocity of their centre of mass?

A. $5m / s$

B. $6m / s$

C. $8m/s$

D. Zero

Answer:

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10. 10 Two particles of masses m_1 and m_2 initially at rest start moving towards each other under their mutual force of attraction. The speed of the centre of mass at any time t, when they are at a distance r apart, is

A. zero

B. $\left(G\frac{m_1m_2}{r^2}.\ \frac{1}{m_1}\right)t$

C. $\left(G\frac{m_1m_2}{r^2}.\ \frac{1}{m_2}\right)t$

D. $\left(G\frac{m_1m_2}{r^2}.\ \frac{1}{m_1+m_2}\right)t$

Answer:

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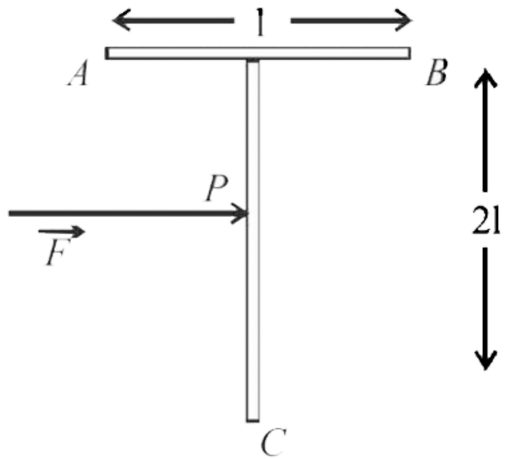
11. A 'T' shaped object with dimensions shown in the figure, is lying on a smooth floor. A force $'\vec{F}'$ is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the location of P with respect C.



A. $\frac{4}{3}l$

B. l

C. $\frac{2}{3}l$

D. $\frac{3}{2}l$

Answer:

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12. Two spheres of masses 2M and M are initially at rest at a distance R apart. Due to mutual force of attraction, they approach each other. When they are at separation $R/2$, the acceleration of the centre of mass of spheres would be

A. $0m/s^2$

B. gm / s^2

C. $3gm / s^2$

D. $12gm / s^2$

Answer:

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13. 3Masses 8 kg, 2 kg, 4 kg and 2 kg are placed at the corners A, B, C, D respectively of a square ABCD of diagonal 80 cm. The distance of centre of mass from A will be

A. 20 cm

B. 30 cm

C. 40 cm

D. 60 cm

Answer: B

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14. If linear density of a rod of length 3m varies as $\lambda = 2 + x,$ them the position of the centre of gravity of the rod is

A. $\frac{7}{3}m$

B. $\frac{12}{7}$

C. $\frac{10}{7}m$

D. $\frac{9}{7}m$

Answer: B

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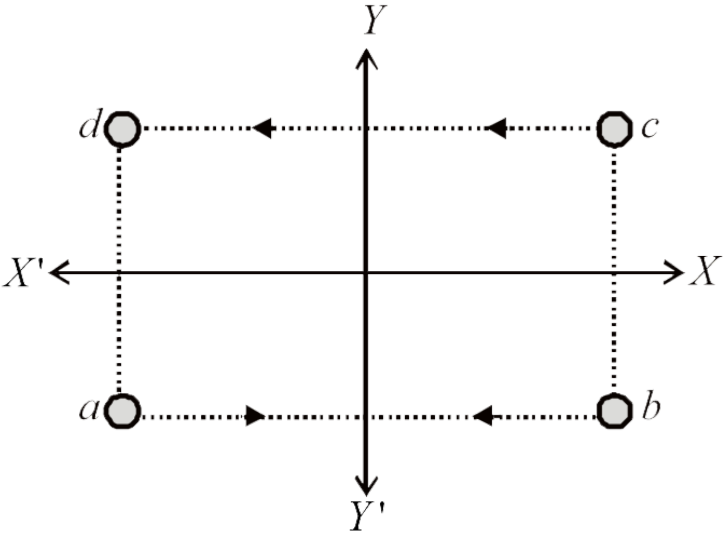
15. Four bodies of equal mass start moving with same speed as shown in the figure. In which of the following combination the centre of mass will remain at origin



A. c and d

B. a and b

C. a and c

D. b and d

Answer:

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16. Three identicle particle each of mass $1kg$ are placed with their centres on a straight line. Their centres are marked A, B and C respectively. The distance of centre of mass of the system from A is.

A. $\frac{PQ + PR + QR}{3}$

B. $\frac{PQ + PR}{3}$

C. $\frac{PQ + QR}{3}$

D. $\dfrac{PR + QR}{3}$

Answer:

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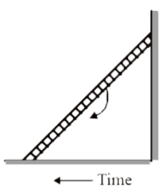
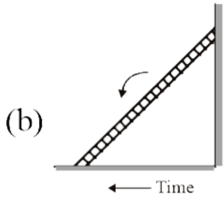
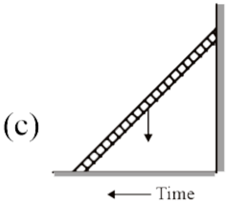
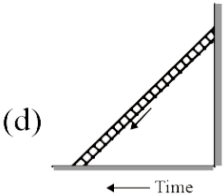
17. A ladder is leaned against a smooth wall and it is allowed to slip on a frictionless floor. Which figure represents the track of its centre of mass ?

A. (a) 

B. 

C. 

D. 

Answer:

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18. Two paricle A and B initially at rest, move towards each other under mutual force of attraction. At the instant when the speed of A is V and the speed of B is 2V, the speed of the centre of mass of the system is

A. 0

B. V

C. 2V

D. $\frac{V}{2}$

Answer:

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19. Cricket bat is cut at the location of its centre of mass as shown in the fig. Then

A. The two pieces will have the same mass

B. The bottom piece will have larger mass

C. The handle piece will have larger mass

D. Mass of handle piece is double the mass of bottom piece

Answer:

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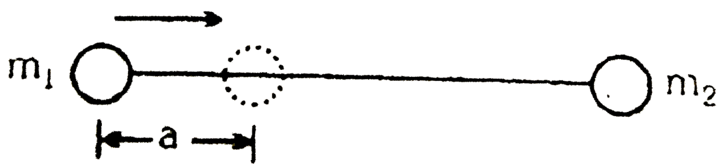
20. Considering a system having two masses m_1 and m_2 in which first mass is pushed towards centre of mass by a distance a, the distance required to be moved for second mass to keep centre of mass at same position is :-



A. $\frac{m_1}{m_1 + m_2} d$

B. $\frac{m_1}{m_2} d$

C. d

D. $\frac{m_2}{m_1} d$

Answer:

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21. Choose the wrong statements about the centre of mass (CM) of a system of two particles

The CM lies on the line joining the two particles midway between them

The CM lies on the line joining them at a point whose distance from each particle is proportional to the square of the mass of that particle

The CM is on the line joining them at a point whose distance from each particle is proportional to the mass of that particl

The CM lies on the line joining them at a point whose distance from each particle is inversely proportional to the mass of that particle

A. 1, 2 and 3 are correct

B. 1 and 2 are correct

C. 2 and 4 are correct

D. 1 and 3 are correct

Answer:

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22. Choose the wrong statements about the centre of mass of a body

A. It lies always outside the body

B. It lies always inside the body

C. It lies always on the surface of the body

D. It may lie within, outside or on the surface of the body

Answer:

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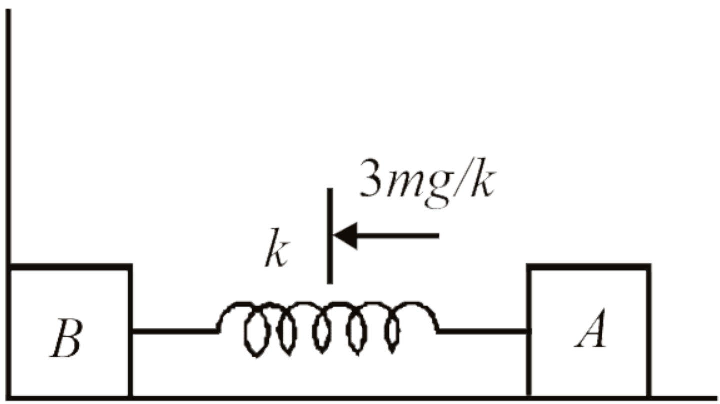
23. A system consists of block A and B each of mass m connected by a light spring as shown in the figure with block B in contact with a wall. The block A compresses the spring by 3mg/k from natural length of spring and then released from rest. Neglect friction anywhere



Acceleration of centre of mass of system comprising A and B just after A is released is

A. 0

B. $3g/2$

C. 3g

D. None of these

Answer:

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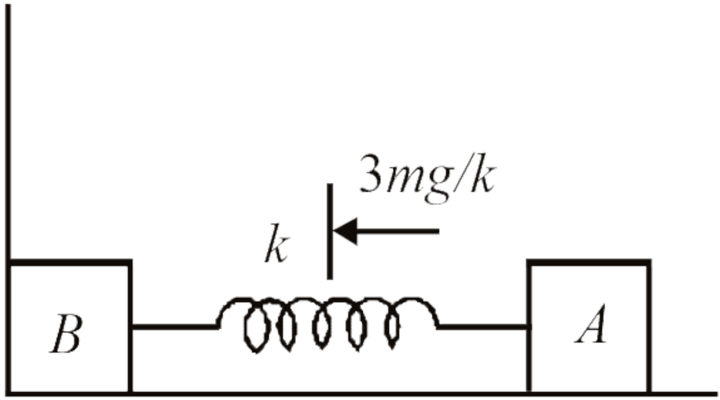
24. A system consists of block A and B each of mass m connected by a light spring as shown in the figure with block B in contact with a wall. The block A compresses the spring by 3mg/k from natural length of spring and then released from rest. Neglect friction anywhere.



Velocity of centre of mass of system comprising A and B when block B just loses contact with the wall

A. $3g\sqrt{\frac{m}{k}}$

B. $\frac{3g}{2}\sqrt{\frac{m}{k}}$

C. $2g\sqrt{\frac{m}{k}}$

D. None of these

Answer:

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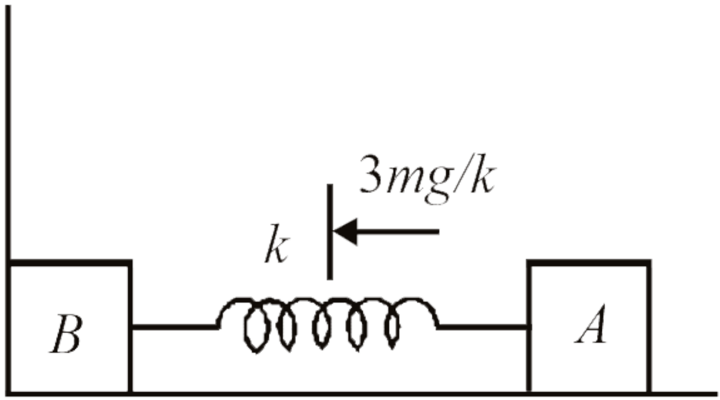
25. A system consists of block A and B each of mass m connected by a light spring as shown in the figure with block B in contact with a wall. The block A compresses the spring by 3mg/k from natural length of spring and then released from rest. Neglect friction anywhere.



Maximum extension in the spring after system

loses contact with wall

A. $\dfrac{3mg}{\sqrt{2k}}$

B. $\dfrac{\sqrt{3}mg}{2k}$

C. $\dfrac{\sqrt{3}mg}{\sqrt{2}k}$

D. None of these

Answer:

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26. Statement-1 : The centre of mass of a system of n particles is the weighted average of the position vector of the n particles making up the system

. Statement-2 : The position of the centre of mass of a system is independent of coordinate system

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement -1 is False, Statement-2 is True

D. Statement -1 is True, Statement-2 is False.

Answer:

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27. Statement-1 : The centre of mass of a proton and an electron, released from their respective positions remains at rest.

tatement-2 : The centre of mass remains at rest, if no external force is applied

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-2

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-2

C. Statement -1 is False, Statement-2 is True

D. Statement -1 is True, Statement-2 is False.

Answer:

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28. Statement-1 : Position of centre of mass is independent of the reference frame

. Statement-2 : Centre of mass is same for all bodies

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-3

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-3

C. Statement -1 is False, Statement-2 is True

D. Statement -1 is True, Statement-2 is False.

Answer:

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