PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

STATICS

Numerical Examples

1. Two particles of masses 1 kg and 2 kg are positioned on x-and y-axes at distances of 1 m and

2 m from the origin respectively. Find the position of the centre of mass of the system.

Watch Video Solution

2. Two masses, initially at rest, attract each other with a constant force. If there is no external force acting on the masses, prove that the centre of mass of the system remains stationary.

View Text Solution

3. A small sphere of radius R is kept attached to the smooth inner wall of a hollow sphere of radius 6 R Fig. The system is kept on a frictionless horizontal table. On releasing the small sphere, as it reaches the other end of the diameter, what will be the coordinates of the centre of the large sphere? Masses of the small and large sphere are M and 4M respectively.

View Text Solution

4. The position vectors of two masses of 6 and 2 units are 6i-7j and 2i+5j-8k respectively. Deduce the position of their centre of mass.

Watch Video Solution

5. Locate the centre of mass of a triangular lamina.

View Text Solution

6. Three particles of masses 1 g, 2g, and 3g are placed at the vertices of an equilateral triangle of

side 1 m. Locate the centre of mass of the system.

Watch Video Solution

7. In the HCI molecule the separation between the nuclei of the two atoms is about 1.27×10^{-10} m. Find the approximate location of the Centre of mass 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.

Watch Video Solution

8. Two objects of mass 10 kg and 2kg are moving with velocities $\left(2\hat{i}-7\hat{j}+3\hat{k}\right)m/s$ and $\left(-10\hat{i}+35\hat{j}-3\hat{k}\right)$ m/s respectively. Calculate the velocity of the centre of mass of the system.

Watch Video Solution

9. A stone is dropped from the top of a tower of height 60 m. At the same time, another stone is thrown up from the foot of the tower with a velocity 20 m/s. Calculate the displacement of the

centre of mass of the two stones at time of collision. (g=10 m/s^2)

View Text Solution

10. Masses of 2 kg and 5 kg are suspended at the two ends of a light rod of length 1.4 m. At which point should the rod be supported at to keep the system horizontal?

Watch Video Solution

11. One end of a rope of length L is tied to a vertical pole. A man is pulling the rope with a constant force at its other end. Which point on the pole should the rope be tied at to uproot the pole most easily?

View Text Solution

12. There is an obstruction of height h in front of a wheel of radius r weighing W. What is the minimum horizontal force that is to be applied at

the centre O of the wheel to overcome the obstruction? Given, h $<$ r.

View Text Solution

13. A horizontal force F is applied on a uniform sphere of radius r and weight W and as a result, the sphere slides over the horizontal table. If the coefficient of friction between the sphere and the table is μ, then show that h =r$\left(1-\frac{\mu W}{F}\right)$.

View Text Solution

14. A uniform iron rod of length 50 cm is bent, at right angles at 30 cm from one end, giving it an L-shape. The L-shaped rod is suspended freely from its point of bending. Find the angle that the 30 cm arm makes with the vertical at equilibrium.

View Text Solution

15. Three force F,F and $\sqrt{2}$ F acting at a point are in equilibrium. Find the angles between the forces.

View Text Solution

16. One end of a light string is fixed to the celling and the other end is tied to the wall. A body of mass 500 g is suspended from that string in such a way that the part of the string towards the wall remains horizontal and the portion towards the ceiling makes an angle of 30° with the ceiling. Find the tension on the two parts of the string.

Watch Video Solution

17. A weight W is suspended by using two strings. One of the strings makes an angle of 30° with the vertical. What should be the direction of the other

string so that the tension in it becomes minimum? Find the tension in each string at this position.

View Text Solution

18. From the markings 20 cm, 40 cm, 60 cm, 80 cm and 100 cm on a light metre ruler, masses of 1 g, 2 g, 3g , 4 g, 5 g, respectively are suspended. At which mark should the ruler be pivoted so that it remains horizontal?

Watch Video Solution

19. Two parallel forces P and Q (P $>$ Q) are acting at two points, A and B, of a body. If the forces interchange their positions, by how much will the point of action of the resultant of the resultant of the two forces shift along the line AB?

View Text Solution

20. The resultant of two parallel forces P and Q is R. If the force P shifts by a distance x, parallel to itself, prove that R will shift by $\frac{Px}{P+Q}$.

View Text Solution

21. Mass of a uniform rod of length 10 m is 10 kg . The rod is placed over knife edges A and B. One end of the rod is resting on the knife edge A and the other end is 2 m outside the knife edge B. A 30-kg weight is now suspended 2 m away from the end A. Find the magnitude of the normal forces on the knife edges.

View Text Solution

22. A ladder weighing W rests with one end against a rough vertical wall and the other end on

a rough floor. It is inclined at an angle of 45° with the horizontal. Coefficient of friction of the ladder with the floor and the wall are μ and μ' respectively. Show that the minimum horizontal force that can move the base of the ladder towards the wall is $\frac{W(1+2\mu-\mu\mu')}{2(1-\mu')}$.

View Text Solution

23. A uniform ladder of length L and mass M leans against a frictionless vertical wall. The ladder makes an angle θ with ground and the coefficient of the static friction between the ground and the

foot of the ladder is μ. What maximum height a man of mass m can climb up the ladder so that the ladder will not skid?

View Text Solution

24. A rod of weight W is kept horizontally on two knife edges with a distance d between them. Centre of gravity of the rod is at a distance x from A. Find the normal reactions at points A and B Fig.

View Text Solution

25. Show that the centre of gravity of three equal weights suspended from three vertices of a triangle coincide with the centre of mass of the triangle.

View Text Solution

26. A person of mass 80 kg is standing on the top of a 18 kg ladder of length 6 m. Upper end of the ladder rests on a smooth vertical wall and the lower end is on the ground 3 m away from the vertical wall. What should be the minimum

coefficient of friction between the floor and the ladder so that the system remains in equilibrium ?

View Text Solution

27. A uniform cylinder of diameter 8 cm is kept on a rough inclined plane whose angle of inclination with the ground is 30°. What should be the maximum height of the cylinder so that it does not topple?

View Text Solution

28. A hollow cylinder of height 100 cm and diameter 8 cm has its top end open. It contains water up to a height of 50 cm. Mass per square centimetre of the hollow cylinder is 9 g. Find the height of the centre of gravity of the water-cylinder system from the base of the cylinder.

View Text Solution

29. A uniform narrow rod of mass M and length 2 L is kept vertically, along the y-axis (as shown in Fig.) on a smooth horizontal plane. The lower end of

the rod coincides with the origin (0,0). Due to a slight disturbance at time $t = 0$, the rod slides along the positive x-axis and begins to fall. Determine (i) the shift in the centre of gravity during the fall,

(ii) the equation of the locus of a point at a distance r from the lower end of the rod and also mention the shape of the locus.

View Text Solution

30. A circular metal plate of uniform thickness has a radius of 10 cm. A hole of radius 4 cm is punched

on the plate a little away from its centre. Centres of the plate and of the hole are 5 cm apart. Find the centre of gravity of the plate with the hole.

View Text Solution

31. A mass of 10 kg is suspended using two strings. One string makes an angle of 60° with the vertical. What should be the angle made by the other string so that the tension in the string will be minimum? Find the tension in each wire.

View Text Solution

32. A chain of mass m and length l is kept on a horizontal frictionless table, such that $\frac{1}{4}$ th of the length of the chain is hanging out of the table. Find the work done to pull the hanging part of the chain onto the table.

View Text Solution

Higher Order Thinking Skill Hots Questions

1. Describe the moment of a force about a point as a vector quantity.

View Text Solution

2. What is the significance of moment of a force about a point?

View Text Solution

3. It is easier to open or close a door by pushing it at the edges than by pushing closer to the hinges. Explain.

View Text Solution

4. State whether three forces of magnitude 1 dyn, 2 dyn and 3 dyn acting simultaneously on a body can keep it in equilibrium.

View Text Solution

5. A bomb is thrown vertically upwards. At its topmost position it explodes into a number of fragments. What would be the locus of the centre of gravity of the bomb ?

View Text Solution

6. A pingpong ball is floating at the vertex of a vertical fountain. State whether the equilibrium of the ball is vertically stable, unstable or neutral.

View Text Solution

7. A rectangular parallelepiped of mass m has three sides of length l, $2l$ and $3l$ respectively. State with reason, in which position the block should be kept at rest on a horizontal floor so as to attain the highest stability of equilibrium.

View Text Solution

8. Two particles initially at rest are approaching each other due to their mutual force of attraction. What is the velocity of the centre of mass of the system when the particles have a relative velocity v ?

View Text Solution

9. A piece of stone thrown vertically upwards comes to rest momentarily at its maximum height. Is the stone in equilibrium at this position?

View Text Solution

View Text Solution

10. Should there be any change in the position of the centre of gravity of a hollow sphere when it is (i) half filled, (ii) completely filled with water?

View Text Solution

11. It is easier to stand on two legs than to stand on a single leg. Why?

View Text Solution

12. Passengers on a boat should not be allowed to stand up on the boat while crossing a river. Why?

View Text Solution

13. Two arms of a common balance are unequal. How can the balance be used to find the correct mass of an object?

View Text Solution

14. A businessman uses a faulty balance of unequal arms of lengths x and y respectively. He sells W kg of tea to each customer. While selling to the 1 st and the 2 nd customers he keeps the counterpoising weight on the left pan and on the right pan respectively. Does he gain or lose?

View Text Solution

15. A businessman uses a faulty balance of unequal arms. He buys some old papers from a person and for this he uses a $\frac{1}{2}$ kg

counterpoising weight. He then readily agrees to weigh the papers alternately by changing the pans of the balance during successive weighings. Show that he gains in every 1 kg of purchase. [Upthrust due to air is neglected.]

View Text Solution

16. A person may stand on the lower steps or at the top of a ladder. In which of these cases does the possibility of sliding of the ladder become maximum?

View Text Solution

17. Why is it easier to walk with two equal loads in both hands than with the entire load in one hand?

View Text Solution

18. Babies fall down frequently while trying to walk. Why?

View Text Solution

Exercise Multiple Choice Questions

1. Two particles, initially at rest due to their mutual attraction move towards each other. When their relative velocity becomes v , velocity of the centre of mass of the system becomes

A. zero

B. v

C. 1.5 v

D. 3 v

Answer: A

Watch Video Solution

2. Position vectors of two equal masses with respect to the origin are $\vec{a}$ and $\vec{b}$ respectively. Position vector of the centre of mass of these masses is

A. $\vec{a} + \vec{b}$

B. $\frac{\vec{a} + \vec{b}}{2}$

C. $\vec{a} \times \vec{b}$

D. $\frac{\vec{b} - \vec{a}}{2}$

Answer: B

Watch Video Solution

3. Position vector of the centre of mass of a system of N particles of total mass M is

A. $\frac{\sum^{\vec{M}r} p}{M}$

B. $\sum_{\frac{p=1}{r}}^{N} \vec{r}_p$

C. $\frac{\sum_{\frac{p=1}{r}}^{N} m_p \vec{r}_p}{\sum_{p=1}^{N} m_p}$

D. $\frac{\sum_{\frac{p=1}{r}}^{N} m_p \vec{r}_p}{\sum_{p=1}^{N} r_p}$

Answer: C

View Text Solution

4. A stick is thrown in air. It lands a little away from the thrower. The locus of the path of the centre of mass of the stick will be a parabola

A. in all cases

B. only when the stick is uniform

C. if the stick had only linear motion and no rotational motion

D. if the stick is of such shape that its centre of mass is on the stick itself and not outside

Answer: A

View Text Solution

5. A man is hanging from a rope attached to a balloon containing hot air. The system is at rest in air. If the man climbs up the rope to the balloon, then centre of mass of the system

A. remains at rest

B. moves upwards

C. moves downwards

D. first moves up and then moves back to the initial position

Answer: A

View Text Solution

6. All the particles of a body are situated at a distance R from the origin. The distance of the centre of mass of the body from the origin is

A. $= R$

B. $\leq R$

C. $> R$

D. $\geq R$

Answer: B

Watch Video Solution

7. Consider a system of two identical particles. One of the particle is at rest and the other has an acceleration $\vec{a}$. The centre of mass has an acceleration

A. zero

B. $\frac{1}{2}\vec{a}$

C. $\vec{a}$

D. $\overrightarrow{2}\,a$

Answer: B

 Watch Video Solution

8. A body falling vertically downwards under gravity breaks in two parts of unequal masses. The centre of mass of the tow parts taken together shifts horizontally towards

A. heavier piece

B. lighter piece

C. does not shift horizontally

D. depends on the vertical velocity at the time of breaking

Answer: C

View Text Solution

9. A uniform metal disc of radius R is taken and out of it a disc of diameter R is cut off from the end. The centre of mass of the remaining part will be

A. $\frac{R}{4}$ from the centre

B. $\frac{R}{3}$ from the centre

C. $\frac{R}{5}$ from the centre

D. $\frac{R}{6}$ from the centre

Answer: D

View Text Solution

10. The centre of mass of a solid cone along the line from the centre of the base to the vertex is at

A. one-fourth of the height

B. one-third of the height

C. one-fifth of the height

D. none of these

Answer: A

View Text Solution

11. A pulley fixed to the ceiling carries a string with blocks of masses m and 3 m attached to its ends. The masses of string and pulley are negligible. When the system is released the acceleration of centre of mass will be

A. zero

B. $-\frac{g}{4}$

C. $\frac{g}{2}$

D. $-\frac{g}{2}$

Answer: C

View Text Solution

12. Two particles each of mass 1 g are placed at distance of 1 m and 3 m respectively from the

origin along x-axis. The centre of mass of the system from the origin is

A. 1 m

B. 2 m

C. 2.5 m

D. 3.5 m

Answer: B

 Watch Video Solution

13. A uniform metre scale of mass m is suspended horizontally by two vertical ropes fitted at its two ends. An object of mass 2 m is placed at the 75 cm mark on the scale. Ratio of tensions in the two strings is

A. $1:2$

B. $1:3$

C. $2:3$

D. $3:4$

Answer: A

Watch Video Solution

Watch Video Solution

14. Height of a solid cone is h and radius of its circular base is r. The cone has been placed on it base on an inclined plane. Maximum angle of inclination for which the cone will not topple over is

A. $\cos^{-1}\frac{2r}{h}$

B. $\tan^{-1}\frac{4r}{h}$

C. $\tan^{-1}\frac{3r}{h}$

D. $\sin^{-1}\frac{4r}{h}$

Answer: C

View Text Solution

Very Short Answer Type Questions Based On Centre Of Mass

1. A rocket in space is being propelled by the ejection of a gas. What is the velocity of the centre of mass of the rocket-fuel system?

A.

B.

C.

D.

Answer: zero

View Text Solution

2. A rocket in space is being propelled by the ejection of a gas. Will the velocity of the centre of mass of the rocket be zero?

View Text Solution

3. Can the centre of mass of a body lie outside the body?

View Text Solution

4. Does the centre of mass of a body necessarily lie inside the body?

View Text Solution

5. Give the location of the centre of mass of a solid cylinder having uniform mass density.

Watch Video Solution

6. Two particles, due to their mutual attraction approach each other. Given the value of velocity of the centre of mass of the system at the moment when their relative velocity is v.

View Text Solution

7. A uniform rod of length 1 m is bent at right angles at its mid-point. What is the distance of the centre of mass from the mid-point of the rod?

Watch Video Solution

8. Write down dimension of the moment of force.

View Text Solution

9. Write down the name of anticlockwise moment of a force.

Watch Video Solution

10. Mention the clockwise moment of a force.

Watch Video Solution

11. Moment of a force about a point is _____ the area of the triangle formed by joining that point the initial point of application of the force and the final point of application of the force. [Fill in the blank]

View Text Solution

12. Moment of force is a vector ___true or false ?

Watch Video Solution

13. Give the vector representation of the moment of force.

Watch Video Solution

14. It is _____ to open a door by pushing it near the outer edge than by pushing it near th e hinge. [Fill in the blank]

View Text Solution

Very Short Answer Type Questions Based On Moment Of A Force

1. Write down the CGS unit of the moment of force.

Watch Video Solution

Very Short Answer Type Questions Based On Equilibrium Of A Body

1. Some forces act at a point such that their magnitudes and directions can be represented by

the sides of a closed polygon taken in order. What is the resultant of the forces?

Watch Video Solution

2. Lengths of the arms of a balance are equal but the weights of the pans are different. When an object is put on the left pan, it weighs W_1 and on the right pan it weighs W_2. What is the actual weight of the object?

View Text Solution

3. A man is at the top of a ladder and another instance he stands on one of the lower steps. In which case does the foot of the ladder have a higher chance of slipping ?

View Text Solution

4. Can two unequal force that lie in same plane produce equilibrium ?

View Text Solution

5. A gas filled balloon remains at rest at a certain height. The balloon is in stable equilibrium',___ true or false?

View Text Solution

6. When a body revolves in a circular path at a constant speed it is in an unstable equilibrium ___ true or false?

View Text Solution

7. At one end of a weightless rope of length 10 m, a car of mass M is tied. The other end of the rope is in the hands of a man of mass M. The arrangement stands on a horizontal frictionless surface. The man is at x=0 and the car is at x =10 m. As the man pulls the car with the rope locate the point where they meet.

View Text Solution

8. Under the action of three forces F ,F and $\sqrt{2}$F, a particle remains in equilibrium. Find the angle

between the first two forces.

Watch Video Solution

Very Short Answer Type Questions Based On Centre Of Gravity

1. What is the position of the centre of gravity of a uniform rectangular lamina?

View Text Solution

2. For a uniform body, if the shape is kept the same but its size is changed uniformly, will the position of the centre of gravity change ?

View Text Solution

3. When a uniform rod is heated at one of its ends will the position of the centre of gravity be shifted ?

View Text Solution

4. Is centre of gravity changes it's position if the shape changes of a body without change of it's weight?

View Text Solution

5. Is centre of gravity of a body to be many?

View Text Solution

6. Can the centre of gravity of a long glass tube lie at the mid point of its length?

View Text Solution

7. A rod weighin W is placed horizontally over knife edges A and B. Distance between the knife edges is d and the distance of the centre of gravity of the rod from A is x. What are the reactions at A and B?

View Text Solution

8. Centre of mass and centre of gravity of a body are not the same in general __ correct or incorrect

?

View Text Solution

Short Answer Type Questions I

1. When does the moment of a force become (i) zero and (ii) maximum when the force is acting on a body?

Watch Video Solution

2. Torque is called moment of force. Explain why?

Watch Video Solution

Problem Set I Based On Centre Of Mass

1. The position vectors of three particles of masses $m_1 = 1kg, \quad m_2 = 2kg$ and $m_3 = 3kg$ are $r_1 = (i + 4j + k)m, \quad r_2 = (i + j + k)m$ and $r_3 = (2i - j - 2k)m$ respectively. Find the position vector of their centre of mass.

Watch Video Solution

2. Four particles of mass 2 kg , 4 kg , 5 kg , and 3 kg are placed at the four vertices A, B, C and D of a square of side 1 m. Find the position of centre of mass of the particle.

Watch Video Solution

Problem Set I Based On Moment Of A Force

1. A mass of 2 kg is kept at one end of a 10 cm long rod, and a mass of 5 kg at the other end. Find the

point of suspension for the rod so that it remains horizontal. Neglect the weight of the rod.

Watch Video Solution

2. At what height should a rope of length x be tied to a long vertical pole so that a person standing on the ground can pull down the pole by applying a force F at the other end of the rope most conveniently?

View Text Solution

Problem Set I Based On Equilibrium Of A Body

1. A weightless wire has its ends rigidly fixed. From the mid-point of the wire on object of mass 500 g is hung so that each part of the wire subtends an angle of 30° with the horizontal. Find the tension in each part of the rope.

Watch Video Solution

2. A rod of negligible mass carries a 5 kg mass at a distance of 10 cm from its fulcrum. Another mass m is kept 5 cm away on the other side such that

the rod remains horizontal. Find the value of m and the reaction at the fulcrum.

Watch Video Solution

3. A uniform ladder is standing against a vertical smooth wall, resting on a horizontal floor. The ladder makes an angle of 45° with the floor when its lower end is about to slip. What is the value of the coefficient of friction between the ladder and the floor?

View Text Solution

4. Vertical angle of a V-shaped container is 60° . A sphere of mass 400 g is kept in it. What will be the force exerted by the sphere, normally on each side wall of the container?

Watch Video Solution

5. The centre of gravity of a hollow cylinder of mass 200 g is 10 cm above its base. If 500 g of water is poured into the cylinder the water level comes up to a height of 6 cm. What will be the height of the centre of gravity of the cylinder containing water?

Watch Video Solution

Problem Set I Based On Centre Of Gravity

1. A uniform straight rod mass 50 kg and length 4 m is to be supported on two supports equidistant from the respective ends. What can be the maximum distance of the supports so that a 30 kg counterpoising weight can be kept in equilibrium at any point on the rod?

View Text Solution

2. A bridge of mass 10 tonne and length 50 m is supported at its ends by two pillars. What weight do the pillars sustain when a lorry of mass 4 tonne is 10 m away from the first pillar?

View Text Solution

Problem Set Ii Based On Centre Of Mass

1. A circular hole of diameter 10 cm is punched in a uniform circular lamina of diameter 26 cm such that the centre of the hole is 6 cm away from the

centre of the lamina. Find the position of the centre of mass of the lamina with the hole.

View Text Solution

2. Four identical spheres each of radius a are placed on a horizontal table touching one another so that their centres lies at the corners of a square of side 2 a. Find the position of their centre of mass.

Watch Video Solution

3. Two particles m_1 = 2 kg and m_2 = 3 kg have position vectors $\vec{r}_1 = t\hat{i} + 2t^2\hat{j} + 2t\hat{k}$, where $\vec{r}_2 = \hat{i} + 2t^3\hat{j} + 5\hat{k}$ position vectors are in metres and time in seconds. Find (i) position vector of centre of mass (ii) velocity of centre of mass and (iii) acceleration of centre of mass.

Watch Video Solution

4. The density of a linear rod of length L varies as ρ = A+Bx, where x is the distance from the left end.

Locate the centre of mass.

Watch Video Solution

Problem Set Ii Based On Equilibrium Of Force

1. Five masses 1 g, 2 g, 3 g, 4 g, and 5 g are suspended serially at a separation of 25 cm from a weightless metre rod. Where should the rod the be supported so that it remains horizontal?

Watch Video Solution

Problem Set Ii Based On Equilibrium Of Body

1. To lift a motor car from a ditch, one end of a rope ABC is attached to a point A of a tree and the other end is tied at a point C of the car. At the mid-point B of the rope ,a pull of 200 kg -wt is applied at right angles to AC. If $\angle ABC = 120^\circ$, find the tension in the rope.

View Text Solution

2. A body of mass 20 kg is suspended using two ropes. One of the ropes is 30° to the vertical.

What should be the inclination of the other rope with the vertical so that tension in this will be minimum ? Find the values of the tensions in the two strings also.

View Text Solution

3. One end of a uniform ladder rests against a smooth vertical wall and the other end is on rough ground. A man of 80-kg weight stands on the ladder at $\frac{1}{4}$th up its lengt. Angle of the ladder with the horizontal is 30° . Find the reaction of the wall and the coefficient of friction between the

ladder and the ground. The mass of the ladder is 40 kg.

View Text Solution

4. A ladder of mass 30 kg and length 5 m is kept leaning against a vertical smooth wall. A man of mass 60 kg climbed up $\frac{3}{4}th$ the length of the ladder. If the coefficient of friction between the floor and the ladder is 0.5, what should be the maximum distance of the foot of the ladder from the wall to avoid slipping?

View Text Solution

5. The upper end of a 100 cm long uniform wire is rigidly fixed. At the other end, a spherical body of mass 40 g and diameter 2 cm is suspended. Mass per unit length of the wire is 0.008 g . cm^{-1}. Find the position of the centre of gravity of the system.

Watch Video Solution

Problem Set Ii Miscellaneous

1. The lengths of left and right arms of a balance are 10.5 cm and 10 cm respectively. Without the scale pans, the balance remains horizontal. Even with two scale pans of different masses the balance remains horizontal. Keeping a body on the right pan, equilibrium is achieved by putting a counterpoising 100-g weight on the left pan. What is the actual mass of the body?

View Text Solution

Hots Numerical Problems Based On Centre Of Mass

1. Two blocks of equal mass m are connected by an unstretched spring and the system is kept at rest on a frictionless horizontal surface. A constant force F is applied on one of the blocks pulling it away from the other as shown in the Fig. (i) Find the position of the centre of mass at time t. (ii) If the extension of the spring is x_0 at time t, find the displacement of the two blocks at thin instant.

View Text Solution

2. Consider a two-particle system with the particle having masses m_1 and m_2 . If the first particle is pushed towards the centre of mass through a distance d, by what distance should be second particle be moved so as to keep the centre of mass at the same position?

Watch Video Solution

Hots Numerical Problems Based On Equilibrium Of Force

1. A counterpoising 50-g weight is suspended from the ends of two strings of length 7 cm and 24 cm. The other ends of the strings are fixed rigidly at the two ends of a uniform rod of length 25 cm. If the weight and the midpoint of the rod remain in equilibrium on the same vertical line, find teh tension in the strings.

View Text Solution

2. Two uniform rods AB and BC , each of length L and mass M , are hinged smoothly at the point B.

Midpoints of the rods are connected by an inextensible string of length $\frac{l}{\sqrt{2}}$. The combination stands vertically on a horizontal plane supported at A and C. Find the tension in the string.

View Text Solution

Hots Numerical Problems Based On Centre Of Gravity

1. Three uniform rods, each of length 2l and of the same mass are kept along three arms of a square

in order. Find the position of the centre of gravity of the system.

Watch Video Solution

2. Diameter of a glass bottle with a flat base is 4 cm and the bottle has mass 30 g. Centre of gravity of the empty bottle is 10 cm above the base. Up to what height the bottle should be filled with water such that , when it floats vertically in a tank of water such that when it floats vertically in a tank of water, its centre of gravity will be at the mid-point of the immersed portion of the bottle?

View Text Solution

Hots Numerical Problems Miscellaneous

1. A string passes over two smooth pulleys kept at a horizontal distance $2l$. The two free ends of the string support two equal masses. From the middle of the string a third object of the same mass is suspended and released. How far would this mass descend vertically?

View Text Solution

2. Four identical bricks are kept one over another in such a way that a part of each brick is projected out of the brick below it. For equilibrium of the system, how much of the three upper bricks can be extended out?

View Text Solution

3. A horizontal square table is standing on four legs fitted at the mid-point of each side. Weight of the table is W. What maximum weight can be placed at any corner of the table, so that it does not overturn ?

View Text Solution

Entrance Corner Assertion Reason Type

1. These questions have statement I and statement II. Of the four choices given below, choose the one that best describes the two statements.

Statement I: The centre of mass of the system will not alter in any direction if the external force is not exerted on it.

Statement II: If net external force is zero then the linear momentum of the system remains constant.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

View Text Solution

2. Statement : Position of centre of mass of a body is independent of the shape and size of the body.

Statement II: The centre of mass of a body may be in a position where there is no mass.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

View Text Solution

3. Statement I: Centre of mass of a rigid body always lies inside the body.

Statement II: Centre of mass and centre of gravity coincide if gravity is uniform.

A. Statement I is true, statement II is true, statement II is a correct explanation for

statement I.

B. Statement I is true, statement II true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

View Text Solution

4. Statement I: The centre of mass of an electron-proton system, when released moves faster towards proton.

Statement II: Proton is heavier than electron.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

View Text Solution

5. Statement I: When a body dropped from a height explodes in mid air its centre of mass keeps moving in vertically downward direction.

Statement II: Explosion occurs under internal forces only External force is zero.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: C

View Text Solution

Entrance Corner Multiple Correct Answers Type

1. Four forces act on a point object. The object will be in equilibrium,if

A. all of them are in the same plane

B. they are opposite to each other in pairs

C. the sum of x,y and z components of forces is zero separately

D. they form a closed figure of 4 sides when added as per polygon law.

Answer: B::C::D

Watch Video Solution

Comprehension Type

1. A solid cylinder rolls up an inclined plane of angle of inclination 30° . At the bottom of the inclined plane the centre of mass of the cylinder has a speed of $5\ \mathrm{m.s}^{-1}$.

The distance up to which the cylinder goes up the plane is

A. 4 m

B. 3.8 m

C. 3.6 m

D. 3 m

Answer: B

Watch Video Solution

2. A solid cylinder rolls up an inclined plane of angle of inclination 30° . At the bottom of the inclined plane the centre of mass of the cylinder

has a speed of 5 $\mathrm{m.s}^{-1}$.

Time taken for the cylinder to return to the bottom is

A. 3.5 s

B. 3.7 s

C. 3.0 s

D. 3.8 s

Answer: C

View Text Solution

3. A particle of mass 1 kg has velocity $\overrightarrow{v}_1 = (2t)\hat{i}$ and another particle of mass 2 kg has velocity $\overrightarrow{v}_2 = (t^2)\hat{j}$.

Net force on the centre of mass at 2 s

A. $\frac{20}{9}$ unit

B. $\sqrt{68}$ unit

C. $\frac{\sqrt{80}}{3}$ unit

D. none of these

Answer: B

Watch Video Solution

4. A particle of mass 1 kg has velocity $\vec{v}_1 = (2t)\hat{i}$ and another particle of mass 2 kg has velocity $\vec{v}_2 = (t^2)\hat{j}$.

Velocity of the centre of mass at 2 s

A. $\frac{20}{9}$ unit

B. $\sqrt{68}$ unit

C. $\frac{\sqrt{80}}{3}$ unit

D. none of these

Answer: C

Watch Video Solution

5. A particle of mass 1 kg has velocity $\vec{v}_1 = (2t)\hat{i}$ and another particle of mass 2 kg has velocity $\vec{v}_2 = (t^2)\hat{j}$.

Displacement of the centre of mass in 2 s

A. $\frac{20}{9}$ unit

B. $\sqrt{68}$ unit

C. $\frac{\sqrt{80}}{3}$ unit

D. none of these

Answer: A

Watch Video Solution

Integer Answer Type

1. Two ice skaters A and B approach each other at right angles. Skater A has a mass 30 kg and velocity 1 $\mathrm{m.s}^{-1}$, skater B has a mass 20 kg and velocity $2\mathrm{m.s}^{-1}$. They meet and cling together. Find the final velocity (in $\mathrm{m.s}^{-1}$) of the couple.

Watch Video Solution

Examination Archive With Solutions Wbchse

1. Two particless of mass 2 g, and 3 g are situated at the locations (3 cm , 5 cm) and (4 cm, 6 cm) respectively. Find the position vector of the centre of mass of the two particles.

Watch Video Solution

2. Explain why the concept of centre of mass is much more fundamental than centre of gravity.

View Text Solution

3. Find the velocity of the centre of mass of two identical particles moving with velocities v_1 and v_2 .

Watch Video Solution

4. Show that in absence of any external force the centre of mass of two moving particles moves with uniform velocity.

Watch Video Solution

5. Three force F_1, F_2, F_3 -of which F_2 and F_3 are mutually perpendicular__ act on a particle of mass m so that the particle is stationary. Find the acceleration of the particle when F_1 is withdrawn.

Watch Video Solution

6. Define centre of mass. Write down its mathematical form. Two particles (2 cm, 3 cm) and (4 cm , 5 cm) respectively. Find the position vector of the centre of mass of the two particles.

View Text Solution

Examination Archive With Solutions Wbjee

1. A large number of particles are placed around the origin each at a distance R from the origin. The distance of the centre of mass of the system from the origin is

A. $= R$

B. $\leq R$

C. $> R$

D. $\geq R$

Answer: B

Watch Video Solution

2. Two bodies of masses m_1 and m_2 are separated by a distance R. The distance of the centre of mass of the bodies from the mass m_1 is

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

B. $\frac{m_1 R}{m_1 + m_2}$

C. $\frac{m_1 m_2}{m_1 + m_2} R$

D. $\frac{m_1 + m_2}{m_1} R$

Answer: A

Watch Video Solution

3. Two particles A and B (both initially at rest) start moving towards each other under a 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 is

A. zero

B. v

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

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

Answer: A

Watch Video Solution

Examination Archive With Solutions Jee Main

1. Distance of the centre of mass of a solid uniform cone from its vertex is z_0. If the radius of its base is R and its height is h, then z_0 is equal to

A. $\frac{h^2}{4R}$

B. $\frac{3h}{4}$

C. $\frac{5h}{8}$

D. $\frac{3h^2}{8R}$

Answer: B

Watch Video Solution

Examination Archive With Solutions Aipmt

1. A rod of weight W is supported by two parallel knife edge A and B and is in equilibrium in a horizontal position. The knives are at a distance d

from each other. The centre of mass of the rod is at distance x from A. The normal reaction on A is

A. $\frac{Wx}{d}$

B. $\frac{Wd}{x}$

C. $\frac{W(d-x)}{x}$

D. $\frac{W(d-x)}{d}$

Answer: D

Watch Video Solution

2. Two spherical bodies of mass M and 5 M and radii R and 2 R are released in free space with initial separation between their centres equal to 12 R. If they attract each other due to gravitational force only, then the distance covered by by the smaller body before collision is

A. 2.5 R

B. 4.5 R

C. 7.5 R

D. 1.5 R

Answer: C

View Text Solution

Cbse Scanner

1. Four bodies have been arranged at the corners of a rectangle shown in Fig. Find the centre of mass of the system.

View Text Solution

2. Why are we not able to rotate a wheel by pulling or pushing along its radius?

Watch Video Solution

3. Why do we use a wrench of long arm to unscrew a unit tightly fitted to a bolt?

View Text Solution