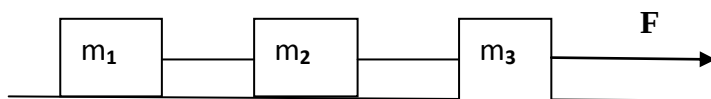


- Which one of the following statements is true about action and reaction forces referred to in Newton's third law of motion? (UEE:2003)
  - They act up on the same body.
  - They are equal in magnitude but need not have the same line of action.
  - They act up on two different bodies.
  - They are not equal in magnitude but have the same line of action.
- Which of the following statements is **NOT** true?(UEE:2003)
  - The magnitude of average angular velocity is directly proportional to the angular displacement during a given time.
  - Average angular velocity and instantaneous angular velocity are the same for uniform angular motion.
  - The direction of the average angular velocity is determined by the right hand rule.
  - The direction of average angular velocity is parallel to a tangent line along the trajectory of the object.
- A cart moving at a speed  $V$  collides with an identical stationary cart on an air track and the two stick together after collision. What is their velocity after collision? (UEE: 2003).
  - $-0.5 V$ .
  - Zero.
  - $0.5 V$ .
  - $V$ .
- Three blocks of mass  $m_1$ ,  $m_2$  and  $m_3$  are connected by thread and placed on a smooth horizontal surface as shown in the figure below. A force  $F$  is applied on the block of mass  $m_3$  in forward direction as shown. Neglecting friction, find the tension in the thread connecting  $m_1$  and  $m_2$ (UEE:2003)

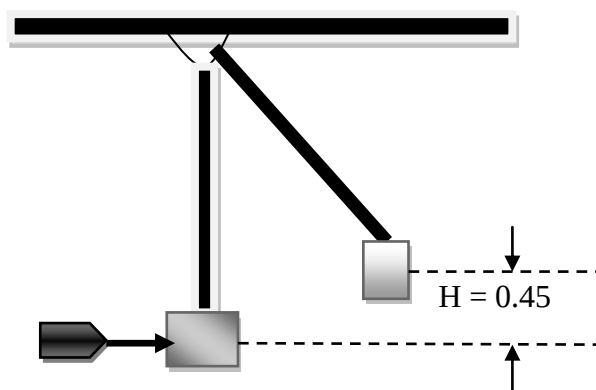


- $\frac{m_1 F}{m_1 + m_2 + m_3}$
  - $\frac{m_2 F}{m_1 + m_2 + m_3}$
  - $F - \frac{m_3 F}{m_1 + m_2 + m_3}$
  - $\frac{(m_2 + m_3) F}{m_1 + m_2 + m_3}$
- When a small mass  $m$  suspended from one end of a vertical string and then whirled in a horizontal circle at a constant speed  $v$ , (UEE: 2003).
    - The string stays vertical.
    - The string becomes inclined to the vertical.
    - There is no force on  $m$  except its weight.
    - The angle of inclination to the vertical of the string does not depend on  $v$ .

6. A block slides on a rough  $45^0$  incline. The coefficient of friction between block and incline is  $\mu_k$ . What is the ratio of acceleration when the block accelerates down the inclined to the acceleration when the block is projected up the incline? (UEE:2003)
- A.  $\frac{\mu_k - 1}{\mu_k + 1}$       B.  $\frac{\frac{\mu_k}{\sqrt{2}} - 1}{\mu_k + 1}$       C.  $\frac{1 - \mu_k}{1 + \mu_k}$       D.  $\frac{1 + \mu_k}{1 - \mu_k}$
7. As a satellite moves in an elliptical orbit around the earth, the gravitational attraction of the earth for the satellite:(UEE:2003)
- A. is greater than the satellite's gravitational attraction for the earth.  
B. is less than the satellite's gravitational attraction for the earth.  
C. varies inversely as the square to the distance between the earth and the satellite.  
D. remains constant.
8. A car (mass  $m_1$ ) is driving at velocity  $v$ , when it smashes into an unmoving car (mass  $m_2$ ), locking bumpers. Both cars move together at the same velocity. The common velocity will be given by :( UEE: 2004).
- A.  $\frac{m_1 v}{m_2}$       B.  $\frac{m_2 v}{m_1}$       C.  $\frac{m_1 v}{(m_1 + m_2)}$       D.  $\frac{(m_1 + m_2) v}{m_1}$
9. A ladder of length 3 m and mass 20 kg leans against a smooth, vertical wall so that the angle between the wall and the ladder is  $30^0$ . Determine the magnitude of the normal forces at the contact point on the wall ( $N_w$ ) and at the contact point on the ground ( $N_g$ ) (UEE: 2004).
- A.  $N_w = 57.7 \text{ N}$ ,  $N_g = 200 \text{ N}$ .      C.  $N_w = 0 \text{ N}$ ,  $N_g = 200 \text{ N}$ .  
B.  $N_w = 200 \text{ N}$ ,  $N_g = 57.7 \text{ N}$ .      D.  $N_w = 200 \text{ N}$ ,  $N_g = 0 \text{ N}$ .
10. A block of mass 0.25 kg is placed on top of a light vertical spring of force constant 5000N/m and pushed downward so that the spring is compressed by 0.10 m. After the block is released from rest, it travels upward and then leaves the spring. To what maximum height above the point of release does it rise? (UEE: 2004).
- A. 10.2 m.      B. 9.2 m.      C. 8.0 m.      D. 9.0 m.
11. A ladder of length 3 m and mass 20 kg leans against a smooth, vertical wall so that the angle between the wall and the ladder is  $30^0$ . What are the magnitudes of the normal forces at the contact point on the wall ( $N_w$ ) and at the contact point on the ground ( $N_g$ ) (UEE: 2005).
- A.  $N_w = 0 \text{ N}$ ,  $N_g = 200 \text{ N}$ .      C.  $N_w = 57.7 \text{ N}$ ,  $N_g = 200 \text{ N}$   
B.  $N_w = 200 \text{ N}$ ,  $N_g = 0 \text{ N}$ .      D.  $N_w = 200 \text{ N}$ ,  $N_g = 57.7 \text{ N}$

12. A bullet of mass 10 gm, moving horizontally, strikes and embeds itself in a box of mass 1 kg suspended from a light string as shown in the figure below. If the composite mass rises to a height  $H = 0.45$  m, then what is the speed of the bullet before collision? (UEE: 2005).

- A. 303 m/s.
- B. 300 m/s.
- C. 90.9 m/s.
- D. 90 m/s.



13. Which one of the following statements is true about the motion of a particle in a circular path? (UUE: 2006).

- A. The centripetal acceleration is constant if the particle's speed is constant.
- B. The tangential acceleration can be perpendicular to the velocity vector of the particle.
- C. The centripetal acceleration is always in the direction perpendicular to the velocity vector of the particle.
- D. The acceleration is always perpendicular to the velocity vector of the particle.

14. Two particles with masses  $2m$  and  $3m$  are moving toward each other along the  $x$  axis with the same initial speeds  $v$ . Particle  $2m$  is traveling to the left, and particle  $3m$  is traveling to the right. They undergo an elastic glancing collision such that particle  $2m$  is moving in the negative  $y$  direction after the collision. What are the  $x$  component of the final velocity of particle  $3m$  and the kinetic energy of the particle  $2m$ , respectively? (UEE: 2006).

- |                              |                              |
|------------------------------|------------------------------|
| A. $0.33 v$ and $0.7 mv^2$ . | C. $0.67 v$ and $0.7 mv^2$ . |
| B. $0.33 v$ and $1.4 mv^2$ . | D. $0.67 v$ and $1.4 mv^2$ . |

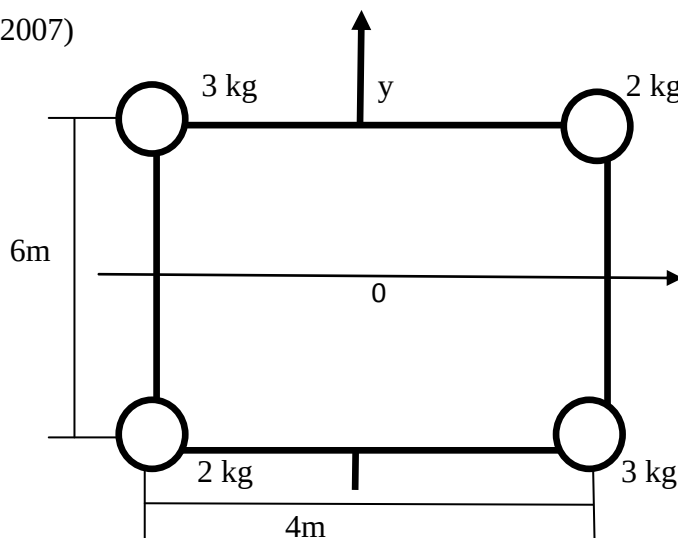
15. A hard ball moving on a horizontal frictionless surface with a speed of 5 m/s in the positive  $x$  direction strikes a stationary hard ball of the same mass. After the collision, the first ball moves with a speed of 4 m/s along a direction that makes an angle of  $37^\circ$  with its initial direction of motion. What is the struck ball's speed and the smallest angle between its direction of motion and the positive  $x$  axis after the collision? (UEE: 2007).

- |                           |                           |
|---------------------------|---------------------------|
| A. 3 m/s and $53^\circ$ . | C. 4 m/s and $53^\circ$ . |
| B. 3 m/s and $37^\circ$ . | D. 4 m/s and $37^\circ$ . |

16. A man standing on a frictionless surface continuously fired 120 bullets horizontally in 1 minute using a machine gun. If each bullet has a mass of 10 g and leaves the muzzle of the gun with a speed of 800 m/s, what is the average force exerted by the gun on the man? (UEE:2007) A. 8 N. B. 16 N. C. 960 N. D. 16000 N.

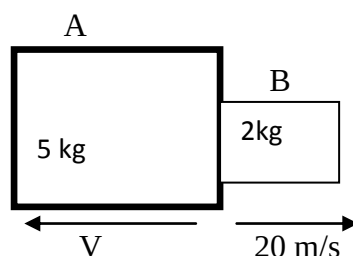
17. The particles shown in figure below are connected by rectangular rigid rods of negligible mass. The origin of the  $xy$  plane is at the centers of the rectangle. The system rotates in the  $xy$  plane about the  $z$  axis with an angular speed of 6 rad/s. What is the rotational kinetic energy of the system? (UEE: 2007)

- A. 2574 J.  
B. 2340 J.  
C. 1287 J.  
D. 1170 J.

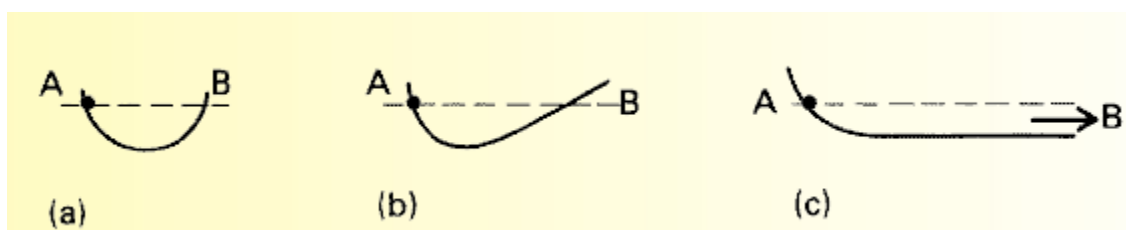


18. What is the necessary and sufficient condition for conservation of linear momentum? (UEE:2008)
- A. The presence of more linear than nonlinear forces in the system.  
B. Net force on the system is zero.  
C. The presence of only non-linear forces.  
D. Internal forces exceed external forces.
19. If the impulse of a rotating disc is non-zero, what can you conclude? (UEE:2008)
- A. The change in linear momentum is zero.  
B. The torque acting on object is constant.  
C. Impulse of the disc equals its moment of inertia.  
D. The change in angular momentum is non zero.
20. A large mass (A) and a small mass (B) are pushing one another apart, as shown in the figure below. The small mass moves away at a velocity of 20 m/s to the right. What is the recoil velocity of the large mass? (UEE:2008)

- A. -20 m/s.
- B. 8 m/s.
- C. 20 m/s.
- D. -8 m/s.

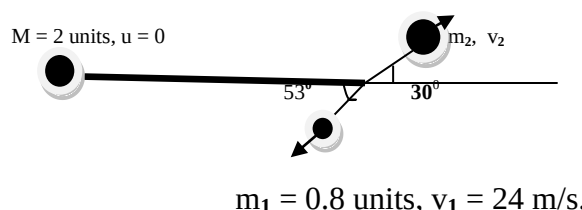


21. A fun making boy swings a blinking ball tied to the end of a string in a vertical circle. If the radius of the circle is 0.5 m, then what should be the minimum speed of the ball at the bottom of the circle to make a complete circular motion at the top? (UEE:2009).
- A. 5 m/s.                      B.  $\sqrt{5}$  m/s.                      C.  $\sqrt{15}$  m/s.                      D.  $2\sqrt{5}$  m/s.
22. Galileo carried out a ‘thought’ experiment on motion. The line between A and B represents a surface and the center of the ball is placed at A. What would happen in each of the three situations shown in the figure below, without friction when the ball is released? (UEE:2009)



- A. The ball would never reach point B in all instances.
- B. The ball would reach B in all instances even if point B keeps on receding to infinity in (c).
- C. The ball would reach point B in (a) and (b) and not in (c).
- D. The ball would reach point B only in (a).
23. A Uranium atom initially at rest has a mass of 2 units and spontaneously disintegrated in to two fragments. One of the fragments has a mass of 0.8 units and moves at a speed of 24 m/s as shown in figure below. What is the speed of the second fragments? (UEE: 2009)

- A. 25.6 m/s.
- B. 21.3 m/s.
- C. 16 m/s.
- D. 14.8 m/s.

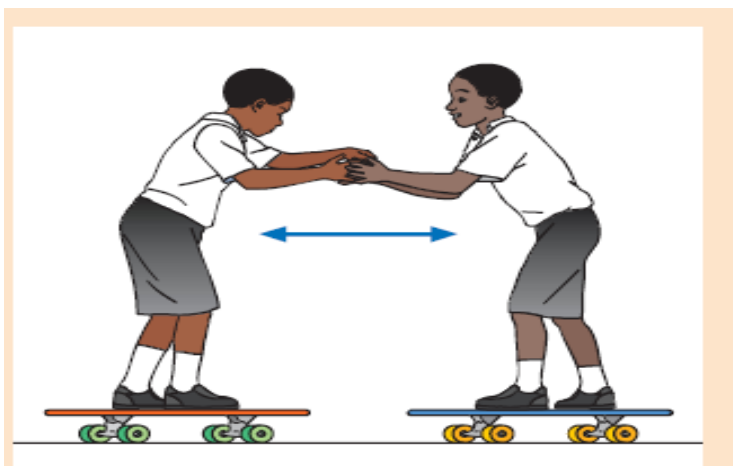


24. A 1kg object explodes and breaks up in three pieces. One piece has a mass of 400 g and has a velocity of  $(15\hat{i} + 10\hat{j})$  m/s. A second piece has a mass of 250 g and has a velocity of  $(25\hat{i} + 10\hat{j})$  m/s. What is the velocity of the third piece? (UEE: 2009).
- A.  $(-4.3\hat{i} + 35\hat{j})$  m/s.                      C.  $(45\hat{i} - 4.3\hat{j})$  m/s.

B.  $(-35\hat{i} - 4.3\hat{j})$  m/s.

D.  $(-35\hat{i} - 4.3\hat{j})$  m/s.

25. Two students A and B, with masses  $m_A$  and  $m_B$  respectively, stand on a wheeled trolleys as shown in the figure below. If student A has large mass and push student B, then what can be said about their accelerations? (UEE: 2010)

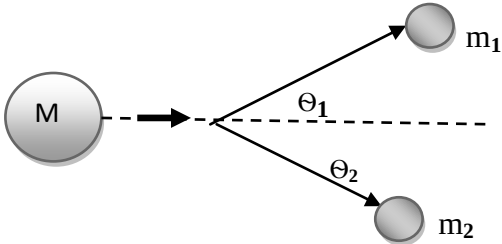


- A. The acceleration of student A is less than that of student B.  
B. The acceleration of student B is less than that of student A.  
C. Both boys will be accelerated by the same magnitude but in opposite directions.  
D. There would be no acceleration because the forces are equal and opposite.
26. For a constant force  $F$ , if the impulse imparted to the system is large, then what can you conclude about the collision? (UEE:2010)
- A. Linear momentum is conserved.  
B. Kinetic energy is conserved.  
C. The contact or impact time is large.  
D. The change in velocity is small.
27. An open trolley is rolling on a level surface without friction loss through a vertical downpour of rain, as shown in the figure below.



As the trolley rolls, an appreciable amount of rainwater accumulates in the cart. What will be the speed of the cart? (UEE: 2010)

- A. It increases because of conservation of mechanical energy.  
B. It decreases because of conservation of momentum.

- C. It decreases because of conservation of mechanical energy.
- D. It remains the same because the raindrops are falling perpendicular to the direction of the cart's motion.
28. A satellite moves at a constant speed in a circular orbit about the center of the Earth at an altitude half the radius of the Earth above its surface. If  $g$  is the gravitational acceleration at the Earth and  $R$  its radius, then what is the speed of the satellite? (UEE:2010)
- A.  $\sqrt{3gR/2}$ .                      B.  $\sqrt{2gR}$ .                      C.  $\sqrt{gR}$ .                      D.  $\sqrt{2gR/3}$ .
29. A ball of mass  $M$  moves with speed  $V$  in the  $+x$ -direction. It explodes into two pieces that go off at angles  $\theta_1$  and  $\theta_2$ , as shown below. What are the magnitudes of the momenta of the two pieces? (UEE: 2011).
- A.  $P_1 = \frac{MV \cos \theta_2}{\sin(\theta_1 + \theta_2)}$ ,  $P_2 = \frac{MV \cos \theta_1}{\sin(\theta_1 + \theta_2)}$ .
- B.  $P_1 = \frac{MV \sin \theta_2}{\sin(\theta_1 + \theta_2)}$ ,  $P_2 = \frac{MV \sin \theta_1}{\sin(\theta_1 + \theta_2)}$ .
- C.  $P_1 = MV \tan \theta_2$ , and  $P_2 = MV \tan \theta_1$ .
- D.  $P_1 = \frac{MV \cos \theta_2}{\cos(\theta_1 + \theta_2)}$ ,  $P_2 = \frac{MV \cos \theta_1}{\cos(\theta_1 + \theta_2)}$ .
- 
30. The rate of change of momentum of the raindrop can be given by  $F = ma + u \frac{\Delta m}{\Delta t}$ . In this expression what does  $u$  represent? (UEE: 2011).
- A. The velocity of the extra mass added to the raindrop.
- B. The velocity of the raindrop.
- C. The velocity of the loss in mass of raindrop.
- D. The rate of change of the velocity for combined system.
31. A trolley is set to move on a smooth track that is banked at an angle of  $30^\circ$ . For a trolley moving with a speed  $5 \text{ m/s}$  to round the curve. What is the radius of the banked surface? (UEE: 2011).    A.  $5 \text{ m}$ .                      B.  $2.5 \text{ m}$ .                      C.  $10 \text{ m}$ .                      D.  $3.5 \text{ m}$ .

**THE END**