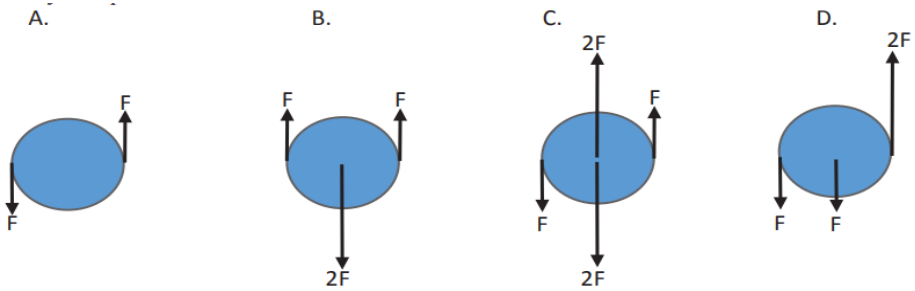
Chapter: Dynamics

MCQs:

1. If the external force applied is zero, then which of the following is conserved?
   a. Linear momentum c. Torque
   b. Angular momentum d. Time period
2. No force is required for a body moving with,
   a. Constant velocity c. Constant speed on the circular path
   b. Constant acceleration d. Variable acceleration
3. A bullet of mass $10g$ is fired from a gun of mass $1kg$ with recoil velocity of gun $5m/s$. The velocity of the of bullet will be,
   a. $30km/min$ b. $60km/min$ c. $30m/s$ d. $500m/s$
4. Gravel is dropped onto a conveyer belt at the rate of $0.5kg/s$. The extra force required to keep the belt moving at $2m/s$ is,
   a. $1N$ b. $2N$ c. $0.5N$ d. $4N$
5. When a man weighing $10kg$ in the lift is accelerated download with the acceleration of $1m/s^2$ then apparent weight is:
   a. $98N$ b. $88N$ c. $72N$ d. $68N$
6. A $2kg$ block moves at constant acceleration of $2m/s^2$ when it is pulled horizontally by $10N$. If it is pulled by $20N$ force on the same surface then acceleration will be:
   a. $4m/s^2$ b. $5m/s^2$ c. $7m/s^2$ d. $10m/s^2$
7. A block of $2kg$ slides at a constant velocity of $20m/s$ on a horizontal surface if it is pulled horizontally by $8N$. Then coefficient of sliding friction will be.
   a. 0.2 b. 0.4 c. 0.5 d. 1
8. A block is sliding down a 30^0 smooth inclined plane. Then coefficient of sliding friction will be,
   a. $\frac{1}{\sqrt{3}}$ b. $\frac{\sqrt{3}}{2}$ c. $\frac{1}{2}$ d. $Zero$
9. If the normal force is doubled, the coefficient of friction is,
   a. Halved b. Tripled c. Doubled d. Not changed
10. Forces are applied to a rigid body. The forces all act in the same plane. In which diagram is the body in equilibrium?



11. A block of mass m is placed on a smooth inclined plane of inclination θ with the horizontal. The force exerted by the plane on the block has a magnitude,
    a. mg b. $\frac{mg}{\cos\theta}$ c. $mg\cos\theta$ d. $mg\tan\theta$
12. An athlete runs some distance before taking a long jump because:
    a. He gains energy to take him through long distance.
    b. It helps to apply large force.
    c. By running action and reaction force increases.
    d. By running he gives himself a larger inertia of motion.
13. Choose the correct statement
    a. A body can be accelerated by frictional force
    b. There can be zero friction
    c. Kinetic friction is greater than limiting friction
    d. Frictional force is directly proportional to surface area of contact

SAQs

1. Conservation of linear momentum is described with the help of Newton's laws of motion.
   a. Is the momentum a vector or a scalar quantity?
   b. State the law of conservation of momentum.
   c. A jumbo jet of mass 4 x105 kg travelling at a speed of 5000 m/s lands on the airport. It takes 2 minutes to come to rest. Calculate the average force applied by the ground on the aeroplane.

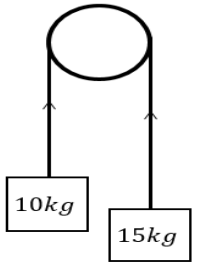
d. After landing the aeroplanes' momentum becomes zero. Explain how the law of conservation holds here.

2. Frictional force is the opposing force that acts between two surfaces when they are in contact,
   a. State the laws of limiting friction.
   b. A box of mass 15 kg placed on horizontal floor is pulled by a horizontal force. What will be the work done by the force if coefficient of sliding friction between the box and the surface of the floor is 0.3 and body moves at unit distance.
   c. Why limiting friction is always greater than kinetic friction?
3. You want to move a 500 N crate across a level floor. To start the crate moving, you have to pull with a 230 N horizontal force. Once the crate starts to move, you can keep it moving at constant velocity with only 200 N.
   a. Which Newton's law of motion is applicable in the crate's motion?
   b. Draw free body diagram for crate (i) just before it starts to move (ii) moving at constant speed.
   c. Find the coefficients of static and kinetic friction.
4. Momentum and impulse are related to each other using Newton's 2nd law,
   a. Define momentum and impulse. Give its unit and dimension.
   b. When a man weighing 10 kg in lift is accelerated downward with the acceleration of $1m/s^2$, then apparent weight is either increased or decreased. Calculate its apparent weight.
   c. A block is sliding down a 30^0 smooth inclined plane. Then coefficient of sliding friction will be what?
5. Newton's laws are fundamental laws in physics,
   a. Explain how Newton's first law of motion follows from the second law.
   b. Why does a cricketer lower his hand while catching a ball?
   c. Why is it easier to pull a body than to push it?
   d. A cricket ball of mass $145g$ is moving with a velocity of $14m/s$ and is being hit by a bat, so that the ball is turned back with a velocity of $22m/s$. The force of blow acts on the ball for $0.015sec$. Find the average force exerted by the bat on the ball.
6. Frictional force is the opposing force that acts between two surfaces when they are in contact,
   a. Is friction force a necessary evil? Explain.
   b. Why is the kinetic friction less than the limiting friction?
   c. Define angle of repose. Show that the angle of repose and the angle of friction are equal for the given pair of surfaces.
   d. An iron block of mass $10kg$ rests on a wooden plane inclined at 30^0 to the horizontal. It is found that the least force parallel to the plane which causes the block to slide up is $100N$. Calculate the coefficient of friction between the two surfaces.
7. Newton's laws are fundamental laws in physics,
   a. Write the significance of Newton's 1st, 2nd and 3rd law.
   b. If action and reaction are always equal and opposite, why don't they always cancel each and leave no force for acceleration of the body?
   c. Show that the principle of conservation of linear momentum can be verified by using Newton's laws.
   d. A $550N$ physics student stands on a bathroom scale in an elevator. As the elevator starts moving the scale reads $450N$. Draw free body diagram of the problem and find the magnitude and direction of the acceleration of the elevator.
8. Free body diagram is a graphical illustration used to visualize the applied forces, using free body diagram technique solve the following problems,
   a. A chair of mass $10kg$ is sitting on a horizontal floor which is not frictionless. You push on the chair with a constant force of magnitude $30N$ which is directed at an angle of 30^0 below the horizontal and chair slides along the floor. Draw free body diagram and calculate normal force that the floor exerts on the chair.
   b. In a physics lab experiment, a $6kg$ box is pushed across a flat table by a horizontal force F.

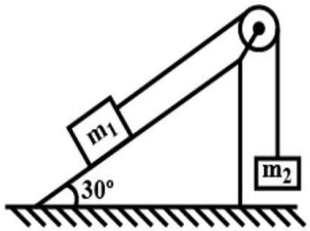
i. If the box is moving at a constant speed of $0.35m/s$ and the coefficient of kinetic friction is 0.12, What is the magnitude of F?

ii. If the box is speeding up with a constant acceleration of $0.18m/s^2$, what will be the magnitude of F?

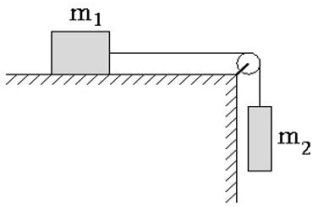
c. Two masses $10kg$ and $15kg$ are connected at the two ends of a light inextensible string that passes over a frictionless pulley. Using free body diagram method, find the acceleration of masses and the tension in the string, when the masses are released.



d. A block of mass m_1, is lying on frictionless plane inclined at an angle of 30^0. It is connected to another block of mass m_2, with the help of a string passing over a pulley. If $m_1 = 6kg$ and $m_1 = 8kg$ then calculate the tension and acceleration of the each block.



e. Two bodies of masses $4kg\ and\ 5kg$ are tied to a string as shown in figure. If the table and pulley both are smooth, find the acceleration of the masses and the tension in the string.



9. Some additional short questions:
   a. What is equilibrium? Write the conditions for a body to be in stable equilibrium.
   b. Can a body be in equilibrium if it is in motion? Explain.
   c. Why does a man carrying a load on his back lean forward?
   d. Why horse is more stable than a man?
   e. What is moment of force? Why is it difficult to open and close a door by applying force near a hinge?