

PHYS 1200 Physics of Everyday Experience

Review questions and exercises for Lecture 6 (M-5)

1. Several forces are acting on an object. Will the object necessarily accelerate?
2. A car travels at uniform speed in a circle. Is it accelerating?
3. Identical forces act on two objects, one of mass m and another of mass $2m$. What are the accelerations of the objects?
4. In Newton's second law, $F = ma$, what are the proper units for m , a , and F ?
5. What force keeps the moon in its orbit around the earth?
6. A mass of 100 kg is suspended by a rope. What is the tension force in the rope?
7. A force $F = 500 \text{ N}$ is applied to accelerate an object of mass 10 kg. If an opposing force of 200 N also acts on the object, what is its acceleration?
8. Give a few examples of contact and non-contact forces.
9. In what sense does Newton's second law of motion include the first law (principle of inertia)?
10. A box rests on an inclined plane without slipping. The angle of the inclined plane is increased and the box begins moving down the inclined plane with constant velocity. Explain this situation in terms of Newton's Second Law.
11. A net force of 12 N is applied to a mass of 8 kg. What is the resulting acceleration of the mass?
12. A chain hangs from the rear view mirror of your car. If the car suddenly stops, explain what happens to the chain.

Answers and Solutions:

1. An object will accelerate if there is a net force on it. If there are several forces acting on an object but the net force is zero it will not accelerate.
2. Velocity includes both magnitude (speed) and direction. If an object moves in a circular path, its velocity is constantly changing so it is accelerated.
3. $F = m a \rightarrow a = F / m$. For the same force, the object mass $2 m$ will experience half the acceleration as the object of mass m .
4. F in Newtons [N], m in [kg], and a in $[m/s^2]$.
5. The gravitational force of the earth.
6. The tension in the rope must support the weight of the object. $T = w = mg = 100 \text{ kg} \times 10 \text{ m/s}^2 = 1000 \text{ N}$.
7. Net force $F_{\text{NET}} = 500 \text{ N} - 200 \text{ N} = 300 \text{ N}$. $F = ma \rightarrow a = F_{\text{NET}} / m = 300 \text{ N} / 10 \text{ kg} = 30 \text{ m/s}^2$, in the direction of the 500 N force.
8. Contact forces: friction, tension; non-contact forces: gravity, electric force, magnetic force.
9. $F = m a$. If $F = 0$, then $a = 0$. If $a = 0$, the object moves with constant velocity.
10. If the box does not slip the friction force must be larger than the force of gravity down the incline. As the angle is increased, the force of gravity increases and at some point the forces of gravity and the friction force balance each other, so the net force is zero and the object slides with constant velocity.
11. $F = m a \rightarrow a = F / m = 12 \text{ N} / 8 \text{ kg} = 3/2 \text{ m/s}^2 = 1.5 \text{ m/s}^2$.
12. Since the chain has inertia its tendency is to keep moving, so it moves forward and hits the windshield.