

Multiple choice questions (Select the best answer in each question.)

1. A rocket is accelerating at 5 m/s^2 upward. Inside, a mass of 10 kg hangs at equilibrium from a spring with spring constant $k=10 \text{ N/m}$. How much is the spring stretched from its equilibrium position?
 a) 1.0m b) 2.5m c) 5.0m d) 10.0m e) none of the above
2. Two identical blocks of mass m are connected by a spring. They slide across a frictionless surface at a speed v . The blocks collide with a felt-lined wall, and then rebound. What is the average velocity of the two blocks after the rebound?
 a) v b) $v/\sqrt{2}$ c) $v/\sqrt{3}$ d) $v/2$ e) $v/4$
3. A hollow cylinder, a hollow sphere, and a solid cylinder of the same mass are released from the same height and roll without slipping down a ramp. Which of the following is false?
 a) all three will have the same total kinetic energy at the bottom of the ramp.
 b) all three have the same velocity at the bottom of the ramp.
 c) all three have the same angular momentum at the bottom of the ramp
 d) none of the above
 e) more than one of the above
4. Two large square plates are separated by a small distance d and have a large number of microscopic, elastically bouncing balls moving at perpendicularly to the two plates. If each ball has mass m , the balls travel at velocity v and there are N balls, find the distance between the plates d when a compressive force F is applied to the plates.
 a) $d = Nm v / F$
 b) $d = NF / (m v)$
 c) $d = 2Nm v^2 / F$
 d) $d = Nm v^2 / F$
 e) $d = Nm v^2 / (2F)$
5. Alice and Bob are on opposite sides of a spinning plate, which is spinning counterclockwise, viewed from above. Alice wants to throw a water balloon onto Bob's face. Where should she aim it? (Assume that the plate is large, but spins at a low angular velocity).
 a) directly at Bob's face.
 b) above Bob's face.

- c) above and to the right (Alice's right) of Bob's face.
 - d) above and to the left (Alice's left) of Bob's face
 - e) It is impossible to hit Bob's face.
6. It takes 240 s for the escalator to bring a boy, who is standing still, from the bottom to the top. If the boy walks on the moving escalator, it takes 60 s for him to reach the top. If the escalator is not operating, how long does it take for the boy to walk from the bottom to the top?
- a) 80 s b) 140 s c) 150 s d) 60 s e) 120 s
7. An opened parachute of mass 1.0 kg is coming straight down from the sky. Attached to the parachute is the upper end of a light spring scale, while a block of mass 10 kg is attached to its lower end of the scale. The scale reading is 80 N. The air resistance at the moment is approximately _____.
- a) 55 N b) 66 N c) 77 N d) 88 N e) 99 N
8. Fireman Bob is trying to reach a fire at a height of 30 m. What should the minimum initial speed of the water jet on the ground be?
- a) 30 m/s b) 12 m/s c) 300 m/s d) 5 m/s e) 24 m/s
9. Following question 8, the area of the cross section of the hose is 10 cm^2 . What is the recoil force?
- a) 588 N b) 60 N c) 705 N d) 24 N e) 5 N
10. In a traffic accident, a taxi of mass 1500 kg runs into a bus of 6000 kg, initially at rest. The two vehicles are locked together after impact and slide for a distance of 4 m. It is known that the frictional force between the locked vehicles and the ground is 25000 N. Find the speed of the taxi just before impact.
- a) 23.1 km/h b) 46.2 km/h c) 69.5 km/h d) 93 km/h e) 0 km/h