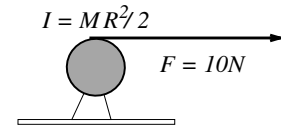
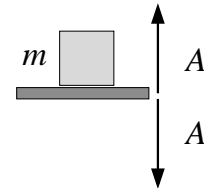


6. A solid disk, of mass $M = 2\text{ kg}$, radius $R = 3\text{ cm}$ and rotational inertia $I = \frac{1}{2}MR^2$, is supported by an axle and has a string wrapped around it. What is the magnitude of the linear acceleration of the string if it is pulled with a force $F = 10\text{ N}$?

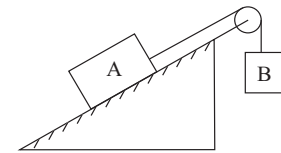


- (1) 10 m/s^2 (2) 5 m/s^2 (3) 16 m/s^2 (4) 12 m/s^2 (5) 15 m/s^2
7. If the radius of the Earth were twice its current value, but its mass were the same, then what would be the acceleration of gravity g at the Earth's surface?
- (1) 2.5 m/s^2 (2) 10 m/s^2 (3) 5 m/s^2 (4) 20 m/s^2 (5) 40 m/s^2
8. A cube of wood with each side of length L is placed horizontally so that its top surface is a distance L under water of density ρ_w . What is the force, due to the water pressure, on one vertical side of the cube? Do not include the effect of the air pressure on top of the water.
- (1) $1.5\rho_w gL^3$ (2) $\rho_w gL^3$ (3) $2\rho_w gL^3$ (4) $3\rho_w gL^3$ (5) $2.5\rho_w gL^3$

9. A platform is oscillating vertically, up and down with an amplitude $A = 0.4\text{ m}$. A block of mass $m = 2\text{ kg}$ sits on the platform but is not attached to it. The angular frequency ω starts out small and slowly increases. For what value of ω does the block start to bounce on the platform? Give the answer in units of radians/s.



- (1) 5 (2) $20/\pi$ (3) 10 (4) 2.5π (5) 4π
10. Block A with a mass of 10 kg , rests on a incline of 30° to the horizontal. The coefficients of kinetic and static friction are both 0.20 . The attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 7.0 kg , is attached to the dangling end of the string. The acceleration of B is:



- (1) 0.15 m/s^2 , down (2) 0.15 m/s^2 , up (3) 1.5 m/s^2 , up (4) 1.5 m/s^2 , down (5) 0
11. A simple pendulum consists of a mass hanging on a massless string of length 2 meters. You move the mass so that the string is at an angle of 37° to the vertical and release. During the subsequent motion, what is the maximum speed of the mass in m/s ? (Take $\cos 37^\circ = 0.8$, $\sin 37^\circ = 0.6$, $g = 10\text{ m/s}^2$.)
- (1) $2\sqrt{4}$ (2) $4\sqrt{2}$ (3) 2 (4) 4 (5) 8
12. (CONTINUATION) At the instant the pendulum momentarily comes back to $\theta = 37^\circ$, what is the magnitude of its acceleration?
- (1) 6 (2) 0 (3) 8 (4) 10 (5) 32
13. A uniform limp rope of length L hangs on a peg a distance L off the ground. Half of the rope is on the left of the peg, and half on the right. Someone nudges the rope, so that one side is a little longer than the other, and it proceeds to slide off the peg (no friction) on to the ground. How fast is it going when one end of it hits the ground?
- (1) $\sqrt{gL/2}$ (2) $\sqrt{3gL/2}$ (3) \sqrt{gL} (4) $\sqrt{3gL/4}$ (5) $\sqrt{2gL}$

14. A tank of water is mounted on wheels and rolls without frictional losses on a track. As the tank moves, water trickles out at a constant rate through a hole in the bottom. The speed of the tank will:
- (1) Remain the same
 - (2) decrease at a constant rate
 - (3) increase at constant rate
 - (4) decrease at a variable rate
 - (5) increase at a variable rate
15. A block of mass 2 kg is stationary on a horizontal table. The coefficient of static friction between the block and the table is 0.7. What is the friction force on the block?
- (1) 0 (2) 14 N (3) 1.4 N (4) 0.14 N (5) 7 N
16. A hand grenade at rest explodes into three fragments of equal mass. Two of the fragments fly off at right angles to each other, each with a speed of 10 m/s. What is the speed of the third fragment in m/s?
- (1) 14 (2) 10 (3) 20 (4) 17 (5) 5
17. A travelling wave is described as $y(x, t) = 5 \sin(2x + 8t)$. What is its velocity? (Positive means the positive x-direction.)
- (1) -4 (2) $+4$ (3) -16 (4) $+16$ (5) $+20$
18. A uniform ladder of length of 2 meters leans against a window, making an angle of 30° to the vertical. There is no friction between the ladder and window—the coefficient of static friction between the ladder and the ground is 0.6. If the window can withstand a force of 10 N without breaking, what is the maximum the mass of the ladder can be?
- (1) 3.4 kg (2) 5 kg (3) 1 kg (4) 4.3 kg (5) 2.5 kg
19. A spherical bowling ball rolls without slipping along a flat wooden surface with uniform velocity of 2 m/s. It then comes across a patch of ice (with NO friction between the ball and the ice). What happens to the ball?
- (1) It continues to roll with $v = 2$ m/s.
 - (2) It stops rotating, and slides with $v = 2$ m/s.
 - (3) It stops rotating, and slides with $v > 2$ m/s.
 - (4) It continues to roll, but now $v > 2$ m/s.
 - (5) It stops rotating, and slides with $v < 2$ m/s.
20. A particular spring does not obey Hooke's Law, but instead the force it exerts is given by $F = -20x - 60x^2$ N. When the spring is compressed by 0.1 meters from its equilibrium position, how much energy is stored?
- (1) 0.12 (2) 0.10 (3) 0.26 (4) 20.6 (5) 0.8

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 12