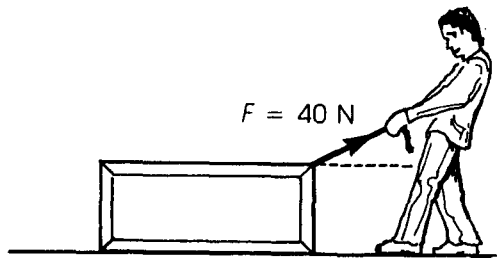
Problems

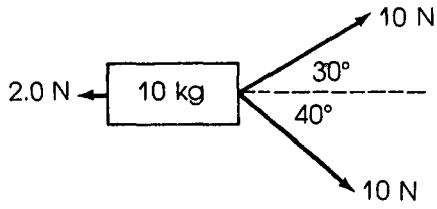
8. A 3.0 kg toy is pulled by a force of 24 N. If the toy starts from rest, how far will it travel in the first 5.0 s?
9. A 40 kg sprinter starts from rest and 2.0 s later is running at a speed of 8.0 m/s. What is the average net horizontal force acting on her? What exerts this force?
10. An 8.0 g bullet travelling at 400 m/s passes through a heavy block of wood in 4.0×10^{-4} s, emerging with a velocity of 100 m/s. Ignore any motion of the wood.
    (a) With what average force did the wood oppose the motion of the bullet?
    (b) How thick is the block of wood?
11. A 0.22 calibre rifle shoots a bullet of mass 1.8 g with a muzzle velocity of 500 m/s. If the barrel is 25 cm long, what is the average force exerted on the bullet while it is in the barrel?
12. A motorist has a reaction time of 0.60 s. (Reaction time is the interval between seeing a danger and applying the brakes.) While driving at 72 km/h, he sees a child run suddenly onto the road, 40 m in front of his car. If the mass of the car is 1000 kg and the average horizontal force supplied during braking is 8000 N, will he be able to stop in time to avoid hitting the child?
13. A child's wagon experiences a frictional force of 73 N whenever it is in motion, regardless of the load it is carrying. An applied horizontal force of 128 N causes the wagon to accelerate at 5.0 m/s^2. The same applied force, with a child on the wagon, causes it to accelerate at 1.0 m/s^2. What is the mass of the child?
14. A sled of 6.0 kg mass is moving along a smooth, horizontal ice surface with a velocity of v_0. A force of 36 N is applied to the sled in its direction of motion, increasing its velocity to 2 v_0 while it moves 10 m. Find (a) the sled's original velocity, v_0, and (b) the length of time that the force acted.
15. A net force of 8.0 N gives a mass m_1 an acceleration of 2.0 m/s^2 and a mass m_2 an acceleration of 4.0 m/s^2. What acceleration would the force give the two masses if they were fastened together?

17. A gardener pushes down along the handle of a lawn mower of 20 kg mass with a force of 150 N. The handle makes an angle of 60° with the ground. Calculate the instantaneous acceleration of the mower if the frictional force between its wheels and the ground at that instant is 25 N.

18. A man drags a package across the floor with a force of a 40 N, as shown. The mass of the package is 10 kg. If the acceleration of the package is 3.5 m/s², and friction can be neglected, at what angle to the horizontal does the man pull?



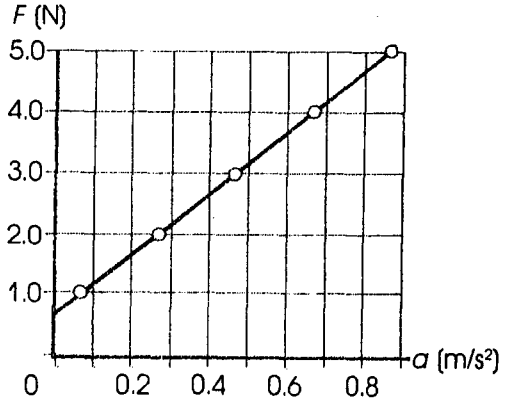
19. Two girls pull a sled across a field of snow, as shown in the diagram. A third girl pulls backward with a 2.0 N force. If the mass of the sled is 10 kg, determine its instantaneous acceleration.



20. A boy with a mass of 30 kg pulls a cart with a mass of 100 kg towards himself by a rope. With what force does he have to pull on the rope to accelerate the cart at 2.0 m/s²? With what force must his feet push on the ground to keep him from moving towards the cart? If there is no friction between his feet and the ground, what is his acceleration?

21. A plane takes off from a level runway with two gliders in tow, one behind the other. The first glider has a mass of 1600 kg and the second a mass of 800 kg. The frictional drag may be assumed as constant and equal to 2000 N on each glider. The towrope between the first glider and the plane can withstand a tension of 10 000 N.
    (a) If a velocity of 40 m/s is required for takeoff, how long a runway is needed?
    (b) How strong must the towrope between the two gliders be?

22. A cart is pulled in each of several trials, with a different number of stretched elastic bands. A constant acceleration is observed in each trial. The graph shows acceleration versus force exerted by the stretched bands.
    (a) What is the mass of the cart?
    (b) An extrapolation of the graph does not pass through the origin. What does this indicate?



8. 1.0×10^2 m
9. 1.6×10^2 N[F]
10. (a) -6.0×10^1 N[F] (b) 1.0×10^{-1} m
11. 9.0×10^2 N[F]
12. yes, by 3.0 m
13. 44 kg
14. (a) 6.3 m/s[F] (b) 1.1 s
15. 1.3 m/s²[F]
17. 2.5 m/s²[F]
18. 29°
19. 1.4 m/s² [E5.6°S]
20. 2.0×10^2N, 2.0×10^2N, -6.7 m/s²
21. (a) 3.2×10^2 m (b) 4 000 N
22. (a) 5.0 kg (b) friction force of 0.60 N