

Newton's Second Law

For each question, **draw a free-body diagram** and **label all forces**. Then use Newton's second law to answer the question. Use kinematics if necessary.

- 1) Ryan pushes a 10 kg box on a frictionless horizontal floor, accelerating it at 8.5 m/s^2 . What force is he applying?
- 2) A 10 kg box is pushed with 90 N on a level floor. Friction is 25 N opposing motion. Find the acceleration.
- 3) Ryan pushes a 10 kg box across a smoother horizontal floor with a force of 85 N. The box accelerates at 7.5 m/s^2 . What is the force of friction between the floor and the box?
- 4) A 1.2 kg ball falls toward Earth. Its downward acceleration is measured as 6.8 m/s^2 . Find the upward air resistance acting on it.
- 5) A 0.80 kg pair of pants falls off a clothesline. Air resistance is a constant 4.0 N. Determine the acceleration of the pants.
- 6) A 40.0 kg box is pushed along the ground with a force of 550 N.
 - a) Assuming no friction, find the acceleration.
 - b) If friction equals 80.0 N, what is the acceleration now?
- 7) The "Hellevator" ride exerts an upward force on a 50 kg rider, causing an upward acceleration of 15 m/s^2 . What force is the ride exerting on the rider?
- 8) A 60 kg passenger in an elevator accelerates upward at 3.0 m/s^2 . What normal force does the floor exert on the passenger?
- 9) Two friends pull a 75 kg sled across a frozen pond. Amy pulls with 175 N and Naomi with 125 N. Friction is 140 N, and the wind pushes back with 120 N. What is the sled's acceleration?
- 10) A 1500 kg lift is pulled upward by a cable with a tension of $2.2 \times 10^4 \text{ N}$. Friction in the rails is $2.0 \times 10^3 \text{ N}$ downward. Find the acceleration.
- 11) A $2.4 \times 10^5 \text{ kg}$ rocket is accelerated upward with a thrust of $5.0 \times 10^6 \text{ N}$. Determine its acceleration. Neglect air resistance.
- 12) As they are skating, Jason gives Ajay a push with 120 N, and Ajay accelerates at 1.5 m/s^2 .
 - a) Find Ajay's mass.
 - b) Find Ajay's weight.
 - c) Describe Ajay's motion once Jason stops pushing.

- 13) Angus pushes a 450 kg crate with 1500 N while Scott pushes opposite with 300 N. If the crate accelerates at 0.30 m/s^2 , find the force of friction.
- 14) Jackie pushes his twin (55 kg) from rest across ice toward a bench 40 m away using 500 N. How long does this take? Assume no friction.
- 15) Calvin drives a 2300 kg car at 20 m/s and brakes to a stop over 50 m. Determine the force of friction acting on the car.
- 16) Heather pushes a book across a table with a force of 15 N from rest for 5.0 s. Once she stops pushing, the book stops after 3.0 s. What is the force of friction on the book?