

Unit 4 WS 4: Net Force, N2L, and Kinematics

Level III: Multiple Steps, Multiple Concepts

1. A ball (0.4kg) is dropped from the top of Bard. As it falls, it experiences a constant 1.5N of drag. Bard is roughly 25m tall. How much time will it take for the ball to reach the ground?
2. A race car weighs 700kg. It starts from rest and travels 40.0m in 3.0s. The car uniformly accelerates during the entire time. How large is the traction force between the wheels and the ground if the drag force applied by air is 789N? (Assume no backward friction.)
3. A car (2640lbs) initially moving 22.4mi/hr needs to speed up as it gets onto a highway. The driver presses on the gas pedal, causing the car to experience 1800N of traction forward. The car also experiences 100N of drag and 200N of friction from the axles. If the driver holds down the gas pedal for 6s, how fast will the car be moving at the end of this time?
4. A sign in an elevator states that the maximum occupancy is 20 persons. Suppose that the safety engineers assume the weight of the average rider is 180 lbs. The elevator car itself weighs 1.5 tons. Initially moving 3.36mi/hr upwards, the elevator slows to a stop over the course of 2.0s. How much tension must the cable pulling the elevator car be able to apply without breaking?

$1 \text{ kg} = 1000 \text{ g}, 1.00 \text{ lbs} = 4.45 \text{ N}, 1 \text{ ton} = 2000 \text{ lbs}$
$1 \text{ mi} = 5280 \text{ ft}, 3.28 \text{ ft} = 1.00 \text{ m}, 1 \text{ km} = 1000\text{m}, 1 \text{ km} = 0.62 \text{ mi}$

Level IV: Multiple Steps, Multiple Concepts, and Variables

5. While falling, a ball of mass m_{BALL} experiences a constant drag force of F_{D} .
 - a. What acceleration (a_{BALL}) does it experience as it falls? You can use m_{BALL} , F_{D} , and g in your solution.
 - b. If it started from rest, how much time does it take to fall a distance d ?

6. A car (m_{CAR}) experiences a forward force F_{T} of traction, a backward frictional force F_{f} , and a backward drag force of F_{D} as it accelerates to its top speed of v_{MAX} .
 - a. What is the acceleration of the car?
 - b. How far will the car travel as it makes its way to its top speed?

Level V: Multiple Steps, Multiple Concepts, and Research/Estimations

7. How much traction (force) is needed between the wheels of a Ferrari (or any other awesome car) and the ground during maximum acceleration? Things you'll want to look up:
 - a. Weight of your car in pounds (or the mass in kg if you can find it)
 - b. Zero-to-Sixty Time for your car (time it takes the car to go from 0mi/hr to 60mi/hr) in seconds
 - c. Average drag force: 350N
 - d. Assume no backwards friction
 - e. **NOTE:** Start by determining the acceleration of the car (in m/s^2) using the Zero-to-Sixty Time.