1. A stone weighing 4 lb falls from rest toward the earth from a great height. As it falls it is acted upon by air resistance that is numerically equal to \( \frac{1}{2}v \) (in pounds), where \( v \) is the velocity (in feet per second).
   (a) Find the velocity and distance fallen at time \( t \) sec.
   (b) Find the velocity and distance fallen at the end of 5 sec.

2. A ball weighing 6 lb is thrown vertically downward toward the earth from a height of 1000 ft with an initial velocity of 6 ft/sec. As it falls it is acted upon by air resistance that is numerically equal to \( \frac{3}{4}v \) (in pounds), where \( v \) is the velocity (in feet per second).
   (a) What is the velocity and distance fallen at the end of one minute?
   (b) With what velocity does the ball strike the earth?

3. A ball weighing \( \frac{3}{4} \) lb is thrown vertically upward from a point 6 ft above the surface of the earth with an initial velocity of 20 ft/sec. As it rises it is acted upon by air resistance that is numerically equal to \( \frac{3}{4}v \) (in pounds), where \( v \) is the velocity (in feet per second). How high will the ball rise?

4. A ship which weighs 32,000 tons starts from rest under the force of a constant propeller thrust of 100,000 lb. The resistance in pounds is numerically equal to 8000\( v \), where \( v \) is in feet per second.
   (a) Find the velocity of the ship as a function of the time.
   (b) Find the limiting velocity (that is, the limit of \( v \) as \( t \to +\infty \)).
   (c) Find how long it takes the ship to attain a velocity of 80% of the limiting velocity.

5. A body of mass 100 g is dropped from rest toward the earth from a height of 1000 m. As it falls, air resistance acts upon it, and this resistance (in newtons) is proportional to the velocity \( v \) (in meters per second). Suppose the limiting velocity is 245 m/sec.
   (a) Find the velocity and distance fallen at time \( t \) secs.
   (b) Find the time at which the velocity is one-fifth of the limiting velocity.

6. An object of mass 100 g is thrown vertically upward from a point 60 cm above the earth's surface with an initial velocity of 150 cm/sec. It rises briefly and then falls vertically to the earth, all of which time it is acted on by air resistance that is numerically equal to 200\( v \) (in dynes), where \( v \) is the velocity (in cm/sec).
   (a) Find the velocity 0.1 sec after the object is thrown.
   (b) Find the velocity 0.1 sec after the object stops rising and starts falling.

7. Two people are riding in a motorboat and the combined weight of individuals, motor, boat, and equipment is 640 lb. The motor exerts a constant force of 20 lb on the boat in the direction of motion, while the resistance (in pounds) is numerically equal to one and one-half times the velocity (in feet per second). If the boat started from rest, find the velocity of the boat after (a) 20 sec, (b) 1 min.

8. A boat weighing 150 lb with a single rider weighing 170 lb is being towed in a certain direction at the rate of 20 mph. At time \( t = 0 \) the tow rope is suddenly cast off and the rider begins to row in the same direction, exerting a force equivalent to a constant force of 12 lb in this direction. The resistance (in pounds) is numerically equal to twice the velocity (in feet per second).
   (a) Find the velocity of the boat 15 sec after the tow rope was cast off.
   (b) How many seconds after the tow rope is cast off will the velocity be one-half that at which the boat was being towed?