Newton's Laws II

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April 5, 2011

Take $g = 10$ m s^{-1}, and the density of air = 1.3 kg m^{-3}.

1. Water is squirting horizontally at 4.0 m s^{-1} from a burst pipe at a rate of 3.0 kg m s^{-1}. The water strikes a vertical wall at right angles and runs down it without rebounding. Calculate the force the water exerts on the wall.

2. A machine gun fires 300 bullets per minute horizontally with a velocity of 500 m s^{-1}. Find the force needed to prevent the gun moving backwards if the mass of each bullet is 8.0×10^{-3} kg.

3. Coal is falling onto a conveyor belt at a rate of 540 tonnes per hour. The belt is moving horizontally at 2.0 m s^{-1}. Find the extra force required to maintain the speed of the belt.

4. The rotating blades of a hovering helicopter sweep out an area of radius 4.0 m imparting a downward velocity of 12 m s^{-1} to the air displaced. Find the mass of the helicopter.

5. Find the force exerted on each square metre of a wall which is right angles to a wind blowing at 20 m s^{-1}. Assume that the air does not rebound.

6. Hailstones with an average mass of 4.0 g fall vertically and strike a flat roof at 12 m s^{-1}. In a period of 5.0 minutes, six thousand hailstones fall on each square metre of roof and rebound vertically at 3.0 m s^{-1} . Calculate the force on the roof if it has an area of 30 m^2.

7. The speed of rotation of the blades of the helicopter in question 4 is increased so that the air now has a downward velocity of 13 m s^{-1}. Find the upwards acceleration of the helicopter.