Introduction to Physics : Notes/W.S.-30

Forces

The **mass** of an object is the quantity of matter that the object contains. The mass of an object will be the same on the moon as it is on the Earth. The units for mass are in kilograms (kg).

A **force** is a push or a pull. If one force acts on an object, the object will accelerate. A force may be positive or negative. A positive force will accelerate an object to the right. A negative force will accelerate it to the left. The units are in newtons (N).

The **weight** of an object is the force of gravity that acts on the object. The weight equals the acceleration due to gravity multiplied by the mass. The units are in newtons (N).

$$\text{weight} = -9.8 \cdot \text{mass (earth)}$$
$$\text{weight} = -1.6 \cdot \text{mass (moon)}$$

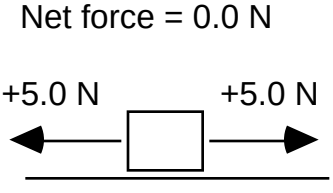
In general, the force on an object equals the mass multiplied by the acceleration:

$$\text{force} = \text{mass} \cdot \text{acceleration}$$

$$f = m \cdot a$$

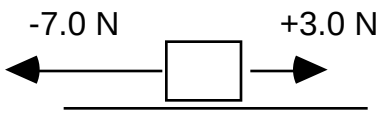
Two or more forces may act on an object. The **net force** or total force on the object, is equal to the sum of all of the forces acting on that object.

If the forces are **balanced**, the net force is zero. The object will not accelerate and the velocity will be zero or constant.



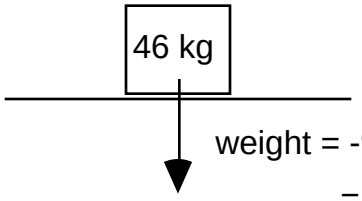
If the forces are **unbalanced**, the object will accelerate.

Net force = -4.0 N



Examples:

Box on floor (on Earth)



weight = -9.8 x 46

= -451 N

Falling Ball (on Earth)

mass = 0.75 kg

acceleration = -9.8m/s/s

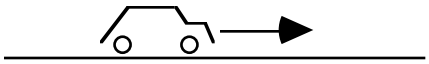
force = 0.75x(-9.8) = -7.4 N

Accelerating Car

mass = 900 kg

acceleration = +3m/s/s

net force = +2700 N



Problems:

1) Define the following:

a) mass -

b) force -

c) weight -

d) net force -

e) balanced forces -

f) unbalanced forces -

2)a) Give the units for; mass _____ , acceleration _____ , force _____ , weight _____ .

b) A 23 kg box sits on the floor. Its weight on Earth is _____ .

c) If a single force of 35 N acts to the right on a 2.7 kg ball, the acceleration will be _____ .

d) The weight on Earth of an object is -74 N. Its mass is _____ .

3) A 0.25 kg ball is dropped near the Earth's surface. The acceleration is _____ . The force of gravity (or weight) is _____ . If the ball is taken to the moon, its mass will be _____ . The weight of the ball on the moon is _____ . (note: the acceleration due to gravity on the moon is -1.6 m/s^2)

4) If the net force on an object is zero, then the forces are _____ (balanced or unbalanced).

5) If the net force on an object is not zero, then the object _____ (accelerates or doesn't accelerate).

6) The following forces act on a 2.5 kg object; +8.0 N, -5.0 N, +9.0 N, and -7.0 N. The net force is _____ . The acceleration is _____ .

7) An 1100 kg car accelerates to the left at -4.5 m/s^2. The net force is _____ .

8) A 65 N force accelerates an object at 7.3 m/s^2. The mass is _____ . The weight of the object on Earth is _____ .

Answers: 1)a) It is the quantity of matter., b) It is a push or a pull., c) It is the force of gravity., d) It is the total force., e) The net force equals zero., f) The net force does not equal zero., 2)a) kg, m/s^2, N, N, b) -225 N, c) 13 m/s^2, d) 7.6 kg, 3) -9.8 m/s^2, -2.5 N, 0.25 kg, -0.4 N, 4) balanced, 5) accelerates, 6) +5 N, +2 m/s^2, 7) -4950 N, 8) 8.9 kg, -87.3 N.