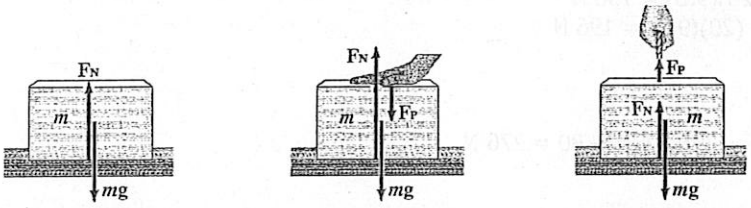
POINT 4 Normal Force

A. Normal force

a. Normal force is the force that a surface exerts on an object with which it is in contact. The direction of the normal force is perpendicular to the contact surface.

b. If an object rests on a horizontal surface and there are no vertically acting forces except the object's weight and the normal force, the magnitude of the normal force is equal to the object's weight.

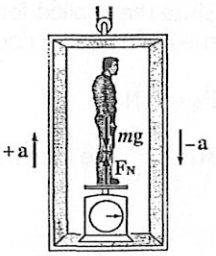
c. If other forces are applied to the object in the vertical direction, the magnitude of the normal force is not equal to the object's weight.



$F_N = mg$ $F_N = mg + F_P$ $F_N = mg - F_P$

B. Apparent weight

a. The apparent weight is the force that an object exerts on the platform of a scale with which it is in contact. In other words, the apparent weight is the normal force exerted on the object by the platform of the scale.



b. If a scale and the object on it have no acceleration, the scale registers the true weight of the object, mg.

weight = mg

c. If a scale and the object on it are accelerating, the apparent weight is not equal to the true weight. The acceleration is positive if the scale and the object accelerates upward, and the acceleration is negative if the scale and the object accelerates downward.

$F_N - mg = ma$ F_N (apparent weight) $= mg + ma$

d. If a scale and the object on it fall freely, the acceleration is –g, and the apparent weight is zero. In this situation, the object experiences apparent weightlessness.

PROBLEM 4 **Normal Force**

A 20-kg crate rests on the frictionless horizontal surface of a table.

a) Find the weight of the crate and the normal force acting on it.
b) If the crate is pushed down with a force of 80 N, what is the normal force on the crate?
c) If the crate is pulled upward with a force of 100 N, what is the normal force on the crate?
d) What happens when the crate is pulled upward with a force of 200 N?

Solution m = 20 kg

a) **weight = F_G = mg** = (20)(9.8) = 196 N
F_N = F_G F_N = mg = (20)(9.8) = 196 N

b) F_P = 80 N

F_N = F_G + F_P = mg + F_P = (20)(9.8) + 80 = 276 N

c) F_P = 100 N

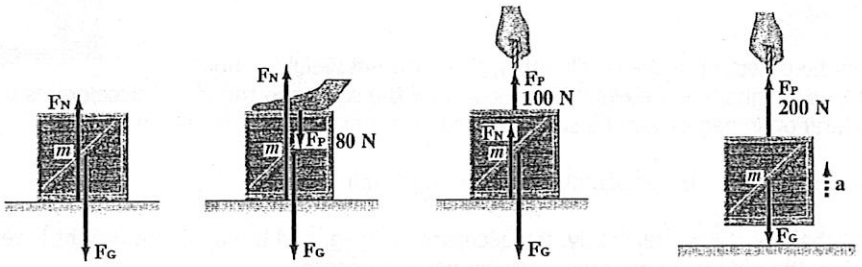
F_N + F_P = F_G F_N = F_G – F_P = mg – F_P = (20)(9.8) – 100 = 96 N

d) F_P = 200 N

Since the applied force greater than the weight of the crate acts upward, the crate accelerates upward and the normal force does not act on the crate.

F_N = 0 N

Note: The minimum value of normal force is zero.



Name: _____

Normal and Frictional Forces

$F_N = F_g$ $\qquad$ $F_f = \mu F_N$

1. a 14.0kg object is resting on a horizontal surface. What is the normal acting on the object?

2. a 20.0 Kg object is resting on a ramp with an inclie of 42°. What is the normal force acting on the object

3. a 9.6 Kg object is pulled along a horizontal surface. If the coefficient of friction between the surfaces is 0.11, what is the force of friction?

4. a 20.0 Kg object is placed on a horizontal surface. A force of 3.0N is required to keep the object moving at a constant speed, what is the coefficient of friction betwee the two surfaces

5. a 16.2 kg object is pulled along a frictionless horizontal surface by a horizontal net force of 10.2N. What is the normal force acting on the object?

6. a 6.2 kg object is pulled along a horizontal surface as shown in the diagram by a force of 22.0 N. If the acceleration of the object is 1.1 m/s^2, what is the coefficient of friction between the surfaces?