1. Consider a person free falling before opening his parachute. He has a mass of 75 kg and air resistance is 200 N.

a. What is his downward force?

b. What is his acceleration, including air resistance?

2. You slide a crate across the level floor that has a mass of 25 kg.

a. What is the normal force on the crate?

b. If friction is 100 N, how much force would have to be applied to the crate to get it to move?

3. A 30 kg crate is pulled halfway up an incline and then left to sit. What is the normal force on the crate if the incline is 45°?

45°

4. An airplane is propelled by 20,000 N of force and maintains a constant speed of 250 mph. How much air resistance is present?

5. A 40 kg mass is suspended between two ropes that are hanging at 45° angles to the vertical (90° apart from each other).

45°

a. What is the tension on the rope directly connected to the mass?

b. What is the tension in the other two supporting ropes?

6. A toy rocket with a mass of 200 grams is shot vertically with a force of 20 N.

a. What is the rocket's weight?

b. What is the upward acceleration of the rocket at lift off?

c. How high will the rocket go vertically in 4 seconds (disregard air resistance)?

Make a diagram for each question and show work:

1. Consider a person free falling before opening his parachute. He has a mass of 75 kg and air resistance is 200 N.

750 N

200 N

a. What is his downward force?

**W = mg = 75 kg x 10 m/s/s = 750 N**

b. What is his acceleration, including air resistance?

**Net force = 750 N – 200 N = 550 N**

**f = ma … a = f/m**

normal

**a = 550 N / 75 kg = 7.3 m/s/s**

2. You slide a crate across the level floor that has a mass of 25 kg.

25 kg

a. What is the normal force on the crate?

250 N

***“Normal refers to perpendicular to the surface. This is the same magnitude as the weight of the crate.***

**W = mg = 25 kg x 10 m/s/s = 250 N**

b. If friction is 100 N, how much force would have to be applied to the crate to get it to move?

***Net force will include friction in this case to move the crate (its weight is the downward force). Therefore, 250 N + 100 N = 350 N. The net force must be over 350 N. (If there was a less massive object the friction force would be less.)***

f┴

3. A 30 kg crate is pulled halfway up an incline and then left to sit. What is the normal force (f┴) on the crate if the incline is 45°?

45⁰

f┴

**W = mg … 30 kg x 10 m/s/s = 300 N**

45⁰

**45⁰ in both triangles cos 45⁰ = f┴ / 300 N**

300 N

**f┴ = 300 N x cos 45⁰ = 212 N**

4. An airplane is propelled by 20,000 N of force and maintains a constant speed of 250 mph. How much air resistance is present?

**Since the airplane is moving at constant speed, the net force must be zero. Therefore, air resistance is equal and opposite to the propulsion of 20,000 N.**

5. A 40 kg mass is suspended between two ropes that are hanging at 45° angles to the vertical (90° apart from each other).

45

a. What is the tension (T) on the rope directly connected to the mass?

**W = mg = 40 kg x 10 m/s/s = 400 N**

T

400 N

**The tension (T) on the vertical rope is 400 N**

b. What is the tension in the other two supporting ropes?

W

**2 ropes support vertical load (200 N each)**

6. A toy rocket with a mass of 200 grams is shot vertically with a force of 20 N.

a. What is the rocket's weight?

20 N

**W = mg 🡪 0.2 kg x 10 m/s/s = 2 N**

***200 g = 0.2 kg***

2 N

b. What is the upward acceleration of the rocket at lift off?

**Net force = ma**

**net force = 20 N – 2 N = 18 N**

**f = ma … a = f/m = 18 N / 0.2 kg = 90 m/s/s**

c. How high will the rocket go vertically in 4 seconds (disregard air resistance)?

**dy = ½ at2 = ½ (90 m/s/s)(4)2 = 720 m**