

Physics 11 – Forces Summary Quiz

1. What is the acceleration of a 1300kg mass that is $5.46 \times 10^7 m$ away from a $8.24 \times 10^{21} kg$ planet? (Remember: $G = 6.67 \times 10^{-11}$)

$$F_g = G \frac{M_1 M_2}{r^2}$$

$$F = ma$$

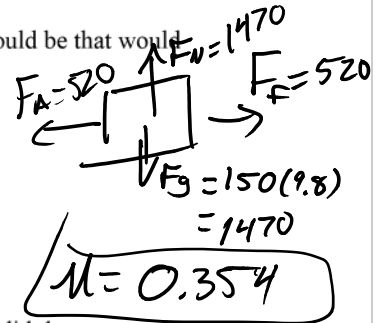
$$a = \frac{GM}{r^2} = \frac{6.67 \times 10^{-11} (8.24 \times 10^{21})}{(5.46 \times 10^7)^2}$$

$$a = 1.821 \times 10^{-4} m/s^2 = 0.000184 m/s^2$$

2. A 150kg stationary crate is pulled by a 520N force.

- a. What is the maximum coefficient of static friction that could be that would still result in the box moving?

$$F_f = 520 N = 520$$

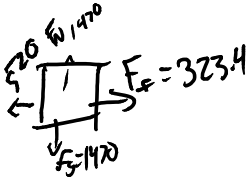


$$F_f = \mu F_N$$

$$\frac{520}{1470} = \mu \frac{1470}{1470}$$

$$\mu = 0.354$$

- b. The coefficient of kinetic friction is $\mu_k = 0.22$. How far did the mass move in 3.4s when pulled by the 520N force?



$$F_f = \mu F_N$$

$$F_f = 0.22(1470) = 323.4$$

$$F_{net} = \Sigma F$$

$$a = 1.31 m/s^2$$

$$ma = F_A + F_f$$

$$150 a = 520 - 323.4$$

displacement

$$v_i = 0 m/s$$

$$v_f = ?$$

$$a = 1.31 m/s^2$$

$$d = ?$$

$$t = 3.4 s$$

$$d = v_i t + \frac{1}{2} a t^2$$

$$d = 0(3.4) + \frac{1}{2} (1.31)(3.4)^2$$

$$d = 7.58 m$$

3. You are travelling on a bus when the driver suddenly applies the brakes to avoid a collision. Describe how your body would move in response to the sudden brake.

Newton's 1st Law
Your body continues to move at same pace, until forced to stop by _____



4. After his bungee jumping, Steve ($m = 62.4 \text{ kg}$) is hanging from the rope that has a spring constant of $k = 611.5 \frac{\text{kg}}{\text{s}^2}$. How far does Steve stretch the rope?

Forces Balanced $F_g = F_e$

$$F_g = 9.8(62.4) = 611.52 \text{ N}$$

$$611.52 = k \Delta x$$

$$611.52 = 611.5 \Delta x$$

$$\Delta x = 1 \text{ m}$$

5. A bowling ball and a ping pong ball collide.

a. Which experiences the greater force from the collision?

Newton's 3rd Law

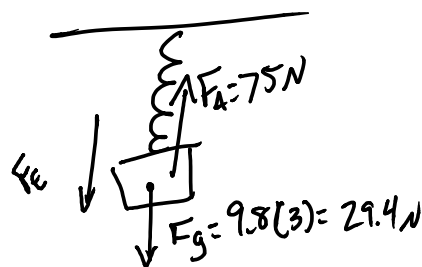
Neither. They experience equal force.

b. Will they have different accelerations? Why or why not?

Yes. $F = ma$ if the force is the same, but the masses are different, the acceleration must be different.

6. A 3kg mass suspended from a spring. It is pushed upward with a force of 75N and moves the spring 13cm from its equilibrium position.

a. Find the spring constant of the spring.



$$F_{\text{net}} = 0 = F_A - F_g - F_e$$

$$0 = 75 - 29.4 - F_e$$

$$F_e = 45.6 \text{ N}$$

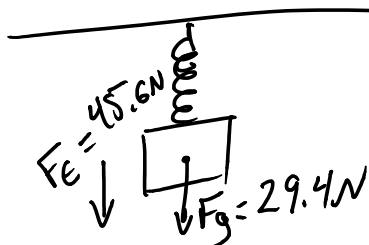
0.13m

$$45.6 \text{ N} = k \Delta x$$

$$45.6 \text{ N} = k \left(\frac{0.13}{.13} \right)$$

$$k = 350.8 \text{ kg/s}^2$$

b. Find the acceleration of the block when it is released.



$$F_{\text{net}} = F_g + F_e$$

$$F_{\text{net}} = 75 \text{ N}$$

$$ma = 75 \text{ N}$$

$$3a = 75 \text{ N}$$

$$a = 25 \text{ m/s}^2$$

Forces & Kinematics

Forces

$$F = ma$$

Kinematics

$$d = v_f t + \frac{v_i t}{2}$$

$$d = v_i t + \frac{1}{2} a t^2$$

Force:

$$F = ma$$

What is shared? →

$$d = \frac{v_f + v_i}{2} t$$

$$d = v_i t + \frac{1}{2} a t^2$$

$$a = \frac{v_f - v_i}{t}$$

$$v_f^2 = v_i^2 + 2ad$$

Acceleration

When solving any problem that includes forces and regular motion (v_i, v_f, d or t)

Step 1: Find a way to get acceleration.

→ Use kinematics formulas

or

Find a force use F_{net} after

→ Use F_{net} to find acceleration

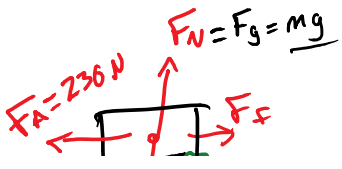
Find $v_i, v_f, d, \text{ or } t$

Ex.

A box is at rest until it experiences a 230N push. It slides along the grass ($\mu_k = 0.17$) and reaches a velocity of 2.5m/s after it travels 3.4m. What is the mass of the box?

$$F_A = 230N$$

Force → $m = ?$



$$v_i = 0 \text{ m/s}$$

$$v_f = 2.5 \text{ m/s}$$

$$F = ?$$

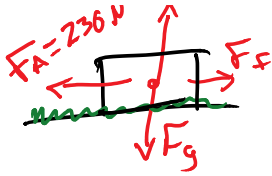
$$d = 3.4 \text{ m}$$

$$v_f^2 = v_i^2 + 2ad$$

$$\frac{v_f^2 - v_i^2}{2d} = \frac{2ad}{2d}$$

$$a = \frac{v_f^2 - v_i^2}{2d} = \frac{2.5^2}{2(3.4)}$$

$$a = 6.25 = 0.919 \text{ m/s}^2$$



$$a = \frac{6.25}{6.8} = 0.919 \text{ m/s}^2$$

$$F_{\text{net}} = F_A + F_F$$

$$m a = F_A + \mu F_N$$

$$m (0.919) = 230 - (0.17) m (9.8)$$

$$0.919 m = 230 - 1.666 m$$

$$+ 1.666 m$$

$$+ 1.666 m$$

$$\frac{2.585 m}{2.585} = \frac{230}{2.585}$$

$$m = 89.0 \text{ kg}$$