Key

Force Review Sheet

Useful Equations: $\Sigma F = ma$ $\quad F_f = \mu F_N$ $\quad \Sigma F = F_{\text{one direction}} - F_{\text{opposite direction}}$

1. Which has more inertia, a mouse or an elephant. How does that relate to Newton's 1st Law?

   Elephant. Larger Mass.

2. Using Newton's 1st Law of Motion, explain why beach ball in the back of a pickup truck rolls when to the back when the truck accelerates.

   The beach ball remains at rest unless a net external force acts upon it. When the truck accelerates the beach ball is simply maintaining its original position.

3. What physical quantity is the measure of the amount of inertia an object has?

   Mass.

4. What is equilibrium? What are the two scenarios in which equilibrium occurs?

   When an object is at rest or Constant Velocity

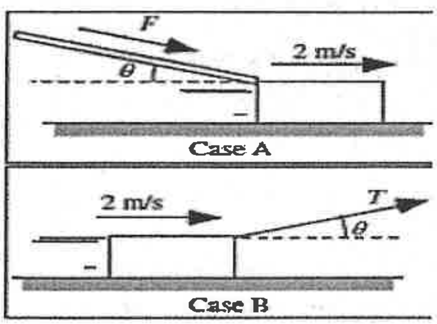
5. Can an object be in motion if there is no net force on the object (equilibrium)? Why or why not?

   yes, if the object is moving with constant velocity. $\Sigma F = 0N$

6. In which direction does friction act? What happens to the force of friction as F_n increases?

   Opposite of the direction of Motion. If F_N increases, F_f increases

7. In the diagram below, all forces, masses and surfaces are equal. In case A, the force is applied below the horizontal and in case B the force is applied above the horizontal. In which case is the force of friction the greatest? Why?



   Case A An applied force downward increases the Normal force. When Normal force increases so does friction

   $F_f = \mu_k F_N$ $\quad \uparrow F_f \quad \uparrow F_N$

   Directly Related

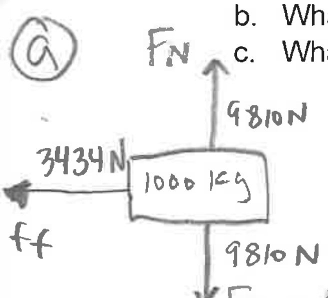
8. A box has four books inside of it and is placed on a table. Explain what would need to occur for the following scenarios to be true. (ex: Remove books, add books, pull at angle above the horizontal, pull at angle below horizontal)
   a. The Fg of the box and books is greater than the Fn the table supplies to the box
   b. The Fg of the box and books is less than the Fn the table supplies to the box

   (a) Pull above the horizontal

   (b) Pull below the horizontal

9. A 1000 kg car is traveling down the road when the driver slams on the brakes, creating a frictional force that stops the car. The coefficient of friction is 0.35.
   a. Draw a freebody diagram.
   b. What is the amount of frictional force acting on the car?
   c. What is the acceleration of the car?

(a)



$F_g = (1000\ kg)(9.81\ m/s^2)$

(B) $F_f = \mu_k F_N$

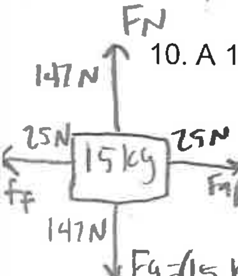
$f_f = (0.35)(9810N)$

$= 3434N$

(C) $\Sigma F = ma$

$a = \frac{\Sigma F}{m} \ldots \frac{(3434N - 0N)}{1000\ kg} = 3.43\ m/s^2$

$\Sigma F = 0$

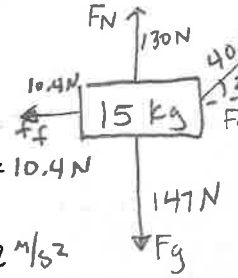


10. A 15 kg crate is pushed to the right with a force of 25 N. The crate moves at constant velocity.
    a. Draw a freebody diagram.
    b. What is the net force acting on the crate? $\Sigma F = 0$
    c. What is the frictional force? 25 N
    d. What is the coefficient of friction?

$F_g = (15\ kg)(9.81\ m/s^2) = 147N$

$F_f = \mu_k F_N \ldots \frac{F_f}{F_N} = \mu_k \quad \frac{25N}{147N} = 0.17$

11. A student pulls a 15 kg box with a force of 40.0 N at an angle of 25° above the horizontal. If the coefficient of friction, μ is .08.
    a. Draw a freebody diagram.
    b. What are the components of the 40.0 N force?
    c. What is the normal force acting on the box? 130 N
    d. What is the force of friction (F_f)? $F_f = (0.08)(130N) = 10.4N$
    e. What is the acceleration of the box?



$F_{ay} = F\sin \ldots (40N)\sin(25°) = 16.9N$

$F_{ax} = F\cos \ldots (40N)\cos(25°) = 36.3N$

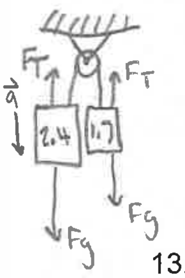
$F_N + F\sin = F_g$

$F_N + 16.9N = 147N$

$F_N = 130N$

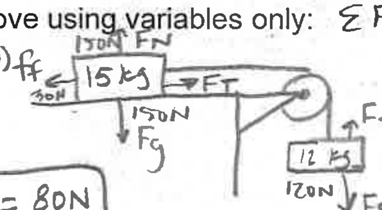
$\Sigma F = ma \ldots a = \frac{\Sigma F}{m} \rightarrow \frac{36.3N - 10.4N}{15\ kg} = 1.72\ m/s^2$

12. Two hanging masses, 2.4 kg and 1.7 kg, are connected to each other by a string through a pulley.
    a. Draw a free body diagram for the scenario above.
    b. In what direction does the 2.4 kg mass accelerate when allowed to move freely? Downward
    c. Determine the net force equation for the system above using variables only. $\Sigma F = F_{gM_1} - F_{gM_2}$
    d. How could you determine the acceleration of the system? $a = \frac{\Sigma F}{M_1 + M_2}$ $\quad \Sigma F = F_{g2.4} - F_{g1.7}$
    e. Write the equation that would allow you to find the tension on the 2.4 kg object.



$\vec{a} = \frac{\Sigma F}{M} \ldots \vec{a} = \frac{F_{gM_1} - F_T}{M_1} \ldots (M_1)\vec{a} = F_{gM_1} - F_T \ldots F_{gM_1} - (M_1)\vec{a} = -F_T$

13. A 15 kg weight that is on a ledge is attached with a string, to a 12 kg weight that is hanging over the edge of the ledge. If the coefficient of friction, m, is 0.20: ↳ Mass 1
    a. Draw a free body diagram for the scenario above:
    b. Determine the net force equation for the system above using variables only: $\Sigma F = F_{gM_1} - F_f$
    c. What is the acceleration of the system? $F_f = (0.20)(150)$
    d. What is the tension in the string?



(c) $a = \frac{\Sigma F}{M_1 + M_2}$

$a = \frac{120N - 30N}{(12\ kg + 15\ kg)} = 3.33\ m/s^2$

(d) $3.33\ m/s^2 = \frac{F_{gM_1} - F_T}{12\ kg} = \frac{120N - F_T}{12\ kg}$

$F_T = 80N$

14. A 9 kg bowling ball collides with a 1 kg bowling pin.
    a. Which experiences a greater force of impact, the bowling ball or the bowling pin?
    b. How does the acceleration of the bowling ball and the bowling pin compare? Why?

(a) Both Forces are equal (B) $a_{bowling\ ball} < a_{pin}$ Since the pin has less mass, in order for it to produce an equal force it must have a larger acceleration.

$F = ma$

15. For each of the following situations, identify the action/reaction pair
    a. A ball bounces on a floor.
       → Floor pushes on ball.
    b. A rock hits a wall
       → Wall pushes back on rock.
    c. A person walking.
       → Ground pushes back on person's feet.