Name: ____________________

Period: ____________________

Weight, Friction, and Equilibrium

Weight

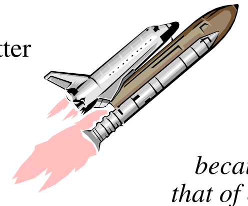
Force of Weight (in Newtons) → $F_w = mg$ ← Mass (in kg); ← Acceleration of gravity (9.8 m/sec^2)

Weight equals mass times the acceleration of gravity.

Weight is the force of gravity on mass.

Mass is the amount matter (atoms and molecules) of an object.

Weight changes if gravity changes; mass does not change with gravity.



On another planet your mass would be the same, but your weight would change depending on the amount of gravity.

On the moon you would weight 1/6th your weight on the earth, because the moon's gravity is 1/6th that of earth's. A large bag of dogfood could be carried easily with one arm.

Ex. What is the weight of a 2 kg mass?	
Variables: $2 \text{ kg} = m$ $g = 9.8 \text{ m/s}^2$ $F_w = ?$	Equation: $F_w = mg$ Solve: $F = (2 \text{ kg})(9.8 \text{ m/s}^2)$ $F = 19.6 \text{ N}$

Ex. What is the mass of a 39.2 N mass?	
Variables: $g = 9.8 \text{ m/s}^2$ $39.2 \text{ N} = F_w$ $m = ?$	Equation: $F_w = mg$ $m = F_w/g$ Solve: $m = (39.2 \text{ N})/(9.8 \text{ m/s}^2)$ $m = 4 \text{ kg}$

If you know mass you can find weight; if you know weight you can find mass.

$F_w = mg$ allows you to convert between mass and weight easily.

The Feather or the Hammer?

Do heavy things fall faster?
NO! They fall at the same rate.

Heavy and light object fall at the same rate.

g is a constant — 9.8 m/s²
The acceleration of all falling objects is the same.

Yet you know that a hammer will fall faster than a feather. Why?
Because the feather has more air friction.

Friction

Friction is caused by two things moving against each other.

Friction always opposes motion.

Friction causes things to wear out and causes **heat**, so we use **lubricants** to reduce friction.

Direction of Motion →

Air friction: -20 N ←

→ Engine: 100 N

Net Force = 100N - 20N = 80N (right)

Kinds of Friction (from most to least friction): sliding (rubbing) friction; rolling friction; viscous friction (in fluids); air friction.

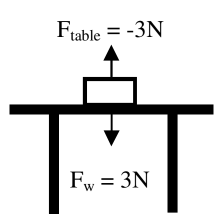
Equilibrium (State of Equality)

At equilibrium the following are true:

$F_{net} = 0$ N (no net force)
$a = 0 \text{ m/s}^2$ (no acceleration)
$\Delta v = 0$ m/s (constant speed)

An object at rest is also at equilibrium with a constant speed of 0 m/s.

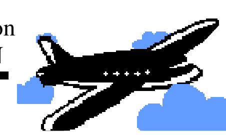
Object on a Table



$F_{net} = 0$ N
$a = 0 \text{ m/s}^2$
At Equilibrium!

Object at Constant Speed

Air friction = -600 N ←



→ Engine = 600N

$F_{net} = 0$ N
$a = 0 \text{ m/s}^2$
At Equilibrium!

1. Weight 2. Equilibrium 3. Mass 4. Heat 5. g	A. When all forces on an object are balanced. B. The force of gravity on an object. C. The acceleration of gravity. D. The a product of friction. E. The measure of the matter in an object.	1. Rolling friction 2. Air friction 3. Viscous friction 4. Sliding friction 5. Friction	A. Resistance of a fluid on an object. B. Resistance of air pushing against an object. C. Resistance of two objects pushing against each other. D. Any force that resists motion. E. Resistance of a wheel or ball.

More, less, or the same as on the Earth

When an astronaut lands on the moon:

The astronaut's mass is: ____________________

The astronaut's weight is: ___________________

The astronaut's inertia is: ____________________

Which of Newton's Three Laws Applies? Law 1, 2, or 3?

___ Pushing a cart down the hall, when you try to turn it it tries to go straight.

___ More acceleration takes more force.

___ When you push your knuckles into a table, it hurts your knuckles.

___ A ball thrown into the ground bounces back up.

Using $g = 10\ m/s^2$, find the weight of a 4 kg object.

An object weighs 350 N. Find its mass.
Use $g = 10\ m/s^2$.

If 100 kg person weighed 400 N on the planet Zorg, what is the acceleration due to gravity on Zorg?

A sled is pushed with 30 N and sliding friction is 10 N. Find the net force on the sled.

Two boys push on a box with 3 N and 6 N to the right. The net force is 7 N. Find the force of friction.

A car's engine pushes with 45N to the right. If it is at equilibrium, how much air friction is there and what is the car's acceleration?

A 25kg object accelerates at $5\ m/s^2$. Find the force.

A boat's motor pushes with 25 N of force and viscous friction resists with 5 N. If the boat is 100 kg, find its acceleration.