Name: _A3/4_

No Net Force

Newton's 1st Law: Objects in motion **have a constant velocity** ← speed+direction **and** objects at rest stay at rest **unless acted upon by a net force (unbalanced forces)**.

If the forces acting on an object are balanced (no net force), what might that object be doing? What are the options?

No net force

- No motion (still)
- Motion in a straight line at constant speed

What are the options for what an object might be doing if the forces on the object are not balanced (i.e. there is a net force)?

net Force

- Accelerates (or decelerates)
- Same speed, but changing direction

Newton's 1st Law is called the "Law of Inertia." Inertia is:
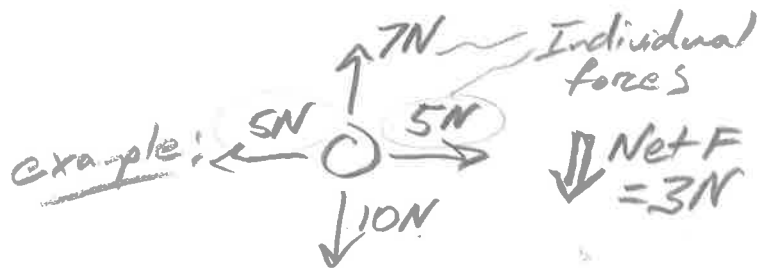
resistance to change in motion

What objects of things have the most inertia? Give some examples.

Heavy, massive things → Trains.
→ Bowling Balls

Force Vector (in this class): A force with an arrow showing direction.

example: $3N$ ↗

Net force: Sum of all force vectors acting on an object

example: $5N$ ← ○ → $5N$ ↓ $10N$

$7N$ ↑ Individual forces
↓ Net F = 3N

The basic metric unit of force is the _Newtons_. Its abbreviation is _N_. It is approximately equal to _¼ lb_ or _raw hamburger patty_

1. Each of the pictures on the right shows one or more force vectors.

   A) Look at the pictures and decide if the forces are balanced or unbalanced. Label them appropriately.

   B) Look at each of the pictures and determine the **net force**. If the net force is not zero, draw and label a new vector representing the **net force**.
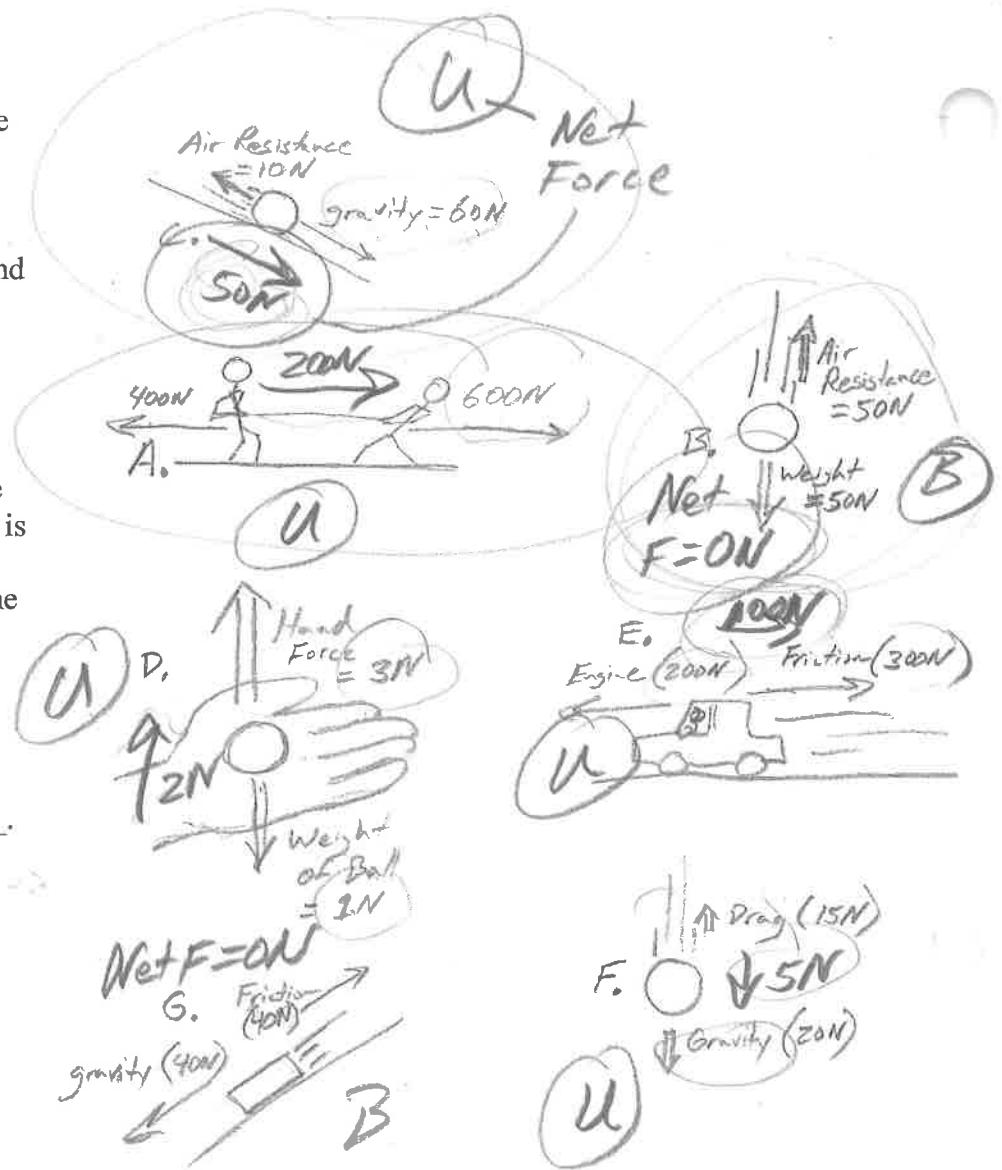
2. Forces are balanced whenever the net force on an object is ___*ON*___.

3. The ball in picture C is rolling down a hill. What does the net force tell you about the ball's motion?

   Accelerates

4. The ball in picture B is falling from the sky. What does the net force tell you about the ball's motion?

   Constant Velocity

5. The ball and hand in picture D are just beginning to move. What does the net force tell you about their motion?

   Accelerate upward

6. The car in picture E is driving to the left. What does the net force tell you about the car's motion?

   Decelerate

7. The box in picture G is sliding down a hill. What does the net force tell you about the box's motion?

   Constant Velocity

8. The ball in picture F is falling from the sky. What does the net force tell you about the ball's motion?

   Accelerate

U Net Force

Air Resistance =10N   gravity=60N
50N

400N   200N   600N
A.   *U*

Air Resistance =50N
B. Weight =50N   *B*
Net F=0N

D. Hand Force = 3N
U   2N
Weight of Ball = 2N
NetF=0N   G. Friction (40N)
gravity (40N)   *B*

E. 100N
Engine (200N)   Friction (300N)
U

F. Drag (15N)
5N
Gravity (20N)
U

Newton's 2nd Law:

$$F = ma$$

Force → N

acceleration

↑ mass

Mass: Stuff

Metric Base Unit for Mass = _____ kilograms _____, which is abbreviated _____ kg _____

A 1kg mass weighs about __10__ Newtons or about __2.2__ pounds.

Weight: Force of gravity

Calculating forces using Newton's 2nd law:

6. A 2kg mass accelerates at a rate of 3m/s/s. What net force caused this acceleration?

$$F = ma = 2kg(3m/s^2) = 6N$$

7. An unbalanced force was applied to a 7kg object. The object accelerated at a rate of 8m/s/s. What was the magnitude of the unbalanced force?

$$F = ma = 7kg(8m/s^2) = 56N$$

8. A 3kg bowling ball is dropped from an airplane. Gravity causes the bowling ball to accelerate at a rate of __-10m/s²__. What is the weight of the bowling ball? In other words, what force of gravity acts on the bowling ball?
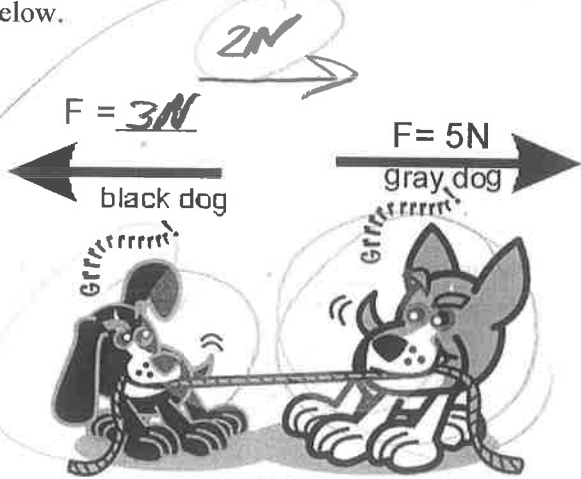
$$F = ma = 3kg(-10m/s^2) = -30N \text{ or } 30N$$

Gravity causes a force even when an object is sitting still. If we know how fast gravity *would* accelerate the object *if* gravity were not balanced by any other force, then we can figure out the force of gravity acting on an object. This is the underlined weight of the object.

9. What is the weight of a 30kg child who is standing on the Earth?

10. What is the weight of the same 30kg child, if that child is standing on Mars?

Acceleration Due to Gravity Comparison	
Body	Acceleration Due to Gravity, "g" [m/s²]
Sun	274.13
Mercury	3.59
Venus	8.87
Earth	9.81
Moon	1.62
Mars	3.77
Jupiter	25.95
Saturn	11.08
Uranus	10.67
Neptune	14.07
Pluto	0.42

11. Fill in **all** of the missing forces in the two diagrams below.

2N

F = 3N

F= 5N
gray dog

black dog

a = 2 m/s/s
rope mass = 1kg
Net Force = 2N

F=ma
=1kg(2m/s²)
=2N

2000N

F = 3000N

F= 1000N
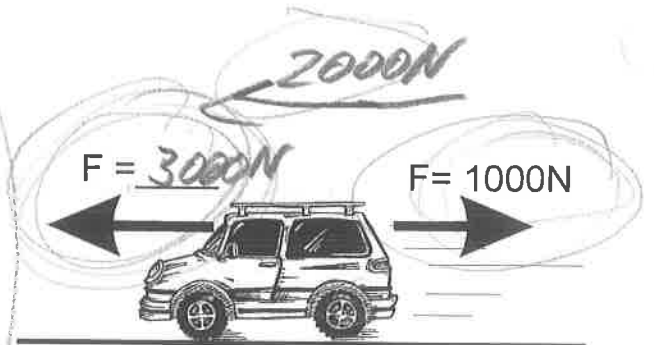
a = -4 m/s/s
car mass = 500kg
Net Force = _____

F=ma
= 500kg(-4m/s²)
= -2000N