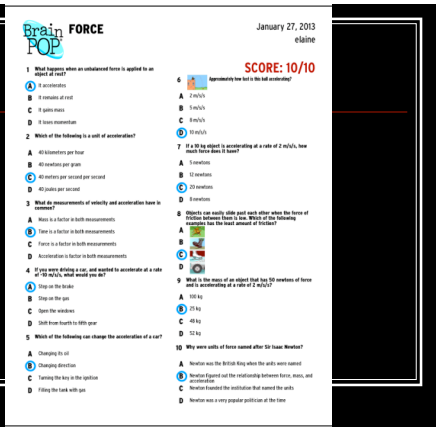
INTRODUCTION TO FORCES

WHERE DO THEY COME FROM? HOW ARE THEY MEASURED? HOW ARE THEY ADDED & SUBTRACTED?

Here's Tim & Mobey on Force

- Brainpop
- Log is: mms308 / password: marshall



Brain POP **FORCE**

January 27, 2013
elaine

SCORE: 10/10

1 What happens when an unbalanced force is applied to an object at rest?
(A) It accelerates
B It remains at rest
C It gains mass
D It loses momentum

2 Which of the following is a unit of acceleration?
A 40 kilometers per hour
B 40 newtons per gram
(C) 40 meters per second per second
D 40 joules per second

3 What do measurements of velocity and acceleration have in common?
A Mass is a factor in both measurements
(B) Time is a factor in both measurements
C Force is a factor in both measurements
D Acceleration is factor in both measurements

4 If you were driving a car, and wanted to accelerate at a rate of +10 m/s/s, what would you do?
(A) Step on the brake
B Step on the gas
C Open the windows
D Shift from fourth to fifth gear

5 Which of the following can change the acceleration of a car?
A Changing its oil
(B) Changing direction
C Turning the key in the ignition
D Filling the tank with gas

6 Approximately how fast is this ball accelerating?
A 2 m/s/s
B 5 m/s/s
C 8 m/s/s
(D) 10 m/s/s

7 If a 10 kg object is accelerating at a rate of 2 m/s/s, how much force does it have?
A 5 newtons
B 12 newtons
(C) 20 newtons
D 8 newtons

8 Objects can easily slide past each other when the force of friction between them is low. Which of the following combinations has the least amount of friction?
A
B
(C)
D

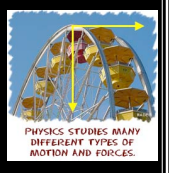
9 What is the mass of an object that has 50 newtons of force and is accelerating at a rate of 2 m/s/s?
A 100 kg
(B) 25 kg
C 48 kg
D 52 kg

10 Why were units of force named after Sir Isaac Newton?
A Newton was the British King when the units were named
(B) Newton figured out the relationship between force, mass, and acceleration
C Newton founded the institution that named the units
D Newton was a very popular politician at the time

7. Forces & Motion

WHAT DOES MOTION HAVE TO DO WITH FORCES?

- You'd be surprised at how closely these two concepts go together.
- Suppose I asked you to move a heavy desk in the classroom. How would you move it?
  - Get on one side & start pushing
  - Grab the legs & start pulling
- Either way, you would be using force.



WHAT IS A FORCE?

- A **push** or **pull**
- Change the **motion** of all objects
- Anytime you see something moving, you can be sure that a force created its motion.

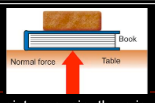
FORCES ARE EVERYWHERE

- Without forces, sports, dancing, driving… basically *everything* would be impossible.
- Some forces, like **weight**, are present when things are not moving.

TYPES OF FORCES

1. **Contact** force: created between two touching objects (holding a pencil, hugging someone, etc)
2. **Gravity**: force of attraction between two objects, Earth's gravity pulls on all objects
3. **Friction**: a force that resists motion between two surfaces that are pressed together

TYPES OF FORCES

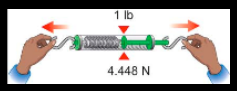


- Looking at this picture again, there is another force present … what is it?
  - What is holding the skater up?
  - The ground!
- 4. This is the **normal** force.
- It is the support force exerted upon an object which is in contact with another stable object.
- For example, if a book is resting upon a surface, then the surface is exerting an upward force upon the book in order to support the weight of the book.

Normal Force (add this to your drawing!)

UNITS

- **Newton** (**N**)
- 1 newton = accelerating a 1 kg object at 1 m/s each second
- 1 pound = **4.448** newtons



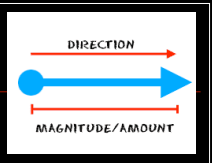
$$1\ \mathrm{N} = 1\ \frac{\mathrm{kg \cdot m}}{\mathrm{s}^2}$$

FORCES HAVE MAGNITUDE & DIRECTION

- Like velocity, force is a **vector**.
- That means it has **size** (magnitude) & direction.
  - Magnitude = **amount** or **strength** of the force
  - Measured in Newtons

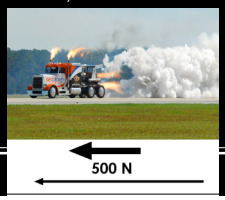
FORCE VECTORS

- A vector is an arrow used to show the direction & size of a force.
- The arrow points in the direction of the force.
- The length or thickness of the arrow represents the size or magnitude of the force.



FORCE VECTOR EXAMPLES

- A smaller force of 5 N would have a small skinny arrow.
- A larger force of 500 N would have either a long arrow or a thick one.
  - (yes, this a real image of The Shockwave jet truck traveling at at 376 mph - it set the record for semis.)



COMBINING FORCES

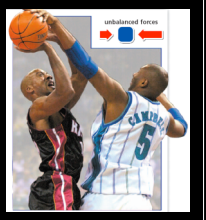
- Usually, more than one force is exerted on an object at the same time.
- The sum of all forces acting on an object is called the **net** force.
- You need to look at the net force in order to figure out if or how an object will move.

BALANCED FORCES

- Net force = **zero**
- **No** change in motion
- (object is not moving)
- *List 3 examples of balanced forces:*
  - Paper on desk
  - You in the chair
  - Flag not moving

UNBALANCED FORCES

- There is a **net** force acting on an object.
- Causes a change in motion
- Possible to add the forces together to find the size & direction of the net force.

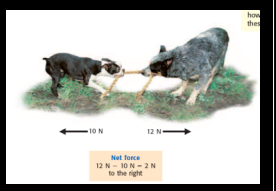


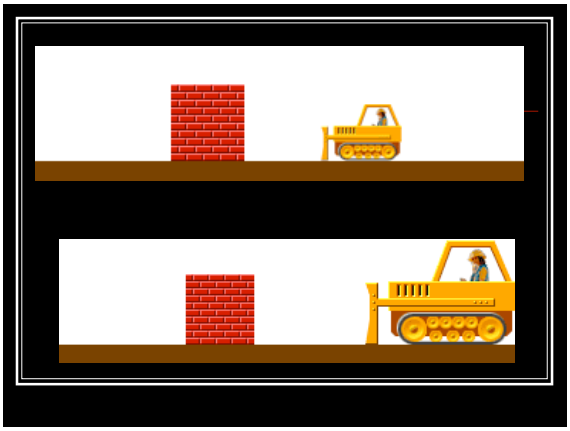
UNBALANCED FORCES

- If the forces are moving in the **same** direction, **add** the forces.
- Example:
  - Girl pushes 25 N to the right
  - Boy pulls 20 N to the right
  - Net Force = 45 N to the right
  - The piano moves to the right

UNBALANCED FORCES

- If the forces are moving in **opposite** directions, **subtract** the forces.
- Example:
  - Dog #1 pulls 10 N to the left
  - Dog #2 pulls 12 N to the right
  - Net Force = 2 N to the right





8. Balanced & Unbalanced Forces

YOU TRY IT: CALCULATING NET FORCE

1. 15 N → ← 25 N
2. 8 N → 12 N →
3. 18 N ← 22 N ←
4. 2 N ← 14 N ←
5. 3 N → 3 N ←
6. 7 N ← 7 N →

YOU TRY IT: NET FORCE

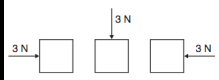
1. 15 N → ← 25 N
   10 N ←
2. 8 N → 12 N →
3. 18 N ← 22 N ←
4. 2 N ← 14 N ←
5. 3 N → 3 N ←
6. 7 N ← 7 N →

YOU TRY IT: NET FORCE

1. 15 N → ← 25 N
   10 N ←
2. 8 N → 12 N →
   20 N →
3. 18 N ← 22 N →
   4 N →
4. 2 N ← 14 N ←
   16 N ←
5. 3 N → 3 N ←
   0 N
6. 7 N ← 7 N →
   0 N

SAMPLE TEST QUESTION #1

A force is acting on each of the objects below.



What can be concluded about these forces?

A They are the same because they point toward the objects.

B They are the same because they have the same magnitude.

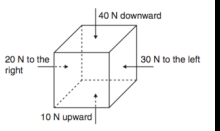
C They are different because they have different magnitudes.

D They are different because they have different directions.

- Answer: D
  - Each box has the same magnitude of force (3 N), but in 3 different directions.
  - That makes them totally different from one another.
  - D is the only possible answer.

SAMPLE TEST QUESTION #2

15 Four forces are acting on a box, as shown below.



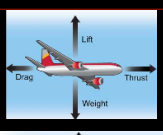
This box will increase in speed

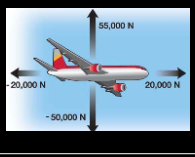
A downward and to the left.
B downward and to the right.
C upward and to the left.
D upward and to the right.

- Answer: A
  - The box will move 30 N downward & 10 N to the left

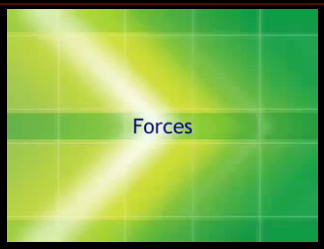
SAMPLE TEST QUESTION #3

- Four forces are acting on a plane; lift, drag, thrust, and weight. Using the values in the picture, what is the net force (direction & size) acting on the plane?
  - Answer: 5,000 N upward





9. Forces review



Draw this in your little book at the bottom of pg12