Gravity
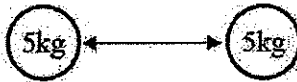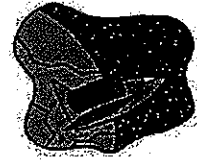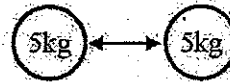
Gravity is a force that pulls any two masses towards each other. Nothing can stop gravity.

Gravity increases with mass.
Less mass: less gravity

(5kg) ←→ (5kg)

Heavier things have more gravitational force (weight) because they have more mass.

Gravity decreases with distance.
Less distance: more gravity

(5kg) ←→ (5kg)

More mass: more gravity

(10 kg) ←→ (10 kg)

More distance: less gravity

(5kg) ←———→ (5kg)

As a spaceship gets closer to a planet, the gravity between the planet and the ship gets stronger.

Friction

Friction is a force that opposes moving objects and occurs any time objects touch. Friction causes heat and takes energy away from moving objects and machines.

M → *friction*

The object and the table heat up as the two object rub against each other.

Rough surfaces have more friction than smooth surface.

An object must be touching something to have friction.

Air friction (air resistance) occurs when objects move thru air. Air friction increases with speed.

Friction can be helpful. A car use the friction of its tires to turn corners.

What is gravity?

force that pulls objects together

Does gravity increase or decrease?
  I If you increase the mass of one of the objects?
  I If you decrease the distance between the two objects?
  D If you decrease one of the masses?
  D If the objects are farther apart?

If an object is not touching a table is there friction between them?

No, friction required contact

What is another name for air friction? air resistance

Friction always causes what? Heat

For each pair of the objects, which has more inertia?
A. A freight train or a car?
B. A ping pong ball or a baseball?
C. A fast bowling ball or a slow bowling ball? Same

Give an example of good friction.

Varies

Give an example of bad friction.

Varies

$F_k = 8$ N   [8.5 kg] ← → 20 N
$F_s = 15$ N

A. What is the normal force acting on the object?
Fw = mg = 8.5 kg · 10 m/s² = 85N = Fn

B. How do static and kinetic friction compare?
Fs > Fk

C. Will this object start to move? Yes

D. Why?
20N > 15N

E. Calculate its acceleration. F=ma a = F/m
Fnet = 12N m = 8.5 kg $\frac{12N}{8.5kg}$ = 1.4 m/s²

Two very small people are pulling a box. Identify the four shown forces as $F_{Applied}$, T, Fw, Fn.
A. T   F₁— the two men pulling WITH A ROPE.
B. Fn F₂— the force pushing up by the floor.
C. Fw F₃— the force pulling down on the mass.
D. Ff F₄— the force trying to stop the mass from moving.
E. Ff Which force is in the negative x-direction?
F. Fn Which force is in the positive y-direction?
G. T   Which force is in the positive x-direction?
H. Fw Which force is in the negative y-direction?
I. Which forces would be used in this equation: $\Sigma F_y = ma$? Fw + Fn
J. Which forces would be used in this equation: $\Sigma F_x = ma$? T + Ff

F₄ ← [M] → F₁

F₃   ↑F₂   Floor

Balanced or unbalanced forces?

U 10 N left and 5 N right?   B If a = 0?

U An object accelerating?   B If Δv = 0?

B An object at constant speed?   U When an object turns a corner?

B An object at rest?

Balanced or unbalanced forces? Fnet = 21 N
Calculate the net force and acceleration of the object.

$F = ma$

$a = \frac{F}{m}$ $\frac{21N}{3kg} = 7m/s^2$

10N ← [3kg] → 31N

Which falls faster, heavy or light objects?
Why? Same speed

g acts on all objects equally

Will it accelerate faster or slower?
S If you increase an object's mass.
F If you increase the force on the object.
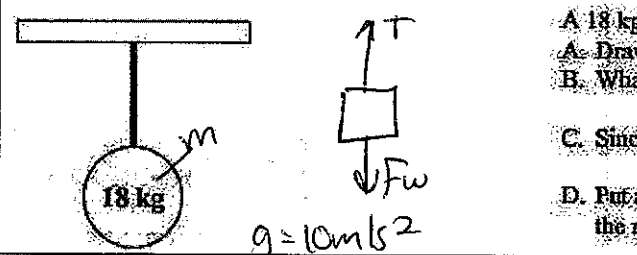

A 2 kg object is thrown into the air going 5 m/s.
A. Is the object's initial velocity ⊕ or –?
B. Is the object's acceleration + or ⊖?
C. What is the force pulling down on the object (give a number).

–10m/s²

Notice that an object can be moving the opposite way of the acceleration.

Which has more inertia:
A 50 kg object or a 10 kg object?
A 30 kg object on the earth or in space? Same
A 20 kg object going 50 m/s, or a 30 kg object at rest.

What is the difference between mass and weight?
mass - amount of matter in an object
weight - g acting on mass

Which changes in space? weight

Mass or Weight: W 20 N; M 30 kg?

A 4 kg object accelerates 12 m/s² to the left, find the force on it.
$F = ma$

$F = 4kg \cdot 12m/s^2 = 48N$

A 30 N net force pulls to the right on a 5 kg object. Find its acceleration. $F = ma$ $a = \frac{F}{m}$

$\frac{30N}{5kg} = 6m/s^2$

Calculate the weight of a 12 kg object.

$Fw = mg$ g = 10m/s

$Fw = 12kg \cdot 10m/s^2 = 120N$

[diagram: 18 kg object suspended] T↑ [box] ↓Fw   g = 10m/s²

A 18 kg object is suspended by a rope.
A. Draw and label all of the forces acting on the object.
B. What is the weight of the object? $Fw = mg$
$18kg \cdot 10m/s^2 = 180N$
C. Since it is hanging at rest, what is the acceleration of the object? 0 m/s²
D. Put all of the above into ΣF = ma and calculate the force exerted by the rope. $T - Fw = ma$ $T - 180N = 18kg \cdot 0m/s^2$ $T = 180N$

Which has more inertia?
A) A 10 m/s car or a 20 m/s car?
B) A heavy rock or a light rock?
C) An astronaut on the earth or in space? Same

Balanced or unbalanced forces?
A) U When an object is changing motion?
B) U When an elevator starts to move up?
C) B When an elevator is between floors?
D) B When a car is using cruise control?
E) U When a car is coming to a stop?

An unbalanced or net force causes an object to change Velocity
or Direction. (Use this for the next question.)

A car has three ways to accelerate. What are they?
Speed up   change direction
Slow down

Which of Newton's Laws applies?
A) 2 A racing car needs to accelerate faster, so they make the car lighter.
B) 3 You push your knuckles into a table and your knuckles start to hurt.
C) 1 For a sky diver to fall thru the air at a constant speed, the force of gravity and the force of air friction must be equal.

If there is friction on the table, draw and label all the forces acting on the two masses to the left.

Suzie the slouch is sitting on the school bus. When the bus accelerates forward,
A. Which way does Suzie move relative to the bus? Backwards
B. Which way does Suzie move relative to the ground? Same Place
C. Which of Newton's Laws does this show? 1st - Inertia

Does the force of gravity increase or decrease?
A. D If you increase the distance between the objects?
B. I If you decrease one of the masses?

If you need more help with the following, look at the table on the back of "Forces 5".
A. If you double the distance, by how much does the gravity change? ¼
B. If you triple one of the masses, by how much does the gravity change? 3X
C. If you cut the distance to 1/3, by how much does the gravity change? 0.11

What is Newton's First Law? Inertia

What is Newton's Second Law?
$F = ma$

What is Newton's Third Law?
equal + opposite

Which of Newton's Laws applies?
A. 3 To walk forward your foot has to push backwards.
B. 2 Your car will accelerate faster if you don't have extra weight in the trunk.
C. 1 Without a seat belt, you would be launched forward if your car stops suddenly.