**Common Exam 1**

8:30-9:45 am Friday, Oct. 2nd (Arrive by 8:15 am)

TIER 116 (Tiernan Lecture Hall 1)

Bring calculators

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HW #5: Newton's laws (**Due 1 pm central time, 10/7, Wednesday**).

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Last class…

Chapter 4: The Laws of Motion

Force, Net force

Newton's 1st Law : If $\vec{F}_{net} = 0$, $\vec{v}$ does not change.

Newton's 2nd Law : $\vec{F}_{net} = m\vec{a}$

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Today.. Newton's 3rd Law : Action-reaction

Various Forces

Gravity force
Normal force
Tension

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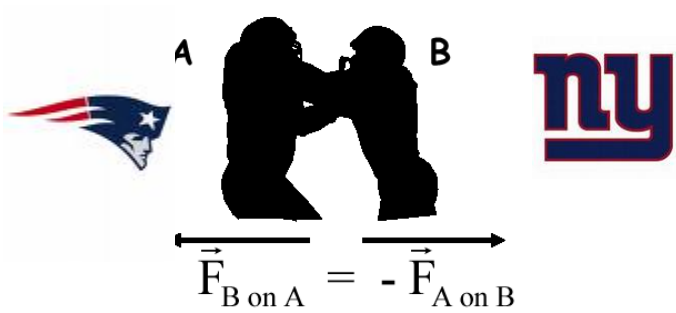
## Newton's 3rd Law

When object A exerts a force $\vec{F}$ on object B,
then object B exerts force $-\vec{F}$ on object A




**Action-reaction pair:** Equal magnitude and opposite direction

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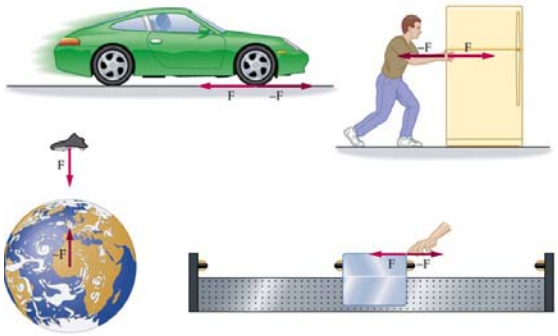
## Action-reaction versus net force

- The 3rd law pair of forces are always applied to *different* objects!

Net force in Newton's 1st and 2nd laws is the sum of forces on the *same* object.

**Examples of action & reaction**

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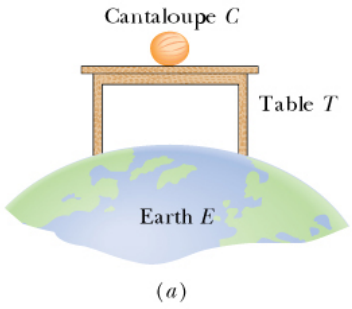
iClicker Quiz

Find reaction force for the gravity on the cantaloupe

(a) Force on the cantaloupe from the table
(b) Gravity force on the earth from the cantaloupe
(c) Force on the table from the cantaloupe
(d) Force on the earth from the table
(e) Gravity force on the table from the earth



$(a)$

## Various forces

Motivation

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \ldots = m\vec{a}$$

To find the acceleration, we need to add all forces applied to an object of mass m.

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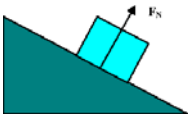
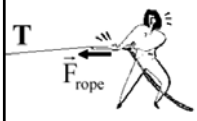
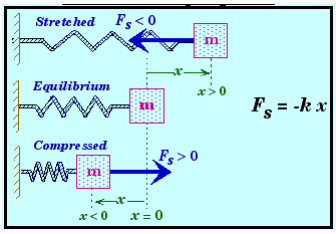
## Various Forces






- Gravitational Force
- Normal Force
- Tension Force
- Friction Force
- Spring Force
- Other forces…

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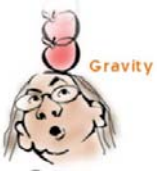
# Gravitational Force (Weight):




**Weight: From the Earth on objects near Earth Surface**

Magnitude:

$F = mg$, where $g = 9.8\ m/s^2$

**Direction: Pointing downward**

·**Weight:** The **force** that the **Earth** is pulling the **object** with near the surface of the Earth.

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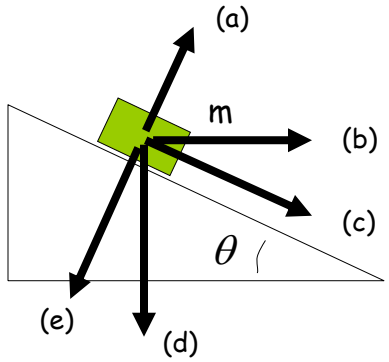
iClicker Quiz

A block of mass m is on an inclined surface as below.
What is the direction of the gravity force on the block?

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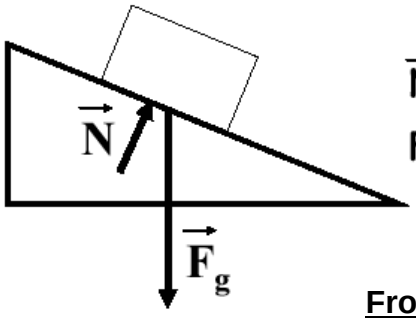
# Normal Force: $\vec{N}$

Force from a solid surface which keeps objects from falling through




**Direction:**

$\vec{N}$ ⊥ surface

Force on surface = - $\vec{N}$

**Magnitude:**

Determined by analyzing forces

From surface on objects in contact

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iClicker Quiz

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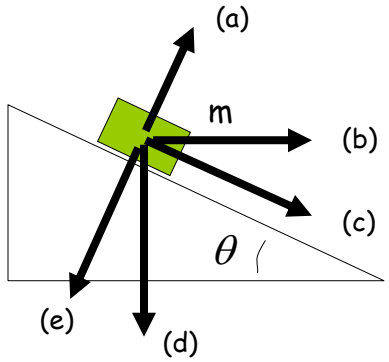
What is the direction of the normal force on the block?

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## Sample Prob #6

The position $y$ of a particle moving along the $y$ axis depends on the time $t$ according to the equation $y = at - bt^2$. The dimensions of the quantities $a$ and $b$ are respectively:

A. $L^2/T$, $L^3/T^2$
B. $L/T^2$, $L^2/T$
C. $L/T$, $L/T^2$
D. $L^3/T$, $T^2/L$
E. none of these

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**8.** A car traveling at a constant speed of 24 m/s passes a trooper. He sets immediately off in chase with a constant acceleration of 6 m/s2 . How long does it take the trooper to over take the speeding car?

A) 8 s
B) 12 s
C) 24 s
D) 32 s
E) 40 s

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**10**. A projectile is fired straight upward at 174 m/s, velocity of projectile 20 s later is:
A) 126 m/s up
B) 374 m/s down
C) 26 m/s down
D) 374 m/s up
E) 40m/s down

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**5**. Two vectors have magnitudes and directions: A=200 at 60 degree and B=300 at 135 degree. The magnitude of the vector **A+B** is :
A) 200
B) 300
C) 350
D) 400
E) 500

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**Workout problem 1**
You throw a ball with a launch velocity of **Vo=(**30m/s**)i+ (**40 m/s**) j** toward a wall . Your distance from the wall is 90 m.
**a)** At what height above release point does the ball hit the wall**?**
**b)** What is the magnitude of velocity when it hits the wall?

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