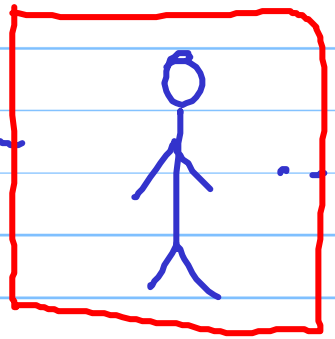
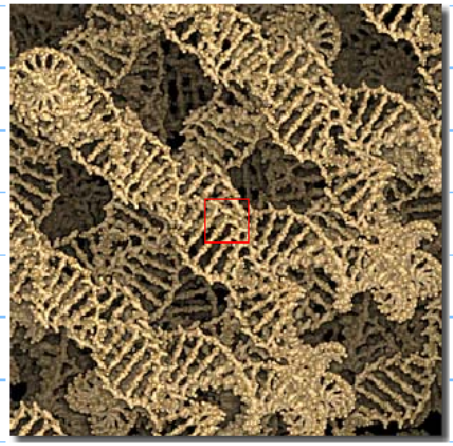
LECTURE 2
CHAPT. 3-4

# PHY 100. KINEMATICS, NEWTON'S LAWS

- RECITATIONS START NEXT WEEK
- PROBLEM SET #1 POSTED ONLINE

RECAP FROM LAST CLASS:
THE HUMAN EXPERIENCE IS A TINY FRACTION OF THE UNIVERSE!





LARGE

SMALL

EXPECT SURPRISES!

SCIENCE: IS A METHODOLOGY TO UNDERSTAND THE WORLD AROUND US.

HYPOTHESIS → OBSERVATION → SYNTHESIS

- SCIENCE IS DRIVEN BY OBS. (FALSIFIABLE) AND IS EVER CHANGING.
- PREDICTIONS
- FEW IDEAS EXPLAIN A LOT

INERTIA: AN OBJECT'S TENDENCY TO KEEP MOVING OR REMAIN AT REST.

LAW OF INERTIA: A BODY WILL STAY AT REST IF IT WAS AT REST, OR WILL KEEP MOVING IF IT WAS MOVING, UNLESS IT IS SUBJECT TO EXTERNAL INFLUENCES.

ABSTRACTION: THE BALL SHOULD ROLL FOREVER ON A LEVEL SURFACE AT CONSTANT SPEED IN THE ABSENCE OF RESISTANCE.

FALLING OBJECTS: IN ABSENCE OF RESISTANCE, ALL FALLING BODIES EXPERIENCE THE SAME ACCELERATION.

1) HEAVY OBJECTS FALL THE SAME DISTANCE IN THE SAME TIME REGARDLESS OF WEIGHT

2) AIR RESISTANCE & FRICTION CAN CAUSE VIOLATIONS (DEPENDS ON MEDIUM)

3) THE MOTION IS NOT AT CONSTANT SPEED: THERE IS AN ACCELERATION: SPEED IS INCREASING.

GALILEO ABSTRACTED MOTION IN TWO WAYS:

1) FALLING TENDENCY (ACCELERATED)
2) RESISTANCE (EXTERNAL)

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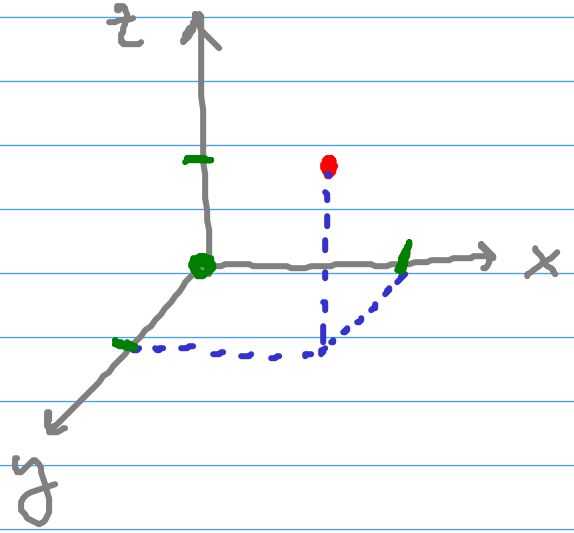
MEASURE MOTION: WE NEED A POSITION (COORDINATE SYSTEM)




POSITION.

AVERAGE SPEED: $\bar{v} = \frac{\Delta d}{\Delta t}$

$\Delta$ = CHANGE IN

$\Delta d = d_2 - d_1$

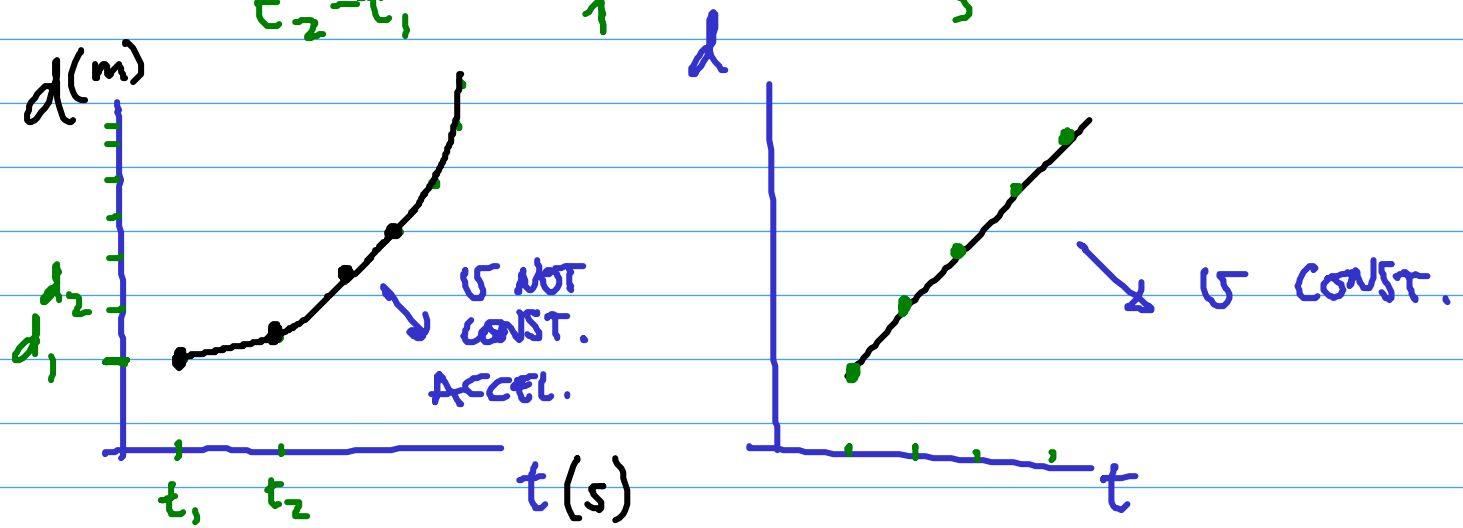
$\Delta t = t_2 - t_1$

AVERAGE VELOCITY: $\frac{\Delta d}{\Delta t}$ WITH DIRECTION

AVERAGE ACCELERATION: $\frac{\Delta v}{\Delta t}$ WITH DIRECTION

Ex: CAR FROM 50 TO 70 mph IN 1 s OR IN 3 hrs.

$$a = \frac{v_2 - v_1}{t_2 - t_1} = \frac{70 - 50}{1} = 20 \frac{\text{mph}}{\text{s}}$$




COMPARE TO INSTANTENEOUS : SPEEDOMETER MEASURES INST. SPEED.

# LAWS OF NEWTON:

LAW OF INERTIA

1) A BODY PERSISTS IN ITS STATE OF MOTION UNLESS ACTED ON BY AN EXTERNAL FORCE.

FORCE: EXTERNAL INFLUENCE THAT CAUSES THE BODY TO ACCELERATE

- CONTACT
- AT A DISTANCE (PULL)

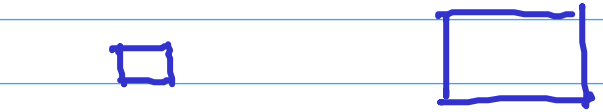
AIR RESISTANCE
FRICTION
GRAVITY

2) $F \propto a$ ; $m \propto \frac{1}{a}$ ; $a \propto \frac{1}{m}$

$$F = ma$$

$$a = \frac{F}{m}$$

A FORCE PRODUCES ACCELERATION IN INVERSE PROPORTION TO ITS MASS

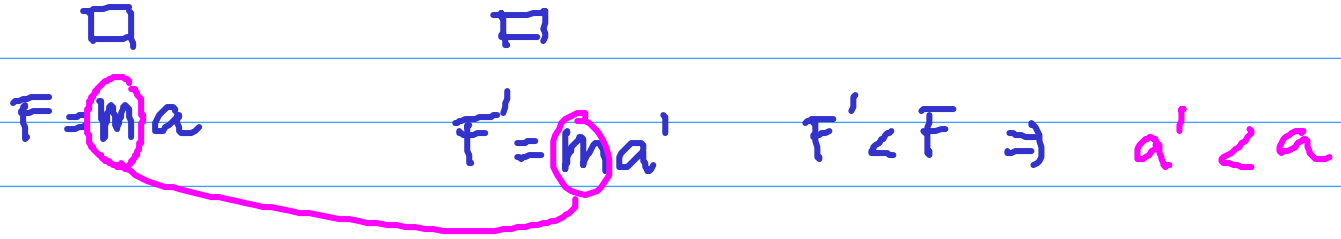


$F = ma$ $\quad$ $F = m'a'$

I COULD MOVE A CAR FROM REST, BUT WITH THE SAME FORCE, I CANNOT MOVE (ACCELERATE) A TRUCK.

$m' > m \ (F = F) \Rightarrow a' < a$

FOR A GIVEN F: $m \uparrow \Rightarrow a \downarrow$




FORCE HAS UNITS OF N (NEWTON)
MASS kg
ACC. $m/s^2$

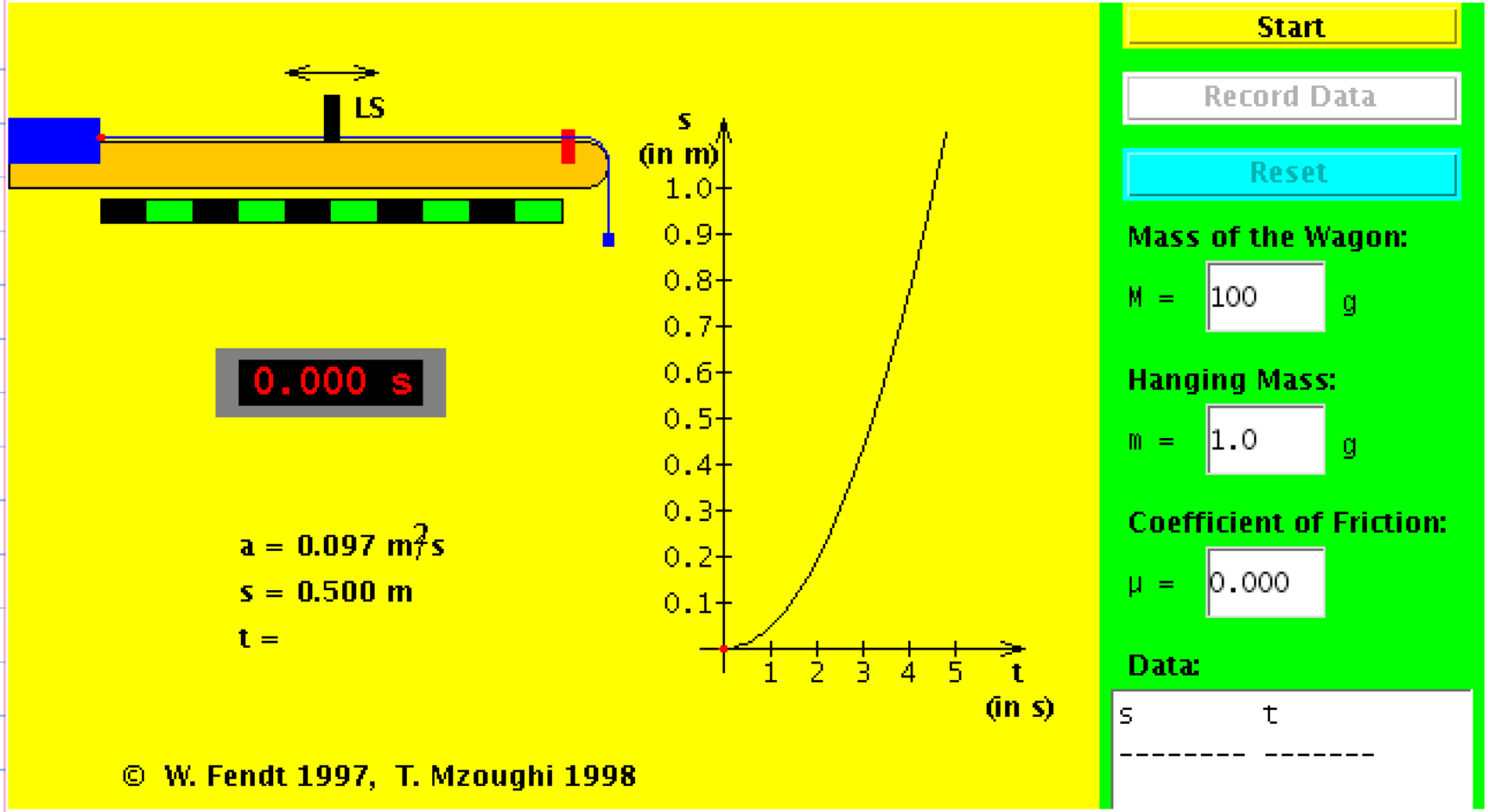
MASS VS WEIGHT INTERLUDE:

WEIGHT IS A FORCE: N, lbs (GRAV. FORCE ON A MASS)

MASS IS A PROPERTY INHERENT TO THE BODY.

THE WEIGHT ON EARTH IS NOT THE SAME AS ON THE MOON, BUT THE MASS IS.

http://www.fisica.uniud.it/~deangeli/applets/Multimedia/physics/physengl/newtons2law.htm

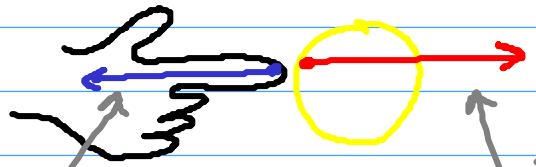



FORCE IS PROPORTIONAL TO ACCELERATION.

IF YOU DOUBLE THE HANGING MASS (m) THEN THE FORCE PULLING THE WAGON IS DOUBLED, AND THEREFORE THE ACCELERATION CAUSED BY THAT PULL ON THE WAGON (M) IS ALSO DOUBLED.

3) FOR EVERY ACTION THERE IS A REACTION

WHEN I PUSH A TENNIS BALL, THE TENNIS BALL EXERTS THE SAME FORCE BACK ON ME



FORCE I EXERT ON THE BALL

REACTION FORCE FROM THE BALL ON ME