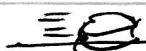


128

HORIZONTAL MOTION (WITHOUT DRAG)

V_{INITIAL}



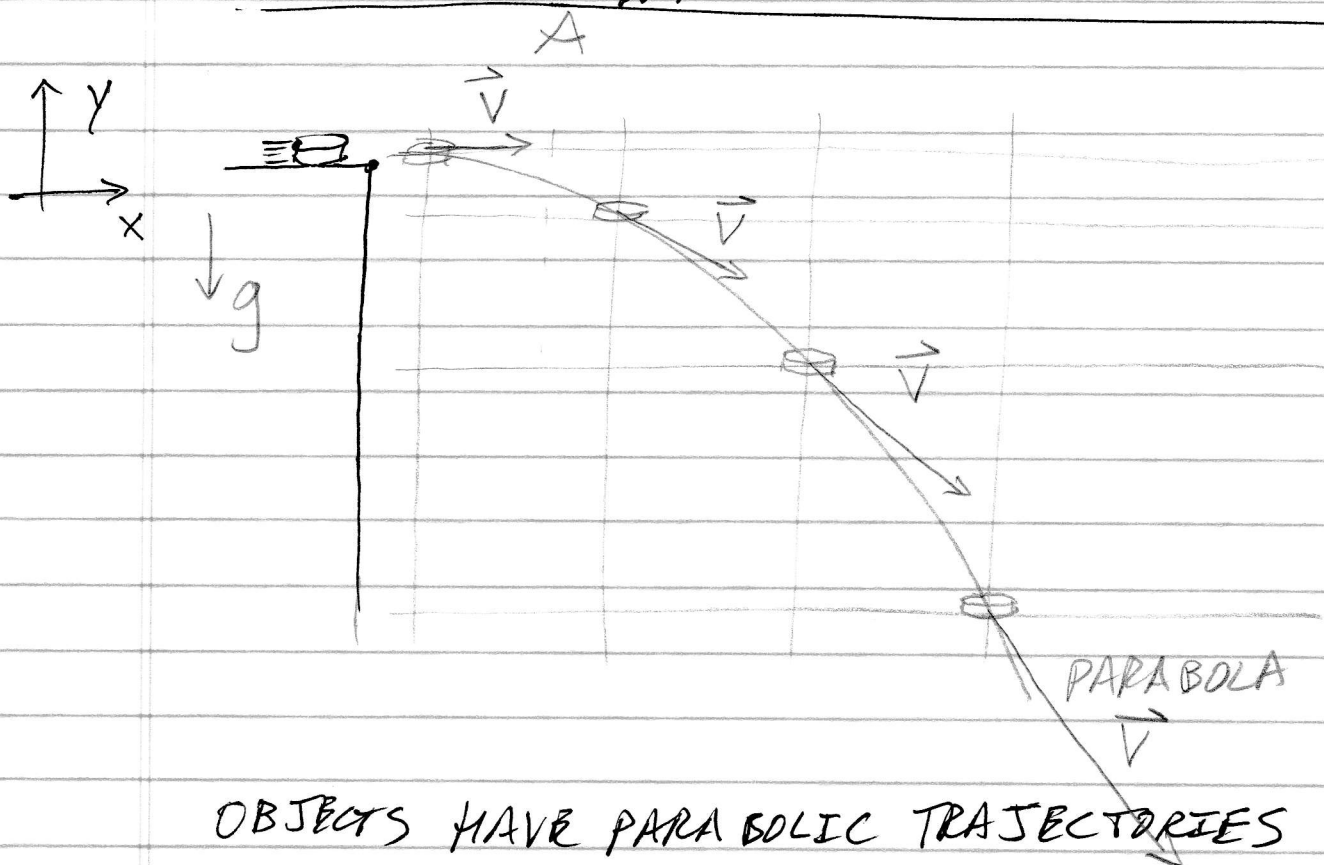
$$a = 0$$

NO FRICTION

$$\Rightarrow V_x = \text{CONSTANT}$$

$$x = x_0 + V \cdot t$$

2 DIMENSIONAL DRAG-FREE PROJECTILE MOTION



OBJECTS HAVE PARABOLIC TRAJECTORIES

$$V_y = V_y - g t$$

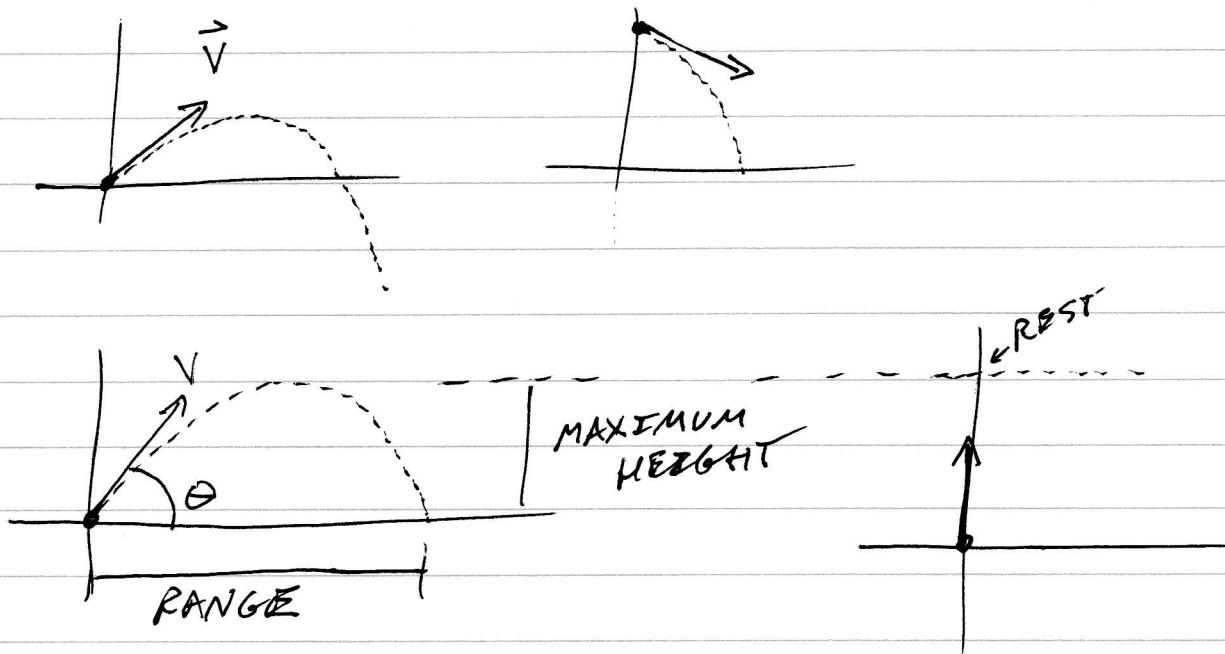
$$V_x = \text{CONST.}$$

$$y(t) = -\frac{1}{2} g t^2$$

$$x(t) = V_{x0} t$$

1-28

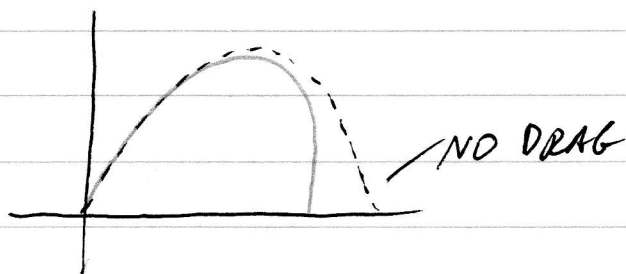
OTHER CASES:



HOW TO GET MAXIMUM RANGE? $\theta = 45^\circ$

IF DRAG IS INCLUDED, THE PROBLEM IS HARDER, BUT

LOOKS LIKE THIS:



WHAT CAUSES MOTION?

IT IS THE NET EFFECT OF FORCES ACTING ON AN OBJECT

AGAINST THE OBJECT'S RESISTANCE TO MOTION, WHICH IS CALLED INERTIA

INERTIA IS THE RESISTANCE OF AN OBJECT TO BEING ACCELERATED. BASED ON ITS MASS.

ARISTOTLE - THE NATURAL STATE OF AN
OBJECT IS REST. ALL OBJECTS
SEEK REST. (WRONG)
(FORCES CAUSE VELOCITY)

GALILEO - THE NATURAL STATE OF AN
OBJECT IS CONSTANT VELOCITY.
(RIGHT)
(FORCES CAUSE VELOCITY TO
CHANGE)
ACCELERATION ✓

NEWTON - 3 LAWS OF MOTION BASED ON
GALILEO'S IDEAS

FORCES

LIST

GRAVITY

FRICTION

⊕ → ELECTRIC FORCES } E & M

N → MAGNETIC FORCES }

MUSCLES PUSHING/PULLING

⊕ → DRAG FLUID OR AIR

→ PRESSURE OR BUOYANCY

EXPLOSION

CONTACT FORCE

ATOMIC

⋮

FUNDAMENTAL FORCES

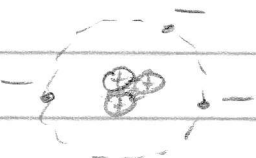
(4)

4th • GRAVITY

2nd • ELECTRO-MAGNET

1st • STRONG ATOMIC

3rd • WEAK ATOMIC



NEWTON'S LAWS OF MOTION

I. "IF THE NET FORCE ON AN OBJECT IS ZERO, ITS VELOCITY WILL BE UNCHANGED."

NET FORCE IS THE RESULTING FORCE.

INCLUDES SIZE AND DIRECTION OF ALL FORCES ON OBJECT.

IF $\vec{F}_{\text{net}} = 0$, ACCELERATION IS ZERO $\vec{a} = 0$

II. "IF THERE IS UNBALANCED NET FORCE, THEN THE OBJECTS ACCELERATES:

- IN DIRECTION OF NET FORCE
- PROPORTIONAL TO THE NET FORCE
- INVERSELY PROPORTIONAL TO MASS."

$$\vec{F}_{\text{net}} = m\vec{a} \quad \text{OR} \quad \vec{a} = \frac{\vec{F}_{\text{net}}}{m} \quad \text{WHERE } F \text{ IS (N)}$$

$m \text{ IS (kg)}$

$$a = \frac{\text{MOTIVATION}}{\text{RESISTANCE}} \quad a \text{ IS } \left(\frac{m}{s^2}\right)$$

ONCE I HAVE ACCELERATION, I CAN FIND VELOCITY AND POSITION AT A LATER TIME

III. "FOR EVERY FORCE OF ONE OBJECT ON ANOTHER, THE OTHER EXERTS AN EQUAL BUT OPPOSITE FORCE ON THE FIRST OBJECT."