Unit#3: Motion

Test Review

Scalars and Vectors

Scalar - magnitude only

ex. 5 m/s

Vector - magnitude <u>and</u> <u>direction</u>

ex. 5 m/s [N]

Distance, Position, Displacement

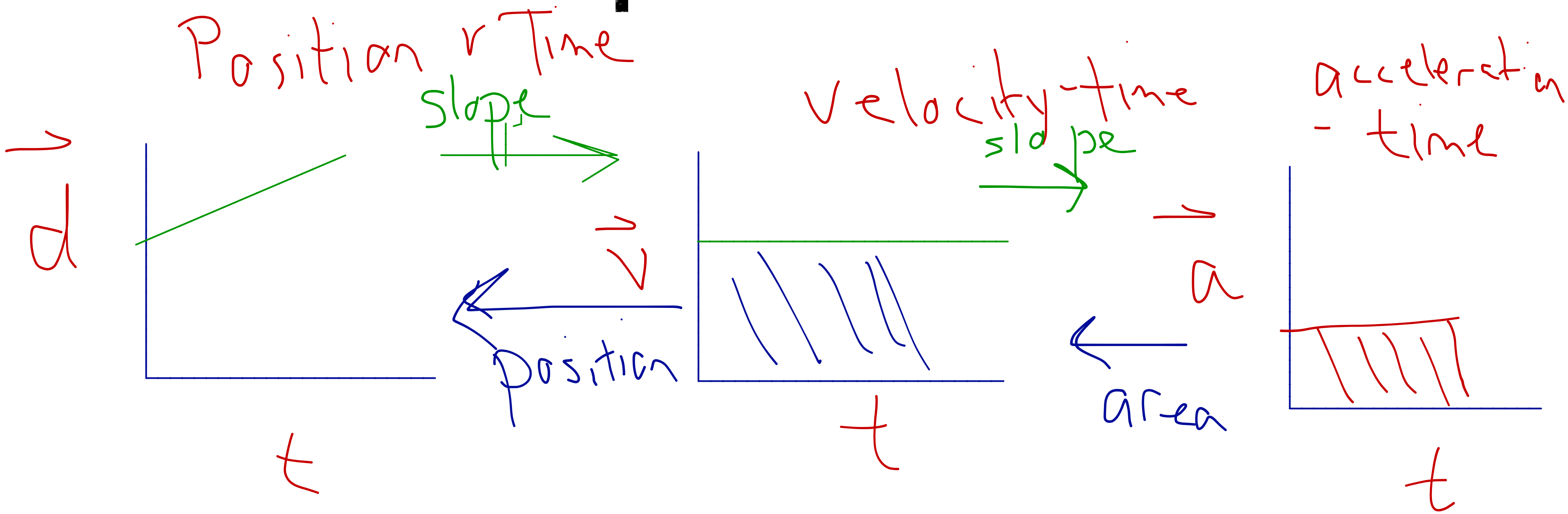
distance (d) – how far an object travelled

Position ($\vec{d}$) – where an object is relative to a reference point

displacement ($\Delta\vec{d}$) – change in position

$\vec{d}_2 - \vec{d}_1$

Motion Graphs



Uniform Acceleration

acceleration is constant

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$$

Mass vs. Weight

Mass - amount of matter in an object

kg

Weight - the Force of gravity on an object

$= \text{mass (kg)} \times 9.8\, m/s^2$

Newton’s Laws of Motion

Inertia

- a property of matter that causes an object to resist changes in its state of motion
- it is directly proportional to the mass of the object

large mass = lots of inertia

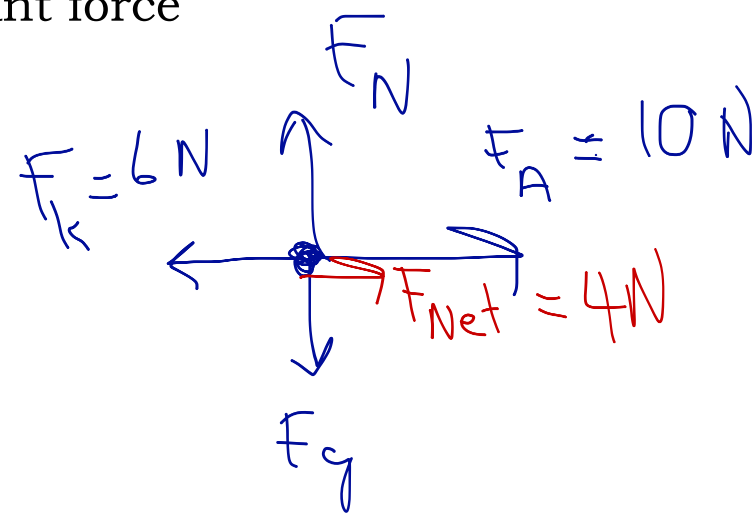
small mass = little amount of inertia

Newton's First Law of Motion: The Law of Inertia

- If the net force acting on an object is zero, the object will maintain its state of rest or constant velocity.
  - objects at rest remain at rest unless acted upon by a net force
  - objects in motion remain in motion unless acted upon by a net force
  - if the velocity of an object is constant (or zero), the net external force acting on it is zero
  - if the velocity of an object is changing either in magnitude, direction, or both, the change must be caused by a net external force acting on the object

Net Forces

- Net Force:
  - the vector sum of all the forces acting on an object
  - also called the resultant force
  - symbol F_{Net}



What is a Newton ?

- Newton:
  - the magnitude of the net force needed to give a 1-kg object an acceleration of 1 m/s^2
  - 1 N = 1 kg x m/s^2

Newton's Second Law of Motion

- If the external net force on an object is not zero, the object accelerates in the direction of the net force. The magnitude of the acceleration is directly proportional to the net force and inversely proportional to the object's mass.

$$\vec{a} = \frac{\vec{F}_{Net}}{m}$$

$$\vec{F}_{Net} = m\vec{a}$$

Pg. 42 #2 b

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

- Calculate the acceleration when a bowler exerts a net force of 18N [forward] on a 7.5 kg bowling ball

Given: $F_{Net} = 18\,N$ [Forward]

$m = 7.5\,kg$

Unknown: $\vec{a}$ = acceleration

Steps: $\vec{a} = \frac{F_{Net}}{m}$

$\vec{a} = \frac{18\,kg\,\frac{m}{s^2}\,[F]}{7.5\,kg}$

$\vec{a} = 2.4\,m/s^2\,[F]$

Pg. 42 #3b

$28 g \div 1000 = 0.028 kg$

- Calculate the net force given that a 28-g arrow has an acceleration of 2.4 x 10^3 m/s^2

Given: $\vec{a} = 2.4 \times 10^3 \frac{m}{s^2}$

$m = 0.028 kg$

Unknown: F_{Net}

Steps

$F_{net} = ma$

$= (0.028 kg)(2400 \frac{m}{s^2})$

$= 67.2 \ kg \frac{m}{s^2}$

$= 67 N$

Pg. 45 #3

- Calculate the net force needed to cause a 1310 kg sports car to accelerate from 0 to 28.6 m/s [forward] in 5.60 s.

Given: $m = 1310\ kg$

$\Delta t = 5.60\ s$

$V_1 = 0\ m/s$

$V_2 = 28.6\ m/s$

Unknown: F_{Net}

Steps: $F_{Net} = ma$

$a = \frac{V_2 - V_1}{\Delta t}$

$\vec{a} = \frac{28.6\ m/s - 0}{5.60\ s}$

$\vec{a} = \frac{28.6\ \frac{m}{s}\ [Forward]}{5.60\ s}$

$\vec{a} = 5.11\ \frac{m}{s^2}\ [Forward]$

$F_{NET} = (1310\ kg)(5.11\ \frac{m}{s^2})\ [F]$

$= 6690\ N\ [Forward]$

Newton's Third Law of Motion

- For every force, there is a reaction force equal in magnitude but opposite in direction
- When applying Newton's Third law, the action and reaction forces will appear on separate FBDs. Since they appear on separate FBDs, they are not added together.

Friction

- force that opposes motion or attempted motion.

Static - not moving

$$\mu_s = \frac{F_s}{F_N}$$

$$F_s = \mu_s F_N$$

Kinetic - moving

$$\mu_k = \frac{F_k}{F_N}$$

$$F_k = \mu_k F_N$$

Class / Home Work

Pg 65 #1-12 (Tuesday)

Pg 65 #14

Pg 66-67 #1, 5-7, 10-13, 17