

## Motion, Acceleration, and Forces

- 1) Motion - movement of something, which is dependent on a frame of reference.
- 2) Displacement - is the distance and direction of an object's final position from its initial position.
- 3) Vector - quantity that specified by both a size and a direction of an object.  $\xrightarrow{8\text{ m/s}} \text{East}$
- 4) Speed - distance an object travels per unit of time.  
 $s = 4\text{ m/s}$
- 5) Instantaneous speed - speed at a single instant of time.
- 6) Average speed - total distance traveled divided by the total travel time.
- 7) Velocity - speed and direction of an object.

### 8) Calculation (Velocity)

Example #1

$$V = \underline{\quad\quad} \quad d = 200\text{ m} \quad t = 5.00\text{ s}$$

$$V = \frac{d}{t} = \frac{200\text{ m}}{5.00\text{ s}} = \boxed{40.0\text{ m/s}}$$

Example #2

$$V = 10.0\text{ mi/hr} \quad d = \underline{\quad\quad} \quad t = 5.00\text{ hr}$$

$$V = \frac{d}{t} \quad d = (V)(t) = (10.0\text{ mi/hr})(5.00\text{ hr}) = \boxed{50.0\text{ mi}}$$

Exempl. #3

$$V = 9.00 \text{ m/s}$$

$$d = 9000 \text{ m} \quad t = \underline{\hspace{2cm}}$$

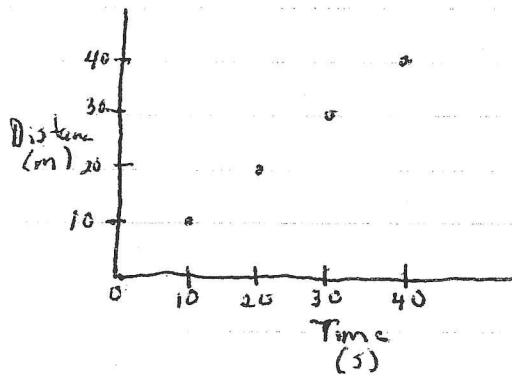
$$V = \frac{d}{t}$$

$$t = \frac{d}{V} = \frac{9000 \text{ m}}{9.00 \frac{\text{m}}{\text{s}}} = \left( \frac{9000 \text{ m}}{1} \right) \left( \frac{\text{s}}{9.00 \text{ m}} \right) = \boxed{1000 \text{ s}}$$

9) Graphing motion

Data

Time	Distance
0s	0m
10s	10m
20s	20m
30s	30m
40s	40m



10) Acceleration -

Change in velocity divided by the time involved in the change of velocity, or a change in direction.

11) Calculations (Acceleration)

$$\bar{a} = \frac{V_F - V_I}{\Delta t}$$

$\bar{a}$  = aver. acceleration

$V_F$  = Final Velocity

$V_I$  = Initial Velocity

$\Delta t$  = change in time

Example #1 (Positive Acceleration)

$$\bar{a} = \underline{\hspace{2cm}} \quad V_F = 25 \text{ m/s} \quad V_I = 15 \text{ m/s} \quad \Delta t = 5 \text{ s}$$

$$\bar{a} = \frac{V_F - V_I}{\Delta t} = \frac{25 \text{ m/s} - 15 \text{ m/s}}{5 \text{ s}} = \frac{10 \text{ m/s}}{5 \text{ s}} = \left( \frac{10 \text{ m}}{\text{s}} \right) \left( \frac{1}{5 \text{ s}} \right) = 2 \frac{\text{m}}{\text{s}^2}$$

Example #2 Deceleration (Negative Acceleration)

$$\bar{a} = \underline{\hspace{2cm}} \quad V_F = 50 \text{ m/s} \quad V_I = 100 \text{ m/s} \quad \Delta t = 5 \text{ s}$$

$$\bar{a} = \frac{V_F - V_I}{\Delta t} = \frac{50 \text{ m/s} - 100 \text{ m/s}}{5 \text{ s}} = \frac{-50 \text{ m/s}}{5 \text{ s}} = -10 \frac{\text{m}}{\text{s}^2}$$

Example #3

$$\bar{a} = 5 \text{ m/s}^2 \quad \Delta V = 20 \text{ m/s} \quad t = \underline{\hspace{2cm}}$$

$$\bar{a} = \frac{\Delta V}{\Delta t} \quad \Delta t = \frac{\Delta V}{\bar{a}} = \frac{20 \text{ m/s}}{5 \frac{\text{m}}{\text{s}^2}} = \left( \frac{20 \text{ m}}{\text{s}} \right) \left( \frac{\text{s}^2}{5 \text{ m}} \right) = \boxed{4 \text{ s}}$$

Example #4

$$\bar{a} = 10 \text{ m/s}^2 \quad V_F = \underline{\hspace{2cm}} \quad V_I = 2.0 \text{ m/s} \quad \Delta t = 5.0 \text{ s}$$

$$\bar{a} = \frac{V_F - V_I}{\Delta t}$$

$$(\Delta t)(\bar{a}) = \frac{V_F - V_I}{\Delta t} (\Delta t)$$

$$(\Delta t)(\bar{a}) + V_I = V_F + V_I + V_I$$

$$V_F = (\Delta t)(\bar{a}) + V_I$$

$$V_F = (\Delta t)(\bar{a}) + V_I$$

$$= (5) \left( \frac{10 \text{ m}}{\text{s}^2} \right) + 2.0 \text{ m/s}$$

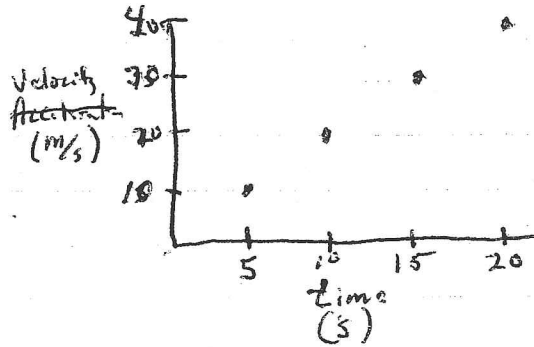
$$= 50 \frac{\text{m}}{\text{s}} + 2.0 \text{ m/s}$$

$$= 52 \text{ m/s}$$

12) Graphing acceleration

Data

time	Velocity
0s	0m/s
5s	10m/s
10s	20m/s
15s	30m/s
20s	40m/s



13) Force - any push or pull on an object measured in Newtons (N).

14) Net Force - When 2 or more forces acts on a object at the same time.

15) balanced forces - Forces on an object that are equal in size and opposite in direction.

16) Unbalanced Forces - Forces combine to produce a net force that is not zero, the forces acting on the object

Example:

$$\begin{array}{c} 5N \rightarrow 5N \rightarrow \\ \hline F_{\text{Net}} = 10N \end{array}$$

$$\begin{array}{c} 5N \rightarrow \leftarrow 5N \\ \hline F_{\text{Net}} = 0N \end{array}$$

$$\begin{array}{c} 10N \rightarrow \leftarrow 5N \\ \hline F_{\text{Net}} = 5N \end{array}$$

$$F_{\text{Net}} = 10N$$

$$F_{\text{Net}} = 0N$$

$$F_{\text{Net}} = 5N$$

17) Friction - the force that opposes the sliding motion of two surfaces that are in contact.

18) Types of Friction:

1) Sliding Friction - Force that acts in the opposite direction to the motion of a surface sliding on another surface.

2) Static Friction - Frictional force that prevents two surfaces in contact from sliding past each other.

3) Rolling Friction - Force due to one surface rolling over another.

4) Fluid Friction - Force due to one surface going across or through a fluid.  
Note: Fluid - liquid or gas

19) Terminal Velocity - the velocity at which an object becomes constant when falling in a gravitational field. The object accelerates at  $9.8 \text{ m/s}^2$  until air resistance slows it down.

20) Calculation (Force)

$$F = m a$$

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

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

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$m = \text{mass (kg)}$

$a = \text{Acceleration } \text{m/s}^2$

## Problems

- 1) What is the velocity of a 650g object traveling 400m in 20.0 seconds?
- 2) How long does it take an object traveling 60.0 mi/hr for a distance of 12000 miles?
- 3)  $V = 0.65 \text{ Ft/s}$      $d = \underline{\hspace{2cm}}$      $t = 2.00 \text{ hr.}$
- 4) How much does an object accelerate when the velocity changes 6.0 m/s in 3.0 seconds?
- 5) What is the acceleration of a car going from 20 m/s to 5.0 m/s in 2.0 seconds?
- 6) If the acceleration of an object is  $10.0 \text{ m/s}^2$  with a initial velocity 1.00 m/s and final velocity 19.0 m/s, how long will it take?
- 7) What is the resulting velocity of a plane traveling 450 mi/hr south and flies into a 50 mi/hr wind traveling south?
- 8) What is the net force of an object moving east with 4000 N and another object moving into it west with 8000 N of force?