(*) clicker questions FBD 1) A 2) A 3) D constant $\vec{v}$ has to have forward force if F_f is not slowing it down

Conclusions: 4) B initial F_A gone after initial so only drag force diminishes

1) An object will accelerate in the direction of the net force.

2) Acceleration is directly proportional to the net force on an object.

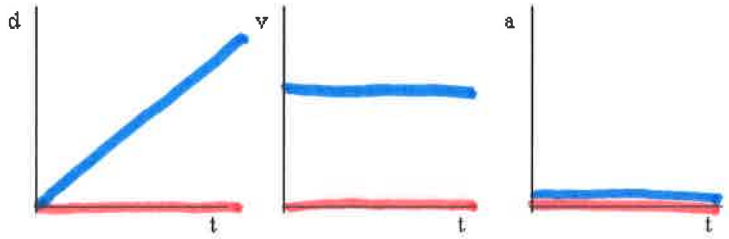
3) Acceleration is inversely proportional to the mass of an object.

$$a = \frac{F_{NET}}{m}$$

Balanced Forces

If all the forces acting on an object are balanced,

1) $\vec{a} = 0\ m/s^2$
2) constant $\vec{v}$ or at rest
3) in equilibrium
4) $\Sigma F = 0N$ or $F_{NET} = 0N$



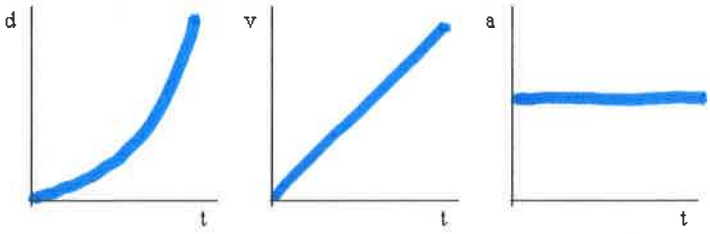
— at rest

— constant $\vec{v}$

Unbalanced Forces

If all the forces acting on an object are **not** balanced,

1) $\vec{a} \neq 0\ m/s^2$
2) accelerating
3) not in equilibrium
4) If F_{NET} is constant + not zero, then $\vec{a}$ is constant



Newton's Second Law of Motion:

$\vec{a} = \frac{F_{NET}}{m}$ $\quad \vec{a} \propto F_{NET}$ or ΣF $\quad \vec{a} \propto \frac{1}{m}$

Variable:	$\mathbf{F_{net}}$	**m**	**a**
Quantity:	net force resultant force	mass	acceleration
Units:	$Kg \cdot \frac{m}{s^2} = N$ Newton	Kg	m/s^2
Type:	vector	scalar	vector

Write the unit for force in terms of fundamental units:

$1N = 1Kg \cdot 1\frac{m}{s^2}$ or $F = ma$

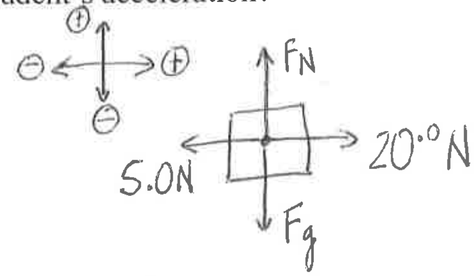
1) A net force of 100. N (F) acts west on a 5.0 kg (m) mass. Determine the magnitude and direction of the acceleration of the mass.

$\vec{a} = \frac{\vec{F}}{m}$ $\quad \frac{100.N}{5.0Kg} = 20.\frac{m}{s^2}$ west

2) A 1.6 -kg box (m) is accelerated at 2.0 m/s^2 ($\vec{a}$). Determine the magnitude of the net force.

$F = ma = (1.6Kg)(2.0\,m/s^2) = 3.2N$

3) An 80. kg student is pulled on roller blades by a friend who exerts a force of 20.0 N. Friction between the wheels and the ground exert a force of 5.0 N. What is the student's acceleration?



$\vec{a} = \frac{F_{NET}}{m}$ $\quad \frac{(20.0N + -5.0N)}{80.0kg}$ $\quad 0.19 \frac{m}{s^2}$

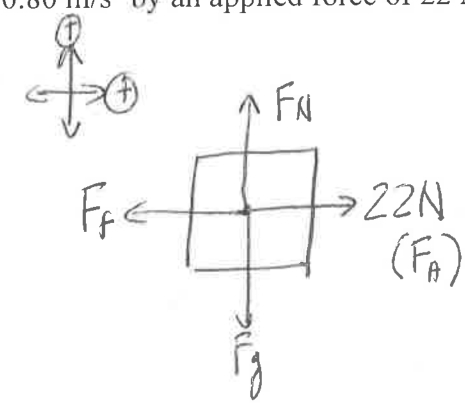
4) A 1000. kg car accelerates from rest to 20. m/s in 5.0 seconds. What net force acts on the car?

m $\quad V_i \quad V_f \quad t$

$\vec{a} = \frac{V_f - V_i}{t} = \frac{20. m/s - 0 m/s}{5.0 s}$ $\quad F = ma$

$F = (1000. kg)(4.0 m/s^2) = 4.0 \times 10^3 N$

5) A 15.0 kg crate is dragged across the floor with an acceleration of 0.80 m/s² by an applied force of 22 N. How much friction is acting on the crate?



$F_{NET} = F_A + F_f + F_N + F_g = ma$ ($F_N + F_g$ crossed out: 0N)

$F_{NET} = (15.0 kg)(0.80 m/s^2) = 12N$

$F_{NET} - F_A = F_f$

$12N - 22N = -10N = F_f$

Mass and Weight

Mass: measure of amount of matter
mass is related to an object's inertia

Property: same everywhere

Weight: a measure of the amount of gravitational force on an object

Property: varies by location

Relationship between mass and weight: $F = ma$ $F = mg$ ↓ $W = mg$

Variable:	$\mathbf{F_g}$	**g**
Quantity:	1) gravitational force or 2) weight	1) acceleration due to gravity 2) gravitational field strength
Units:	N	m/s^2 or N/kg
Type:	vector	vector

Estimation Skills - some common masses and weights:

Penny = 3 grams (0.003 kg) | 1 kilogram mass = 2.2 pounds | 1 apple = 1 newton

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1. What is the weight of a 1.0 kilogram mass:

a) here on Earth? $g = 9.8\ m/s^2$

$F = mg$

$F = (1.0kg)(9.8\frac{m}{s^2}) = 9.8N$

b) In deep space?

$g = 0\ \frac{m}{s^2}$

then $F = 0N$

weightless

2. What is the mass of a 1.0 N apple:

a) here on Earth?

$m = \frac{F}{g} = \frac{1.0N}{9.8\frac{m}{s^2}} = 0.10kg$

b) In deep space?

0.10kg

mass stays the same