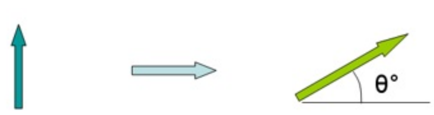
PHYSICS 2204
UNIT 2: DYNAMICS
STUDY GUIDE 1

Dynamics	The study of the different forces that produce different types of motion.
Force	• is a push or a pull exerted on an object • measured in Newtons • vector quantity (magnitude, units ans direction) • 1N is approximately 100g There are Four major types of forces 1) Gravitational 2)STRONG Nuclear Force 3)WEAK Nuclear Force 4) Electric and Magnetic Forces
Mechanical Forces	involve contact with an object. Include such things as: 1) Buoyant 2) Magnetic 3) Gravity and Friction 4) Static 5) Elastic 6) Friction
Mass	• measurement of the amount of matter something contains • is measured in kilograms or grams • of an object doesn't change when an object's location changes • is a scalar quantity
Weight	• is the measurement of the pull of gravity on an object (Newtons). • force of gravity • measured in Newtons • vector qunaity • changes with location • formula is : • Weight = force of gravity $W = F_g = mg$ • The gravitational accelerations of earth is $g = 9.81\ m/s^2$ • slope of a weight versus mass graph gives the acceleration due to gravity
Vectors	• quantity has direction and magnitude  • Direction is illustrated by arrowhead • Magnitude is illustrated by length of line segment and is the amount of push or pull • Vectors are added head to tail

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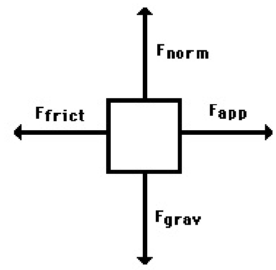
<td>Free Body Diagram</td>
<td>When drawing an FBD,
(i) the object is drawn as a simple shape
(ii) arrows are drawn outward from the object to represent the force vectors.

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<td>Normal Force</td>
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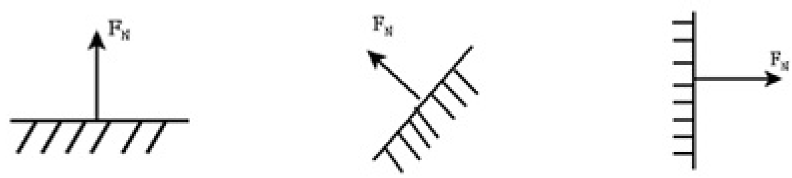
the force that surfaces exert to prevent solid objects from passing through each other.
The normal force is always perpendicular to the surface.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<td>Net Force:</td>
<td>is the vector sum of all the individual forces acting upon an object. A net force may be the result of one more forces. Combing forces may also be referred to as

Unbalanced Force (F_{un})
or
Net Force (F_{net})
or
Resultant Force (F_R)

For Linear forces Linear forces, those acting in a straight line, The Forces be simply added arithmetically.

$$F_{net} = F_1 + F_2 + F_3 + ...$$

Free body diagrams are very useful in determining the number of forces in calculating the net force

There are two ways to classify the Net forces acting on an object:

1) Balance Forces ($F_{net} = 0$) : No acceleration

2)Unbalance Forces ($F_{net} \neq 0$) : Acceleration</td>
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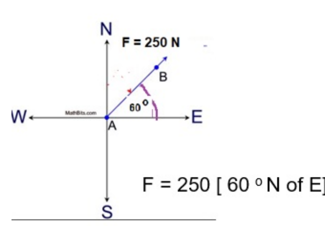
<td>Navigation Method</td>
<td>method commonly used to show direction for vector quantities in two dimension: using compass bearings north [N], south[S], east [E] and west [W] to identify direction.

To draw this vector, start with the second compass bearing you are given in the square brackets and then move the angle in the direction of the first bearing you are given.

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<td>Splitting forces into its components</td>
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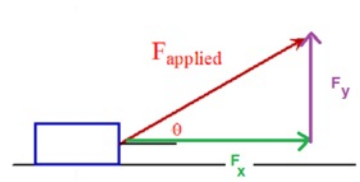
If a force F is directed at an angle of θ with the horizontal, then the horizontal (F_x) and vertical (F_y) components are calculated as follows:



$F_x = F \cdot \cos\theta$ And $F_y = F \cdot \sin\theta$

- As the angle from the x-axis increases (steeper), x-component decreases & y-component increases.
- As the angle from the x-axis decreases (less steep), x-component increases & y-component decreases.
- At an angle of 45 °, the F_x component is equal to the F_y component of the force
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<td>Apparent Weight (Effective Weight)</td>
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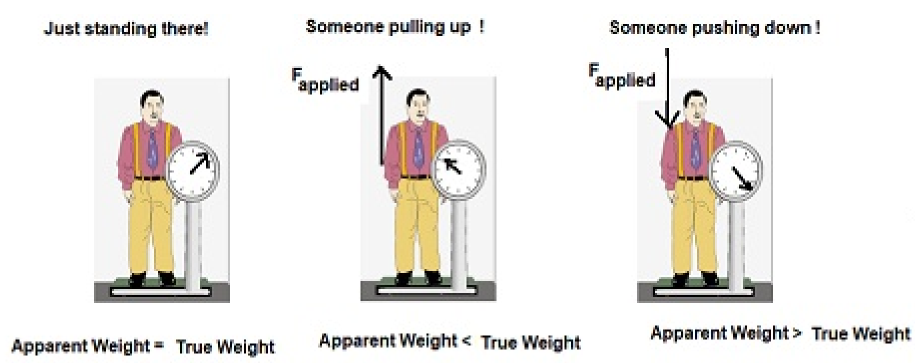
a property of objects that corresponds to how heavy an object is. The apparent weight of an object will differ from the weight of an object whenever the force of gravity acting on the object is not balanced by an equal but opposite normal force. It is the reading you get on a scale. The apparent weight is equals to normal force.



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<td>Newton's 1st Law (Law of inertia)</td>
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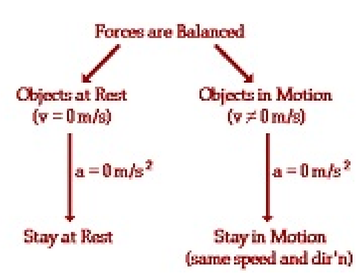
Objects at rest will remain at rest, and objects in motion will remain in motion at a constant speed in a straight line, unless an unbalanced force acts on them.



Inertia is that quantity which is solely dependent upon mass. The more mass which an object has, the more inertia it has - the more tendency it has to resist changes in its state of motion.
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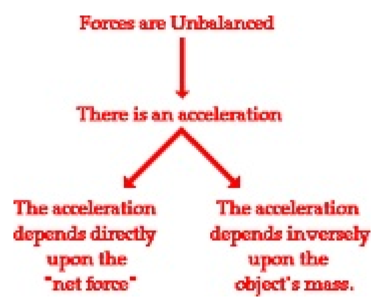
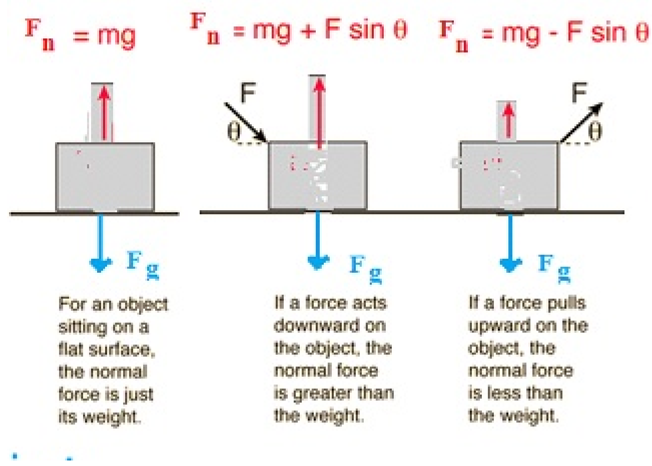
Frame of Reference	is a place from which motion is observed An inertial frame of reference is one in which Newton's First Law is valid. When there is no motion or When there is uniform motion (A Non-Inertia frame of reference is one where Newton’s First Law is NOT Valid. There is acceleration involved in a non- inertia reference frame
Newton's 2nd Law	When an unbalanced force acts on an object, it will accelerate. Its acceleration depends directly on the force, and inversely on the object's mass. $$a = \frac{F_{Net}}{m}$$ 
Newton's 3rd Law (Action reaction Law	When object A exerts a force on object B, then object B exerts the same amount of force back on object A. For every action force there is an equal and opposite reaction force. $$\mathbf{F}_{\mathbf{A\ on\ B}} = -\mathbf{F}_{\mathbf{B\ on\ A}}$$ There are two important things to point out: (1) the minus sign indicates that the directions are opposite. (2) there are two objects and the so-called "action" and "reaction" forces act on different objects (namely each other).
Problem Solving with Newton’s Laws	• Identify the physical principles involved by listing the givens and the quantities to be calculated. • Sketch the situation, using arrows to represent all forces. • Determine the system of interest. The result is a free-body diagram that is essential to solving the problem. • Apply Newton’s second law to solve the problem. If necessary, apply appropriate kinematic equations from the chapter on motion along a straight line. • Check the solution to see whether it is reasonable.

Normal Force or Apparent Weight	Three ways to calculate normal force 
Friction Force	Friction is a force that opposes motion. Two types of friction: 1. Static Friction(– force that tries to keep an object at rest. 2. Kinetic Friction – force that tries to stop a moving object. $F_{fr} = \mu F_N$ Where: µ(mu)= coefficient of friction (no units) F_N =normal force (Newton's)