Vector Nature of Force (Section 2.1 in text)

A **force** is a push or a pull on an object (F). It is a vector quantity so it has magnitude and direction too. If I can get a 1 kg object accelerating at a rate of 1 m/s^2, then I am exerting 1 Newton (N) of force.

$$1\ N = 1\ kg \bullet m/s^2$$

Kinematics (and the related formulas) is the study of motion. It concerns itself with displacement, velocity and acceleration.

Dynamics is the study of why things are in motion and takes forces into consideration .

Mechanics is the branch of physics that is concerned with kinematics and dynamics.

Fundamental Forces in Nature

Over the years, physicists have discovered only 4 fundamental forces found in the universe. These are:

1) Gravity – the attraction between any 2 masses. Earth's mass is so huge that it's force of attraction is quite noticeable and important in our lives. (F_g represents the force of gravity)
2) Electromagnetism – the attraction or repulsion between 2 electrically charged particles.
3) Strong nuclear force – this is responsible for keeping atomic nuclei together.
4) Weak nuclear force – this one governs radioactive decay of nuclei.

Contact Forces & Free Body Diagrams (FBD)

We create forces all the time when we directly push and pull on objects. Other than gravity (a fundamental, non-contact force), we will mostly be dealing with contact forces. There are 6 affects that force can have on an object:

- Speed up an object	- Start an object moving	- Make an object change direction
- Slow down an object	- Stop a moving object	- Deform or change shape of object

Obviously a force on an object has an effect. To analyze the effect a force or multiple forces will have, it is necessary to create a labeled diagram. **Free-Body Diagrams (FBD**) are a way of representing all the forces acting on an object. FBD's are a necessary step in solving dynamic problems.

Typical forces on FBD's. → Applied Force - $\vec{F}_{app}$

→ Normal Force – $\vec{F}_N$ – force that acts on an object perpendicular to the surface on which it is resting

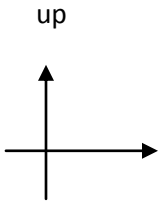
→ Force of Gravity – $\vec{F}g$

Drawing a FBD

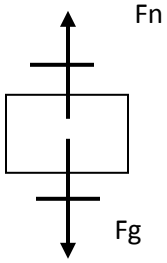
- Establish reference coordinates (NSEW…or up/down, right/left etc.)
- Represent the object as a simple circle or square. Do not dry a realistic sketch.
- From the centre of the circle or square, draw the force vectors.
- Label the force vectors with the magnitude.

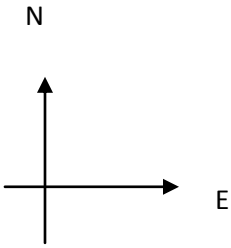
** Do not show forces that the *FBD object exerts* on other objects.

We will practice some drawings below.

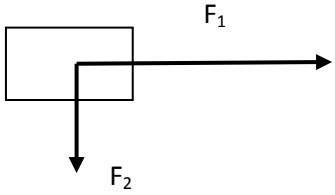


Pencil sitting on a desk





2 dogs pulling a bone. One pulling east is pulling harder than one pulling south.



If you know the size of the force, label the vector with this information.

Adding Force Vectors (look at pages 61-63)

Remember that forces are vectors. You will add them just like displacement or velocity vectors.

Remember: Collinear (1D) vectors are added mathematically as integers (+/-)

Non-collinear (2D) vectors are added graphically, tail-to-tip. Simplify the vectors into a triangle and use Pythagorean and trigonometry (SOH CAH TOA) to solve.