Grade 11 Notes April 6th to 10th, 2020

Hello everyone. Included in this download are the notes I would like you to review for this week. They include

1. Forces

2. Force of Gravity

3. Normal Force

4. Force of Friction

You don't have to do all in one day. Space it out over the week.

On Thursday this week I will post an assignment that will test you on these concepts. This assignment will be due the next Wednesday April 15th.

This is the schedule I hope to keep ~ Monday Notes (except next week when it will be Tuesday as Monday is Easter) Thursday Assignment, the next Wednesday Submit Assignment.

Be sure to submit your Very Voracious Vectors assignment. I have created an assignment link on the google classroom for both so you can submit it here. If you have already done so, don't submit again. Or submit a blank page and I will give you your mark on the assignment.

Any questions email me please. I have uploaded a zipped pdf version of the textbook to my website www.misstakken.weebly.com if you don't have yours.

Forces

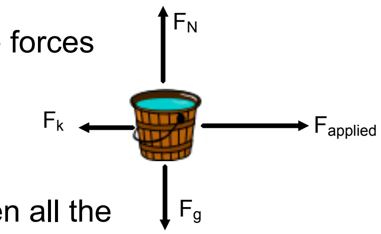
A force is a push or a pull in a particular direction. Force is a vector quantity, symbol F and is measured in Newtons (N)

Forces speed objects up, slow objects down, push objects around corners, up hills or hold them still.

Free Body Diagrams

A **Free Body Diagram** (FBD) is a drawing of just the object being analyzed, not the entire situation. The diagram shows all the forces acting on that object not the forces the object is putting on other things.

Example: A pail is pushed across the floor. Show all the forces acting on the pail.

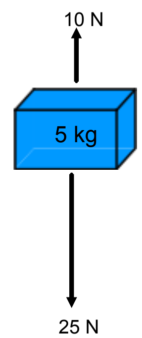


Net Forces

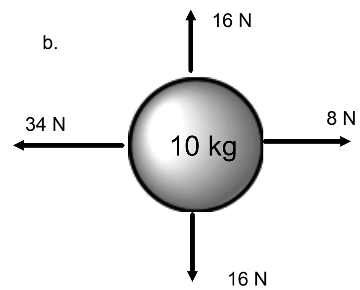
The net force is the overall force acting on an object when all the components are added together taking into consideration direction.

Example: Find the net force in the following scenarios.

a.



b.



Here $F_{net} = 34 - 8$

$F_{net} = 26$ N [Left]

The up and down forces are balanced so they have no vertical net force component.

Here $F_{net} = 25 - 10$

$F_{net} = 15$ N [Down]

Acceleration from Net Force

According to Newton's 2nd Law $F_{net} = ma$. So if we know the net force on an object by finding the sum of all forces, and we are given the mass we can also determine the acceleration. Note the acceleration of an object is always in the same direction as the net force.

Example: Find the acceleration of the objects in the previous example.

a. $a = F_{net}/m$

$a = 15/5$

$a = 3$ m/s^2 [Down]

b. $a = F_{net}/m$

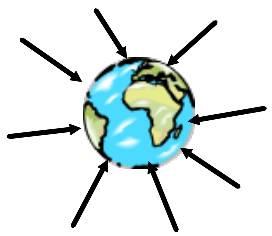
$a = 26/10$

$a = 2.6$ m/s^2 [Left]

Now you try pg 146 # 36

Force of Gravity

One force we experience constantly is the **force of gravity**, which is a force of attraction between all objects. The force of gravity between Earth and objects at or near its surface is directed towards the Earth's centre. This direction is referred to as vertically downward.



The force of gravity is an **action-at-a-distance** force. This means that contact between the two surfaces is not needed for the force to be present.

F_g is extremely small unless at least one of the objects is very large. F_g between a pen and a desk is negligible, between the pen an the Earth large and between the Earth and the Moon huge.

The force of gravity is measured using the equation

$$F_g = mg$$

Where m is the mass and g is the acceleration due to gravity (9.8 m/s^2 on Earth). The value of g changes depending on your location in the universe. For example on the moon the acceleration due to gravity (or sometimes called the gravitational field strength) is 1.6 m/s^2 and on Saturn it is 10.44 m/s^2. It varies with location. However, we can assume it stays constant on Earth at 9.8 m/s^2.

Example: What is F_g on a 10 kg bag of flour? $F_g = mg$
$F_g = 10x9.8$
$F_g = 98$ N [Down]

This is also known as the weight of the object. The terms weight and force of gravity are the same. When discussing weight in physics we don't mean mass we mean force of gravity. Your weight can change from location to location in the universe because g is not constant but your mass is always the same.

Now force of gravity is only dependent on mass and the gravitational field strength. However, it looks like objects fall at different rates due to air resistance slowing some objects down more than others. But if we remove air resistance the all object accelerate at the same rate, regardless of mass.
Watch this video to see what I mean. https://www.youtube.com/watch?v=E43-CfukEgs

When the force of gravity when you are falling is balanced by an upward force like air resistance or thrust you can achieve "weightlessness" or zero gravity. You are still falling but not acceleration any more.

Watch this video to see what I mean. https://www.youtube.com/watch?v=k3xSYRa9G0g

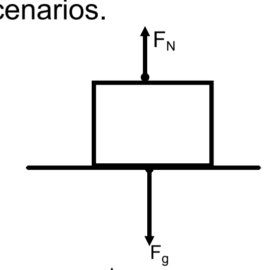
<u>The Normal Force</u>

When an object on your desk it at rest, gravity pulls the object down. But the object must also experience an opposing force to balance the force of gravity (otherwise) we'd all sink to the centre of the Earth). The opposing force is the desk pushing back on the object upwards. This type of force is called the **normal force**. The normal force always acts perpendicular to the surfaces of the objects in contact. Contact has to occur. If the objects are not touching the surface the normal force does not exist.

Most of the time it is a reaction to gravity but really it is a reaction to all perpendicular forces acting to a surface on an object. Symbol F_N.

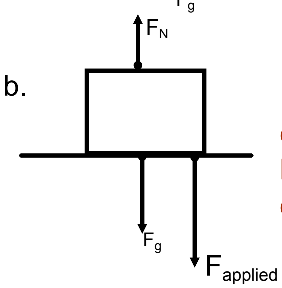
Example: Determine the what the normal force is equal to in the following scenarios.

a.



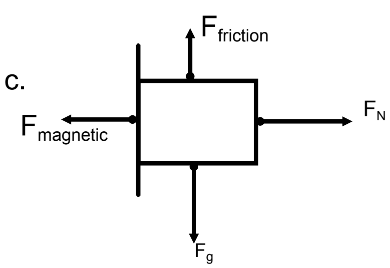
Here $F_N = F_g$ in size but is going in the opposite direction. So $F_N = F_g$ [Up]

b.



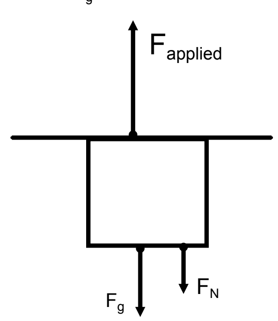
Here $F_N = F_g + F_{applied}$ in size but is going in the opposite direction. So $F_N = F_g + F_{applied}$ [Up]. This scenario would happen if someone was pushing down on the box or sitting on top of it. They would provide the applied force.

c.



Here $F_N = F_{magnetic}$ in size but is going in the opposite direction. So $F_N = F_{magnetic}$ [Right]. This scenario would happen if someone was sticking a paper to the whiteboard using a magnet. Gravity is balance by friction so the paper doesn't slide down the board but the normal force is perpendicular (90^o) to the board so it must balance the magnetic force.

d.



Here $F_N = F_{applied} - F_g$ in size but is going out from the surface, so down. This scenario would happen if someone was holding an object against the ceiling. Gravity still goes down so you must counteract with an applied force up. If you push harder the ceiling will push down with a force to balance the subtraction of gravity from applied force.

Now you try pg 182 # 32, 35, 36, 37, 38

Force of Friction

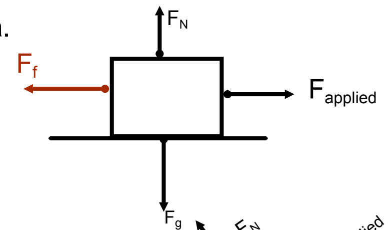
Friction is another force caused by objects in contact. Friction acts in a way that opposes the motion of an object (or attempted motion) and is parallel to the surfaces in contact. F_f

If an object is stationary we have **static friction** F_{fs} (the friction needed to keep an object from moving).

If an object is moving we have **kinetic friction** F_{fk} (the force that acts against the motion).

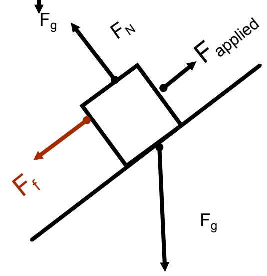
Example: Draw the arrow for the friction in each scenario.

a.



Here the friction goes against the motion supplied by the applied force. You don't need an applied force for friction to be present. Can be sliding to a stop.

b.



Here the friction goes against the applied force parallel to the surface which is called an inclined plane (hill). Notice gravity still goes straight down and the normal force is perpendicular to the surface. If the object was sliding down the hill the friction would go up the hill.

To calculate the friction on an object we need to know the value of its normal force (usually gravity but not always) and the value of the coefficient of friction. The coefficient of friction is a number is depends on the surfaces in contact. For example ice has a lower coefficient of friction than sandpaper. The coefficient of friction has no units (just a number) and is represented by the symbol µ (greek letter mu). It is always between 0 and 1.

The formula for friction is $F_f = \mu F_N$

Example: Find the value of the force of friction on a 20 kg object being pushed right on a horizontal surface with a coefficient of friction of 0.2.

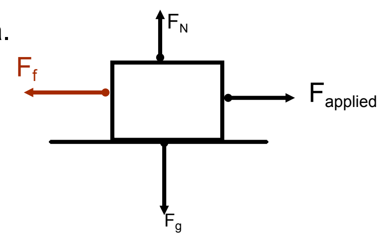
$F_f = \mu F_N$

$F_f = 0.2 \times 20 \times 9.8$

$F_f = 39.2$ N [L]

Here $F_N = mg$ as it is on a horizontal surface and no one is pushing up or down on the object.

a.



Now you try pg 173 # 3

Check the google classroom site on Thursday for this week's assignment quesitons.