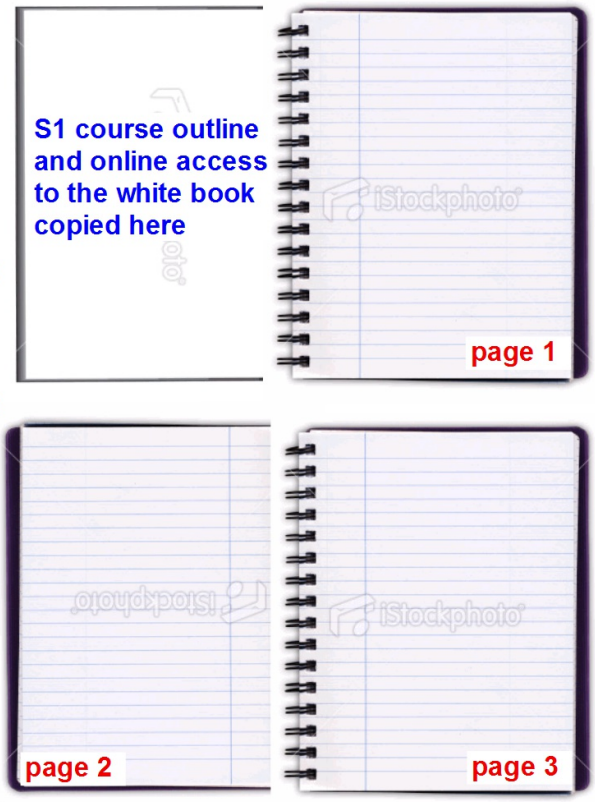
Semester 1
SIPI info

use colored pencils or markers to group, divide, seperate, or highlight seperate ideas as I have

this is your main resource for this class, like a hard copy of google, but you must practice using it to understand what is in here, where it is, and how to use it

number pages 1-60 in the SIPI
to save those pages for the year

the beginning part of the SIPI will have written information to use as a resource



the later part of the SIPI will have 3-D projects to help organize some of the processes and ideas we use

measurement	symbol	common units	abreviation
distance	d	meter	m
time	t	second	s
speed	s	meters per second	m/s
velocity	v	meters per second	m/s
acceleration	a	meters per second per second	m/s^2 or m/s/s
force	F	newton	N
mass	m	kilogram	kg
weight	W	newton	N
pressure	Pr	pascal	Pa
momentum	p	kilogram meter per second	kgm/s
Work	W	Joule	J
Power	P	Watt	W
Energy	KE, PE	Joule	J
frequency	f	Hertz (cycles per second)	Hz
wavelength	λ	meters	m
charge	q	Coulomb	C
potential difference	V	volt	v
current	I	ampere	A
resistance	R	ohm	Ω

page 1

prefix chart

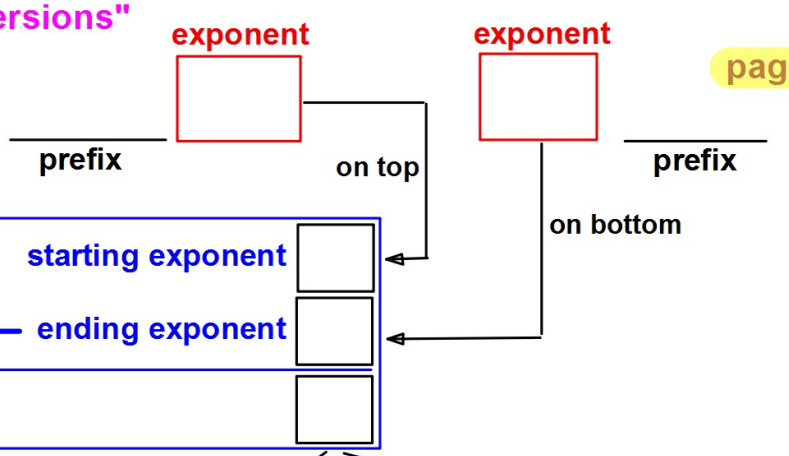
if there is only 1 letter,
it is just a unit!
if there are 2 letters,
the first is the prefix!

Prefix	*Symbol*	*Exponential*
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deca	da	10^{1}
1 letter	unit alone	10^{0}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

page 2

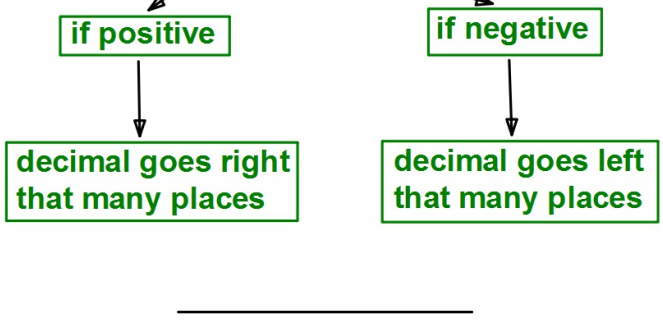
"Flowmap for prefix conversions"

step 1: determine starting and ending exponents



step 2: subtract starting and ending exponents

step 3: move decimal



Format for Scientific Notation

to write in SN: place the decimal with 1 number to the left and then count back to the original spot to get the exponent

this is the format for Scientific Notation

the exponent on the 10 means which direction and how far the decimal moves to show the real number
positive is right, negative is left

small numbers get negative exponents

7.121×10^{9}

large numbers get positive exponents

only one number to the left of the decimal

all others to the right (except trailing zeros)

factor label converstion format

8 m/s to km/hr

$$\frac{8\ \text{m}}{\text{s}}$$

$$\frac{8\ \cancel{\text{m}} \quad 1\ \text{km}}{\text{s} \quad 1000\ \cancel{\text{m}}}$$

convert m to km, m/m cancels

$$\frac{8\ \cancel{\text{m}} \quad 1\ \text{km} \quad 60\ \cancel{\text{s}}}{\cancel{\text{s}} \quad 1000\ \cancel{\text{m}} \quad 1\ \text{min}}$$

convert s to min, s/s cancels

$$\frac{8\ \cancel{\text{m}} \quad 1\ \text{km} \quad 60\ \cancel{\text{s}} \quad 60\ \cancel{\text{min}}}{\cancel{\text{s}} \quad 1000\ \cancel{\text{m}} \quad 1\ \cancel{\text{min}} \quad 1\ \text{hr}}$$

convert min to hr, min/min cancels

multiply by everything on top, divide by everything on the bottom

$$\frac{8\ \cancel{\text{m}} \quad 1\ \text{km} \quad 60\ \cancel{\text{s}} \quad 60\ \cancel{\text{min}}}{\cancel{\text{s}} \quad 1000\ \cancel{\text{m}} \quad 1\ \cancel{\text{min}} \quad 1\ \text{hr}} = 28.8\ \text{km/hr}$$

explain/describe for yourself these key terms:

scalar quantity

vector quantity

resultant vector

net force

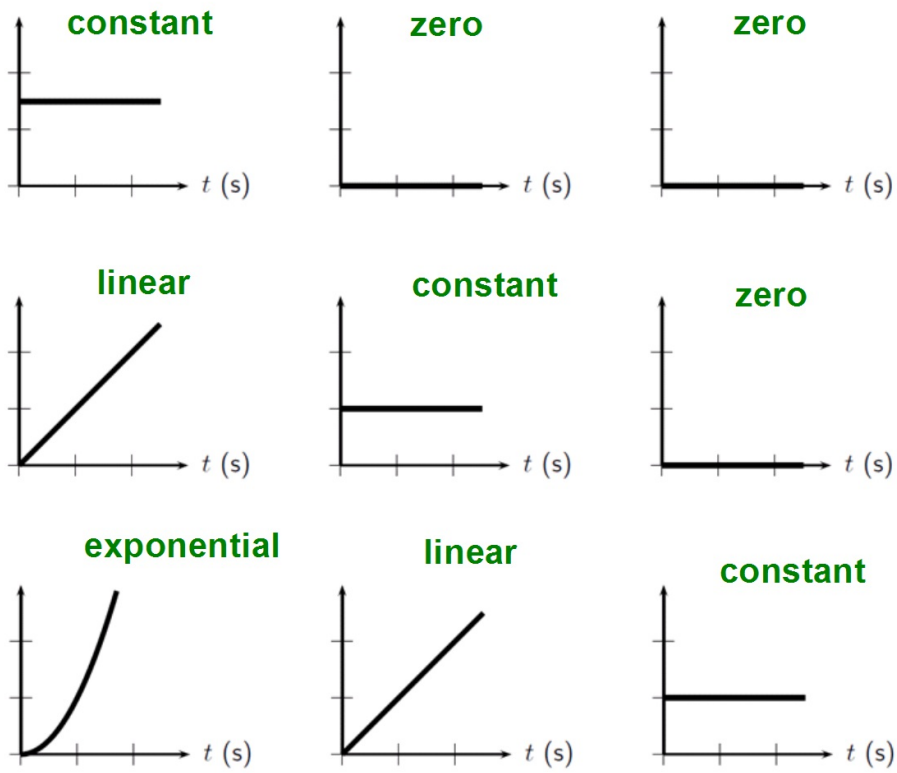
directly proportional

inversely proportional

next time we check your SIPI we expect to see explanations and definitions for these terms, not just these terms!

position/velocity/acceleration vs time graphs

	position	velocity	acceleration
no motion	constant	zero	zero
uniform motion	linear	constant	zero
motion with constant acceleration	exponential	linear	constant



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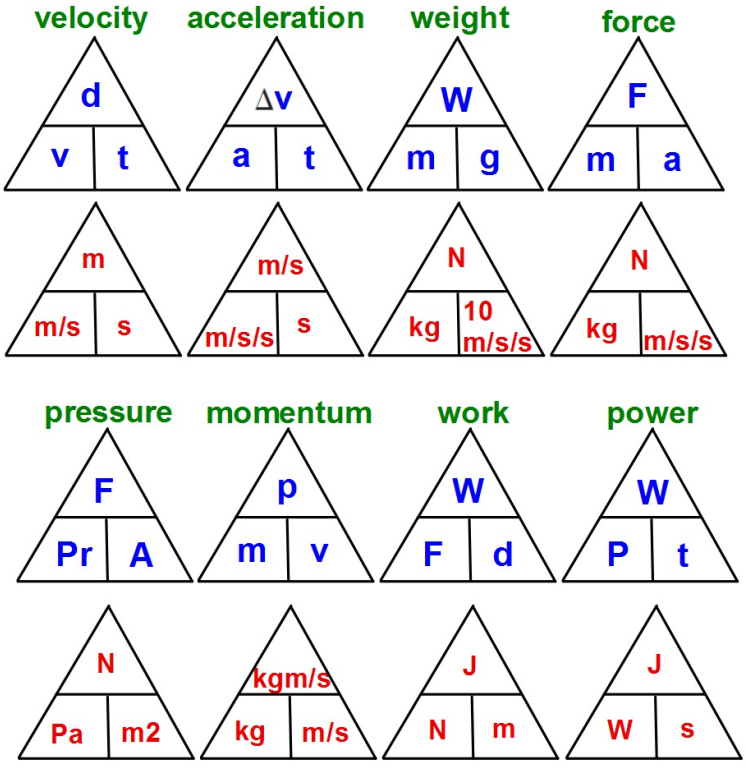
Semester 1 triangle formulas



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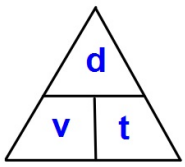
summary of ch 4 - linear motion

given 2, find the 3rd
distance, time, average velocity



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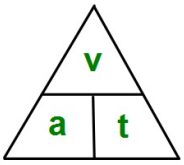
given 2, find the 3rd
acceleration, time, average velocity



distance $d = \frac{1}{2} at^2$ $\Delta v = v_{final} - v_{initial}$

acceleration due to gravity $g = 10\ m/s^2$

falling velocity $v = 10t$ falling distance $d = 5t^2$

velocity is speed with direction

velocity is a change in distance per time

acceleration is a change in velocity which means change in speed or direction

most important idea of chapter 5 - projectile motion

THE 2 COMPONENTS OF A VECTOR ARE COMPLETELY INDEPENDENT OF EACH OTHER

page 10

CHANGING ONE COMPONENT WILL NOT CHANGE THE OTHER

gravity will change the vertical component of a thrown ball but will have nothing to do with the horizontal component

projectiles thrown at different horizontal speeds will still fall with gravity exactly the same

the best launch angle for distance is 45 degrees

launch angles that add to 90 degrees will land in the same spot

big idea for chapter 3

Summary of Newton's 1st Law

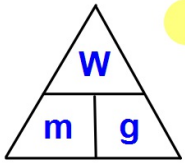
page 11

mass is the amount of matter and is the same everywhere

W - weight

m - mass

g - acceleration due to gravity



weight is a force and depends on gravity

1 kg = 10 N = 2.2 lbs

Inertia is based on mass

Inertia means resisting change in motion

which means changing speed or direction

which means changing velocity

which is acceleration

which requires a non-zero net force

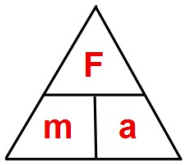
friction is a force and acts opposite the direction of motion

big idea for chapter 6

Newton's 2nd Law

page 12

acceleration and mass are inversely related



acceleration and force are directly related

forces cause accelerations in the direction of the net force

terminal velocity - maximum fall speed

force of gravity down matches force of air resistance up

speed is constant, acceleration is zero, net force is zero

Chapter 7 summary - Newton's 3rd Law

forces come in pairs equal and opposite

you kick a ball, the ball pushes your foot

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if you push a door with 100 N, it pushes back on your hand with 100 N

a raindrop falling from the sky is pulled down by the earth but also pulls up on the earth with the same force

2 objects react to the same force in different ways

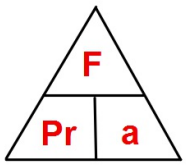
large mass means small acceleration

small mass means large acceleration

Pressure

pressure is force per unit area

$$\text{pressure} = \frac{\text{force}}{\text{area of application}} \qquad P = \frac{F}{A}$$



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the unit for pressure is the pascal, seen as Pa

if you spread the same weight over a larger area, each piece feels less pressure

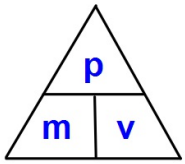
a steak knife on its side won't have enough pressure to cut a steak

if you shrink the area holding the same weight, each piece feels more pressure

a steak knife on end can focus that force with lots of pressure

Chapter 8 summary - Momentum

momentum (P) is mass in motion, and defined as mass x velocity



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if an object bounces, the impulse is larger

$$\text{impulse} = \text{change in momentum}$$
$$Ft = \Delta(mv)$$

if the ΔP takes a short time, the forces are larger

if the ΔP takes a long time, the forces are smaller

P is always conserved when there are no external forces acting
this means total P before = total P after

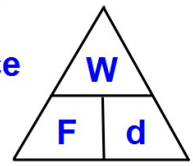
inelastic - objects may deform, connect, and/or generate heat

elastic - objects collide without being permanently deformed and without generating heat

Ch 9 - Work, Power, Energy

Work - is defined as force x distance

the unit of work is the Joule



Work = ΔE

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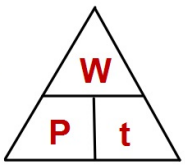
Power is the rate at which work is done

the unit for power is the Watt



units of energy are also Joules

if an object is moving, it has Kinetic Energy $\text{KE} = \frac{1}{2}mv^2$

energy of position is Potential Energy $\text{PE} = mgh$

the law of conservation of energy says that energy cannot be created nor destroyed, only transfered with no net loss or gain

efficiency is the ratio of $\frac{\text{useful work output}}{\text{total work input}}$

Ch 10 - Circular Motion

rotation - axis is inside the object

revolution - axis is outside the object

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centripetal force - inward force that holds objects into circular motion

centrifugal force - fictional assumed outward force of objects moving in a circle

linear/tangental speed - the instantanious ratio of distance per time

rotational/angular speed - counting revolutions per unit time

kids on a merry go round have different linear speeds but the same rotational speed

Ch 12 - Rotational Motion

rotational inertia:

how easy or hard it is to change an object's rotational speed

depends on the location of the mass

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further from the center is harder, closer to the center is easier

Ch 13 - Universal Law of Gravitation

gravitational force comes from mass

anything with mass has an attracting force of gravity

$$F = \frac{Gm_1m_2}{d^2} \qquad m_1 = \frac{Fd^2}{Gm_2} \qquad d = \sqrt{\frac{Gm_1m_2}{F}}$$

$$G = 6.67 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$$

that force is directly proportional to the masses

m x 2 means F x 2 m / 3 means F / 3

that force is inversely proportional to the square of the distance

d x 2 means F / 4 d / 3 means F x 9

Semester 2

S2 formulas will go on this page, so leave room

number pages 1-40 in the SIPI
to save those pages for the year

front cover

S1 course outline is written here if you had me first semester

page 1

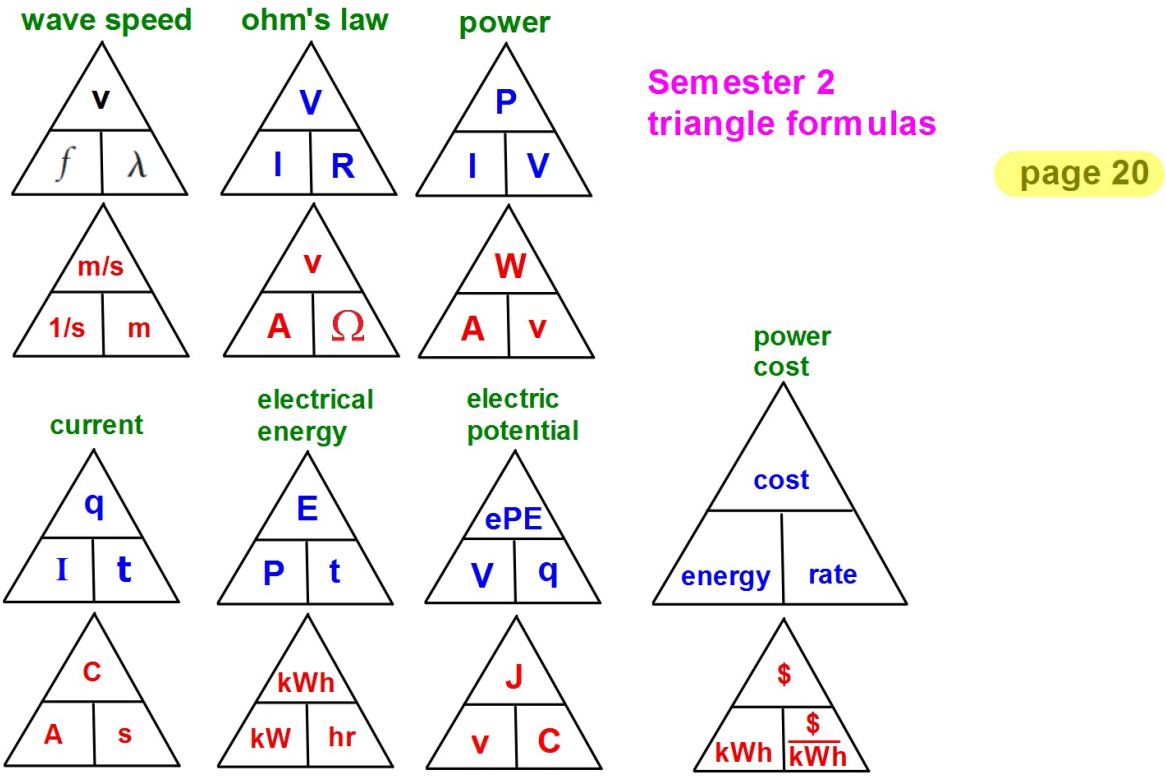
page 2

page 3

back cover

S2 course outline gets copied here

S2 course outline also explains access to the white book online



Semester 2
triangle formulas

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ch 25 - waves

constructive interference - 2 waves combine to make a larger wave

destructive interference - 2 waves combine to make a smaller wave

node - the part of a standing wave that never seems to move from rest position because the waves continually cancel each other out

atinode - peaks and troughs of a standing wave where the amplitude is the greatest due to constructive interference

The Doppler Effect - a percieved change in frequency due to motion of the source

in front of the source, wavelength is shorter, pitch is higher

behind the source, wavelength is longer, pitch is lower

Pitch is wavelength. Volume is amplitude.

when a source is traveling faster than the waves it makes, and is outside the ripples, it makes a bow wave (2D)/shock wave (3D)

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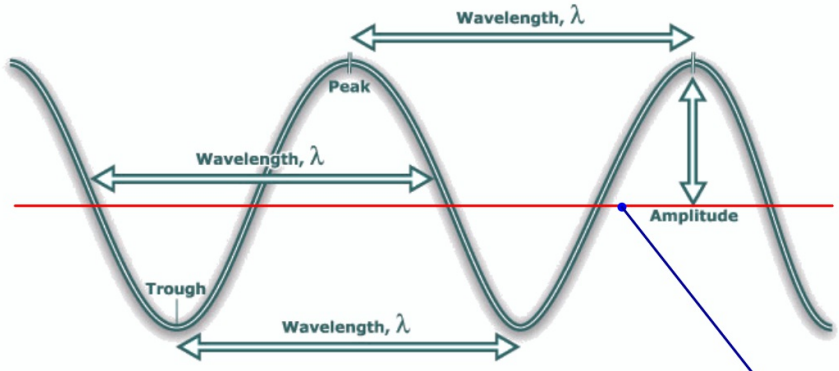
ch 25 Parts of a transverse wave (medium moves perpendicular)



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crest/peak - high point **trough - low point** **midpoint (rest position)**

amplitude - distance from rest to crest

wavelength - distance between identical parts of consecutive waves

period - one complete cycle of a wave without repeating

period is seconds per cycle

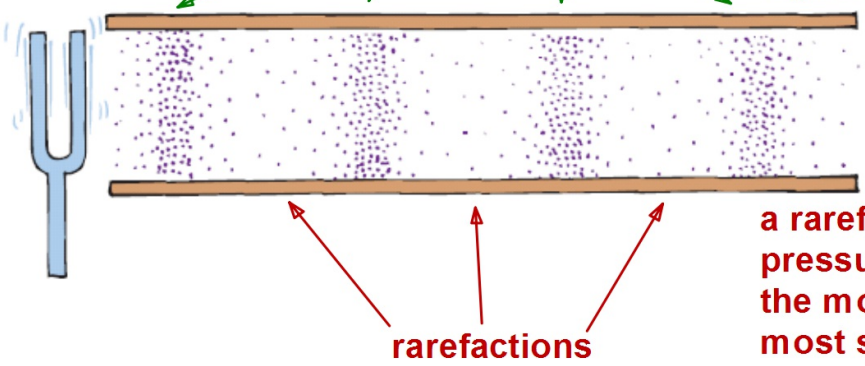
$$\text{period} = \frac{1}{\text{frequency}}$$

frequency - # of cycles per unit time

unit is Hertz (Hz) - cycles per second

$$\text{frequency} = \frac{1}{\text{period}}$$

ch 25 Parts of a longitudinal wave (medium moves parallel)



a compression is high pressure area where the molecules are most squeezed together

a rarefaction is the low pressure area where the molecules are most spread apart

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amplitude is the difference between how squeezed and how spread

a longitudinal wave also has wavelength, period, and frequency

ch 27 - light and EM waves

all EM waves come from vibrating charged particles and travel at the speed of light 300,000 km/s

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radio waves ← long wavelength, low frequency, low energy
microwaves
infrared waves
visible light waves
ultraviolet waves
x-rays
gamma rays ← short wavelength, high frequency, high energy

sound needs a medium to travel, light does not

3 types of materials waves can encounter
- transparent - almost fully transfered
- transluscent - partially transfered
- opaque - fully blocked

ch 29 summary - reflection, refraction

reflection - when a wave reaches a boundary between 2 mediums, it can partially or fully bounce back

the law of reflection says the angle of incidence = angle of reflection

real image - appears in front of the surface of reflection

virtual image - appears behind the surface of reflection

diffuse reflection - when the surface bumps are large compared to the waves, they will bounce randomly instead of predictably

refraction - when a wave changes medium, it changes speed, changes wavelength, frequency stays the same

if speed increases - it bends away from the normal

if speed decreases - it bends toward the normal

dispersion - each color has slightly different wavelengths, frequencies, and velocities so when refracted, they don't bend the same and seperate (prism, rainbow)

the critical angle is the angle of incidence that causes the ray to be refracted parallel to the boundary (perpendicular to the normal)

farther than the critical angle causes total internal reflection

ch 31 summary - diffraction

diffraction - waves bending around an object or through an opening

waves that are large compared to the object, bend more

waves that are small compared to the object , bend less

iridescence - light bouncing off 2 close surfaces can appear colorful by destructive interference canceling certain color wavelengths

ch 32 summary - electrostatics

an atom has a nucleus in the center, made of neutrons with no charge and positively charged protons. Negatively charged electrons orbit around the nucleus

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law of conservation of charge - charges can be moved, shared, gained, or lost but are never created or destroyed

like charges repel, opposite charges attract

Coulomb's Law - the force between 2 charges is directly proportional to the size of the charges but inversely proportional to the square of the distance between them

$$F = k \frac{q_1 q_2}{d^2}$$

k is the electrical proportionality constant - $k = 9.0 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$

the SI unit of charge is a coulomb, shortened by "C"

3 ways to charge an object - contact, friction, induction

ch 33 summary - electric fields and potential

electric field lines represent electric fields and show the direction of force on a positive test charge, away from positive, toward negative

charges are always evenly distributed on the surface of objects and the charge in the center remains zero

page 28

electric potential energy is the energy an object has due to its location in an electric field

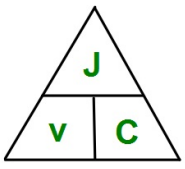
doing work to move a charge into a field gives it energy

Work = ΔE

electric potential is electric potential energy per charge

$$\text{electric potential} = \frac{\text{electrical potential energy}}{\text{charge}}$$

$$1 \text{ volt} = 1 \frac{\text{joule}}{\text{coulomb}}$$



the SI unit for electric potential is the volt

ch 34 - electric current

resistance (R) is the opposition to current flow and measured in ohms (Ω)

current (I) is the flow of charge and measured in amperes (A)

potential difference (V) is the pressure that causes current to flow and is measured in volts (v)

Ohm's Law:
voltage = current x resistance
$V = I \times R$
1 volt (v) = 1 amp (A) x 1 ohm (Ω)

we need a difference in potential at either end of a conductor for current to flow

alternating current (AC) simply moves charges back and forth page 29

direct current (DC) charges move 1 direction from a finite supply

our power grid is AC with a potential difference of 120 v and a frequency of 60 Hz

electric power is the rate at which electrical energy is converted to other forms of energy

power = current x voltage
$P = I \times V$
1 Watt (W) = 1 amp (A) x 1 volt (v)

we are charged for power by the kilowatt-hour

Ch 35 main ideas - circuits

a basic circuit needs a voltage source, resistor, and complete path

series circuit	parallel circuit
only 1 path	multiple paths page 30
all on or all off	individual control of branches
shared power so things get dimmer as added and brighter as taken away	each branch maintains its own source of power, unaffected by other branches
uses less power and is cheaper	uses more power, more money
Ohm's Law for Series Circuits $V_t = I \times R_t$	Ohm's Law for Parallel Circuits $V_t = I \times R_t$
Current is the same everywhere	Voltage is the same at each branch
Total resistance is the sum of each resistor $R_t = R_1 + R_2 + \ldots$	Total current is the sum of current at each branch $I_t = I_1 + I_2 + \ldots$
Voltage is divided proportionally among each resistor $V_1 = I \times R_1$, $V_2 = I \times R_2$	$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
total resistance will be LARGER than any 1 resistor	total resistance will be SMALLER than any 1 resistor

Ch 36 - Magnetism

magnetic forces are similar to electric forces but you cannot isolate their poles so if you break a magnet, you get 2 smaller magnets

magnets are surrounded by magnetic fields which we represent with magnetic field lines drawn from north to south on the outside of the magnet

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charges need to be moving to create magnetic fields

orbiting or spinning electrons produce magnetic fields

each spinning electron is a tiny magnet, but the material isn't a magnet unless those domains work together

an electric current produces a magnetic field

a current carrying wire will have a circular magnetic field around it

all you need to make an electromagnet is a battery, coil of wire, and potentially magnetic material

ch 37 - electromagnetic induction

magnets can produce electricity and electricity can produce magnets

electromagnetic induction - inducing voltage and current by changing the magnetic field around a conductor

page 32

moving a coil of wire near a magnetic field will induce voltage and current...a current carrying wire produces a magnetic field

more loops or faster movement will create more voltage but require more force

motors and generators are made of the same things but the transfer of energy is opposite directions

a motor inputs electrical energy as current flowing through wires, which create magnetic fields, interact with a permanent magnet, and create forces and output mechanical energy

a generator inputs mechanical energy, uses that force to turn a coil of wire in a magnetic field which cretates flowing current and outputs voltage and electric energy

ch 37 - transformers

they are made of a primary and secondary coil wrapped around the same iron core

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transformers increase (step up) or decrease (step down) voltage through electromagnetic induction

current in the primary coil makes the core magnetic, which causes current flow in the secondary coil

the ratio of wraps from the primary coil to the number of wraps on the secondary coil is the same ratio for the voltage transformation

transformers modify voltage but power stays the same so current will adjust and is inversely proportional to voltage

$$\frac{\text{primary voltage}}{\text{number of primary turns}} = \frac{\text{secondary voltage}}{\text{number of secondary turns}}$$

Nuclear

nuclear reactions are based on the idea that mass = energy

adding energy to particles is adding mass, losing energy is losing mass

there are 2 types of nuclear reactions:

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fission is when a heavy atom is broken apart into 2 light atoms, mass is lost, energy is released

common fuels for fission are uranium and plutonium

nuclear power plants use fission to generate heat to create steam pressure

fusion is when 2 light atoms fuse together, mass is lost, energy is released. It starts with the lightest of atoms, hydrogen.

stars in the sky burn fuel and expel energy and light by fusion

as atoms fuse in a star and give off energy, they turn hydrogen into the other atoms in our universe

page 40 - scientific notation foldable