

- Exam Questions????
- International System of Units

International System of Units (SI):

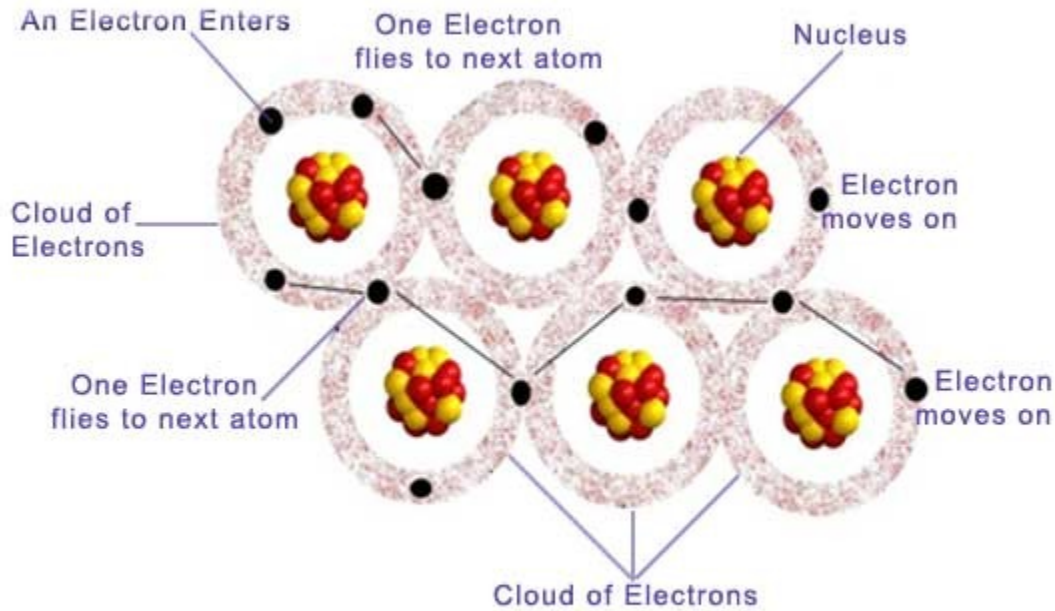
Prefix		Base	Decimal	English word	Typical Usage
Name	Symbol	10			
<u>yotta</u>	Y	<u>10<sup>24</sup></u>	1000000000000000000000000	septillion	
<u>zetta</u>	Z	<u>10<sup>21</sup></u>	100000000000000000000000	sextillion	
<u>exa</u>	E	<u>10<sup>18</sup></u>	100000000000000000000000	quintillion	
<u>peta</u>	P	<u>10<sup>15</sup></u>	100000000000000000000000	quadrillion	
<u>tera</u>	T	<u>10<sup>12</sup></u>	1000000000000	trillion	National Debt
<u>giga</u>	G	<u>10<sup>9</sup></u>	1000000000	billion	R, F, P
<u>mega</u>	M	<u>10<sup>6</sup></u>	1000000	million	R, F, P
<u>kilo</u>	k	<u>10<sup>3</sup></u>	1000	thousand	R, F, P, V, I
<u>hecto</u>	h	<u>10<sup>2</sup></u>	100	hundred	
<u>deca</u>	da	<u>10<sup>1</sup></u>	10	ten	
		<u>10<sup>0</sup></u>	1	one	
<u>deci</u>	d	<u>10<sup>-1</sup></u>	0.1	tenth	
<u>centi</u>	c	<u>10<sup>-2</sup></u>	0.01	hundredth	
<u>milli</u>	m	<u>10<sup>-3</sup></u>	0.001	thousandth	C, L, I, V
<u>micro</u>	μ	<u>10<sup>-6</sup></u>	0.000001	millionth	C, L, I, V
<u>nano</u>	n	<u>10<sup>-9</sup></u>	0.000000001	billionth	C, I, L
<u>pico</u>	p	<u>10<sup>-12</sup></u>	0.000000000001	trillionth	C, I
<u>femto</u>	f	<u>10<sup>-15</sup></u>	0.000000000000001	quadrillionth	
<u>atto</u>	a	<u>10<sup>-18</sup></u>	0.000000000000000001	quintillionth	
<u>zepto</u>	z	<u>10<sup>-21</sup></u>	0.000000000000000000001	sextillionth	
<u>yocto</u>	y	<u>10<sup>-24</sup></u>	0.000000000000000000000001	septillionth	

Prefixes adopted before 1960 already existed before SI. 1873 was the introduction of the CGS system.

[https://en.wikipedia.org/wiki/International\\_System\\_of\\_Units](https://en.wikipedia.org/wiki/International_System_of_Units)

C= Capacitance . F= frequency, L = inductance, V = voltage, I = Current.

- Electricity is Flow of electrons driven thru the valence (outer) band of the atoms of a conductor :



## Drifting of an Electron from Atom to Atom

Figure 1: Representation of the flow of electricity in atoms

<https://www.electrical4u.com/images/february16/1455958135.jpg>

- Electrical Units of measure.
  - Amp I Current, Flow of 1 coulomb ( $6.24 \times 10^{18}$  electrons) per second. Note relationship of Charge and current.
  - Volts: V Electrical Potential: electric potential difference, electric pressure or electric tension is the difference in electric potential between two points pushes charged electrons (current) through a conducting loop. A. Electric current of one ampere AT 1 VOLT IS one watt of power . B. 1 Amp into 1 Farad capacitor will charge the capacitor to 1 Volt IN 1 SECOND.
  - Watt: W Rate of work done. 1 volt at 1 Amp is 1 Watt. 746 Watts is 1 horse power. Also Voltage squared divided by resistance

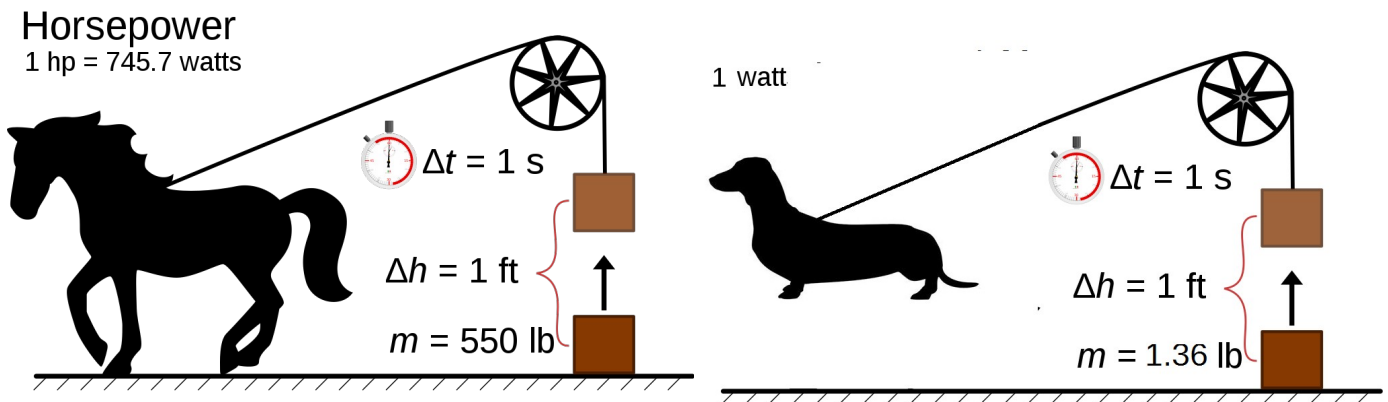


Figure 2: Comparison of a horse power and a watt

- Ohm:  $\Omega$  measure of Resistance or opposition to the flow of electric current. 1 amp through 1 ohm will result in 1V
- Wait for cranium to cool down. Now AC stuff
- Reactance:  $X_{AC}$  The voltage across a capacitor or inductor divided the current through it. This is the same equation as resistance.
- Impedance:  $Z$  Impedance extends the concept of resistance to alternating current accounting for reactance in combination with resistance. Complex impedance is stated as  $R \pm jX$  where  $jX$  is the reactive part.
- Henry:  $L$  Inductance changing current induces a voltage. Opposes change of current. henry (H), which is the amount of inductance that causes a voltage of one volt, when the current is changing at a rate of one ampere per second.  $E = L * dI/dT$ . With an increase in frequency reactance goes up.

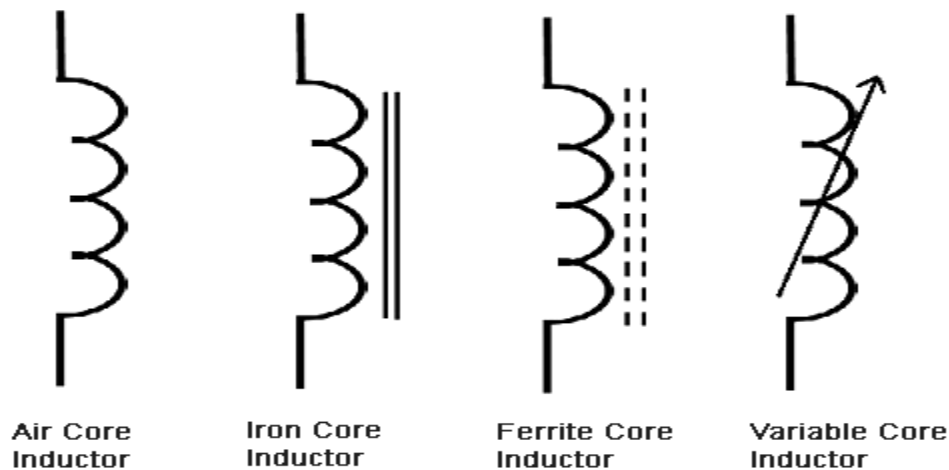


Figure 3: Schematic symbols for an inductor

- Farad:  $C$  Capacitance A capacitance of one farad (F) means that one coulomb of charge on each conductor causes a voltage of one volt. A capacitor opposes change in Voltage ,  $I=C*dV/dT$ . Or with an increase in frequency reactance goes down.

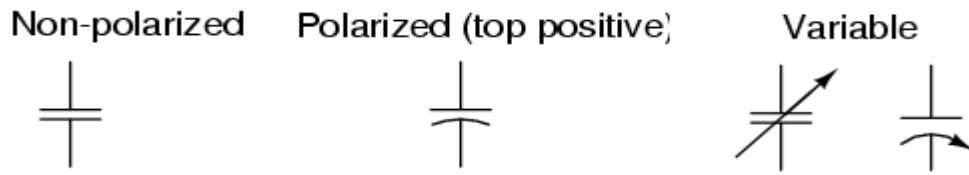


Figure 4: Schematic symbols for a capacitor

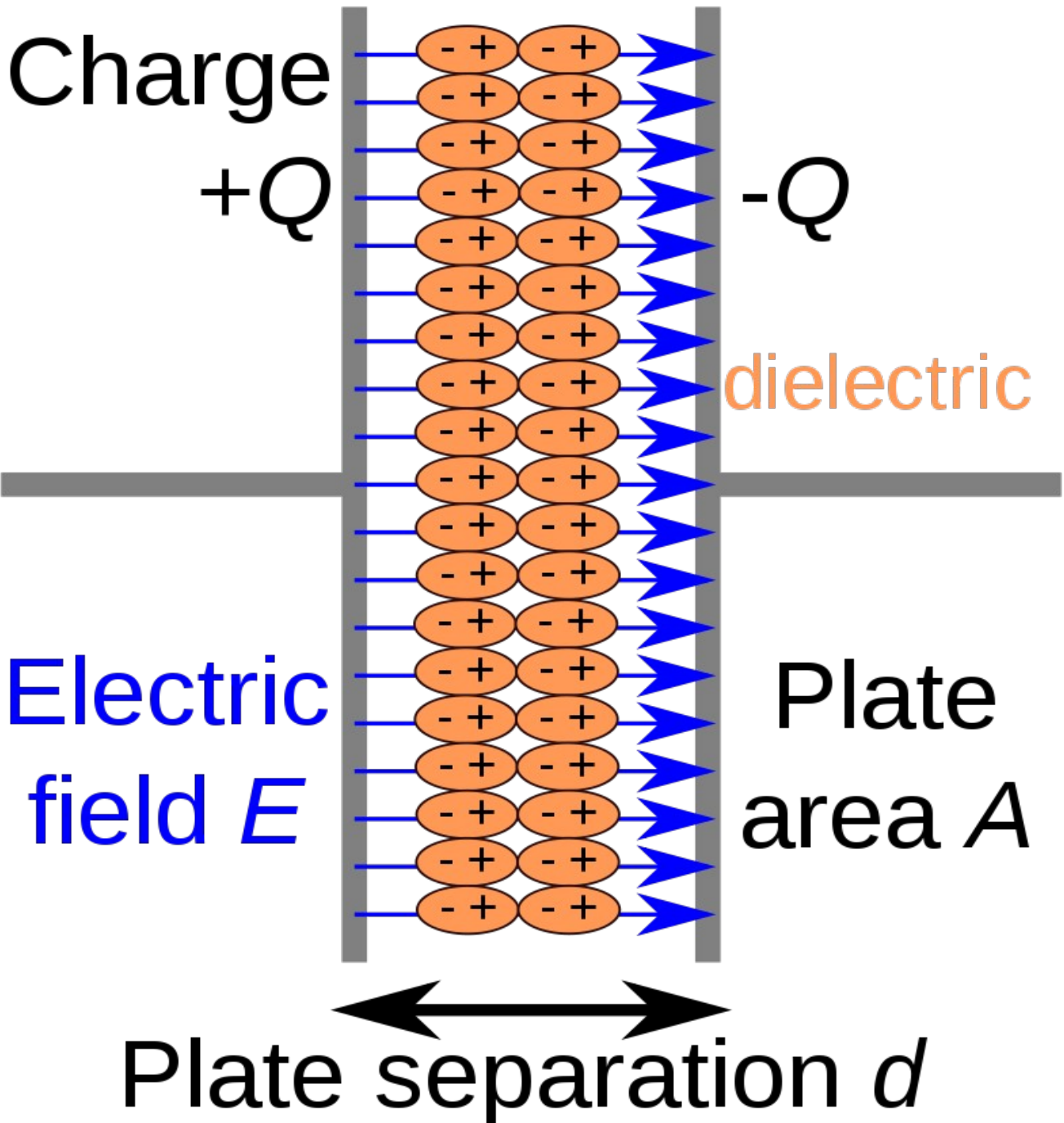


Figure 5: Representation of a capacitor

- Resonance: The frequency at which the reactance of an inductor and capacitor are equal. This can be either series or parallel connection the inductor and capacitor. This can be used in a filter to select or reject a frequency. Additionally resonance can set the frequency in an oscillator.
- dB: A exponential, power of 10 , a relative measurement.

10dBm = power relative to a mW.

20dB = 10X more voltage and 100X more power.  $P = \text{voltage squared} / \text{resistance}$

dB =  $\text{Log}_{10} (\text{Voltage} / \text{Reference Voltage})$  or  $\text{Log}_{10} (\text{power} / \text{Reference power})$

	Watts	Voltage		
		50 ohms	300 ohms	600 ohms
-30 dBm	1E-06	0.007	0.017	0.024
-20 dBm	1E-05	0.022	0.055	0.077
-10 dBm	0.0001	0.071	0.173	0.245
0 dBm	0.001	0.224	0.548	0.775
10 dBm	0.01	0.707	1.732	2.449
20 dBm	0.1	2.236	5.477	7.746
30 dBm	1	7.071	17.321	24.495

Figure 6: dBm and voltage at different resistances

- Wavelength (signal) : the distance over which the wave's shape repeats Measured in meters. Speed of light divided by Wavelength equals frequency. Speed of light =  $3 \times 10^8$  meters (apx) per second in free space.

Band	MHz
80	4
40	8
10	30
2	150

