PSC2121 Exam III Review

Electricity and Magnetism

Electric Charge - unit: coulomb, positive or negative
Charge is conserved.
Like charges repel, unlike attract.
Inverse square law (like gravity)
\[ F = k \frac{q_1 q_2}{r^2} \quad k = 9 \times 10^9 \text{Nm}^2/\text{C}^2 \]
\[ q_{\text{proton}} = -q_{\text{electron}} = 1.6 \times 10^{-19} \text{C} \]

Electroscope measures static charge.
Electric current \( I = q/t \) ampere = coulomb/sec
Electrons move in solids - flow is opposite to direction of current.
- insulators: glass, plastic, rubber, diamond
- semiconductors: silicon, germanium
- conductors: metals, graphite
- superconductors: lead, tin, mercury (when \( T < 4 \text{ K} \)) no resistance

Electric potential \( V = W/q \) volt = joule/coulomb \( W = qV \)
Resistance \( R = V/I \) ohm = volt/amp \( \Omega = V/A \)
Power \( P = V \cdot I = V^2/R = I^2R \) watt = volt-amp
Energy \( W = Pt \) kilowatt-hour
Magnetism caused by moving electric charge
applies force to moving charge

Quantum Theory

X-rays electromagnetic radiation \( \lambda \sim 1 \text{ Å} = 0.1 \text{ nm} = 10^{-10} \text{ m} \)
\[ \gamma \text{-rays} \quad \lambda \sim 10^{-4} \text{ Å} = 10^{-5} \text{ nm} \]
\[ \alpha \text{-particles} \quad \text{heavy, positive charge, He nucleus 2p + 2n} \]
\[ \beta \text{-particles} \quad \text{light, negative charge, electrons} \quad \text{cathode rays} \]
which ones are deflected by electric or magnetic fields?
energy of quantum: \( E = hf = hc/\lambda \)
\( h = \text{Planck's constant} = 6.6 \times 10^{-34} \text{ joule-sec} \)

Photoelectric Effect - explained by Einstein
- dim Blue light (high \( f \)) \( \Rightarrow \) ejects electrons from metal
- bright Red light (low \( f \)) \( \Rightarrow \) no electron emission

Duality - sometimes wave-like
- sometimes particle-like

Matter waves: De Broglie wavelength \( \lambda = h/mv \)

Periodic Table

element - elementary substance
atom - smallest unit
nucleus

11/1/2001
protons, \( p + \) charge  
neutrons, \( n \) neutral  
\( p \) and \( n \) = nucleons  
\[
\text{mass } 1.67 \times 10^{-27} \text{ kg}
\]
electron cloud  
\[
\text{mass } 9.1 \times 10^{-31} \text{ kg}
\]
atomic number \( Z \)  
= \# of protons  
= \# of electrons  
mass number \( A \)  
= \# of nucleons  
= \( p + n \)

isotope - same element \((Z)\), different mass \((A)\)  
atomic mass - amu - based on abundance of isotopes  
standard: carbon-12 = 12.00000

Periodic Table  
row  
Period - increasing atomic number  
column  
Group - related chemical properties  
outer (valence) electrons
Quantum (wave) mechanics explains Periodic Table  
Schrödinger Equation - wave properties of particles  
Heisenberg Uncertainty Principle - 
\( \) can not know both position AND momentum exactly
Pauli Exclusion Principle - only ONE electron in each state
4 quantum numbers - specify electron state in atom  
\( n \) - level \( \Rightarrow \) period  
\( l \) - orbital \( \Rightarrow \) group  
\( m \) - magnetic - suborbital  
\( s \) - spin \( \pm \)

Chemical Bonding  
Group VIII - Noble gasses inert - no bonding  
attempt to complete shell, achieve inert gas configuration
Lewis diagram - try for 8 dots (2 for Group I)

<table>
<thead>
<tr>
<th>ionic</th>
<th>polar covalent</th>
<th>non-polar covalent</th>
<th>metallic</th>
</tr>
</thead>
<tbody>
<tr>
<td>electron</td>
<td>transfer</td>
<td>unequal share</td>
<td>equal share</td>
</tr>
<tr>
<td>electrical</td>
<td>insulators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>electronegativity difference</td>
<td>&gt; 1.7</td>
<td>0-1.7</td>
<td>0</td>
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