Particle Nature: Photo Electric Effect

- Solar Cells
- Low intensity --> few electrons
- KE of electrons independent of intensity
- Light Packets $\rightarrow$ Quanta
- $E = hf$
- $h = \text{Planck’s Const} \rightarrow$
- $h = 6.63 \times 10^{-34} \text{ J.s}$
Problem 2

- In black and white photography, a photon of energy $4 \times 10^{-19}$ J is required to activate the chemicals used in developing films.
- Why does red light used in film development does not damage the films?
- Frequency of red light $\rightarrow 4 \times 10^{14}$ Hz
Film Development

\[ E = hf \]

\[ E_{\text{red}} = hf_{\text{red}} \]

\[ f_{\text{red}} = 4 \times 10^{14} \text{ Hz} \]

\[ E_{\text{red}} = \left(6.63 \times 10^{-34} \text{ Js}\right) \times \left(4 \times 10^{14} \frac{1}{s}\right) \]

\[ E_{\text{red}} = 2.65 \times 10^{-19} \text{ J} \]

\[ E_{\text{red}} < E \Rightarrow \text{Film development can be carried on in red light} \]
• Atomic Structure
• **Introduction**
  
  - Matter is composed of Discrete Units
  - Element: Simplest unit
  - Combine in fixed ratios

[Diagram showing the combination of oxygen and lead to form lead oxide]

- 1 kg oxygen
- 13 kg lead
- 14 kg yellow lead oxide

- 1 oxygen atom with 1 mass unit
- 1 lead atom with 13 mass units
- Lead oxide particle with 14 mass units
- **What is an electron:**
  - Negatively charged particles
  - Very less mass
  - Mass of electron = $9.11 \times 10^{-31}$ Kg
  - Compare your mass to the electron mass!!
    - Your mass = 70 Kg
    - Electron mass = $9.11 \times 10^{-31}$ Kg
    - You are nearly $7.7 \times 10^{31}$ times heavier
    - $77,000,000,000,000,000,000,000,000,000,000$ Electrons!!
  - Charge of electron = $1.6 \times 10^{-19}$ Coulombs
Discovery of the Electron

- A cathode ray: Beam of electrons
- Can be deflected by a magnet
- J.J. Thompson’s Discovery of electron
Millikan’s Oil Drop Experiment

- Oil Drops $\rightarrow$ Ionize them
- mg = Electrical force
- e/m ratio
- $1.6 \times 10^{-19}$ Coulombs
- $9.11 \times 10^{-31}$ Kg
- **The Nucleus**
  
  - **Ernst Rutherford → Nucleus**
    - Radius of the nucleus = about $10^{-13}$ cm
    - Radius of the atom = about $10^{-8}$ cm.
    - Electrons take up 100,000 times the size of nuclees
Nucleus

- Nucleus has protons and neutrons.
- Protons are + charges
- Neutrons have no charge
- 2000 times more massive than electron

• Why is an atom electrically neutral?
Rutherford’s alpha particle scattering Scattering.

- What is alpha particle?
  - Bare nucleus of He
  - Has one proton and one neutron

- Measurement of scattering angle
Scattering of Alpha Particles