1ST WEEK SUMMARY

Coverd: Lecture 1a, 1b

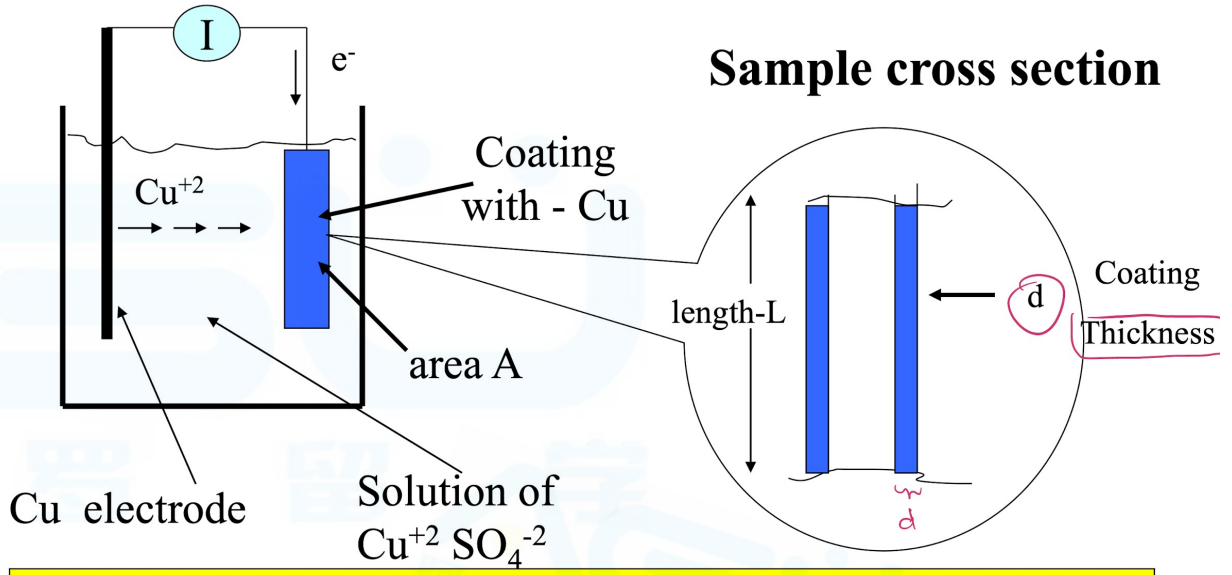
DIMENSIONS AND UNITS

- Common unit conversion
  - Length: 1 inch = 2.54 cm, 1 foot = 12 inch
  - Mass: 1 lb = 454 g
  - Pressure: 1 atm = 14.7 psi = 101.3 kPa
  - Temperature: $^{\circ}C = (^{\circ}F - 32) \times 5 / 9$, $^{\circ}F = 32 + (9 / 5) \times {}^{\circ}C$, $K = {}^{\circ}C + 273.15$
  - ✪ Amount: lbmol -> kgmol
  - …
  - My recommendation: https://www.convert-measurement-units.com/conversion-calculator.php

EXAMPLE

Solution on Lecture 1a

Example: Electrolytic coating



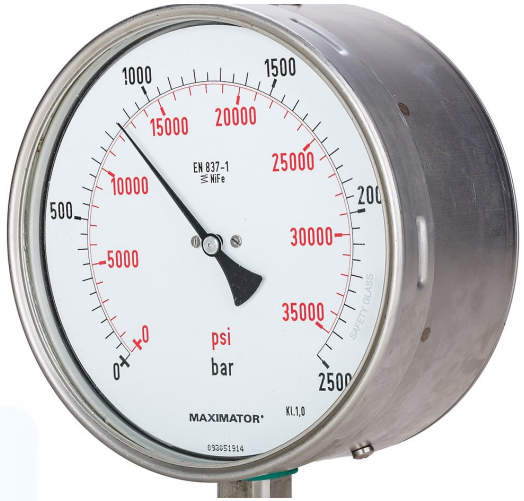
Given a current I, how many minutes are required for a thickness d ?

Given : I=5 Amp, A=20cm^2, d=0.1mm ρ_{cu}=8.96g/cc, MW_{Cu}=63.5g/gmol

ABSOLUTE/GAUGE PRESSURE

- P_g (gauge pressure) = P_{in} – P_{env}
- Classic problem:

  1atm = how high of a water column (on Earth) ?



The length of water column that exert 1 atm pressure is 10.3 m.

Explanation:

The **pressure in water is** defined as,

$P = d \times g \times h$

Here, P is the pressure, d is the density of water, g is acceleration due to gravity and h is height under water.

We have density of water, d = 1000 Kg/m^3, g = $9.8m/s^2$ and P = 101325 Pa.

Substitute the values in above formula we get

$101325 = 1000 \times 9.8 \times h$

$h = \frac{101325}{1000 \times 9.8} = 10.3m$

Thus, the length of water column that exert 1 atm pressure is **10.3 m.**

Learn more : Topic : Pressure in water

brainly.in/question/8557547

CONSTANTS

- Avogadro's number: N_A = 6.023 E23 / gmol

- Molar ratio (n_i) / mass ratio (m_i)
- Molar concentration ($c_i = n_i/V$) / mass concentration ($w_i = m_i/V$)

INTERPOLATION

- Interpolation vs extrapolation:
- Mathematically speaking, **interpolation** is the process of determining an unknown value within a sequence based on other points in that set, while **extrapolation** is the process of determining an unknown value outside of a set based on the existing "curve."

DIMENSIONLESS NUMBERS

- A calculated number, used mostly in engineering field, that has a physical meaning/property but without the expression of units.
- The most important one in Chemical Engineering: Reynolds number (Re)
  - Describes the turbulency of a flow
  - < 2000 laminar
  - > 4000 turbulent
  - Re : Principle of Chemical Engineering I course
  - Nu, Bi : Principles of Chemical Engineering II course

$$Re = \frac{\text{inertia forces}}{\text{viscous forces}} = \frac{\rho \cdot V \cdot D}{\mu}$$

↑ Velocity

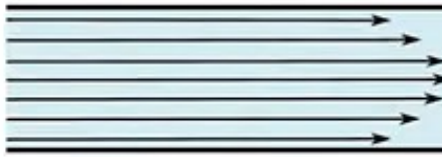
↑ Characteristic dimension

↑ Density

↓ Viscosity

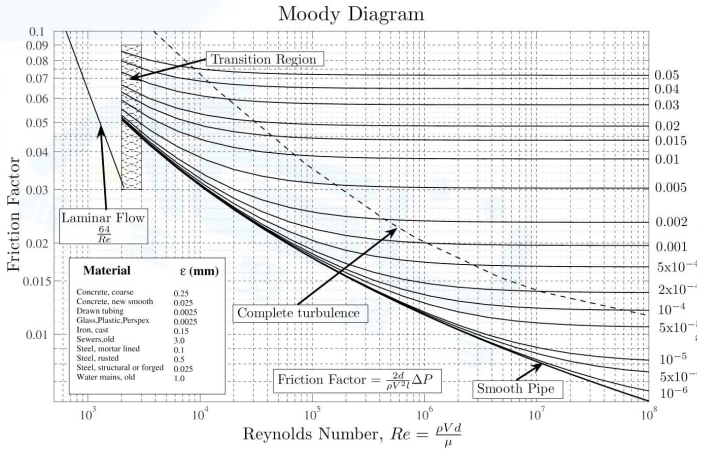
→ ↑ Re

laminar flow



turbulent flow





SIGNIFICANT NUMBERS

- It's a mess. Too many different rules and standards.
- Easy work, don't carp. If you are unsure, check with your lecturer.
- What you learned in Principle of Chemistry still works:
  - Round your result to have the same SF as the operand with the least SF.
  - Smaller than 5, always round down; otherwise, round up.
  - Usually, you don't need to contain too many digits of a number when other operands having far less SF. Usually, two more is well enough.

3RD WEEK SUMMARY

Covered: Lecture 2a, 2b

IDEAL VS. REAL GASES

- Differentiation (ideal: infinitesimal volume occupied, no KE loss (rigid bodies), no attractive/repulsive forces, etc.) (real: low T and high P – less Brown motion)
- $P\tilde{V}$ = RT (ideal), $P\tilde{V}$ = ZRT (real), compressibility factor Z
- Under STP (1 atm, 273.15 K), molar volume($\tilde{V}$) for idea gases = 22.4 L/mol. Under 1 atm, 298.15K, molar volume = 24.45 L/mol
- Gas laws: Boyles Law (const T), Charles Law (const P), Gay-Lussac Law (const V), Dalton law (partial pressure), Amagat's Law (partial volume) etc.

GAS EOS

- EOS: Equation of States. Extended version of ideal gas law P$\tilde{V}$ = RT.
- Van der Waals equation: $\left(P + \frac{a}{\tilde{V}^2}\right)\left(\tilde{V} - b\right) = RT, a = \frac{27R^2T_c^2}{64P_c}, b = \frac{RT_c}{8P_c}$

- T_c and P_c are intrinsic for each kind of gas molecules. c - critical

Z CHART

- Compressibility factor (Z) in $P\tilde{V}$ = ZRT. This is one of the most frequent used ones for real gases. $Z = Z(T_r, P_r), T_r = \frac{T}{T_c}, P_r = \frac{P}{P_c}$.
- Trend: T increases, Z decreases.
- Z = 1 → ideal
- Z > 1: High P and Low T (dense)
- Z < 1: Low P and High T (thin)