

1ST WEEK SUMMARY

Coverd: Lecture 1a, 1b

DIMENSIONS AND UNITS

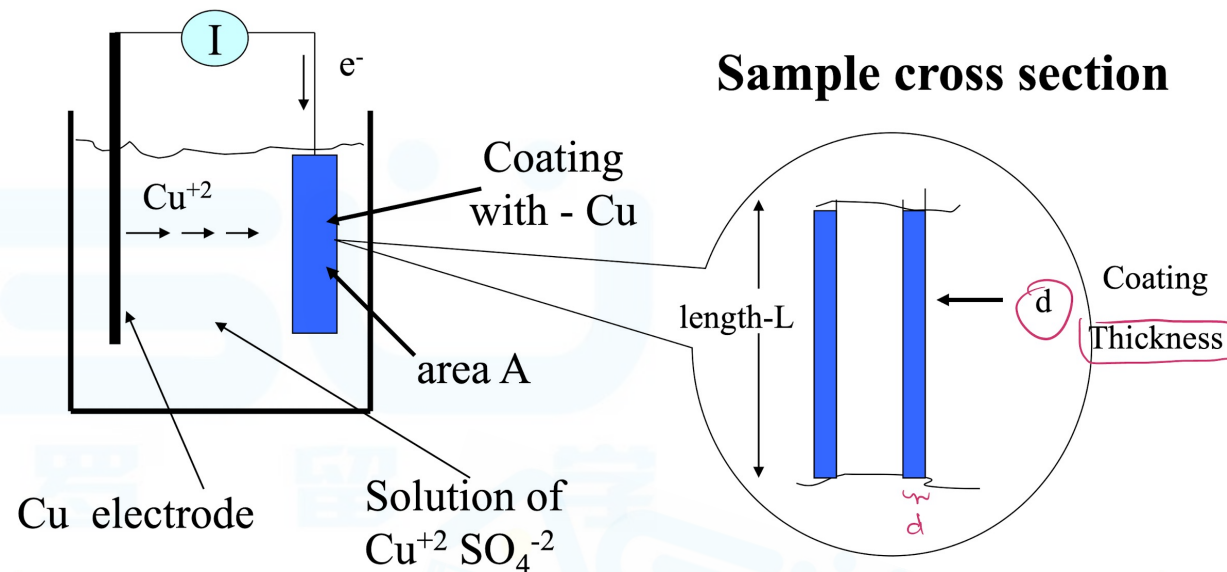
- Common unit conversion
 - Length: 1 inch = 2.54 cm, 1 foot = 12 inch
 - Mass: 1 lb = 454 g
 - Pressure: 1 atm = 14.7 psi = 101.3 kPa
 - Temperature: $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5 / 9$, $^{\circ}\text{F} = 32 + (9 / 5) \times ^{\circ}\text{C}$, $\text{K} = ^{\circ}\text{C} + 273.15$
 - ★ Amount: lbmol $\rightarrow$ kmol
 - ...
 - 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 : $I=5 \text{ Amp}$, $A=20\text{cm}^2$, $d=0.1\text{mm}$ $\rho_{\text{cu}}=8.96\text{g/cc}$, $\text{MW}_{\text{Cu}}=63.5\text{g/mol}$

ABSOLUTE/GAUGE PRESSURE

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

1 atm = 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, $d = 1000 \text{ Kg/m}^3$, $g = 9.8 \text{ m/s}^2$ and $P = 101325 \text{ Pa}$.

Substitute the values in above formula we get

$$101325 = 1000 \times 9.8 \times h$$

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

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: $N_A = 6.023 \text{ E}23 / \text{gmol}$
- Molar ratio (n_i) / mass ratio (m_i)
- Molar concentration ($c_i = n_i/V$) / mass concentration ($w_i = m_i/V$)

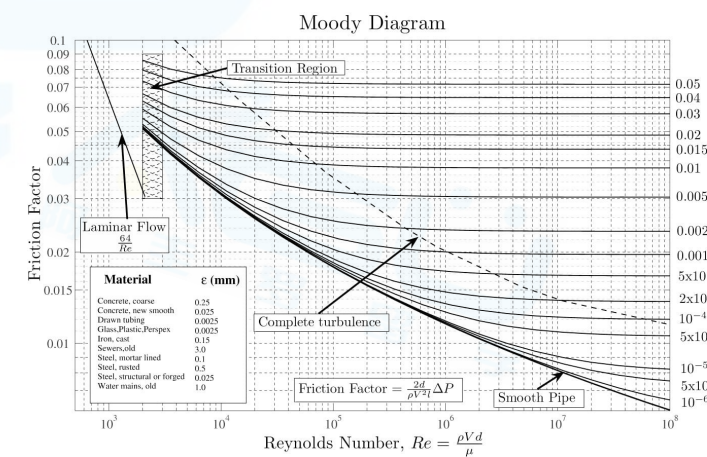
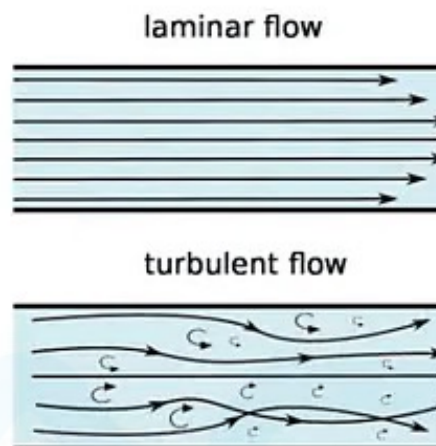
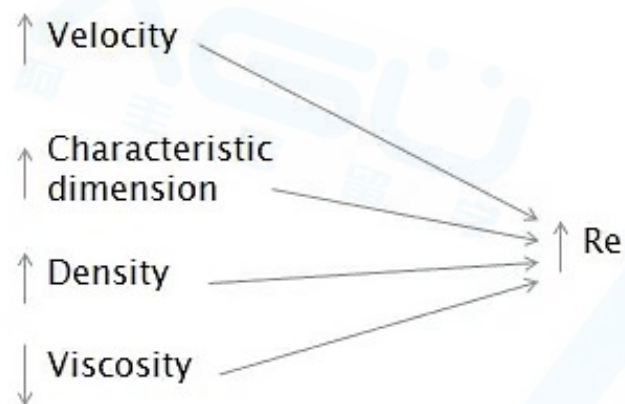
INTERPOLATION

- 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

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



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 ideal gases = **22.4** L/mol.
Under 1 atm, 298.15K, molar volume = **24.45** L/mol
- **Gas laws**: Boyle's 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: **E**quation **o**f **S**tates. Extended version of ideal gas law $P\tilde{V} = RT$.
- Van der Waals equation: $\left(P + \frac{a}{\tilde{V}^2}\right)(\tilde{V} - b) = RT$, $a = \frac{27R^2T_c^2}{64P_c}$, $b = \frac{RT_c}{8P_c}$
- 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.
- $Z = 1 \rightarrow$ ideal
- $Z > 1$: High P and Low T (dense)
- $Z < 1$: Low P and High T (thin)