



# Medical Physics

## The First Stage

Second Term – Second Lecture

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**Important of Thermodynamics to A Science-Based Profession such as Pharmacy**

Drug solubility, partitioning between immiscible solvents, drug–excipient interactions, and drug-receptor binding can all be understood based on the description of such systems according to thermodynamic terms. Our understanding of these properties is critically dependent on a basic understanding of the three fundamental laws of thermodynamics. So we will study thermodynamics in detail to understand our pharmacy science.

**Thermodynamics Applications in Pharmacy**

Thermodynamics have several applications in pharmacy. In summary, the laws of thermodynamics are valuable in pharmacy for understanding drug stability, formulation, pharmacokinetics, and biopharmaceutics, among other areas.

For example:

Drug Stability: The first law of thermodynamics, which deals with energy conservation, is important in understanding the stability of drugs. It helps in determining how drugs degrade over time and how to store them properly to maintain their efficacy.

Drug Formulation: The second law of thermodynamics, which deals with entropy, is crucial in drug formulation. It helps in understanding the physical and chemical properties of drugs, which is essential for designing drug formulations and delivery systems.

Pharmacokinetics: The laws of thermodynamics are also relevant in pharmacokinetics, which involves the study of drug movement within the body.



Understanding thermodynamic principles can help in predicting how drugs will distribute, metabolize, and be eliminated within the body.

Biopharmaceutics: Thermodynamics plays a role in biopharmaceutics, which focuses on how the body interacts with drugs. This includes understanding factors such as drug solubility, permeability, and stability, all of which are influenced by thermodynamic principles.

### **Application of Thermodynamics in Medicine**

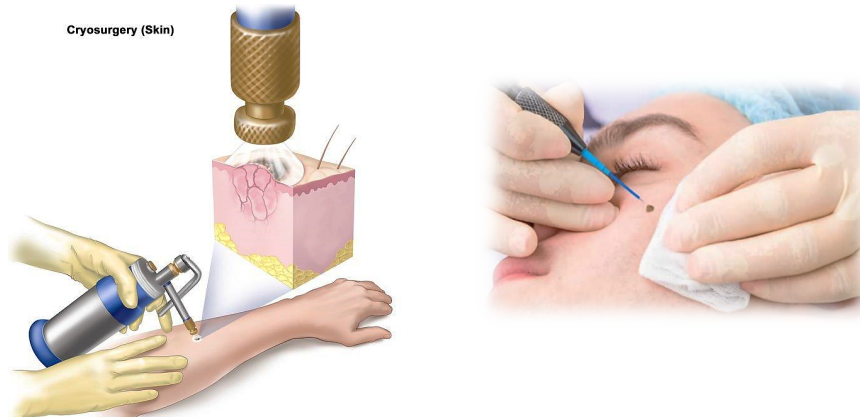
It can be applicable in different types such as:

- Diagnostic and treatment department.
- Surgical department.
- Pharmaceutical manufacturing and preparation.
- Nursery department.
- Emergency department.
- Services department.

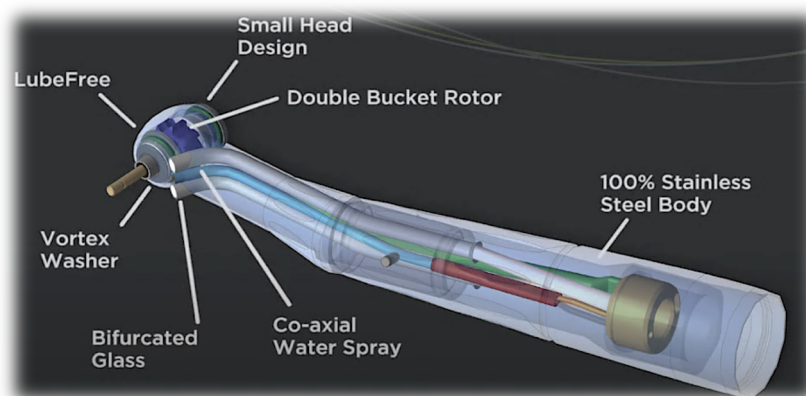


### Some Examples

Cryosurgery: is a type of surgery that involves the use of extreme cold "such as nitrogen gas" to destroy abnormal tissues, such as tumors or birthmark.



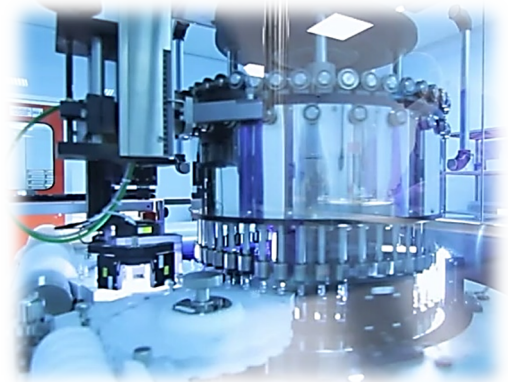
Dental Air Turbine: This equipment is being used by the dentists to drill a cavity in a decaying tooth, which is to be filled with some filling material like mercury amalgam. Air at high pressure from a compressor is expanded in a air turbine. The turbines shaft rotates at about 10,000 – 400,000 rpm. A diamond drill bit is attached is the turbine though a flexible cable shaft. As the cutting speed is very



high a water spray is also provide in the handle, which hold the drilling tool. By using this equipment, the preparation a cavity is made simple and quick.



Vacuum Pump and Suction Pump: it are used for drying processes, ensuring that moisture levels are controlled to maintain product stability. Freeze-drying, a common method for preserving sensitive drugs, also relies on vacuum pumps to remove water while maintaining the integrity of the product.



Suction Pump for medication: used during and after surgery to remove surgical fluids, tissue (including bones), gases and bodily fluids. Medela designs high-quality vacuum technology to deliver a reliable build-up of suction power and for easy handling, both of which are important aspects for daily hospital use.



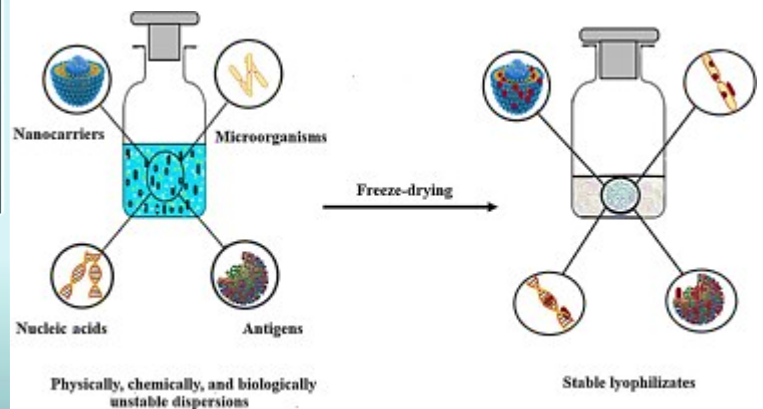
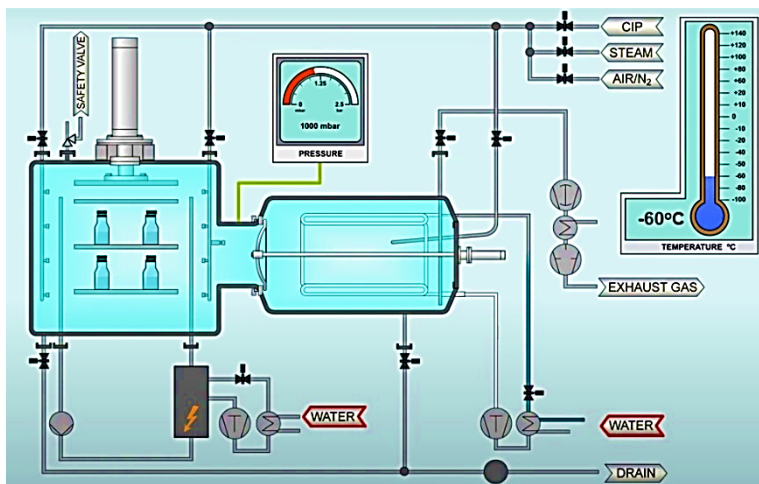
Oil Free Air Compressor in Pharmaceutical: in pharmaceutical industry "specially which containing natural plants containing oil", a dry oil-free screw air



compressor is a must to ensure the class 0 oil-free clean and dry compressed air with high purity.



Freeze Drying in Pharmaceutical: in the pharmaceutical industry, freeze drying is used for preserving and storing high value products such as vaccines, cytostatics, antibiotics, biologicals, hormones, active ingredients and reactives. It is also used for collagens, manufacturing active pharmaceutical ingredients (APIs) and



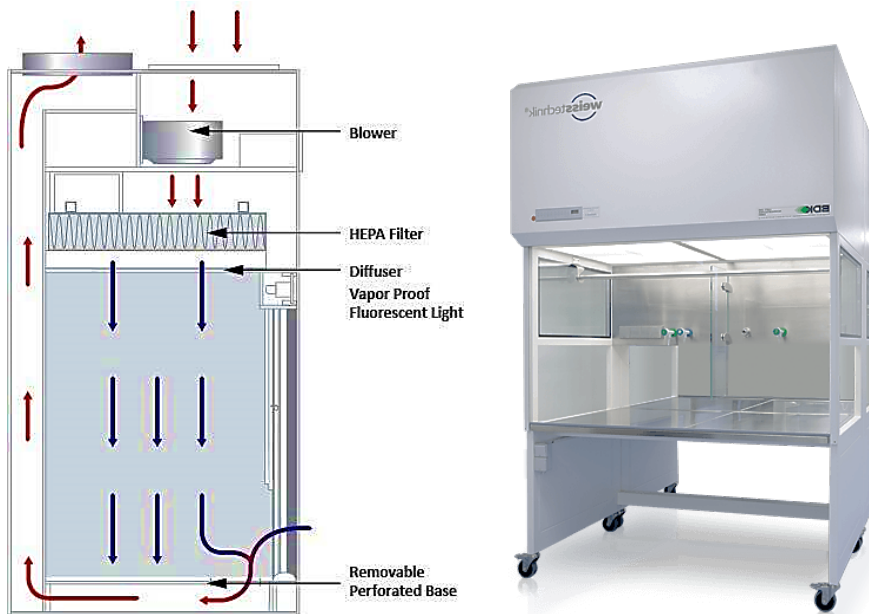
Refrigerated Centrifuge in Pharmaceutical:

Refrigerated centrifuges are indispensable across a spectrum of disciplines, where precise thermal management is critical to maintaining sample integrity during high-speed rotations. These instruments are particularly vital in biomedical and pharmaceutical research for tasks such as separating blood components for transfusions and clinical diagnostics, where maintaining specific temperatures is non-negotiable for preserving the biological activity of these substances.





Laminar Flow Equipment: These are used to take care of the pharmacy and its protection from environment particularly for burned cases. In a laboratory and pharmaceuticals plant, a dry atmosphere with relative humidity of about 5 to 50% is maintained in packing hygroscopic products like coated pills and gelatine capsules. With the help of the laminar flow test tablets clean air at the required humidity and temperature will be available in a small volume.





**Quick Quiz:**

- (Q1) What is the important of thermodynamics to a science-based profession such as pharmacy?
- (Q2) Give an examples for uses and application of thermodynamic in medicine