

سنتر فیوتشر

Subject:

لیمیاء اعدادی

Chapter:

الشمو «ا»

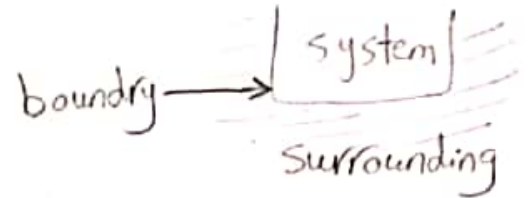
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Thermodynamic

Thermo/dynamic called science of energy
 ↓ اتعني
 حرارة heat ↓ اتعني
 قوة power

System % النظام
 anything chosen for study
 أي شيء محط الدراسة يسمى نظام او system



Surrounding % كل ما هو خارج النظام يسمى الوسط المحيط
 region outside the system

Boundary % الحد الفاصل بين surrounding & system
 surface separate between system and surrounding
 (real or imaginary)

* Types of system

① Closed system نظام مغلق

هو نظام لا يسمح بانتقال الكتلة
 ولكن يسمح بانتقال الحرارة
 No mass can enter or
 leave the system, but
 energy can cross
 the boundary
 mass change X
 heat change ✓

② Isolated system نظام معزول

هو نظام لا يسمح بانتقال
 الكتلة ولا الحرارة
 No mass can enter or
 leave the system and
 the energy can't cross
 the boundary
 mass change X
 heat change X
ملحوظة
 Isolated system is
 special case from
 the closed system

③ Open system نظام مفتوح

هو نظام يسمح بتبادل
 الكتلة والحرارة
 Both mass and energy
 can cross the boundary
 mass change ✓
 heat change ✓

الأبعاد Dimension للتعبير عن الكميات الفيزيائية

① primary dimension
(fundamental) أساسية

Ex:- mass الكتلة
length الطول
time الزمن
temp درجة الحرارة

② secondary dimension
(derived) مشتقة

Ex:- Volume الحجم
Velocity السرعة
acceleration المعجلة

الوحدات Units

	SI system (international system)	English system (united state system)
mass	kg, gm, --	lbm
length	m, cm, --	ft
time	sec	sec

$$1 \text{ lbm} = 0.4539 \text{ kg}$$

$$1 \text{ ft} = 0.3048 \text{ m}$$

(*) Acceleration gravity (g)

SI system
 $g = 9.807 \text{ m/s}^2$

English system
 $g = 32.174 \text{ ft/s}^2$

	temperature scale	Thermodynamic scale
SI system	$^{\circ}\text{C}$	$^{\circ}\text{K}$
English system	$^{\circ}\text{F}$	$^{\circ}\text{R}$

لحل المسائل في هذا chapter لازم تحول درجات الحرارة إلى thermodynamic scale

$$T(^{\circ}\text{C}) + 273 = T(^{\circ}\text{K})$$

$$T(^{\circ}\text{F}) + 460 = T(^{\circ}\text{R})$$

$$1.8 T(^{\circ}\text{C}) + 32 = T(^{\circ}\text{F})$$

$$1.8 T(^{\circ}\text{K}) = T(^{\circ}\text{R})$$



Temp difference between two scale is the same

SI system $\Rightarrow \Delta T(^{\circ}\text{C}) = \Delta T(^{\circ}\text{K})$

English system $\Rightarrow \Delta T(^{\circ}\text{F}) = \Delta T(^{\circ}\text{R})$

When say The rise in temp or The drop in temp ملحوظة
 ستستخدم قوانين temp difference

EX The temperature of system drop by 27°F during Cooling process.

Express this drop in temp $^{\circ}\text{R}$??

$$\Delta T(^{\circ}\text{F}) = 27^{\circ}\text{F}$$

$$\therefore \Delta T(^{\circ}\text{F}) = \Delta T(^{\circ}\text{R})$$

$$\therefore \Delta T(^{\circ}\text{R}) = 27^{\circ}\text{R}$$

Ex During the heating process the temperature of system was 10°C

Express the temp in K , $^{\circ}\text{R}$, $^{\circ}\text{F}$??

Soln

$$T(^{\circ}\text{K}) = T(^{\circ}\text{C}) + 273$$

$$T(^{\circ}\text{K}) = 10 + 273 = 283 \text{ K}$$

$$\begin{aligned} T(^{\circ}\text{R}) &= 1.8 T(^{\circ}\text{K}) \\ &= 1.8 (283) = 509.4^{\circ}\text{R} \end{aligned}$$

$$\begin{aligned} T(^{\circ}\text{F}) &= 1.8 T(^{\circ}\text{C}) + 32 \\ &= 1.8 (10) + 32 = 50^{\circ}\text{F} \end{aligned}$$

* Force

القوة Force = mass \times acceleration

$$F = m \cdot a$$

النيوتن Newton = $\text{kg} \cdot \frac{\text{m}}{\text{s}^2}$

* وحدات قياس القوة
(SI system)

(bound force) $1 \text{ lbf} = 32.174 \text{ lbm} \cdot \frac{\text{ft}}{\text{s}^2}$ (English system)

Newton is the force required to accelerate 1 kg of body by rate 1 m/s^2

bound force (1 lbf) is the force required to accelerate body of 32.174 lbm by rate ft/s^2

Ex What is the force required to accelerate 30 kg of body at a rate of 15 m/s^2

Soln $\rightarrow F = m \cdot a$
 $= 30 \text{ kg} \times 15 \text{ m/s}^2$
 $= 450 \text{ kg m/s}^2 = 450 \text{ Newton}$

* Relation between mass & weight %

$$\text{weight} \leftarrow \boxed{W = m g} \rightarrow \text{acceleration gravity}$$

↓
mass عجلة الجاذبية

(specific weight) الوزن النوعي

هو وزن وحدة الحجم من المادة
the weight of unit volume of substance

$$\text{specific weight} \leftarrow \boxed{W = \rho \cdot g} \rightarrow \text{acceleration gravity}$$

↓
الوزن النوعي عجلة الجاذبية

↓
الكثافة = $\frac{\text{الكتلة}}{\text{الحجم}}$ density

* Work الشغل

$$\text{Work} = \text{Force} \times \text{distance}$$

$$\boxed{W = F \cdot L}$$

وحدات قياس الشغل

SI system \Rightarrow

N.m

English system \Rightarrow

Btu (British thermal unit)

$$W = F \cdot L$$

$$\text{but } P = \frac{F}{A}$$

$$dW = P A \Delta L$$

$$F = PA$$

$$\boxed{W = P \Delta V}$$

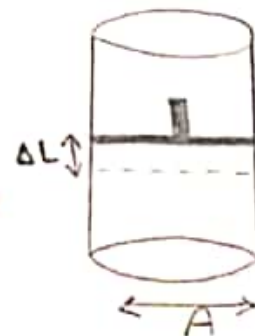
at Const pressure
عند ثبات الضغط

Work \leftarrow pressure \leftarrow change in volume

$$\boxed{W = P (V_2 - V_1)}$$

$$\boxed{W = \int_{V_1}^{V_2} P dV}$$

at $P \neq \text{Const}$
عند تغير الضغط



For ideal gas \rightarrow $PV = nRT$ \rightarrow درجة الحرارة \rightarrow temp
 pressure \leftarrow volume \leftarrow no. of moles \leftarrow general gas Const
 الضغط \leftarrow الحجم \leftarrow عدد المولات \leftarrow الثابت العام للغازات

$$\therefore P = \frac{nRT}{V}$$

$$W = \int_{V_1}^{V_2} P \cdot dV = \int_{V_1}^{V_2} \frac{nRT}{V} \cdot dV$$

$$W = nRT \int_{V_1}^{V_2} \frac{dV}{V} = nRT \ln[V]_{V_1}^{V_2}$$

$$= nRT [\ln V_2 - \ln V_1]$$

$$P \propto \frac{1}{V}$$

$$W = nRT \ln \frac{V_2}{V_1} \Rightarrow \begin{matrix} T = \text{Const} \\ V \neq \text{Const} \end{matrix} \begin{matrix} \text{عند ثبوت} \\ \text{وتغير الحجم} \end{matrix}$$

$$W = nRT \ln \frac{P_1}{P_2} \Rightarrow \begin{matrix} T = \text{Const} \\ P \neq \text{Const} \end{matrix} \begin{matrix} \text{عند ثبوت} \\ \text{وتغير الضغط} \end{matrix}$$

Units of Work

$$\textcircled{1} W = P \Delta V$$

$$= \text{atm} \cdot \text{L} = \text{L} \cdot \text{atm}$$

$$W = nRT \ln \frac{V_2}{V_1}$$

$$\text{mole} \times 0.082 \frac{\text{L} \cdot \text{atm}}{\text{mole} \cdot ^\circ\text{K}} \times ^\circ\text{K} \ln \frac{\text{m}^3}{\text{m}^3}$$

$$= \text{--- L} \cdot \text{atm}$$

$$R = 0.082 \frac{\text{L} \cdot \text{atm}}{\text{mole} \cdot ^\circ\text{K}} = 2 \frac{\text{Calory}}{\text{mole} \cdot ^\circ\text{K}}$$

$$\textcircled{2} W = nRT \ln \frac{V_2}{V_1}$$

$$\text{mole} \times 2 \frac{\text{Calory}}{\text{mole} \cdot ^\circ\text{K}} \times ^\circ\text{K} \ln \frac{\text{m}^3}{\text{m}^3}$$

$$= \text{--- Calory}$$

$$\textcircled{3} 1 \text{ Calory} = 4.182 \text{ Joule}$$

$$\textcircled{4} \text{Joule} = 10^7 \text{ erg}$$