شركة تدريب هندسي

E.CAMP

PHYSICS 1

2021 - 2022 No. 17

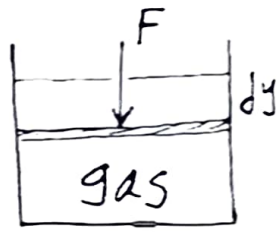
الطريق الدائري بجوار المدرسة المعمارية

01064763583

"CH.8: Thermodynamics -- Last"

1 Work in thermodynamics:

* إذا تم التأثير على المكبس بقوة يحدث تغير في حجم الغاز ويمكن حساب الشغل من العلاقة



$$W = -\int_{V_i}^{V_F} P\,dV$$

area Under P-V curve

$dW = -F\,dy$
$dW = -PA\,dy$
$dW = -P\,dV$
$W = -\int P\,dV$

P --- Pressure (N/m^2 or Pa)

V_i -- Initial Volume

V_F -- Final Volume

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*Note: Negative sign means that:

(1) $W \longrightarrow (+)$

إنضغاط، Compression "Work on the system

(2) $W \longrightarrow (-)$

تمدد Expansion "Work by the system

2 First-Law of thermodynamics:

* القانون الأول للديناميكا الحرارية (Conservation of energy)
(قانون بقاء الطاقة)

$$\Delta E_{int} = Q + W$$

- ΔE_{int}: (+) increased, (−) decreased
- Q: (+) added, (−) removed
- W: (+) ON system, (−) BY system

⇒ ΔE_{int} -- change in internal energy (Tempreture)
التغير في الطاقة الداخلية للغاز

⇒ Q -- amount of heat كمية الحرارة

⇒ W -- Work on the gas (Volume)

Note: For ideal gases

$$PV = nRT$$

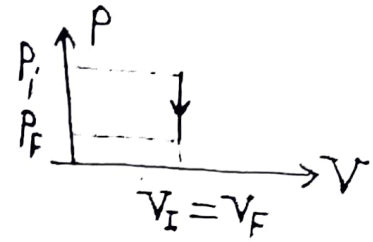
n -- Number of moles
R -- Universal gas constant (8.31 J/mol.K)
T -- in kelvin

3 Processes: العمليات

(1) IsoVolumetric: (Isochoric)

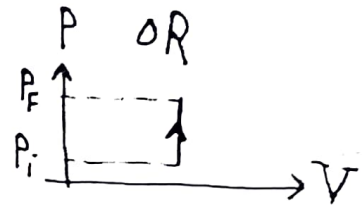
(1) $V_i = V_F$ الحجم ثابت

(2) $\frac{P_2}{P_1} = \frac{T_2}{T_1}$



(3) $W = zero$

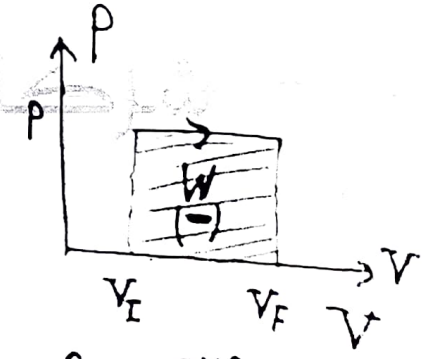
(4) $\Delta E_{int} = Q$



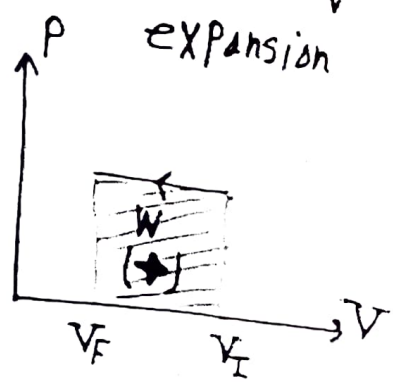
(2) Isobaric: الضغط ثابت

(1) $P_I = P_V$

(2) $\frac{V_2}{V_1} = \frac{T_2}{T_1}$



(3) $W = -P(V_F - V_I)$



(4) $\Delta E_{int} = Q + W$

compression

(4) Isothermal: الحرارة ثابتة

(1) $T_1 = T_2 \quad \therefore \Delta T = 0 \Rightarrow \boxed{\Delta U = 0}$

(2) $\frac{P_2}{P_1} = \frac{V_1}{V_2}$

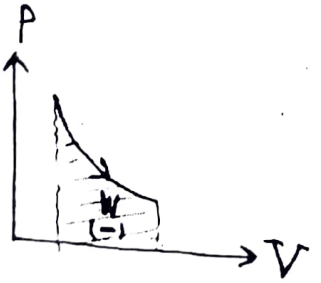
(3) $W = -\int_{V_I}^{V_F} P \, dV$ "الشغل"

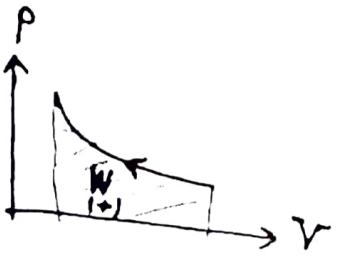
$\because PV = nRT \Rightarrow P = \frac{nRT}{V}$

$\therefore W = -\int_{V_i}^{V_F} \frac{nRT}{V} dV = -nRT \int_{V_i}^{V_F} \frac{1}{V} dV$

$= -nRT \ln(V) \Big|_{V_i}^{V_F} = -nRT[\ln(V_F) - \ln(V_i)]$

$= nRT[\ln(V_i) - \ln(V_F)] = \boxed{nRT \ln\left(\frac{V_i}{V_F}\right)}$



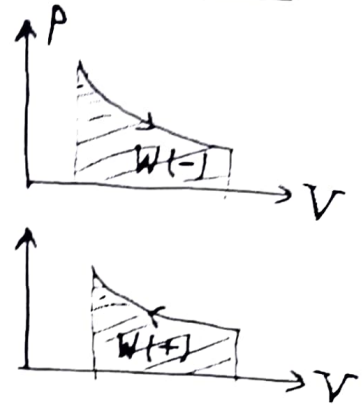


(4) $0 = Q + W \Rightarrow \boxed{W = -Q}$

4 Adiabatic: النظام المعزول

(1) Isolated system $\boxed{Q = 0}$

(2) $\boxed{\Delta E_{int} = W}$



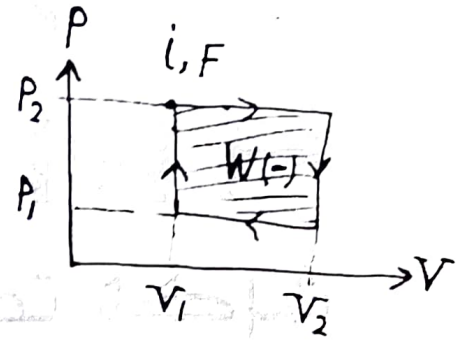
5 Cyclic Process: دورى

$T_i = T_F$

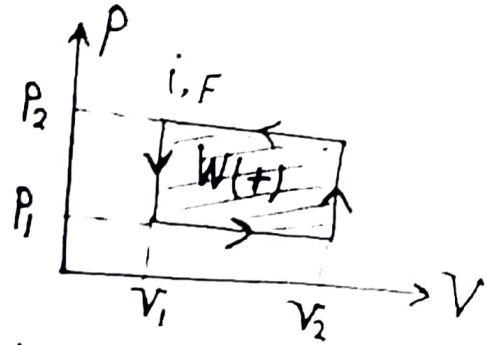
$\therefore \Delta T = 0$

(1) $\boxed{\Delta E_{int} = 0}$

(2) $\boxed{Q = -W}$



$W = -(P_2 - P_1)(V_2 - V_1)$



$W = (P_2 - P_1)(V_2 - V_1)$

* Note:

Work

- CW (−)
- CCW (+)

الجزء الأخير

3 Mechanisms of heat transfer:

أنظمة إنتقال الطاقة الحرارية

(a) Conduction التوصيل

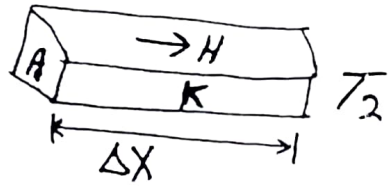
(b) Convection الحمل

(c) Radiation الإشعاع

تعريفات

a Conduction:

* is the flow of heat directly through a physical material due to a tempretkre gradient.



* هو التدفق المباشر للحرارة خلال مادة فيزيائية نتيجة التدرج في درجة الحرارة.

$$H = P = \dot{Q} \quad \text{Watt}$$

$$H = K A \frac{\Delta T}{\Delta X} \quad \text{Watt}$$

H → Heat flow rate or Heat current

A → cross section area

ΔX → thickness السمك

$\frac{\Delta T}{\Delta X}$ → tempretkre

K → thermal conductivity التوصيلة الحرارية (W/m·K)

* Important Notes:

(1) Thermal Conductivity (K):

→ Is the ability of the material to conduct heat.

→ High K = Good Conductor موصل جيد

→ Low K = Good insulator عازل جيد

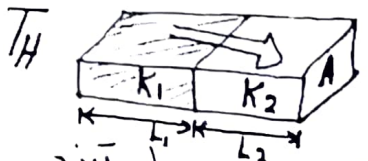
(2) "K" Unit is "W/m·K"

(3) $\frac{\Delta T}{\Delta X} = \frac{T_H - T_L}{L}$ called Tempreture gradient

تدرج الحرارة

(4) Compound rod: القضيب المركب (أكثر من مادة)

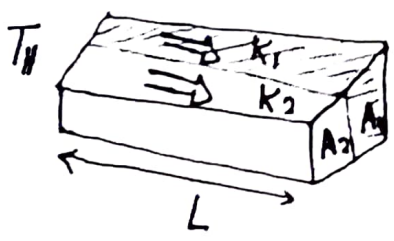
(a) series: التوالى



في حالة وجود مادتين مختلفين على التوالى يكون

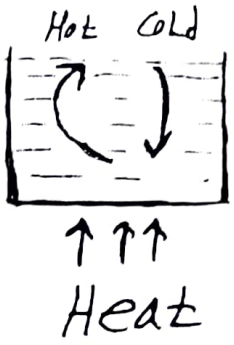
$$P = A \frac{T_H - T_L}{\frac{L_1}{K_1} + \frac{L_2}{K_2}}$$

(b) Parallel: التوازى



$$P = (A_1 K_1 + A_2 K_2) \frac{T_H - T_L}{L}$$

B Convection:



* is the flow of fluid due to a difference in tempretures, the fluid "carries" the heat withit.

* هو تدفق الموائع نتيجة إختلاف الحرارة، وبالتالى يحمل المائع الحرارة من خلال حركته.

* Types of Convection:

(a) Natural (free) convection يتحرك المائع بحرية (طبيعى / حر)

(b) forced convection يوجد مؤثر خارجى (مروحة).

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* Newton's law of cooling: قانون نيوتن للتبريد

$$H = hA(T_s - T_f)$$

$h \rightarrow$ convection heat transfer coefficient معامل الإنتقال الحرارى بالحمل

$T_s \rightarrow$ surface tempreture درجة حرارة الجسم

$T_f \rightarrow$ fluid tempreture (الماء) " " السائل

$A \rightarrow$ surface area مساحة سطح الجسم

Radiation:

→ is the energy transfer in the form of electromagnetic waves.

* هو انتقال الحرارة في صورة موجات كهرومغناطيسية.

→ does not required medium

→ The fastest type $C = 3 \times 10^8$ m/s

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*Stefan – Boltzmann Law:

$$H = \varepsilon \beta A (T_s^4 - T_{surr}^4)$$

H → heat flow rate by radiation.

ε → emissivity $0 \leq \varepsilon \leq 1$

$\varepsilon = 1$ blackbody

β → stefan's constant $\beta = 5.67 \times 10^{-8}$ $W/m^2 \cdot K^4$

T_s → surface tempreture (Kelvin)

T_{surr} → surrounding tempreture. (Kelvin)

Notes:

(1) Ideal absorber: الماص المثالي

→ $e = 1$ called black body

→ can absorb all energy incident on it يمتص كل الطاقة الساقطة عليه

(2) Ideal reflector: العاكس المثالي

→ $e = 0$

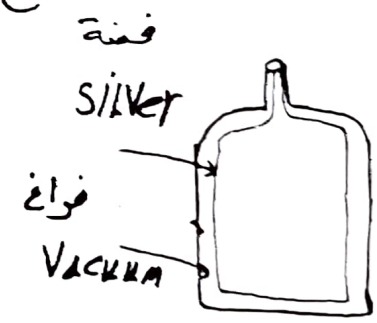
→ absorbs none of the energy.

(3) Dewar flask: الوعاء الحافظ للحرارة

→ like thermos bottle

→ Vaccum: to prevent conduction and convection

→ silvered surfaces: To prevent radiation.



* مسائل الجزء + MCQ ⇐ هتنزل في مذكرة المراجعة من المحاضرة