1

حل اسئلة محاضرة 3

Prove that $\boxed{dw = P\,dV}$ -1

- For work expanding
- the surface is pushed out an amount dn, where $n \perp$ surface

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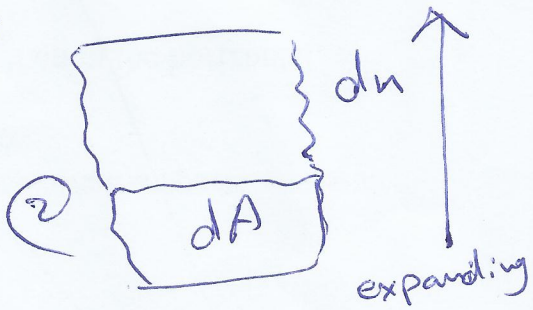
Sol.

① $w = \underset{w}{F} \cdot \underset{w}{d}$

Force displacement



③ $dw_{\delta A} = \dfrac{dw}{A}$

For a unit of surface area

$= \dfrac{F \cdot dn}{A}$ ← displacement

$P \leftarrow$

$\boxed{dw_{\delta A} = P\,dn}$

V = Area × height

$\boxed{dV = A \times dn}$

$\therefore dW = P\,A\,dn$

$\boxed{dw = P\,dV}$

(2)

$Work_{min}$ in blowing a balloon with spherical shape and diameter of 8 inches (1 inch = 0.0254 meter)

assuming MSLP = 1013.25 hPa or 101325 Pa

Sol.

$$W_{total} = \int P\,dV = P\,\Delta V = P(V_f - V_i)$$

$$\therefore W = \frac{\pi}{6} P d^3$$

where V_i = zero

$$d_m = 0.2032 \leftarrow \frac{8 \times 0.0254}{\text{inch}} \quad \text{m}$$

$$\simeq 0.2$$

$$\therefore W = \frac{\pi}{6} \times 101325 \times (0.2)^3$$

$$= 424 \text{ Joul}$$

the volume of the sphere

$$V = \frac{4}{3}\pi r^3$$

$$d = 2r \Rightarrow r = \frac{d}{2}$$

$$\therefore V = \frac{4}{3}\pi\left(\frac{d}{2}\right)^3$$

$$\Rightarrow V = \frac{4}{3}\pi\frac{d^3}{8}$$

$$\Rightarrow V = \frac{1}{6}\pi d^3$$

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it is the minimum work because we neglected the work done in stretching the latex that the balloon is made of.