



**MathsNET**

A joined up approach to  
teaching and learning  
mathematics

# Reservoirs and thermodynamic potentials

---

- What makes reservoirs a special kind of phase?
- Give an expression for the infinitesimal  $dH$ , where  $H$  is the enthalpy.
- What are the values of the following partial derivatives:  $(\frac{\partial H}{\partial P})_S$  and  $(\frac{\partial H}{\partial S})_P$
- Give an expression for the infinitesimal  $dF$ , where  $F$  is the Helmholtz free energy.
- What are the values of the following partial derivatives:  $(\frac{\partial F}{\partial V})_T$  and  $(\frac{\partial F}{\partial T})_V$

# Reservoirs and thermodynamic potentials

---

- Gibbs free energy** The Gibbs free energy is defined as  $G = H - TS$ , where  $H$  is the enthalpy. Use what you have learnt from the video to find an expression for the infinitesimal  $dG$  and the values of  $\left(\frac{\partial G}{\partial P}\right)_T$  and  $\left(\frac{\partial G}{\partial T}\right)_P$
  
- Grand potential** The Grand potential is defined as  $\Omega = E - TS - \sum_i \mu_i n_i$ . Use what you have learnt from the video to find an expression for the infinitesimal  $d\Omega$ . You will need to use an extended form of the first and second laws of thermodynamics:  $dE = TdS - PdV + \sum_i \mu_i dn_i$ . Use the expression you derived to find values for  $\left(\frac{\partial \Omega}{\partial V}\right)$ ,  $\left(\frac{\partial \Omega}{\partial T}\right)$  and  $\left(\frac{\partial \Omega}{\partial \mu_i}\right)$