

(1) Definition (40%)

- (a) Boyle Temperature
- (b) Critical Point
- (c) Isolate System
- (d) Adiabatic change
- (e) The Second Law of Thermodynamics
- (f) Chemical Potential
- (g) Ideal Solution
- (h) Phase

(2) An electric battery is charged by supplying 250 kJ of energy to it as electrical work, but in the process it loses 25 kJ of energy as heat to the surroundings. What is the change in internal energy of the battery? (15%)

(3) Calculate the change in molar entropy when a sample of hydrogen gas expands isothermally to twice its initial volume. (15%)

(4) Calculate the difference between  $G_m$  and  $G_m^\ominus$  for a gas when the pressure falls from 1.00 bar to 0.5 bar as a result of a reaction at 25°C ( $G_m$ : molar Gibbs Energy) (15%)

(5) One biochemical reaction has a standard Gibbs energy of  $-20 \text{ kJmol}^{-1}$  and a second biochemical reaction has a standard Gibbs energy of  $-100 \text{ kJmol}^{-1}$ . What is the ratio of their equilibrium constants at 310 k? (15%)

Table 1.2 The gas constant in various units

$R$
$8.31451 \text{ JK}^{-1} \text{ mol}^{-1}$
$8.20578 \times 10^{-2} \text{ L atm K}^{-1} \text{ mol}^{-1}$
$8.31451 \times 10^{-2} \text{ L bar K}^{-1} \text{ mol}^{-1}$
$8.31451 \text{ Pa m}^3 \text{ K}^{-1} \text{ mol}^{-1}$
$62.364 \text{ L Torr K}^{-1} \text{ mol}^{-1}$
$1.98722 \text{ cal K}^{-1} \text{ mol}^{-1}$