



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – JULY 2005
PHYSICAL CHEMISTRY I – SCH 2104
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer ALL questions. Each question carries 20 marks.

1. What do you understand by the terms "*Bond and Resonance Energy*".
2. Two litres of H_2 initially at STP are expanded to a volume of four litres. Calculate the work done in joules.
3. Gas evolved during the fermentative growth of a bacterial culture had a volume of 580cm^3 at 17°C . What was the volume of this gas at the growth of 37°C . Assume STP conditions.
4. The gas pressure in a fixed vessel of fixed volume was to be reduced to 1kPa , but the vacuum pump could lower the pressure only to $1,5\text{kPa}$ at 17°C . Could the required vacuum be obtained by cooling to 25°C ?
5. State the four Laws of Thermodynamics.

End of question Paper!!!

SELECTED SI UNITS AND CONVERSION FACTORS^a

(See also Appendix D, p. 820)

Physical Quantity	Name of Unit	Symbol
BASIC UNITS		
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
DERIVED UNITS		
Force	newton	N = kg m s ⁻² = J m ⁻¹
Pressure	pascal	N m ⁻²
Energy	joule	J = kg m ² s ⁻² = N m
Electric charge	coulomb	C = A s
Electric potential difference	volt	V = N m C ⁻¹ = kg m ² s ⁻² A ⁻¹
Frequency	hertz	Hz = s ⁻¹
CONVERSION FACTORS		
1 Å = 10 ⁻¹⁰ m		1 eV = 10 ⁻⁷ J
1 liter = 10 ⁻³ m ³		1 cal = 4.1840 J
1 atm = 101,325 N m ⁻²		1 eV = 1.6022 × 10 ⁻¹⁹ J
0°C = 273.15 K		1 cm ⁻¹ = 1.9865 × 10 ⁻²³ J

VALUES OF PHYSICAL AND CHEMICAL CONSTANTS

(In SI units and based on the 1973 scale)

Speed of light	$c = 2.997925 \times 10^8 \text{ m s}^{-1}$
Mass of electron	$m = 9.1095 \times 10^{-31} \text{ kg}$
Electronic charge	$e = 1.6022 \times 10^{-19} \text{ C}$
Planck constant	$h = 6.6262 \times 10^{-34} \text{ J s}$
Boltzmann constant	$k = 1.3807 \times 10^{-23} \text{ J K}^{-1}$
Avogadro constant	$N_A = 6.0220 \times 10^{23} \text{ mol}^{-1}$
Gas constant	$R = 8.3144 \text{ J K}^{-1} \text{ mol}^{-1}$
Faraday constant	$F = 96485 \text{ C mol}^{-1}$
Permittivity	$\epsilon_0 = 8.8542 \times 10^{-12} \text{ C}^2 \text{ V}^{-2} \text{ m}^{-1}$
Bohr radius	$a_0 = 5.2918 \times 10^{-11} \text{ m} = 0.5292 \text{ Å}$
Atomic mass unit	$1 \text{ amu} = 1.66053 \times 10^{-27} \text{ kg}$
Standard molar gas volume	$V_m = 24.414 \text{ liters}$
kT at 25°C (298.15 K)	$4.116 \times 10^{-21} \text{ J}$
RT at 25°C (298.15 K)	$2.479 \text{ kJ mol}^{-1}$

ENERGY CONVERSION FACTORS[†]

kJ mol^{-1}	kcal mol^{-1}	J molecule^{-1}	eV	cm^{-1}
1 kJ mol ⁻¹	1	1.6605 × 10 ⁻²⁴	0.010363	83.591
1 kcal mol ⁻¹	4.1840	6.9478 × 10 ⁻²⁴	0.043360	349.73
1 J molecule ⁻¹	6.0220 × 10 ²³	1.4393 × 10 ²⁴	6.2414 × 10 ²⁴	5.034 × 10 ²²
1 eV	96.480	23.062	1	8065
1 cm ⁻¹	0.011963	2.3534 × 10 ⁻³	1.9865 × 10 ⁻²³	1.2397 × 10 ⁻⁴

[†] Electron volts and wave numbers (cm⁻¹) are defined as amounts of energy per particle.