

DEPARTMENT OF CHEMISTRY
SCHOOL OF NATURAL AND APPLIED SCIENCES
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
FIRST SEMESTER EXAMINATION 2012/2013 SESSION

COURSE CODE: CHM211
COURSE TITLE: PHYSICAL CHEMISTRY II
TIME ALLOWED: 2 HOURS
INSTRUCTIONS: Answer any three questions

UNITS: 2

- Q1(a)** (i). Briefly explain the terms internal energy and enthalpy and show how they are related.
(ii). The work done when a gas is compressed in a cylinder is 462 J. During the process, there was heat transfer of 128 J from the gas to the surrounding. Calculate ΔE .
- (b). Nitroglycerine decomposes resulting in an explosion and causing a change of 5.72×10^3 kJ of heat per mole. $C_3H_5(NO_3)_3 \rightarrow 3CO_2(g) + 5/2H_2O(g) + 1/4O_2(g) + 3/2N_2(g)$
State whether the decomposition is exothermic or endothermic and draw the enthalpy diagram for the process.
- Q2(a)** (i). State the laws of thermochemistry.
(ii). Define the following terms "standard heat of formation", "standard heat of vaporization" and "specific heat capacity."
- (b). 30 g of a substance was heated in pure boiling water and transferred into a calorimeter containing 45 g of water at $25^\circ C$. The temperature of the water increase by 12%.
What is the specific heat capacity of the substance?
- Q3(a)** What is order of a reaction?
(b). A given first order reaction was 90% completed within a given period of time. Determine the ratio of this time to that of the reaction's half-life ($t_{1/2}$)
(c). Given the equation $aA + bB \rightarrow cC$. Assuming the concentration of A and B are **EQUAL**, $a = b = 1$, and the order of A and B are the same.
Derive the first order kinetics equation of the reaction.
- Q4(a)** State Hess' law.
(b). Determine the enthalpy of the reaction; $C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g)$ from the equations below using Hess' law
i. $C(\text{graphite}) + O_2(g) \rightarrow CO_2(g) \quad \Delta H_{rxn} = -393.5 \text{ kJ}$
ii. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l) \quad \Delta H_{rxn} = -571.0 \text{ kJ}$
iii. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) \quad \Delta H_{rxn} = -890.0 \text{ kJ}$
(c). Using a **diagram only**, describe the collision theory of gas molecules when temperature was raised from T_1 to T_2