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

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

**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 acylinder is 462J. During the process, there was heat transfer of 128J from the gas to the surrounding. Calculate $\Delta E$.

**(b).** Nitroglycerinedecomposes resulting in an explosion and causing a change of $5.72 \times 10^3$kJ of heat per mole. $C_3H_5(NO_3)_3 \rightarrow 3CO_2(g) + 5/2H_2O(g) + 1/4O_2(g) \backslash = 3/2N_2(g)$

State whether the decomposition is exothermic or endothermic and draw the enthalpy diagram for the process.

**Q2(ai).** State the laws of thermochemistry.

**(ii).** Define the following terms " standard heat of formation", " standard heat of vaporization" and "specific heat capacity."

**(b).** 30g of a substance was heated in pure boiling water and transferred into a calorimeter containing 45g of water at 25°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; $C(graphite) + 2H_2(g) \rightarrow CH_4(g)$ from the equations below using Hess' law

i. $C(graphite) + O_2(g) \rightarrow CO_2(g)$ $\Delta H_{rxn} = -393.5kJ$
ii. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ $\Delta H_{rxn} = -571.0kJ$
iii. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ $\Delta H_{rxn} = -890.0kJ$

**(c.).** Using a **diagram only**, describe the collision theory of gas molecules when temperature was raised from $T_1$ to $T_2$