※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Kinetic investigations are concerned with rate of concentration change of reactants and products. Consider, for example, a reaction

$$A \rightarrow products$$

The following figures show schematically the variations in concentrations of A under different experimental conditions. Figure (a) represents the concentrations of A changing over time without the presence of catalyst and Figure (b) represents the data collected with the presence of catalyst.
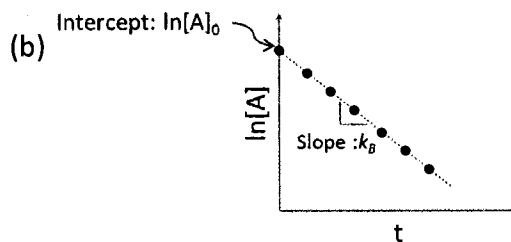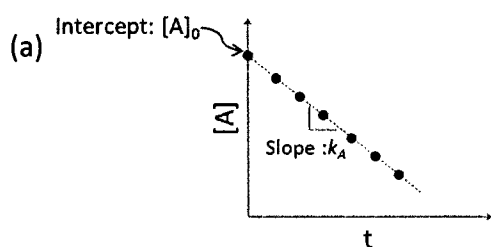
(1) Please define k_A and k_B. (4 points)

(2) Please derive the equations to express the concentration change of A over time using the parameters given ([A], $[A]_0$, t, k_A and k_B) for each reaction respectively. (16 point)

Note:　[A] is the concentration of compound A.

　　　　$[A]_0$ is the initial concentration of compound A.

　　　　t is time

2. Which of the following solutions has the lowest osmotic pressure? (10 points)

　Please state your reason and the theory or property you applied clearly for full credits.

　　(A) 0.15 M NaCl

　　(B) 0.10 M $CaCl_2$

　　(C) 0.15 M $Ba(NO_3)_2$

　　(D) 0.20 M NH_3

　　(E) 0.10 M $Al(NO_3)_3$

3. Please define the ΔH for a reaction. Use the bond dissociation energies given below to determine the value of ΔH (in kJ) for the following reaction. Based on the ΔH value you calculated, is this reaction an exothermic reaction? (10 points)

　　　　2 HCl (g) + F_2 (g) $\rightarrow$ 2 HF (g) + Cl_2 (g)
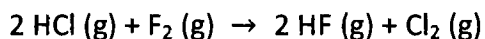
　　　　D(H–Cl) = 432 kJ/mol　　　D(F–F) = 155 kJ / mol

　　　　D(H–F) = 567 kJ/mol　　　　D(Cl–Cl) = 242 kJ / mol

4. A and B react exothermically to form a compound. A series of experiments is performed in which varying ratios of A to B are used, with a constant total number of moles, in each case. The observed temperature rise is plotted as the right figure. What is the simplest chemical formula for this compound? Please state your reason for full credits. (10 points)
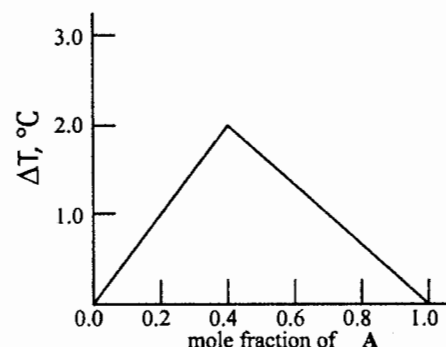
5. The potential energy curve shown on the right is for a reaction occurring with a catalyst.

　(1) Is this reaction an exothermic reaction? (2 points)

　(2) What kind of energy do E_1 and E_2 represent? (5 points)

　(3) **Please sketch a figure exactly the same as the right one on your answer sheet.** Draw a curve on the same diagram showing how the energy curve would look if the same reaction was run with no catalyst present. State your reason. (8 points)
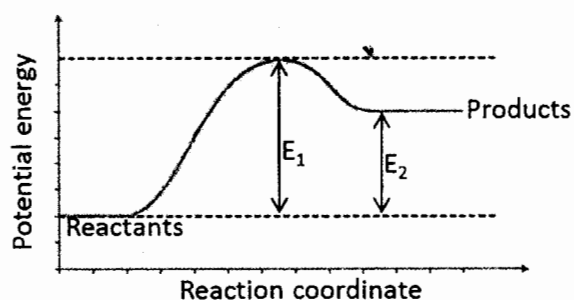
6. For the rate law involving a reaction of Br_2 and NO that is described completely by $d[NO]/dt = k [NO]^2$. The stoichiometric equation for the reaction is　$2NO + Br_2$ ---> $2NOBr$. If the rate of consumption of Br_2 molecules is 7.2×10^{-3} mol dm^{-3} s^{-1} when the initial concentration of Br_2, NO and NOBr were 10^{-2} mol dm^{-3}, 2×10^{-2} mol dm^{-3}, and 0 mol dm^{-3} (i.e., $[Br_2]_0 = 10^{-2}$ mol dm^{-3}; $[NO]_0 = 2 \times 10^{-2}$ mol dm^{-3}; $[NOBr]_0 = 0$ mol dm^{-3}).

　(1) What is the rate of consumption of NO? What is the rate of formation of NOBr? (8 point)

　(2) If the initial concentration of Br_2 is increased by a factor of 4 by what factor is the rate of consumption of NO molecules increased? Please state your reason. (7 points)

7. Sparkling wine is bottled under a CO_2 pressure of 4.0 atm. The solubility of CO_2 at 4.0 atm is 0.68 g/100 g H_2O. What is its solubility after the bottle is opened if the partial pressure of CO_2 is 4.0×10^{-4} atm? Please state you reason and the theory you apply clearly for full credits. (10 points)

8. A photon of light has a frequency of 2×10^{14} s^{-1} therefore

　(1) What is the wavelength (m)? (5 points)

　(2) What is the energy (J) of this one photon of light? (5 points)