

*****請標示清楚答案之題號*****

第一部份：選擇題（單選，每題 4 分，共 20 分；答錯一題倒扣 1 分）

- 1) Which of the following aqueous solutions is basic?
 - (a) KCN
 - (b) $Al_2(SO_4)_3$
 - (c) $FeCl_3$
 - (d) $NaNO_3$
 - (e) NH_4Cl

- 2) Which of the following ions has the smallest radius?
 - (a) K^+ (b) Li^+ (c) Be^{2+} (d) O^{2-} (e) F^-

- 3) Which of the following is a possible set of n , l , m , and s quantum numbers for the last electron added to form a gallium atom ($Z = 31$)?
 - (a) 3, 1, 0, $-\frac{1}{2}$ (b) 3, 2, 1, $\frac{1}{2}$ (c) 4, 0, 0, $\frac{1}{2}$ (d) 4, 1, 1, $\frac{1}{2}$ (e) 4, 2, 2, $\frac{1}{2}$

- 4) Which of the following equations correctly describes the relationship between K_b for the formate ion (HCO_2^-) and K_a for formic acid (HCO_2H)?
 - (a) $K_b = K_w \times K_a$ (b) $K_b = K_a/K_w$ (c) $K_b = K_w/K_a$
 - (d) $K_b = K_w + K_a$ (e) $K_b = K_w - K_a$

- 5) Which statement(s) correctly describes the following reaction?

$$3 Sn^{2+}(aq) + Cr_2O_7^{2-}(aq) + 14 H^+(aq) \rightleftharpoons 3 Sn^{4+}(aq) + 2 Cr^{3+}(aq) + 7 H_2O(l)$$
 - (a) Both the Sn^{2+} and H^+ ions are oxidizing agents.
 - (b) The $Cr_2O_7^{2-}$ ion is the oxidizing agent.
 - (c) The Sn^{2+} ion is reduced.
 - (d) The Sn^{4+} ion must be a weak reducing agent.
 - (e) None of the above are true.

第二部份：填充題（每題 3 分，共 30 分）

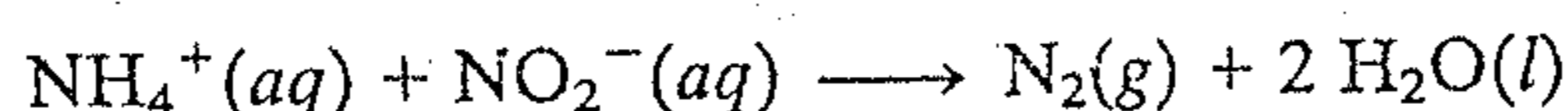
- 1) The molecular formula for *hydronium ion* is (a).
- 2) Both proteins and DNAs are biopolymers.
The repeating units for proteins are (b).
The repeating units for DNAs are (c).
- 3) Fats in human body are usually formed by the reaction of (d) and (e).
- 4) The following table is the relationship between the hybridization of the central atom and the molecular geometry.

Molecules	Hybridization	Molecular Geometry
CH_4	sp^3	Tetrahedral
CO_2	<u>(f)</u>	<u>(g)</u>
XeF_4	<u>(h)</u>	<u>(i)</u>
O_3	sp^2	<u>(j)</u>

第三部份：計算問答題（共 50 分）

1) Caffeine, a stimulant found in coffee, tea, chocolate, and some medications, contains 49.48% carbon, 5.15% hydrogen, 28.87% nitrogen, and 16.49% oxygen by mass and has a molar mass of 194.2. Determine the molecular formula of caffeine. (10)

2) Given the following experimental data determine the rate law for the reaction.

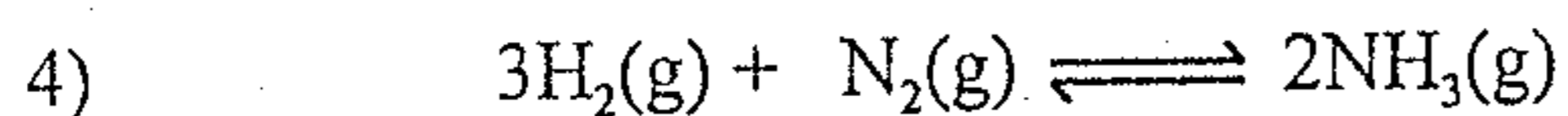


	Initial Concentration of NH_4^+ (M)	Initial Concentration of NO_2^- (M)	Initial Instantaneous Rate of Reaction (M/s)	
Trial 1	5.00×10^{-2}	2.00×10^{-2}	2.70×10^{-7}	(10)
Trial 2	5.00×10^{-2}	4.00×10^{-2}	5.40×10^{-7}	
Trial 3	1.00×10^{-1}	2.00×10^{-2}	5.40×10^{-7}	

3) At 50 °C the value of K_w , the dissociation constant for water, is 5.47×10^{-14} .

(a) Using Le Chatelier's principle, predict whether the autoionization of water is exothermic or endothermic? (5)

(b) Calculate the pH of pure water at 50 °C. (5)



(a) Calculate the standard-state enthalpy (ΔH°), entropy (ΔS°), and free energy (ΔG°) of the above reaction. (15)

(b) Predict the direction of the spontaneous reaction under standard state conditions. (5)

* Note: The standard enthalpy of formation (ΔH_f°) for $\text{NH}_3(\text{g})$ is -46 (kJ/mol).

The standard entropy values (S°) for $\text{H}_2(\text{g})$, $\text{N}_2(\text{g})$ and $\text{NH}_3(\text{g})$ are +131 (J/Kmol), +192 (J/Kmol), and +193 (J/Kmol), respectively.