

單選題 (共 20 題, 每題 5 分, 答錯倒扣 2 分, 共 100 分) (考生應作答於『答案卡』)

- Which of the following statements is correct?
 - During the polymerization, polyether would not produce small molecules
 - Cross-linking will decrease glass transition temperature (T_g)
 - The light scattering method can be used to measure M_w of polymer
 - A polymer is a large molecule made up of many small repeating units via ionic bonds
- Which polymer is made through free-radical addition polymerization?
 - Polyamide
 - Polyethylene Terephthalate
 - Polypropylene
 - Polycarbonate
- For a reaction with the rate law: $\text{Rate} = [X]^1[Y]^2[Z]^1$, the overall order of the reaction is
 - 1
 - 2
 - 3
 - 4
- A chemist needs to prepare a solution buffered at pH 4.80 using one of the following acids (and its sodium salt):
 - chloroacetic acid ($K_a = 1.35 \times 10^{-3}$)
 - propanoic acid ($K_a = 1.3 \times 10^{-5}$)
 - hypochlorous acid ($K_a = 3.5 \times 10^{-8}$)
 - benzoic acid ($K_a = 6.4 \times 10^{-5}$)
- Which one of the following sets of quantum numbers is not possible?
 - $n=3 \quad l=1 \quad m_l=2 \quad m_s=-1/2$
 - $n=4 \quad l=3 \quad m_l=-2 \quad m_s=+1/2$
 - $n=2 \quad l=0 \quad m_l=0 \quad m_s=+1/2$
 - $n=1 \quad l=1 \quad m_l=1 \quad m_s=-1/2$
- The maximum number of electrons that occupy an energy level described by the principal quantum number (n) is
 - $n-1$
 - n
 - n^2
 - $2n^2$
- Please describe at which condition we would get the maximized buffer capacity.
 - $[H^+] = 100K_a$
 - $[H^+] = 10K_a$
 - $[H^+] = K_a$
 - $[H^+] = 0.1K_a$

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8. A buffered solution contains 0.45 M NH_3 ($K_b = 1.8 \times 10^{-5}$) and 0.20 M NH_4Cl . Calculate the pH of this solution.
- (A) 9.61
(B) 8.05
(C) 7.83
(D) 4.41
9. Calculate the pH of the solution that results when 0.20 mol of gaseous HCl is added to 1.0 L of the buffered solution from Question 8.
- (A) 10.13
(B) 9.05
(C) 6.33
(D) 5.21
10. Which one of the following statements about standard states is incorrect?
- (A) The standard state of an element is the form in which it is stable at 1 atm and a specified temperature, usually 25°C .
(B) The standard state of a gaseous compound is the gas at a pressure of 1 atmosphere.
(C) The standard state of a liquid compound is the pure liquid.
(D) The standard state of an aqueous solute is a saturated solution in water.
11. Chlorine reacts with NO to form NOCl . The reaction, $\text{NO} + 1/2\text{Cl}_2 \rightarrow \text{NOCl}$, proceeds as follows:

Experiment Number	$[\text{NO}]$	$[\text{Cl}_2]$	Initial Rate (M/min)
1	0.110	0.0320	0.120
2	0.330	0.0320	1.08
3	0.220	0.0160	0.240

Based on the data above, the rate equation for the reaction is

- (A) $\text{Rate} = k[\text{NO}]$
(B) $\text{Rate} = k[\text{NO}]^2$
(C) $\text{Rate} = k[\text{NO}]^2[\text{Cl}_2]$
(D) $\text{Rate} = k[\text{NO}][\text{Cl}_2]^{1/2}$

For the reactant X involved in the reaction $xX \rightarrow \text{products}$, the initial concentration of X (X_0) is 2.00M, and the first three successive half-lives are 40.0, 80.0, and 160.0 min.

12. The rate constant k (without units) is:

- (A) 5.00×10^{-2}
(B) 6.25×10^{-3}
(C) 1.79×10^{-3}
(D) None of the above

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13. The Balmer series describes the spectral line emissions of which atom?
- (A) hydrogen
 - (B) helium
 - (C) nitrogen
 - (D) oxygen
14. Please select which statement is incorrect?
- (A) There is only one equilibrium constant for a particular system at a particular temperature, but there are an infinite number of equilibrium positions
 - (B) The apparent units for K are determined by the powers of the various concentration terms and thus depend on the reaction being considered.
 - (C) The equilibrium expression for a reverse reaction is the reciprocal of that for the original reaction.
 - (D) The concentrations of reactants and products are the same at equilibrium.
15. Which of the following microscopy techniques cannot be used for the study of the structure of the solid surface, properties, and arrangement of any adsorbed molecules?
- (A) Transmission electron microscopy
 - (B) Fluorescence microscopy
 - (C) Scanning tunneling microscopy
 - (D) Atomic force microscopy
16. Under the same conditions of temperature and pressure, the rates of diffusion of different gases are
- (A) Directly proportional to the square root of the molecular masses
 - (B) Directly proportional to the square root of the vapor densities
 - (C) Inversely proportional to the square roots of their molecular masses
 - (D) Inversely proportional to the square roots of their molar volumes
17. The kinetic gas equation is given by the relation
- (A) $PV = \frac{1}{3} mN\mu^2$
 - (B) $PV = \frac{1}{2} mN\mu^2$
 - (C) $PV = \frac{1}{4} mN\mu^2$
 - (D) $PV = mN\mu^2$
18. The compressibility factor (z), i.e. the extent to which a real gas deviates from ideal behavior is given by
- (A) $z = PV/RT^2$
 - (B) $z = PV/2RT$
 - (C) $z = PV/RT$
 - (D) $z = 2PV/RT$
19. For a particle in a cubic box ($L_x=L_y=L_z$), how many degenerate energy levels have energy equal to $14 h^2/8 mL^2$?
- (A) 3
 - (B) 4
 - (C) 5
 - (D) 6

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20. Which of the processes below is a reversible expansion of a gas?

- (A) Expansion of a gas in the vacuum
- (B) Controlled expansion of a gas against a pressure of 1 atm
- (C) Controlled expansion, with the gas pressure in equilibrium with the external pressure
- (D) Isothermal expansion of a gas

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