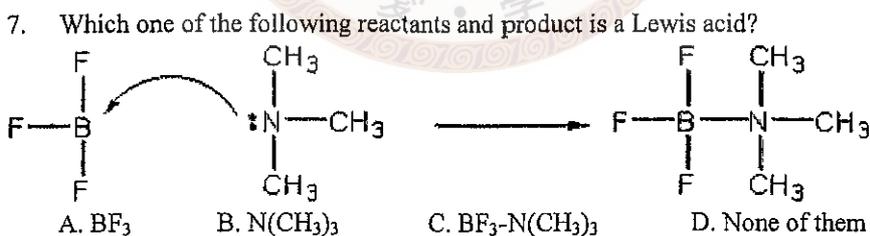※ 注意：請於試卷上「選擇題作答區」依序作答。

Section A: (60%)

1. What is the oxidation number of V in V_2O_5?
   A. +5 　　 B. +6 　　 C. +7 　　 D. –7

2. If the half life of a reaction with respect to a reactant concentration is $0.693/k$, what is the reaction order of the reactant?
   A. First order 　　 B. Second order 　　 C. Third order 　　 D. Zero order

3. Which of the following statements is a wrong description of the ideal gas model?
   A. There is no interaction among the gas molecules
   B. The collision between two gas molecules is totally elastic
   C. The volume of each gas molecule is perfectly spherical
   D. Each molecule is undergoing linear motion between collisions

4. Which of the following is not an ionic compound?
   A. $Ca_5(PO_4)_3OH$ 　　 B. $CaHPO_4$ 　　 C. SiO_2 　　 D. $NaNO_3$

5. Calculate the molarity of pure water.
   A. 10 M 　　 B. 1.0 M 　　 C. 55.6 M 　　 D. 5.5 M

6. For any spontaneous chemical reactions in a beaker at constant temperature, which of the following condition must be satisfied?
   A. $\Delta S_{system} \geq 0$ 　　 B. $\Delta H - T\Delta S_{system} < 0$
   C. $\Delta G \geq 0$ 　　 D. $\Delta S_{universe} < 0$

7. Which one of the following reactants and product is a Lewis acid?

   A. BF_3 　　 B. $N(CH_3)_3$ 　　 C. $BF_3\text{-}N(CH_3)_3$ 　　 D. None of them

8. Consider a mineral salt perovskite $MgSiO_3$. If some of the Si atoms are substituted by Al, determine the value x for the resultant non-stoichiometric perovskite compound $MgSi_{0.95}Al_{0.05}O_x$.
   A. 2.9 　　 B. 2.95 　　 C. 2.975 　　 D. 3

接 背 面

9. The molecular shape of BF_3 is
   A. trigonal planar   B. T-shape   C. tetrahedral   D. linear

10. The compound 2-germaacetic acid (GeH_3COOH), is an unstable weak acid. At 25°C, a 0.050 M solution of 2-germaacetic acid has a pH of 2.42. Determine the K_a of 2-germaacetic acid.
    A. 3.12×10^{-4} B. 0.076   C. 2.42   D. 0.38

11. Which of the following species can function as an enzyme in organisms?
    A. DNA   B. protein   C. cellulose   D. fatty acids

12. Refer to the following wavefunction calculated for a particle in a one-dimensional box,
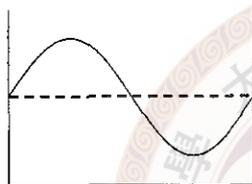
    the probability that a particle will appear in the middle of the box is
    A. 0.0   B. 1.0   C. 0.5   D. 0.25

13. For a solution of 34 wt% HNO_3, calculate the molarity of the acid if the density of the solution is identical to pure water.
    A. 8 M   B. 6.1 M   C. 5.4 M   D. 7.1 M

14. Which of the following compound does not have sp^2 hybrid orbitals?
    A. diamond   B. graphite   C. benzene   D. C_2H_4

15. Consider the most stable Lewis structure of SO_4^{2-}, what is the formal charge of S?
    A. –2   B. –1   C. 0   D. +1

16. For a $[H^+]$ concentration of 0.02040 M, the pH value should read
    A. 1.69036   B. 1.6904   C. 1.690   D. 1.69

17. Which of the following statement is CORRECT?
    A. Orbital means electron density
    B. For orbitals with the same l quantum number (same shape), the larger the orbital, the higher the energy
    C. Experimentally we can measure the shape of an orbital
    D. The 2s and 2p orbitals are degenerate for a carbon atom

接 次 頁

18. For proteins or polypeptides, the descriptions of β-sheets, α-helices or turns belong to the category of
    A. primary structure   B. secondary structure   C. tertiary structure
    D. quaternary structure

19. Which one of the following statement is WRONG?
    A. The higher the temperature, the faster the rate of the reaction.
    B. Reaction rate is higher when the reaction is more exothermic.
    C. Reaction rate is higher when the surface areas of the reactants are larger.
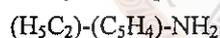   D. For a zero-order reaction, the reaction rate is independent of the reactant concentration.

20. What is the overall reaction order of the following rate law?
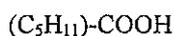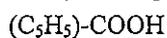
    $Rate = k[A][B]^{\frac{1}{2}}$

    A. 1½   B. 1   C. ½   D. –1½

Section B: (40%)

1. (a) Identify and explain which of the following bases is the weaker one **(5%)**:
      $(H_5C_2)-(C_5H_4)-NH_2$
      $(O_2N)-(C_5H_4)-NH_2$
   (b) Identify and explain which of the following acids is the weaker one **(5%)**:
      $(C_5H_5)-COOH$
      $(C_5H_{11})-COOH$

2. The equilibrium constants of H_3PO_4 are given as:
   $K_{a1} = 7.5 \times 10^{-3}$, $K_{a2} = 6.2 \times 10^{-8}$, $K_{a3} = 4.8 \times 10^{-13}$
   (a) Explain why K_{a2} is smaller than K_{a1} but larger than K_{a3}. **(5%)**

   (b) Calculate the ratio $[H_3PO_4]/[HPO_4^{2-}]$ and determine the mole fraction of HPO_4^{2-} at pH = 7.405. **(15%)**

3. The best laboratory vacuum system can pump down to as few as 1.0×10^9 molecules per cubic meter of gas. Calculate the corresponding pressure, in atmospheres, assuming a temperature of 0°C. **(10%)**

試題必須隨卷繳回