112BE02

國立臺北科技大學112學年度碩士班招生考試

系所組別：3602

化學工程與生物科技系生化與生醫工程碩士班

第一節　普通化學　試題 (選考)

注意事項：

1.本試題共 40 題，每題 2.5 分，共 100 分。
2.不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

Choose the **BEST** answer of the multiple-choice questions **(2.5 points/question)**

1. Which of the following is true about a system at equilibrium?
   A) The concentration(s) of the reactant(s) is equal to the concentration(s) of the product(s).
   B) No new product molecules are formed.
   C) The concentration(s) of reactant(s) is constant over time.
   D) The rate of the reverse reaction is equal to the rate of the forward reaction and both rates are equal to zero.
   E) None of these choices are true.
2. For the reaction $H_2(g) + Cl_2(g) \rightleftarrows 2HCl(g)$, $K_c = 5.14 \times 10^{25}$ at a temperature of 391 K. What is Kp at this temperature?
   A) 5.14×10^{25}
   B) 1.65×10^{27}
   C) 1.60×10^{24}
   D) 5.30×10^{28}
   E) 5.00×10^{22}
3. The compound $MgCl_2$ is named
   A) magnesium chlorine
   B) magnesium dichloride
   C) magnesium(II) chloride
   D) magnesium chloride
   E) dimagnesium chloride
4. In this list, which substance can be classified as a chemical?
   A) salt
   B) sleep
   C) cold
   D) heat
   E) temperature
5. A red blood cell will undergo hemolysis in
   A) Water
   B) 0.9% NaCl
   C) 5% glucose
   D) 5% NaCl
   E) 10% glucose
6. A sample of solid NH4NO3 was placed in an evacuated container and then heated so that it decomposed explosively according to the following equation:

   $$NH_4NO_3(s) \rightleftarrows N_2O(g) + 2H_2O(g)$$

   At equilibrium the total pressure in the container was found to be 2.77 atm at a temperature of 500. °C. Calculate K_p.
   A) 0.853
   B) 1.71
   C) 0.787
   D) 3.15
   E) 85.0
7. An autoclave is used to sterilize surgical equipment because
   A) it allows water to boil at temperatures less than 100 °C
   B) it allows water to boil at 100 °C at pressures less than 1 atm
   C) it allows water to boil at 100 °C at pressures greater than 1 atm
   D) it allows water to boil at temperatures above 100 °C
   E) it provides very high temperatures and very low pressures
8. Use the reaction: $2AgNO_3 + H_2SO_4 \rightarrow Ag_2SO_{4(s)} + 2H_2O_{(l)}$.
   What volume of 0.123 M $AgNO_3$ is needed to form 0.657 g of $Ag_2SO_{4(s)}$? (molecular weight of $AgNO_3$ is 169.87 g/mol)
   A) 34.2 L
   B) 17.1 mL
   C) 34.3 mL
   D) 0.7 mL
   E) 53.4 mL

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9. Vapor pressure can be described as
   A) the temperature at which bubbles of vapor appear in a liquid
   B) the pressure exerted on the Earth by the particles in the air
   C) the temperature at which the vapor pressure of a liquid equals atmospheric pressure
   D) the pressure exerted by a gas above the surface of its liquid
   E) the pressure within the lungs during inhalation

10. According to the Atomic Theory,
   A) all atoms are different.
   B) atoms are neither created nor destroyed during a chemical reaction.
   C) atoms of the same element combine to form compounds.
   D) all matter is made up of tiny particles called electrons.
   E) a compound can contain different numbers of atoms while it has the same kinds of atoms.

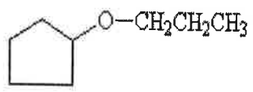
For the question(11 & 12) that follow, consider the following equation.

$$Mg_3N_{2(s)} + 6H_2O_{(l)} \rightarrow 3Mg(OH)_{2(s)} + 2NH_{3(g)}$$

11. How many grams of H2O are needed to produce 150 g of Mg(OH)2? (Mw of Mg = 24.3)
   A) 46 g
   B) 18 g
   C) 130 g
   D) 93 g
   E) 23 g

12. When 36.0 g of H2O react, how many grams of NH3 are produced?
   A) 34.0 g
   B) 10.0 g
   C) 5.67 g
   D) 102 g
   E) 11.3 g

13. What is the common name of this compound?

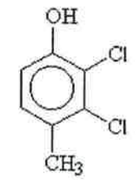


   A) cyclopentyl propyl ether
   B) cyclopentyl propyl ketone
   C) 1-cyclopropyl-1-propylalcohol
   D) propylcyclopentanol
   E) 3-cyclopentylpropanol

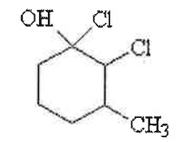
14. Of the elements: B, C, F, Li, and Na, the element with the largest atomic radius is
   A) B
   B) C
   C) F
   D) Li
   E) Na.

15. The condensed structural formula for 2,3-dichloro-4-methylcyclohexanol is

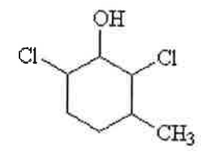
   A)



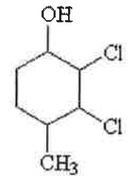
   B)



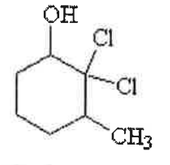
   C)



   D)



   E)



16. Ionization energy is
    A) the energy an ion acquires from an electron.
    B) the energy needed to remove an electron from the outermost energy level.
    C) highest for metals in Group 1A (1).
    D) higher for potassium than for lithium.
    E) higher for chlorine than for fluorine.

17. Absolute zero is
    A) the freezing point of water using the Celsius scale.
    B) the boiling point of liquid nitrogen.
    C) the temperature on the Kelvin scale corresponding to 32 °F.
    D) the coldest temperature possible.
    E) the freezing point of liquid nitrogen.

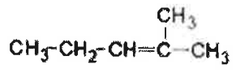
18. The molar solubility of _____ is not affected by the pH of the solution.
    A) Na_3PO_4
    B) NaF
    C) KNO_3
    D) $AlCl_3$
    E) MnS

19. Consider the reaction for which K = 38.5 at a high temperature. If an equimolar mixture of reactants gives the concentration of the product to be 0.50 M at equilibrium, determine the equilibrium concentration of the hydrogen.
    A) 1.1×10^{-1} M
    B) 8.1×10^{-2} M
    C) 4.0×10^{-2} M
    D) 1.2×10^{1} M
    E) 6.5×10^{-3} M

20. What is the correct answer for the $\frac{36 \times 0.12345}{6.77}$ calculation?
    A) 0.65645
    B) 0.656
    C) 0.66
    D) 1.52
    E) 1.5

21. The K_a of hypochlorous acid (HClO) is 3.0 × 10-8 at 25 °C. What is the percent ionization of hypochlorous acid in a 0.015 M aqueous solution of HClO at 25 °C
    A) 4.5×10^{-8}
    B) 14
    C) 2.1×10^{-5}
    D) 0.14
    E) 1.4×10^{-3}

22. What is the IUPAC name for the following compound?

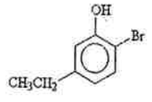


    A) 3-methyl-4-pentene
    B) 4-methyl-3-pentene
    C) 2-methyl-2-pentene
    D) 2-methyl-3-pentene
    E) hexene

23. An enantiomer is
    A) a stereoisomer that is not a mirror image of another molecule.
    B) a stereoisomer that is a mirror image of another molecule.
    C) a diastereoisomer.
    D) a structural isomer.
    E) a cis-trans isomer.

24. The Ka of benzoic acid is 6.30×10^{-5}. The pH of a buffer prepared by combining 50.0 mL of 1.00M potassium benzoate and 50.0 mL of 1.00 M benzoic acid is _____.
    A) 1.705
    B) 0.851
    C) 3.406
    D) 4.201
    E) 2.383

25. What is the name for this compound?



    A) 2-bromo-5-ethylcyclohexanol
    B) 2-bromo-5-ethylphenol
    C) 4-bromo-1-ethyl-5-phenol
    D) 6-bromo-3-ethylphenol
    E) 2-bromo-5-methylphenol

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26. Which of the following is arranged correctly in order of increasing distance from Earth's surface?
    A) mesosphere < troposphere < stratosphere < thermosphere
    B) troposphere < mesosphere < stratosphere < thermosphere
    C) troposphere < mesosphere < thermosphere < stratosphere
    D) troposphere < stratosphere < mesosphere < thermosphere
    E) mesosphere < troposphere < thermosphere < stratosphere

27. Which of the following is a buffer system?
    A) H_3PO_4 and Na_2HPO_4
    B) HCl and NaOH
    C) H_2CO_3 and $KHCO_3$
    D) NaCl and NaOH
    E) H_2O and HCl

28. What is the common name of the ether that is an isomer of 2-propanol?
    A) isopropyl ether
    B) diethyl ether
    C) dimethyl ether
    D) ethyl methyl ether
    E) 1-propanol

29. The K_a of H_2CO_3 is 4.3×10^{-7}. What is the pH of a buffer with 0.10 M H_2CO_3 and 0.010 M $NaHCO_3$?
    A) 4.3×10^{-7}
    B) 7.63
    C) 6.37
    D) 5.37
    E) 7.37

30. The source of energy for red blood cells is
    A) amino acids.
    B) lactate.
    C) fatty acids.
    D) glycerol.
    E) glucose.

31. The second law of thermodynamics states that _____.
    A) $\Delta E = q + w$
    B) $\Delta H°rxn = \Sigma n\Delta H°f$ (products) - $\Sigma m\Delta H°f$ (reactants)
    C) for any spontaneous process, the entropy of the universe increases
    D) the entropy of a pure crystalline substance is zero at absolute zero
    E) $\Delta S = qrev/T$ at constant temperature

32. Which of the following is an example of a quantitative observation?
    A) The piece of metal is longer than the piece of wood.
    B) Solution 1 is much darker than solution 2.
    C) The liquid in beaker A is blue.
    D) The temperature of the liquid is 60°C.
    E) At least two of these are quantitative observations.

33. The concentration of fluoride ions in a saturated solution of barium fluoride is _____ M. The solubility product constant of BaF2 is 1.7×10^{-6}
    A) 3.8×10^{-4}
    B) 3.0×10^{-3}
    C) 1.5×10^{-2}
    D) 7.5×10^{-3}
    E) 1.4×10^{-4}

34. Which of the following molecules has a nonlinear structure?
    A) XeF_2
    B) $BeCl_2$
    C) O_3
    D) CO_2
    E) N_2O (central atom is N)

35. The molecular structure of PF^{6-} is:
    A) pyramidal.
    B) tetrahedral.
    C) square planar.
    D) octahedral.
    E) none of these are correct.

36. Which of the following statements is incorrect?
    A) Scientific method is looking at the world differs from nonscientific forms of inquiry.
    B) The scientific method does not allow for the use of inferences, and everything must be proven by direct observation.
    C) A theory is a guess about the behavior or properties of matter.
    D) Scientists must isolate and study one variable at a time when performing experiments.
    E) A behavior of matter that has universal validity is called a natural law.

37. Which of the following is incorrectly named?

A) $Pb(NO_3)_2$, lead(II) nitrate
B) PO_4^{3-}, phosphate ion
C) NH_4ClO_4, ammonium perchlorate
D) $Mg(OH)_2$, magnesium hydroxide
E) NO_3^-, nitrite ion

38. What is the missing product from this reaction?

$$^{32}_{15}P \rightarrow {}^{32}_{16}S + \_\_\_\_\_$$

A) $^{4}_{2}He$
B) $^{0}_{-1}e$
C) $^{0}_{0}\gamma$
D) $^{0}_{1}e$
E) $^{0}_{1}p$

39. In which of the compounds below is there more than one kind of hybridization (sp, sp^2, sp^3) for carbon?

I. $CH_3CH_2CH_2CH_3$
II. $CH_3CH{=}CHCH_3$
III. $CH_2{=}CH{-}CH{=}CH_2$
IV. $H{-}C{\equiv}C{-}H$

A) II and III
B) III and IV
C) I, II, and III
D) III only
E) II only

40. Which one is false?

A) 1.1 moles Na = 5.47 × 1023 atoms
B) 1 mole Al = 6.022×1023 atoms
C) 4.52 × 1023 molecules CH4 = 0.75 moles
D) 1.8 moles H2O = 1.08×10^{24} molecules
E) None of these are false.