

國立臺灣大學九十四學年度轉學生入學考試試題

科目：普通化學(B)

題號：35

共 6 頁之第 / 頁

題目共有四部分：I (60%)，II (10%)，III (15%)，IV (15%)，請依題序將答案寫在答案紙上。寫在題目紙上者，不予計分。

( $h=6.62607 \times 10^{-34}$  Js,  $R=8.3145$  J mol<sup>-1</sup> K<sup>-1</sup>= 0.08206 L atm K<sup>-1</sup> mol<sup>-1</sup>)

I. Select the answer you think is most appropriate.(60%每題兩分)

1. The prefix for 10<sup>9</sup> is

- a) milli
- b) micro
- c) nano
- d) Giga

2. How many significant figures in:

(a) 5.0 (b) 0.050 (c)  $5 \times 10^2$  (d)  $5.00 \times 10^2$ ?

- a) 2,3,2,2
- b) 2,2,1,3
- c) 2,3,2,3
- d) 2,3,1,3

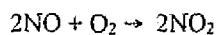
3. How many moles of oxygen atoms are in one mole of Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>?

- a) 3
- b) 4
- c)  $7.22 \times 10^{24}$
- d) 12

4. How many grams of H are in 2.75 moles of H<sub>2</sub>O?

- a) 5.5440
- b) 2.772
- c) 5.54
- d) 2.77

5. How many moles of the excess reagent will be left if 10.0 g of NO react with 10.0 g of O<sub>2</sub>?



- a) 0.312 moles
- b) 0.146 moles
- c) 0.667 moles
- d) 0.333 moles

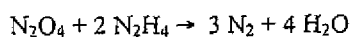
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科目：普通化學(B)

題號：35

共 6 頁之第 > 頁

6. How many grams of  $N_2$  will be produced from 15.0 g of  $N_2O_4$ ?



- a) 45.0 g
- b) 13.7 g
- c) 15.0 g
- d) 4.50 g

7. For the same reaction above, what is the limiting reagent if one started with 42.5 g  $N_2O_4$  and 25.4 g  $N_2H_4$ ?

- a)  $N_2O_4$
- b)  $N_2H_4$

8. What is the molarity of a solution made by diluting 20.0 mL of 3.00 M NaOH with 40.0 mL of  $H_2O$ ?

- a) 3.12 M
- b) 1.00 M
- c) 1.80 M
- d) 3.24 M

9. How many molecules of  $I_2$  are in 25.0 mL of 0.124 M solution of  $I_2$ ?

- a)  $3.10 \times 10^3$  molecules of  $I_2$
- b)  $3.10 \times 10^{21}$  molecules of  $I_2$
- c)  $1.87 \times 10^3$  molecules of  $I_2$
- d)  $1.87 \times 10^{21}$  molecules of  $I_2$

10. 42.0 mL of  $Pb(NO_3)_2(aq)$  solution react with 25.0 mL of 0.140 M NaCl solution. What is the molarity of the  $Pb(NO_3)_2(aq)$  solution?

- a)  $3.50 \times 10^3$  M
- b)  $4.17 \times 10^3$  M
- c)  $1.75 \times 10^3$  M

11. Suppose an osmotic membrane separates a 5.00 % sugar solution from a 10.0 % sugar solution. Which solution will become diluted as osmosis takes place.

- a) 5.00% sugar solution
- b) 10.0% sugar solution

國立臺灣大學九十四學年度轉學生入學考試試題

題號：35

科目：普通化學(B)

共 6 頁之第 3 頁

12. An 8.30 kg piece of metal at 53.0°C is placed in 1.00 kg of water at 23.0°C. If the specific heat of the metal is 0.500 J/g-°C, what is the final temperature of the water? Specific heat of water = 4.184 J/g-°C
- a) 38.0 °C
  - b) 23.5 °C
  - c) 44.2 °C
  - d) 18.7 °C
13. 4 ice cubes are at 0.00°C, each with a volume of 1.00 in<sup>3</sup>; How much heat is needed to melt the ice cubes? Density of ice is 0.917 g/cm<sup>3</sup> and the heat of fusion of ice is 333 J/g-°C.
- a) 2.00 x 10<sup>4</sup> kJ
  - b) 2.00 x 10<sup>4</sup> cal
  - c) 2.00 x 10<sup>4</sup> J
  - d) 2.00 x 10<sup>4</sup> kcal
14. What is the wavelength of a radio station that broadcasts at a frequency of 100.3 MHz?,
- a) 3.009 x 10<sup>16</sup> m
  - b) 3,000 x 10<sup>3</sup> m
  - c) 2.991 m
  - d) 5.001 x 10<sup>2</sup> m
15. There are 14 f orbitals in the n = 2 shell..
- a) True
  - b) False
16. Find the energy in J/mol for light of wavelength 6220 nm.
- a) 3.20 x 10<sup>-20</sup> J/mol
  - b) 1.29 x 10<sup>1</sup> J/mol
  - c) 1.29 x 10<sup>4</sup> J/mol
  - d) 3.20 x 10<sup>-1</sup> J/mol
17. Which of the following is isoelectronic to As?
- a) P
  - b) Sb<sup>+</sup>
  - c) Se<sup>-1</sup>
  - d) Kr<sup>3+</sup>

國立臺灣大學九十四學年度轉學生入學考試試題

題號：35

科目：普通化學(B)

共 6 頁之第 4 頁

18. Al has a lower first ionization energy than Mg.

- a) False
- b) True

19. Predict which pair(s) of elements will form ionic compounds.

- a) Cs, F
- b) Cl, O
- c) H, H
- d) Ba, O

20. The number of valence electrons for  $S^{2-}$  is:

- a) 2
- b) 4
- c) 6
- d) 8

21. How many valence electrons are there in  $PO_4^{3-}$ ?

- a) 23
- b) 29
- c) 32
- d) 26

22. Which of the following bonds is the most polar?

- a) C-N
- b) C-H
- c) C-Br
- d) C-O

23. A compound with a total coordination number (number of electron dense regions) of 5 will have the electron regions distributed as

- a) Trigonal Planar
- b) Tetrahedral
- c) Trigonal Bipyramidal
- d) Octahedral

24. Give the molecular geometry for  $NH_2^-$

- a) Linear
- b) Tetrahedral
- c) Trigonal pyramidal
- d) Bent

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科目：普通化學(B)

共 6 頁之第 5 頁

25. Give the molecular geometry for  $I_3$ .
- a) Trigonal bipyramid
  - b) Trigonal planar
  - c) Linear
  - d) Bent
26. Identify the hybridization state of  $NO_2^-$ .
- a)  $sp^3$
  - b)  $sp$
  - c)  $sp^3d$
  - d)  $sp^2$
27. Which of the following statements is INCORRECT?
- a) Air at 1 atm pressure will support a column of Hg 760 mm high.
  - b) The atmospheric pressure on earth is always 760 torr.
  - c) A barometer is a device for measuring pressure.
  - d) Pressure is the force per unit area.
28. Which is true for 8.00 g of He at STP?
- a) It has a pressure of 2.00 atm.
  - b) It has a volume of 22.4 L.
  - c) It has a temperature of 0K.
  - d) It has a volume of 44.8 L.
29. Uranium reacts with fluorine to produce a compound which is a gas at  $57^\circ C$ . The density of this gas is 13.0 g/L at  $7^\circ C$  and 1 atm. pressure. What is the molecular formula of this compound?
- a)  $UF_2$
  - b)  $UF_3$
  - c)  $UF_4$
  - d)  $UF_6$
30. A sample of oxygen gas is collected over water at  $23^\circ C$  and a barometer pressure of 751 torr. The vapor pressure of water at  $23^\circ C$  is 21 torr. What is the partial pressure of  $O_2$  (g) in the collected sample?
- a) 21 torr
  - b) 772 torr
  - c) 730 torr
  - d) 728 torr

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共 6 頁之第 6 頁

II. Draw the structures corresponding to the following names: (10%)

- a) Oxalic acid
- b) Ethyl phenyl ether
- c) 3,3-Diethyl-6-methyl-4-nonene
- d) 1,1-Dimethylcyclopentane

III. If 10 ml of an unknown gas takes 6.3 seconds to pass through small orifice while 10 ml of a standard gas, Oxygen  $O_2$  takes 5.6 seconds to pass through the same orifice under the same conditions of temperature and pressure, what will be the molecular mass of the unknown gas? (15%)

IV. When heated, the DNA double helix separates into two random-coil single strands. When cooled, the random coils reform the double helix:

(double helix)  $\leftrightarrow$  (2 random coils)

- (a) What is the sign of  $\Delta S$  for the forward process? Why (5%)
- (b) Energy must be added to overcome H-bonds and dispersion forces between the strands. What is the sign of  $\Delta G$  for the forward process when  $T\Delta S$  is smaller than  $\Delta H$ . (5%)
- (c) Write an expression that shows  $T$  in terms of  $\Delta H$  and  $\Delta S$  when the reaction is at equilibrium. (This temperature is called the melting temperature of the nucleic acid.) (5%)