

科目：普通化學 適用：應化系二

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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## 一. 選擇題: (70% 每小題 2%)

1. Convert 5687.4 g to mg.

- a) 5.6874 mg    b) 56.784 mg    c) 568.74 mg    d)  $5.6874 \times 10^3$  mg  
e)  $5.6874 \times 10^6$  mg

2. Express the volume  $245 \text{ cm}^3$  in liters.

- a) 245 L    b) 24.5 L    c) 2.45 L    d) 0.245 L    e) 0.0245 L

3. One second contains this many picoseconds.

- a)  $1 \times 10^{12}$     b)  $1 \times 10^{-12}$     c)  $1 \times 10^{-9}$     d)  $1 \times 10^9$     e)  $1 \times 10^{15}$

4. Which of the following atomic symbols is incorrect?

- a)  ${}^{14}_6\text{C}$     b)  ${}^{37}_{17}\text{Cl}$     c)  ${}^{32}_{15}\text{P}$     d)  ${}^{39}_{19}\text{K}$     e)  ${}^{14}_8\text{N}$

5. Which statement is *not* correct?

- a) The mass of an alpha particle is 7300 times that of the electron.  
b) An alpha particle has a  $2^+$  charge.    c) Three types of radioactive emission are gamma rays, beta rays, and alpha particles.  
d) A gamma ray is high-energy "light."  
e) There are only three types of radioactivity known to scientists today.

6. Which of the following are incorrectly paired?

- a) Phosphorus, Pr    b) Palladium, Pd    c) Platinum, Pt    d) Lead, Pb  
e) Potassium, K

7. A species with 12 protons and 10 electrons is

- a)  $\text{Ne}^{2+}$     b)  $\text{Ti}^{2+}$     c)  $\text{Mg}^{2+}$     d) Mg    e)  $\text{Ne}^{2-}$

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8. When the equation  $\text{C}_4\text{H}_{10} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$  is balanced with the smallest set of integers, the sum of the coefficients is

- a) 4   b) 28   c) 33   d) 15   e) 30

9. Iron is biologically important in the transport of oxygen by red blood cells from the lungs to the various organs of the body. In the blood of an adult human, there are approximately  $2.60 \times 10^{13}$  red blood cells with a total of 2.90 g of iron. On the average, how many iron atoms are present in each red blood cell? (molar mass (Fe) = 55.85 g)

- a)  $8.33 \times 10^{-10}$    b)  $1.20 \times 10^9$    c)  $3.12 \times 10^{22}$    d)  $2.60 \times 10^{13}$   
e)  $5.19 \times 10^{-2}$

10. A 51.24-g sample of  $\text{Ba}(\text{OH})_2$  is dissolved in enough water to make 1.20 liters of solution. How many mL of this solution must be diluted with water in order to make 1.00 liter of 0.100 molar  $\text{Ba}(\text{OH})_2$ ?

- a) 400. mL   b) 333 mL   c) 278 mL   d)  $1.20 \times 10^3$  mL   e) none of these

11. You mix 260. mL of 1.20 M lead(II) nitrate with 300. mL of 1.90 M potassium iodide. The lead(II) iodide is insoluble. Which of the following is false?

- a) The final concentration of  $\text{Pb}^{2+}$  ions is 0.0482 M.  
b) You form 131 g of lead(II) iodide.   c) The final concentration of  $\text{K}^+$  is 1.02 M.  
d) The final concentration of  $\text{NO}_3^-$  is 1.02 M.   e) All are true.

12. When  $\text{NH}_3(\text{aq})$  is added to  $\text{Cu}^{2+}(\text{aq})$ , a precipitate initially forms. Its formula is:

- a)  $\text{Cu}(\text{NH}_3)_4^{2+}$    b)  $\text{Cu}(\text{NO}_3)_2$    c)  $\text{Cu}(\text{OH})_2$    d)  $\text{Cu}(\text{NH}_3)_2^{2+}$    e)  $\text{CuO}$

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13. A solution contains the ions  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ , and  $\text{Ni}^{2+}$ . Dilute solutions of  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ , and  $\text{Na}_2\text{S}$  are available to separate the positive ions from each other. In order to effect separation, the solutions should be added in which order?

- a)  $\text{Na}_2\text{SO}_4$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{S}$    b)  $\text{Na}_2\text{SO}_4$ ,  $\text{Na}_2\text{S}$ ,  $\text{NaCl}$    c)  $\text{Na}_2\text{S}$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$   
d)  $\text{NaCl}$ ,  $\text{Na}_2\text{S}$ ,  $\text{Na}_2\text{SO}_4$    e)  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{Na}_2\text{S}$

14. What mass of  $\text{NaOH}$  is required to react exactly with 25.0 mL of 1.2 M  $\text{H}_2\text{SO}_4$ ?

- a) 1.2 g   b) 1.8 g   c) 2.4 g   d) 3.5 g   e) none of these

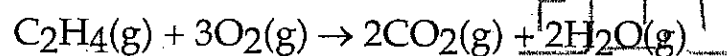
15. A sample of helium gas occupies 12.4 L at  $23^\circ\text{C}$  and 0.956 atm. What volume will it occupy at  $40^\circ\text{C}$  and 1.20 atm?

- a) 0.488 L   b) 6.28 L   c) 12.4 L   d) 10.4 L   e) 17.2 L

16. Which gas sample has the greatest number of molecules?

- a)  $\text{He}$    b)  $\text{Cl}_2$    c)  $\text{CH}_4$    d)  $\text{NH}_3$    e) all gases the same

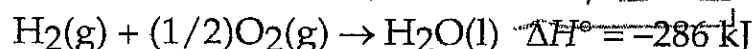
17. Gaseous  $\text{C}_2\text{H}_4$  reacts with  $\text{O}_2$  according to the following equation:



What volume of oxygen at STP is needed to react with 1.50 mol of  $\text{C}_2\text{H}_4$ ?

- a) 4.50 L   b) 33.6 L   c) 101 L   d) 67.2 L  
e) Not enough information is given to solve the problem.

18. Consider the reaction



Which of the following is true?

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- a) The reaction is exothermic. b) The reaction is endothermic. c) The enthalpy of the products is less than that of the reactants. d) Heat is absorbed by the system. e) Both a and c are true.

19. In Bohr's atomic theory, when an electron moves from one energy level to another energy level more distant from the nucleus

- a) energy is emitted. b) energy is absorbed. c) no change in energy occurs. d) light is emitted. e) none of these

20. Which of the following statements is *true*?

- a) The exact location of an electron can be determined if we know its energy.  
 b) An electron in a 2s orbital can have the same  $n$ ,  $l$ , and  $m_l$  quantum numbers as an electron in a 3s orbital.  
 c) Ni has 2 unpaired electrons in its 3d orbitals.  
 d) In the buildup of atoms, electrons occupy the 4f orbitals before the 6s orbitals.  
 e) Only three quantum numbers are needed to uniquely describe an electron.

21. How many electrons in an atom can have the quantum numbers  $n = 3, l = 2$ ?

- a) 2 b) 5 c) 10 d) 18 e) 6

22. Which of the following atoms would have the largest second ionization energy?

- a) Mg b) Cl c) S d) Ca e) Na

23. List the following atoms in order of increasing ionization energy: Li, Na, C, O, F.

- a)  $\text{Li} < \text{Na} < \text{C} < \text{O} < \text{F}$  b)  $\text{Na} < \text{Li} < \text{C} < \text{O} < \text{F}$  c)  $\text{F} < \text{O} < \text{C} < \text{Li} < \text{Na}$   
 d)  $\text{Na} < \text{Li} < \text{F} < \text{O} < \text{C}$  e)  $\text{Na} < \text{Li} < \text{C} < \text{F} < \text{O}$

24. Atoms having greatly differing electronegativities are expected to form:

- a) no bonds b) polar covalent bonds c) nonpolar covalent bonds  
 d) ionic bonds e) covalent bonds

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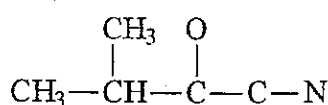
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25. Which of the following molecules has a dipole moment?

- a)
- $\text{CH}_4$
- b)
- $\text{CCl}_4$
- c)
- $\text{CO}_2$
- d)
- $\text{SO}_3$
- e) none of these

26. Complete the Lewis structure for the molecule:



This molecule has \_\_\_\_\_ single bonds and \_\_\_\_\_ multiple bonds.

- a) 4, 2 b) 6, 3 c) 11, 5 d) 11, 2 e) 13, 0

27. 30.0 mL of pure water at 280. K is mixed with 50.0 mL of pure water at 330. K.

What is the final temperature of the mixture?

- a) 290. K b) 311 K c) 320. K d)
- 326 K
- e) 405 K

28. The hybridization of Se in  $\text{SeF}_6$  is

- a) sp b)
- $\text{sp}^2$
- c)
- $\text{sp}^3$
- d)
- $\text{dsp}^3$
- e)
- $\text{d}^2\text{sp}^3$

29. Which of the species below would you expect to show the least hydrogen bonding?

- a)
- $\text{NH}_3$
- b)
- $\text{H}_2\text{O}$
- c) HF d)
- $\text{CH}_4$
- e)
- all the same

30. A solution of hydrogen peroxide is 30.0%  $\text{H}_2\text{O}_2$  by mass and has a density of 1.11 g/cm<sup>3</sup>. The molarity of the solution is:

- a) 7.94 M b) 8.82 M c) 9.79 M d) 0.980 M e) none of these

31. Calculate the  $[\text{H}^+]$  in a solution that has a pH of 2.30.

- a) 2.3 M b) 11.7 M c)
- $5.0 \times 10^{-3} \text{ M}$
- d)
- $2.0 \times 10^{-12} \text{ M}$
- e) none of these

32. The pH in a solution of 1.0 M  $\text{H}_2\text{A}$  ( $K_{a1} = 1.0 \times 10^{-6}$ ;  $K_{a2} = 1.0 \times 10^{-10}$ ) is:

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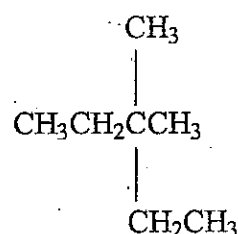
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- a) 8.00    b) 7.00    c) 6.00    d) 3.00    e) none of these

33. The solubility of  $\text{Mg}(\text{OH})_2$  ( $K_{\text{sp}} = 8.9 \times 10^{-12}$ ) in 1.0 L of a solution buffered (with large capacity) at pH 10.0 is:

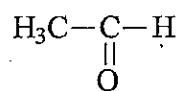
- a)  $8.9 \times 10^9$  moles    b)  $8.9 \times 10^{-4}$  moles    c)  $8.9 \times 10^{-1}$  moles  
d)  $8.9 \times 10^{-7}$  moles    e) none of these

34. Name the following:



- a) n-heptane    b) 2-methyl-2-ethylbutane    c) 3,3-dimethylpentane  
d) 2,2-diethylpropane

35. Classify the following molecule:



- a) acid    b) aldehyde    c) amine    d) ketone    e) carbonyl

二. 計算題組：(30% 每小題 5%)

36-37. The reaction  $\text{A} \rightarrow \text{B} + \text{C}$  is known to be zero order in A with a rate constant of  $5.0 \times 10^{-2} \text{ mol/L}\cdot\text{s}$  at  $25^\circ\text{C}$ . An experiment was run at  $25^\circ\text{C}$  where  $[\text{A}]_0 = 1.0 \times 10^{-3} \text{ M}$ .

36. The integrated rate law is

- a)  $[\text{A}] = kt$     b)  $[\text{A}] - [\text{A}]_0 = kt$     c)  $\frac{[\text{A}]}{[\text{A}]_0} = kt$     d)  $\ln \frac{[\text{A}]}{[\text{A}]_0} = kt$   
e)  $[\text{A}]_0 - [\text{A}] = kt$

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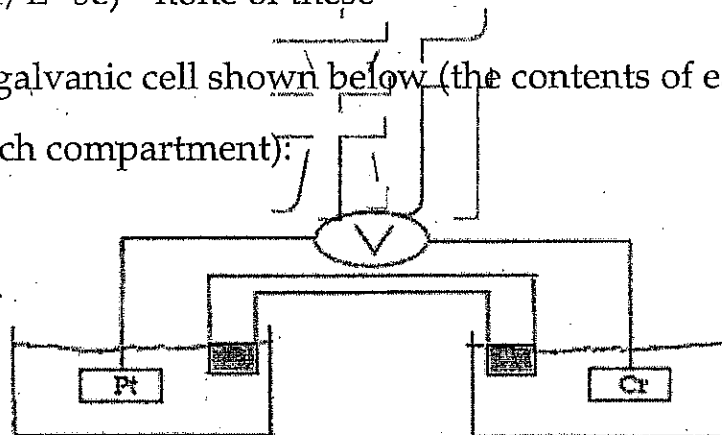
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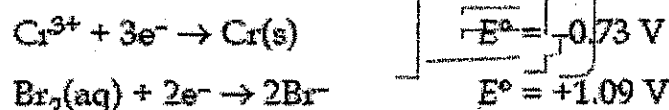
37. After 5.0 minutes, the rate is

- a)  $5.0 \times 10^{-2} \text{ mol/L} \cdot \text{s}$  b)  $2.5 \times 10^{-2} \text{ mol/L} \cdot \text{s}$  c)  $1.2 \times 10^{-2} \text{ mol/L} \cdot \text{s}$   
d)  $1.0 \times 10^{-3} \text{ mol/L} \cdot \text{s}$  e) none of these

38–39. Consider the galvanic cell shown below (the contents of each half-cell are written beneath each compartment):



The standard reduction potentials are as follows:

38. What is  $E^\circ$  for this cell?

- a) 1.82 V b) 0.36 V c) 4.75 V d) 1.79 V e) 4.40 V

39. Which of the following statements about this cell is false?

- a) This is a galvanic cell. b) Electrons flow from the Pt electrode to the Cr electrode.  
c) Reduction occurs at the Pt electrode. d) The cell is not at standard conditions.  
e) To complete the circuit, cations migrate into the left half-cell and anions migrate into the right half-cell from the salt bridge.

40–41. A common car battery consists of six identical cells each of which carries out

40. The value of  $E^\circ$  for such a cell is 2.04 V. Calculate  $\Delta G^\circ$  at 25°C for the reaction.

- a) -787 kJ b) -98 kJ c) -394 kJ d) -197 kJ e) -0.121 kJ

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41. Suppose that in starting a car on a cold morning a current of 125 amperes is drawn for 15.0 seconds from a cell of the type described above. How many grams of Pb would be consumed? (The atomic weight of Pb is 207.19.)

- a) 8.05    b) 2.01    c) 0.0180    d) 0.0360    e) 4.02

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