

招生學年度	105	招生類別	碩士班
系所班別	化學系碩士班、材料科學與工程學系碩士班		
科目名稱	普通化學		
注意事項	本考科可使用掌上型計算機		

每題 2.5 分，共 100 分

- Calculate  $5.1234 + 0.033 \div 1.650$  and report to the correct number of significant figures.  
(1) 3.1      (2) 3.125      (3) 5.143      (4) 5.12      (5) 5.1340
- A species with 12 protons and 10 electrons is  
(1)  $\text{Ne}^{2+}$       (2)  $\text{Ti}^{2+}$       (3)  $\text{Mg}^{2+}$       (4) Mg      (5)  $\text{Ne}^{2-}$
- You are given a compound with the formula  $\text{MCl}_2$ , in which M is a metal. You are told that the metal ion has 26 electrons. What is the identity of the metal?  
(1) Fe      (2) Al      (3) Zn      (4) Co      (5) Ni
- A hypothetical element consists of two isotopes of masses 69.95 amu and 71.95 amu with abundances of 25.7% and 74.3%, respectively. What is the average atomic mass of this element?  
(1) 70.95 amu      (2) 69.95 amu      (3) 70.5 amu      (4) 71.4 amu      (5) 71.95 amu
- For which compound does 0.256 mole weigh 12.9 g?  
(1)  $\text{C}_2\text{H}_4\text{O}$       (2)  $\text{CO}_2$       (3)  $\text{CH}_3\text{Cl}$       (4)  $\text{C}_2\text{H}_6$       (5) none of these
- Which of the following is a strong acid?  
(1) HF      (2) KOH      (3)  $\text{HClO}_4$       (4) HClO      (5) HBrO
- What volume of 18 M sulfuric acid must be used to prepare 2.30 L of 0.145 M  $\text{H}_2\text{SO}_4$ ?  
(1) 19 mL      (2) 0.33 mL      (3)  $1.1 \times 10^3$  mL      (4) 2.9 mL      (5) 6.0 mL
- A gas sample is held at constant pressure. The gas occupies 3.62 L of volume when the temperature is  $21.6^\circ\text{C}$ . Determine the temperature at which the volume of the gas is 3.42 L.  
(1) 312 K      (2) 278 K      (3) 20.4 K      (4) 295 K      (5) 552 K
- Calculate the root mean square velocity for the  $\text{O}_2$  molecules in a sample of  $\text{O}_2$  gas at  $11.8^\circ\text{C}$ . ( $R = 8.3145 \text{ J/K mol}$ )  
(1) 95.91 m/s      (2) 14.90 m/s      (3) 471.2 m/s      (4) 272.0 m/s      (5)  $8.973 \times 10^{26}$  m/s
- 30.0 mL of pure water at 282 K is mixed with 50.0 mL of pure water at 306 K. What is the final temperature of the mixture?  
(1) 294 K      (2) 297 K      (3) 342 K      (4) 588 K      (5) 24 K
- What is the specific heat capacity of a metal if it requires 178.1 J to change the temperature of 15.0 g of the metal from  $25.00^\circ\text{C}$  to  $32.00^\circ\text{C}$ ?  
(1)  $0.590 \text{ J/g}^\circ\text{C}$       (2)  $11.9 \text{ J/g}^\circ\text{C}$       (3)  $25.4 \text{ J/g}^\circ\text{C}$       (4)  $1.70 \text{ J/g}^\circ\text{C}$       (5)  $283 \text{ J/g}^\circ\text{C}$
- What is the wavelength of a photon of red light (in nm) whose frequency is  $4.55 \times 10^{14} \text{ Hz}$ ?  
(1) 659 nm      (2)  $1.52 \times 10^6$  nm      (3) 152 nm      (4) 455 nm      (5) none of these
- How many *f* orbitals have the value  $n = 3$ ?  
(1) 0      (2) 3      (3) 5      (4) 7      (5) 1
- Which of the following atoms or ions has three unpaired electrons?  
(1) N      (2) O      (3) Al      (4)  $\text{S}^{2-}$       (5)  $\text{Ti}^{2+}$

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15. Which of the following species would be expected to have the lowest ionization energy?  
 (1)  $F^-$       (2) Ne      (3)  $O^{2-}$       (4)  $Mg^{2+}$       (5)  $Na^+$
16. As indicated by Lewis structures, which of the following would probably not exist as a stable molecule?  
 (1)  $C_2H_5OH$       (2)  $C_2H_2$       (3)  $C_3H_4$       (4)  $CH_2O$       (5)  $CH_3O$
17. How many of the following molecules possess dipole moments?  
 $BH_3$ ,  $CH_4$ ,  $PCl_5$ ,  $H_2O$ ,  $HF$ ,  $H_2$   
 (1) 1      (2) 2      (3) 3      (4) 4      (5) 5
18. The Cl-Kr-Cl bond angle in  $KrCl_4$  is closest to  
 (1)  $90^\circ$       (2)  $107^\circ$       (3)  $109^\circ$       (4)  $120^\circ$       (5)  $180^\circ$
19. The hybridization of the central atom in  $I_3^-$  is:  
 (1)  $sp$       (2)  $sp^2$       (3)  $sp^3$       (4)  $dsp^3$       (5)  $d^2sp^3$
20. Which of the following molecules contains the shortest C-C bond?  
 (1)  $C_2H_2$       (2)  $C_2H_4$       (3)  $C_2H_6$       (4)  $C_2Cl_4$       (5)  $C_2Br_4$
21. The configuration  $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2py})^1(\pi_{2px})^1$  is the molecular orbital description for the ground state of  
 (1)  $Li_2^+$       (2)  $Be_2$       (3)  $B_2$       (4)  $C_2^+$       (5)  $C_2$
22. Which substance involves no bonding forces except London dispersion forces?  
 (1)  $NaCl(l)$       (2)  $HF(l)$       (3)  $H_2O(l)$       (4)  $N_2(s)$       (5)  $K(s)$
23. A crystal was analyzed with x-rays having 2.33 Å wavelength. The angle of first-order diffraction ( $n = 1$ ) was  $19.2^\circ$ . What would be the angle for second-order diffraction ( $n = 2$ )?  
 (1) 38.4 Å      (2) 41.1 Å      (3) 9.46 Å      (4) 14.2 Å      (5) 4.72 Å
24. Which of the compounds below is an example of a network solid?  
 (1)  $S_8(s)$       (2)  $SiO_2(s)$       (3)  $MgO(s)$       (4)  $NaCl(s)$       (5)  $C_{25}H_{52}(s)$
25. In the unit cell of sphalerite,  $Zn^{2+}$  ions occupy half the tetrahedral holes in a face-centered cubic lattice of  $S^{2-}$  ions. The number of formula units of ZnS in the unit cell is:  
 (1) 6      (2) 4      (3) 3      (4) 2      (5) 1
26. The measure of resistance to flow of a liquid is  
 (1) van der Waals forces      (2) vapor pressure      (3) London forces      (4) surface tension  
 (5) viscosity
27. A 20.0-g sample of methyl alcohol ( $CH_3OH$ , molar mass = 32.04 g/mol) was dissolved in 43.3 g of water. The mole fraction of  $CH_3OH$  is:  
 (1) 0.260      (2) 0.624      (3) 0.316      (4) 0.84      (5) 0.206
28. The vapor pressure of water at  $25.0^\circ C$  is 23.8 torr. Determine the mass of glucose (molar mass = 180 g/mol) needed to add to 500.0 g of water to change the vapor pressure to 22.8 torr.  
 (1) 21.9 g      (2) 219 g      (3) 180 g      (4) 188 g      (5) 18.8 g

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29. Calculate the molarity of a solution containing KCl and water whose osmotic pressure at 21.6°C is 125 torr. Assume complete dissociation of the salt.  
 (1) 0.00680 M    (2) 0.0264 M    (3) 0.0464 M    (4) 0.00340 M    (5) 0.0928 M
30. Determine the molecularity of the following elementary reaction:  $O_3 \rightarrow O_2 + O$ .  
 (1) unimolecular    (2) bimolecular    (3) termolecular    (4) quadmolecular  
 (5) molecularity cannot be determined
31. For a reaction:  $aA \rightarrow \text{Products}$ ,  $[A]_0 = 4.2 M$ , and the first two half-lives are 56 and 28 minutes, respectively. Calculate  $k$  (without units).  
 (1)  $7.5 \times 10^{-2}$     (2)  $4.3 \times 10^{-3}$     (3)  $3.7 \times 10^{-2}$     (4)  $8.5 \times 10^{-3}$     (5) none of these
32. Determine the equilibrium constant for the system  $N_2O_4 \rightleftharpoons 2NO_2$  at 25 °C. The concentrations are shown here:  $[N_2O_4] = 2.32 \times 10^{-2} M$ ,  $[NO_2] = 1.41 \times 10^{-2} M$ .  
 (1) 0.608    (2) 1.65    (3)  $1.17 \times 10^2$     (4) 0.369    (5)  $8.57 \times 10^{-3}$
33. Consider the reaction  $HNO_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$ . Which species is a conjugate base?  
 (1)  $HNO_2(aq)$     (2)  $H_2O(l)$     (3)  $H_3O^+(aq)$     (4)  $NO_2^-(aq)$     (5) two of these
34. A solution in which the pOH is 12.1 would be described as  
 (1) very acidic    (2) slightly acidic    (3) neutral    (4) very basic    (5) slightly basic
35. Calculate the  $[H^+]$  in a solution that is 0.16 M in NaF and 0.25 M in HF. ( $K_a = 7.2 \times 10^{-4}$ )  
 (1)  $7.2 \times 10^{-4} M$     (2) 1.6 M    (3)  $1.1 \times 10^{-3} M$     (4) 0.20 M    (5)  $4.6 \times 10^{-4} M$
36. The solubility in mol/L of  $Ag_2CrO_4$  is  $1.8 \times 10^{-4} M$ . Calculate the  $K_{sp}$  for this compound.  
 (1)  $6.5 \times 10^{-8}$     (2)  $1.8 \times 10^{-4}$     (3)  $3.6 \times 10^{-4}$     (4)  $2.3 \times 10^{-11}$     (5)  $5.8 \times 10^{-12}$
37. Which of the following is true for exothermic processes?  
 (1)  $\Delta S_{surr} < 0$     (2)  $\Delta S_{surr} = -\Delta H/T$     (3)  $\Delta S_{surr} = 0$     (4)  $\Delta S_{surr} > 0$     (5) two of these
38. For a certain reaction,  $\Delta H^\circ = -74.4 \text{ kJ}$  and  $\Delta S^\circ = -227 \text{ J/K}$ . If  $n = 3$ , calculate  $\epsilon^\circ$  for the reaction at 25°C.  
 (1) 0.0233 V    (2) 0.491 V    (3) 0.277 V    (4) 0.0700 V    (5) 0.237 V
39. Consider a certain type of nucleus that has a half-life of 32 min. Calculate the percent of original sample of nuclides remaining after 2.5 hours have passed.  
 (1) 40%    (2) 20%    (3) 6.9%    (4) 3.9%    (5) 3.2%
40. Which of the following is paramagnetic?  
 (1)  $Zn(H_2O)_6^{2+}$     (2)  $Mn(CN)_6^{2-}$  (strong field)    (3)  $Co(NH_3)_6^{3+}$  (strong field)  
 (4)  $Cu(CN)_3^{2-}$     (5) none of these