

國立臺灣大學九十三年學年度轉學生入學考試試題

科目：普通化學(A)

題號：21

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※ 請在答案卷上標明題號依序作答

(I) Write (O) for the true (×) for the false

For instance: Which of the following are equal to 4 (A) 2+2 (B) 2-2 (C) 2×2 (D) 2÷2 (E) 2²

Answer: (A) O (B) × (C) O (D) × (E) O

5 points each question (60 in total)

- Which of the following molecules or compounds whose size is in the region of nm (say 1~999)?
(A) H₂
(B) glucose
(C) heme
(D) nylon66 (M_n 10⁶ dalton)
(E) a single crystal of NaCl suitable for the analysis using X-ray single-crystal diffraction
- Which of the following statements regarding the periodicity is correct?
(A) the electron affinity of the halogens decreases with the increasing atomic number
(B) the elements of group 1 and 18 likely form ionic compounds
(C) the elements that have the values of electronegativity close to 2.0 likely form the covalent bonds to each other
(D) metalloid are in the middle of the periodic table and inbetween alkaline earth and main group elements
(E) the 3rd ionization energy of beryllium is more than five fold of its 2nd ionization energy
- With the given chemical equation, which of the following statements is correct?
 $\text{CH}_4(\text{g}) + \text{I}_2(\text{g}) \rightarrow \text{CH}_3\text{I}(\text{g}) + \text{HI}(\text{g}) \quad \Delta H^\circ = 23 \text{ KJ}$
(A) the oxidation of methane by iodine is endothermic
(B) the forward reaction is spontaneous at 25 °C, 1 atm
(C) the change of heat capacity is positive
(D) the energy of the C—I bond is 23 KJ/mole lower than that of the C—H bond
(E) this ΔH° may be evaluated with the difference of the heat of formation between iodomethane and methane
- Which of the following statements regarding the chemical bond is correct?
(A) bond forming process is always exothermic
(B) the four C—H bonds of methane have the same bond energy
(C) the σ -bond in CO₂ is stronger than its π -bond
(D) in any chemical reaction, the total bond enthalpy is conservative
(E) a compound that has significant resonance structures has to have delocalized electrons
- Which of the following compound cannot have unsaturated bond? O for yes × for no.
(A) C₈H₁₆ (B) C₆H₁₄ (C) C₆H₁₂ (D) C₆H₁₀ (E) C₄H₁₀O
- Which of the following configuration is at the ground state?
(A) 1s²2s²2p³3s¹ (B) 1s²2s²3s² (C) [Ar]4s¹ (D) [Ar]3d⁵4s¹ (E) [Ar]3d¹⁰4s¹
- Which of the following molecule has trigonal planar geometry?
(A) CO₃²⁻ (B) AlCl₃ (C) ClO₃⁻ (D) PF₃ (E) XeO₃
- Which of the following compounds has unpaired electron?
(A) SeF₄ (B) NO₂ (C) O₂ (D) CuCl₄ (E) CoCl₄⁻
- Which of the following is the primary alcohol?
(A) CH₃CH(CH₂CH₂NH₂)(OH)
(B) CH₃C≡CCH(OH)CH₂CH₃
(C) CH₃CH₂CH(OH)CH₂CH₃

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- (D) $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)(\text{CH}_2\text{OH})$
 (E) $(\text{HO})\text{CH}=\text{CH}(\text{CH}_2\text{CH}_2\text{CH}_3)$

- 10 Which of the following statements regarding phenol ($\text{C}_6\text{H}_5\text{OH}$) is correct?
 (A) there are five atoms in the molecule bonded with sp^2 hybridization
 (B) it is basic in water
 (C) its reaction with sodium resulting in basic solution
 (D) its saturated aqueous solution is electrically conducting
 (E) its phenyl group is more electron rich than benzene
- 11 Which of the following statements regarding the states of a substance is correct?
 (A) the boiling point drops when the atmospheric pressure increases
 (B) the critical temperature is the lowest temperature at which a critical fluid could be vaporized.
 (C) the vapor pressure of a critical fluid is always higher than the critical pressure
 (D) a critical fluid may always be liquidified by applying pressure to it
 (E) the vapor pressure of a liquid always increases with the increasing temperature, however, the density of a liquid always decreases with the increasing temperature
- 12 With the given information for the reaction below at 350°C , which of the statements is correct?
- | | |
|---------------------------|---|
| | $2\text{NO}_{2(g)} \rightarrow \text{N}_2\text{O}_{4(g)}$ |
| ΔH°_f kJ/mol | 33.18 9.16 |
| S° J/mol·K | 240.1 304.3 |
- (A) $\Delta G^\circ = -57.2$ kJ/mol
 (B) the forward reaction may be spontaneous at 273 K
 (C) the forward reaction goes further when temperature is raised
 (D) the forward reaction is hindered when atmospheric pressure increases
 (E) the color of the reaction system first becomes lighter than enhanced when the volume of the reaction container is increased.

II Choose the only correct answer for each of the following questions
(2 points each question, -0.5 for each wrong answer, 20 in total)

- 13 Which of the following atoms is likely to be radio-active?
 (A) $^{13}\text{C}(z=6)$ (B) $^{23}\text{Na}(z=11)$ (C) $^{27}\text{Al}(z=13)$ (D) $^{28}\text{P}(z=15)$ (E) $^{56}\text{Fe}(z=26)$
- 14 Which of the following irradiation can result in molecular vibrations?
 (A) IR (B) visible (C) UV (D) microwave (E) X-ray
- 15 What is the bond order of He_2^+ ?
 (A) 0 (B) 0.5 (C) 1 (D) 1.5 (E) He_2^+ can not exist
- 16 Which of the following compounds has the lowest boiling point?
 (A) CCl_4 (B) CS_2 (C) Cl_4 (D) I_2 (E) CHCl_3
- 17 What is the main solute-solvent interaction that is responsible for dissolving AgCl into water?
 (A) ion—dipole (B) dipole—dipole (C) hydrogen bonding
 (D) London dispersion (E) AgCl is insoluble, for no solute-solvent interaction
- 18 At 24°C , 738 mm-Hg, what is the density of ammonia?
 (A) 1.48 g/L (B) 0.836 g/L (C) 0.677 g/L (D) 0.148 g/L
- 19 Which of the following has the largest pH value in water?

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- (A) 1.0 M CH_3COOH (B) 0.1 M CF_3COOH (C) 0.01 M HClO_4
(D) 1.0 M CH_3COOH and 0.1 M NaOAc (E) 0.1 M HClO_4 and 1.0 M NaClO_4
- 20 Adding 8.0 mL of 0.400 M NaOH into 20.0 mL of 0.250 M benzoic acid, the $\text{pH} = 3.99$. What is the K_a of benzoic acid?
(A) 1.0×10^{-5} (B) 1.8×10^{-5} (C) 1.0×10^{-4} (D) 1.2×10^{-4} (E) 1.8×10^{-4}
- 21 Adding $\text{AgNO}_3(\text{s})$ into the mixed solution of the same volume of 0.10 M Cl^- and 0.10 M CrO_4^{2-} , what is $[\text{Cl}^-]$ when the ppt of Ag_2CrO_4 takes place? $K_{\text{sp}}(\text{AgCl}) = 1.8 \times 10^{-10}$, $K_{\text{sp}}(\text{Ag}_2\text{CrO}_4) = 2.4 \times 10^{-12}$
(A) 2.4×10^{-11} (B) 4.9×10^{-6} (C) 3.7×10^{-5} (D) 6.1×10^{-3} (E) 0.10
- 22 The heat of reaction for which of the following reactions is the molar heat of formation for ethanol?
(A) $2\text{C}(\text{graphite})_{(\text{s})} + 6\text{H}_{(\text{g})} + \text{O}_{(\text{g})} \rightarrow \text{CH}_3\text{CH}_2\text{OH}_{(\text{l})}$
(B) $4\text{C}(\text{graphite})_{(\text{s})} + 6\text{H}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightarrow 2\text{CH}_3\text{CH}_2\text{OH}_{(\text{l})}$
(C) $2\text{C}(\text{graphite})_{(\text{s})} + 3\text{H}_{2(\text{g})} + 1/2\text{O}_{2(\text{g})} \rightarrow \text{CH}_3\text{CH}_2\text{OH}_{(\text{l})}$
(D) $\text{C}_2\text{H}_6_{(\text{g})} + 1/2\text{O}_{2(\text{g})} \rightarrow \text{CH}_3\text{CH}_2\text{OH}_{(\text{l})}$
- 23 Regarding a reaction of first order, which of the following statements is correct?
(A) it is an uni-molecular process
(B) its rate constant is proportional to the reactant concentration
(C) its reaction rate is proportional to the activation energy
(D) its half life is constant
- 24 Which of the following regarding to the electronic states in hydrogen atom is correct?
(A) the electron in the state of $n = 2$ may be closer to the nucleus than in $n = 1$
(B) to ionize the electron from $n = 3$ needs the UV light
(C) the orbitals beyond $n = 1$ are all degenerate
(D) the hydrogen molecule will have two degenerate states for each principal quantum number n
- 25 At 25 °C and 1 atm, four containers of 1.0 L are respectively filled with H_2 , CH_4 , NH_3 and O_2 , which of the following statements regarding these four gases is correct?
(A) four containers have the same number of molecules
(B) H_2 has the largest average kinetic energy
(C) O_2 strays away most from the ideal gas behavior
(D) methane and ammonia have the closest values of PV/nRT
- 26 Which of the following statements regarding the transition metal compounds is correct?
(A) the electronic configuration of iron in $\text{Fe}(\text{CN})_6^{3-}$ is $t_{2g}^3 e_g^2$
(B) the magnetic moments of paramagnetic $\text{Fe}(\text{H}_2\text{O})_6^{3+}$ is about $(35)^{1/2}$
(C) the blood is consisted of hemoglobin, so the blood is paramagnetic
(D) the major absorbance wavelength for the d-d transition in heme is longer than 500 nm
- 27 Which of the following polymers is not formed from the condensation reaction?
(A) nylon (B) cellulose (C) protein (D) polystyrene (E) PET
- 28 Why does the rubber need to have the process of vulcanization?
(A) lengthening the chain length of the polymer backbone
(B) increasing the polymer branching
(C) increasing the crosslinking
(D) softening the polymer
- 29 Which of the following regarding the lead battery during discharging is correct?

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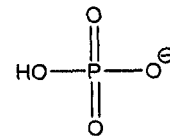
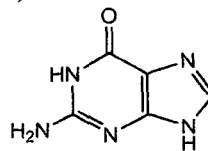
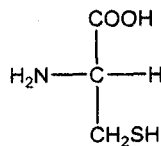
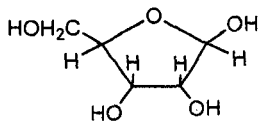
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- (A) the density of sulfuric acid decreases
 (B) lead is dissolved at the cathode
 (C) PbO is produced at both electrodes
 (D) the oxidation state of lead is increased from +2 to +4 at cathode, but decreases from +2 to 0 in the anode
- 30 Which of the following can be the conductive material ?
 (A) $-(C_2H_4)_n-$ (B) $-(C_2H_2)_n-$ (C) $-(CH_2CHCH_3)_n-$ (D) $-(CH_2CHC_6H_5)_n-$
- 31 Which of the following electronic configurations is of the ground state of X_2 wherein X belongs to the elements of the 2nd row
 (A) $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\sigma_{2p})^1(\pi_{2p})^1$
 (B) $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\sigma_{2p})^1(\sigma_{2p}^*)^1$
 (C) $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^1(\pi_{2p}^*)^1$
 (D) $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^2(\pi_{2p}^*)^0$
- 32 Which of the following structures is a linking base between the helixes of DNA?
 (A) (B) (C) (D)



III Gain points by showing how to work out the problem
 (10 points each problem, 20 points in total)

- Draw a plot of dissociation percentage (α_1 , α_2 , α_3) versus pH quantitatively for 0.1 M carbonic acid, wherein dissociation percentage is defined as $\alpha_1 = [H_2CO_3]/[H_2CO_3]_0$, $\alpha_2 = [HCO_3^-]/[H_2CO_3]_0$, $\alpha_3 = [CO_3^{2-}]/[H_2CO_3]_0$.
- Silver crystallizes in a cubic closest packed structure. The radius of a silver atom is 144 pm. Calculate the density of solid silver.

試題必須隨卷繳回