八十五學年度轉學生入學考試

科目 普通化學 共 6 頁第 1 頁 *請在試卷【答案卷】內作答

選擇題：五選一，不倒扣

1 If the system $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ is at equilibrium at constant temperature, and the number of moles of CaO in the vessel is doubled,
(a) The reaction quotient, Q, is doubled.
(b) The reaction quotient, Q, is halved.
(c) The number of moles of CO_2 present at equilibrium is halved.
(d) The number of moles of $CaCO_3$ in the vessel increases.
(e) The partial pressure of CO_2 in the vessel remains unchanged.

2 All of the following are acid–base conjugate pairs EXCEPT
(a) $HONO, NO_2^-$ (b) H_3O^+, OH^- (c) $CH_3NH_3^+, CH_3NH_2$
(d) HS^-, S^{2-} (e) $C_6H_5COOH, C_6H_5COO^-$

3 When K_2O is added to water, the solution is basic because it contains a significant concentration of
(a) K^+ (b) K_2O (c) O^{2-} (d) O_2^{2-} (e) OH^-

4 A solution has $[OH^-] = 4.8 \times 10^{-3}$. Its pH is
(a) 11.7 (b) 8.4 (c) 4.8 (d) 3.7 (e) 2.3

5 A buffer that is a mixture of acetic acid and potassium acetate has a pH = 5.24. The $[OAc^-]/[HOAc]$ ratio in this buffer is
(a) 1 : 1 (b) 3 : 1 (c) 5 : 1 (d) 1 : 3 (e) 1 : 5

6 A weak base, B, has basicity constant $K_b = 2 \times 10^{-5}$. The pH of any solution in which $[B] = [BH^+]$ is
(a) 4.7 (b) 7.0 (c) 9.3 (d) 9.7 (e) 10.3

7 The molar solubility, s, of $Mn(OH)_2$ in water in terms of its K_{sp} is
(a) $s = (K_{sp})^{1/2}$ (b) $s = (K_{sp})^{1/3}$ (c) $s = (K_{sp}/4)^{1/3}$ (d) $s = (K_{sp}/6)^{1/3}$
(e) $s = (K_{sp}/27)^{1/4}$

8 The relationship between the K_{sp} of AgBr and the molar solubility, z, of AgBr in 0.20 F KBr is that K_{sp} equals
(a) z^2 (b) $z/0.20$ (c) $z^{1/2}$ (d) $4z^3$ (e) $0.20\ z$

9 The amount of energy required to remove the electron from a Li^{2+} ion in its ground state is how many times greater than the amount of energy needed to remove the electron from an H atom in its ground state?
(a) 2 (b) 3 (c) 4 (d) 6 (e) 9

10 The most intense line in the Brackett series of the spectrum of atomic hydrogen is the transition
(a) $n_H = \infty \rightarrow n_L = 1$ (b) $n_H = 8 \rightarrow n_L = 4$ (c) $n_H = \infty \rightarrow n_L = 4$
(d) $n_H = 4 \rightarrow n_L = 3$ (e) $n_H = 5 \rightarrow n_L = 4$

11 The ground state electronic configuration of Fe^{3+} is
(a) $(Ar)^{18}3d^34s^2$ (b) $(Ar)^{18}3d^64s^2$ (c) $(Ar)^{18}3d^5$ (d) $(Ar)^{18}3d^44s$
(e) $(Ar)^{18}3d^6$

12 When arranged in order of increasing atomic number, the elements exhibit periodicity for all of the following properties EXCEPT
(a) atomic radii (b) atomic weights (c) ionization energy
(d) boiling point (e) electronegativity

13 Which one of the five oxides of chlorine is paramagnetic?
(a) Cl_2O (b) ClO_2 (c) Cl_2O_4 (d) Cl_2O_5 (e) Cl_2O_7

14 Each of the following molecules has a nonzero dipole moment EXCEPT
(a) C_6H_6 (b) CO (c) SO_2 (d) NH_3 (e) LiH

15 In the best Lewis structure for ICl_3 the formal charge on I is
(a) 0 (b) +1 (c) −1 (d) +2 (e) −2

16 In which of the following compounds does every atom have eight electrons in its valence shell?

(a) IF_5 (b) C_2H_4 (c) SF_4 (d) NO_2 (e) KH

17 Which of the following diatomic species do you expect to have the longest bond length?

(a) NO^+ (b) O_2^- (c) CO (d) O_2^+ (e) N_2^+

18 For the reaction between permanganate ion and oxalate ion in basic solution the unbalanced equation is

$$MnO_4^- + C_2O_4^{2-} \rightarrow MnO_2(s) + CO_3^{2-}$$

When this equation is balanced the number of OH^- ions is

(a) zero (b) two on the right (c) two on the left (d) four on the right (e) four on the left

19 In the reaction

$$2NH_4^+ + 6NO_3^- + 4H^+(aq) \rightarrow 6NO_2(g) + N_2(g) + 6H_2O$$

the reducing agent is

(a) NH_4^+ (b) NO_3^- (c) $H^+(aq)$ (d) NO_2 (e) N_2

20 The standard heat of combustion of ethylene is −1411 kJ/mol. The standard heat of vaporization of liquid water is 44.0 kJ/mol. What is ΔH^0, in kilojoules per mole, for the reaction

$$C_2H_4(g) + 3\,O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$$

(a) −1323 (b) −1367 (c) −1411 (d) −1455 (e) −1499

21 A gas absorbs 100 J of heat and is simultaneously compressed by a constant external pressure of 1.50 atm from 8.00 to 2.00 L in volume. What is ΔE in joules for the gas?

(a) −812 (b) +812 (c) −912 (d) +912 (e) 1012

24 An adiabatic process is one in which there is no transfer of heat across the boundary between system and surroundings. For such a process
(a) $P_{ext}\Delta V = 0$ (b) $q = w$ (c) $\Delta E = w$ (d) $\Delta H = 0$ (e) $\Delta E = q$

25 Which of the following is true for the reaction $H_2O(\ell) \rightleftharpoons H_2O(g)$ at 100 °C and 1-atm pressure?
(a) $\Delta H = 0$ (b) $\Delta S = 0$ (c) $\Delta H = \Delta E$ (d) $\Delta H = T\Delta S$ (e) $\Delta H = \Delta G$

26 For the reaction $A(g) \rightleftharpoons B(g) + C(g)$, the equilibrium constant at a certain temperature is 2.0×10^{-4} atm. A mixture of the three gases is placed in a flask and the initial partial pressures are $P_A = 2.0$ atm, $P_B = 0.50$ atm, and $P_C = 1.0$ atm. Which of the following is true at the instant of mixing?
(a) $\Delta G^0 = 0$ (b) $\Delta G^0 < 0$ (c) $\Delta G = 0$ (d) $\Delta G < 0$ (e) $\Delta G > 0$

25 If a process is both endothermic and spontaneous then
(a) $\Delta S > 0$ (b) $\Delta S < 0$ (c) $\Delta H < 0$ (d) $\Delta G > 0$ (e) $\Delta E = 0$

28 For the gas-phase decomposition $PCl_5 \rightleftharpoons PCl_3(g) + Cl_2(g)$
(a) $\Delta H < 0$ and $\Delta S < 0$ (b) $\Delta H > 0$ and $\Delta S > 0$ (c) $\Delta H > 0$ and $\Delta S < 0$
(d) $\Delta H < 0$ and $\Delta S > 0$ (e) $\Delta H = 0$ and $\Delta S > 0$

27 The reaction $A(g) + 2B(g) \rightarrow C(g) + D(g)$ is an elementary process. In an experiment, the initial partial pressures of A and B are $P_A = 0.60$ atm and $P_B = 0.80$ atm. When $P_C = 0.20$ atm, the rate of the reaction, relative to the initial rate, is
(a) $\frac{1}{48}$ (b) $\frac{1}{24}$ (c) $\frac{9}{16}$ (d) $\frac{3}{4}$ (e) $\frac{1}{6}$

28 For a hypothetical reaction $A + 2B \rightarrow 3C + D$, $d[C]/dt$ is equal to
(a) $-d[A]/dt$ (b) $-d[B]/dt$ (c) $+3d[A]/dt$ (d) $-\frac{1}{2}d[B]/dt$ (e) $+d[A]/dt$

29 For a reaction for which the activation energies of the forward and reverse directions are equal in value,
(a) the stoichiometry is the mechanism (b) $\Delta H = 0$ (c) $\Delta S = 0$
(d) the order is 0 (e) there is no catalyst

30 Potassium hexacyanoferrate(II) is the compound
(a) $K_4[Fe(CN)_6]$ (b) $KFe(SCN)_4$ (c) $K_3[Fe(CN)_6]$ (d) $K_3[Fe(SCN)_6]$
(e) $K_4[Fe(NCO)_6]$

31 Which of the following complexes exhibits optical isomerism?
(a) *trans*-dithiocyanatotetraamminechromium(III) ion
(b) *cis*-dicarbonatodiamminecobaltate(III) ion
(c) *trans*-dicarbonatodiamminecobaltate(III) ion
(d) *cis*-diglycinatoplatinum(II)
(e) *trans*-diglycinatoplatinum(II)

32 Of the following complexes, the one with the largest value of the crystal field splitting, Δ_0, is
(a) $Fe(H_2O)_6^{2+}$ (b) $Ru(H_2O)_6^{2+}$ (c) $Fe(NH_3)_5^{3+}$ (d) $[Ru(CN)_6]^{3-}$
(e) $[Fe(CN)_6]^{3-}$

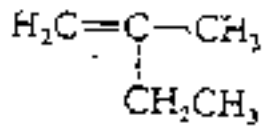
33 The most likely mode of decay for $^{13}_{7}N$ is
(a) α emission (b) β^- emission (c) β^+ emission (d) γ emission
(e) electron capture

34 Of the following particles, the one with the smallest mass is the
(a) electron (b) proton (c) positron (d) H atom (e) neutrino

35 When $^{226}_{88}Rn$ emits an alpha particle, the nuclide formed is
(a) $^{222}_{87}Fr$ (b) $^{222}_{86}Rn$ (c) $^{224}_{86}Rn$ (d) $^{224}_{84}Po$ (e) $^{222}_{84}Po$

36 The $-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-$ linkage occurs in all of the following substances EXCEPT
(a) nylon (b) glycogen (c) protein (d) valylglycine (e) *N*-ethylacetamide

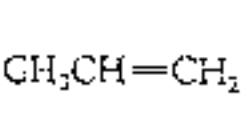
37 The correct systematic name of



is
(a) 2-ethyl-1-propene (b) 1-methyl-1-ethyl-ethylene (c) 2-ethyl-2-propene
(d) 2-methyl-1-butene (e) 3-methyl-3-butene

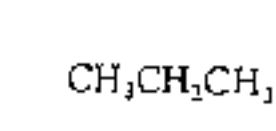
38

I



II

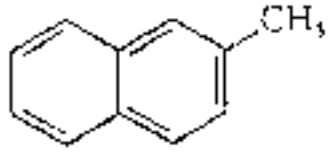
III



IV

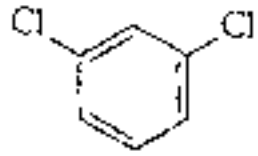
Of the compounds listed above, which would react readily with HBr?
(a) I (b) I and II (c) II (d) II and IV (e) I and III

39

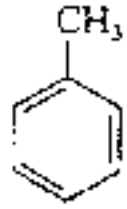


I

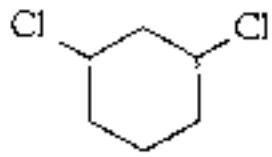
II



III



IV



V

Which of the compounds listed above are aromatic?
(a) III and V (b) III, IV, and V (c) I, II, and IV (d) I (e) I, III, and IV

40 The product of the reaction of 2-butene with HBr is
(a) 1-bromobutane (b) 2-bromobutane (c) 3-bromobutane
(d) 1,3-dibromobutane (e) 2,3-dibromobutane