※請將選擇題作答於試卷內之「選擇題作答區」。

I.選擇題（共 80 分，每題 4 分，單選與多選混合，每題答案可能為一至多個，全部選項正確始得題分 4 分，答錯不倒扣）

1. Which of the following statement(s) is or are *not* SI unit ?
(A) Kilogram (B) Mole (C) Liter (D) Kelvin

2. Calculate the density of a material if 3.00×10^2 g occupies a volume of 4.63 cm^3.
(A) 64.7 g/cm^3 (B) 64.8 g/cm^3 (C) 64.79 g/cm^3 (D) 64.80 g/cm^3

3. What is sum of *x*, *y*, and *z* in the following balanced reaction ?
$$x Cr_2O_7^{2-}{}_{(aq)} + y I^-{}_{(aq)} + z H^+{}_{(aq)} \rightarrow m Cr_{3+(aq)} + n IO_3^-{}_{(aq)} + o H_2O$$
(A)3 (B) 7 (C) 10 (D)12

4. Which of the following statement about the name of HNO_2, H_2SO_3, and $HClO_3$ is correct ?
(A) HNO_2: nitric acid, H_2SO_3: sulfurous acid, $HClO_2$: chlorous acid
(B) HNO_2: nitrous acid, H_2SO_3: sulfurous acid, $HClO_2$: chloric acid
(C) HNO_2: nitric acid, H_2SO_3: sulfuric acid, $HClO_2$: hypochlorous acid
(D) HNO_2: nitrous acid, H_2SO_3: sulfuric acid, $HClO_2$: chloric acid

5. Which of the following ion(s) with a charge of +2 ?
(A) phosphate ion (B) chromate ion (C) sulfate ion (D) cyanide ion

6. Which of the following statement about orbital energy is or are correct ?
(A) In Na atom, the energy level: 2s < 2d
(B) In H atom, the energy level: 3s < 3d
(C) In Mn atom, the energy level: 3d<4s
(D) In F atom, the energy level: 3s < 3d

7. Which of the following molecule(s) is or are polar ?
(A) CO_2 (B) SO_2 (C) BF_3 (D) $BeCl_2$

8. To consider about the periodic properties of the elements, which of the following statement(s) about radius is or are correct ?
(A) Ne > Ar > Kr > Xe (B) P > S > Cl > Ar (C) Be > Mg > Ca > Sr (D) Br > Se > As > Ge

9. Which of the following statement(s) about first ionization energy is or are *not* correct ?
(A) N > C > B (B) Si> Al > Mg (C) Ne > F > O (D) Cl > S > P

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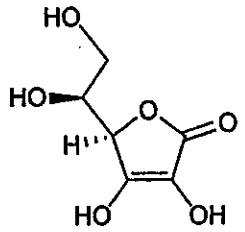
10. Which of the following statement(s) about covalent bonding is or are correct ?
(A) Electrons are shared between atoms of nonmetals to form stable compounds
(B) The fact that the boiling point of HF is higher than that of HCl is due to the formation of covalent bonding
(C) Electrons are completely transferred from metal to nonmetal atom, and the resulting charged atoms are held together by electrostatic attractions
(D) Molecules that have permanent dipoles are attracted to each other

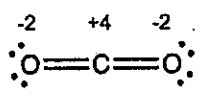
11. VSEPR theory is commonly employed to predict the shapes of molecules, which of the following prediction(s) in shape is or are correct ?
(A) N_2O: linear (B) SH_4: seesaw (C) PCl_4^+: tetrahedral (D) PF_3: pyramidal

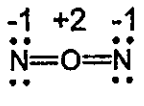
12. The following figure shows the structure of vitamin C/ascorbic acid, which of the statement(s) about ascorbic acid is or are correct ?

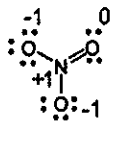


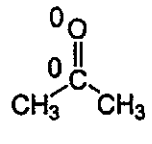
(A) There are 15 sigma bonds and 4 pi bonds
(B) There are 17 sigma bonds and 2 pi bonds
(C) There are 20 sigma bonds and 2 pi bonds
(D) Ascorbic acid is a weak acid

13. Which of following statement(s) about formal charge is or are correct ?

(A) 

(B) 

(C) 

(D) 

14. Calculate K_b value of X and equilibrium concentration of XH^+ based on the following information.
If a 0.035M solution of X has a pH value of 11.33 at 25 °C.

$$X_{(aq)} + H_2O_{(l)} \rightleftarrows XH^+_{(aq)} + OH^-_{(aq)}$$

(A)1.4×10^{-4} ; 2.1×10^{-3} M (B)1.4×10^{-4} ; 4.2×10^{-3} M (C)2.8×10^{-4} ; 2.1×10^{-3} M (D)2.8×10^{-4} ; 4.2×10^{-3} M

15. Consider the following equilibrium for which $\Delta H > 0$

$$N_{2(g)} + O_{2(g)} \rightleftarrows 2NO_{(g)}$$

Which of the following statement(s) is or are correct?
(A)A catalyst is added to the mixture, the equilibrium shifts to the right
(B)The reaction mixture is heated, the equilibrium shifts to the right
(C)The volume of the reaction vessel is doubled, the equilibrium shifts to the left
(D)$O_{2(g)}$ is added to the system, the equilibrium shifts to the right

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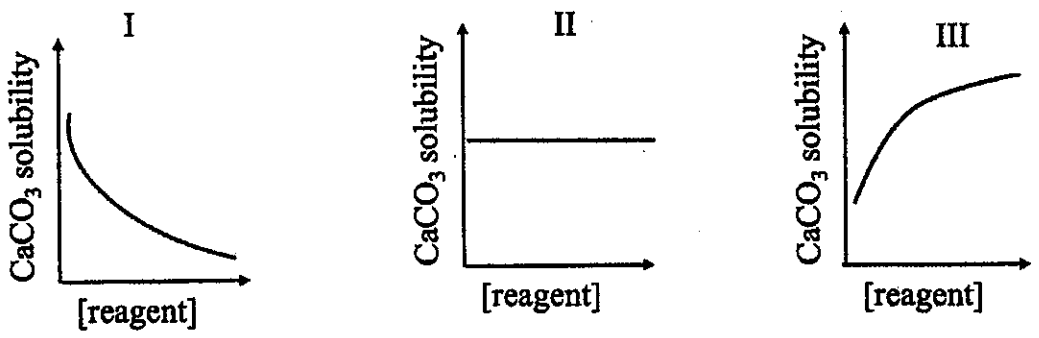
16. The average pH of normal arterial blood is 7.04. At normal body temperature (37 °C), $K_w = 2.4 \times 10^{-14}$. Calculate $[H^+]$ and pOH for blood at this temperature.
(A)$[H^+]$: 1×10^{-7} M, pOH: 7.00 (B)$[H^+]$: 1.5×10^{-7} M, pOH: 6.96 (C)$[H^+]$: 2.5×10^{-7} M, pOH: 6.60 (D)$[H^+]$: 4×10^{-8} M, pOH: 6.22

17.The following graphs represent the behavior of $CaCO_3$ under different circumstances.



(a)Which graph represents what happens to the solubility of $CaCO_3$ as HNO_3 is added?
(b)Which graph represents what happens to the solubility of $CaCO_3$ as $NaNO_3$ is added?
(A)a: I, b: II (B)a: III, b: II (C)a: III, b: I (D)a: II, b: III

18. Which of the following process(es) is or are spontaneous?
(A)Dissolution of sugar in a cup of hot coffee (B)The ripening of a banana (C)formation of CH_4 and O_2 molecules from CO_2 and H_2O at room temperature and 1 atm of pressure (D)the reaction of nitrogen atoms to form N_2 molecules at room temperature and 1 atm

19. Which of the following statement(s) is or are correct?
(A)If a system undergoes an irreversible process, the entropy of the universe decrease
(B)All spontaneous processes occur at an observable rate
(C)If a system undergoes an irreversible process, the change in entropy of the system is exactly matched by an equal change in entropy of the surroundings
(D)No spontaneous processes in nature are spontaneous in both directions at the same temperature and pressure

20.A voltaic cell is constructed that uses the following reaction and operates at 298 K:
$Fe_{(s)} + Cu^{2+}_{(aq)} \rightarrow Fe^{2+}_{(aq)} + Cu_{(s)}$

$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$ $E^0 = 0.34$ V at 298 K
$Fe^{2+}_{(aq)} + 2e^- \rightarrow Fe_{(s)}$ $E^0 = -0.44$ V at 298 K

What is the emf of this cell when $[Cu^{2+}] = 3.00$ M and $[Fe^{2+}] = 0.10$ M?
(A)0.80 V (B) 0.78 V (C) 0.76 V (D) 0.74 V

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※ 注意：請於試卷上「非選擇題作答區」標明題號並依序作答。

II.非選擇題，請考生將答案填寫於答案卷上(共 20 分)

1.Draw molecular orbital of the following diatomic molecules:
(A)B_2 (B) C_2 (C) N_2 (6 分)

2.Bond order of O_2^+, O_2, and O_2^-. (3 分)

3.Draw valid Lewis structures of following molecules:
(A)SO_3 (B) ICl_4^- (6 分)
(C)NCS^- (three possible structures), which one is the dominant structure? (5 分)

試題隨卷繳回