

第 25 届全国华文独中数理学识比赛 (2008)
化学学科

1. 下列何者属于加成聚合物?

Which of the following is an addition polymer?

- (A) 纤维素 cellulose (B) 淀粉 starch
(C) 蚕丝 silk (D) 天然胶 natural rubber
(E) 奈米碳管 carbon nanotube

2. 下列何种化合物可能因打击而爆炸?

Which of the following compounds may explode when subjected to knocking?

- (A) 钾 potassium (B) 氯酸钾 potassium perchlorate
(C) 黄磷 yellow phosphorous (D) 电石 calcium carbide
(E) 硫磺 sulphur

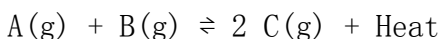
3. 下列分子中, 何者不含氢键?

Among the following molecules, which one does not exhibit hydrogen bonding?

- (A) 水 water (B) 蛋白质 protein
(C) 乙醇 ethyl alcohol (D) 甘油 glycerol
(E) 丙酮 acetone

4. 在密闭容器内 $A(g) + B(g) \rightleftharpoons 2 C(g) + \text{热}$ 的平衡反应中, 若升高温度则下列何者正确?

The following chemical reaction has attained equilibrium in a closed container.



Which of the following is true when we raise the temperature?

- (A) 降低逆反应速率 decreasing the reverse reaction rate
(B) 平衡向右移动 shifting equilibrium reaction to the right
(C) 平衡常数变小 decreasing the equilibrium constant
(D) 反应速率常数不变 same as the reaction rate constant
(E) 不发生任何事情 nothing happened

5. 已知 30 °C 时, 纯水的蒸气压为 32.0 mmHg, 则在此温度下, 1.0 m NaCl 理想水溶液的蒸气压为多少 mmHg?

The vapor pressure of pure water is 32.0 mmHg at 30 °C. What would be the vapor pressure of an ideal solution with 1 m NaCl?

- (A) 31.9 (B) 31.4 (C) 30.9 (D) 30.4 (E) 29.8

6. 定温下, 於 100 毫升的 0.10 M 醋酸水溶液中, 将 0.01 摩尔醋酸钠晶体溶入时, 下列数值何者会变小?

Which of the following would decrease in value when 0.01 mol of $\text{CH}_3\text{COONa}(s)$ is dissolved into a 100 mL 0.10 M $\text{CH}_3\text{COOH}(aq)$ solution at constant temperature?

- (A) 溶液之 pH 值 pH of solution
(B) 醋酸的解离度 percent dissociation of CH_3COOH
(C) 醋酸的解离常数 dissociation constant of CH_3COOH
(D) 溶液中的总带电荷量 the total charge of the solution
(E) 以上皆非 none of the above

7. 若 $Z(\text{OH})_2^{2-}$ 含有电子总数为 60, 则 ^{92}Z 原子的中子数为何?

If there are a total of 60 electrons in $Z(\text{OH})_2^{2-}$, what is the number of neutrons in an atom of ^{92}Z ?

- (A) 52 (B) 46 (C) 34 (D) 32 (E) 30

8. 某密闭容器内含 7.00 克一氧化碳及 3.20 克甲烷, 若一氧化碳的分压为 300 mmHg, 则甲烷的分压为多少?

There are 7.00 g CO and 3.20 g CH₄ in a closed vessel. If the partial pressure of CO is 300 mmHg, what is the partial pressure of CH₄? [H=1, C=12, O=16]

- (A) 320 mmHg (B) 280 mmHg
(C) 240 mmHg (D) 200 mmHg
(E) 180 mmHg

9. 下列何者氧的原子个数最多?

Which of the following contains the greatest number of oxygen atoms?

- (A) 20 克的纯水 20g pure water
- (B) STP 下 22.4 升的氧气 22.4 L oxygen gas at STP
- (C) 3×10^{23} 个臭氧分子 3×10^{23} ozone molecules
- (D) 0.01 mol 磷酸 0.01 mol of phosphoric acid
- (E) 0.5 mol 双氧水 0.5 mol hydrogen peroxide

10. 下列溶液中, 何者的渗透压最大?

Which of the following solution has the greatest osmotic pressure?

- (A) 纯水 pure water
- (B) 0.1 M HCl
- (C) 0.1 M CH_3COOH
- (D) 0.1M NH_3
- (E) 0.1 M HOCl

11. 定温、定压下, 1 单位体积 A_2 气体与 1 单位体积 B_2 气体混合, 生成气体 A_aB_b ($b > a$), 待完全反应后气体总体积变为 $4/3$ 单位, 则 a: b 为何?

Under the conditions of constant temperature and pressure, 1 unit volume of A_2 (g) reacts with 1 unit volume of B_2 (g) to produce a gaseous compound A_aB_b ($b > a$). At the completion of reaction, the total volume is $4/3$ units volume. What is the ratio a:b?

- (A) 1: 2
- (B) 1: 3
- (C) 2: 3
- (D) 3: 4
- (E) 1: 1

12. 在 27°C 下, 24.6 升的 N_2O_4 与 NO_2 混合气体平衡时, 压力为 1.0 atm, 若 x 为 N_2O_4 与 NO_2 的摩尔数比值, 则下列何者正确? (假设 27°C 时, 平衡反应 $\text{N}_2\text{O}_4(g) \rightleftharpoons 2 \text{NO}_2(g)$ 的平衡常数 $K_P = 1.6$)

At 27°C , 24.6 L of a mixture of N_2O_4 and NO_2 gases has a total pressure of 1 atm. If x is the molar ratio of N_2O_4 to NO_2 , which of the following is true? (The equilibrium constant K_P of $\text{N}_2\text{O}_4(g) \rightleftharpoons 2 \text{NO}_2(g)$ is 1.6 at 27°C)

- (A) $x \geq 1$
- (B) $1 > x \geq 0.7$
- (C) $0.7 > x \geq 0.4$
- (D) $0.4 > x \geq 0.2$
- (E) $0.2 > x$

13. 下列物质何者含矽元素?

Which of the following materials contains silicon element?

- (A) 冰晶石 cryolite (B) 硼砂 borax (C) 明矾 alum
(D) 水泥 cement (E) 塑胶 plastic

14. C_4H_8 有几种可能的异构体?

There are how many structural isomers of C_4H_8 ?

- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

15. 下列那一原子有最大的第二游离能?

Which of the following atoms has the largest second ionization energy?

- (A) ${}_{16}S$ (B) ${}_{19}K$ (C) ${}_{20}Ca$ (D) ${}_{38}Sr$ (E) ${}_{56}Ba$

16. 荷质比 ($\frac{e}{m}$) 为粒子电荷量(不考虑正负)与质量的比值, 下列何种粒子具有最大的荷质比?

The charge to mass ratio (e/m) is the ratio of particle charge to its mass (irrespective to positive or negative charge). Which of the following particles has the largest charge to mass ratio?

- (A) 电子 electron (B) 质子 proton
(C) 中子 neutron (D) α 粒子 α particle
(E) γ 粒子 γ particle

17. 下列原子或离子中, 何者的电子排布为基态?

Which of the following electron configurations is in the ground state of the species?

- (A) ${}_{12}Mg : [Ne] 3s^1 3p_x^1$ (B) ${}_6C : [He] 2s^2 2p_x^1 2p_y^1$
(C) ${}_{30}Zn^{2+} : [Ar] 4s^2 3d^8$ (D) ${}_{25}Mn : [Ar] 3d^7$
(E) ${}_{29}Cu : [Ar] 3d^{10}4p^1$

18. 常温下，密闭容器内的理想气体平衡反应 $A(g) + 2B(g) \rightleftharpoons 2C(g) + \text{热}$ ，其浓度平衡常数为 K_C ，压力平衡常数为 K_P ，则下列叙述，何者正确？

Under normal temperature, the following ideal gases attain chemical equilibrium in a closed vessel. $A(g) + B(g) \rightleftharpoons 2C(g) + \text{Heat}$ with concentration equilibrium constant K_C and pressure equilibrium constant K_P . Which of the following statements is correct?

- (A) 若容器体积增大，则 C 的产量增加 The amount of C will increase when we increase the volume of the container.
(B) 若容器体积缩小，则 K_C 增大 The K_C will increase when we decrease the volume of the container.
(C) 若温度升高，则 K_P 增大 The K_P will increase when we raise the temperature.
(D) 反应若高於常温时， K_C 恒大於 K_P The K_C will be always greater than K_P when $T > 25^\circ\text{C}$
(E) 以上皆非 none of the above

19. 有关“苯胺”的叙述，何者错误？

Among the following statements about aniline, which one is false?

- (A) 苯胺为第二胺 Aniline is a secondary amine.
(B) 可由硝基苯以铁与稀盐酸还原制备 Aniline can be produced from reduction reaction of nitrobenzene with iron and dilute hydrochloric acid.
(C) 难溶於水但可溶於盐酸溶液 Aniline does not dissolve in water readily but can dissolve in hydrochloric acid solution.
(D) 可与乙酐反应生成乙酞胺苯 Aniline can react with acetic anhydride to form acetanilide.
(E) 分子式为 $C_6H_5NH_2$ $C_6H_5NH_2$ is the formula of aniline.

20. 下列各分子解离能的大小次序，何者正确？

Which of the following shows the correct order of bond dissociation energies?

- (A) $H_2 > F_2 > Cl_2$
(B) $F_2 > Cl_2 > H_2$
(C) $Cl_2 > F_2 > H_2$

(D) $H_2 > Cl_2 > F_2$

(E) $F_2 > H_2 > Cl_2$

21. 下列有关“酯类与脂肪”的叙述，何者错误？

The following descriptions about esters and fats, which is false?

(A) 酸与醇脱水可产生酯 Dehydration of Carboxylic acid and alcohol can produce ester.

(B) 甘油与脂肪酸反应可生成酯 Glycerol can react with fatty acids to form esters.

(C) 石蜡是一种酯类化合物 Paraffin is a type of ester compound.

(D) 油脂在氢氧化钠溶液中加热，可水解为脂肪酸钠 Lipid in hot NaOH(aq) solution, can be hydrolyzed to the sodium salts of fatty acids.

(E) 阿斯匹灵含有酯的官能基 Aspirin contains an ester functional group.

22. 在 27°C 时，含某化合物 0.40 克的 100.0 毫升溶液，其渗透压为 0.30 atm，则该化合物的分子量为多少 g/mol？

(气体常数 gas constant $R = 0.082 \text{ atm} \cdot \text{L/mol} \cdot \text{K}$)

At a temperature of 27°C, a 100 mL solution contains 0.40 g of an unknown compound. If the solution has an osmotic pressure of 0.30 atm, what is the molar mass of this unknown compound in g/mol?

(A) 120

(B) 133

(C) 246

(D) 328

(E) 426

23. 常温下，重 35.512 克的某酸溶液 35.0 毫升，以 0.100 M 的氢氧化钠溶液滴定至当量点时，用去 40.0 毫升的氢氧化钠溶液，则此酸可为下列何酸？

(假设常温下水的比重为 1.00, H 1, N 14, O 16, P 31, S 32, Cl 35.5, I 127)

Under normal temperature, 35.512 g of a certain liquid acid has a volume of 35.0 mL, and it would require 40.0 mL of 0.100 M NaOH(aq) to titrate to the equivalent point. The unknown acid could probably be which of the following?

(A) 氢硫酸 H_2S

- (B) 盐酸 HCl
- (C) 氢碘酸 HI
- (D) 氢氰酸 HCN
- (E) 氯酸 HClO₃

24. 已知下列半反应的标准还原电位:



则反应 $2\text{Na}_{(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow 2\text{Na}^+_{(aq)} + 2\text{OH}^-_{(aq)} + \text{H}_{2(g)}$ 的 ΔE° 为多少伏特?

The standard half-reduction potentials are given as follow:

For the reaction $2\text{Na}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{Na}^+(aq) + 2\text{OH}^-(aq) + \text{H}_2(g)$, what is the reaction potential ΔE° in volt ?

- (A) -4.59
- (B) -1.88
- (C) 1.88
- (D) 4.59
- (E) 0.00

25. 若化合物 A₂B 的重量百分组成为 60% A 与 40% B, 则化合物 AB₂ 的重量百分组成, 与下列何组最接近?

If the composition of a compound A₂B is 60% A and 40% B by weight, which is the closest weight % of A and B in compound AB₂ ?

- (A) 27% A 与 73% B
- (B) 33% A 与 67% B
- (C) 40% A 与 60% B
- (D) 50% A 与 50% B
- (E) 67% A 与 33% B

26. 有一反应: $2\text{X}(aq) + \text{Y}(aq) \rightleftharpoons \text{Z}(aq)$ 。当以 2 M 的 X 与 1 M 的 Y 反应平衡后, 可得 0.5 M 的 Z; 若欲由 1 M 的 Y 制备 0.9 M 的 Z, 则所须 X 的最低浓度, 与下列何者最接近?

A chemical equilibrium is represented by $2\text{X}(aq) + \text{Y}(aq) \rightleftharpoons \text{Z}(aq)$. 2M of X can react with 1M of Y to produce 0.5M of Z after reaching equilibrium. Which of the following is close to the minimum concentration of X required to react with 1M Y in order to produce

0.9M of Z ?

- (A) 3 M (B) 5 M (C) 7 M (D) 9 M (E) 11 M

27. 定温 25°C 下, 将 50.0 毫升 0.4 M 氢氧化钠水溶液与 50.0 毫升 0.4 M 醋酸水溶液混合, 则混合溶液的 pH 值与下列数值何者最接近?
(在 25°C 时, 醋酸的酸解离常数为 1.8×10^{-5})

At constant temperature of 25°C, 50.0 mL of 0.4 M sodium hydroxide aqueous solution was mixed with 50.0 mL 0.4 M acetic acid aqueous solution. What is the pH of the solution? (K_a of acetic acid is 1.8×10^{-5} at 25°C)

- (A) 6.0 (B) 7.5 (C) 9.0 (D) 10.5 (E) 11.5

28. 容器内含 1 摩尔氢与 1 摩尔氧的均匀混合气体, 令此气体自器壁的小孔向真空扩散, 当容器压力减至一半时, 此时容器内氧的莫耳分率为多少? (假设遵守理想气体行为)

A vessel contains a gaseous mixture of 1 mol H_2 and 1 mol O_2 . What is the mol fraction of oxygen when the gas mixture has effused through a tiny hole on the wall of the vessel to a vacuum surrounding and the total pressure of the vessel has reduced to one half of initial pressure? (Assuming O_2 and H_2 behave as ideal gases).

- (A) 0.2 (B) 0.5 (C) 0.6 (D) 0.8 (E) 0.9

29. 反应方程 $4HBr(g) + O_2(g) \rightarrow 2H_2O(g) + 2Br_2(g)$ 其正向反应速率 =

$k[HBr][O_2]$, 若将 HBr 及 O_2 之分压均加倍时, 则反应速率应变为原有之:

$4HBr(g) + O_2(g) \rightarrow 2H_2O(g) + 2Br_2(g)$ has the forward reaction rate $k[HBr][O_2]$. If we double both the partial pressures of HBr and O_2 , the rate of reaction would increase by how many times of the original rate?

- (A) 2 倍 (B) 4 倍 (C) 8 倍 (D) 16 倍 (E) 32 倍

30. 下列分子中，何者碳原子的混成轨域和水分子中的氧原子相同？

Among the following compounds, which one has the carbon atom with the same hybridization as the oxygen atom in water molecule?

- (A) CO_2 (B) CH_4 (C) C_2H_4 (D) C_2H_2 (E) CO

答案:

1	D
2	B
3	E
4	C
5	C
6	B
7	A
8	C
9	B
10	B
11	B
12	C
13	D
14	C
15	B
16	A
17	B
18	D
19	A
20	D
21	C
22	D
23	C
24	C
25	A
26	B
27	C
28	D
29	B
30	B