

2015 年第三十二届全国华文独中数理学识比赛 - 化学

下列元素周期表资料，可供回答问题之参考

1 H 1.0																	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.0											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.0	17 Cl 35.5	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 64.0	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 80.0	36 Kr 83.8

1. 某 X 酯($C_6H_{12}O_2$)进行水解产生 Y 酸和 Z 醇。Z 可以通过氧化被转化为 Y。X 酯的公式可能是....

Ester X ($C_6H_{12}O_2$) undergoes hydrolysis to an acid Y and alcohol Z. Through oxidation, Z can be converted to Y. Formula of ester X could be

- (A) $CH_3COOCH_2CH_2CH_2CH_3$ (B) $(CH_3)_2CHCOOCH_2CH_3$
 (C) $CH_3CH_2CH_2COOCH_2CH_3$ (D) $C_2H_5COOCH(CH_3)_2$
 (E) 以上皆非 (None of the above)

2. 下列粒子的电子组态，何者为基态之电子组态?

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

- (A) $_{29}Cu : [Ar]3d^94s^2$ (B) $_{26}Fe^{3+} : [Ar]3d^5$ (C) $_{17}Cl : 1s^22s^22p^63s^33p^4$
 (D) $_{24}Cr^{3+} : [Ar]3d^24s^1$ (E) $_{8}O : 1s^22s^22p_x^22p_y^2$

3. 下列 1 莫耳物质所形成的水溶液，何者导电度最大?

Which of the following aqueous solutions prepared by dissolving 1 mole of the material in the water has the highest electrical conductivity?

- (A) Na_2O (B) Cl_2 (C) $Pt(NH_3)_3Cl_4$
 (D) $HCHO$ (E) CH_3COCl

4. 已知方程式 $3A \rightarrow 2B$ 的速率定律式: $rate = k[A]$ ，其速率常数 = 0.0447 hr^{-1} 。则此反应的半生期为何?

The rate law for the reaction $3A \rightarrow 2B$ is $rate = k[A]$ with a rate constant of 0.044 hr^{-1} . What is the half-life of the reaction?

- (A) 0.0224 hr (B) 0.0645 hr (C) 15.7 hr
 (D) 22.4 hr (E) 44.7 hr

5. 试将液态水在-10℃下凝结，则在这过程中 ΔH , ΔS ,和 ΔG 各自正负为何?
 Consider the of freezing of liquid water at -10℃, what are the signs for ΔH , ΔS , and ΔG , respectively?

- (A) +, -, 0 (B) -, +, 0 (C) -, +, - (D) +, -, - (E) -, -, -

6. 下列何者配位化合物当和 AgNO_3 水溶液混合时，会产生沉淀?
 Which of the following coordination compounds will form a precipitate when treated with an aqueous solution of AgNO_3 ?

- (A) $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$ (B) $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$ (C) $\text{Na}_3[\text{Cr}_3[\text{Cr}(\text{CN})_6]]$
 (D) $\text{Na}_3[\text{CrCl}_6]$ (E) 以上皆非 (None of the above)

7. 以下化合物有几个具有几何异构体?
 How many of the following compounds exhibit geometric isomers?

(1) $\text{Pd}(\text{NH}_3)_2\text{Br}_2$ (平面四方形; square planar)

(2) $[\text{Co}(\text{NH}_3)_2]\text{Cl}_3$

(3) $\text{K}_2[\text{CoBr}_4]$

(4) $[\text{Ni}(\text{NH}_3)_4(\text{NO}_2)_2]$

- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

8. 五氧化二氮(N_2O_5)在四氯化碳中的分解反应是： $2\text{N}_2\text{O}_{5(\text{g})} \rightarrow 4\text{NO}_{2(\text{g})} + \text{O}_{2(\text{g})}$
 下表为在定温下其浓度随时间的变化结果，根据此推知此反应速率常数 K 的单位应为下列何者?

The decomposition of N_2O_5 in CCl_4 is : $2\text{N}_2\text{O}_{5(\text{g})} \rightarrow 4\text{NO}_{2(\text{g})} + \text{O}_{2(\text{g})}$

Under constant temperature, the concentration of N_2O_5 measured at specified time interval was shown in the following table. Based on these results, what is the unit of rate constant K ?

时间(分) (min)	0	20	40	60
$[\text{N}_2\text{O}_5](\text{M})$	0.0100	0.0051	0.0025	0.0013

- (A) min^{-1} (B) M min^{-1} (C) $\text{M}^{-1} \text{min}^{-1}$
 (D) $\text{M}^{-2} \text{min}^{-1}$ (E) $\text{M}^{-3} \text{min}^{-1}$

9. 在化合物 X_2Y 和 YZ_2 中，Y的质量百分比分别为40%和50% 则在化合物 X_2YZ_3 中Y的质量百分比最接近多少?

The mass percentage of Y in chemicals of X_2Y and YZ_2 are 40% and 50%, respectively. Then, what is the mass percentage of Y in chemical X_2YZ_3 ?

- (A) 10% (B) 20% (C) 25%

(D) 30%

(E) 35%

10. 某烃的某一种同分异构物只能生成一种一氯取代物,该烃的分子式可以是下列何者?

Which of the following alkanes can only form one mono-chlorinated derivative?

(A) C₃H₈

(B) C₄H₁₀

(C) C₅H₁₂

(D) C₆H₁₄

(E) 以上皆非 (none of the above)

11. 在下列反应中,水仅作还原剂的是?

In which of the following reactions, H₂O plays the role of a reducing agent?

(A) 2Na+2H₂O→2NaOH+H₂

(B) Cl₂+H₂O→HCl+HClO

(C) SO₂+H₂O→H₂SO₃

(D) CaC₂+2H₂O→Ca(OH)₂+C₂H₂

(E) 2F₂+2H₂O→4HF+O₂

12. 有关游离能大小比较,何者错误?

Which one is false regarding the ionization energy?

(A) F⁻ > Cl⁻

(B) F > N > O

(C) Na > Cl⁻

(D) F > Cl

(E) K⁺ > Ar

13. 下列何者是「非缓冲溶液」?

Which one of the followings is not a buffer solution?

(A) 50 毫升 0.4 M CH₃COOH 和 50 毫升 0.2 M NaOH 的混合液
Mixing 50 mL of 0.4 M CH₃COOH and 50 mL of 0.2 M NaOH

(B) 50 毫升 0.2 M HCl 和 50 毫升 0.4 M CH₃COONa 的混合液
Mixing 50 mL of 0.2 M HCl and 50 mL of 0.4 M CH₃COONa

(C) 50 毫升 0.4 M HCl 和 50 毫升 0.2 M Na₂CO₃ 的混合液
Mixing 50 mL of 0.4 M HCl and 50 mL of 0.2 M Na₂CO₃

(D) 50 毫升 0.2 M KH₂PO₄ 和 50 毫升 0.2M K₂HPO₄ 的混合液
Mixing 50 mL of 0.2 M KH₂PO₄ and 50 mL of 0.2 M K₂HPO₄

(E) 50 毫升 0.2 M NaOH 和 50 毫升 0.4 M NH₄Cl 的混合液
Mixing 50 mL of 0.2 M NaOH and 50 mL of 0.4 M NH₄Cl

14. 下列五组物质中,哪一组物质之分子几何结构最为相似?

For the followings pair of chemicals, which chemicals pair shows the most similar molecular geometry structure?

(A) CO₂, SiO₂

(B) N₂O, NO₂

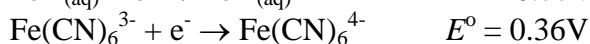
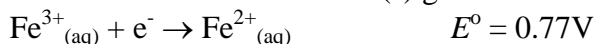
(C) NF₃, BF₃

(D) NH₃, P₄

(E) SO₃²⁻, CO₃²⁻

15. 根据以下讯息选择正确的叙述.

Choose the correct statement(s) given the following information.

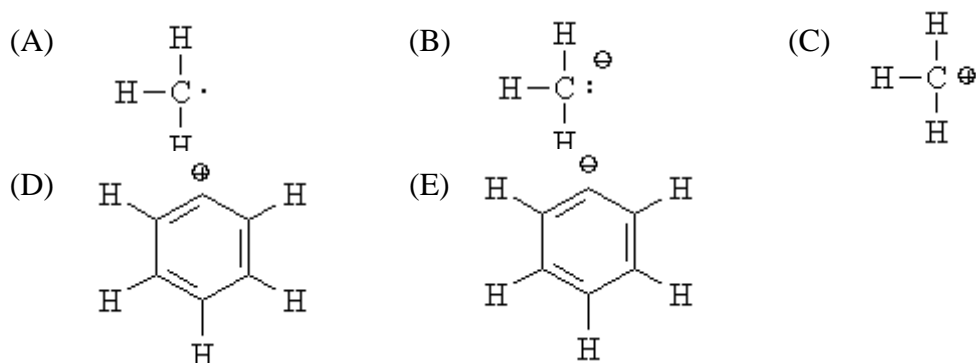


- I. $\text{Fe}^{2+}_{(\text{aq})}$ 比 Fe^{2+} 的 CN^- 错合物更容易被氧化
 $\text{Fe}^{2+}_{(\text{aq})}$ is more likely to be oxidized than Fe^{2+} complexed to CN^- .
- II. $\text{Fe}^{3+}_{(\text{aq})}$ 比 Fe^{3+} 的 CN^- 错合物更容易被还原
 $\text{Fe}^{3+}_{(\text{aq})}$ is more likely to be reduced than Fe^{3+} complexed to CN^- .
- III. Fe 离子与 CN^- 的错合物对氧化与还原趋势没有影响
 Complexation of Fe ions with CN^- has no effect on their tendencies to become oxidized or reduced.

- (A) I only (B) II only (C) I and II
 (D) III only (E) 已上皆非 (none of the above)

16. 下列哪一项是苯与 CH_3Cl 和 AlCl_3 的反应中间体?

Which of the following is an intermediate in the reaction of benzene with CH_3Cl and AlCl_3 ?



17. 下列何者的命名为正确:

Which of the following compound is named correctly?

- (A) 3,4-二氯戊烷 (3,4-dichloropentane)
 (B) 1-氟-2,4-甲基-3-丙基环己烷 (1-fluoro-2,4-methyl-3-propylcyclohexane)
 (C) 1,1-二甲基-2,2-二乙基丁烷 (1,1-dimethyl-2,2-diethylbutane)
 (D) 顺式-1,3-二甲基丁烷 (*cis*-1,3-dimethylbutane)
 (E) 2-氟-1-氯-4,4-二甲基壬烷 (2-fluoro-1-chloro-4,4-dimethylnonane.)

18. 下列哪个电磁光谱的产生是经由电子的跃迁?

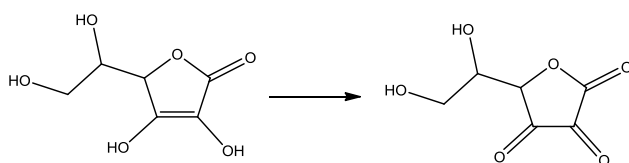
Which region of electromagnetic spectrum can be used to produce the electronic transition?

- (A) 紫外光(UV) (B) 红外线(IR) (C) 微波(microwave)
 (D) 可见光(visible) (E) 无线电波(radio wave)

19. CN^- , NO^- , O_2 , OF^+ , OF^- 试问顺磁性有多少个?
How many of the followings are paramagnetic?
 CN^- , NO^- , O_2 , OF^+ , OF^-
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
20. 丙基红指示剂 $K_a = 3.3 \times 10^{-6}$, pH 值的变色区间约为以下何者?
The propyl red indicator has $K_a = 3.3 \times 10^{-6}$. What would be the approximate pH range over which it would change color?
(A) 3.5~5.5
(B) 4.5~6.5
(C) 5.5~7.5
(D) 6.5~8.5
(E) 以上皆非 (none of the above)
21. 电解 9 克水时, 若在阴极阳极接产生气体, 则理论上在阳极可得多少升的何种气体 (在标准状况下: 1 atm、25 °C)?
When electrolyzing 9 g of H_2O , if both electrodes will produce gases, then how many liters of what kind of gas can be produced in anode under standard condition (standard condition: 1 atm, 25 °C)?
(A) 2.8 升氢气 (2.8L of H_2)
(B) 2.8 升氧气 (2.8L of O_2)
(C) 5.6 升氢气 (5.6L of H_2)
(D) 5.6 升氧气 (5.6L of O_2)
(E) 11.2 升氧气 (11.2L of O_2)
22. 下列有关 $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ 的叙述, 哪一项正确?
Which statements is correct about compound $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$?
(A) 此化合物的 Fe^{3+} 配位数为 3
The coordination number of Fe^{3+} in $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ is 3
(B) K^+ 与 Fe^{3+} 以配位键结合
 K^+ binds Fe^{3+} through coordinate covalent bond
(C) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ 中 Fe^{3+} 的电子组态为 $[\text{Ar}]3d^5$
The electron configuration of Fe^{3+} in $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ is $[\text{Ar}]3d^5$
(D) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ 溶于水后会解离成 K^+ 、 Fe^{3+} 和 $\text{C}_2\text{O}_4^{2-}$
When $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ is dissolved in water, it will dissociate into K^+ , Fe^{3+} , and $\text{C}_2\text{O}_4^{2-}$
(E) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ 中的 $\text{C}_2\text{O}_4^{2-}$ 具有 2 个负电荷, 故以离子键方式与 Fe^{3+} 结合
 $\text{C}_2\text{O}_4^{2-}$ of $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ possesses 2 negative charges, so it binds Fe^{3+} through ionic bond

23. 下列有五种元素其电子组态分别为 A: $1s^2 2s^2 2p^1$ 、B: $[\text{Ne}]3s^2 3p^1$ 、C: $[\text{Ar}]3d^{10} 4s^2 4p^1$ 、D: $[\text{Ne}]3s^2 3p^3$ 、E: $[\text{Ar}]3d^{10} 4s^2 4p^3$ ，请问下列有关该五种元素及其化合物性质的叙述与比较，哪一项正确？
The electron configuration of 5 elements are: A: $1s^2 2s^2 2p^1$ Fe³, B: $[\text{Ne}]3s^2 3p^1$, C: $[\text{Ar}]3d^{10} 4s^2 4p^1$, D: $[\text{Ne}]3s^2 3p^3$, and E: $[\text{Ar}]3d^{10} 4s^2 4p^3$. Which of the following statements regarding these 5 elements and their character is correct?
- (A) A 属于金属元素 (A is a metallic element.)
 (B) 电负度最小者为 E (E has the smallest electron negativity)
 (C) 第一游离能最小者为 C (C has the smallest first ionization energy)
 (D) 非金属性质最强者为 B (B has the strongest non-metallic property)
 (E) D 的氧化物溶于水为碱性溶液 (The aqueous solution of the oxide of D is basic)

24. 维生素 C (MW = 176) 是很好的抗氧化剂，它的氧化过程，其结构变化如下图所示。若在酸性条件下，以 0.100M 的过锰酸钾溶液滴定 3.52 克维生素 C 时，至少须加入多少毫升过锰酸钾溶液，才能到达滴定终点呈现紫红色？
Vitamin C (Mw = 176) is a good antioxidant. During its oxidation reaction, the structural change is shown as below. Under acidic condition, 3.52 g of vitamin C is titrated with 0.100 M of K_2MnO_4 . How many mL of K_2MnO_4 solution is needed to reach the titration end point with purple color?



- (A) 0.04 (B) 0.08 (C) 40 (D) 80 (E) 160

25. 在恒温 25 °C 下，2.45 L 的圆形容器中放入 NH_3 0.3 mol、 HCl 0.1 mol、 NO 0.1 mol。平衡后，则下列叙述何者正确？
At constant temperature of 25 °C, 0.3 mol of NH_3 , 0.1 mol of HCl , and 0.1 mol of NO are put in a 2.45 L round bottle.. After attaining equilibrium, which one of the following statements is correct?
- (A) 容器中的总压为 5 atm (the total pressure in the bottle is 5 atm)
 (B) 容器中 NH_3 的分压为 3 atm (the partial pressure of NH_3 is 3 atm)
 (C) NO 的莫耳分率为 1/2 (the molar fraction of NO is 0.5)
 (D) 定压中加入 0.4 克的 He， NO 分压为 1 atm (under constant pressure, when 0.4 g of He is added, then the partial pressure of NO becomes 1 atm)
 (E) 定容下加入 1.6 克 O_2 ，假设 $2\text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g})$ 不会发生，总压变为 3 atm
Under conditions of constant volume, when 1.6 g of O_2 is added and assuming the reaction of $2\text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g})$ cannot occur, then the total pressure would be 3 atm.