

下列元素週期表資料，可供回答問題之參考

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

選擇題 (共 25 題)

1. 下列那些元素或離子於基態時的電子組態，軌域中含有未配對電子(即某一軌域只含有一個電子)?

For the following elements or ions, which ground state electron configuration contains an unpaired electron in its orbital?

- (A) Sc^{3+}
 (B) Cl
 (C) Mg
 (D) Cu^+
 (E) Ti
2. Na、Mg、Al 為第三週期的元素，請問以下敘述那個正確?
 Which of the following is correct regarding elements of Na, Mg, and Al?
- (A) 第一游離能 (First ionization Energy) : $\text{Mg} > \text{Al} > \text{Na}$
 (B) 第二游離能 (Secondary ionization Energy) : $\text{Na} > \text{Mg} > \text{Al}$
 (C) 第三游離能 (Third ionization Energy) : $\text{Al} > \text{Na} > \text{Mg}$
 (D) 原子半徑 (Atomic Radius): $\text{Mg} > \text{Na} > \text{Al}$
 (E) 電負度 (Electron Negativity): $\text{Mg} > \text{Na} > \text{Al}$

3. 若 P、Q⁺、R²⁺与 S 其電子組態分別為：

P : $1s^2 2s^2 2p^6 3s^2$, Q⁺ : $1s^2 2s^2 2p^6 3s^1$, R²⁺ : $1s^2 2s^2 2p^6$, S : $1s^2 2s^2 2p^6$, 則下列敘述何者正確?

If the electron configurations of P, Q⁺, R²⁺ and S are as follow:

P : $1s^2 2s^2 2p^6 3s^2$, Q⁺ : $1s^2 2s^2 2p^6 3s^1$, R²⁺ : $1s^2 2s^2 2p^6$, S : $1s^2 2s^2 2p^6$

Which of the following statements is correct?

- (A) P、Q、R 是同一元素 P, Q, and R refer to the same element
- (B) R 与 S 是同族元素 R and S are in the same Group
- (C) Q 变成 P 是吸熱反應 Q changes to P is an endothermic reaction
- (D) S 是氦原子 S is helium atom
- (E) P 的穩定離子態為+1 The stable ionic state for P is +1

4. CO₂ 分子形狀為直線型，NH₃ 分子形狀為三角錐形，如果依照路易斯電子點式排列，在這兩分子內，CO₂ 分子中的共價鍵數目與 NH₃ 的未鍵結電子對(孤電子對)數目分別為若干?

The molecular shape of CO₂ is linear and NH₃ is pyramid. Based on their Lewis structure, what is the respective number of covalent bonds in CO₂ and of lone pair electron in NH₃?

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

5. 下列是 4 個量子(n, l, m_l 與 s)之組合，那一組合是違反包利不相容原理? Which set of the 4 quantum numbers (n, l, m_l, and s) is against Pauli exclusion principle?

- (A) 2,1,-1,-1/2 (B) 3,2,-2,-1/2 (C) 3,3,2,+1/2
- (D) 5,4,3,-1/2 (E) 2,0,0,-1/2

6. 下列那種離子可以從水中將 Fe³⁺ 沉淀出?

Which of the following ions would be useful in the precipitation of Fe³⁺ from water?

- (A) SO₄²⁻ (B) Cl⁻ (C) NO₃⁻ (D) CH₃COO⁻ (E) OH⁻

7. 將下列分子依擴散速率快慢順序排列：

Arrange the following molecules in order of increasing diffusion rate

F₂、Cl₂、NO、NO₂、CH₄

- (A) Cl₂ < NO₂ < F₂ < NO < CH₄
- (B) Cl₂ < F₂ < NO₂ < CH₄ < NO
- (C) CH₄ < NO₂ < NO < F₂ < Cl₂
- (D) CH₄ < NO < F₂ < NO₂ < Cl₂
- (E) F₂ < NO < Cl₂ < NO₂ < CH₄

8. 可逆反應 $P_{(g)} \rightleftharpoons Q_{(?) + R_{(?)}$ ，正反應是吸熱反應。

隨著溫度升高，氣體平均分子量有變小趨勢，則下列判斷那個是正確的？

For the reversible reaction, $P_{(g)} \rightleftharpoons Q_{(?) + R_{(?)}$, the forward reaction is endothermic. With the increase of temperature, the average molecular weight of the gases decreases. Which of the following statement is correct?

(A) Q 和 R 可能都是氣體 Both Q and R may be gases.

(B) Q 和 R 一定都是氣體 Both Q and R must be gases.

(C) R 的產率與溫度無關

The yield of C has nothing to do with the temperature

(D) Q 和 R 可能都是固體 Both Q and R may be solids

(E) 隨著溫度升高， K_p 值會變小

With the increase of temperature, K_p decreases.

9. 下列的那一項可產生氫氣？

Which of the following can produce hydrogen gas?

(I) 水蒸氣通過鐵絲 Passing steam over hot iron wire

(II) HCl 稀水溶液的電解 Electrolysis of aqueous dilute HCl solution.

(III) 鈉與乙醇的反應 Reacting sodium with ethanol.

(IV) 水與甲烷的反應 Reaction of water and methane.

(A) I,II,III (B) I, III (C) II,IV (D) IV (E) 其他的組合 None of the above.

10. 8 克的氧氣存在一個關閉的瓶之中，瓶子的容量為 11.2 公升，當溫度從 80°C 上升到 160°C 的時候，下列那一項將會發生？

8 g oxygen was kept in a closed bottle with a volume of 11.2 L. When the temperature was increased from 80°C to 160°C , which of the following would happen?

(I) 氣壓將增加 The gas pressure would increase.

(II) 氧氣質量將增加 The mass of oxygen would increase.

(III) 氧氣分子活動的能量將增加 The kinetic energy of gas molecule would increase.

(IV) 氧氣容量將增加到 22.4 公升 The gas volume would increase to 22.4 L.

(A) I,II,III (B) I, III (C) II,IV (D) IV (E) 其他的組合 None of the above.

11. 关于重量百分率浓度皆为 1% 的四種水溶液，(i) NaCl (ii) Na₂SO₄ (iii) C₂H₅OH (iv) C₆H₁₂O₆，下列敘述何者正確？
Aqueous solutions of (i) NaCl (ii) Na₂SO₄ (iii) C₂H₅OH (iv) C₆H₁₂O₆ have the concentration of 1 wt%. Which of the following statements is correct?
- (A) C₂H₅OH 的凡特荷夫因子 = 2 The van't Hoff factor of C₂H₅OH is 2.
(B) 溶液 (i) 的重量莫耳浓度最大 Solution (i) has the largest molality.
(C) 凝固點之高低順序為：(iv) > (ii) > (iii) > (i).
The order of freezing point is (iv) > (ii) > (iii) > (i).
(D) 沸點之高低順序為：(i) > (ii) > (iii) > (iv)
The order of boiling point is (i) > (ii) > (iii) > (iv)
(E) 以上都不对 None of the above

12. $\text{Cr}(\text{OH})_3 (\text{s}) \rightleftharpoons \text{Cr}^{3+} (\text{aq}) + 3 \text{OH}^{-} (\text{aq})$
Cr(OH)₃ 的溶度积的表达式应该是…
The expression for the solubility product for Cr(OH)₃ is...

- (A) $K_{\text{sp}} = [\text{Cr}^{3+}][\text{OH}^{-}]/[\text{Cr}(\text{OH})_3]$ (B) $K_{\text{sp}} = 3 [\text{Cr}^{3+}][\text{OH}^{-}]$ (C) $K_{\text{sp}} = [\text{OH}^{-}]^3 / [\text{Cr}^{3+}]$
(D) $K_{\text{sp}} = [\text{Cr}^{3+}][\text{OH}^{-}]^3$ (E) $K_{\text{sp}} = [\text{Cr}(\text{OH})_3] / [\text{Cr}^{3+}][\text{OH}^{-}]^3$

13. 关于溶液浓度的敘述，何者正確？
Which of the following statements on solution concentration is correct?
- (A) 取 18 M 浓硫酸水溶液 100 毫升與 500 毫升的純水混合後，浓度變為 3 M
After adding 500 mL of pure water to 100 mL of 18 M H₂SO₄, the final concentration is 3M
- (B) 取 25 克 CuSO₄ · 5H₂O 晶體溶於 100 克水中，其重量莫耳浓度為 1 m
After dissolving 25 g of CuSO₄ · 5H₂O crystals in 100 g of water, the final molal concentration is 1 m
- (C) 取 50 % NaOH_(aq) 40 克與 10 % NaOH_(aq) 60 克混合後，浓度變為 30 %
Mixing 40 g of 50 % NaOH_(aq) with 60 g of 10 % NaOH_(aq) results in final concentration of 30%
- (D) 某汞汙泥的含汞量為 402 ppm，相當於重量百分率浓度為 4.02×10^{-2}
The mercury content of a solid waste is 402 ppm, which is equivalent to 4.02×10^{-2} wt%
- (E) 取 90 克葡萄糖溶於 410 克水中，其重量莫耳浓度為 1 m
Dissolve 90 g of glucose in 410 g of water and the molal concentration is 1 m.

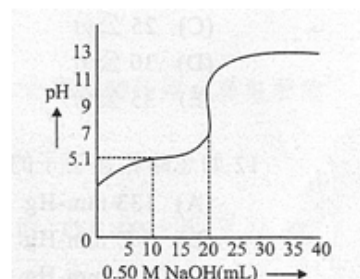
14. 下列各化合物分別与水混合後，其溶液何者為鹼性？

Which of the following aqueous solution is alkaline?

- (A) $(\text{CH}_3)_2\text{SiCl}_2$ (B) NH_4Cl (C) NaHCO_3
 (D) CH_3COCl (E) $\text{Bi}(\text{OH})_2\text{NO}_3$

15. 某一元弱酸 HA 之溶液 100 毫升，以 0.50M 氫氧化鈉溶液滴定後得滴定曲線如圖所示，則弱酸 HA 之浓度為何？

Using 0.50 M NaOH solution to titrate 100 mL of a monoprotic weak acid (HA) solution, the titration curve is as shown on the right. What is the initial concentration of the weak acid?



- (A) 0.05 M (B) 0.10 M (C) 0.12 M
 (D) 0.15 M (E) 0.20 M

16. 接上一題，該弱酸的解离常数 K_a 值為何？

As illustrated in the previous question (question #15), what is the dissociation constant, K_a , for the monoprotic weak acid (HA)?

- (A) 8×10^{-5} (B) 8×10^{-6} (C) 8×10^{-7}
 (D) 7×10^{-6} (E) 7×10^{-5}

17. 在标准状态 (STP) 下有一反应 $2A \rightarrow C+D$ ，其 A 浓度與時間的關係如下表所示，則此反应的速率常数数值約為多少？

For the reaction of $2A \rightarrow C+D$, under STP conditions, the concentrations of A at various time are as shown in the following table. What is the rate constant (k) for this reaction?

- (A) 0.003 (B) 0.0693 (C) 0.089
 (D) 0.693 (E) 0.139

表 (Table)

時間 (秒) Time (S)	0	5	10	15
[A]/ (M)	10	5	2.5	1.25

18. 下列反应皆為吸熱反应，何者之 ΔH 值最大？

Following reactions all are endothermic. Which one has the largest ΔH value?

- (A) $\text{F}_{2(g)} \rightarrow 2\text{F}_{(g)}$ (B) $\text{Cl}_{2(g)} \rightarrow 2\text{Cl}_{(g)}$ (C) $\text{N}_{2(g)} \rightarrow 2\text{N}_{(g)}$
 (D) $\text{O}_{2(g)} \rightarrow 2\text{O}_{(g)}$ (E) $\text{H}_{2(g)} \rightarrow 2\text{H}_{(g)}$

19. 下列何者不是氧化還原反應?

Which of the following is not a redox reaction?

- (A) $3\text{KClO} \rightarrow 2\text{KCl} + \text{KClO}_3$
- (B) $2\text{KI} + \text{H}_2\text{O}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + \text{I}_2 + 2\text{H}_2\text{O}$
- (C) $\text{CuSO}_4 + 4\text{NH}_3 \rightarrow [\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
- (D) $\text{ClO}_3^- + 3\text{SO}_3^{2-} \rightarrow \text{Cl}^- + 3\text{SO}_4^{2-}$
- (E) $3\text{HNO}_2 \rightarrow \text{HNO}_3 + 2\text{NO} + \text{H}_2\text{O}$

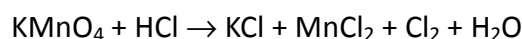
20. 關於電解氯化銅(II)溶液，下列敘述何者是錯誤的？

Which of the following statements is wrong regarding the electrolysis of CuCl_2 solution?

- (A) Cu^{2+} 與 H^+ 向陰極移動
 Cu^{2+} and H^+ move to cathode
- (B) Cl^- 與 OH^- 向陽極移動
 Cl^- and OH^- move to anode
- (C) 在陽極之主要反應產物是 $\text{O}_2(\text{g})$
The major product at anode is $\text{O}_2(\text{g})$
- (D) 在陰極之主要反應產物是 $\text{Cu}(\text{s})$
The major product at cathode is $\text{Cu}(\text{s})$
- (E) 以上皆錯 None of the above.

21. 關於下列氧化還原反應方程式之敘述何者是正確的？

For redox reaction below, which of the following statements is correct?



- (A) 反應之平衡係數為 2, 16, 2, 2, 5, 8
The stoichiometric coefficients to balance the equation are 2, 16, 2, 2, 5, 8
- (B) MnO_4^{-1} 是氧化劑 MnO_4^{-1} is an oxidant.
- (C) Cl^{-1} 被還原成 Cl_2 Cl^{-1} is reduced to Cl_2
- (D) MnO_4^{-1} 放出 5 個電子 MnO_4^{-1} releases 5 electrons
- (E) 還原半反應式為 $\text{Cl}_2 \rightarrow 2\text{Cl}^{-1} + 2\text{e}^{-1}$
The half reduction reaction is $\text{Cl}_2 \rightarrow 2\text{Cl}^{-1} + 2\text{e}^{-1}$.

22. 下列各組物質的關係，何者正確？

Which of the description about the relationship of each group of matters is correct?

- (A) O_2 、 O_3 ：倍比定律。
 O_2 and O_3 illustrate the law of definite proportion
- (B) 1-戊烯、2-戊烯：幾何異構物
 1-pentene and 2-pentene are geometrical isomerism
- (C) 澱粉、纖維素：同分異構物
 Starch and cellulose are structural isomerism
- (D) 苯、甲苯：芳香族化合物
 Benzene and toluene are aromatic compounds
- (E) $^{12}_6C$ 、 $^{14}_6C$ ：同位素 $^{12}_6C$ and $^{14}_6C$ are isotopes.

23. 欲分辨下列各組物質，所用的方法何者錯誤？

To differentiate the following pairs of compounds, which of the method is wrong?

- (A) 1-丁炔與 2-丁炔，可以用氯化亞銅氨水溶液辨別
 1-Butyne and 2-butyne can be differentiated by using $CuCl/NH_3$ solution.
- (B) 乙苯與正丙苯，可以用酸性過錳酸鉀水溶液辨別
 Ethyl benzene and n-propyl benzene can be differentiated by using acidic $KMnO_4$ solution.
- (C) 乙烯與乙烷，可以用溴的四氯化碳溶液辨別
 Ethylene and ethane can be differentiated by using Br_2/CCl_4 solution
- (D) 乙烯與乙炔，可以用硝酸銀的氨水溶液辨別
 Ethylene and acetylene can be differentiated by using $AgNO_3/NH_3$ solution
- (E) 乙烯與苯，可以用過錳酸鉀水溶液辨別
 Ethylene and benzene can be differentiated by using $KMnO_4$ solution

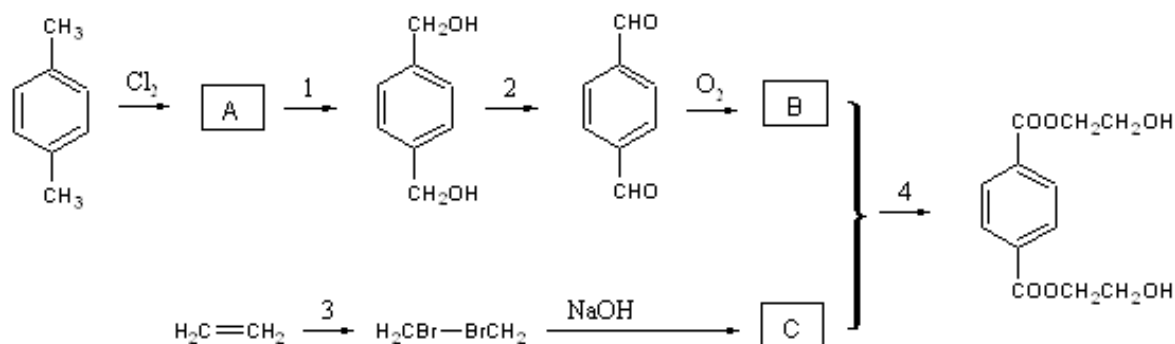
24. 生物中的蛋白質最小單位為 α -氨基酸(α -amino acid)，下列何者是 α -氨基酸？

α -Amino acid is the smallest component of protein. Which of the following structures is one type of α -amino acids?

- (A) NH_2COCO_2H (B) $NH_2CO_2CH_3$ (C) $NH_2CH(CH_3)CO_2H$
 (D) $CH_3NH(CH_3)CO_2H$ (E) $NH_2CH_2CH_2CO_2H$

25. 以下為一有機合成酯反應之流程圖，下列敘述何者是錯的? (E)

Following is a scheme for synthesizing an ester. Which of the following statement is wrong?



- (A). 化合物 A 是取代反应之產物。
Compound A is a product of substitution reaction
- (B). 反应試劑 1 為 $\text{NaOH}(\text{aq})$ 。
Reagent 1 is $\text{NaOH}(\text{aq})$
- (C). 反应試劑 3 為溴水。
Reagent for 3 is bromine water.
- (D). 化合物 C 是乙二醇。
Compound C is ethylene glycol.
- (E). 反应 4 是还原反应。
Reaction 4 is reduction.

解答

題號	1	2	3	4	5	6	7	8	9	10
答案	B	A	A	C	C	E	A	A	A	B

題號	11	12	13	14	15	16	17	18	19	20
答案	C	D	D	C	B	B	E	C	C	C

題號	21	22	23	24	25	26	27	28	29	30
答案	B	D	B	C	E					