

科目：普通化學

適用：應化系二

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答，試題須隨卷繳回。

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第 1 頁

一、單選題 (80%，每題 4 分)

1. Determine the numbers of protons, neutrons, and electrons in an atom of $^{238}_{92}\text{U}$.
[A] 238, 238, 238 [B] 92, 92, 92 [C] 146, 238, 92 [D] 92, 146, 92 [E] 146, 92, 146
2. A white powder is analyzed and found to contain 43.64% phosphorus and 56.36% oxygen by mass. The compound has a molar mass of 283.88 g/mol. What is the compound's molecular formula? (P: 31)
[A] P_2O_5 [B] P_4O_{10} [C] P_4O_6 [D] P_4O_7 [E] P_4O_9
3. The formula for sodium dihydrogen phosphate is
[A] NaHPO_4 [B] $\text{Na}(\text{HPO}_4)_2$ [C] NaH_2PO_4 [D] Na_2HPO_4 [E] $\text{Na}_2\text{H}_2\text{PO}_4$
4. Which of the following is *false*?
[A] Oxidation is an increase in oxidation state.
[B] Reduction is a decrease in oxidation state.
[C] Oxidation is a loss of electrons; reduction is a gain of electrons.
[D] In a redox reaction, an oxidizing agent is reduced and a reducing agent is oxidized.
[E] In a redox reaction, the electrons transferred from the oxidizing reagent to the reducing reagent.
5. Given the equation $3A + B \rightarrow C + D$, you react 2 moles of A with 1 mole of B . Which of the following is true?
[A] A is the limiting reactant because you need 3 moles of A and have 2.
[B] A is the limiting reactant because of its higher molar mass.
[C] B is the limiting reactant because 3 A molecules react with 1 B molecule.
[D] B is the limiting reactant because you have fewer moles of B than A .
[E] Neither reactant is limiting.
6. Which of the ways of describing solution composition is dependent of temperature?
[A] mass percent [B] molarity [C] molality [D] mole fraction [E] none of these
7. Consider two organic molecules, ethanol and benzene. One dissolves in water and the other does not. Why?
[A] One is an electrolyte, the other is not. [B] One is ionic, the other is not.
[C] Ethanol contains a polar O-H bond, and benzene does not.
[D] They have different molar masses. [E] Two of these are correct.

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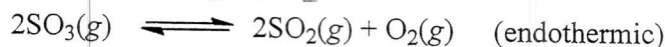
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8. A balloon contains 10.0 g of neon gas. With the temperature kept constant, 10.0 g of argon gas is added. What happens?

- [A] The balloon stays the same size, but the pressure increases.
 [B] The volume of the balloon expands by more than 2 times.
 [C] The balloon doubles in volume.
 [D] The volume of the balloon expands by less than 2 times.
 [E] None of these.

9. What will happen to the number of moles of SO_3 in equilibrium with SO_2 and O_2 in the reaction

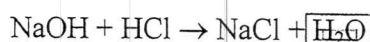
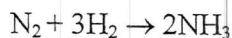
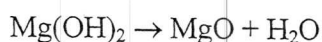
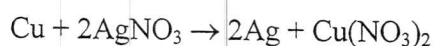


in each of the following cases?

- (i) Oxygen gas is added;
- (ii) the pressure is increased by decreasing the volume of the reaction container;
- (iii) the pressure is increased by adding argon gas;
- (iv) the temperature is increased;
- (v) gaseous sulfur dioxide is removed.

- [A] (i): increase, (ii) increase, (iii) no effect, (iv) decrease, (v) decrease
 [B] (i): increase, (ii) no effect, (iii) increase, (iv) decrease, (v) decrease
 [C] (i): decrease, (ii) increase, (iii) increase, (iv) decrease, (v) decrease
 [D] (i): decrease, (ii) increase, (iii) no effect, (iv) increase, (v) decrease
 [E] (i): increase, (ii) decrease, (iii) no effect, (iv) increase, (v) decrease

10. How many of the following are oxidation-reduction reactions?



[A] 3

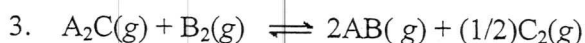
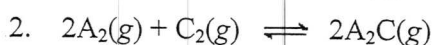
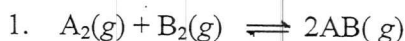
[B] 4

[C] 0

[D] 1

[E] 2

11. For the hypothetical reactions 1 and 2, $K_1 = 10^2$ and $K_2 = 10^{-4}$.



What is the value for K for reaction 3?

[A] 10^{-2} [B] 10^2 [C] 10^4 [D] 10^6 [E] 10^{-4}

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12. Which of the following sets of quantum numbers is allowed?

[A] $n = 4, l = 2, m_l = 3, m_s = +\frac{1}{2}$

[B] $n = 2, l = 2, m_l = -1, m_s = -\frac{1}{2}$

[C] $n = 3, l = 2, m_l = 1, m_s = +1$

[D] $n = 1, l = 0, m_l = 0, m_s = -\frac{1}{2}$

[E] $n = 5, l = -3, m_l = 0, m_s = -\frac{1}{2}$

13. Methyl orange is an indicator with a K_a of 1×10^{-4} . Its acid form, HIn, is red, while its base form, In⁻, is yellow. At pH 6.0, the indicator will be

[A] red.

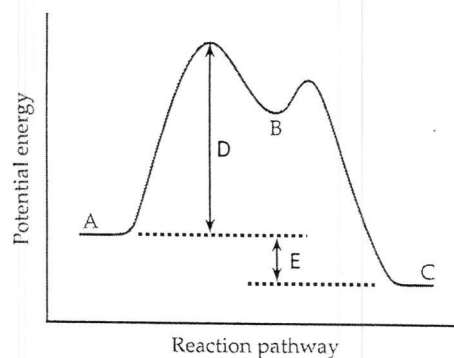
[B] yellow.

[C] orange.

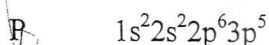
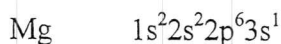
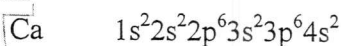
[D] blue.

[E] none of these.

14. Determine the correct labels for the reaction coordination diagram indicated by the letters.

[A] A: reactants; B: intermediate; C: products; D: E_a ; E: ΔH° .[B] A: products; B: transition state; C: reactants; D: E_a ; E: ΔH° .[C] A: reactants; B: transition state; C: products; D: E_a ; E: ΔH° .[D] A: reactants; B: intermediate; C: products; D: E_a ; E: ΔG° .[E] A: reactants; B: intermediate; C: products; D: ΔH° ; E: E_a .

15. How many the following electron configurations for the species in their ground state are correct?



[A] 3

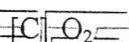
[B] 4

[C] 5

[D] 1

[E] 2

16. Which of the following species has the largest dissociation energy?

17. The rate constant k is dependent on

[A] the orientation of the collision.

[B] the frequency of collisions.

[C] the temperature.

[D] the probability that a collision will have sufficient energy to cause a reaction

[E] all of the above

18. Identify the major attractive force in HF.

[A] dipole-dipole interactions

[B] hydrogen bonding

[C] ionic bonding

[D] London dispersion forces

[E] none of these

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19. Which of the following properties of a solution is not a colligative property?

[A] freezing point depression

[B] osmotic pressure

[C] boiling point elevation

[D] vapor pressure

[E] vapor-pressure lowering of a solution with a nonvolatile solute.

20. Arrange the ions Te^{2-} , I^- , Cs^+ , and Ba^{2+} in order of increasing size.[A] $\text{Te}^{2-} < \text{I}^- < \text{Cs}^+ < \text{Ba}^{2+}$ [B] $\text{Cs}^+ < \text{Ba}^{2+} < \text{I}^- < \text{Te}^{2-}$ [C] $\text{Ba}^{2+} < \text{Cs}^+ < \text{I}^- < \text{Te}^{2-}$ [D] $\text{Te}^{2-} < \text{I}^- < \text{Ba}^{2+} < \text{Cs}^+$ [E] $\text{I}^- < \text{Te}^{2-} < \text{Cs}^+ < \text{Ba}^{2+}$

二、簡答與計算題，請列出關鍵公式與計算過程。(20%)

1. For the SF_4 molecule:

(A) (3%) Draw a Lewis structure.

(B) (3%) Label the angles of the S-F bonds.

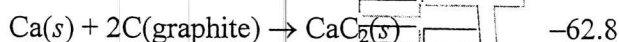
(C) (2%) What is the shape of the molecule around the central atom?

(D) (2%) What is the hybridization of the central atom?

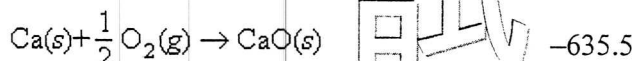
(E) (2%) Is the molecule polar or nonpolar?

(F) (2%) Does the central atom obey the octet rule? Why?

2. (6%) Consider the following data:



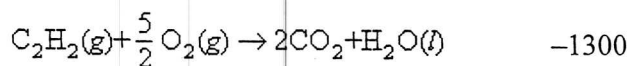
-62.8



-635.5



-653.1



-1300



-393.51

Use Hess's law to find the change in enthalpy at 25°C for the following equation: