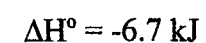
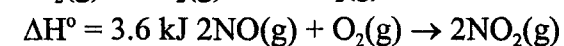
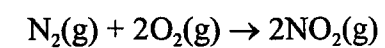


## 選擇題，五選一

1. Consider the reaction,  $2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$ . How many moles of carbon are needed to produce 5 moles of Fe?  
(A) 15.0 mol  
(B) 6.67 mol  
(C) 5.00 mol  
(D) 10.0 mol  
(E) none of the above
2. Aluminum reacts with sulfuric acid,  $\text{H}_2\text{SO}_4$ , to produce aluminum sulfate,  $\text{Al}_2(\text{SO}_4)_3$ , and hydrogen gas. What is the amount of aluminum sulfate that can be produced by reacting 2.5 g of aluminum?  
(A) 10.5 g  
(B) 15.8 g  
(C) 31.6 g  
(D) 0.250 g  
(E) none of the above
3. When a 5.0 g sample of ethane,  $\text{C}_2\text{H}_6$ , is burned in excess oxygen, 8.2 g of water is collected. What is the percentage yield for this reaction?  
(A) 91%  
(B) 84%  
(C) 56%  
(D) 95%  
(E) none of the above
4. Given:



What is the standard enthalpy of formation for nitric oxide, NO?

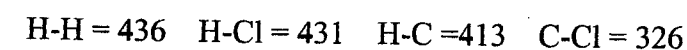
# 國立清華大學 命題紙

八十八學年度轉學生入學考試

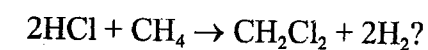
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- (A) 10.3 kJ
- (B) 10.3 kJ
- (C) 5.2 kJ
- (D) -20.6 kJ
- (E) none of the above

5. Given the following bond energies in  $\text{kJ mol}^{-1}$ :



What is the approximate reaction enthalpy for the reaction,



- (A) -164 kJ
- (B) 164 kJ
- (C) 82 kJ
- (D) -82 kJ
- (E) none of the above

6. Which of the lists of substances is in the order of increasing nitrogen-nitrogen bond strength?

- (A)  $\text{N}_2$ ,  $\text{HNNH}$
- (B)  $\text{HNNH}$ ,  $\text{H}_2\text{NNH}_2$
- (C)  $\text{HNNH}$ ,  $\text{N}_2$
- (D)  $\text{N}_2$ ,  $\text{H}_2\text{NNH}_2$
- (E) none of the above

7. Which of the following reactions has a negative change in entropy?

- (A)  $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- (B)  $2\text{HgO}(\text{s}) \rightarrow 2\text{Hg}(\text{l}) + \text{O}_2(\text{g})$
- (C)  $5\text{H}_2(\text{g}) + 4\text{C}(\text{s}) \rightarrow \text{C}_4\text{H}_{10}(\text{g})$
- (D)  $2\text{NH}_3(\text{g}) \rightarrow \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$
- (E) none of the above

8. The  $\Delta G_f^\circ$  for methane is  $-50.8 \text{ kJ mole}^{-1}$ , and the  $\Delta H_f^\circ$  is  $-74.5 \text{ kJ mol}^{-1}$ . What is the value of  $\Delta S_f^\circ$  for  $\text{CH}_4$ ?

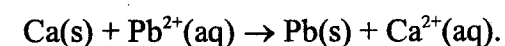
(A)  $-152 \text{ J mol}^{-1} \text{ K}^{-1}$   
(B)  $-79.5 \text{ J mol}^{-1} \text{ K}^{-1}$   
(C)  $-204 \text{ J mol}^{-1} \text{ K}^{-1}$   
(D)  $-24.8 \text{ J mol}^{-1} \text{ K}^{-1}$   
(E) none of the above

9. Consider the following oxidation-reduction reaction.  
 $\text{Br}_2(\text{g}) + 2\text{I}^-(\text{aq}) \rightarrow \text{I}_2(\text{s}) + 2\text{Br}^-(\text{aq})$

If  $\Delta G^\circ$  for the reaction is  $-106 \text{ kJ}$ , what is the value of  $E^\circ$ ?

(A)  $1.10 \text{ V}$   
(B)  $0.275 \text{ V}$   
(C)  $0.550 \text{ V}$   
(D)  $2.55 \text{ V}$   
(E) none of the above

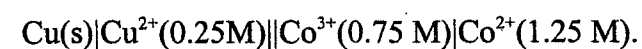
10. Consider the reaction,



The concentration of the  $\text{Pb}^{2+}$  is  $0.5 \text{ M}$  and that of  $\text{Ca}^{2+}$  is  $1.5 \text{ M}$ . If  $E^\circ$  for the reaction is  $2.74 \text{ V}$ , what is  $E$ (volts) for the reaction?

(A)  $2.52 \text{ V}$   
(B)  $2.75 \text{ V}$   
(C)  $3.28 \text{ V}$   
(D)  $2.73 \text{ V}$   
(E) none of the above

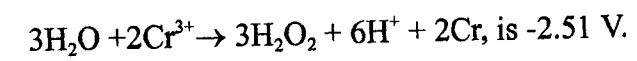
11. Consider the electrochemical cell,



If  $E^\circ$  for the cell is 1.47 V, what is  $E$ (volts) for the cell?

- (A) 1.45 V
- (B) 1.57 V
- (C) 1.63 V
- (D) 1.31 V
- (E) none of the above

12. The  $E^\circ$  for the reaction,



What is the value of  $K$  for the reaction?

- (A)  $2.6 \times 10^{23}$
- (B)  $3.6 \times 10^{42}$
- (C)  $4.1 \times 10^{-255}$
- (D) 17
- (E) none of the above

13. Molten  $\text{CaBr}_2$  is placed in an electrolytic cell. Electrons flow in electrode A and out electrode B. What happens at electrode A?

- (A) Reduction occurs.
- (B) Oxidation occurs.
- (C)  $\text{Br}_2$  is formed.
- (D) Calcium ions are produced.
- (E) none of the above

14. How many grams of  $\text{Ag}^+$  can be deposited as silver metal by  $2.50 \times 10^4 \text{ C}$  of charge?

- (A) 28.0 g
- (B) 18.0 g
- (C) 56.0 g
- (D) 0.250 g
- (E) none of the above

15. Which of the following is not a nucleophile?

- (A)  $\text{Na}^+$
- (B)  $\text{CN}^-$
- (C)  $\text{OH}^-$
- (D)  $\text{NH}_3$
- (E) none of the above

16. Which of the following is ethylene glycol?

- (A)  $\text{CH}_3\text{CHOHCH}_2\text{OH}$
- (B)  $\text{CH}_2\text{CHOH}$
- (C)  $\text{CH}_2\text{OHCH}_2\text{OH}$
- (D)  $\text{CH}_2\text{OHCHOHCH}_2\text{OH}$
- (E) none of the above

17. Which of the following is readily oxidized to produce a ketone?

- (A)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- (B)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
- (C)  $(\text{CH}_3)_3\text{COH}$
- (D)  $(\text{CH}_3)_2\text{CHOH}$
- (E) none of the above

18. Consider the reaction rate data for the reaction,  $\text{A} + 3\text{B} \rightarrow \text{products}$ .

Initial [A]	Initial [B]	$-\Delta [\text{A}] / \Delta t$
0.015 M	0.024 M	$2.3 \times 10^{-5} \text{ mol h}^{-1}$
0.030 M	0.024 M	$4.6 \times 10^{-5} \text{ mol h}^{-1}$
0.015 M	0.012 M	$1.2 \times 10^{-5} \text{ mol h}^{-1}$

What is the rate equation for this reaction?

- (A)  $k[\text{A}]$
- (B)  $k[\text{A}][\text{B}]$
- (C)  $k[\text{A}][\text{B}]^3$
- (D)  $k[\text{B}]$

(E) none of the above

19. The rate equation for the reaction,  $2A + 3B \rightarrow \text{products}$ , is found to be  $\text{rate} = k[A][B]$ . What is the molecularity of the slow step for this reaction?

- (A) unimolecular
- (B) bimolecular
- (C) termolecular
- (D) tetramolecular
- (E) none of the above

20. Consider the reaction,  $2A + B \rightarrow \text{products}$ . If the reaction is first order in both A and B, what are appropriate units for the rate constant,  $k$ ?

- (A)  $\text{mol L}^{-1}$
- (B)  $\text{L mol}^{-1} \text{s}^{-1}$
- (C)  $\text{mol}^2 \text{s}$
- (D)  $\text{s mol}^{-2}$
- (E) none of the above

21. Consider the reaction,  $A + B \rightarrow \text{products}$ , which has the rate equation,  $\text{rate} = k[A]$ . The value of the rate constant is  $0.15 \text{ h}^{-1}$ . What will be the concentration of A after 2.0 hours if the initial concentration of A was 0.050 M?

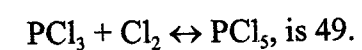
- (A) 0.045 M
- (B) 0.040 M
- (C) 0.037 M
- (D) 0.032 M
- (E) none of the above

22. Consider the reaction,  $A + B \rightarrow$ , which has the rate equation,  $\text{rate} = k[A]$ . The half-life for the reaction is 2.8 days. What is the value of the rate constant,  $k$ , for the reaction?

- (A)  $4 \text{ d}^{-1}$

- (B)  $1.8 \text{ d}^{-1}$
- (C)  $0.62 \text{ d}^{-1}$
- (D)  $0.25 \text{ d}^{-1}$
- (E) none of the above

23. The equilibrium constant for the vapor phase reaction,



If the value for the rate constant for the forward reaction is  $0.015 \text{ L mol}^{-1} \text{ s}^{-1}$ ,  
what is the rate constant for the reverse reaction?

- (A)  $33 \text{ mol L}^{-1}$
- (B)  $3300 \text{ s}^{-1}$
- (C)  $3.1 \times 10^{-4} \text{ s}^{-1}$
- (D)  $320 \text{ s}^{-1}$
- (E) none of the above

24. The rate constant for a chemical reaction is 0.031 at  $25^\circ\text{C}$ . If the temperature is increased to  $49^\circ\text{C}$ , the rate constant increases to 0.093. What is the activation energy for the reaction?

- (A)  $37 \text{ kJ mol}^{-1}$
- (B)  $28 \text{ kJ mol}^{-1}$
- (C)  $16 \text{ kJ mol}^{-1}$
- (D)  $0.84 \text{ kJ mol}^{-1}$
- (E) none of the above

八十八學年度轉學生入學考試  
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25. Which of the following is a typical catalyst in a biological system?  
(A)  $\text{HNO}_3$   
(B) Sn  
(C)  $\text{C}_4\text{H}_{10}$   
(D)  $\text{H}_2\text{SO}_4$   
(E) none of the above
26. Calculate the mass of excess reagent remaining at the end of the reaction  
 $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ , in which 90.0 g of  $\text{SO}_2$  are mixed with 100.0 g of  $\text{O}_2$ .  
(A) 11.5 g (B) 22.5 g (C) 67.5 g (D) 77.5 g (E) 400 g
27. Identify the oxidizing agent in the following reaction  
 $2\text{MnO}_4^- + 5\text{H}_2\text{SO}_3 \rightarrow 2\text{Mn}^{2+} + 5\text{SO}_4^{2-} + 4\text{H}^+ + 3\text{H}_2\text{O}$   
(A)  $\text{MnO}_4^-$  (B)  $\text{H}_2\text{SO}_3$  (C)  $\text{Mn}^{2+}$  (D)  $\text{SO}_4^{2-}$  (E)  $\text{H}^+$
28. 5.02 g of unknown gas is sealed in a 1.0 L flask at  $37^\circ\text{C}$  and 3.75 atm. Which one of the following is most likely to be the unknown  
(A)  $\text{H}_2\text{O}$  (B) HBr (C) HCN (D)  $\text{H}_2\text{S}$  (E)  $\text{C}_2\text{H}_2$
29. Calculate the work done against an atmospheric pressure of 1.0 atm when 7.65 mole of zinc dissolves in excess acid at  $30.0^\circ\text{C}$ .  
 $\text{Zn(s)} + 2\text{H}^+(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{H}_2(\text{g})$   
(A) 22.4 kJ (B) 24.9 kJ (C) 0 (D) -2.52 kJ (E) -19.3 kJ
30. Which one of the following sets of atomic quantum numbers ( $n, l, m_l, m_s$ ) is unacceptable?  
(A) (4, 3, -1, 1/2) (B) (3, 0, 1, -1/2) (C) (3, 0, 0, 1/2) (D) (2, 1, 1, -1/2)  
(E) (2, 0, 0, 1/2)

31. How many unpaired electrons does an atom of sulfur have?  
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4
32. Which of the following would be the electron configuration of an excited state of an oxygen atom?  
(A)  $1s^2 2s^2 2p^4$  (B)  $1s^2 2s^2 2p^5$  (C)  $1s^2 2s^2 2p^3 3s^1$  (D)  $1s^2 2s^2 2p^6$  (E)  $1s^2 2s^2 2p^3$
33. Which ion is isoelectronic with Ar?  
(A)  $Fe^{2+}$  (B)  $F^-$  (C)  $Br^-$  (D)  $Ga^{3+}$  (E)  $Ca^{2+}$
34. Which of the following solid would have the highest melting point?  
(A) NaF (B) NaCl (C) NaBr (D) NaI
35. The formal charge on the sulfur atom in the resonance structure of  $SO_2$  which has one single bond and one double bond is:  
(A) 0 (B) +1 (C) -1 (D) +2 (E) -2
36. According to the VSEPR theory, the shape of the  $SO_3$  molecule is  
(A) pyramidal (B) tetrahedral (C) trigonal planar (D) distorted tetrahedron  
(E) square planar
37. Which one of the following is a polar molecule?  
(A)  $PBr_5$  (B)  $CCl_4$  (C)  $BrF_5$  (D)  $XeF_2$  (E)  $XeF_4$
38. The number of atoms in a face-centered cubic unit cell is  
(A) 1 (B) 2 (C) 3 (D) 4 (E) 8
39. Which of the following liquids would have the highest viscosity at the same temperature?  
(A)  $CH_3OCH_3$  (B)  $CH_2Cl_2$  (C)  $C_2H_5OH$  (D)  $CH_3Br$  (E)  $HOCH_2CH_2OH$

40. Which of the following solutions has the highest osmotic pressure at 25 °C?  
(A) 0.2 M KBr (B) 0.2 M ethanol (C) 0.2 M Na<sub>2</sub>SO<sub>4</sub> (D) 0.2 M KCl  
(E) all the same
41. The vapor pressure of water at 20 °C is 17.5 mmHg. What is the vapor pressure of water over a solution prepared from 200.0 g of sucrose (C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>) and 350.0 g water?  
(A) 0.51 mmHg (B) 16.0 mmHg (C) 17.0 mmHg (D) 18.0 mmHg (E) 19.4 mmHg
42. The activation energy for the reaction  $\text{Sn}^{2+} + 2\text{Co}^{3+} \rightarrow \text{Sn}^{4+} + 2\text{Co}^{2+}$  is 60 kJ/mol. By what factor will the rate constant increase when the temperature is raised from 10 °C to 28 °C?  
(A) 1.002 (B) 4.6 (C) 5.6 (D) 2.8 (E) 696
43. For a chemical reaction  $\text{A} \rightarrow \text{C}$ , a plot of  $1/[\text{A}]$  versus time was found to give a straight line with a positive slope. What is the order of reaction?  
(A) zero (B) first (C) second (D) none of the above
44. A certain first-order reaction  $\text{A} \rightarrow \text{B}$  is 25% complete in 42 min at 25 °C. What is the half-life of the reaction?  
(A) 21 min (B) 42 min (C) 84 min (D) 101 min (E) 120 min
45. A certain weak acid (HA) is 1.5% ionized in a 0.25 M solution of the acid. What is the value of  $K_a$  for this acid?  
(A)  $7.1 \times 10^{-4}$  (B)  $1.4 \times 10^{-5}$  (C)  $1.8 \times 10^{-5}$  (D)  $5.6 \times 10^{-5}$  (E)  $1.5 \times 10^{-2}$
46. A solution is prepared by mixing 500 mL of 0.10 M NaOCl and 500 mL of 0.20 M HOCl. What is the pH of this solution?  $K_a(\text{HOCl}) = 3.2 \times 10^{-8}$   
(A) 4.10 (B) 7.00 (C) 7.19 (D) 7.49 (E) 7.80

47. For which type of titration will the pH be basic at the equivalence point?  
 (A) strong acid vs. strong base (B) strong acid vs. weak base  
 (C) weak acid vs. strong base (D) none of the above
48. Which of the following species has the highest entropy ( $S^0$ ) at 25 °C?  
 (A)  $\text{CH}_3\text{OH}(l)$  (B)  $\text{CO}(g)$  (C)  $\text{MgCO}_3(s)$  (D)  $\text{H}_2\text{O}(l)$  (E)  $\text{Ni}(s)$
49. How many coulombs of charge are required to cause reduction of 0.25 mole of  $\text{Cu}^{2+}$  to Cu?  
 (A) 0.25 C (B) 0.50 C (C)  $1.2 \times 10^4$  C (D)  $2.4 \times 10^4$  C (E)  $4.8 \times 10^4$  C
50. The overall reaction  $2\text{Co}^{3+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq}) \rightarrow 2\text{Co}^{2+}(\text{aq}) + \text{Cl}_2(g)$  has a standard cell voltage of  $E_{\text{cell}}^0 = 0.46$  V. Given that  $\text{Cl}_2(g) + 2e^{-} \rightarrow 2\text{Cl}^{-}(\text{aq})$   $E^0 = 1.36$  V. Calculate the standard reduction potential for the following half reaction:  $\text{Co}^{3+}(\text{aq}) + e^{-} \rightarrow \text{Co}^{2+}(\text{aq})$   
 (A) 1.82 V (B) -0.90 V (C) 0.90 V (D) -1.82 V (E) -1.36 V