單選題(1–20)，每題 5 分，共 100 分。 ※注意：單選題考生應作答於答案卡。

1. The standard enthalpy of reaction for $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is −92.22 kJ mol^{-1}. What is the change in enthalpy when 1.00 ton of $2NH_3(g)$ is formed? (A) ≈ 5.87×10^4 mol (B) ≈ −5.42×10^6 kJ (C) ≈ 5.42 GJ (D) ≈ −2.71 GJ (E) ≈ −2.71 GJ mol^{-1}.
2. The standard enthalpy of reaction for $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$ is −3120 kJ mol^{-1}. What is the specific enthalpy of combustion of ethane? (A) ≈ −1560 kJ mol^{-1} (B) ≈ 1560 kJ g^{-1} (C) ≈ −51.88 kJ (D) ≈ 103.76 kJ (E) ≈ 51.88 kJ g^{-1}.
3. The enthalpy of combustion of graphite is −393.5 kJ mol^{-1}, and that of diamond is −395.41 kJ mol^{-1}. The densities of graphite and diamond are 2.250 g cm^{-3} and 3.510 g cm^{-3}, respectively. What is the internal energy change for the transition C(s, graphite)→C(s, diamond) when the sample is under a pressure of 150 kbar? (A) ≈ 30.65 kJ mol^{-1} (B) ≈ 1.91 kJ mol^{-1} (C) ≈ 28.74 kJ mol^{-1} (D) ≈ 1.916×10^{-6} kJ mol^{-1} (E) ≈ 1.5×10^{10} kJ mol^{-1}.
4. From the following data, the standard enthalpy of formation of N_2O_5 from $N_2(g)$ and $O_2(g)$ is calculated to be (A) −43.8 kJ mol^{-1} (B) 11.3 kJ mol^{-1} (C) 66.4 kJ mol^{-1} (D) 70.3 kJ mol^{-1} (E) −55.1 kJ mol^{-1}.
   $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $\Delta_r H^\circ$ = −114.1 kJ mol^{-1}
   $4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g)$ $\Delta_r H^\circ$ = −110.2 kJ mol^{-1}
   $N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\Delta^r H^\circ$ = +180.5 kJ mol^{-1}
5. Given that the constant-pressure heat capacities of liquid water and water vapor are 75.29 J K^{-1} mol^{-1} and 33.58 J K^{-1} mol^{-1}, respectively, the enthalpy of vaporization of water at 100 °C from its value at 25 °C (44.01 kJ mol^{-1}) is calculated to be (A) −3.13 kJ mol^{-1} (B) 3.13 kJ mol^{-1} (C) 40.88 kJ mol^{-1} (D) 47.14 kJ mol^{-1} (E) 44.01 kJ mol^{-1}.
6. The standard Gibbs free energy of reaction for the isomerization of borneol to isoborneol in the gas phase at 503 K is 9.4 kJ mol^{-1}. When the total pressure is 600 Torr, what is the Gibbs free energy of reaction for a mixture consisting of 0.15 mol of borneol and 0.30 mol of isoborneol? (A) ≈ 7.38 kJ mol^{-1} (B) ≈ 2.90 kJ mol^{-1} (C) ≈ −2.90 kJ mol^{-1} (D) ≈ 12.30 kJ mol^{-1} (E) ≈ 6.50 kJ mol^{-1}.
7. In the Haber process for ammonia synthesis, the equilibrium constant is K = 0.036 for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at 500 K. If a reactor is charged with partial pressures of 0.020 bar of N_2 and 0.020 bar of H_2, what will be the equilibrium partial pressure of H_2? (A) ≈ 0.060 bar (B) ≈ 0.020 bar (C) ≈ 1.1×10^{-3} bar (D) ≈ 7.6×10^{-5} bar (E) ≈ 3.8×10^{-5} bar.
8. In the Haber process for ammonia synthesis, the equilibrium constant is K = 0.036 for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at 500 K. If a reactor is charged with partial pressures of 0.020 bar of N_2 and 0.020 bar of H_2, what will be the equilibrium partial pressure of NH_3? (A) ≈ 0.040 bar (B) ≈ 0.020 bar (C) ≈ 1.1×10^{-3} bar (D) ≈ 7.6×10^{-5} bar (E) ≈ 3.8×10^{-5} bar.
9. The equilibrium pressure of $H_2(g)$ over a mixture of solid uranium and solid uranium hydride at 500 K is 1.04 Torr. What is the standard Gibbs free energy of formation of $UH_3(s)$ at 500 K? (A) ≈ −41.0 kJ mol^{-1} (B) ≈ −82.1 kJ mol^{-1} (C) ≈ 82.1 kJ mol^{-1} (D) ≈ 1.4×10^{-3} kJ mol^{-1} (E) ≈ −5.8×10^{-3} kJ mol^{-1}.
10. What is the standard enthalpy change of a reaction for which the equilibrium constant doubles when the temperature is increased by 10 K from 298 K? (A) ≈ 9178.4 kJ mol^{-1} (B) ≈ 76.3 kJ mol^{-1} (C) ≈ 52.9 kJ mol^{-1} (D) ≈ −52.9 kJ mol^{-1} (E) ≈ −76.3 kJ mol^{-1}.
11. The two half-reactions are:
    $Cu^+(aq) + e^- \rightarrow Cu(s)$ $E^0(Cu^+,Cu)$ = 0.52 V
    $Cu^{2+}(aq) + e^- \rightarrow Cu^+(aq)$ $E^0(Cu^{2+},Cu^+)$ = 0.15 V
    What is the equilibrium constant for the disproportionation reaction $2Cu^+(aq) \rightleftharpoons Cu(s) + Cu^{2+}(aq)$ at 298K? (A) ≈ 0.67 (B) ≈ 0.37 (C) ≈ 1.45 (D) ≈ 2.2×10^4 (E) ≈ 1.8×10^6.
12. The reaction is $2AgCl(s) + H_2(g) \rightarrow 2Ag(s) + 2Cl^-(aq) + 2H^+(aq)$ with a standard cell potential E° = 0.22 V. The potential of the cell Pt(s)|H_2(g)|HCl(aq)|AgCl(s)|Ag(s) is 0.312 V at 25 °C. What is the pH of the electrolyte solution? (A) ≈ 0.78 (B) ≈ 1.56 (C) ≈ 3.12 (D) ≈ 6.24 (E) ≈ 7.00.
13. The molar solubility of AgBr is 0.731 μmol dm^{-3} at 25 °C. What is the potential of the cell

見背面

Ag(s)|AgBr(aq)|AgBr(s)|Ag(s) at this temperature? (A) ≈ 0.36 V (B) ≈ −0.73 V (C) ≈ −0.36 V (D) ≈ −0.18 V (E) ≈ -4.02×10^{-3} V.

14. The standard potential of the cell Ag(s)|AgI(s)|AgI(aq)|Ag(s) is +0.9509 V at 25 °C. What is the solubility constant of AgI? (A) ≈ 9.59×10^{-5} (B) ≈ 9.19×10^{-9} (C) ≈ 8.45×10^{-17} (D) ≈ 6.87×10^{-33} (E) ≈ 9.19×10^{-9} mol dm^{-3}.

15. The viscosity of water at 20 °C is 1.0019 mN s m^{-2} and at 30 °C it is 0.7982 mN s m^{-2}. What is the activation energy for the motion of water molecules? (A) ≈ −8.4 kJ mol^{-1} (B) ≈ 0.2 kJ mol^{-1} (C) ≈ 4.2 kJ mol^{-1} (D) ≈ 9.2 kJ mol^{-1} (E) ≈ 16.8 kJ mol^{-1}.

16. What is the ratio of rates of catalyzed to noncatalyzed reactions at 37 °C, given that the Gibbs energy of activation for a particular reaction is reduced from 150 kJ mol^{-1} to 15 kJ mol^{-1}? (A) ≈ 0.1 (B) ≈ 1.1 (C) ≈ 52.4 (D) ≈ 2.7×10^{11} (E) ≈ 5.4×10^{22}.

17. The enzyme-catalyzed conversion of a substrate at 25 °C has a Michaelis constant of 0.015 mol dm^{-3} and a maximum velocity of 4.25×10^{-4} mol dm^{-3} s^{-1} when the enzyme concentration is 3.60×10^{-9} mol dm^{-3}. The catalytic efficiency is calculated to be (A) ≈ 7.9×10^{6} dm^3 mol^{-1} s^{-1} (B) ≈ 1.2×10^{5} s^{-1} (C) ≈ 1.5×10^{-2} mol dm^{-3} (D) ≈ 5.6×10^{-4} dm^3 mol^{-1} s^{-1} (E) ≈ 8.5×10^{-6} s^{-1}.

18. Consider the following chain mechanism:
(1) AH → A· + H·
(2) A· → B· + C
(3) AH + B· → A· + D
(4) A· + B· → P
Under the steady-state approximation for the radical intermediates, what is the reaction order with respect to AH for the decomposition of AH? (A) 0.5 (B) first (C) 1.5 (D) second (E) third.

19. Consider the following mechanism for the thermal decomposition of R_2:
(1) $R_2 \rightarrow R + R$, rate constant = k_a
(2) $R + R_2 \rightarrow P_B + R'$, rate constant = k_b
(3) $R' \rightarrow P_A + R$, rate constant = k_c
(4) $R + R \rightarrow P_A + P_B$, rate constant = k_d
where R_2, P_A, and P_B are stable hydrocarbons, and R and R′ are radicals. Under the steady-state approximation for the radical intermediates, what is the rate of decomposition of R_2 as a function of the concentration of R_2? (A) $-k_a[R_2]$ (B) $-k_a[R_2]-k_b[R_2]$ (C) $-k_a[R_2]+k_b\sqrt{\frac{k_a}{k_d}}\sqrt{[R_2]}$ (D) $-k_a[R_2]-k_b\sqrt{\frac{k_a}{k_d}}\sqrt{[R_2]}$ (E) $-k_a[R_2]-k_b\sqrt{\frac{k_a}{k_c}}\sqrt{[R_2]}$.

20. The atmospheric pressure is 1.00 atm and the temperature is 20.2 °C. A strip of magnesium metal (molar mass of Mg: 24.31 g mol^{-1}) with a mass of 12.5 g is dropped into a beaker of dilute hydrochloric acid. Given that magnesium is the limiting reactant, the work done by the system as a result of the reaction is calculated to be (A) ≈ 0.00 kJ (B) ≈ 0.51 kJ (C) ≈ −1.25 kJ (D) ≈ −30.49 kJ (E) ≈ −30.49 kJ mol^{-1}.

Gas constant	8.3145 J K^{-1} mol^{-1}
Faraday's constant	96.485 kC mol^{-1}
1 atm = 760 Torr = 101.325 kPa	

試題隨卷繳回