

A-Level 化學 9701 Paper 1 選擇題操卷練習

A-Level (中六 / GCE A Level) 化學 | 時限：60 分鐘 | 總分：40 分 | 共 40 題

甲部：物理化學與無機化學 (第 1 至 20 題，每題 1 分，共 20 分)

每題選出一個最正確的選項。

1. What amount of substance is present in 4.00 g of calcium carbonate ($M_r = 100.0$)?

A) 0.0400 mol B) 0.400 mol C) 4.00 mol D) 0.0200 mol (1 分)

答案：答案：A。 $n = m / M_r = 4.00 / 100.0 = 0.0400 \text{ mol}$ 。

2. What volume is occupied by 0.250 mol of an ideal gas at room temperature and pressure (molar volume 24.0 dm³)?

A) 3.00 dm³ B) 9.60 dm³ C) 24.0 dm³ D) 6.00 dm³ (1 分)

答案：答案：D。 $V = n \times 24.0 = 0.250 \times 24.0 = 6.00 \text{ dm}^3$ 。

3. 5.85 g of sodium chloride ($M_r = 58.5$) is dissolved to make 250 cm³ of solution. What is the concentration?

A) 0.400 mol dm⁻³ B) 0.100 mol dm⁻³ C) 0.0234 mol dm⁻³ D) 1.00 mol dm⁻³ (1 分)

答案：答案：A。 $n = 5.85 / 58.5 = 0.100 \text{ mol}$; $c = 0.100 / 0.250 = 0.400 \text{ mol dm}^{-3}$ 。

4. What is the pH of 0.010 mol dm⁻³ hydrochloric acid at 298 K?

A) 1.00 B) 12.00 C) 0.010 D) 2.00 (1 分)

答案：答案：D。強酸完全解離， $[H^+] = 0.010$ ， $pH = -\log 0.010 = 2.00$ 。

5. What is the pH of 0.010 mol dm⁻³ sodium hydroxide at 298 K ($K_w = 1.00 \times 10^{-14}$)?

A) 2.00 B) 7.00 C) 14.00 D) 12.00 (1 分)

答案：答案：D。 $[OH^-] = 0.010$ ， $pOH = 2.00$ ， $pH = 14.00 - 2.00 = 12.00$ 。

6. A weak monobasic acid has pH 3.00 in 0.100 mol dm⁻³ solution. What is K_a ?

A) $1.0 \times 10^{-5} \text{ mol dm}^{-3}$ B) $1.0 \times 10^{-3} \text{ mol dm}^{-3}$ C) $1.0 \times 10^{-7} \text{ mol dm}^{-3}$ D) $1.0 \times 10^{-1} \text{ mol dm}^{-3}$ (1 分)

答案：答案：A。 $[H^+] = 1.0 \times 10^{-3}$; $K_a = [H^+]^2 / [HA] = 1.0 \times 10^{-6} / 0.100 = 1.0 \times 10^{-5}$ 。

7. Burning 0.0250 mol of a fuel raises the temperature of 50.0 g of water by 10.0 K ($c = 4.18 \text{ J g}^{-1} \text{ K}^{-1}$). What is the enthalpy change of combustion per mole?

A) -2.09 kJ mol⁻¹ B) -20.9 kJ mol⁻¹ C) -83.6 kJ mol⁻¹ D) -418 kJ mol⁻¹ (1 分)

答案：答案：C。 $q = 50.0 \times 4.18 \times 10.0 = 2090 \text{ J} = 2.09 \text{ kJ}$; $\Delta H = -2.09 / 0.0250 = -83.6 \text{ kJ mol}^{-1}$ 。

8. 25.0 cm³ of 0.100 mol dm⁻³ NaOH is titrated with 0.200 mol dm⁻³ HCl. What volume of acid is required?

A) 12.5 cm³ B) 25.0 cm³ C) 50.0 cm³ D) 6.25 cm³ (1 分)

答案：答案：A。NaOH 摩爾數 = $25.0 \times 0.100 = 2.50 \text{ mmol}$; 體積 = $2.50 / 0.200 = 12.5 \text{ cm}^3$ 。

9. The theoretical yield of a reaction is 0.200 mol and the actual yield is 0.160 mol. What is the percentage yield?

A) 20.0% B) 125% C) 160% D) 80.0% (1 分)

答案：答案：D。百分產率 = $0.160 / 0.200 \times 100 = 80.0\%$ 。

10. 1.60 g of a gas occupies 1.20 dm³ at room temperature and pressure (24.0 dm³ mol⁻¹). What is its Mr?

A) 16.0 B) 64.0 C) 0.800 D) 32.0 (1 分)

答案：答案：D。n = $1.20 / 24.0 = 0.0500$ mol ; Mr = $1.60 / 0.0500 = 32.0$ 。

11. What amount of gas is present in 2.40 dm³ at room temperature and pressure (24.0 dm³ mol⁻¹)?

A) 0.0100 mol B) 1.00 mol C) 0.100 mol D) 57.6 mol (1 分)

答案：答案：C。n = $V / 24.0 = 2.40 / 24.0 = 0.100$ mol。

12. A gas sample has p = 1.00 x 10⁵ Pa, V = 2.40 x 10⁻³ m³ and T = 298 K. What is n? (R = 8.31 J K⁻¹ mol⁻¹)

A) 0.969 mol B) 9.69 mol C) 0.0969 mol D) 0.00969 mol (1 分)

答案：答案：C。n = $pV / RT = (1.00 \times 10^5 \times 2.40 \times 10^{-3}) / (8.31 \times 298) = 240 / 2476 = 0.0969$ mol。

13. A radioisotope has a half-life of 6.0 hours. What mass remains from 8.0 g after 24 hours?

A) 2.0 g B) 1.0 g C) 0.50 g D) 0.25 g (1 分)

答案：答案：C。24 / 6.0 = 4 個半衰期 ; $8.0 / 2^4 = 8.0 / 16 = 0.50$ g。

14. What is the oxidation number of chromium in the dichromate ion, Cr₂O₇²⁻?

A) +7 B) +6 C) +3 D) +12 (1 分)

答案：答案：B。設 Cr 為 x : $2x + 7(-2) = -2$, $2x = 12$, x = +6。

15. What is the oxidation number of sulfur in sulfuric acid, H₂SO₄?

A) +4 B) +6 C) +2 D) -2 (1 分)

答案：答案：B。2(+1) + x + 4(-2) = 0 , x = +6。

16. What is the electron configuration of an iron atom (Z = 26)?

A) [Ar] 3d⁸ B) [Ar] 3d⁵ 4s¹ C) [Ar] 3d⁶ 4s² D) [Ar] 3d⁶ 4s¹ 4p¹ (1 分)

答案：答案：C。Fe 有 26 個電子：18 個填入氬芯，餘 8 個為 3d⁶ 4s²。

17. How many moles of ions are produced when 1 mol of Al₂(SO₄)₃ dissolves completely?

A) 2 mol B) 5 mol C) 3 mol D) 7 mol (1 分)

答案：答案：B。每單位產生 2 個 Al³⁺ 及 3 個 SO₄²⁻，共 5 mol 離子。

18. A compound contains 40.0% C, 6.7% H and 53.3% O by mass. What is its empirical formula?

A) C₂H₄O B) CH₂O C) CHO D) C₂H₆O (1 分)

答案：答案：B。摩爾比 C : H : O = $40.0/12.0 : 6.7/1.0 : 53.3/16.0 = 3.33 : 6.7 : 3.33 = 1 : 2 : 1$ 。

19. What is the atom economy of CaCO₃ -> CaO + CO₂? (Mr: CaCO₃ = 100.1, CaO = 56.1)

A) 44.0% B) 100% C) 66.0% D) 56.0% (1 分)

答案：答案：D。原子經濟 = $56.1 / 100.1 \times 100 = 56.0\%$ 。

20. What is the percentage by mass of nitrogen in ammonium nitrate, NH_4NO_3 ($M_r = 80.0$)?

A) 17.5% B) 28.0% C) 70.0% D) 35.0% (1 分)

答案：答案：D。每個單位含 2 個 N： $28.0 / 80.0 \times 100 = 35.0\%$ 。

乙部：有機化學與分析（第 21 至 40 題，每題 1 分，共 20 分）

每題選出一個最正確的選項。

21. 0.100 mol of zinc reacts completely with excess dilute hydrochloric acid. What volume of hydrogen is produced at r.t.p. ($24.0 \text{ dm}^3 \text{ mol}^{-1}$)?

A) 1.20 dm^3 B) 2.40 dm^3 C) 4.80 dm^3 D) 24.0 dm^3 (1 分)

答案：答案：B。 $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ ，比例 1:1， $n(\text{H}_2) = 0.100 \text{ mol}$ ， $V = 2.40 \text{ dm}^3$ 。

22. What mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ($M_r = 249.7$) is needed for 0.0500 mol?

A) 12.5 g B) 6.24 g C) 25.0 g D) 1.25 g (1 分)

答案：答案：A。 $m = n \times M_r = 0.0500 \times 249.7 = 12.485 \text{ g} \approx 12.5 \text{ g}$ 。

23. 25.0 cm^3 of $0.400 \text{ mol dm}^{-3}$ solution is diluted to 250 cm^3 . What is the new concentration?

A) $0.0400 \text{ mol dm}^{-3}$ B) $0.400 \text{ mol dm}^{-3}$ C) $0.00400 \text{ mol dm}^{-3}$ D) 4.00 mol dm^{-3} (1 分)

答案：答案：A。稀釋 10 倍：摩爾數不變， $c = 0.400 \times 25.0 / 250 = 0.0400 \text{ mol dm}^{-3}$ 。

24. A buffer contains equal concentrations of a weak acid ($\text{pK}_a = 4.76$) and its conjugate base. What is the pH?

A) 7.00 B) 9.24 C) 4.76 D) 2.38 (1 分)

答案：答案：C。 $[\text{A}^-] = [\text{HA}]$ ， $\text{pH} = \text{pK}_a + \log(1) = 4.76$ 。

25. For $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$, equilibrium concentrations are $[\text{H}_2] = 0.20$, $[\text{I}_2] = 0.30$ and $[\text{HI}] = 0.60 \text{ mol dm}^{-3}$. What is K_c ?

A) 6.0 B) 0.167 C) 10.0 D) 1.0 (1 分)

答案：答案：A。 $K_c = [\text{HI}]^2 / ([\text{H}_2][\text{I}_2]) = 0.36 / 0.060 = 6.0$ 。

26. For a reaction with $\Delta H = +50.0 \text{ kJ mol}^{-1}$ and $\Delta S = +100 \text{ J K}^{-1} \text{ mol}^{-1}$, what is ΔG at 500 K?

A) $+100 \text{ kJ mol}^{-1}$ B) $-50.0 \text{ kJ mol}^{-1}$ C) $+50.0 \text{ kJ mol}^{-1}$ D) 0.0 kJ mol^{-1} (1 分)

答案：答案：D。 $\Delta G = \Delta H - T\Delta S = 50.0 - 500 \times 0.100 = 0.0 \text{ kJ mol}^{-1}$ 。

27. $E(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$ and $E(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$. What is E_{cell} for $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$?

A) $+0.42 \text{ V}$ B) -1.10 V C) $+1.10 \text{ V}$ D) $+0.34 \text{ V}$ (1 分)

答案：答案：C。 $E_{\text{cell}} = E(\text{陰極}) - E(\text{陽極}) = 0.34 - (-0.76) = +1.10 \text{ V}$ 。

28. How much charge is needed to deposit 2.00 mol of copper from Cu^{2+} ? ($F = 96\,500 \text{ C mol}^{-1}$)

A) 193 000 C B) 386 000 C C) 96 500 C D) 772 000 C (1 分)

答案：答案：B。 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ，需 4.00 mol 電子： $4.00 \times 96\,500 = 386\,000 \text{ C}$ 。

29. A current of 0.500 A flows for 1930 s through copper(II) sulfate solution. What mass of copper is deposited? ($A_r \text{ Cu} = 63.5$)

A) 0.635 g B) 0.318 g C) 0.159 g D) 1.27 g (1 分)

答案：答案：B。 $Q = 0.500 \times 1930 = 965 \text{ C}$ ； $n(\text{e}^-) = 0.0100 \text{ mol}$ ； $n(\text{Cu}) = 0.00500 \text{ mol}$ ； $m = 0.318 \text{ g}$ 。

30. Doubling [A] doubles the initial rate, while doubling [B] has no effect. Which is the rate equation?

A) $\text{rate} = k[A]^2$ B) $\text{rate} = k[A][B]$ C) $\text{rate} = k[B]$ D) $\text{rate} = k[A]$ (1 分)

答案：答案：D。速率與 [A] 成正比、與 [B] 無關，所以 $\text{rate} = k[A]$ 。

31. What are the units of the rate constant for $\text{rate} = k[A][B]$ (overall second order)?

A) s^{-1} B) $\text{dm}^3 \text{mol}^{-1} \text{s}^{-1}$ C) $\text{mol dm}^{-3} \text{s}^{-1}$ D) $\text{dm}^6 \text{mol}^{-2} \text{s}^{-1}$ (1 分)

答案：答案：B。 $\text{mol dm}^{-3} \text{s}^{-1} = k (\text{mol dm}^{-3})^2$ ，故 k 的單位為 $\text{dm}^3 \text{mol}^{-1} \text{s}^{-1}$ 。

32. Why does a small rise in temperature greatly increase the rate of a reaction?

A) The activation energy falls sharply B) The concentration of reactants rises C) A larger proportion of molecules has energy greater than the activation energy. D) The molecules become smaller (1 分)

答案：答案：C。溫度上升令能量分佈右移，超過活化能的分子比例大幅增加。

33. What is the bond angle in an ammonia molecule?

A) 107 degrees B) 109.5 degrees C) 120 degrees D) 90 degrees (1 分)

答案：答案：A。氨的氮原子有一對孤對電子，排斥較強，鍵角為 107° 。

34. What is the shape of the SF_6 molecule?

A) Tetrahedral B) Trigonal bipyramidal C) Octahedral D) Square planar (1 分)

答案：答案：C。硫與六個氟形成六個電子域，無孤對電子，故為八面體。

35. What are the shape and bond angle of BF_3 ?

A) Pyramidal, 107 degrees B) Tetrahedral, 109.5 degrees C) Trigonal planar, 120 degrees D) Linear, 180 degrees (1 分)

答案：答案：C。硼有三個鍵對、無孤對電子，故為平面三角形，鍵角 120° 。

36. How many structural isomers have the molecular formula C_4H_{10} ?

A) 1 B) 2 C) 3 D) 4 (1 分)

答案：答案：B。丁烷與 2-甲基丙烷，共 2 個結構異構物。

37. How many non-cyclic structural isomers (ignoring cis-trans) have the formula C_4H_8 ?

A) 3 B) 2 C) 4 D) 5 (1 分)

答案：答案：A。丁-1-烯、丁-2-烯及 2-甲基丙-1-烯，共 3 個。

38. What is the major product when hydrogen bromide is added to propene?

A) 1-bromopropane B) 1,2-dibromopropane C) propan-2-ol D) 2-bromopropane (1 分)

答案：答案：D。按馬氏規則，氫加在含氫較多的碳上，溴加在中间碳，得 2-溴丙烷。

39. Propan-1-ol is refluxed with excess acidified potassium dichromate(VI). What is the organic product?

A) Propanoic acid B) Propanal C) Propanone D) Propene (1 分)

答案：答案：A。一級醇在迴流及過量氧化劑下先成醛，再氧化為丙酸。

40. Which reagent gives an orange precipitate with a carbonyl compound?

A) Tollens' reagent B) 2,4-dinitrophenylhydrazine C) Fehling's solution D) Bromine water (1 分)

答案：答案：B。2,4-二硝基苯肼與醛及酮均生成橙色沉澱。

