

Questions

1. What is the oxidation state of chlorine in each of the following substances?



A -1, 0, +2 B -1, +1, +2 C +5, -1, -1 D +5, -1, +1 E +5, +1, +2

2. In which reaction is hydrogen the oxidising agent?

- A. $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$
B. $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$
C. $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
D. $2\text{Na} + \text{H}_2 \rightarrow 2\text{NaH}$
E. $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

3. Which compound contains two different elements with identical oxidation states?

- A. HClO B. HClO_4 C. $\text{Mg}(\text{OH})_2$ D. Na_2SO_4 E. NH_4Cl

4. Which reaction is not an oxidation-reduction reaction?

- A. $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
B. $2\text{Mg}(\text{NO}_3)_2 \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$
C. $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$
D. $\text{SO}_2 + \text{NO}_2 \rightarrow \text{SO}_3 + \text{NO}$
E.

6. What is the pH of a 200 mL $0.15 \text{ mol L}^{-1} \text{ HNO}_3$?

- A. -0.52 B. 0.52 C. -0.82 D. 0.82 E. 1.52

7. What is the OH^- concentration of a solution having pH 4.2?

- A. 6.31×10^{-5} B. 1.58×10^{-5} C. 6.31×10^{-10} D. 1.58×10^{-9} E. 1.58×10^{-10}

8. 0.23 mol L^{-1} solutions of each of the following conduct electricit

14. An unknown metal nitrate solution contains one of the metal cations below. Identify the cation based on the tests and observations below.

Test	Observation
Add 2 drops NaOH(aq)	forms a white precipitate
Add excess NaOH(aq)	precipitate remains
Add H ₂ SO ₄ (aq) to a new sample	forms a colourless solution

A. Na⁺

B. Mg²⁺

C. Ba²⁺

D. Zn²⁺

E. Al³⁺

15. Which combination of substances in aqueous solution will not produce a precipitate?

A. NaOH + HClO₄

B. 0.000008871 0 595.32 841.92 reW*BT/F3 11.04 Tf1 0 0 1 80.544 558.19 Tm0 0.0000088

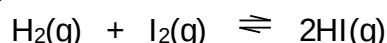
20. Upon complete combustion, a 10.0 g sample of a compound containing only carbon, hydrogen and oxygen forms 23.98 g CO₂ and 4.91 g H₂O. What is the empirical formula of the compound?

- A. CH₂O₂ B...C₂H₂O C. C₃H₃O D. C₆H₃O₂ E. C₆H₆O

21. Use the given information to calculate the mass of butane (C₄H₁₀) that releases 10,000 kJ of heat energy on combustion. $M(C_4H_{10}) = 58.0 \text{ g mol}^{-1}$ $\Delta H(\text{butane}) = -2877 \text{ kJ mol}^{-1}$

- A. 3.48 g B. 16.7 g C. 172 g D. 195 g E. 202 g

22. Heating 2.00 mol of hydrogen and 3.00 mol of iodine in a 1.00 L sealed container at a fixed temperature results in the reaction below. The mixture of gases at equilibrium contains 2.40 mol of iodine.



Calculate the equilibrium constant, K_c.

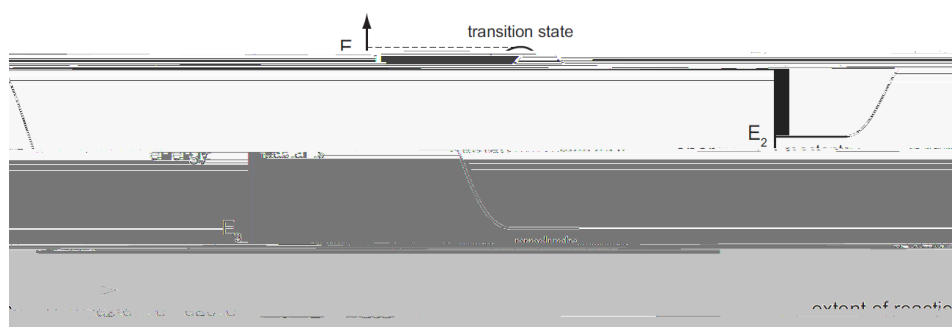
- A. 0.107 B. 0.357 C. 0.429 D. 2.33 E. 9.35

23. Which statements about the collision theory of reactions are correct?

- I. Only collisions where molecules have the correct orientations lead to reactions.
- II. Only collisions with an energy greater than a certain value lead to reactions.
- III. Reactions occur faster at higher temperatures because the particles are moving faster and with more energy.

- A. I only B. II only C. III only D. II and III only E. I, II and III

24. The reaction pathway diagram below illustrates the energies of the reactants, the products and the transition state of a reaction.



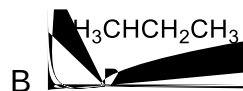
Which expression represents the activation energy of the forward reaction?

- A. E₁ - E₂ B. E₁ - E₃ C. E₂ - E₁ D. E₂ - E₃ E. E₃ - E₂

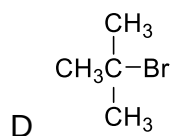
25.

33. Structural isomerism and stereoisomerism should be considered in answering this question. Compound J is reacted with KOH dissolved in ethanol. Three isomeric alkenes with molecular formula C_4H_8 are formed. What is compound J?

A



C CH_3CHCH



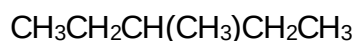
E

34. Considering only structural isomers, what is the number of alcohols of each type with the formula $C_5H_{12}O$?

	Primary	Secondary	Tertiary
A	3	3	1
B	3	3	2
C	4	2	2
D	4	3	1
E	4	3	2

35. Histidine is an amino acid.

36. Which of the statements about the following two compounds is correct?



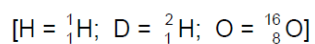
The two compounds are

- A. Identical B. Structural isomers C. Geometric isomers
D. cis-trans isomers E. Stereoisomers

37. Lewis dot structures can be used to determine whether a compound is polar due to having a molecular dipole. Which of the following compounds does NOT have a molecular dipole?

- A. O_3 B. SeO_3 C. XeO_3 D. NH_3 E. PCl_3

38. Which ion has both more electrons than protons and more protons than neutrons?



- A. H^+ B. D^- C. H_3O^+ D. OD^- E. OH^-

39. Which species has the smallest number of electrons?

- A. B^{3+} B. Be^{2+} C. Li^+ D. H^- E. He^+

40. Which compound is non-polar (no net dipole moment) despite having polar covalent bonds?

- A. CO_2 B. H_2O C. HCN D. N_2 E. NaCl