A Level Chemistry Diagnostic Test 2

Help

Set by: T. Editor

Please be aware that for tests your answer to each question **will be visible to your teacher(s) after you submit your test** so that they can provide further feedback and support if they wish to do so.
Assignments are different. We do not share with your teachers any of your entered answers or the number of your attempts to questions in assignments.

Instructions

This test will give you a broad idea of which topics you most need to spend more time on in your revision.

There is a total of **24** multiple-choice questions, divided into **5** sections.

Test sections

- Stoichiometry and Acids/Bases
- Kinetics and Equilibria
- Enthalpy and Entropy
- Inorganic Chemistry
- Organic Chemistry

Click ‘Start’ when you are ready to begin the test.

Stoichiometry and Acids/Bases

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1. Which of the following is a balanced equation for the reaction of a Group 1 metal with water?

- $2\,\mathrm{M(s)} + \mathrm{H_2O(l)} \longrightarrow \mathrm{M_2O(aq)} + \mathrm{H_2(g)}$
- $\mathrm{M(s)} + 2\,\mathrm{H_2O(l)} \longrightarrow \mathrm{M(OH)_2(aq)} + \mathrm{H_2(g)}$
- $2\,\mathrm{M(s)} + 2\,\mathrm{H_2O(l)} \longrightarrow 2\,\mathrm{MOH(aq)} + \mathrm{H_2(g)}$
- $\mathrm{M(s)} + \mathrm{H_2O(l)} \longrightarrow \mathrm{MO(aq)} + \mathrm{H_2(g)}$

2. Which of the following statements about strong and weak acids is correct?

- A strong acid can react with both strong and weak bases, while a weak acid can only react with strong bases.
- A strong acid in solution always has a $\mathrm{pH} < 3$.
- When present at the same concentration, a strong acid has a lower pH than a weak acid.
- Whether an acid is strong or weak depends on its concentration.

3. Phenol has a $\mathrm{p}K_\mathrm{a}$ value of 10. Calculate the pH of a $0.10\,\mathrm{mol\,dm^{-3}}$ solution of phenol.

- 1.0
- 5.0
- 5.5
- 10

4. Which of the following statements about buffers is correct?

- A buffer is always neutral.
- Buffers can be produced through partial neutralisation of strong acids.
- A buffer always contains equal concentrations of an acid and its conjugate base.
- Buffer solutions resist changes in pH, but will change in pH if subjected to a large enough addition of acid or base.

Kinetics and Equilibria

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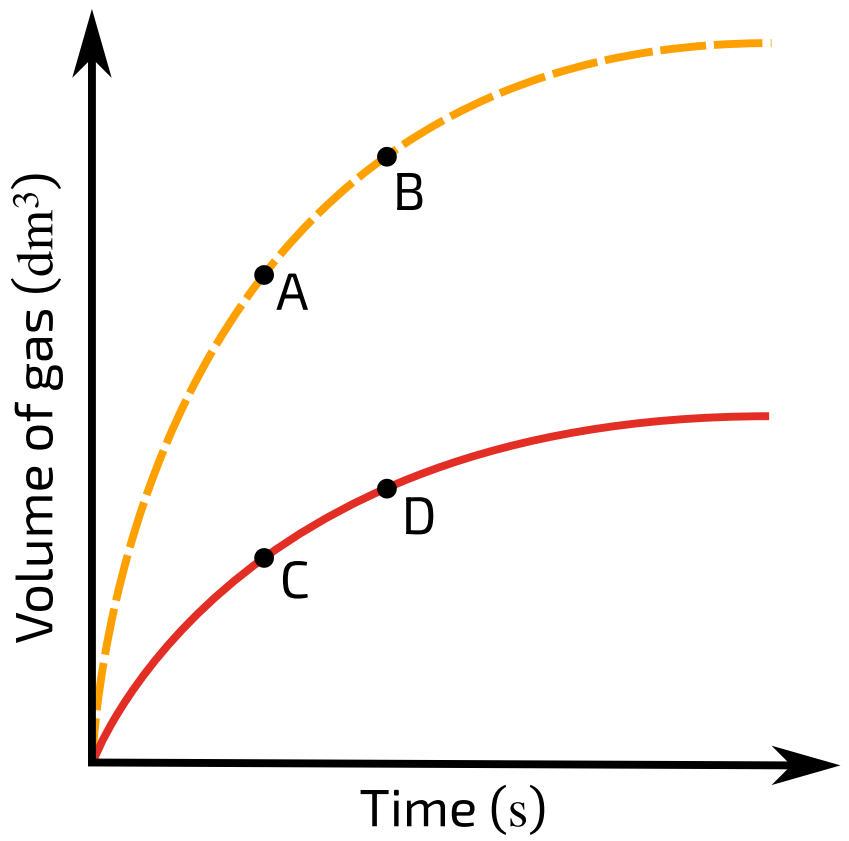
5. At which two points are the rates of the reaction approximately equal, on the basis of the graph provided?



Graph showing volume of gas evolved over time in two different reaction setups.

- A and C
- A and D
- B and C
- B and D

6. The reaction below was experimentally investigated by observing the reaction rate at different concentrations of the reagents X and Y. The results are shown in a table.

$$2\,\mathrm{X}\,(\mathrm{aq}) + \mathrm{Y}\,(\mathrm{aq}) \longrightarrow \mathrm{X_2Y}\,(\mathrm{aq})$$

$[\mathrm{X}]/\mathrm{mol\,dm^{-3}}$	$[\mathrm{Y}]/\mathrm{mol\,dm^{-3}}$	$\mathrm{rate}/\mathrm{mol\,dm^{-3}\,s^{-1}}$
0.10	0.10	0.020

0.30	0.10	0.060
0.10	0.20	0.080

What are the orders of the reaction with respect to X and Y respectively?

	X	Y
○	1	1
○	2	2
○	1	2
○	2	1

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7. Two solutions are mixed together and a gas evolves as a reaction takes place. The rate of reaction is seen to decrease over time. Which of the following offers the best explanation for this observation?

- ○ The concentration of the reagents decreases over time, leading to a lower collision rate.
- ○ The reaction heats up the mixture, leading to a smaller proportion of collisions being successful.
- ○ The product blocks the active sites of the reagents, preventing the reaction from going ahead.
- ○ The particles have progressively less energy, leading to a lower collision rate.

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8. Write an expression for the equilibrium constant, given the following equilibrium.

$$\mathrm{X}\,(\mathrm{aq}) + \mathrm{Y}\,(\mathrm{aq}) \rightleftharpoons 2\,\mathrm{Z}\,(\mathrm{aq})$$

- ○ $K = \frac{[Z]}{[X][Y]}$
- ○ $K = \frac{[X][Y]}{[Z]}$
- ○ $K = \frac{[Z]^2}{[X][Y]}$
- ○ $K = \frac{[X][Y]}{[Z]^2}$

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Enthalpy and Entropy

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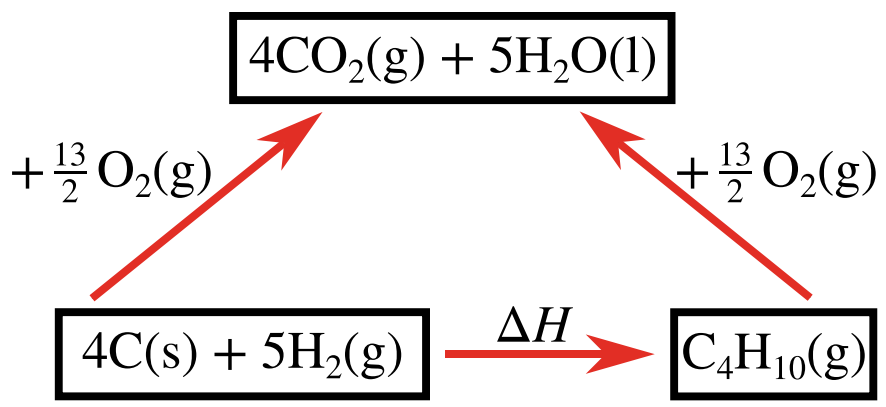
9. Express the enthalpy change of formation of butane in terms of the relevant enthalpy changes of combustion.



- $\Delta H = \frac{13}{2}\Delta H_c(\mathrm{C_4H_{10}}) - 4\Delta H_c(\mathrm{C}) - 5\Delta H_c(\mathrm{H_2})$
- $\Delta H = 4\Delta H_c(\mathrm{C}) + 5\Delta H_c(\mathrm{H_2}) - \frac{13}{2}\Delta H_c(\mathrm{C_4H_{10}})$
- $\Delta H = \Delta H_c(\mathrm{C_4H_{10}}) - 4\Delta H_c(\mathrm{C}) - 5\Delta H_c(\mathrm{H_2})$
- $\Delta H = 4\Delta H_c(\mathrm{C}) + 5\Delta H_c(\mathrm{H_2}) - \Delta H_c(\mathrm{C_4H_{10}})$

10. What does a positive enthalpy change indicate about a reaction?

- None of the above
- It can go ahead only in the presence of a catalyst.
- It cannot go ahead.
- It is slow.

11. Which of the following statements about lattice enthalpies of formation is correct?

- The lattice enthalpy of formation does not depend on the size of the ions.
- The lattice enthalpy of formation becomes more negative the higher in value the charges on the ions are.
- The lattice enthalpy of formation becomes more negative the larger the ions are.

- The lattice enthalpy of formation does not depend on the charges of the ions.

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12. Which of the following reactions will have an enthalpy change corresponding to the lattice enthalpy of formation for magnesium chloride?

- $\mathrm{Mg^{+}\,(g) + Cl^{-}\,(g) \longrightarrow MgCl\,(s)}$
- $\mathrm{Mg^{2+}\,(g) + 2\,Cl^{-}\,(g) \longrightarrow MgCl_2\,(s)}$
- $\mathrm{Mg\,(s) + \tfrac{1}{2}\,Cl_2\,(g) \longrightarrow MgCl\,(s)}$
- $\mathrm{Mg\,(s) + Cl_2\,(g) \longrightarrow MgCl_2\,(s)}$

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Inorganic Chemistry

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13. A given number of moles of $\mathrm{Mg(OH)_2}$ is added to $1.0\,\mathrm{dm^3}$ of water and the pH is recorded. The same number of moles of $\mathrm{Ba(OH)_2}$ is added to another beaker containing $1.0\,\mathrm{dm^3}$ of water and the pH is found to be higher. Explain this observation.

- $\mathrm{Mg(OH)_2}$ is more soluble than $\mathrm{Ba(OH)_2}$
- $\mathrm{Ba(OH)_2}$ contains more hydroxide ions per mole than $\mathrm{Mg(OH)_2}$
- $\mathrm{Ba(OH)_2}$ is more soluble than $\mathrm{Mg(OH)_2}$
- $\mathrm{Mg(OH)_2}$ contains more hydroxide ions per mole than $\mathrm{Ba(OH)_2}$

14. Which of the following correctly describes what happens to the first ionisation energy when crossing a period in the periodic table?

- Ionisation energy increases throughout.
- Ionisation energy mostly decreases, but there are a few increases.
- Ionisation energy mostly increases, but there are a few decreases.
- Ionisation energy decreases throughout

15. Which of the following best describes what happens when HCl dissolves in water?

- The HCl molecules become surrounded by water molecules and remain this way.
- The HCl molecules break apart homolytically in water, giving rise to $\mathrm{H\cdot}$ and $\mathrm{Cl\cdot}$ radicals which interact with the water molecules.
- The $\mathrm{H^+}$ and $\mathrm{Cl^-}$ ions initially arranged in a regular lattice separate and get surrounded by water molecules.
- The HCl molecules break apart heterolytically in water, giving rise to $\mathrm{H^+}$ and $\mathrm{Cl^-}$ ions which interact with the water molecules.

16. When an excess of HCl is added to a solution containing $\mathrm{Cu^{2+}}$ ions, a yellow solution forms. What is the shape of the complex responsible for this colour?

- tetrahedral

- trigonal planar
- octahedral
- square planar

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17. What is the oxidation state of Cr in the $[\mathrm{Cr(OH)_6}]^{3-}$ complex?

- -3
- 0
- +3
- +6

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18. Carbon dioxide sublimates at $-78.5\,^{\circ}\mathrm{C}$ while silicon dioxide is a solid at RTP and has a melting point above $1710\,^{\circ}\mathrm{C}$. Which of the following best accounts for this difference?

- Both carbon dioxide and silicon dioxide exist as simple covalent molecules, but silicon dioxide has more electrons and therefore forms stronger van der Waals interactions.
- Separating carbon dioxide molecules only requires breaking weak van der Waals interactions, while silicon dioxide exists as an ionic lattice, meaning ionic interactions need to be broken in order for it to melt.
- Both carbon dioxide and silicon dioxide exist as simple covalent molecules, but the bonds in silicon dioxide are stronger.
- Separating carbon dioxide molecules only requires breaking weak van der Waals interactions, while silicon dioxide exists as a giant covalent lattice, meaning covalent bonds need to be broken in order for it to melt.

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Organic Chemistry

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19. What is the systematic name of CH_3CH_2CHO?

- propanone
- ethanone
- propanal
- ethanal

20. Which of the following mechanisms takes place when hydroxide ions react with chloromethane?

- nucleophilic addition
- nucleophilic substitution
- electrophilic substitution
- electrophilic addition

21. When phenol reacts with bromine, the expected product is...

- bromobenzene
- 3-bromophenol
- phenol (no reaction occurs)
- 2,4,6-tribromophenol

22. How many signals do you expect to see in the ^{13}C spectrum of methylbenzene?

- 1
- 3
- 5
- 7

23. A polymer is produced from two different monomers: a diamine and a dicarboxylic acid respectively. Other than the polymer, what substance is produced during the polymerisation?

- $H_2NC(=O)H$
- H_2O
- $H_2C=O$
- NH_3

24. In a Friedel Crafts acylation, a catalyst (halogen carrier) is required to facilitate the formation of the electrophile that gets attacked by the aromatic ring. Which of the following is **not** suitable for this purpose?

- Cl_2
- $FeCl_3$
- Fe
- $AlCl_3$

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