

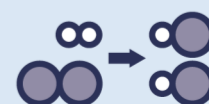
Name:
Class:



Science
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C4.2 Knowledge Quiz: Extraction of Metals

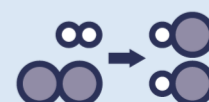
Describe what the reactivity series shows.	The reactivity series is a list of metals from most reactive to least reactive.
Write the general word equation for the reaction of a metal and acid.	Metal + acid → salt + hydrogen
State what salt is formed when potassium reacts with nitric acid.	Potassium nitrate
State what you would observe if metals of different reactivities were added to hydrochloric acid.	The more reactive metal would create more bubbles than the less reactive metal.
Define 'displacement reaction'	A reaction where a more reactive element replaces a less reactive element in a compound.
State the products made when lead oxide reacts with carbon	Lead + carbon dioxide
Write the word equation for the displacement reaction between copper oxide and carbon.	Copper oxide + carbon → copper + carbon dioxide
When zinc oxide reacts with carbon, state what has been oxidised.	Carbon
Describe the difference between a sodium atom and a sodium ion.	A sodium atom is neutral (no charge) with the electronic configuration 2, 8, 1. A sodium ion is positively charged with the electronic configuration 2, 8.
Define ionic bonding	Ionic bonding occurs in compounds formed from metals combined with non-metals. Electrons are lost or gained to form a stable electronic configuration.
Describe how sodium fluoride is formed	Ionic bonding occurs in sodium fluoride because sodium is a metal and fluorine is a non-metal. As sodium fluoride forms, an electron is transferred from a sodium atom to a fluorine atom, forming Na ⁺ and F ⁻ ions.
Describe the relationship between the group of the periodic table and the number of outer shell electrons.	The group of the periodic table that an element is in tells you how many outer shell electrons the element has.
(HT only) List the ions that make up Na ₂ O	Na ⁺ O ²⁻
(HT only) Describe what spectator ions are.	Ions that are the same in the reactants and the products.



Name:
Class:



(HT only) Write an ionic equation for the following reaction: $\text{Zn}_{(s)} + \text{CuCl}_{2(aq)} \rightarrow \text{ZnCl}_{2(aq)} + \text{Cu}_{(s)}$	$\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + \text{Cu}_{(s)}$
(HT only) Define oxidation in terms of electrons	When electrons are lost.
(HT only) Define reduction in terms of electrons	When electrons are gained.
(HT only) Identify what has been reduced and what has been oxidised in this reaction: $\text{Zn}_{(s)} + \text{CuCl}_{2(aq)} \rightarrow \text{ZnCl}_{2(aq)} + \text{Cu}_{(s)}$	Zn is oxidised to form Zn^{2+} Cu^{2+} is reduced to form Cu
(HT only) Use the following ionic equation to write two half equations. $\text{Br}_{2(s)} + 2\text{Na}^{+}_{(aq)} + 2\text{I}^{-}_{(aq)} \rightarrow 2\text{Na}^{+}_{(aq)} + 2\text{Br}^{-}_{(aq)} + \text{I}_{2(s)}$	$\text{Br}_{2(s)} + 2\text{e}^{-} \rightarrow 2\text{Br}^{-}_{(aq)}$ $2\text{I}^{-}_{(aq)} \rightarrow \text{I}_{2(s)} + 2\text{e}^{-}$
(HT only) Using the half equations in the question above, identify which species are reduced and which are oxidised.	Br_2 is reduced to form Br^{-} I^{-} is oxidised to form I_2
(HT only) Write an ionic equation for the following reaction: $\text{Fe}_{(s)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{FeSO}_{4(aq)} + \text{H}_{2(g)}$	$\text{Fe}_{(s)} + 2\text{H}^{+}_{(aq)} \rightarrow \text{Fe}^{2+}_{(aq)} + \text{H}_{2(g)}$
(HT only) Write two half equations for the following reaction: $\text{Fe}_{(s)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{FeSO}_{4(aq)} + \text{H}_{2(g)}$	$\text{Fe}_{(s)} \rightarrow \text{Fe}^{2+} + 2\text{e}^{-}$ $2\text{H}^{+}_{(aq)} + 2\text{e}^{-} \rightarrow \text{H}_{2(g)}$
(HT only) Using the half equations in the question above, identify which species are reduced and which are oxidised.	Br_2 is reduced to form Br^{-} I^{-} is oxidised to form I_2
Define electrolysis.	The process of passing an electric current through a substance, to split it up into its ions.
List the ions present in molten sodium bromide.	Na^{+} Br^{-}
Predict the movement of ions in sodium bromide when the current is switched on in electrolysis	Na^{+} moves towards the negative electrode (cathode) Br^{-} moves towards the positive electrode (anode)
Explain why electrolysis cannot be carried out with a solid ionic substance	Ions need to be free to move so that current can flow to complete the circuit. Therefore ionic compounds must be molten or dissolved in solution.

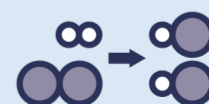


Name:
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Science
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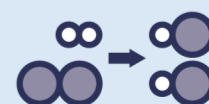
Describe a use of electrolysis.	Electrolysis can be used to extract metals from ionic compounds.
Describe a disadvantage of extraction of metals by electrolysis.	Heating ionic compounds to melt them takes a huge amount of energy which is costly Electricity used during electrolysis is costly
Describe how electrolysis is used to extract aluminium from its ore.	Cryolite is added to lower the melting point of a cryolite and aluminium oxide mixture. Inert electrodes are used to electrolyse the molten aluminium oxide. Pure aluminium is produced at the negative electrode.
State what is produced when a positive ion is discharged at an electrode.	When a positive ion is discharged at an electrode, a metal is produced
State what is produced when a negative ion is discharged at an electrode.	When a negative ion is discharged at an electrode, a non-metal is produced
Describe what happens at the positive electrode when molten lithium fluoride is electrolysed.	Fluoride ions (F^-) will move towards the positive electrode (anode). Here, the ions will be discharged. They will lose electrons to form elemental fluorine gas. This is called oxidation. Bubbles of fluorine gas will be observed.
Describe what happens at the negative electrode when molten sodium chloride is electrolysed.	Sodium ions (Na^+) will move towards the negative electrode (cathode). Here, the ions will be discharged. They will gain electrons to form sodium metal. This is called reduction. Sodium metal will be observed forming
<i>(HT Only) Write half equations to describe the discharge of ions at each electrode when molten sodium chloride is electrolysed.</i>	$2Cl^- \rightarrow Cl_2 + 2e^-$ $Na^+ + e^- \rightarrow Na$
List the ions present in the electrolytes of molten lithium fluoride.	Molten lithium fluoride contains Li^+ and F^-
List the ions present in the electrolytes of aqueous lithium fluoride solution.	Lithium fluoride solution contains Li^+ , F^- , H^+ and OH^- ions
If the two positive ions in solution are K^+ and H^+ , which positive ion would be discharged at the cathode? Explain your answer.	Hydrogen is less reactive than potassium, therefore the hydrogen ion would be discharged
If the two negative ions in solution are OH^- and SO_4^{2-} , which negative ion would be discharged at the anode? Explain your answer.	The hydroxide ion (OH^-) would be discharged Hydroxide ions are always discharged at the anode unless a halide ion is present. There is no halide ion present.



Name:
Class:



Predict what will be observed at the anode and cathode during the electrolysis of aqueous sodium chloride solution.	At the cathode: Bubbles of hydrogen gas would be observed. At the anode: Bubbles of chlorine gas would be observed.
Describe the apparatus used for electrolysis	Electrolyte contained in a beaker. Electrodes, such as graphite, inserted into the electrolyte. The electrodes connected in a series circuit with a power supply.
Describe how to test for the presence of hydrogen gas and what the positive result would be.	Place a lit splint into the gas and it will make a squeaky pop sound if hydrogen is present.
Describe how to test for the presence of oxygen gas and what the positive result would be.	Place a glowing splint into the gas and the splint will relight if oxygen is present.
Describe how to test for the presence of chlorine gas and what the positive result would be.	Place damp blue litmus paper in a test tube of the gas and the litmus paper is bleached if chlorine is present.
TIF - Define corrosion.	The destruction of materials by chemical reactions with substances in the environment.
TIF - State methods used to prevent corrosion.	Electroplating, greasing, painting, sacrificial protection and galvanising are methods used to prevent corrosion.
TIF - Explain how electroplating is carried out.	An electrolyte containing the metal is used to electrolyse the metal object that is connected to the negative electrode. The result is a coating of a less reactive metal to protect it from corroding.
(HT Only) List some disadvantages of mining and quarrying.	Destruction of habitats and disruption of ecosystems.
(HT Only) Define bioleaching.	<i>Bioleaching is a method to extract metals from their ore using living organisms such as bacteria.</i>
(HT Only) Define phytomining.	Phytomining is a method to extract copper metal from low-grade copper ore in soil, using plants
Describe how metals are recycled	Scrap metal is collected and transported to a sorting centre where items are broken up, and sorted into different kinds of metals. Other materials such as plastic are removed. Then the metals are melted down and are recast into new items
State two environmental benefits of recycling metals.	Less damage to the environment as no quarries or mines are required.



Name:
Class:



	Valuable metal ores are preserved.
Suggest how the public and businesses might be encouraged to recycle their waste metals	Provide information about the need to recycle Charge for waste Reward people to recycle (or fine people who don't recycle) Put labels on cans to show which can be recycled Provide recycling bins and areas

