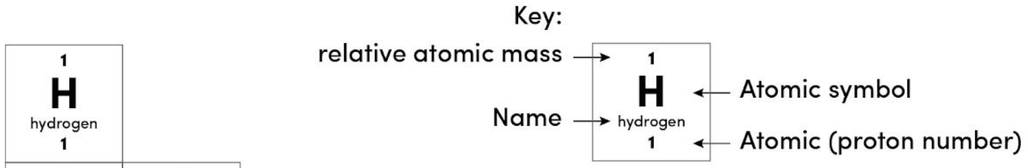
Combined Science - Chemistry - Key Stage 4

Electrolysis Half Equations - Higher Tier

Mr Campbell

Periodic Table of Elements



1 H hydrogen 1																4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[97] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[267] Rf rutherfordium 104	[270] Db dubnium 105	[269] Sg seaborgium 106	[270] Bh bohrium 107	[270] Hs hassium 108	[278] Mt meitnerium 109	[281] Ds darmstadtium 110	[281] Rg roentgenium 87	[285] Cn copernicium 112	[286] Nh nihonium 113	[289] Fl flerovium 114	[289] Mc moscovium 115	[293] Lv livermorium 116	[293] Ts tennessine 117	[294] Og organesson 118

Source: Oak

Independent task

Describe what has happened in terms of electrons for the changes below to occur. State if electrons have been lost or gained and how many have been lost or gained.

1. $Al \rightarrow Al^{3+}$
2. $Br \rightarrow Br^{-}$
3. $N^{3-} \rightarrow N$
4. $K^{+} \rightarrow K$

Independent task

Describe what has happened in terms of electrons for the changes below to occur. State if electrons have been lost or gained and how many have been lost or gained.

1. $Al \rightarrow Al^{3+}$ Lost 3 electrons
2. $Br \rightarrow Br^{-}$ Gained 1 electrons
3. $N^{3-} \rightarrow N$ Gained 3 electrons
4. $Mg^{2+} \rightarrow Mg$ Lost 2 electrons

Independent task

Explain how aluminium ions, Al^{3+}, form aluminium atoms at the cathode during the electrolysis of aluminium oxide.

Aluminium ions are _____ charged so are attracted to the _____ cathode.

At the cathode aluminium ions _____ three electrons to form aluminium atoms.

Independent task answers

Explain how aluminium ions, Al^{3+}, form aluminium atoms at the cathode during the electrolysis of aluminium oxide.

Aluminium ions are positively charged so are attracted to the negative cathode.

At the cathode aluminium ions lose three electrons to form aluminium atoms.

Independent task

Key tips

Have to balance in terms of both **atoms/ions** and **charge**

Remember the formula of your non-metal Cl_2, Br_2, I_2, O_2, H_2 (diatomic)

Balance the half equations below

1. $Ca^{2+} + e^- \rightarrow Ca$
2. $Br^- \rightarrow Br_2 + e^-$
3. $Al^{3+} + e^- \rightarrow Al$
4. $H^+ + e^- \rightarrow H_2$
5. $OH^- \rightarrow H_2O + O_2 + e^-$

Challenge: construct the half equations for the reactions at each electrode for the electrolysis of molten potassium oxide.

Independent task answers

Balance the half equations below

1. $Ca^{2+} + 2e^- \rightarrow Ca$
2. $2Br^- \rightarrow Br_2 + 2e^-$
3. $Al^{3+} + 3e^- \rightarrow Al$
4. $2H^+ + 2e^- \rightarrow H_2$
5. $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

Challenge: construct the half equations for the reactions at each electrode for the electrolysis of molten potassium oxide.

Cathode: $K^+ + e^- \rightarrow K$ Anode: $2O^{2-} \rightarrow O_2 + 4e^-$

Independent task

For the electrolysis of molten calcium oxide

1. Explain how calcium ions, Ca^{2+}, form calcium atoms, Ca, at the cathode.
2. Balance the half equation for the formation of oxygen at the anode.
   $O^{2-} \rightarrow O_2 + e^-$

1. Construct the equation for the half equation at the cathode.
2. Explain which species has been oxidised and which has been reduced.

Independent task answers

For the electrolysis of molten calcium oxide

1. Calcium ions are positive so are attracted to the negative cathode. The Ca^{2+} ions gain two electrons forming calcium atoms.
2. $2O^{2-} \rightarrow O_2 + 4e^-$
3. $Ca^{2+} + 2e^- \rightarrow Ca$
4. Ca^{2+} has been reduced because it gained electrons. O^{2-} has been oxidised because it lost electrons.