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Question 12 (Answer: **C**)

- With copper electrodes the anode dissolves as fast as the cathode plates out.
- So copper ions are replaced as quickly as they are removed.
- The concentration of the solution – and its blue colour – stays constant, and no oxygen is formed.

Question 13 (Answer: **D**)

- In *dilute* sodium chloride solution it is the water that is discharged at the anode, not the chloride.
- So oxygen is released: $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$.
- At the cathode hydrogen ions gain electrons: $2H^+ + 2e^- \rightarrow H_2$.

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Question 13 (Answer: **C**)

- With *copper* electrodes the anode dissolves, so no oxygen forms and the blue colour stays.
- With *carbon* electrodes the anode cannot dissolve, so oxygen is released and the blue colour fades.
- Copper is deposited at the cathode in both cases – it is the anode that differs.

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Question 13 (Answer: **A**)

- At the cathode hydrogen is produced, because hydrogen is below sodium in the reactivity series.
- At the anode chlorine is produced, because the solution is *concentrated* in chloride.
- Sodium is never deposited from aqueous solution, and oxygen would need a dilute solution.

Question 14 (Answer: **A**)

- Bromide ions lose electrons at the anode – the positive electrode.
- Those electrons travel out through the external wire, round through the power supply, to the cathode.
- At the cathode they are handed to the lead ions, so electron flow is from the positive electrode round to the negative one.

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Question 10 (Answer: **C**)

- The steel object is the negative electrode, so Cu^{2+} gains electrons there and coats it reddish-brown.
- The copper anode dissolves at the same rate, so the solution's blue colour does not fade.
- The copper electrode loses mass while the steel object gains it.

Question 11 (Answer: **B**)

- The anode is positive, so negative ions travel there and *lose* electrons.
- In concentrated chloride solution it is chloride that is discharged.
- $2Cl^- \rightarrow Cl_2 + 2e^-$: two ions per molecule, with the electrons on the right.

3(a)	M1 ionic M2 molten M3 in aqueous solution
3(b)(i)	increase
3(b)(ii)	becomes paler blue or becomes colourless
3(b)(iii)	bubbles
3(b)(iv)	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ M1 any negatively charged OH species **losing** electrons **OR** $H_2O + O_2$ as only products (other than electrons) on RHS M2 any negatively charged OH species **losing** electrons **AND** $H_2O + O_2$ as only products (other than electrons) on RHS M3 correct equation
3(c)(i)	increases
3(c)(ii)	no change
3(d)(i)	bauxite
3(d)(ii)	cryolite
3(d)(iii)	**M1** anodes **or** carbon / graphite react with oxygen / O_2 **M2** (form) carbon dioxide

Question 14 (Answer: **C**)

- At the negative electrode positive ions gain electrons: $2H^+ + 2e^- \rightarrow H_2$.
- At the positive electrode negative ions lose electrons: $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$.
- Reduction always happens at the cathode and oxidation at the anode, so the pair cannot be swapped.