

Question 29 (Answer: C)

- Cryolite is added to *lower* the melting point, saving energy.
- Oxide ions are negative, so they travel to the *anode* and lose electrons there.
- Aluminium ions are positive, so they gain electrons at the cathode to form the metal.

Question 28 (Answer: C)

- The heat comes from burning the coke in the blast of hot air.
- $C + O_2 \rightarrow CO_2$ is strongly exothermic and raises the furnace above 1500 °C.
- Decomposing the limestone absorbs energy, so it cools the furnace rather than heating it.

Question 29 (Answer: B)

- At the anode oxide ions lose electrons: $2O^{2-} \rightarrow O_2 + 4e^-$.
- At the cathode aluminium ions gain electrons: $Al^{3+} + 3e^- \rightarrow Al$.
- The oxygen made at the anode burns the hot carbon away as CO_2 , which is why that electrode needs replacing.

Question 32 (Answer: B)

- The coke burns first in the hot air blast: $C + O_2 \rightarrow CO_2$.
- That carbon dioxide is then reduced by more hot coke to carbon monoxide.
- The carbon monoxide finally reduces the iron(III) oxide, so the order is 1, 3, 2.

Question 33 (Answer: C)

- Oxidation happens at the anode, so look for electrons being *lost*.
- Reaction 3 has oxide ions losing electrons, so it is at the anode.
- Reaction 2 is the oxygen made there attacking the carbon anode, so it happens at the anode too; reaction 1 is the cathode.

2(a)(i)	hematite
2(a)(ii)	burning of carbon (coke)

2(a)(iii)	carbon monoxide
2(a)(iv)	$3\text{CO} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + 3\text{CO}_2$ M1 species M2 correct equation
2(a)(v)	M1 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ M2 $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$
2(b)	M1 atoms of the same element that have the same number of protons M2 but different numbers of neutrons
2(c)(i)	p = 26 and 26 n = 28 and 32 e = 24 and 23
2(c)(ii)	M1 NaOH(aq) OR NH ₃ (aq) M2 green ppt. (insoluble in excess, ppt. turns brown near surface on standing)
2(d)(i)	a substance that oxidises another substance and is itself reduced M1 'a substance' oxidises another substance M2 is itself reduced
2(d)(ii)	loss of (one) electron
2(d)(iii)	acidified
2(e)	iodine

Question 28 (Answer: C)

- Hematite is iron(III) oxide, so the iron has to lose its oxygen.
- Loss of oxygen is reduction, done by carbon monoxide in the blast furnace.
- Electrolysis is reserved for more reactive metals such as aluminium.

Question 28 (Answer: D)

- Hematite is iron(III) oxide, and it is reduced by carbon monoxide.
- $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ – three CO per Fe₂O₃.
- Calcium compounds are involved in removing the sandy impurities, not in reducing the ore.

Question 30 (Answer: D)

- Carbon monoxide forms when hot coke reduces carbon dioxide: $\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$.
- That carbon monoxide then reduces the ore: $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$.
- Check the balancing – iron(III) oxide needs three CO, not one.