# B12 · Extra practice

Worked solutions | Items 1-2

Extra practice for this lesson. Original questions, not released diploma items. Select one option for multiple choice; other tasks state the required response.

Use the givens and conditions in each prompt. Enter the requested count, coefficient, oxidation number or potential with the stated unit and precision.

### B12-D01 · Numerical response

Iron rusts with oxygen in water. What is E°cell, in volts to two decimal places? Use $O_2/OH^-$ +0.40 V and $Fe^{2+}/Fe$ −0.45 V.

**1.** E°cell = 0.40 − (−0.45) = +0.85 V.

**2.** The oxygen half-reaction is the cathode, and the iron half-reaction is the anode.

### B12-D02 · Numerical response

A zinc block is joined to a steel pipe. What is protected minus sacrificial, in volts to two decimal places? Use $Zn^{2+}/Zn$ −0.76 V and $Fe^{2+}/Fe$ −0.45 V.

**1.** −0.45 − (−0.76) = +0.31 V. Positive means that zinc is the stronger reducing agent.

**2.** Subtract the sacrificial value from the protected value.

# B12 · Extra practice

Worked solutions | Items 3-4

### B12-D03 · Multiple choice

Tin-plated steel is scratched. Which statement is correct? Use $Sn^{2+}/Sn$ −0.14 V and $Fe^{2+}/Fe$ −0.45 V.

A. The tin corrodes
B. The iron corrodes
C. Neither metal corrodes
D. The tin protects the iron

**1.** Iron is below tin on the table, so it is the stronger reducing agent and is oxidized at the scratch.

**2.** The lower value is oxidized first.

### B12-D04 · Multiple choice

To protect a buried pipeline with a power supply, which terminal is the pipeline joined to?

A. The positive terminal
B. The negative terminal
C. Neither terminal
D. Both terminals

**1.** The pipeline must be the cathode, and the cathode of an electrolytic cell is joined to the negative terminal.

**2.** Keep the protected metal as the cathode.

# B12 · Extra practice

Worked solutions | Items 5-6

### B12-D05 · Numerical response

A magnesium block protects a steel tank. What is protected minus sacrificial, in volts to two decimal places? Use $Mg^{2+}/Mg$ −2.37 V and $Fe^{2+}/Fe$ −0.45 V.

**1.** −0.45 − (−2.37) = +1.92 V.

**2.** The sacrificial metal is the one with the lower value.

### B12-D06 · Select all that apply

Select every correct statement about a sacrificial anode.

A. It is below the protected metal on the table
B. It is oxidized and used up
C. It must touch the metal or be wired to it
D. It is the cathode

**1.** A sacrificial anode is a stronger reducing agent. It is oxidized, so it is the anode, and it needs a connection and an electrolyte.

**2.** The protected metal is the cathode, not the sacrificial one.

# B12 · Extra practice

Worked solutions | Items 7-8

### B12-D07 · Multiple choice

Why is aluminium made from molten aluminium oxide and not from aqueous $Al^{3+}$?

A. Water is reduced before $Al^{3+}$, so hydrogen forms
B. Aluminium is too heavy to deposit
C. Water is oxidized at the cathode
D. $Al^{3+}$ is not charged

**1.** Water (−0.83 V) is higher than $Al^{3+}$ (−1.66 V), so water is reduced and hydrogen forms. A melt has no water.

**2.** Compare the values at the cathode.

### B12-D08 · Matching

Match each process to its purpose.

Items to match:

1. Electroplating
2. Refining
3. Electrowinning
4. Sacrificial anode

Targets:

A. Recover metal from its ions
B. Coat an object with metal
C. Purify a metal
D. Protect iron by being oxidized

**1.** Electroplating coats, refining purifies, electrowinning recovers metal from ions and a sacrificial anode protects.

**2.** Name the purpose of the process first, then match it to the list.

# B12 · Extra practice

Worked solutions | Items 9-10

### B12-D09 · Multiple choice

In cellular respiration, $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$, which statement is correct?

A. Oxygen is reduced and glucose is the reducing agent
B. Oxygen is oxidized and glucose is the oxidizing agent
C. Carbon is reduced from +4 to 0
D. Nothing is oxidized or reduced

**1.** Oxygen goes from 0 to −2, so it is reduced. Carbon rises on average from 0 to +4, so glucose is oxidized and is the reducing agent.

**2.** Find the oxidation numbers that fall and rise.

### B12-D10 · Numerical response

Nickel is joined to iron. What is protected minus sacrificial for nickel as the sacrificial metal, in volts to two decimal places? Use $Ni^{2+}/Ni$ −0.26 V and $Fe^{2+}/Fe$ −0.45 V.

**1.** −0.45 − (−0.26) = −0.19 V. A negative value means that nickel cannot protect the iron.

**2.** Subtract the sacrificial value from the protected value.

# B12 · Extra practice

Worked solutions | Items 11-12

### B12-D11 · Multiple choice

Which statement compares a sacrificial anode with a power supply?

A. Both keep the protected metal as the cathode
B. Both need no maintenance
C. Only the sacrificial anode keeps iron as the cathode
D. Only the power supply is oxidized

**1.** Both methods keep the protected metal as the cathode. They differ in how they supply the electrons.

**2.** Name the electrode where oxidation does not happen.

### B12-D12 · Written response

A company says its coating is better because its cell voltage is higher. Explain what evidence is still needed.

**1.** A higher value shows a stronger reducing agent. It does not prove lower cost or a longer life.

**2.** Cost, lifetime and upkeep each need their own evidence.