

APOLLO

Electron transfer reactions

SL

Chemistry

First assessment 2025

20 questions | questions

17. Ammonia, NH_3 and nitrous acid, HNO_2 , are compounds of nitrogen. What are the oxidation states of nitrogen in these compounds?

	NH_3	HNO_2
A.	+3	+3
B.	-3	-3
C.	+3	-3
D.	-3	+3

27. A reactivity series of selected elements, arranged from highest activity to lowest, is shown.

Zn
Fe
Cd
Co
Ni
Sn
Pb
Cu

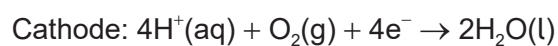
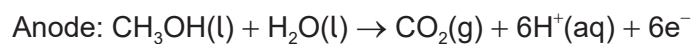
Which reaction is spontaneous?

- A. $\text{Cd}^{2+}(\text{aq}) + \text{Pb}(\text{s}) \rightarrow \text{Pb}^{2+}(\text{aq}) + \text{Cd}(\text{s})$
- B. $\text{Fe}^{2+}(\text{aq}) + \text{Sn}(\text{s}) \rightarrow \text{Sn}^{2+}(\text{aq}) + \text{Fe}(\text{s})$
- C. $\text{Zn}^{2+}(\text{aq}) + \text{Cu}(\text{s}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{Zn}(\text{s})$
- D. $\text{Ni}^{2+}(\text{aq}) + \text{Co}(\text{s}) \rightarrow \text{Co}^{2+}(\text{aq}) + \text{Ni}(\text{s})$

Turn over

2220-0210

30. The methanol fuel cell relies on the oxidation of methanol by oxygen. The two half-equations are as follows:



What is the balanced equation for the overall reaction?

- A. $2\text{CH}_3\text{OH(l)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{CO}_2\text{(g)} + 4\text{H}_2\text{O(l)}$
 - B. $\text{CH}_3\text{OH(l)} + 2\text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} + 2\text{H}_2\text{O(l)}$
 - C. $2\text{CO}_2\text{(g)} + 4\text{H}_2\text{O(l)} \rightarrow 2\text{CH}_3\text{OH(l)} + 3\text{O}_2\text{(g)}$
 - D. $\text{CO}_2\text{(g)} + 2\text{H}_2\text{O(l)} \rightarrow \text{CH}_3\text{OH(l)} + 2\text{O}_2\text{(g)}$
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13. What is the oxidation state of nitrogen in N_2O_4 ?

- A. -4
- B. -2
- C. $+2$
- D. $+4$

27. In which compound does sulfur have an oxidation state of +4?

- A. H_2S
- B. SO_3
- C. H_2SO_3
- D. H_2SO_4

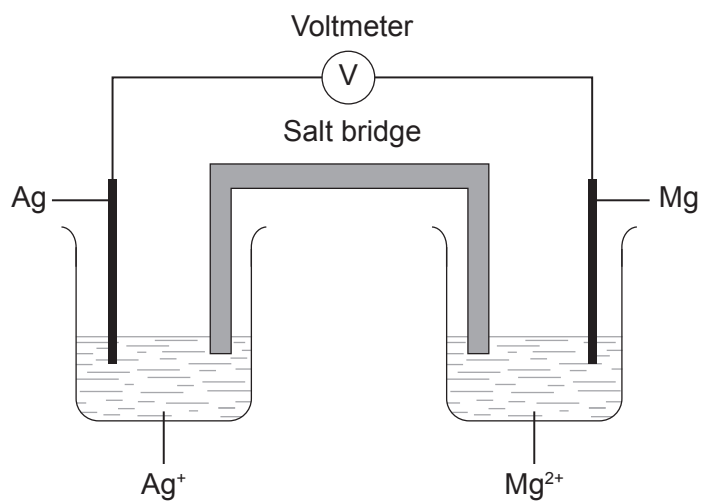
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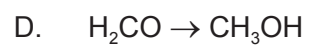
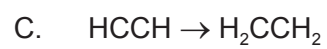
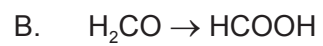
28. Magnesium displaces silver from aqueous silver nitrate.

What is the correct description of the silver electrode in the cell shown?



	Sign	Electrode
A.	+	cathode
B.	+	anode
C.	–	cathode
D.	–	anode

29. Which change represents oxidation of the functional group?

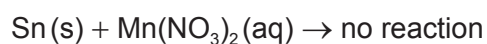
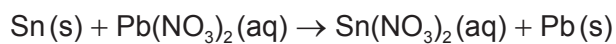


14. Which compounds contain an atom in a +3 oxidation state?



- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

27. The following occurs when tin is added to separate solutions of lead(II) nitrate, $\text{Pb}(\text{NO}_3)_2$, and manganese(II) nitrate, $\text{Mn}(\text{NO}_3)_2$.



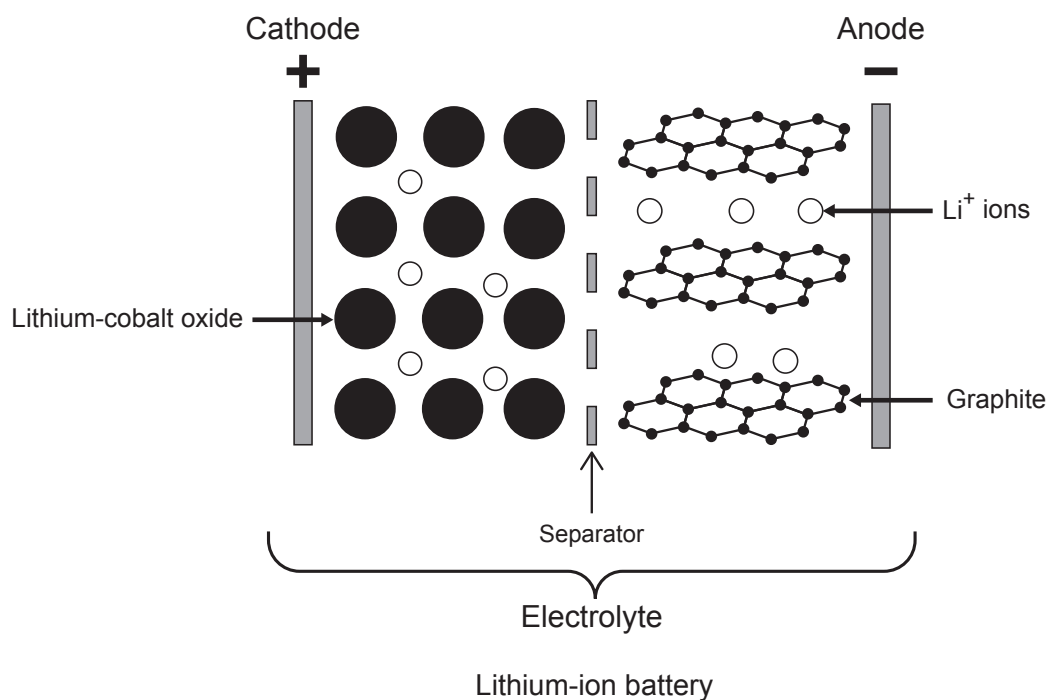
What is the order of decreasing reactivity of the metals?

- A. $\text{Sn} > \text{Pb} > \text{Mn}$
- B. $\text{Sn} > \text{Mn} > \text{Pb}$
- C. $\text{Mn} > \text{Sn} > \text{Pb}$
- D. $\text{Pb} > \text{Sn} > \text{Mn}$

28. What are the products of the electrolysis of molten aluminium oxide, $\text{Al}_2\text{O}_3(\text{l})$?

	Product at anode	Product at cathode
A.	O_2	Al
B.	O_3	Al
C.	Al	O_2
D.	Al	O_3

6. A lithium-ion battery consists of lithium ions on lithium-graphite (LiC_6) and lithium-cobalt oxide (LiCoO_2) in an electrolyte.



- (a) The lithium ions are produced at the anode from the lithium atoms embedded in graphite.

- (i) State a half-equation for the reaction occurring at the anode during discharge. [1]

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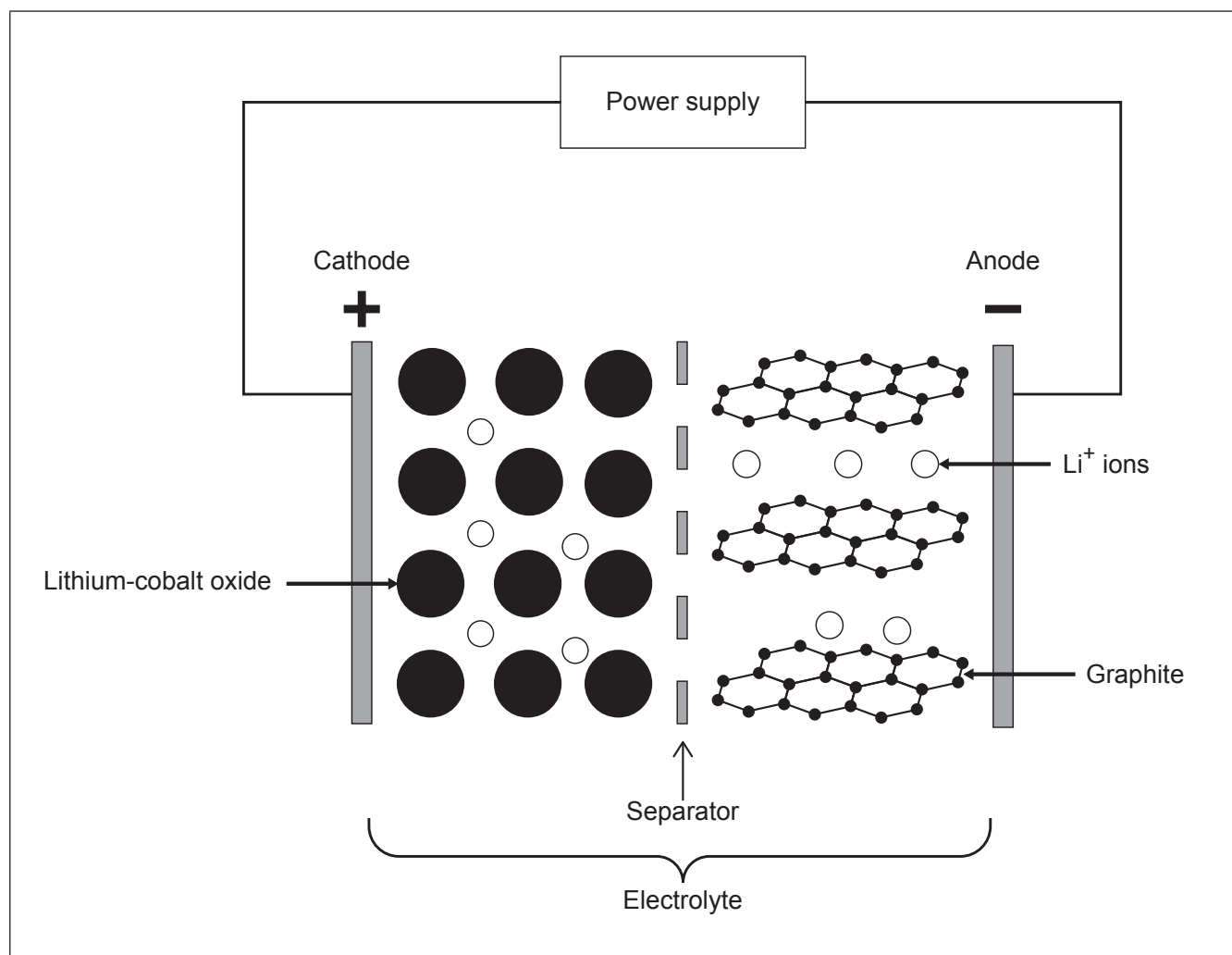
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(Question 6 continued)

- (ii) The lithium-ion battery is rechargeable. Annotate the diagram below to show the direction of the flow of electrons in the wire while the battery is recharging. [1]



- (b) Suggest why solar panels are often connected in parallel with lithium-ion batteries. [1]

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12. What are the oxidation states of the elements in Na_2CrO_4 ?

	Sodium	Chromium	Oxygen
A.	+1	+6	−1
B.	+2	+3	−1
C.	+1	+6	−2
D.	+2	+3	−2

26. Which compound undergoes oxidation when heated with acidified potassium dichromate?

- I. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- II. $\text{CH}_3\text{C}(\text{CH}_3)_2\text{OH}$
- III. $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

27. Iron is a stronger reducing agent than silver. A voltaic cell is constructed using iron and silver electrodes dipped into solutions of their respective ions, $\text{Fe}^{2+}(\text{aq})$ and $\text{Ag}^+(\text{aq})$, of equal concentrations.

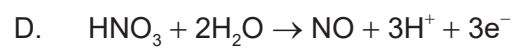
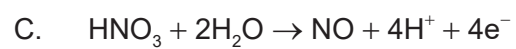
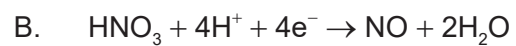
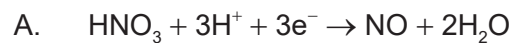
What is correct when the voltaic cell is in operation?

	Negative electrode	Positive electrode	Anode	Cathode
A.	Fe	Ag	Fe	Ag
B.	Ag	Fe	Ag	Fe
C.	Ag	Fe	Fe	Ag
D.	Fe	Ag	Ag	Fe

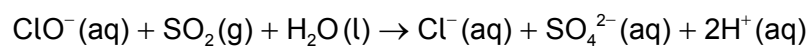
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28. What is the half equation for the reduction of nitric acid to nitrogen(II) oxide in acidic medium?



26. What are the oxidizing and reducing agents in this reaction?



	Oxidizing agent	Reducing agent
A.	ClO^{-}	H_2O
B.	SO_2	SO_4^{2-}
C.	SO_2	ClO^{-}
D.	ClO^{-}	SO_2

27. Which statement about electrochemical cells is correct?

- A. Primary (voltaic) cells use electrical energy to produce a redox reaction.
- B. Electrolytic cells are rechargeable.
- C. Secondary cells can use electrical energy to produce a redox reaction.
- D. Primary (voltaic) cells are rechargeable.

— 10 —

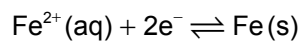
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Section B

Answer **all** questions. Answers must be written within the answer boxes provided.

4. Half-cells such as



can be connected to other half-cells to form a voltaic cell.

- (a) State the chemical formula of a compound that could be dissolved in water to produce the required aqueous solution. [1]

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- (b) Describe how you would connect the $\text{Fe}^{2+}|\text{Fe}$ half-cell to another half-cell to produce electric current through a light bulb. [2]

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- (c) State the units in which the current through the light bulb could be measured. [1]

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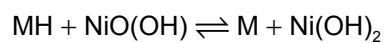


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- 26.** The overall reaction occurring at the electrodes of a rechargeable metal hydride battery can be summarized as:



Which statement is correct?

- A. The oxidation state of Ni does not change.
- B. M is oxidized by loss of hydrogen.
- C. The oxidation state of one H atom changes from -1 to $+1$.
- D. The oxidation state of one O atom changes from -1 to -2 .

27. In a redox titration, manganate(VII) ions are reduced to manganese(II) ions and iron(II) ions are oxidized to iron(III) ions.

$\text{MnO}_4^- (\text{aq})$ reduced to $\text{Mn}^{2+} (\text{aq})$

$\text{Fe}^{2+} (\text{aq})$ oxidized to $\text{Fe}^{3+} (\text{aq})$

What volume, in cm^3 , of $0.1 \text{ mol dm}^{-3} \text{ MnO}_4^- (\text{aq})$ is required to reach the equivalence point in the titration of 20.00 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ Fe}^{2+} (\text{aq})$?

- A. 2.00
- B. 4.00
- C. 20.00
- D. 100.00