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VCE Chemistry ¾
Spontaneous Redox Reactions [1.7]
Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing

Results:

Test	_____ / 15
Extension	_____ / 5

Section A: Test (15 Marks)

Question 1 (4 marks)

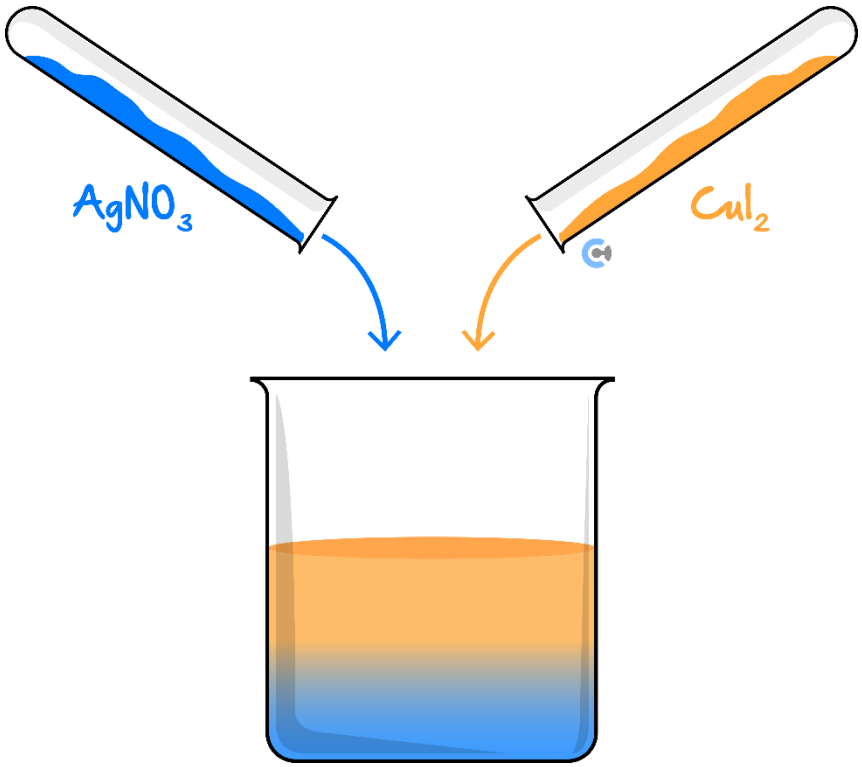
Tick whether the following statements are **true** or **false**.

	True	False
a. Spectator ions do not need to be included in net ionic equations.	✓	
b. In the electrochemical series, every reaction is an oxidation reaction when read backwards.	✓	
c. A spontaneous reaction is defined as one that will take place when heated up gently.		✓
d. Solid metals are typically found on the right side of the electrochemical series.	✓	
e. When there are multiple oxidants and reductants present, they will react simultaneously with one another.		✓
f. Direct spontaneous redox reactions are separated and in turn, produce electricity.		✓
g. The electrochemical series is designed so that the reaction with the most negative E^0 is at the top.		✓
h. The electrochemical series does not predict how quickly any reaction will occur, regardless of how strong the oxidant and/or reductant is.	✓	

Space for Personal Notes

Question 2 (6 marks)

Abigail is investigating chemical reactivity. To do so, she mixes together two solutions, silver nitrate and copper (II) iodide, as shown below:



a. Explain why a spontaneous redox reaction will take place, with reference to oxidant strength. (1 mark)

Because the strongest oxidant, $Ag^+(aq)$ is stronger than the conjugate oxidant of $I^-(I_2)$, so it is above it in the electrochemical series.

b. Write out the:

i. Reduction half-equation. (1 mark)

$$Ag^+(aq) + e^- \rightarrow Ag(s)$$

ii. Oxidation half-equation. (1 mark)

$$2I^-(aq) \rightarrow I_2(s) + 2e^-$$

iii. Net ionic equation. (1 mark)

$$2Ag^{+}(aq) + 2I^{-}(aq) \rightarrow 2Ag(s) + I_2(s)$$

c. With reference to the way in which Abigail conducted this experiment, state the energy transformations that would take place within the beaker. (2 marks)

As she mixed the reactants in **direct contact** (**1**), heat would be produced.
Chemical energy → thermal energy (2)

Space for Personal Notes

Question 3 (5 marks)

Khushi has been told by her chemistry tutor that iron and tin are complicated metals as they can exist in multiple oxidation states.

The following information has been provided to her:

$$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq) \qquad +0.77\,V$$

$$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}(aq) \qquad +0.15\,V$$

$$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s) \qquad -0.44\,V$$

$$Sn^{2+}(aq) + 2e^- \rightleftharpoons Sn(s) \qquad -0.14\,V$$

a. State the strongest oxidant and strongest reductant. (1 mark)

Need to rearrange equations provided – strongest oxidant: Fe3+(aq); strongest reductant: Fe(s)

b.

i. If a can made out of an alloy of tin and iron was filled with $FePO_4, FeSO_4, SnCl_4$ and $Sn(OH)_2$, write out the two half-equations that would occur. (2 marks)

Oxidation: Fe(s) -> Fe2+(aq) + 2e-

Reduction: Fe3+(aq) + e- -> Fe2+(aq)

ii. Hence, write the overall equation that would take place. (1 mark)

2Fe3+(aq) + Fe(s) -> 3Fe2+(aq)

c. Hence or otherwise, propose a suitable metal that the can could be made from **instead of iron and tin**, in order to effectively store the solutions of $FePO_4, FeSO_4, SnCl_4$ and $Sn(OH)_2$. (1 mark)

Silver (from the ECS) or any inert metal like gold or platinum.

Section B: Extension (5 Marks)

Question 4 (5 marks)

Justine conducted an experiment using metals A, B, C and D and solutions of their ions to determine an electrochemical series. The results of the practical are shown in the table below.

Chemicals mixed	Observation
A^+ with B	Fizzing sound
D with B^{2+}	Metal coating forms
C^{3+} with A	No reaction
C with D^{2+}	Heat released

a. List the four metals in **decreasing** reductant strength. (2 marks)

C > D > B > A

b.

i. Given metal C is aluminium and metal B is zinc, state the theoretical E^0 of the reaction involving metal D. **(**1 mark)

-1.18 (Mn)

ii. When Justine's friend, Sam, performed a similar experiment involving the same metals and their respective ionic solutions, his E^0 value did not match that expected from **part b. i.**

Suggest a reason as to why Sam's E^0 value does not align with the one found in the literature. (1 mark)

Not at SLC/not 1M concentration

c. Justine was feeling adventurous (and careless) and decided to place metal *D* (whose identity has been determined in part **b. i**. into a tub of water. Predict and justify **one observation** Justine might make. (1 mark)

$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ due to spontaneous reaction between water and Mn. The bubbles are hydrogen gas forming and pH would increase as OH^- is produced.

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