CHEMISTRY 2021

Unit 3
Key Topic Test 3 - Redox

Recommended writing time*: 45 minutes
Total number of marks available: 50 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: A

Explanation:

Nitrogen is a free element and has an oxidation number of zero while in ammonia, hydrogen has an oxidation number of +1, so nitrogen must have an oxidation number of -3.

Question 2

Answer: B

Explanation:

$Al \rightarrow Al^{3+} + 3e^-$
$Fe^{3+} + 3e^- \rightarrow Fe$
Al undergoes oxidation so acts as the reductant. Fe^{3+} undergoes reduction (is reduced).

Question 3

Answer: D

Explanation:

Difference in E^0 values = $0.45 - {}^-0.34 = 0.79$ V.

Question 4

Answer: D

Explanation:

C^{3+} is the strongest oxidant so it would react with the other 2 reductants (A and B).

Question 5

Answer: D

Explanation:

A^+ would undergo reduction (it is the stronger oxidant) and therefore decreases in concentration. B would undergo oxidation (it is the stronger reductant) and therefore increases the concentration of B^{2+}.

Question 6

Answer: A

Explanation:

OH^- is a stronger reductant than I^- and would therefore react with I_2.

Question 7

Answer: A

Explanation:

Silver is a weaker reductant than Cu so would not react with a Cu^{2+} solution.

Question 8

Answer: C

Explanation:

$Cr_2O_7^{2-}{}_{(aq)} + 14H^+{}_{(aq)} + 6e^- \rightarrow 2Cr^{3+}{}_{(aq)} + 7H_2O_{(l)}$
$7H_2O$ to balance the oxygen. $14H^+$ to balance the hydrogen. 12+ charge on the left and 6+ charge on the right, so 6 electrons on the left are required.

Question 9

Answer: D

Explanation:

$Ni^{2+}(aq) + 2e^- \rightleftharpoons Ni(s)$

$Co^{2+}(aq) + 2e^- \rightleftharpoons Co(s)$

$Cd^{2+}(aq) + 2e^- \rightleftharpoons Cd(s)$

$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$

Cobalt metal would react with Ni^{2+} but not Fe^{2+}.

Question 10

Answer: A

Explanation:

The Mg is a stronger reductant than zinc and copper, so would react with solutions of zinc and copper.

SECTION B: Short-answer questions

Question 1

a. **i.** +4
ii. +7

2 marks

b. $2H_2O_{(l)} + MnO_{2(s)} \rightarrow MnO_4^-{}_{(aq)} + 4H^+{}_{(aq)} + 3e^-$

2 marks
Total 4 marks

Question 2

a. **i.** S
ii. H_2SO_4

2 marks

b. **i.** $2H_2O + S \rightarrow SO_2 + 4H^+ + 4e^-$
ii. $H_2SO_4 + 2H^+ + 2e^- \rightarrow SO_2 + 2H_2O$

2 + 2 = 4 marks

c. $2H_2SO_4 + S \rightarrow 3SO_2 + 4H_2O$

2 marks
Total 8 marks

Question 3

a. From 0 to +3

1 mark

b. $Fe_{(s)} \rightarrow Fe^{3+}{}_{(s)} + 3e^-$

1 mark

c. $O_{2(g)} + 4e^- \rightarrow 2O^{2-}{}_{(s)}$

1 mark

d. $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

1 mark
Total 4 marks

Question 4

a. **i.** $Y \rightarrow Y^{3+} + 3e^-$
ii. $X^{2+} + 2e^- \rightarrow X$

2 marks

b. $3X^{2+} + 2Y \rightarrow 3X + 2Y^{3+}$

1 marks

c. **i.** **+**
ii. cathode

2 marks

d. **i.** Ni
ii. Al

2 marks

e. The electrochemical series is valid under standard conditions* of 1atm pressure, 25°C and using 1M solutions.*

2 marks

f. The salt bridge maintains an overall neutral charge in each cell by allowing ions to move between the two half cells. KNO_3 is a suitable chemical.

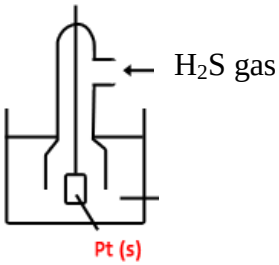
2 marks
Total 11 marks

Question 5

a. Mn^{3+}

1 mark

b. **i.** 1.43V
ii. Mn^{3+}
iii. The H_2S is bubbled over a platinum electrode.



1 + 1 + 2 = 4 marks

c. HCOOH

1 mark

d. H_2SO_3 or Mn^{2+}

1 mark

e. H_2SO_3 or Mn^{2+}

1 mark
Total 8 marks

Question 6

a. **i.** C^{2+}
ii. C

1 + 1= 2 marks

b. **i.** C^{2+}/C and A^{2+}/A
ii. C

1 + 1 = 2 marks

c. C, B, A

1 mark
Total 5 marks