Student Name: _____

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CHEMISTRY 2021

Unit 3
Key Topic Test 3 – Redox

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

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: scientific calculator, pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 10 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in **English.**

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks are **not** deducted for incorrect answers.
If more than one answer is completed for any question, no mark will be given.

Question 1

When nitrogen gas reacts with hydrogen gas to form ammonia (NH_3), the oxidation number of nitrogen changes from;

A. 0 to -3
B. 0 to +3
C. +5 to -3
D. +5 to +3

Question 2

When powdered aluminium is mixed with iron oxide and then ignited, a spectacular reaction occurs and pure iron metal is produced. The equation is;

$$2Al_{(s)} + Fe_2O_{3(s)} \rightarrow Al_2O_{3(s)} + 2Fe_{(l)}$$

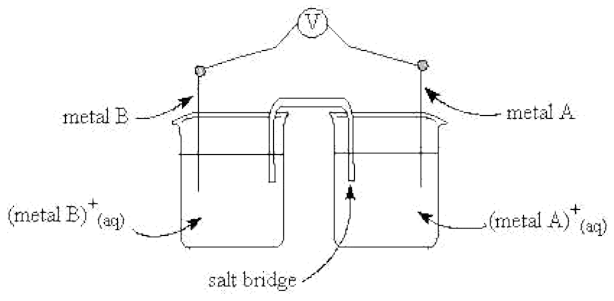
The reaction is a redox reaction where;

A. Al is reduced and Fe^{3+} is oxidised
B. Al acts as a reductant and Fe^{3+} is reduced
C. Al is oxidised and Fe is reduced
D. electrons are transferred from the Fe^{3+} to the Al

The following information applies to the next THREE questions.

The following electrochemical series does not have the half equations written in order.

Half equation	E^0value
$A^+ + e^- \rightarrow A$	0.45V
$B^{2+} + 2e^- \rightarrow B$	-0.34V
$C^{3+} + 3e^- \rightarrow C$	0.89V



Question 3

A cell is created by connecting the two half cells A^+/A with B^{2+}/B. The potential difference of the cell is;

A. 0.11V

B. 0.34V

C. 0.45V

D. 0.79V

Question 4

The only true statement below is;

A. C is the strongest reductant

B. when A is placed in a solution of B^{2+}, a coating of B is observed to form on A

C. A^+ is the strongest oxidant

D. C^{3+} would react with both A and B

Question 5

For the cell created by connecting the two half cells A^+/A with B^{2+}/B, it can be said that;

A. electrons flow through the salt bridge from metal A to metal B

B. metal A is the cathode and has a negative polarity

C. the mass of metal A would decrease and the mass of metal B would increase

D. the concentration of A^+ would decrease and the concentration of B^{2+} would increase

Question 6

A student stains their lab coat with iodine (I_2) solution. They could remove the iodine by soaking the lab coat in;

A. NaOH

B. HCl

C. H_2O_2

D. NaCl

Question 7

A student prepares a solution of copper (II) nitrate. This solution can be stored in a container made of:

A. silver

B. lead

C. nickel

D. manganese

Question 8

For the half equation, $Cr_2O_7^{2-}{}_{(aq)} + xH^+{}_{(aq)} + ye^- \rightarrow 2Cr^{3+}{}_{(aq)} + zH_2O_{(l)}$, the values of *x*, *y* and *z* are;

A. 14, 9, 14

B. 7, 6, 7

C. 14, 6, 7

D. 14, 9, 7

Question 9

A student makes a solution of 1M $FeCl_2$ and 1M $NiCl_2$ but does not label each solution. He could determine which was the nickel solution by:

A. Adding a copper strip to each solution. The copper would turn the nickel solution blue but not the iron solution.

B. Adding cobalt solution to each one. The cobalt solution would react with the nickel solution but not the iron solution.

C. Adding magnesium metal to each one. The magnesium metal would react with the nickel solution but not the iron solution.

D. Adding cobalt metal to each one. The cobalt would react with the nickel solution only and the solution would go clear.

Question 10

A magnesium strip was weighed and placed into solutions of Zn^{2+}, Li^+, Na^+ and Cu^{2+}. In which solutions would the magnesium be oxidised?

A. Zn^{2+} and Cu^{2+}

B. Li^+ and Na^+

C. Cu^{2+} only

D. Li^+ only

SECTION B- Short-answer questions

Instructions for Section B

Questions must be answered in the spaces provided in this book.
To obtain full marks for your responses you should

- Give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
- Show all workings in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.

Make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $H_2(g)$; NaCl(s)

Question 1

a. Determine the oxidation number of manganese in each of the following:

i. MnO_2 _____ **ii.** $KMnO_4$ _____

1 + 1 = 2 marks

b. Write a half equation for the oxidation of MnO_2 to MnO_4^-

_____

2 marks

Total 4 marks

Question 2

Sulfur can react with sulfuric acid according to the (unbalanced) equation;

$$S + H_2SO_4 \rightarrow H_2O + SO_2$$

a. Which species has been;

i. oxidised? _____

ii. reduced? _____

2 marks

b. Write half equations for the;

i. oxidation reaction

_____

ii. reduction reaction

_____

2 + 2 = 4 marks

c. Write a total balanced ionic equation.

_____

2 marks
Total 8 marks

Question 3

In sparklers, fine particles of iron are converted to iron oxide (Fe_2O_3).

a. How does the oxidation number of iron change in this reaction?

_____

1 mark

b. Write a half equation to represent the oxidation of iron.

_____

1 mark

c. Write a half equation to represent the reduction of oxygen gas.

_____

1 mark

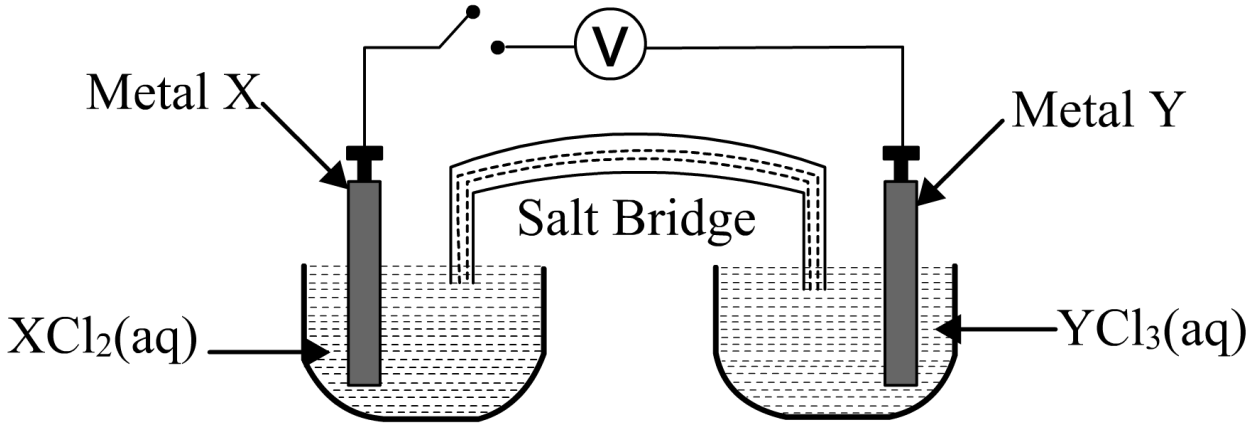
d. Write a total equation.

_____

1 mark
Total 4 marks

Question 4

A student sets up an electrochemical cell as shown below. They have been supplied with metals X and Y and 1M solutions of XCl_2 and YCl_3.



When the switch is closed a potential difference of 1.41V is obtained and the electrons move from right to left through the external circuit.

a. Write half equations in terms of x and y to show the;

i. oxidation reaction _____

ii. reduction reaction _____

1 + 1 = 2 marks

b. Write an overall equation.

_____

1 mark

c. **i.** What is the polarity of electrode X?_____

ii. Is electrode X the anode or cathode? _____

1 + 1 = 2 marks

d. Assuming that the observed potential difference of the cell is correct, suggest what the identity of metals X and Y would be.

i. Metal X _____

ii. Metal Y _____

2 marks

e. It is unlikely that the observed potential difference is the same as the theoretical potential difference. Suggest why.

_____

_____

_____

2 marks

f. The cell stops operating if the salt bridge is removed. Describe the role of the salt bridge and suggest a suitable chemical that could be used.

_____

_____

_____

2 marks
Total 11 marks

Question 5

Examine the (out of order) electrochemical series shown below;

$H_2SO_3 + 4H^+ + 4e^- \Leftrightarrow S + 3H_2O$ +0.44V
$S + 2H^+ + 2e^- \Leftrightarrow H_2S$ +0.14V
$CO_2 + 2H^+ + 2e^- \Leftrightarrow HCOOH$ -0.20V
$Mn^{3+} + e- \Leftrightarrow Mn^{2+}$ +1.57V

a. The strongest oxidant is _____

1 mark

b. When a Mn^{3+}/Mn^{2+} cell is connected to a S/H_2S half cell,

i. what is the theoretical potential difference? _____

ii. which species is acting as the oxidant? _____

iii. Describe a suitable electrode for the anode (you could use an annotated diagram)

_____

_____

_____

_____

1 + 1 + 2 = 4 marks

c. Which chemical from the electrochemical series could be used to reduce sulphur (S)?

_____

1 mark

d. Which chemical could react at the cathode when connected to a S/H_2S half cell?

_____

1 mark

e. What solution that could be used to remove H_2S when H_2S is bubbled through the solution?

_____

1 mark

Total 8 marks

Question 6

A student observes the following;

Metal A is oxidised by a solution of C^{2+}.
When a cell is constructed with A/A^{2+} and B/B^{2+}, electrons flow from A to B.
When a cell is constructed with B and C, C acts as the cathode.

a. **i**. The strongest oxidant is _____

ii. The weakest reductant is_____

1 + 1 = 2 marks

b. If half cells of each metal and its corresponding solution were set up, which combination of half cells would generate the highest potential difference and which electrode would have a positive charge?

i. Highest potential difference

_____

ii. Electrode with positive charge

_____

1+1 = 2 marks

c. Write the metals out in order of increasing reducing strength.

_____

1 mark

Total 5 marks

END OF KEY TOPIC TEST