**End of Topic 6 test**

(Chemical Reactions)

Name Mark scheme Date5/10/2022

1. This question is about the reversible reaction between two gases W and X:

2W + X ⇌ Y + Z

The forward reaction is exothermic. The reaction reaches equilibrium. Use the statements **A**, **B** or **C** to answer the following questions.

Each statement may be used once, more than once or not at all.

1. The equilibrium shifts to the left.
2. The equilibrium shifts to the right.
3. There is no change in the position of the equilibrium.

What happens if:

1. the pressure is increased?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**B**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. the temperature is reduced?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**B**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a catalyst is added?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**C**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

[Total: 3]

1. The equation shows what happens to the hydrated salt cobalt(II) chloride when it is heated.

CoCl2🢞6H2O ⇌ CoCl2 + 6H2O

1. Describe what you would observe when hydrated cobalt(II) chloride is heated in a test-tube.

\_\_**Drops of water (condensation) appear on the test tube**\_\_\_\_\_\_\_\_\_\_\_

\_\_**The colour changes from pink to blue**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [3]

1. Hydrated copper(II) sulfate also decomposes when heated.

You are provided with a blue crystal of copper sulfate. Describe how you could use it to test   
a liquid to see if it contained water.

\_\_\_\_\_**Heat the blue crystal until it turns white**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_**Add some of the liquid to the white crystal**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_**If the white crystal turns to blue again this means the liquid is water**\_\_ [3]

[Total: 6]

1. Ammonia is an important industrial chemical that is manufactured using the Haber process.

N2(g) + 3H2(g) ⇌ 2NH3(g)

The reaction is reversible and exothermic.

It does not happen at room temperature. A temperature of 450 °C is used.

1. Explain why an exothermic reaction needs a high temperature to make it happen.

\_\_\_\_**To overcome high activation energy/ to break bonds**\_\_\_\_\_\_\_ [1]

1. Use ideas about equilibrium to explain why a high temperature is a disadvantage in the   
   Haber process.

\_\_\_\_\_**The forward reaction is exothermic, so high temperature will shift the equilibrium to the left (reverse reaction) and the ammonia yield will be reduced**\_\_\_\_\_\_\_\_\_ [2]

1. An iron catalyst is used.

Explain why a higher temperature would be needed if a catalyst was not used.

\_\_\_**A catalyst lowers the activation energy**\_\_\_

\_\_\_**If a catalyst is not used, higher temperature will be needed**\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [2]

The pressure used is 20 000 kPa.

1. Give **two** advantages of using a high pressure.

\_\_\_\_\_**To speed up the reaction/ increase rate**\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_**To shift equilibrium to the right/making more ammonia**\_\_\_\_\_\_\_\_ [2]

1. Why is a higher pressure not used?

\_\_\_\_\_\_**Using high pressure increases costs/expensive equipments needed**\_\_\_

\_\_\_\_\_\_**Using high pressure is also unsafe (dangerous)/ the reaction vessel may burst**\_\_ [2]

1. Where are the raw nitrogen and hydrogen needed obtained from?
2. nitrogen

\_\_\_\_\_\_\_\_\_**From the air**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. hydrogen

\_\_\_\_\_\_\_\_\_**From water/methane/hydrocarbons**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

[Total: 11]

1. Ammonia is an important component of fertilisers.

It is used to make nitrates and ammonium compounds.

Ammonium phosphate and potassium nitrate are two important fertilisers.

Which **three** elements, essential for plant growth, do they provide?

\_\_\_\_\_**Nitrogen/N2**\_\_\_\_\_\_\_\_\_\_\_\_**Phosphorus/P**\_\_\_\_\_\_\_\_\_\_\_\_\_**Potassium/K**\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [3]

1. Use the chemical reactions **A**, **B**, **C** or **D** to answer the following questions.
2. CuO + H2 🠖 Cu + H2O **(oxidation state of H2 increased)**
3. 2Mg + O2 🠖 2MgO **(oxidation state of Mg increased)**
4. CaCO3 + 2HCl 🠖 CaCl2 + CO2 + H2O
5. CO2 + C 🠖 2CO **(oxidation state of C decreased)**
6. In which reaction is the underlined substance oxidised?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**A and B**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

**b.** In which reaction is the underlined substance reduced?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**D**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

[Total: 2]

1. Six chemical reactionsare given below.
2. 4FeO + O2 🠖 2Fe2O3
3. 4Al + 3O2 🠖 2Al2O3
4. 2H2O2 🠖 2H2O + O2
5. 2NaI + Br2 🠖 2NaBr + I2
6. 2HCl + MgO 🠖 MgCl2 + H2O
7. ZnO + C 🠖 Zn + CO

Answer the following questions. Each letter may be used once, more than one or not at all.

Give the letter **A**, **B**, **C**, **D**, **E** or **F** for the reaction thatshows:

1. a metal being oxidised

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**A and B**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a reaction that is not a redox reaction

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**E**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a non-metal acting as a reducing agent

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**F**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a reaction where a substance is both oxidised and reduced

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**C**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a metal acting as a reducing agent

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**A and B**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a substance changing its oxidation state from (II) to (III)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**A**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

1. a non-metal being reduced.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**D**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1]

[Total: 7]

1. This question is about redox reactions.

**a.** Choose from the words in the list below to complete the following passage.

**blue brown colourless iodine oxidation reduction solution**

Potassium manganate(VII) is an oxidising agent. When it reacts its \_\_**oxidation**\_ state   
changes from (VII) to (II) and its colour changes from purple to \_**colourless**\_\_.  
Potassium iodide is a reducing agent. When it reacts, it changes colour from colourless   
to \_\_**brown**\_\_ because \_\_**iodine**\_\_\_ is formed. **[4]**

**b.** What colour change would you observe if potassium manganate(VII) solution is mixed   
with potassium iodide solution?

\_\_\_\_\_\_\_\_\_\_\_\_\_**purple to brown**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [2]

[Total: 6]

1. For each of the substances listed, give the oxidation state of the underlined element.
2. Cr2O3 **+3**  
    **[1]**
3. I2 **0**  
    **[1]**
4. MnO2 **+4**  
    **[1]**
5. P2O5 **+5**  
    **[1]**
6. SO42− **+6**  
    **[1]**
7. Zn **0**  
    **[1]**

[Total: 6]

[Test total: 44]

**END OF TEST**