AQA – Oxidation, reduction and redox equations – A2 Chemistry P3

1. June/ 2020/Paper_3/No.1

0 1 This question is about emissions of oxides of nitrogen from petrol and diesel engines.

0 1 . 1 Explain how oxides of nitrogen are formed in engines.

[2 marks]

0 1 . 2 State why it is desirable to decrease emissions of oxides of nitrogen from vehicles.

[1 mark]

0 1 . 3 Modern diesel vehicles use diesel exhaust fluids, such as AdBlue, to decrease emissions of oxides of nitrogen.

AdBlue reacts with water in the hot exhaust gases to form ammonia.
In the presence of a catalyst the ammonia reacts with oxides of nitrogen to form nitrogen and water.

Give the oxidation state of nitrogen in each of NO_2, NH_3 and N_2

Complete the equation for the reaction between NO_2 and NH_3

[2 marks]

Oxidation state of nitrogen in

NO_2 _____ NH_3 _____ N_2 _____

Equation

_____ NO_2 + _____ NH_3 → _____ N_2 + _____ H_2O

0 1 . 4 Petrol vehicles have a catalytic converter which decreases emissions of oxides of nitrogen.
Platinum in the catalytic converter acts as a heterogeneous catalyst.

State the meaning of the term heterogeneous catalyst.

[2 marks]

0 1 . 5 Some carbon particulates are also formed in both diesel and petrol vehicles.

Explain why carbon particulates are formed.

[1 mark]

2. June/ 2020/Paper_3/No.11

In which conversion is the metal reduced?

[1 mark]

A $Cr_2O_7^{2-} \rightarrow CrO_4^{2-}$ ⬭

B $MnO_4^{2-} \rightarrow MnO_4^-$ ⬭

C $TiO_2 \rightarrow TiO_3^{2-}$ ⬭

D $VO_3^- \rightarrow VO^{2+}$ ⬭

3. June/ 2020/Paper_3/No.16

Which shows the major product(s) formed when chlorine reacts with cold, dilute, aqueous sodium hydroxide?

[1 mark]

A NaCl only ⬭

B NaClO only ⬭

C NaCl and NaClO ⬭

D NaCl and $NaClO_3$ ⬭

4. June/ 2020/Paper_3/No.31

What is the minimum volume, in cm^3, of 0.02 mol dm^{-3} $KMnO_4$ solution needed to oxidise 0.01 mol of VO^{2+}?

$$5VO^{2+} + MnO_4^- + H_2O \rightarrow 5VO_2^+ + Mn^{2+} + 2H^+$$

[1 mark]

A 10 ⬭

B 50 ⬭

C 100 ⬭

D 200 ⬭

5. June/ 2019/Paper_3/No.15

What is the correct observation when barium metal is added to an excess of water?

[1 mark]

A Forms a colourless solution only ⬭

B Forms a colourless solution and effervesces ⬭

C Forms a white precipitate only ⬭

D Forms a white precipitate and effervesces ⬭

6. June/ 2019/Paper_3/No.16

An aqueous solution of a salt gives a white precipitate when mixed with aqueous silver nitrate and when mixed with dilute sulfuric acid.

Which could be the formula of the salt?

[1 mark]

A $BaCl_2$ ⬭

B $(NH_4)_2SO_4$ ⬭

C KCl ⬭

D $Sr(NO_3)_2$ ⬭

7. June/2021/Paper_3/No.1(1.3-1.8)

0 1 . 3 Sodium ethanedioate is used to find the concentration of solutions of potassium manganate(VII) by titration. The equation for this reaction is

$$2\,MnO_4^- + 16\,H^+ + 5\,C_2O_4^{2-} \rightarrow 2\,Mn^{2+} + 8\,H_2O + 10\,CO_2$$

A standard solution is made by dissolving 162 mg of $Na_2C_2O_4$ (M_r = 134.0) in water and making up to 250 cm^3 in a volumetric flask.

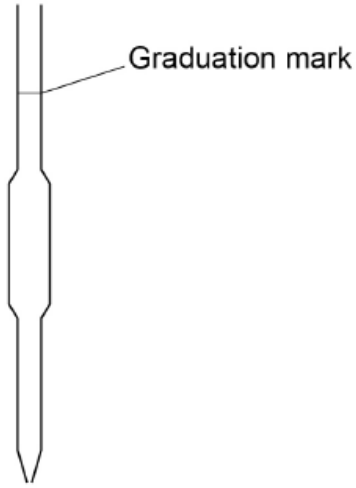
25.0 cm^3 of this solution and an excess of sulfuric acid are added to a conical flask.
The mixture is warmed and titrated with potassium manganate(VII) solution.
The titration is repeated until concordant results are obtained.
The mean titre is 23.85 cm^3

Calculate the concentration, in mol dm^{-3}, of the potassium manganate(VII) solution.

[4 marks]

0 1 . 4 **Figure 1** shows the 25.0 cm^3 pipette used to measure the sodium ethanedioate solution.

Figure 1



On **Figure 1**, draw the meniscus of the solution when the pipette is ready to transfer 25.0 cm^3 of the sodium ethanedioate solution.

[1 mark]

0 1 . 5 Potassium manganate(VII) is oxidising and harmful.
Sodium ethanedioate is toxic.

Suggest safety precautions, other than eye protection, that should be taken when:

- filling the burette with potassium manganate(VII) solution
- dissolving the solid sodium ethanedioate in water.

[2 marks]

Filling the burette _____

_____

Dissolving the solid _____

_____

0 1 . 6 State the colour change seen at the end point of each titration.

[1 mark]

_____

0 1 . 8 When $Na_2C_2O_4(aq)$ is added to a solution containing $[Fe(H_2O)_6]^{3+}$ ions, a reaction occurs in which all six water ligands are replaced by ethanedioate ions.

Explain why the replacement of the water ligands by ethanedioate ions is favourable.
In your answer refer to:

- the enthalpy and entropy changes for the reaction
- how the enthalpy and entropy changes influence the free-energy change for the reaction.

[6 marks]

8. June/2021/Paper_3/No.7

Which does **not** involve the absorption of ultraviolet radiation or visible light?

[1 mark]

A The blue appearance of copper(II) sulfate solution in daylight. ⬭

B The breakdown of ozone in the upper atmosphere. ⬭

C The ionisation of a molecule in a mass spectrometer. ⬭

D The reaction between chlorine and methane at room temperature. ⬭