2021 ASSESSMENT MATERIALS

A- level Chemistry

Inorganic Chemistry

Total number of marks: 47

0 2 The elements sodium to sulfur in Period 3 all react with oxygen to form oxides.

0 2 . 1 Give an equation and **two** observations made for the reaction that occurs when sodium is heated in oxygen.

[2 marks]

Equation _____

Observation 1 _____

Observation 2 _____

0 2 . 2 Give an equation and **one** observation made for the reaction that occurs when phosphorus is heated in oxygen.

[2 marks]

Equation _____

Observation _____

0 2 . 3 The melting points of the highest oxides of the elements sodium to sulfur are shown in **Table 2**.

Table 2

	Highest oxide of					
	sodium	magnesium	aluminium	silicon	phosphorus	sulfur
Melting point / K	1548	3125	2345	1883	573	290

Explain the increase in melting point from sodium oxide to magnesium oxide.

[2 marks]

_____

_____

_____

0 2 . 4 Explain why the melting point of the oxide of silicon is much higher than that of the highest oxide of phosphorus.

[3 marks]

0 3 This question is about Period 3 elements.

0 3 . 3 Explain why the atomic radius decreases across Period 3, from sodium to chlorine.

[2 marks]

0 5 This question is about some Group 7 compounds.

0 5 . 5 Solution **Y** contains **two** different negative ions.

To a sample of solution **Y** in a test tube a student adds

- silver nitrate solution
- then an excess of dilute nitric acid
- finally an excess of concentrated ammonia solution.

The observations after each addition are recorded in **Table 3**.

Table 3

Reagent added to solution Y	**Observation**
silver nitrate solution	cream precipitate containing compound **D** and compound **E**
excess dilute nitric acid	cream precipitate **D** and bubbles of gas **F**
excess concentrated ammonia solution	colourless solution containing complex ion **G**

Give the formulas of **D, E** and **F**.
Give an **ionic** equation to show the formation of **E**.
Give an equation to show the conversion of **D** into **G**.

[6 marks]

Formula of **D** _____

Formula of **E** _____

Formula of **F** _____

Ionic equation to form **E**

_____

Equation to show the conversion of **D** into **G**

_____

0 3 . 1 Explain why complexes formed from transition metal ions are coloured.

[3 marks]

The iron content of iron tablets can be determined by colorimetry.

Method:

- Dissolve a tablet in sulfuric acid.
- Oxidise all the iron from the tablet to $Fe^{3+}(aq)$.
- Convert the $Fe^{3+}(aq)$ into a complex that absorbs light of wavelength 490 nm
- Make the solution up to 250 cm^3
- Measure the absorbance of light at 490 nm with a colorimeter.
- Use a calibration graph to find the concentration of the iron(III) complex.

0 3 . 2 Calculate the energy, in J, gained by each excited electron in the absorption at 490 nm

Speed of light, $c = 3.00 \times 10^8$ m s^{-1}
Planck constant, $h = 6.63 \times 10^{-34}$ J s

[3 marks]

Energy gained by each electron _____ J

0 3 . 3 Describe how a calibration graph is produced and used to find the concentration of the iron(III) complex.

[3 marks]

_____

_____

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

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.

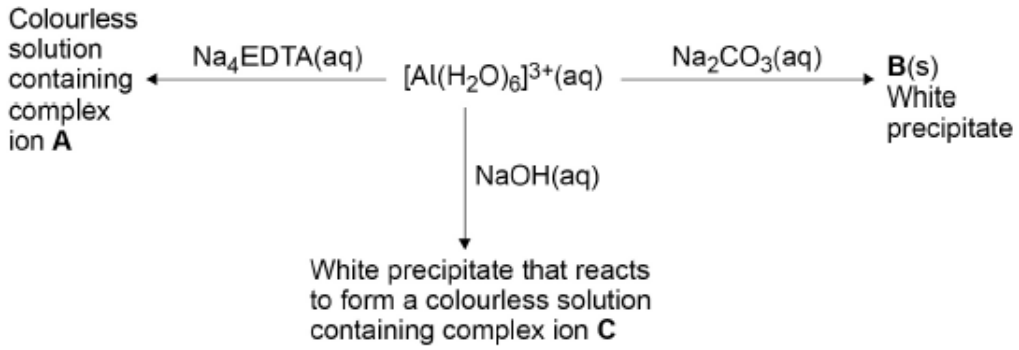
State the meaning of the term heterogeneous catalyst.

[2 marks]

_____

_____

0 5 Some reactions of the $[Al(H_2O)_6]^{3+}(aq)$ ion are shown.



0 5 . 1 Give the formula of the white precipitate **B**.

State **one** other observation when $Na_2CO_3(aq)$ is added to a solution containing $[Al(H_2O)_6]^{3+}(aq)$ ions.

Give an equation for this reaction.

[3 marks]

Formula of **B** _____

Observation _____

Equation

_____

0 5 . 2 Give the formula of the complex ion **C**.

State **one** condition needed for the formation of **C** from $[Al(H_2O)_6]^{3+}(aq)$ and $NaOH(aq)$.

Give an equation for this reaction.

[3 marks]

Formula of **C** _____

Condition _____

Equation

0 5 . 3 Deduce the formula of the complex ion **A**.

[1 mark]

_____

0 5 . 4 Explain, with the use of an equation, why a solution containing $[Al(H_2O)_6]^{3+}$ has a pH <7

[3 marks]

Equation

_____

Explanation _____

_____

1 5 In the test for a halide ion in aqueous solution, dilute nitric acid is added before the addition of silver nitrate solution.

Why is nitric acid added?

[1 mark]

A It increases the concentration of nitrate ions. ⬭

B It prevents the precipitation of silver compounds other than halides. ⬭

C It prevents the silver nitrate being precipitated. ⬭

D It provides the acidic solution required for precipitation. ⬭

1 7 Which shows the electron configuration of an atom of a transition metal?

[1 mark]

A [Ar] $4s^2 3d^0$ ⬭

B [Ar] $4s^2 3d^8$ ⬭

C [Ar] $4s^2 3d^{10}$ ⬭

D [Ar] $4s^2 3d^{10} 4p^1$ ⬭

1 8 Which will **not** act as a ligand in the formation of a complex ion?

[1 mark]

A CH_4 ⬭

B CO ⬭

C H_2O ⬭

D NH_3 ⬭

1 9 Which shows the correct oxidation state and co-ordination number of cobalt in $[Co(NH_3)_5Cl]Cl_2$?

[1 mark]

	oxidation state	co-ordination number	
A	+2	5	⬭
B	+2	6	⬭
C	+3	5	⬭
D	+3	6	⬭

2 1 Which compound decolourises acidified potassium manganate(VII) solution?

[1 mark]

A $Al_2(SO_4)_3$ ⬭

B $CuSO_4$ ⬭

C $FeSO_4$ ⬭

D $Fe_2(SO_4)_3$ ⬭

3 1 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 ⬭

1 5 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 ⬭

1 6 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 $Sr(NO_3)_2$ ⬭

1 8 What is observed when concentrated hydrochloric acid is added to an aqueous solution of $CuSO_4$ until no further change occurs?

[1 mark]

A A colourless gas is evolved and a precipitate forms. ⬭

B A colourless gas is evolved and no precipitate forms. ⬭

C A precipitate forms that dissolves in an excess of concentrated hydrochloric acid. ⬭

D The solution changes colour and no precipitate forms. ⬭