AQA – Transition metal – A2 Chemistry P3

1. June/ 2020/Paper_3/No.3

| 0 | 3 | . | 1 |

Explain why complexes formed from transition metal ions are coloured.

[3 marks]

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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 x 10^8 m s^{-1}
Planck constant, h = 6.63 x 10^{-34} J s

[3 marks]

Energy gained by each electron _____ J

1

| 0 | 3 |. | 3 |

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

[3 marks]

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| 0 | 3 |. | 4 |

The concentration of iron(III) in the solution is 4.66×10^{-3} mol dm^{-3}

Calculate the mass, in mg, of iron in the tablet used to make the 250 cm^3 of solution.

[2 marks]

Mass of iron in the tablet _____ mg

2. June/ 2020/Paper_3/No.4

| 0 | 4 |

Cisplatin, $[Pt(NH_3)_2Cl_2]$, is used as an anti-cancer drug.

| 0 | 4 |.| 1 |

Cisplatin works by causing the death of rapidly dividing cells.

Name the process that is prevented by cisplatin during cell division.

[1 mark]

_____

After cisplatin enters a cell, one of the chloride ligands is replaced by a water molecule to form a complex ion, **B**.

| 0 | 4 |.| 2 |

Give the equation for this reaction.

[2 marks]

_____

| 0 | 4 |.| 3 |

When the complex ion **B** reacts with DNA, the water molecule is replaced as a bond forms between platinum and a nitrogen atom in a guanine nucleotide.
The remaining chloride ligand is also replaced as a bond forms between platinum and a nitrogen atom in another guanine nucleotide.

Figure 1 represents two adjacent guanine nucleotides in DNA.

Complete **Figure 1** to show how the platinum complex forms a cross-link between the guanine nucleotides.

[2 marks]

Figure 1

3
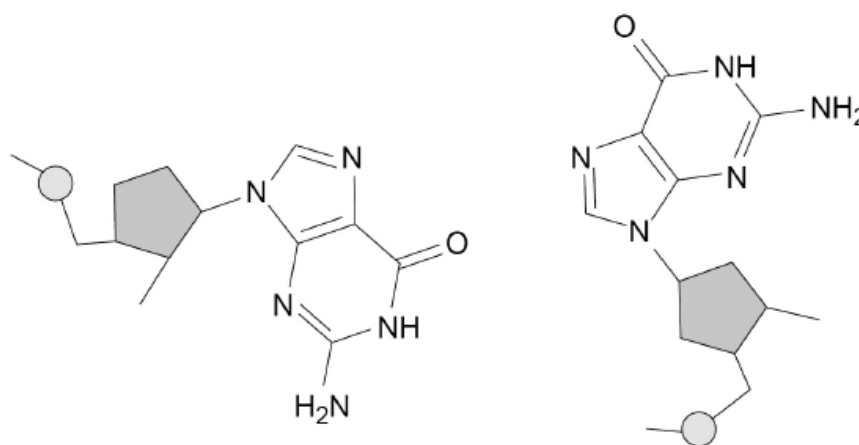
An experiment is done to investigate the rate of reaction in Question **04.2**.

0 4 . 4 During the experiment the concentration of cisplatin is measured at one-minute intervals.

Explain how graphical methods can be used to process the measured results, to confirm that the reaction is first order.

[3 marks]

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_____

In another experiment, the effect of temperature on the rate of the reaction in Question **04.2** is investigated.

Table 1 shows the results.

Table 1

Temperature T/K	$\frac{1}{T}/K^{-1}$	Rate constant k/s^{-1}	ln k
293	0.00341	1.97×10^{-8}	−17.7
303	0.00330	8.61×10^{-8}	−16.3
313	0.00319	3.43×10^{-7}	−14.9
318		6.63×10^{-7}	
323	0.00310	1.26×10^{-6}	−13.6

0 4 . 5 Complete **Table 1**.

[2 marks]

4

0 4 . 6 The Arrhenius equation can be written in the form

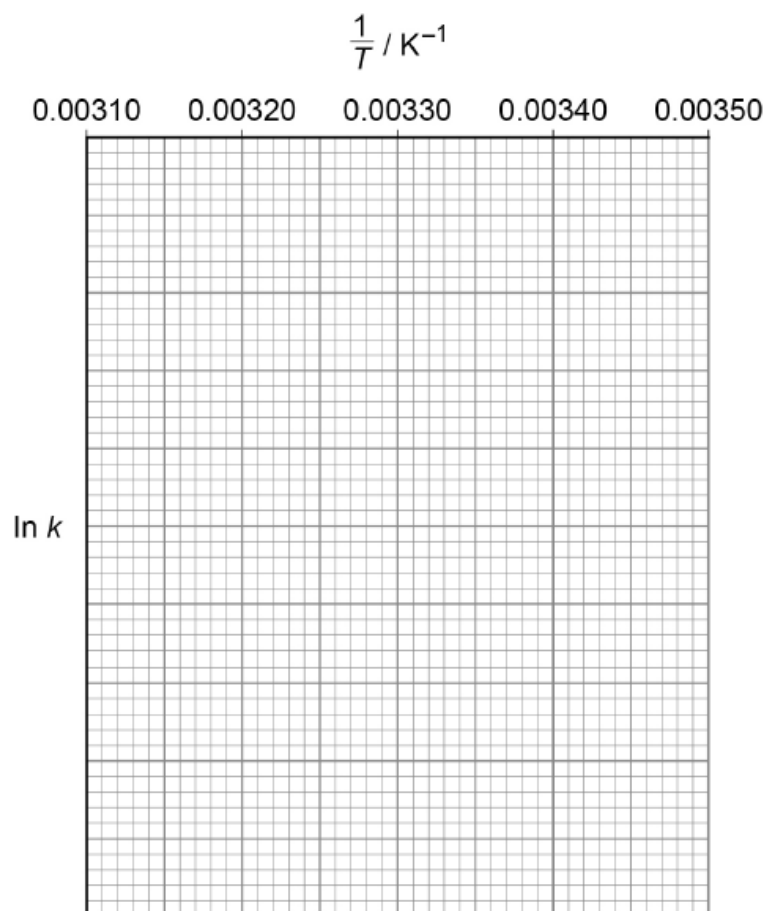$$\ln k = \frac{-E_a}{RT} + \ln A$$

Use the data in **Table 1** to plot a graph of $\ln k$ against $\frac{1}{T}$ on the grid in **Figure 2**.

Calculate the activation energy, E_a, in kJ mol^{-1}

The gas constant, $R = 8.31$ J K^{-1} mol^{-1}

[5 marks]

Figure 2

$\frac{1}{T}$ / K^{-1}

| 0.00310 | 0.00320 | 0.00330 | 0.00340 | 0.00350 |

$\ln k$

E_a _____ kJ mol^{-1}

3. June/ 2020/Paper_3/No.17

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

[1 mark]

A [Ar] $4s^23d^0$ ⬭

B [Ar] $4s^23d^8$ ⬭

C [Ar] $4s^23d^{10}$ ⬭

D [Ar] $4s^23d^{10}4p^1$ ⬭

4. June/ 2020/Paper_3/No.18

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 ⬭

5. June/ 2020/Paper_3/No.19

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	⬭

6. June/ 2020/Paper_3/No.20

Which statement is **not** correct?

[1 mark]

A $CuCl_4^{2-}$ is square planar. ⬭

B NH_4^+ is tetrahedral. ⬭

C $[Co(H_2NCH_2CH_2NH_2)_3]^{2+}$ is octahedral. ⬭

D $[Fe(H_2O)_6]^{2+}$ is octahedral. ⬭

7. June/2021/Paper_3/No.21

Which equation does **not** show the reduction of a transition metal?

[1 mark]

A $TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$ ⬭

B $2FeCl_3 + 2KI \rightarrow 2FeCl_2 + 2KCl + I_2$ ⬭

C $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$ ⬭

D $CoO + 4HCl \rightarrow [CoCl_4]^{2-} + H_2O + 2H^+$ ⬭