



CHEMISTRY ONLINE
— **TUITION** —

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CHEMISTRY

PHYSICAL CHEMISTRY II

Level & Board

AQA (A-LEVEL)

TOPIC:

TRANSITION METALS

PAPER TYPE:

QUESTION PAPER - 2

TOTAL QUESTIONS

10

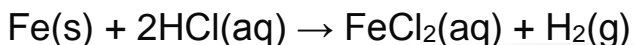
TOTAL MARKS

31

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Transition Metals - 2

1. Iron reacts with dilute hydrochloric acid to form iron(II) chloride and hydrogen.



A 0.998 g sample of pure iron is added to 30.0 cm³ of 1.00 mol dm⁻³ hydrochloric acid.

One of these reagents is in excess and the other reagent limits the amount of hydrogen produced in the reaction.

Calculate the maximum volume, in m³, of hydrogen gas produced at 30 °C and 100 kPa.

Give your answer to 3 significant figures.

In your answer you should identify the limiting reagent in the reaction.
The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

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(6)

2. Which complex exists as optical isomers?

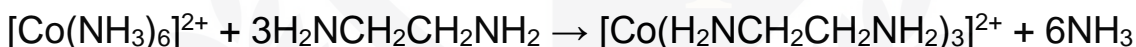
- A. $[\text{Ag}(\text{NH}_3)_2]^+$
- B. $[\text{Co}(\text{C}_2\text{O}_4)_3]^{4-}$
- C. $[\text{Cu}(\text{EDTA})]^{2-}$
- D. $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$

(1)

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

(3)

4. Which statement is correct about this reaction?



- A. The co-ordination number of cobalt decreases.
- B. The enthalpy change is large and positive.
- C. The entropy change is large and positive.
- D. The shape of the complex changes from octahedral.

(1)

5. 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 $\text{Fe}^{3+}(\text{aq})$.
- Convert the $\text{Fe}^{3+}(\text{aq})$ into a complex that absorbs light of wavelength 490 nm

- Make the solution up to 250cm³
- Measure the absorbance of light at 490 nm with a colorimeter.
- Use a calibration graph to find the concentration of the iron(III) complex.

Calculate the energy, in J, gained by each excited electron in the absorption at 490 nm

Speed of light, $c = 3.00 \times 10^8 \text{ m s}^{-1}$

Planck constant, $h = 6.63 \times 10^{-34} \text{ J s}$

(3)

6. A solution absorbs light with wavelengths corresponding to red, yellow and green light. Which ion is most likely to be in the solution?

- A. $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$
- B. $\text{Fe}^{2+}(\text{aq})$
- C. $\text{Fe}^{3+}(\text{aq})$
- D. $\text{Cu}^{2+}(\text{aq})$

(1)

7. Iodine vaporises easily.

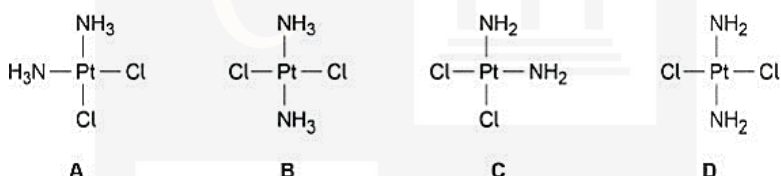
Calculate the volume, in cm³, that 5.00 g of iodine vapour occupies at 185 °C and 100 kPa

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

Give your answer to 3 significant figures.

(4)

8. Cisplatin is an anti-cancer drug.



Which structure represents a stereoisomer of cisplatin?

- A. A
- B. B
- C. C
- D. D

(1)

9. A student does an experiment to determine the percentage of copper in an alloy.

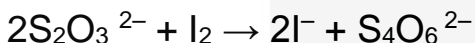
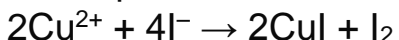
(a)

The student

- reacts 985 mg of the alloy with concentrated nitric acid to form a solution (all of the copper in the alloy reacts to form aqueous copper(II) ions)
- pours the solution into a volumetric flask and makes the volume up to 250 cm³ with distilled water
- shakes the flask thoroughly

- transfers 25.0 cm³ of the solution into a conical flask and adds an excess of potassium iodide
- uses exactly 9.00 cm³ of 0.0800 mol dm⁻³ sodium thiosulfate (Na₂S₂O₃) solution to react with all the iodine produced.

The equations for the reactions are



Calculate the percentage of copper by mass in the alloy.

Give your answer to the appropriate number of significant figures.

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(6)

(b) Suggest two ways that the student could reduce the percentage uncertainty in the measurement of the volume of sodium thiosulfate solution, using the same apparatus as this experiment.

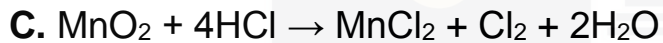
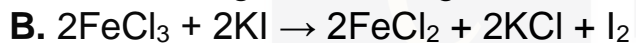
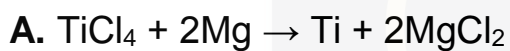
(2)

(c) State the role of iodine in the reaction with sodium thiosulfate.

(d) Give the full electron configuration of a copper(II) ion.

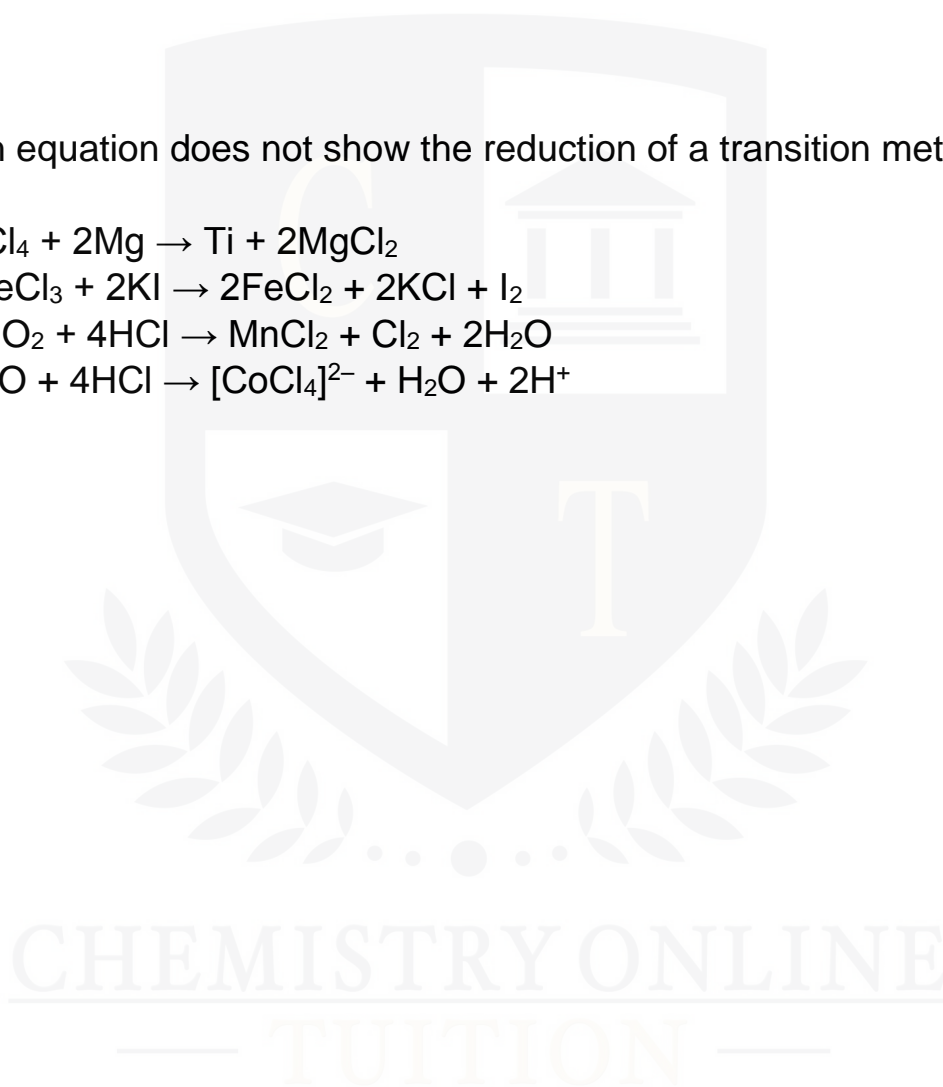
(1)

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



(1)

(1)



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