

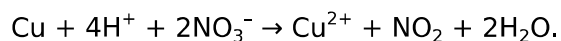
## Transition Metals and Chemistry - Questions by Topic

Q1.

Brass is a metal alloy containing copper and zinc. The presence of zinc in the alloy makes brass less malleable than copper alone.

Prince's metal is one type of brass. It is used to make imitation gold because of its yellow colour.

The copper content of brass can be analysed by first reacting a known sample of the metal with concentrated nitric acid. The reaction of the copper is:



(a) Identify the element that is oxidised and the element that is reduced in the reaction shown. Include relevant oxidation numbers.

(2)

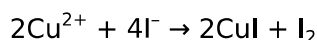
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(b) Suggest one precaution when carrying out this reaction, other than the use of gloves, goggles and lab coats, clearly stating the hazard concerned.

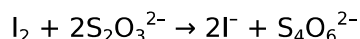
(2)

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(c) The copper ions are then reacted with excess potassium iodide.



The iodine formed is analysed by titration with sodium thiosulfate.



A 5.000 g sample of Prince's metal was analysed.

After reaction with concentrated nitric acid, the sample was diluted to 250 cm<sup>3</sup> and then 10.0 cm<sup>3</sup> aliquots or portions were titrated with 0.100 mol dm<sup>-3</sup> sodium thiosulfate solution.

The mean titre was 22.65 cm<sup>3</sup>.

Calculate the percentage of copper, by mass, in this sample of Prince's metal to an appropriate number of significant figures.

(6)

(d) In aqueous solution, copper(II) and zinc ions react differently with sodium hydroxide solution.

Describe the observations when sodium hydroxide solution is added drop by drop (until in excess) to separate samples of these two ions.

Include relevant **ionic** equations with state symbols.

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(e) Explain, in terms of electronic configurations, why copper is classified as a transition element but zinc is not.

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(f) Explain, in terms of their structures, why brass is less malleable than pure copper.

(2)

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**(Total for question = 20 marks)**

Q2.

Which is **not** a bidentate ligand?

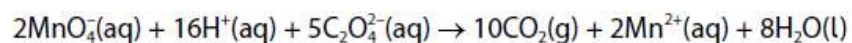
(1)

- A** ethanedioate ion,  $\text{C}_2\text{O}_4^{2-}$
- B** ethanoate ion,  $\text{CH}_3\text{COO}^-$
- C** 1,2-diaminoethane,  $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
- D** 2-aminoethanoic acid,  $\text{NH}_2\text{CH}_2\text{COOH}$

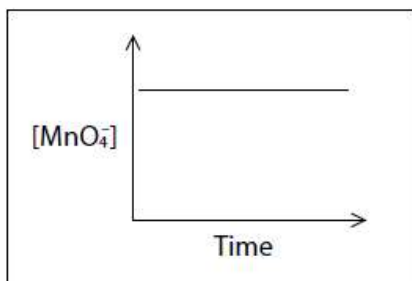
**(Total for question = 1 mark)**

Q3.

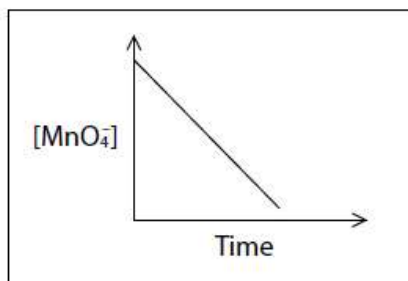
Which sketch shows the change in concentration of manganate(VII) ions with time in the reaction?



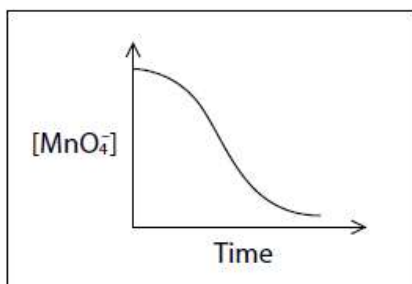
**A**



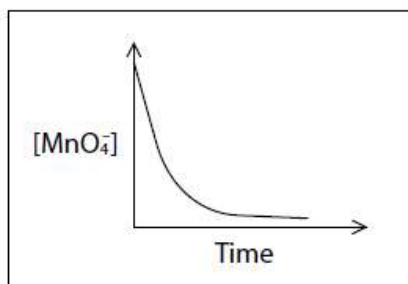
**B**



**C**



**D**



**(Total for question = 1 mark)**

Q4.

This question is about complex ions.

(a) Which complex ion is square planar?

(1)

- A**  $[\text{Cu}(\text{H}_2\text{O})_2(\text{NH}_3)_4]^{2+}$
- B**  $[\text{CuCl}_4]^{2-}$
- C**  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- D**  $[\text{Ag}(\text{NH}_3)_2]^+$

(b) Which copper complex ion is colourless?

(1)

- A  $[\text{CuCl}_2]^-$
- B  $[\text{CuCl}_4]^{2-}$
- C  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$
- D  $[\text{Cu}(\text{H}_2\text{O})_2(\text{NH}_3)_4]^{2+}$

(c) Which complex ion includes a bond angle of  $107^\circ$ ?

(1)

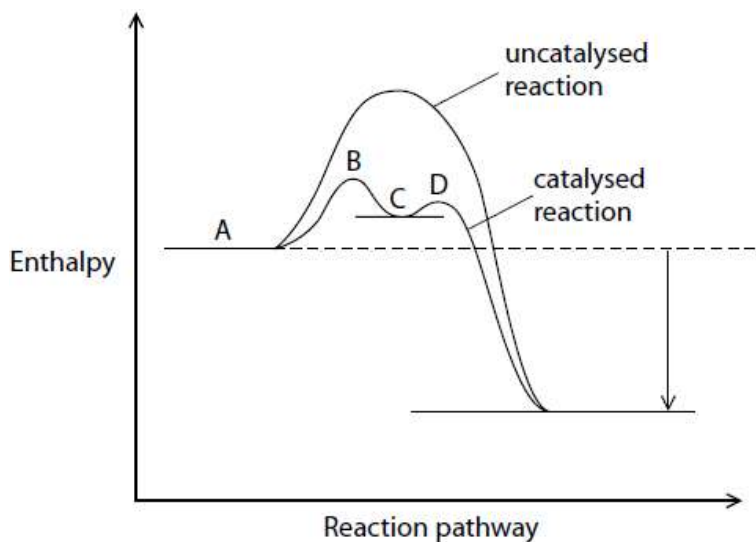
- A  $[\text{Cr}(\text{NH}_3)_6]^{3+}$
- B  $[\text{CuCl}_2]^-$
- C  $[\text{CuCl}_4]^{2-}$
- D  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$

**(Total for question = 3 marks)**

Q5.

In homogeneous catalysis, the catalyst is in the same state as the reactants.

(a) The enthalpy profile diagram for a homogeneously catalysed reaction is

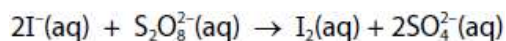


Which label indicates the intermediate species?

(1)

- A
- B
- C
- D

(b) Iodide ions can be oxidised by peroxodisulfate(VI) ions in the reaction shown.



What property of iron(III) ions enables them to act as homogeneous catalysts for this reaction?

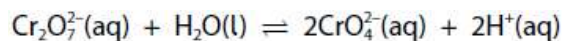
(1)

- A they can be oxidised and then reduced
- B they can gain and then lose electrons
- C they provide an effective surface for reaction to occur on
- D they can form complex ion intermediates with a lower activation energy

**(Total for question = 2 marks)**

Q6.

Which reagent will be **most** effective at shifting the equilibrium towards the chromate(VI) ions?



(1)

- A hydrochloric acid
- B sulfuric acid
- C sodium hydroxide
- D water

**(Total for question = 1 mark)**

Q7.

Which vanadium ion is yellow in aqueous solution?

(1)

- A**  $\text{VO}^{2+}$
- B**  $\text{VO}^{2+}$
- C**  $\text{V}^{3+}$
- D**  $\text{V}^{2+}$

**(Total for question = 1 mark)**