

Mysterious Metal

Metal **M** is a metal that was predicted by Mendeleev in his original periodic table, before its actual discovery. Though it does not occur naturally, it is used in many medical applications, and also possesses a wide chemistry.

Metal **M** was first synthesized from metal **N**. Boiling **N** in H_2O_2 and dilute NH_3 formed a solution of anion **A**, containing 59.98% **N**. **A** gradually undergoes beta decay to form anion **B** containing metal **M** in an oxidation state higher than that of metal **N** in compound **A**. 8-hydroxyquinoline was added to precipitate the remaining **A**. Then, the solution was filtered and boiled off, and the resulting solid was reduced with a stream of H_2 gas at high temperature to form **M**.

Upon heating **M** in a chlorine atmosphere, binary compound **C** is formed. Compound **C** has a polymeric structure in which there are two bridging ligands per atom of **M**. Upon further heating, **C** first decomposes into compound **D**, then compound **E**. If compound **C** is instead dissolved in HCl/KCl , then a solution containing anion **F** is formed. Mild reduction of **F** yields anion **G** in which **M** has a +3 oxidation state and contains an **M-M** quadruple bond. Further reduction results in anion **H**, in which there is an **M-M** bond with bond order 3.5. Anions **G** and **H** have almost exactly the same mass.

In both compound **C** and anion **F** the coordination number of **M** is 6.

1. Identify metals **M** and **N**, as well as anions **A**, **B**, **F**, **G**, **H** and compounds **C**, **D**, **E**. Draw the structure of compound **C**.

A	B	C
D	E	
F	G	
H	M	N

2. Despite the higher bond order, compound **G**'s **M-M** bond is actually slightly longer (3 pm) than that of compound **H**. Explain this observation.