**Investigation - Analytical Chemistry – Part A Marking Key**

**Practical tasks - Identifying Ions in Solutions**

**Task One:** The unknown cation is Fe3+ [1 mark]

Addition of NaOH [1 mark]

Produces an orange precipitate [1 mark]

Fe3+(aq) + 3 OH−(aq) → Fe(OH)3(s) [1 mark]

**Task Two:** The unknown anion is SO42− [1 mark]

When tested with red litmus [1 mark]

No colour change is observed [1 mark]

Addition of Ba(NO3)2 [1 mark]

Produces a white precipitate [1 mark]

SO42−(aq) + Ba2+(aq) → BaSO4(s) [1 mark]

**Task Three:** The unknown cation is Mg2+ [1 mark]

Addition of small volume of NaOH [1/2 mark]

Produces a white precipitate [1/2 mark]

Excess NaOH added [1/2 mark]

The precipitate remains [1/2 mark]

Mg2+(aq) + 2 OH−(aq) → Mg(OH)2(s) [1 mark]

Addition of H2SO4 [1 mark]

No precipitate is formed [1 mark]

(showing ion is Mg2+ rather than Ba2+)

**Task Four:** The unknown anion is NO3 −[1 mark]

When tested with red litmus no change [1 mark]

Addition of barium nitrate no change [1 mark]

Addition of silver nitrate no change [1 mark]

**Task Five:** The cation present is Cu2+ [1 mark]

The anion present is Cl− [1 mark]

**Test for anion**

When tested with red litmus [1/2 mark]

No colour change is observed [1/2 mark]

Addition of Ba(NO3)2 [1/2 mark]

No precipitate is formed [1/2 mark]

New sample with AgNO3 added [1/2 mark]

A white precipitate is formed [1/2 mark]

Cl-−(aq) + Ag+(aq) → AgCl(s) [1 mark]

**Test for cation**

Addition of a small volume of NaOH [1/2 mark]

Produces a blue precipitate [1/2 mark]

Cu2+(aq) + 2OH- (aq) → Cu(OH)2(s) [1 mark]

**Task Six**

No effect on red litmus − not basic − not OH−, CO32−

No reaction with aqueous barium nitrate − not SO42−

No reaction with aqueous silver nitrate − not Cl−, I−

Therefore anion must be NO3− (no equations since no reactions) [1 mark]

A white precipitate formed when a small volume of aqueous sodium hydroxide was added −

Must be Al3+, Zn2+, Pb2+ , Mg2+ or Ba2+ [1 mark]

A white precipitate formed with dilute sulfuric acid −

Must be Ba2+ or Pb2+  [1 mark]

A yellow precipitate formed with aqueous sodium iodide −

Cation must be Pb2+  [1 mark]

Pb2+(aq) + 2 OH- (aq) → Pb(OH)2(s) [1 mark]

Pb2+(aq) + SO42−(aq) → PbSO4(s) [1 mark]

Pb2+(aq) + 2I-(aq) → PbI2(s) [1 mark]