OCR (A) Chemistry GCSE

PAG 7 (chemistry) / PAG C4 (combined science): Production of salts

Notes

Prussian Blue Investigation

Aim

To produce a pure dry sample of Prussian blue and investigate the paints made from the salt.

Equipment list

- 10 cm^3 measuring cylinder
- 100 cm^3 beaker
- Glass rod
- Deionised water
- Dropping pipette
- 100 cm^3 conical flask (x4)
- Filter paper
- Funnel
- Spatula
- Watch glass
- Marker pen
- Pestle and mortar
- Digital balance
- Weighing boats (x6)
- Paintbrush
- Card
- Access to a drying box

Chemicals required

- Hydrated iron(II) sulfate(VI) solid
- Potassium hexacyanoferrate(III) solid
- Propanone
- Three binding agents (egg yolk, linseed oil, 50% PVA)

Method

Preparing the solutions:

1. Weigh 4.0 g of iron(II) sulfate(VI) into a conical flask. Label this flask A.
2. Using a measuring cylinder, add 8 cm^3 of deionised water to flask A. Swirl until the solid has dissolved.
3. Weigh 2.0 g of potassium hexacyanoferrate(III) into another conical flask labelled B.
4. Add 6 cm^3 of deionised water to flask B using a measuring cylinder. Swirl until the solid has dissolved.

Making the Prussian blue:

5. Using a dropper pipette, add the solution B to flask A drop by drop, swirling continuously.

Separating the Prussian blue solid:

6. Place the filter paper in a funnel and place the funnel over a clean conical flask.
7. Add 10 cm^3 of deionised water to flask A, swirling to mix.

8. Pour the mixture from flask A through the filter paper. Wash any solid left in flask A with deionised water and pour this into the funnel. Leave the solution until no more water runs through the funnel.

Drying the Prussian blue

9. Transfer the damp Prussian blue from the filter paper to a small beaker, using a spatula.
10. Add 10 cm^3 of propanone to this beaker and use a glass rod to stir the mixture.
11. Measure the mass of a piece of empty filter paper.
12. Using filter paper and a funnel over a conical flask, filter this new mixture similarly to step 8. Leave until no more propanone comes through the filter paper.
13. Once filtered, place the filter paper with the solid onto a watch glass.
14. Leave the watch glass until the solid is fully dried. This can be sped up using a drying oven.
15. Once dry, measure the mass of the filter paper with the Prussian blue on it.

Investigating the use of Prussian blue in paint:

16. Scrape the dried Prussian blue solid into the mortar. Grind it into a powder using a pestle.
17. Add a sample of the powder into a weighing boat.
18. Add a few drops of a binding agent to the weighing boat. Mix with a wooden splint. Repeat until a thick paint is produced.
19. Using a paintbrush and some card test the properties of the paint e.g. drying time/pigmentation/how well it adheres to the card. Record observations in a table.
20. Repeat steps 17-19 using the other binding agents and compare the results.

Key points

- The formula for Prussian blue is $Fe_4[Fe(CN)_6]_3$
- Prussian blue is a dark blue pigment which will colour surfaces and skin.
- To make the comparison between binding agents fair, the same mass of Prussian blue and volume of binding agent should be used.
- The filtration of the solid may take a while for all the water to drip through so this process could be sped up using a Büchner funnel over a conical flask.

Safety Precautions

- Iron(II) sulfate(VI) is an irritant so only handle it with a spatula. Wash hands immediately if it comes into contact with the skin.
- Potassium hexacyanoferrate and Prussian blue release a very toxic gas when they come into contact with acid. Make sure there are no acids in the lab and do not heat the solids with a flame.
- Propanone is very flammable so keep away from naked flames while carrying out the experiment. Keep the room well ventilated.
- The egg yolk binder should not be used if anyone is allergic to egg.

Analysis of Results

The mass of Prussian blue produced can be recorded and from this, the percentage yield can be calculated.

$$\text{Percentage yield} = \frac{\text{Yield}}{\text{Theoretical yield}} \times 100$$

The results from using the different binders can also be compared using a table similar to the one below:

Binding agent	**Egg yolk**	**50% PVA**	**Linseed oil**
Drying time	*e.g. Quick*		
Ease of mixing	*e.g. Good*		
Ease of painting	*e.g. Good*		
Pigmentation	*e.g. Poor*		
Colour distribution	*e.g. Poor*		
Ranking as binding agent (1 = best)			