National 5 Chemistry – Question Paper 2017

Question 6

A student wanted to investigate whether copper could be used as a catalyst for the reaction between zinc and sulfuric acid.

$$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$$

Using your knowledge of chemistry, suggest how the student could investigate this. 3

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 6

Many candidates had difficulty using their knowledge of chemistry to suggest how a student could investigate whether copper could be used as a catalyst for the reaction between zinc and sulfuric acid.

Many candidates listed physical and chemical properties of copper and/or did not refer to the reaction specified in the question.

Candidate A

- The student could first try the reaction without copper and then again with to see if the reaction happens faster.
- As a catalyst speeds up a reaction.
- If copper was a catalyst it would not be used up during the reaction.

Candidate B

Repeat the experiment using copper and without copper, keep all other vanables the same so it is faur, if the reaction is faster when using copper it is a catalyst.

If it is a catalyst it will speed it up but will not be used up.

Candidate C

the student could add a ~~select~~ piece of copper to each solution and see if any reactions happen like, fizzing, change in colour, change in temperature or combustion, Then that will tell the student that the copper is speeding put the reaction but if that doesnt happen then the student will know that it doesnt work

Candidate D

Student could -
Carry out the reaction with copper being used and calculate the reaction rate using = $\frac{\Delta \text{ quantity}}{\Delta t}$
they could then plot the results of a line graph

The student should repeat this experiment at least three times to have reliable results.

The student could then carry out this experiment again except ~~including~~ without the copper. Again calculating ~~the~~ rate and then plotting results on the same graph as the previous results. Making sure there was an appropriate scale. Therefore, allowing a direct comparison between the reaction with and with out copper ~~allow~~ allowing the student to investigate if copper had ~~has~~ an effect on reaction times.
A catalyst is used to speed up reactions
The student would need to ensure both experiments were done under the same conditions for a fair comparrison

Candidate E

Could look at the reactivity series (electro-chemical series) to see how reactive copper is. They could see how soluble copper sulfate is which it is very soluble. Copper also has a density of 8.96 gcm^{-3}, whereas zinc has 7.14 gcm^{-3} and sulphur has a density of 2.09 gcm^{-3}. Copper also has a higher melting point (1085°C) than zinc (420°C) and sulfur (119°C)

The temperature of when copper would turn into a gas is higher with a boiling point of 2562°C than zinc (907°C) and sulfur (445°C) meaning if heated it would not be used up in a reaction.

As copper is less reactive than zinc this means it won't be used up in the reaction. Could also add copper to one test and repeat the test again but without the copper. If the experiment with the copper is quicker and if it isn't used up then it could be used as a catalyst.

[Turn over

Candidate F

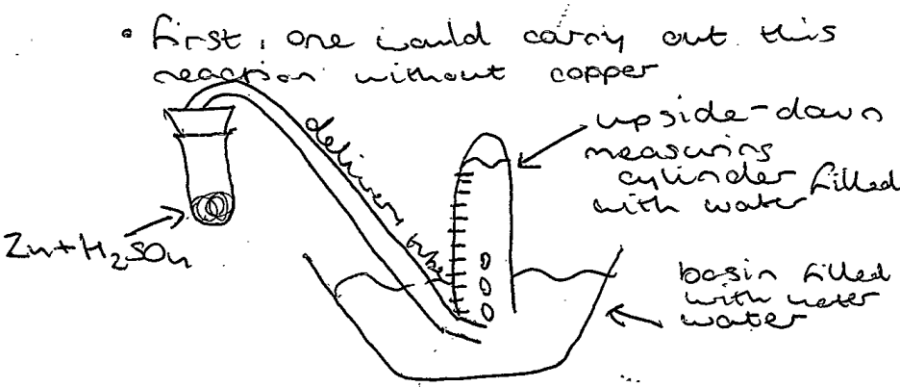
- Zinc displaces Copper because it is higher in the electrochemical series
- A catalyst never used up so you could test if any changes were made to the copper catalyst

Candidate G

Firstly the student could add copper to the reaction and see if it is used up as all ~~catalyst~~ catalysts aren't used during the reaction. Secondly the student could test the rate of reaction before adding the copper using the formula rate = $\frac{\Delta \text{Quantity}}{\Delta \text{Time}}$ then after ~~test~~ with copper to see if the rate increased. If ~~it~~ the copper isn't used during the reaction and it ~~isn't~~ it speeds up the reaction it is a catalyst.

Candidate H

- first, one could carry out this reaction without copper



- As the Zn + H_2SO_4 react, hydrogen gas is produced, this hydrogen then travels down the delivery tube and collects in the measuring ~~cylinder~~ ~~tube cylinder~~ tube.
- As the gas collects, the water level will ~~dec~~ decrease - one should measure how much it decreases over a certain period of time

$$\Rightarrow \text{Average Rate} = \frac{\Delta \text{volume}}{\Delta \text{time}}$$

CONTINUED ON ADDITIONAL SPACE

Q6) - One should then do this ~~react~~ experiment once more, introducing copper. If you conduct the average rate calculation once more, and the average rate has increased, then copper may be used as a catalyst in the reaction of zinc with sulfuric acid. *

- Additionally, if the student wishes to further increase the rate of reaction, they may try decreasing the particle sizes (using powder), heating it up, or increasing the concentration of the ~~acid~~ acid

* In addition, the iron should still remain at the end as catalysts aren't used up in the reaction.

Candidate I

- Copper won't react with the acid so it won't get used up during the reaction, since it is lower than lead on the reactivity series.
- Copper has a higher melting and ~~boiling~~ boiling point than zinc so if heated wouldn't get used up.

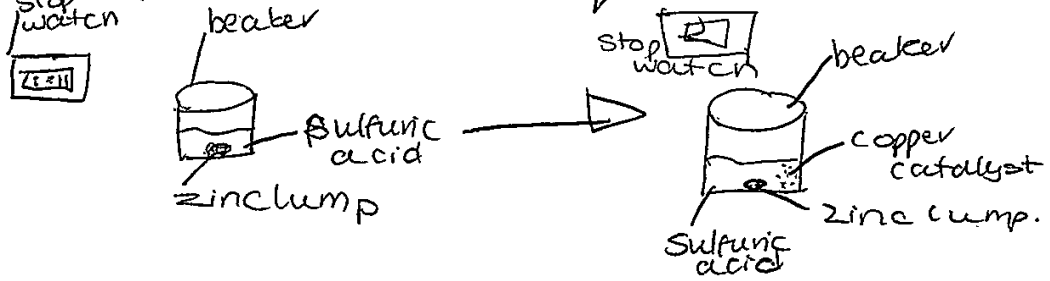
Candidate J

He would first perform the reaction without copper multiple times and then he would perform the reaction with copper multiple times. He would then compare the results.

If the reaction with copper was faster than it acted as a catalyst.

Candidate K

The student could set up an experement with zinc and sulfuric acid. he could put a lump of zinc in the acid and time how long it takes for the reaction to occur. He could repeat that a few times to make sure it's accurate. He could then put the copper in as a catalyst and repeate the experement, (keeping all variables the same) and then time it to see if the reaction was quicker or not.



The student could also try it with zinc powder and see if the reaction is any quicker, however, the student must remember that with powder the reaction will be quicker anyway as in powder the structure has been broken up and there for the reaction is quicker.

National 5 Chemistry – Question Paper 2017

Question 15

A student was given two solutions of sodium carbonate, one solution with a concentration of 0·1 mol l^{-1} and the other with a concentration of 0·2 mol l^{-1}.

Using your knowledge of chemistry, suggest how the student could distinguish between the solutions. 3

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 15

Most candidates had difficulty using their knowledge of chemistry to describe how a student could distinguish between two solutions; 0·1 mol l^{-1} sodium carbonate solution and 0·2 mol l^{-1} sodium carbonate solution. Common incorrect answers referred to reacting the solutions with a base or a metal and comparing the rate of the reaction.

Candidate A

Carry out a titration with an ~~solution~~ acid of a known concentration.

$n = c \times v$

or

Carry out 2 experiments ~~and~~ with the same conditions apart from the concentration, the experiment with a faster rate of reaction has a greater concentration.

Candidate B

the student could do titration on both solution and see which one changes first and which ever one changes first is the lowest concentration.

Candidate C

$c^N v$

$Na_1 CO_3$ $n = cv$

$_1 \quad _2$ concentration = $\frac{\text{number of moles}}{\text{volume}}$

Na_2CO_3

Sodium carbonate is very soluble

It is an ionic bond as Sodium is a metal and carbon and oxygen are non-metals. They form an attraction of positive and negative ions.

Sodium carbonate will conduct in a solution as the ions are free to move.

Sodium carbonate is a salt

so you could heat the solution in an evapourating basing with a bunsen burner to be left with the salt crystals. Therefore the basin with more salt crystals should bowed be more concentrated.

Candidate D

- metal carbonate = salt + water + carbon dioxide
- $C = \frac{n}{V}$
- alkaline.
- To distinguish between them you could add lime water to each and check which one is more milky as carbon dioxide reacts with it & turns lime water milky
- Sodium carbonate is also an alkaline substance, therefore you could add universal indicator/use pH paper/use a pH meter to test which one is more alkaline. The more heavily concentrated solution will turn a darker shade of purple with universal indicator and pH paper and the pH reading would be closer to 11 on the pH meter.

Candidate E

If you ~~wanted~~ test each solution with lime water, the one which would turn more cloudy would have a higher concentration. If you calculate the speed of the reaction, the quicker one would also have a higher concentration as that speeds up a reaction. Sodium carbonate is also very soluble, the one that dissolves quicker in water is the one with the higher concentration. If using a flame test to determine which solution is which, the flame with more sodium would turn a brighter yellow.

Candidate F

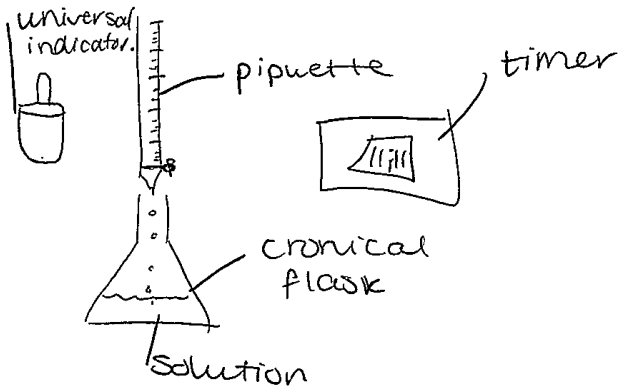
- The student could react them both with magnesium and the faster reaction would be 0·2 mol l^{-1}
- This is because the concentration of the solution is higher which speeds up the reaction
- The formula for the rate of reaction is

$$\text{rate of reaction} = \frac{\text{change in volume/mass}}{\text{change in time}}$$

- Sodium carbonate is a very soluble solution in water
- $Na_2(CO_3)$ is the chemical formula for sodium carbonate
- Solution 1 would react slower than solution 2

Candidate G

The student could do a titration experement with both the solutions and the one ~~was~~ that changes quickest is the 0·1 mol^{-1}.



Candidate H

- Test them both with an acid. Whichever neutralises the acid the most (turns universal indicator the greenest) has the higher concentration of sodium carbonate.
- Burn the solutions. Whichever has the flame colour which is the brightest yellow has the higher concentration of sodium carbonate.
- Test them both with lime water. The one which turns the lime water the most cloudy has more carbon, therefore has the higher concentration of sodium carbonate.
- Test them both with water. Whichever is the most reactive has the higher concentration of sodium carbonate.

Candidate I

the student could carry out a titration and use the formula $PVC = PVC$ to distinguish between the solutions.

Candidate J

The students could do a titration to distinguish the different solutions. First, they should fill ~~an volumetric~~ conical flasks with the two seperate 1 exact same concentration and volume of an acid eg. 50cm³ of 1 mol l⁻¹ sulfuric acid. Next, clean 2 burettes with de-ionised water to prevent contamination which may effect the results and add ~~each~~ one solution into each burrette. Before doing this, ensure you clamp down each burrette using a clamp stand. Place the conical flask filled with acid under ~~the~~ a burrette filled with ~~the~~ a solution and add indicator to the conical flask as it will tell you when the reaction is completed. Slowly release the solution in ~~the~~ conical flask and whisk slowly so that they mix and react. Upon the acid turning from red (pH<7) to almost green (pH ≈ 7) begin to stop the solution and let it trickle until the acid becomes neutral. Repeat this process with the other solution. You can then note down the amount of solution used. Using your formula $c = \frac{n}{v}$, you can determine the ~~solutions~~ concentration of each solution.

Candidate K

They could perform a neutralisation reaction. The solution that requires more alkali is the solution that ~~is~~ is 0·2 mol l^{-1}.

Candidate L

The solution with concentration 0·2 mol l^{-1} would react faster

Candidate M

- the students could titrate the solution seperately to find out which of the students required more acid to become neutral (reach ph 7).

Candidate N

- The higher the concentration the ~~[illegible]~~ faster it will react. So the 0.2 mol l^{-1} would react faster than the 0.1 mol l^{-1} if added to something.
- Could test the pH of the solutions as sodium carbonate is a base which is an alkali meaning it would have a pH above 7 and the 0.2 mol l^{-1} would be the stronger, higher one.

Candidate O

(1) = 0.1 mol L^{-1}

(2) = 0.2 mol L^{-2}

- The Student could lable them