FOKUS KIMIA 2014

Paper 3

Structure

• Reactivity Group 1 with water
• Coagulation of latex

Essay

• Heat of Combustion
• Vulcanized Rubber and Unvulcanised Rubber
• Soap and Detergent in Hard Water
[SPM2010-01] Table 1.1 shows three experiments to investigate the reactivity of Group 1 elements with water. The pH value of the solution formed is measured using pH meter.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Observation during reaction</th>
<th>pH meter reading of the solution after reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td><img src="image1.png" alt="Image" /> 13.0</td>
</tr>
<tr>
<td>II</td>
<td></td>
<td><img src="image2.png" alt="Image" /> 13.1</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td><img src="image3.png" alt="Image" /> 13.0</td>
</tr>
</tbody>
</table>

Table 1.1

(a) Record the pH value of

Experiment I : .................................................................

Experiment II : .................................................................

Experiment III : .................................................................
(b) State the observations during the reaction in Experiment I, Experiment II and Experiment III in table 1.2. [3M]

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2

(c) State three inferences from the experiment II. [3M]

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...................................................................................................................................................
...................................................................................................................................................

(d) State one hypothesis for this experiment. [3M]

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...................................................................................................................................................
...................................................................................................................................................

(e) State the operational definition for the reactivity of Group 1 elements. [3M]

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...................................................................................................................................................
...................................................................................................................................................
(f)(i) Arrange the three elements in ascending order of reactivity. [3M]

(ii) Explain the answer in 1(f)(i) based on atomic size. [3M]

[g] Rubidium is placed below potassium in Group 1 of The Periodic Table of Elements. Predict three observations from the reaction of rubidium with water. [3M]

(i). ........................................................................................................................................

(ii). ........................................................................................................................................

(iii). ........................................................................................................................................
Diagram 1 shows three sets, Set I, Set II and Set III, of the apparatus set-up for an experiment to investigate the effect of ethanoic acid and ammonia solution on the coagulation of latex.

<table>
<thead>
<tr>
<th>Set</th>
<th>Apparatus set-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><img src="image1" alt="Diagram of Set I" /></td>
</tr>
<tr>
<td></td>
<td>Beaker</td>
</tr>
<tr>
<td></td>
<td>Latex + ethanoic acid</td>
</tr>
<tr>
<td>II</td>
<td><img src="image2" alt="Diagram of Set II" /></td>
</tr>
<tr>
<td></td>
<td>Beaker Bikar</td>
</tr>
<tr>
<td></td>
<td>Latex + ammonia solution</td>
</tr>
<tr>
<td>III</td>
<td><img src="image3" alt="Diagram of Set III" /></td>
</tr>
<tr>
<td></td>
<td>Beaker Bikar</td>
</tr>
<tr>
<td></td>
<td>Latex only</td>
</tr>
</tbody>
</table>

Diagram 1
(a) State one hypothesis based on Set I and Set II

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................................................................................................................................................................
................................................................................................................................................................

(b) Record the time taken for the latex to coagulate in Set I and Set III.

Set I : ..................................................................................................................................................

Set III : ...................................................................................................................................................

(c) Construct a table to record the time taken for coagulation in Set I and Set III.


(d) State One observation that can be obtained from each set of this experiment.

Set I : ..................................................................................................................................................
..........................................................................................................................................................

Set II : ..................................................................................................................................................
..........................................................................................................................................................

Set III : ..................................................................................................................................................
..........................................................................................................................................................
(e) State the operational definition for the coagulation of latex.

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........................................................................................................................................
........................................................................................................................................

(f) For this experiment, state:

(i) The manipulated variable : ......................................................................................
........................................................................................................................................
........................................................................................................................................

(ii) The responding variable : ....................................................................................... 
........................................................................................................................................
........................................................................................................................................

(iii) The constant variable : ...........................................................................................
........................................................................................................................................
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(g) (i) Excess hydrochloric acid added to the beaker in Set II after 2:00 p.m. What observation can be made about the latex?
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........................................................................................................................................
........................................................................................................................................

(ii) Explain the answer in 1(g)(i).
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........................................................................................................................................
........................................................................................................................................

(h) Explain why latex can coagulate without acid in Set III.
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........................................................................................................................................
........................................................................................................................................

(i) (i) Explain why the latex in Set I coagulates faster than the latex in Set III.
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........................................................................................................................................
........................................................................................................................................
(ii) The following is a list of chemical substance:

- Nitric acid
- Sodium hydroxide
- Methanoic acid
- Potassium hydroxide

Classify these substance into substances that can coagulate latex and substances that cannot coagulate latex.
Brazil, the fifth largest country in the world imports no oil, since half its cars run on alcohol fuel made from sugarcane. Diagram 3 shows an alcohol fuel station in Brazil.

Different types of alcohols produce different heat of combustions. The value of the heat of combustion is depended on the number of carbon atoms per alcohol molecule. Plan a laboratory experiment to compare the heat combustion of methanol, ethanol and propan-1-ol. [17M]

Your planning should include the following aspects:

(a) Aim of the experiment
(b) All the variables
(c) Statement of the hypothesis
(d) List of substances and apparatus
(e) Procedure of the experiment
(f) Tabulation of data
Diagram 2 shows the stretching phases of a vulcanized rubber and an unvulcanized rubber stands.

<table>
<thead>
<tr>
<th>Stretching phases</th>
<th>Length of vulcanized rubber</th>
<th>Length of unvulcanized rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>45 mm</td>
<td>45 mm</td>
</tr>
<tr>
<td>During</td>
<td>59 mm</td>
<td>60 mm</td>
</tr>
<tr>
<td>After</td>
<td>45 mm</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

Diagram 2

Plan an experiment to compare one characteristic shown in diagram 2 for both types of rubber.

Your planning should include the following aspects: [17M]

(a) Aims of the experiment  
(b) All the variables  
(c) Statement of the hypothesis  
(d) List of substances and apparatus  
(e) Procedure of the experiment  
(f) Tabulation of data
Based on observation in diagram 3, plan an experiment to investigate the effectiveness of cleansing agent X and cleansing agent Y in hard water.

Your planning should include the following aspects.

a) Aim of the experiment
b) All the variables
c) Statement of the hypothesis
d) Lists of substances and apparatus
e) Procedure for the experiment
f) Tabulation of data
(a) Experiment I : 13.0
   Experiment II : 13.1
   Experiment III : 13.0

(b) Experiment | Observation
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Lithium move slowly on water surface with white flame</td>
</tr>
<tr>
<td>II</td>
<td>Potassium move very quickly on water surface with purple flame</td>
</tr>
<tr>
<td>III</td>
<td>Sodium move quickly on water surface with yellow flame</td>
</tr>
</tbody>
</table>

(c) 1. Potassium react very vigorously with water.
   2. An alkaline solution is produced [based pH meter reading = 13]
   3. Heat is released [can feel beaker hot]

(d) Manipulated variable to responding variable
[MV] The lower the position of the metal in group 1,
[RV] the higher is the reactivity of the element with water

(e) What you do, What you see
[What you do] When a metal of Group 1 put into water and pH meter dip into the solution formed
[What you see] The brighter the flame and the pH meter show the reading

(f) (i) Lithium, Sodium, Potassium

(ii) How the size influence the reaction with water?

1. The atomic size increases from lithium to potassium
2. The force of attraction between nucleus to valence electron is weaker because of the distance is further
3. Valence electron easier to donate

(g) (i). Rubidium move on water surface with brighter purple flame
   (ii). A lot of bubbles are produced
   (iii). A colourless solution with pH 13.3 is formed
[SPM2008-01]

(a) Manipulated $\rightarrow$ Responding $\Rightarrow$ Different observation
Set I – Latex Coagulated
Set II – Latex not coagulated

[MV] When present of ethanoic acid,
[RV] latex will coagulated
[RV] latex will not coagulated

(b) Record the time taken for the latex to coagulate in Set I and Set III.
Set I : 5 minutes
Set III : 360 minutes [6 hours]

(c) Experiment | Initial | Final | Time taken/minutes
---|---|---|---
Set I | 8.00 am | 8.05 am | 5
Set III | 8.00 am | 2.00 pm | 360

(d) Set I : White solid formed in 5 minutes
Set II : White solution remain unchanged
Set III : White solid formed in 360 minutes later

(e) **What you do, What you see**
[What you do] When ethanoic acid solution was added into latex solution
[What you see] white solid formed

(f) (i) The manipulated variable : Present of ethanoic acid or ammonia solution
(ii) The responding variable : Coagulation of latex
(iii) The constant variable : latex

NOTE ::: For normal solution – MUST state VOLUME AND CONCENTRATION

(g) (i) White solid will formed.

(ii) 1. Addition of hydrochloric acid with neutralise ammonia solution first.
2. Then neutral the negative charge at protein membrane of latex
3. The neutral molecule of latex will combine one another, entangle and coagulate.

(h) 1. The air contains bacteria. The acid will produce from bacteria activity.
2. The acid produce, will neutralise the negative charge at protein membrane of latex
3. The neutral molecule of latex will combine one another, entangle and coagulate.

_Info!!_
[Bacteria attacks the protein layer on the membrane of each latex particle. The protein in converted to lactic acid]
(ii) \[ \begin{array}{|c|c|}
\hline
\text{Can coagulate latex} & \text{Cannot coagulate latex} \\
\hline
\text{Nitric acid} & \text{Sodium hydroxide} \\
\text{Methanoic acid} & \text{Potassium hydroxide} \\
\hline
\end{array} \]

[SBPtrial11-03] Sample of Answer:

(a) Aim of the experiment
To compare the heat of combustion of different alcohols/(methanol, ethanol, propan-1-ol).

(b) All the variables
\textbf{Manipulated variable: } Different type of alcohols // type of Alcohols
\hspace{1cm} // methanol, ethanol, propan-1-ol
\textbf{Responding variable: } Heat of combustion
\textbf{Controlled variable: } Volume of water // copper can // thermometer

(c) Statement of the hypothesis
\textbf{MUST MV to RV}
The higher the number of carbon atoms in the alcohol molecules, the higher the heat of combustion

(d) List of substances and apparatus
\textbf{Material: } methanol, ethanol, propan-1-ol, water
\textbf{Apparatus: } Copper can, tripod stand, thermometer, measuring cylinder, spirit lamp, weighing balance, wooden block, wind shield.

(e) Procedure of the experiment
1. 250 cm\(^3\) of water is measured and pour into a copper can.
2. The initial temperature of water is recorded.
3. The copper can is placed on a tripod stand.
4. A spirit lamp is filled with methanol and the initial mass is weighted and recorded.
5. The spirit lamp is put under the copper can and the wick of the lamp is lighted immediately.
6. The water is stirred with the thermometer until the temperature rises about 30 °C.
7. The flame is put off and the highest temperature is recorded.
8. The spirit lamp and its content is weighed immediately and the final mass is recorded
9. Steps 1 to 8 are repeated using ethanol and propan-1-ol to replace methanol
### (f) Tabulation of data

<table>
<thead>
<tr>
<th>Types of alcohol</th>
<th>Initial temperature/°C</th>
<th>Highest temperature/°C</th>
<th>Initial mass of spirit lamp/ g</th>
<th>Final mass of spirit lamp/ g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propan-1-ol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### [SPM06-02] Sample of answer

(a) Aims of the experiment
To compare the elasticity of vulcanized and unvulcanized rubber.

(b) All the variables
- **Manipulated variable**: Vulcanized rubber and unvulcanized rubber
- **Responding variable**: Change in length of rubber strip
- **Fixed variable**: Length (size) of rubber strip, mass of weight

(c) Statement of the hypothesis
Vulcanized rubber is more elastic than vulcanized rubber.

(d) List of substances and apparatus
- Substances: Vulcanized rubber strip, unvulcanized rubber strip
- Apparatus: Retort stand and clamps, Bulldog clips, metre rule, 50 g weight

(e) Procedure of the experiment
1. Measured 10 cm of natural rubber
2. Hang natural rubber strips using bulldog clips and clamp it at retort stand
3. measured the initial length of natural rubber
4. Hang a 10 g weight to the end of natural rubber and recorded the length of natural rubber
5. remove the weight and measured the length of natural rubber
6. Repeat steps 1 to 5 for vulcanised rubber.

### (f) Tabulation of data

<table>
<thead>
<tr>
<th></th>
<th>Initial length/cm</th>
<th>Length with weight/cm</th>
<th>Length after removal of weight/ cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulcanized rubber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural rubber</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
[JUJ2014-Set1Paper 3] Sample of Answer

a) Aim of the experiment
To investigate/compare and contrast/study the effectiveness of cleansing agent X and cleansing agent Y in hard water

b) All the variables
Manipulated variable : Type of cleansing agents, // Cleansing agent X, and cleansing agent Y,
Responding variable : Effectiveness cleansing agents // cloth is clean/not/dirty

c) Statement of the hypothesis
Cleansing agent X can clean the cloth. Cleansing agent Y cannot clean the cloth/form scum

d) Lists of substances and apparatus
Materials: Cleansing agent X, Cleansing agent Y, hard Water, pieces of cloth with oily stain/ dirty cloths
Apparatus: Basins/250 cm$^3$ beakers, 100 cm$^3$ measuring cylinder, glass rod, electronic balance

e) Procedure for the experiment

Sample answer 1:
1. Label 2 beaker as X and Y respectively
2. Measure [100-200 cm$^3$] of hard water and pour into two beaker X and Y.
3. [3-5] g of cleansing agent X is put/added/pour into beaker labelled X.
4. [3-5] g of cleansing agent Y is put/added/pour into beaker labelled Y
5. Stir the beakers using glass rod until no changes can be observed
6. Place/put a piece of cloth with oily stain into each beaker.
7. Observed and record all the observation.

Sample 2
1. Measure [100-200 cm$^3$] of hard water and pour into a beaker.
2. [3-5] g of cleansing agent X is put/added/pour into beaker.
3. Stir the beakers using glass rod until no changes can be observed
4. Place/put a piece of cloth with oily stain into each beaker.
5. Observed and record all the observation
6. Repeat step 1-5 using cleansing agent Y.

f) Tabulation of data

<table>
<thead>
<tr>
<th>Type of cleansing agent</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleansing agent X</td>
<td></td>
</tr>
<tr>
<td>Cleansing agent Y</td>
<td></td>
</tr>
</tbody>
</table>