



AP[®] Chemistry (Operational) 2004 Sample Student Responses

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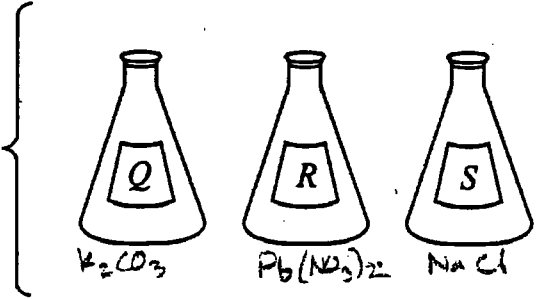
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Your responses to the rest of the questions in this part of the examination will be graded on the basis of the accuracy and relevance of the information cited. Explanations should be clear and well organized. Examples and equations may be included in your responses where appropriate. Specific answers are preferable to broad, diffuse responses.

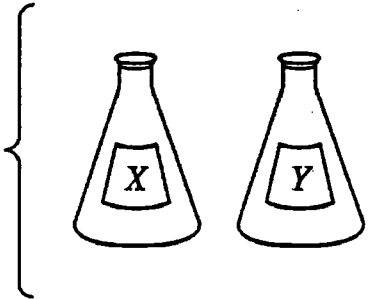
Answer BOTH Question 5 below AND Question 6 printed on page 22. Both of these questions will be graded. The Section II score weighting for these questions is 30 percent (15 percent each).

5. In a laboratory class, a student is given three flasks that are labeled Q, R, and S. Each flask contains one of the following solutions: 1.0 M Pb(NO₃)₂, 1.0 M NaCl, or 1.0 M K₂CO₃. The student is also given two flasks that are labeled X and Y. One of these flasks contains 1.0 M AgNO₃, and the other contains 1.0 M BaCl₂. This information is summarized in the diagram below.

Each flask contains one of the following solutions:
 Pb(NO₃)₂
 NaCl
 K₂CO₃



Each flask contains one of the following solutions:
 AgNO₃
 BaCl₂



- (a) When the student combined a sample of solution Q with a sample of solution X, a precipitate formed. A precipitate also formed when samples of solutions Q and Y were combined.
 - (i) Identify solution Q.
 - (ii) Write the chemical formulas for each of the two precipitates.
- (b) When solution Q is mixed with solution R, a precipitate forms. However, no precipitate forms when solution Q is mixed with solution S.
 - (i) Identify solution R and solution S.
 - (ii) Write the chemical formula of the precipitate that forms when solution Q is mixed with solution R.
- (c) The identity of solution X and solution Y are to be determined using only the following solutions: 1.0 M Pb(NO₃)₂, 1.0 M NaCl, and 1.0 M K₂CO₃.
 - (i) Describe a procedure to identify solution X and solution Y.
 - (ii) Describe the observations that would allow you to distinguish between solution X and solution Y.
 - (iii) Explain how the observations would enable you to distinguish between solution X and solution Y.

a) (i) Solution Q is K₂CO₃
 (ii) Ag₂CO₃
 BaCO₃

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ADDITIONAL PAGE FOR ANSWERING QUESTION 5.

b) (i) Solution R is $Pb(NO_3)_2$
Solution S is $NaCl$

(ii) $PbCO_3$

c) (i) Mix solution S ($NaCl$) with aliquots of both Solution X and solution Y in separately labeled beakers.
(ii) One of these reactions will form a precipitate, the other will not
(iii) The precipitate formed will be $AgCl(s)$, from the reaction of solutions S and $AgNO_3$. Thus, the beaker with the precipitate is $AgNO_3$ and the other one is $BaCl_2$

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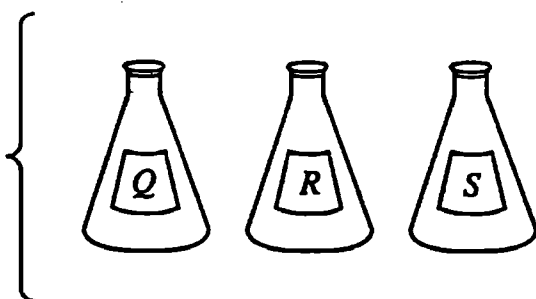
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5. In a laboratory class, a student is given three flasks that are labeled *Q*, *R*, and *S*. Each flask contains one of the following solutions: 1.0 M $\text{Pb}(\text{NO}_3)_2$, 1.0 M NaCl , or 1.0 M K_2CO_3 . The student is also given two flasks that are labeled *X* and *Y*. One of these flasks contains 1.0 M AgNO_3 , and the other contains 1.0 M BaCl_2 . This information is summarized in the diagram below.

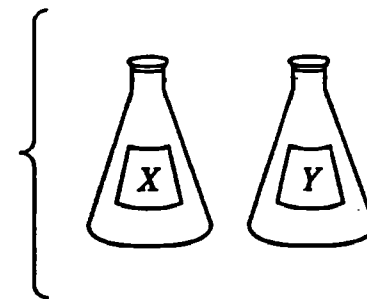
Each flask contains one of the following solutions:

$\text{Pb}(\text{NO}_3)_2$
 NaCl
 K_2CO_3



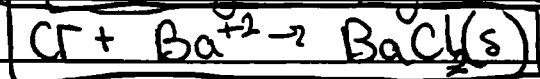
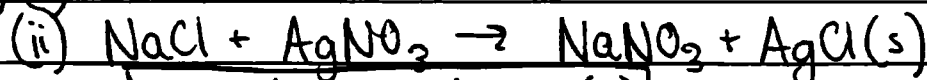
Each flask contains one of the following solutions:

AgNO_3
 BaCl_2



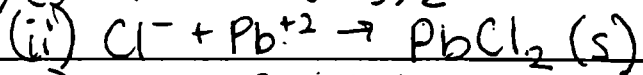
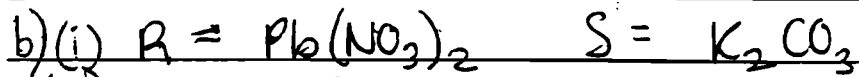
- (a) When the student combined a sample of solution *Q* with a sample of solution *X*, a precipitate formed. A precipitate also formed when samples of solutions *Q* and *Y* were combined.
- Identify solution *Q*.
 - Write the chemical formulas for each of the two precipitates.
- (b) When solution *Q* is mixed with solution *R*, a precipitate forms. However, no precipitate forms when solution *Q* is mixed with solution *S*.
- Identify solution *R* and solution *S*.
 - Write the chemical formula of the precipitate that forms when solution *Q* is mixed with solution *R*.
- (c) The identity of solution *X* and solution *Y* are to be determined using only the following solutions: 1.0 M $\text{Pb}(\text{NO}_3)_2$, 1.0 M NaCl , and 1.0 M K_2CO_3 .
- Describe a procedure to identify solution *X* and solution *Y*.
 - Describe the observations that would allow you to distinguish between solution *X* and solution *Y*.
 - Explain how the observations would enable you to distinguish between solution *X* and solution *Y*.

a.) (i) solution Q is NaCl



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ADDITIONAL PAGE FOR ANSWERING QUESTION 5.



c)(i) The $Pb(NO_3)_2$ could be combined with X and then Y. If no precipitate forms in one of the solutions that one is the $AgNO_3$ because ~~because~~ the reaction between $AgNO_3$ and $Pb(NO_3)_2$ would produce two soluble substances.

(ii) No precipitate in one would mean that one was $AgNO_3$ because the reaction would produce two soluble substances. And the other would therefore be $BaCl_2$.

(iii) The observations would allow me to see that in one two NO_3 substances are produced and they would dissolve in the solution, and the other would produce $PbCl_2$ precipitate.

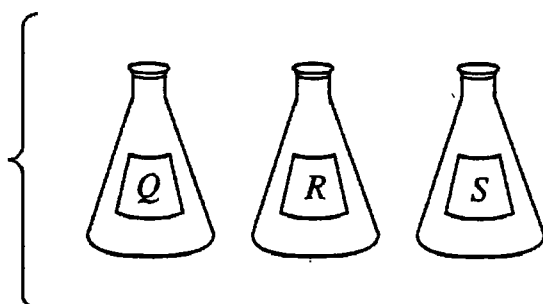
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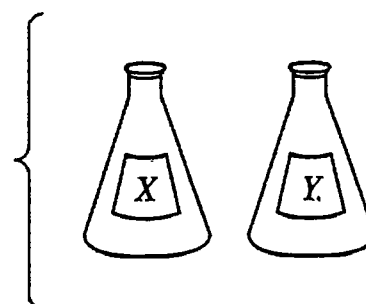
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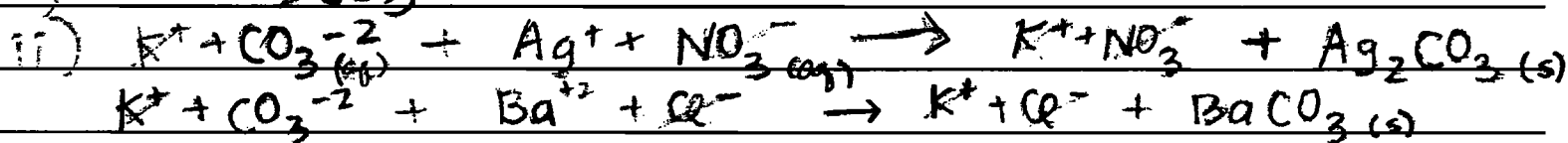
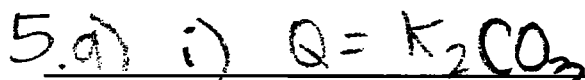
Each flask contains one of the following solutions:
 Pb(NO₃)₂
 NaCl
 K₂CO₃



Each flask contains one of the following solutions:
 AgNO₃
 BaCl₂



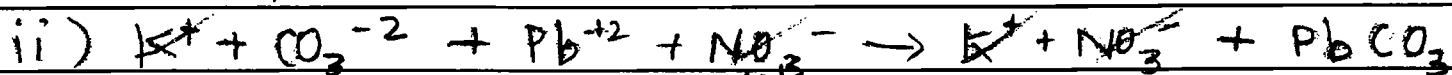
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ADDITIONAL PAGE FOR ANSWERING QUESTION 5.

b) i) R = $Pb(NO_3)_2$
 S = NaCl



c) i) mix each flask ^{separately} with $Pb(NO_3)_2$, NaCl, and K_2CO_3 in different containers for each mixture. First mix flask X with $Pb(NO_3)_2$ then flask Y. Then mix NaCl with X, then Y. Then mix flask X with K_2CO_3 , then mix flask Y.

ii) The observations would make either a precipitate or just a solution. The observations of a solid or even a gas would help to distinguish. If it just created a solution then the observation wouldn't necessarily help except to know that the solution did not change form.

iii) If the observation for either flask had a precipitate when mixed with NaCl then the flask would hold either Pb^{+2} , Hg^{+2} or Ag^+ since Cl is not soluble with these if a ppt was formed when mixed with $Pb(NO_3)_2$. Then Cl^- , Br^- , SO_4^{2-} , I^- , would be part of the solution. If K_2CO_3 formed a ppt then it could be anything except alkali metal and NH_4^+ .

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