

# Hong kong diploma of secondary education examination

[Science](#), [Chemistry](#)



Hong Kong Diploma of Secondary Education Examination Chemistry School-based Assessment Sample Tasks Teachers may use the sample tasks for non-profit making educational and research purposes with proper acknowledgement. © 2010 Hong Kong Examinations and Assessment Authority All Rights Reserved 2010 Chemistry School-based Assessment Practical Related Tasks Volumetric analysis Teacher Notes NSS Chemistry Curriculum Link: Time Required: 40 minutes Topic IV Acids and Bases

Students are expected to have acquired the knowledge of topic IV and have some experience in handling apparatuses such as pipette, burette, and volumetric flask before carrying out the school-based assessment. This experiment involves two tasks: 1. Dilution of sodium carbonate solution 2. Titration of diluted sodium carbonate solution with a standard solution of hydrochloric acid Students should perform the experiment individually. In order to facilitate large class size, both the side benches and the teacher bench may have to be used. Teachers may distribute the experimental worksheet to students beforehand for reducing the stress of the students during practical assessment. In order to test students' knowledge of detecting the end point of a titration, an unfamiliar indicator, bromothymol blue, is used. Students have to decide the colour change at the end point. The assessment is mainly based on the written worksheet. Nevertheless, the teacher can walk around to observe student performance and to give some advice. The teacher can take note whether (1) there is a filter funnel on top of the burette when the titration is carried out; (2) there is a white tile beneath the conical flask when the titration is carried out; (3) there is air space between the tap and the tip of the burette; and (4) the students

perform the experiment safely. Chemistry School-based Assessment Practical Related Tasks Volumetric analysis Assessment Criteria Marks 10 - 9

Remarks There are at least four titration readings (including the trial). The titration readings are recorded in 2 decimal places. The titration results are accurate (i. e. within  $\pm 0.05 \text{ cm}^3$ ) and the standard deviation of the titres is small (i. e. within  $\pm 0.05 \text{ cm}^3$ ). Colour changes are accurately recorded. Calculations are accurate and concise. There are at least three titration readings (including the trial). The titration readings are recorded in 1 decimal place. The titration results are reasonably accurate (i. e. within  $\pm 0.15 \text{ cm}^3$ ) and the standard deviation of the titres is reasonably small (i. e. within  $\pm 0.15 \text{ cm}^3$ ). Colour changes are accurately recorded. Calculations are accurate and concise. There are at least two titration readings (including the trial). The titration readings are recorded. The titration results are barely accurate (i. e. within  $\pm 0.25 \text{ cm}^3$ ) and the standard deviation of the titres is reasonable (i. e. within  $\pm 0.25 \text{ cm}^3$ ). Colour changes are accurately recorded. Calculations are appropriate. There is at least one titration reading (including the trial). The titration readings are recorded. Colour changes are recorded. Calculations are shown.

8—6 5—3 2—1 Chemistry School-based Assessment Practical Related Tasks Volumetric analysis Student Handout Carry out volumetric analysis using the 0.2 M hydrochloric acid, sodium carbonate solution labelled as 'solution A', and an acid base indicator provided. Determine the concentration of solution A. Method 1. Dilute 25.00  $\text{cm}^3$  of solution A to 250.0  $\text{cm}^3$  with deionized water. 2. Transfer 10.00  $\text{cm}^3$  of the diluted solution A to a conical flask and titrate it with 0.2 M hydrochloric acid using the indicator provided. Relevant equation

$\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$  Titration results

Trial	titration	Final burette reading / cm <sup>3</sup>	Initial burette reading / cm <sup>3</sup>	Volume of titrant / cm <sup>3</sup>	Mean titre =	Colour change of indicator:
						from

Calculations to cm<sup>3</sup> Concentration of A = Chemistry School-based Assessment Practical Related Tasks Qualitative Analysis (Distinguish solutions) Teacher Notes NSS Chemistry Curriculum Link: Topic IV Acids and Bases Time Required: 20 minutes This task is designed on testing students' knowledge in precipitation reactions and acid-carbonate reactions. If students have prior knowledge of sub-section (a) and (d) of topic IV, they should be able to complete the task and worksheet without much difficulty. Teachers should prepare aqueous solutions of each of the salts including MgSO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>, and Pb(NO<sub>3</sub>)<sub>2</sub>. Dilute hydrochloric acid is also needed for the experiment. The assessment is mainly based on the worksheet submitted. Nevertheless, any unsafe practice can be noted and appropriately reflected in the marking. Teachers should alert students to perform the experiments with due care. Chemistry School-based Assessment Practical Related Tasks Qualitative Analysis (Distinguish solutions) Assessment Criteria Marks 10 - 9 Remarks Nearly all observations are accurately described. The four solutions are logically distinguished. Safety procedures have been observed. Some observations are accurately described. At least two of the solutions are logically distinguished. Safety procedures have been observed. Some observations are accurately described. At least one of the solutions is logically distinguished. Safety procedures have been observed. 8—6 5—3 2—1 Some observations are accurately described. At least one of the solutions is distinguished. Chemistry School-based Assessment Practical Related Tasks

Qualitative Analysis (Distinguish solutions) Student Handout There are four test tubes randomly labelled as A, B, C and D. Each of the test tubes contains one of the following colourless solutions:  $\text{MgSO}_4(\text{aq})$ ,  $\text{Na}_2\text{CO}_3(\text{aq})$ ,  $\text{Pb}(\text{NO}_3)_2(\text{aq})$ ,  $\text{HCl}(\text{aq})$  Mix the solutions as instructed and complete the table by recording the observations. Mixing solutions A+ B A+C A+D B+C B+D C+D Observation From the observations, distinguish what A, B, C and D are. Explain your distinguishing process.

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A: \_\_\_\_\_ B: \_\_\_\_\_ C: \_\_\_\_\_ D: \_\_\_\_\_

Chemistry School-based Assessment Practical Related Tasks Qualitative

Analysis (Deduce species) Teacher Notes NSS Chemistry Curriculum Link:

Time Required: 30 minutes Topic IV Topic VII Acids and Bases Redox

reactions This task would require students to have a thorough knowledge of quite a number of reactions. It is designed to test the higher cognitive ability of the students. Students should be familiar with precipitation reactions and redox reactions in order to accomplish the task. Teachers may use powder of sodium carbonate as the sample for this experiment. Deionized water, universal pH paper, 2 M HCl, 1 M  $\text{H}_2\text{SO}_4$ , 2 M NaOH, aqueous  $\text{NH}_3$ , and 0.02

M KMnO<sub>4</sub> are also needed. The assessment is mainly based on the worksheet submitted. Nevertheless, any unsafe practice can be noted and appropriately reflected in the marking. Teachers should alert students to perform the experiments with due care. Chemistry School-based Assessment Practical Related Tasks Qualitative Analysis (Deduce species) Assessment Criteria Marks 10 - 9 Remarks Nearly all observations are accurately described. All species are logically deduced. Safety procedures have been observed. Some observations are accurately described. One of the species (cation / anion) is logically deduced. Safety procedures have been observed. At least one observation is accurately described. One of the species (cation / anion) is stated. One observation is accurately described. OR One of the species (cation / anion) is stated. 8—6 5—3 2—1 Chemistry School-based Assessment Practical Related Tasks Qualitative Analysis (Deduce species) Student Handout Perform tests on the sample as instructed, and complete the table by recording the observations. Test Describe the sample. Estimate, using universal pH paper, the pH of an aqueous solution of the sample. Report on the action of 2 M HCl on an aqueous solution of the sample. Report on the action of 1 M H<sub>2</sub>SO<sub>4</sub> on an aqueous solution of the sample. Report on the action of 2 M NaOH on an aqueous solution of the sample. Report on the action of aqueous NH<sub>3</sub> on an aqueous solution of the sample. Report on the action of a few drops of 0.02 M KMnO<sub>4</sub> in 1 M H<sub>2</sub>SO<sub>4</sub> on an aqueous solution of the sample. From the observations, deduce what species are present in the sample. Explain your deduction.

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\_\_ Observation Chemistry School-based Assessment Practical Related Tasks Experiment (Assessment based on a quiz) Teacher Notes NSS Chemistry Curriculum Link: Time Required: Topic IV Acids and Bases 80 minutes (For the practical session) This is a simple experiment requiring students to prepare an insoluble salt. The students can be assessed through their performance in the pre-experimental quiz. The teacher should be able to assess the students based on their pre-experimental quiz. The quiz is for consolidating the knowledge required for the experiment. In a smaller class, the teacher can also choose to assess students' practical skills. In order to alert the students in performing the experiments with care, it can be mentioned clearly to them that marks may have to be adjusted if any unsafe practice is noted. Moreover, the tidiness of the bench during / after experiment can also be used as one of the criteria in assessing the practical performance. For the experiment, besides wearing a pair of safety

spectacles, the students should be reminded to wash their hands thoroughly before leaving the laboratory owing to the toxic nature of barium

compounds. In order to determine the dry weight, the students have to keep the solid in an oven before measuring the weight. Chemistry School-based

Assessment Practical Related Tasks Experiment (Assessment based on a quiz) Assessment Criteria Marks Distribution (Total: 10 marks) 3 2 4 1

Remarks Understanding of the underlying chemical principle of the experiment is demonstrated. Understanding of the experimental procedures is demonstrated. Accurate calculations are shown. Scientific and critical mind is demonstrated. Chemistry School-based Assessment Practical Related

Tasks Experiment (Assessment based on a quiz) Pre-experimental quiz 1.

Write an ionic equation for the reaction involved in the preparation of barium sulphate in this experiment. (1 mark) 2. Can copper(II) chloride be prepared

by mixing copper(II) nitrate solution and sodium chloride solution? Explain your answer. (2 marks) 3. What is the purpose of washing the residue with

deionized water? (1 mark) 4. Suggest a salt that cannot be dried by using

oven. (1 mark) 5. Calculate the no. of moles of barium ions in 10.0 cm<sup>3</sup> of 0.

2 M barium chloride solution. (1 mark) 6. Calculate the no. of moles of

sulphate ions in 10.0 cm<sup>3</sup> 0.2 M sodium sulphate solution. (1 mark) 7.

Calculate the theoretical mass of barium sulphate that should be obtained.

(2 marks) 8. Suggest ONE possible source of error for the experiment. (1

mark) 1 Student Handout Preparation of an insoluble salt — barium sulphate

For preparing an insoluble salt, one method is to mix two soluble reagents

each containing the respective cation and anion. When the ions of the

insoluble salt combine, the precipitate of the salt forms. Such a reaction is



called precipitation. In preparing barium sulphate, barium chloride solution can be mixed with sodium sulphate solution.  $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$  The precipitate formed is then filtered and washed with deionized water. Finally, the precipitate can be dried in an oven or in a desiccator.

**Chemical reagents and apparatus**

0.2 M barium chloride solution  
0.2 M sodium sulphate solution  
Measuring cylinder  
Boiling tube  
Test tube rack  
Filter paper and funnel  
Spatula  
Oven  
Electronic balance

**Precaution**

1. Handle all chemical reagents with care.
2. Barium ions are toxic. Wash the hands thoroughly before leaving the laboratory.
3. All chemical wastes have to be placed into designated bottles for subsequent treatment.

**Procedure**

1. Mix 10.0 cm<sup>3</sup> of 0.2 M barium chloride solution and 10.0 cm<sup>3</sup> 0.2 M sodium sulphate solution in a boiling tube.
2. Weigh a piece of filter paper.
3. Filter the mixture by using the pre-weighed filter paper in a filter funnel.
4. Wash the residue with deionized water.
5. Place the residue together with the filter paper into an oven.
6. After 20 minutes, weigh the residue together with the filter paper.

2 Chemistry School-based Assessment Practical Related Tasks Experiment (Assessment based on a worksheet) Teacher Notes NSS Chemistry Curriculum Link: Time Required: Topic IV Acids and Bases 80 minutes (For the practical session) This is a simple experiment requiring the students to prepare an insoluble salt. The students can be assessed through their performance in the experimental worksheet. The teacher should be able to assess the students based on their written worksheets. For the written worksheet, the teacher should consider whether the students are given adequate time to complete and to hand in within lesson time. However, by asking the students in completing the worksheet within lesson

time can prevent them from copying from each other. In a smaller class, the teacher can also choose to assess students' practical skills. In order to alert the students in performing the experiments with care, it can be mentioned clearly to them that marks may have to be adjusted if any unsafe practice is noted. Moreover, the tidiness of the bench during / after experiment can also be used as one of the criteria in assessing the practical performance. For the experiment, besides wearing a pair of safety spectacles, the students should be reminded to wash their hands thoroughly before leaving the laboratory owing to the toxic nature of barium compounds. In order to determine the dry weight, the students have to weigh the solid placed in oven before measuring the weight.

Chemistry School-based Assessment Practical Related Tasks Experiment (Assessment based on a worksheet) Assessment Criteria Marks Distribution (Total: 10 marks) 1 1 2 2 3 1 Observation is accurately described. Remarks Understanding of the objective of the experiment is demonstrated. Understanding of the experimental procedures is demonstrated. Accurate and precise data and numerical results are recorded. Accurate calculations are shown. Scientific and critical mind is demonstrated.

Chemistry School-based Assessment Practical Related Tasks Experiment (Assessment based on a worksheet) Student Handout Preparation of an insoluble salt — barium sulphate For preparing an insoluble salt, one method is to mix two soluble reagents each containing the respective cation and anion. When the ions of the insoluble salt combine, the precipitate of the salt forms. Such a reaction is called precipitation. In preparing barium sulphate, barium chloride solution can be mixed with sodium sulphate solution.

$$\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$$

The precipitate formed is then filtered and washed with deionized water. Finally, the precipitate can be dried in an oven or in a desiccator.

Chemical reagents and apparatus  
0.2 M barium chloride solution  
0.2 M sodium sulphate solution  
Measuring cylinder  
Boiling tube  
Test tube rack  
Filter paper and funnel  
Spatula  
Oven  
Electronic balance

Precaution  
1. Handle all chemical reagents with care.  
2. Barium ions are toxic. Wash the hands thoroughly before leaving the laboratory.  
3. All chemical wastes have to be placed into designated bottles for subsequent treatment.

1 Procedure  
1. Mix 10.0 cm<sup>3</sup> of 0.2 M barium chloride solution and 10.0 cm<sup>3</sup> 0.2 M sodium sulphate solution in a boiling tube.  
2. Weigh a piece of filter paper.  
3. Filter the mixture by using the pre-weighed filter paper in a filter funnel.  
4. Wash the residue with deionized water.  
5. Place the residue together with the filter paper into an oven.  
6. After 20 minutes, weigh the residue together with the filter paper.

2 Post-experimental Worksheet  
1. What is the objective of the experiment? (1 mark)  
2. What do you observe when you mix barium chloride solution with sodium sulphate solution? (1 mark)  
3. What is the purpose of washing the residue with deionized water? (1 mark)  
4. Suggest a salt that cannot be dried by using oven. (1 mark)  
5. Record your results  
Mass of filter paper = g  
Mass of filter paper + barium sulphate = g  
Mass of barium sulphate = g (2 marks)  
6. Calculate the theoretical mass of barium sulphate that should be obtained. (2 marks)  
7. What is the percentage yield of barium sulphate by mass? (1 mark)  
8. Suggest ONE possible source of error for the experiment. (1 mark)

3 Chemistry School-based Assessment Practical  
Related Tasks  
Experiment (Assessment based on a report)  
Teacher Notes  
NSS Chemistry Curriculum Link: Topic IV Acids and Bases  
Time Required: 80

minutes (For the practical session) This is a simple experiment requiring the students to prepare an insoluble salt. The students can be assessed through their performance in the experimental report. The teacher should be able to assess the students based on their reports. For the reports, it can be in form of a full report or the teacher may consider requiring the students to write a short one without reporting the procedures, etc. As students are required to write experimental reports, the time for doing so should be long and the task could probably not be finished during lesson time. In this regard, the teacher may consider to collect the data sheet copy before letting students leave the laboratory for preventing them from any potential misconduct such as plagiarism. In a smaller class, the teacher can also choose to assess students' practical skills. In order to alert the students in performing the experiments with care, it can be mentioned clearly to them that marks may have to be adjusted if any unsafe practice is noted. Moreover, the tidiness of the bench during / after experiment can also be used as one of the criteria in assessing the practical performance. For the experiment, besides wearing a pair of safety spectacles, the students should be reminded to wash their hands thoroughly before leaving the laboratory owing to the toxic nature of barium compounds. In order to determine the dry weight, the students have to weigh the solid placed in oven before measuring the weight.

Chemistry  
School-based Assessment Practical Related Tasks Experiment (Assessment based on a report)

Assessment Criteria	Marks	Remarks
Demonstration of manipulative skills including filtration and weighing substances with considerable dexterity, taking into account of all necessary safety precautions (such as washing hands before leaving laboratory and wear	10-9	

safety spectacles). Carrying out experimental work independently with confidence. Making all of the required observations with due regard to accuracy and detail, and/or taking most measurements with a precision within that of the apparatus as reflected from the number of decimal places recorded in the data. Making interpretation of the information obtained from an experiment successfully without assistance as reflected from its calculation in percentage yield. Writing the objective and observations in a clear and concise way. Writing a logical, coherent and systematic scientific report.

8-6 Demonstration of a range of manipulative skills including filtration and weighing substances with considerable with dexterity, taking into account of most of the safety precautions(such as washing hands before leaving laboratory and wear safety spectacles). Carrying out experimental work with occasional guidance. Making most of the required observations in a methodical and organised way and/or taking many measurements with a precision within that of the apparatus. The recording is mostly complete. Knowing the objective and writing the observations correctly. Writing a scientific report with the relevant sections containing appropriate contents.

5-3 Demonstration of a range of manipulative skills including filtration and weighing substances with moderate dexterity, and showing some regard for safety. Carrying out experimental work with some guidance. Making the required observations with some accuracy, and/or taking some measurements with a precision within that of the apparatus. The recording is mostly complete. Knowing the objective and writing the observations. Writing a scientific report with the relevant sections containing appropriate contents at times.

2-1 Demonstration of an ability to use the common

apparatus in the laboratory with some dexterity, and showing little regard for safety. Carrying out experimental work with considerable guidance. Making the required observations and/or taking some measurements. Recording some observations. Attempting to write a report.

Chemistry School-based Assessment Practical Related Tasks Experiment (Assessment based on a report) Student Handout Preparation of an insoluble salt — barium sulphate

For preparing an insoluble salt, one method is to mix two soluble reagents each containing the respective cation and anion. When the ions of the insoluble salt combine, the precipitate of the salt forms. Such a reaction is called precipitation. In preparing barium sulphate, barium chloride solution can be mixed with sodium sulphate solution.

$$\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$$

The precipitate formed is then filtered and washed with deionized water. Finally, the precipitate can be dried in an oven or in a desiccator.

Chemical reagents and apparatus

0.2 M barium chloride solution  
0.2 M sodium sulphate solution  
Measuring cylinder  
Boiling tube  
Test tube rack  
Filter paper and funnel  
Spatula  
Oven  
Electronic balance

Precaution

1. Handle all chemical reagents with care.
2. Barium ions are toxic. Wash the hands thoroughly before leaving the laboratory.
3. All chemical wastes have to be placed into designated bottles for subsequent treatment.

1 Procedure

1. Mix 10.0 cm<sup>3</sup> of 0.2 M barium chloride solution and 10.0 cm<sup>3</sup> 0.2 M sodium sulphate solution in a boiling tube.
2. Weigh a piece of filter paper.
3. Filter the mixture by using the pre-weighed filter paper in a filter funnel.
4. Wash the residue with deionized water.
5. Place the residue together with the filter paper into an oven.
6. After 20 minutes, weigh the residue together with the filter paper.

Post-experimental Report Write a detailed report for this

experiment. The report should contain the following sections: (1) Objective (2) (3) (4) (5) Theory Chemical reagents and apparatus Precautions Procedures (in passive voice) (6) Results (including observations and calculations, etc.) (7) Discussion (including possible error and suggestions for further improvement, etc.)

## 2 Chemistry School-based Assessment Practical Related Tasks Investigative Study (Making your own indicator) Teacher Notes

### NSS Chemistry Curriculum Link: Time Required: 20 hours Topic IV Acids and Bases

This investigation is designed to provide students with hands-on experience in isolation of natural occurring chemicals from plants and testing their use as acid-base indicators. Acid-base indicators are organic dyes that change colours at different pH values. In this investigation, students would receive a household oven cleaner and are required to determine the concentration of the alkali of this household oven cleaner using their own indicator. Students could check the suitability of their own indicator with reference to methyl orange and/or phenolphthalein. Teacher may group their students into groups of five. Firstly, students need to extract coloured pigments from several plant materials using water or ethanol. After that, they will observe the colours of these pigments in solutions of different pH. A plant pigment with sharp colour change at a particular pH range is selected for use in acid-base titration. The concentration of sodium hydroxide in oven cleaner is then determined with the acid-based indicator prepared.

(a) Work schedule (i) Searching information and planning investigation (3 hours) Pre-investigation talk: 60 minutes Searching information: 90 minutes Filling in proposal form: 30 minutes Teachers may demonstrate some experiments to arouse students' interest to do the investigation. After introducing the details

of investigative study, students could search information over internet, books and magazines in the library. After collecting information, students have to write the proposal by filling in a proposal 1 form including group name, title of the investigation, aims and the materials required. The investigation emphasizes the solving of authentic problems in daily life. Students are stimulated and motivated as they are asked to apply their background knowledge in solving meaningful problems. At this stage, students should be able to search the relevant background information and experimental details. They could work collaboratively in a group to develop an investigation plan and to solve the problems. (ii) Developing an investigation plan (4 hours) Discussing the proposal form: 10 minutes for each group Writing the revised proposal: 3 hours Before students start to write the proposal, teacher could discuss with the students' draft of the proposal form. Teacher could give suggestion about the chemical reagents and apparatus to be used and remind students about risk assessment. Students should write the proposal including group name, title of the investigation, aims, title of the experiments, materials required, risk assessment and procedure. Students are encouraged to brainstorm, listen to and share opinion, make critiques in a positive way and to accept criticism. (iii) Conducting the investigation (6 hours) Performing experiment: Two sessions (3 hours for each session) Before conducting the investigation, teachers could accord students' proposals in order to arrange the apparatus and materials. Laboratory technician could prepare the apparatus and chemicals while students may purchase their own materials as needed. Two morning sessions could be arranged to conduct investigation (3 hours for



each session). The first session is for extracting the plant pigment. After extracting the plant pigment, extract has to be kept in refrigerator overnight. The second session would be for choosing a suitable indicator for acid-base titration and performing the acid-base titration. Before choosing the suitable indicator, teacher should remind students the concepts about titration curve and acid-base titration. After the experimental sessions, students should be able to suggest the most suitable acid-base indicator. Students could demonstrate mastery of manipulative skills, observation skills and adequacy of general bench performance. They could also learn to be aware of the importance of working safely in laboratory.

2 (iv) Organizing and analyzing data (4 hours) After conducting the investigation, students should write the report and prepare the Power Point for oral presentation. Students have to use accurate terminology and appropriate reporting styles to communicate their findings and conclusions to their classmates and teacher.

(v) Presenting findings (3 hours) Each group should have about 20 minutes for the presentation. This presentation serves to provide students an opportunity to practise their communication skills in chemical knowledge.

(b) Prerequisite concepts and laboratory skills Students should have basic concepts of pH measurement, acid-base reaction and molarity. They should also be able to choose appropriate apparatus for doing extraction and titration. More advanced concept of buffer solution and titration curve could also be learnt from this investigation.

(c) Apparatus and materials

(i) Apparatus Test-tubes, test-tube rack, beakers, heating mantle, knife, mortar and pestle, dropper, funnel, conical flask, titration set-up, etc.

(ii) Material Coloured flowers and plants, ethanol, buffer solution with different pH values, oven cleaner,

hydrochloric acid, ethanoic acid, methyl orange and phenolphthalein, etc. (d)

References (i) Investigative Study in Chemistry - Exemplars of Learning and Teaching Activities (Issued by the Science Education Section, Education

Bureau, 2009) (ii) <http://en.wikipedia.org/wiki/Anthocyanin> (iii) <http://en.wikipedia.org/wiki/Betanin> (iv) [http://www.funsci.com/fun3\\_en/acids/acids.htm#13](http://www.funsci.com/fun3_en/acids/acids.htm#13) (v) [http://www.cityu.edu.hk/flc/msds\\_2\\_1.pdf](http://www.cityu.edu.hk/flc/msds_2_1.pdf) (vi) <http://www.ilo.org/public/english/protection/safework/cis/products/icsc>

3 Chemistry School-

based Assessment Practical Related Tasks Investigative Study (Making your own indicator) Assessment Criteria Proposal Marks 10 - 9 Remarks Rich

background knowledge is demonstrated clearly. The plan is well-organised with clear objectives, a concise rationale of study and feasible procedures.

Various types of plant materials are chosen as acid-base indicator and

appropriate titration setup is used. The investigative study can be completed within an appropriate time frame. Risk assessment has been made. 8—6

Substantial background knowledge is demonstrated. The plan is organised with clear objectives and feasible procedures. Various types of plant

materials are chosen as acid-base indicator and some errors and omissions are found in the titration setup. The investigative study can be completed

within an appropriate time frame. Risk assessment has been made. 5—3

Some background knowledge is demonstrated. The plan is organized with objectives and procedures, but some of which are barely feasible. Two to

three types of plant materials are chosen as acid-base indicator and some errors and omissions are found in the titration setup. The investigative study

cannot be completed within an appropriate time frame. No risk assessment has been made. 2—1 Limited background knowledge is demonstrated. The

plan is poorly organized. Only one type of plant material is chosen as acid-base indicator and incorrect titration setup is used. The investigative study cannot be completed within an appropriate time frame. No risk assessment has been made. 1 Process Marks 10 — 9 Remarks Excellent manipulative skills (filtration, heating solution, titration) are demonstrated. Safety procedures have been observed. Accurate colour changes are recorded. At least four titration readings (including the trial) are recorded in 2 decimal places. The titration results are accurate (i. e. within  $\pm 0.05 \text{ cm}^3$ ) and the deviation of the titres is small (i. e. within  $\pm 0.05 \text{ cm}^3$ ). The experimental work is carried out independently with confidence. Collaborative skills, problem solving skills and self-discipline are fully demonstrated. Good manipulative skills (filtration, heating solution, titration) are demonstrated. Safety procedures have been observed. Accurate colour changes are recorded. At least three titration readings (including the trial) are recorded in 1 decimal place. The titration results are reasonably accurate (i. e. within  $\pm 0.15 \text{ cm}^3$ ) and the deviation of the titres is reasonably small (i. e. within  $\pm 0.15 \text{ cm}^3$ ). The experimental work is carried out with occasional guidance. Collaborative skills, problem solving skills and self-discipline are substantially demonstrated. 5—3 Fair manipulative skills (filtration, heating solution, titration) are demonstrated. Safety procedures have seldom been observed. Reasonably accurate colour changes are recorded. At least two titration readings (including the trial) are recorded. The titration results are barely accurate (i. e. within  $\pm 0.25 \text{ cm}^3$ ) and the deviation of the titres is reasonable small (i. e. within  $\pm 0.25 \text{ cm}^3$ ). The experimental work is carried out with some guidance. Collaborative skills, problem solving skills and self-

discipline are occasionally demonstrated. 2—1 Poor manipulative skills (filtration, heating solution, titration) are demonstrated. Safety procedures have seldom been observed. Barely accurate colour changes are recorded. At least one titration reading (including the trial) is recorded. The titration results are inaccurate with large deviation among the titres. The experimental work is carried out with considerable guidance. Collaborative skills, problem solving skills and self-discipline are poorly demonstrated. 8—6

2 Report Marks 10 - 9 Remarks Correct decision is made on choosing the suitable plant extract with appropriate reasons. Calculations are accurate and concise. Relevant chemical terms and concepts are used throughout the report. The objectives, procedures, results and discussion are presented in a concise, systematic, logical and analytical way. There is effective communication of chemical knowledge / findings. Correct decision is made on choosing the suitable plant extract but with no appropriate reasons. Calculations are accurate and concise but with some errors. Relevant chemical terms and concepts are used throughout the report. The objectives, procedures, results and discussion are presented in a correct way. There is substantial communication of chemical knowledge / findings. 5—3 Incorrect decision is made on choosing the suitable plant extract. Calculations are appropriate. Relevant chemical terms and concepts are occasionally used in the report. Only the procedures and results are presented. There is limited communication of chemical knowledge / findings. 2—1 Incorrect decision is made on choosing the suitable plant extract. Calculations are shown. Relevant chemical terms and concepts are seldom used in the report. Only the procedures and results are presented. There is poor communication of

chemical knowledge / findings. 8—6 3 Chemistry School-based Assessment Practical Related Tasks Investigative Study (Making your own indicator)

Student Handout (a) Purpose (i) To make the natural indicator for acid-base titration. (ii) To determine the concentration of sodium hydroxide in an oven cleaner. (b) Background The red and blue colours of most flowers and some vegetables are due to a group of organic substance known as anthocyanins. These compounds are soluble in alcohol and can be easily isolated and used as acid-base indicators. Assume that you work for a waste disposal company. You have just received a shipment of expired household oven cleaner. Before properly disposing of the product, you must know whether the concentration of the alkalis exceeds the limit defined in the waste disposal regulation. And now, you have a piece of red cabbage in your refrigerator. Could you use the plant pigment extracted from the cabbage as the indicator for your titration? What other plant materials could also be used? (c) Guiding questions (i) What is an acid-base indicator? (ii) What is the working principle of an acid-base indicator? (iii) (iv) (v) Which substances inside red cabbage can be used as an acid-base indicator? What is the basic structure of anthocyanins? How could you extract indicator from plant? 1 (d) Task (i) Define the title, aim and materials required for your investigation in the proposal (Appendix 1). (ii) Search information over internet, books and magazines in the library. (iii) Search the safety information from the Material Safety Data Sheet (MSDS) before performing experiment and assess the risk (Appendix 2). (iv) Design and draw diagram to show how you will perform the experiment (v) (Appendix 3). Consult your teacher for the feasibility of your design. (vi) Write down the procedures including apparatus and reagents used (Appendix

4). (vii) Perform the experiment. (viii) Record the observations and measurements (Appendix 5). (ix) Collect the data for calculation (Appendix 6). (x) Compile a report with discussion and conclusion (Appendix 7). (xi) Prepare a PowerPoint for the oral presentation. (e) Apparatus and materials (i) Apparatus Test tubes, test tube rack, beakers, heating mantle, knife, mortar and pestle, dropper, funnel, conical flask, titration set-up, etc. (ii) Material Coloured flowers and plants, ethanol, buffer solution with different pH values, oven cleaner, hydrochloric acid, ethanoic acid, methyl orange and phenolphthalein, etc. (f) References (i) (ii) <http://en.wikipedia.org/wiki/Anthocyanin> <http://en.wikipedia.org/wiki/Betanin> (iii) [http://www.funsci.com/fun3\\_en/acids/acids.htm#13](http://www.funsci.com/fun3_en/acids/acids.htm#13) (iv) [http://www.cityu.edu.hk/flc/msds\\_2\\_1.pdf](http://www.cityu.edu.hk/flc/msds_2_1.pdf) (v) <http://www.ilo.org/public/english/protection/safework/cis/products/icsc2/ProposalForm>

Group number: \_\_\_\_\_ (Appendix 1) Title of investigation: \_\_\_\_\_ Aims: \_\_\_\_\_

Number of experiments you plan to conduct: \_\_\_\_\_ Titles of the experiments: \_\_\_\_\_

Materials Required: Please give the estimated quantity of chemicals and apparatus required. Chemicals (e. g. 10 g CaO(s)) Apparatus (e. g. 250 cm<sup>3</sup> conical flask) 2) 3 Risk Assessment (Appendix 2) Please list the potential hazards of the substance being used or produced and the safety precautions that should be taken. Also think about what emergency procedures could be taken in case of accidents. Hazardous substances being used or made, hazardous procedure or equipment Nature of the hazards (e. g. toxic, flammable) Control measures and precautions (e. g. substitute

chemicals; reduce scale; use fume cupboard, safety screen, protective gloves or safety spectacles, etc.) Sources of information (e. g. Handbook on Safety in Science Laboratories, ICSCs, MSDSs or Hazcards, etc.) Disposal of residues: 4 Procedures Diagrams of design and experimental set-up (Label all parts with explanation of their functions) (Appendix 3) 5 Procedures You may write up your step-by-step procedures or plan in point form. (Appendix 4) Expected results and findings: Reasons for making your prediction: Major references: 6 Observations and Measurements Record Form (Appendix 5)

Group number: \_\_\_\_\_ Page \_\_\_ of \_\_\_ Title of investigation:

\_\_\_\_\_ Record your experimental results below. Think about what to record and how to record your data, use table where appropriate. Remember to make sufficient relevant observations and measurements to reduce error and obtain reliable evidence. 7 Calculation Record Form (Appendix 6) Group number: \_\_\_\_\_

Page \_\_\_ of \_\_\_ Title of investigation:

\_\_\_\_\_ Please show your calculations in the space below: 8 Discussion and Conclusion (Appendix 7)

Group number: \_\_\_\_\_ Page \_\_\_ of \_\_\_ Title of investigation:

\_\_\_\_\_ Please show your discussion in the space below: 9