

General Instructions

Working time – 45 minutes

Write your answers using a pen in the spaces provided.

If you need additional space to answer a question, use the blank space at the end of the same page OR at the end of the paper and clearly indicate that this has been done.

Task value: 34 marks.**Weighting of this task:****15% of your school-based Chemistry assessment.**

Part 1 – Determining the pH of solutions.**First-hand investigation. GROUP WORK.**

You are to carry out the first-hand investigation in the group to which you have been assigned. After you have carried out the FHI, collect the rest of the assessment task from the supervising teacher.

The remainder of the task is to be carried out individually.

No further communication with other students is permitted.

Recommended time allocation for the first-hand investigation practical:

5 minutes

Aim:

To determine the range in which the pH lies for solutions A and B.

Equipment:

A beaker that is holding –

* Four test tubes containing unknown solution A

and * Four test tubes containing unknown solution B

Dropper bottle of bromothymol blue indicator solution

Dropper bottle of phenolphthalein indicator solution

Dropper bottle of methyl orange indicator solution

Dropper bottle of litmus indicator solution

Test tube rack

Be careful you do not contaminate or waste any solutions – they will not be replaced.

Use one bottle at a time and replace the lid when finished.

Ensure that the correct lid/dropper is replaced onto the correct bottle.

DO NOT put any droppers or lids onto the bench.

Marks may be deducted for incorrect laboratory techniques.

Method:

1. Place four test tubes containing solution A and four test tubes containing solution B into a test tube rack.
2. Add 3 drops of bromothymol blue indicator solution to the first test tube of solution A and thoroughly mix.
3. Record the observed colour into the results table.
4. Using phenolphthalein indicator solution and the second test tube, repeat steps 2 and 3.
5. Using methyl orange indicator solution and the second test tube, repeat steps 2 and 3.
6. Using litmus indicator solution and the second test tube, repeat steps 2 and 3.
7. Repeat steps 2 to 6, replacing solution A with solution B.
8. Return the 8 used test tubes, in their beaker, to the trolley at the front of the room.

Results:

Unknown solution	Colour observed with Indicator solution			
	Bromothymol blue	Phenolphthalein	Methyl orange	Litmus
A				
B				

8M

Ensure that you have packed up the equipment before you collect the rest of the task.

You must not communicate to another student from now on – the rest of the task is to be completed individually.

ENSURE THAT YOUR STUDENT NUMBER IS WRITTEN ON EVERY PAGE.

General Instructions

Write your answers using a pen in the spaces provided.

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Recommended time allocation for processing data from the FHI and secondary sources:
40 minutes

Part 1 – Determining the pH of solutions.
First-hand investigation analysis. INDIVIDUAL WORK.

Indicator	Colour at lower pH's	Range over which the pH changes colour	Colour at higher pH's
Bromothymol blue	Yellow	6.0 – 7.7	Blue
Phenolphthalein	Colourless	8.2 – 10.0	Magenta (pink)
Methyl orange	Red	3.1 – 4.4	Yellow
Litmus	Pink	5.5 – 8.0	Blue

1. Analyse the results obtained for solutions A and B to determine the range in which the pH of each solution lies. Account for your decisions.

5M

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2. A third solution, C, NOT available for you to test, is known to have a hydrogen ion concentration of $8.55 \times 10^{-4} \text{ mol L}^{-1}$.

a. Calculate its pH. **1M**

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b. A pH meter could have been used to measure the pH of solution C. Two advantages of using a pH meter are that it is a quick procedure and it is easy to perform.

Outline ONE other advantage that pH meters have over indicator solutions for the determination of pH. **1M**

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3. “A manufacturer of skin lotions wanted to decide which of the three solutions A, B and C would be the best to use as a solvent in a new lotion.”

Human skin, on average has a pH of 5.5. Most people’s skin pH falls in the range of 4.5 to 6.5. The closer the pH of a skin care product to the natural pH of the skin, the less likely it is to cause skin irritation.

Using the results deduced above for the three solutions A, B and C, recommend the solution that would be most suitable for the manufacturer to use. **1M**

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Part 2 – Processing second hand data.

1. One industrial source of the oxides of sulfur is from the smelting of metal ores to extract the metal.
One such ore is chalcopyrite, CuFeS_2 , which through a series of chemical processes, is used to produce copper metal.
The final step of these chemical processes involves the reaction of copper (I) oxide solid with copper (I) sulfide solid to form copper metal and sulfur dioxide.

- a. Write a balanced equation for the final step of these processes, including states. **2M**

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- b. Calculate the volume of sulfur dioxide that would be produced when exactly 1.00 T (1000.0 kg) of copper metal is produced through this chemical process. Assume room temperature and pressure (ie. 25°C and 100 kPa). Show full working. **3M**

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- c. Outline TWO other sources of sulfur dioxide - one industrial and one natural. **2M**

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2. “Advances in the scientific understanding about atmospheric composition have changed the nature of thinking about the atmosphere.”

Describe TWO pieces of evidence about the concentration of oxides of sulfur in the atmosphere since the industrial revolution which support this statement.

4M

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Marking Guidelines Task 1 2009

Year 12 CHEMISTRY

Part 1 - results.

<i>Marking criteria</i>	<i>Marks</i>
1 mark for each appropriate colour recorded	1 - 8

Part 1 - processing results.

1.

<i>Marking criteria</i>	<i>Marks</i>
Analyses (ie. identifies and relates the components) all four indicators for each of solutions A & B correctly AND Deduces a pH range for each of solutions A & B appropriate for the results recorded and the analysis	5
(1) Analyses three of the indicators for ONE of the solutions fully and appropriately AND deduces a pH range consistent with the results and analysis AND EITHER (a) Analyses two of the results for the other solution correctly OR (b) Deduces a pH range for the other solution that is consistent with the results OR (2) Analyses all four indicators for each of solutions A & B correctly but deduces inappropriate pH ranges	4
Identifies the pH range of ONE of the solutions OR Analyses the results of two indicators for each of solutions A & B (incorrect pH range deduced)	3
Analyses one result for one solution and analyses two results for the other solution OR Correctly classifies solution A as acidic and solution B as basic	2
Correctly classifies solution A as acidic OR Correctly classifies solution B as basic OR	1

Analyses one piece of data for one of the solutions appropriately	
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2. a.

<i>Marking criteria</i>	<i>Marks</i>
Calculates the pH as 3.07	1

2. b.

<i>Marking criteria</i>	<i>Marks</i>
Outlines (ie. indicates the main features of) an advantage of using pH meters not given in the question [eg. more accurate (with detail); non-destructive (with detail)]	1

3.

<i>Marking criteria</i>	<i>Marks</i>
Identifies solution B as being the most suitable for the manufacturer to use (or an answer consistent with the analysis)	1

Part 2.

1. a.

<i>Marking criteria</i>	<i>Marks</i>
Balanced equation that has all four formulae correct, all four co-efficients correct and all four states correct	2
Balanced equation that has all four formulae correct BUT has errors in either the co-efficients correct or states OR Balanced equation that has one or more formulae incorrect BUT has the equation appropriately balanced	1

1. b.

<i>Marking criteria</i>	<i>Marks</i>
Calculates the volume of sulfur dioxide correctly as 65014 L showing full and appropriate working (3 steps) (1) Moles of Cu = 15735.64... mol (2) Moles of SO ₂ = 2622.606... mol (3) Volume of SO ₂ = 65014 L	3
Calculates the volume of sulfur dioxide correctly as 65014 L showing incomplete working OR Calculates the volume of sulfur dioxide incorrectly but shows full and appropriate working	2
Correctly calculates one step of the calculations	1

1. c.

<i>Marking criteria</i>	<i>Marks</i>
Sketches in general terms ONE natural source of sulfur dioxide AND one industrial source of sulfur dioxide	2
Sketches in general terms ONE natural source of sulfur dioxide OR Sketches in general terms ONE industrial source of sulfur dioxide OR Sketches in general terms ONE natural source of sulfur dioxide and one industrial source of sulphur dioxide BUT does not identify which is which	1

2.

<i>Marking criteria</i>	<i>Marks</i>
Describes (giving characteristics and features- what, when, why etc) ONE or TWO pieces of evidence about the concentrations of oxides of sulfur in the atmosphere	3 - 4
Gives the main features of ONE piece of evidence about the concentrations of oxides of sulfur in the atmosphere OR Identifies ONE or TWO pieces of evidence	1 - 2

3.

<i>Marking criteria</i>	<i>Marks</i>
(1) Thoroughly draws out the implications of oxides of sulfur & nitrogen and relates them to their impact on society (2) Thoroughly draws out the implications of oxides of sulfur & nitrogen and relates them to their impact on the environment (3) Presents three equations that are appropriate and relevant	7
(1) Thoroughly draws out the implications of oxides of sulfur & nitrogen and relates them to their impact on society OR the environment (2) Weakly draws out the implications of oxides of sulfur & nitrogen and relates them to their impact on the environment	6

OR society (3) Presents two equations that are appropriate and relevant	
(1) Weakly draws out the implications of oxides of sulfur & nitrogen and relates them to their impact on society OR the environment (2) Identifies an impact of the oxides of sulfur &/or nitrogen on the environment OR society (3) Presents two equations that are appropriate and relevant	5
Identifies an impact of the oxides of sulfur &/or nitrogen on the environment AND on society	4
(1) Describes the formation of acid rain or photochemical smog (2) Identifies an impact of the oxides of sulfur &/or nitrogen on the environment and on society	3
Identifies an impact of the oxides of sulfur &/or nitrogen on the environment AND/OR on society	1 - 2