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: 36 marks.
Weighting of this task: 15% of your school-based Chemistry assessment.

Part 1 – assessing the usefulness of a natural indicator.

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 assess the usefulness of a homemade natural indicator, prepared using flowers from a red pansy.

Equipment:

A beaker that is holding –
* Three test tubes containing unknown solution A
and * Three test tubes containing unknown solution B
and * Three test tubes containing unknown solution C

Dropper bottle of phenolphthalein indicator solution
Dropper bottle of methyl orange indicator solution
Dropper bottle of natural indicator, prepared using flowers from a red pansy
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 the three test tubes containing solution A into the test tube rack.
2. Add 5 drops of the natural 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 of solution A, repeat steps 2 and 3.
5. Using methyl orange indicator solution and the third test tube of solution A, repeat steps 2 and 3.
6. Repeat steps 1 to 5, replacing solution A with solution B.
7. Repeat steps 1 to 5, replacing solution A with solution C.
8. Return the 9 used test tubes, in their beaker, to the trolley at the front of the room.

Results:

Solution (unknown)	Colour observed with Indicator solution		
	Natural indicator	Phenolphthalein	Methyl orange
A			
B			
C			

9M

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. 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.

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

40 minutes

Part 1 –A natural indicator.

First-hand investigation analysis - INDIVIDUAL WORK.

1. Recount the procedure **you** used in class to prepare a natural indicator. 2M

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2.

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

Analyse the results obtained for solutions A, B and C to determine the range in which the pH of each solution lies. **3M**

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This question continues overleaf.

3. Assess the usefulness of the homemade natural pansy indicator as an acid-base indicator. **4M**

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Part 2 – Processing second-hand data.

1. One industrial source of the oxides of sulfur is from the combustion of fuels such as coal which contains small quantities of sulfur minerals, such as $FeS_{2(s)}$. These sulfide minerals in coal are oxidised during combustion, and sulfur dioxide is released.

a. Write a balanced equation for the reaction of $FeS_{2(s)}$ with oxygen during the combustion of coal. One of the products is iron(II) oxide. **1M**

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b. NSW coal is highly sought after because it lower in sulfide minerals (0.3 – 1.0%) than coal from other areas. Coal from one area of the Hunter Valley has been analysed and found to be 0.75% $FeS_{2(s)}$, by mass.
Determine the mass of $FeS_{2(s)}$ that is contained in 1.75 tonne of this coal. **2M**

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c. Calculate the volume of sulfur dioxide that will be produced when 1.75 tonne of the Hunter Valley coal is combusted. Assume room temperature and pressure (ie. 25ºC and 100 kPa). Show full working. **3M**

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

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2. "Technological advances have allowed us to monitor the levels of the oxides of non-metals in the environment, allowing us to conclude that their concentrations have increased".

Describe TWO pieces of evidence that corroborate (support) this statement. **4M**

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3. Assess the impacts of oxides of nitrogen on the environment, making use of appropriate chemical equations. **6M**

Marking Guidelines Task 1 2011
Year 12 CHEMISTRY

Part 1 – determining the pH of solutions.

Results

Marking criteria	*Marks*
1 mark for each correct observation of COLOUR.	1 - 9

NOTE –

→ Each set of test tubes was checked while students were completing the written section of the task. For all groups, the colour observed when methyl orange was added to solution A was the same as the colour observed when methyl orange was added to solution B.

→ Your skills of observation and ability to follow the method were being evaluated here –

* ½ mark was deducted for each observation relating to the clarity of the mixture ("clear"; "opaque") IF the appropriate colour was also recorded (a max of 2 marks was deducted for this; deductions were rounded up to the nearest whole mark).
* 1 mark was deducted for each observation about the clarity of the mixture that had NO colour recorded.

NOTE ALSO – some students also attracted a penalty of "-1" mark because they failed to follow some of the instructions.

1.

Marking criteria	*Marks*
(1) identifies an appropriate material, including its colour, that can be used to make a natural indicator (eg.*" rose petals"* is not good enough since white rose petals would not make an acid/base indicator; whereas dark red rose petals make a useful indicator). (2) describes the procedure used in class to make a natural indicator, clearly outlining the correct sequence of processes (grinding; decanting/filtering) and identifying the critical pieces of equipment used (mortar & pestle) and other chemicals used (sand & ethanol).	2
Either point 1 OR point 2 as above.	1

NOTE – before marking questions 2 AND 3, the answers from all students were divided into TWO groups.

→ Group A – students who interpreted the colour observed when methyl orange was added to solutions A & B as orange (in-between red and yellow) - thus indicating a pH range of 3.1 – 4.4.

→ Group B – students who interpreted the colour observed when methyl orange was added to solutions A & B as an intense shade of yellow – thus indicating a pH range of > 4.4.

2. a.

Marking criteria	*Marks*
Analysis of the results should have yielded the following deductions → <u>Group A</u> – identifies the pH of the solutions as:- A = inconclusive; B = 3.1 - 4.4; C = < 3.1 <u>Group B</u> – identifies the pH of the solutions as;- A = > 10.0; B = 4.4 - 8.2; C = < 3.1 Correctly identifies the pH range for all 3 solutions	3
Correctly identifies the pH range for 2 of the solutions	2
Correctly identifies the pH range for 1 of the solutions	1

NOTE –

Your answer to question 3 was marked based on the answer you gave to question 2.

3.

Marking criteria	*Marks*
(1) Clearly and correctly links ALL THREE of the colours observed (when the natural indicator was added to solutions A, B & C) to the level of acidity/basicity of each solution. The answer can be either quantitative (eg. pink indicates pH < 3.1) OR qualitative (eg. pink indicates a strongly acidic substance). The answer MUST be consistent with the analysis given in question 2. (2) Makes a judgement about the usefulness of red pansy solution as acid/base indicator that is consistent with points 1 and 3. (3) Provides ONE (3 marks) or TWO (4 marks) statements supporting the judgement that detail the usefulness of the red pansy solution as an acid/ base indicator (relating colours, & the pH range they indicate, to their ability to identify/distinguish between solutions with different pH's.) [see below for examples of typical statements.]	3 - 4
(1) Clearly and correctly links the colour observed for TWO (or 3) of the 3 solutions (when the natural indicator was added to solutions A, B & C) to the acidity/basicity of each solution. The answer can be either quantitative (eg. pink indicates pH < 3.1) OR qualitative (eg. pink indicates an acidic substance). The answer MUST be consistent with the analysis given in question 2. OR (2) Covers points (2) AND (3) as outlined for 3-4 marks BUT does not directly link each of the 3 colours (observed when the red pansy indicator was added to each of the solutions) to a specific level of acidity/basicity.	2

Identifies that the red pansy natural indicator gave different colours in each of the 3 solutions	1

Group A
* can be used to distinguish strong acids from weak acids (pink vs colourless)
*can be used to distinguish strong to moderately weak acids from neutral/basic (pink/colourless vs another colour)
* cannot be used to distinguish neutral solutions from basic solutions (not enough info for this)
* cannot be used to distinguish weak bases from strong bases (not enough info for this)

Group B
* can be used to distinguish strong acids from strong bases (pink vs yellow)
* can be used to identify a solution as weakly acidic, neutral or weakly basic (colourless)
* cannot be used to distinguish neutral solutions from weakly basic solutions (both colourless)
* cannot be used to distinguish neutral solutions from weakly acidic solutions (both colourless)

Part 2 – Processing second hand data.

1. a.

Marking criteria	*Marks*
$2FeS_{2(s)} + 5O_{2(g)} \rightarrow 2FeO_{(s)} + 4SO_{2(g)}$	1

1. b.

Marking criteria	*Marks*
Calculates the mass of $FeS_{2(s)}$ as 13.125 kg or 13125 g or 0.00131 T showing working with the same units used consistently in calculations	2
Calculates the mass of $FeS_{2(s)}$ showing working but units used are NOT consistent throughout	1

1.c.

Marking criteria	*Marks*
(1) Using symbol formulae ($n = m/M$ & $V = n.V_M$) (2) Calculates the moles of FeS_2 (109.38 mol) (3) Uses the mole ratio to calculate the moles of SO_2 (218.77 mol) (4) calculates the volume of SO_2 (5420 L)	3
Calculates, correctly, only two steps of (2), (3) & (4) above	2
Calculates, correctly, only one of (2), (3) & (4) above	1

1. d.

Marking criteria	*Marks*
Identifies TWO sources of sulfur dioxide (other than combustion of a fuel)and provides one qualifying statement	2
Identifies ONE other source of sulfur dioxide	1

2

Marking criteria	*Marks*
Describes TWO pieces of evidence that indicate non-metal oxide concentrations in the environment have increased	4
Describes ONE piece of evidence that indicate non-metal oxide concentrations in the environment have increased AND describes ONE piece of evidence without showing how it supports the statement	3
Describes ONE piece of evidence that indicate non-metal oxide concentrations in the environment have increased	2
Describes ONE piece of evidence without showing how it supports the statement	1

3.

Marking criteria	*Marks*
Includes * Clear, relevant and specific assessment of the impacts of NO_x on the environment. * Specifically describes TWO impacts of MORE than one oxide of nitrogen on the environment. * Includes TWO relevant and correct equations	6
Includes • Clear, relevant and specific assessment of the impacts of NOx on the environment. • Outlines TWO impacts of TWO oxides of nitrogen on the environment. • Includes TWO relevant and correct equations.	5
Includes • Assessment of the impacts of NOx of the environment. • Outlines TWO impacts of oxides of nitrogen on the environment. • Includes TWO relevant and correct equations.	4
Includes • Makes value judgements for individual impacts • Includes TWO or ONE impact on the environment. • Includes TWO or ONE correct equations	3-2
Includes one relevant statement	1