Grade 9 Natural Sciences Worksheet

Carbon dioxide

Have you ever wondered why cakes rise in the oven, or what the bubbles in fizzy cold-drinks are actually made of? The answer in each case is the same – carbon dioxide.

Part One: Features of carbon dioxide

Fill in the gaps in the notes below:

Carbon dioxide is a _____ at room temperature, and a _____ of carbon dioxide is formed when two _____ of _____ join with one atom of _____. The chemical formula for carbon dioxide is _____. CO_2 is a _____ product of _____ and our cells produce CO_2 which is expelled via the _____ into the atmosphere. Plants use CO_2 in order to manufacture _____ in the process of _____. Although there is CO_2 gas in the _____ around us, baked products such as cakes do not extract this gas from the air. The CO_2 is produced as a result of a chemical reaction.

Make a labelled diagram showing the structural formula of carbon dioxide.

[15 marks]

Grade 9 Natural Sciences Worksheet

Part Two: Can you make carbon dioxide?

Complete this practical investigation and then write up your observations. Answer all the questions relating to the investigation.

You will need:

Four clean dry saucers

Measuring spoons

2 teaspoons baking powder

2 teaspoons sodium bicarbonate ("bicarb")

10ml water

10ml vinegar

What to do:

1. Label the saucers A, B, C and D and then, according to the table below, place one teaspoon of either bicarb or baking powder ONLY in each of the relevant saucers.

Saucer	**Observation**
A: Bicarb and water	
B: Bicarb and vinegar	
C: Baking powder and water	
D: Baking powder and vinegar	

Grade 9 Natural Sciences Worksheet

2. Now add the water and vinegar to the relevant saucers, as detailed in the table above. Add the reactants one saucer at a time and observe what happens. Make a careful note of your observation in the table before continuing to the next saucer.

3.Explain your observations and try and account for them in a REPORT entitled:

THE BEHAVIOUR OF SODIUM BICARBONATE AND BAKING POWDER IN THE PRESENCE OF WATER AND VINEGAR

[15]

Your teacher will allocate a maximum of 10 further marks for the way in which your conduct the practical. Did you follow instructions? Did you ensure good results by having good experimental protocol? Did you clean up your work area? Did you behave responsibly throughout, etc.

[10]

[25 marks]

Part Three: Investigation into a fruit salt

The commercial fruit salt for indigestion and heartburn, ENO, is known for its property of effervescence. When added to water, it bubbles violently. When swallowed, the ENO will alleviate indigestion, nausea and heartburn resulting from increased acidity in the stomach. The label on a bottle of ENO states that the contents are: "For every 5 g dose – sodium bicarbonate: 2,32 g; anhydrous citric acid: 2,18 g; sodium carbonate: 0,5 g."

1. Why does the ENO exhibit effervescence when it is added to water?
2. Why does one "burp" after swallowing ENO?
3. Why does the ENO alleviate acid indigestion and heartburn?
4. How is ENO related to carbon dioxide?

[15 marks]

Grade 9 Natural Sciences Worksheet

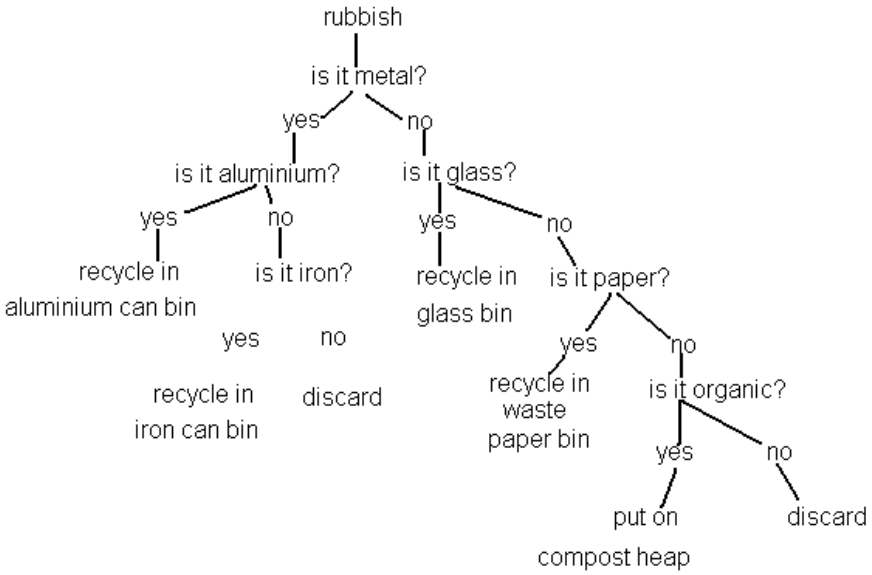
Part Four: A decision tree

Mrs Dlamini had a bit of a mishap in her kitchen. She had five kitchen products in five different glass jars. Her son, Nhlanhla, decided to wash the outside of the jars to help his mother clean the kitchen and he washed the labels off the bottles. All the substances look the same – fine white powder. Mrs Dlamini knows that the five substances are:

Flour * salt * baking powder * icing sugar * bicarbonate of soda.

Which substance is in which jar?

Nhlanhla has been studying "decision trees" at school. Decision trees are charts used to sort and classify things by leading you through a series of "yes/no questions" to an eventual decision. This is a decision tree Nhlanhla made at school today in order to sort the household rubbish for recycling:



Grade 9 Natural Sciences Worksheet

Nhlanhla says that he will make a decision tree for his mother to use to identify each of the five “mystery substances”.

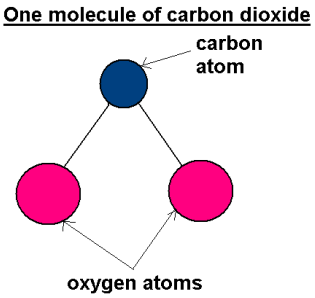
Draw the decision tree for Nhlanhla.

[15 marks]

Grade 9 Natural Sciences Worksheet

Suggested Solutions

<table>
<tr><th>Question number</th><th>Possible marks</th><th>Solution</th></tr>
<tr><td>1</td><td>15</td><td>Carbon dioxide is a gas at room temperature, and a molecule of carbon dioxide is formed when two atoms of oxygen join with one atom of carbon. The chemical formula for carbon dioxide is CO_2. CO_2 is a waste product of cellular respiration and our cells produce CO_2 which is expelled via the lungs into the atmosphere. Plants use CO_2 in order to manufacture glucose in the process of photosynthesis. Although there is CO_2 gas in the air around us, baked products such as cakes do not extract this gas from the air. The CO_2 is produced as a result of a chemical reaction.

 
</td></tr>
<tr><td>2</td><td>15 + 10 for practical work = 25</td><td>
<table>
<tr><th>Saucer</th><th>Observation</th></tr>
<tr><td>A: Bicarb and water</td><td>Two substances mix, no noticeable reaction, even when stirred. ✓✓</td></tr>
<tr><td>B: Bicarb and vinegar</td><td>Immediately the substances come into contact with each other they fizz violently, the reaction continues for a while then slows down and finally stops. ✓✓</td></tr>
<tr><td>C: Baking powder and water</td><td>Immediately the substances come into contact with each other they fizz violently, the reaction continues for a while then slows down and finally stops; the reaction was possibly more violent than that in saucer B. ✓✓</td></tr>
<tr><td>D: Baking powder and vinegar</td><td>Immediately the substances come into contact with each other they fizz violently, the reaction continues for a while then slows down and finally stops; the reaction was possibly more violent than that in saucer B or C. ✓✓</td></tr>
</table>

THE BEHAVIOUR OF SODIUM BICARBONATE AND BAKING POWDER IN</td></tr>
</table>

Grade 9 Natural Sciences Worksheet

		THE PRESENCE OF WATER AND VINEGAR The sodium bicarbonate has carbonate in it which reacts with the acid in the vinegar. ✓ The reaction produces CO_2 gas bubbles ✓ which fizz up and then burst leaving the surface of the liquid. ✓ The water is not acidic, and so no reaction took place with the bicarb. (If the water in your area does possess a small amount of acid, there would have been a small degree of fizzing.) The baking powder reacted with both the water and the vinegar, although more violently with the vinegar. ✓ One of the ingredients in baking powder is sodium bicarbonate – ✓which accounts for the fizzing reaction and the emission of CO_2 gas when vinegar (or any acid is added). ✓ However, in baking, in order to get bubbles in the dough mixture which will assist the cake to rise, although the CO_2 is needed, the vinegar is not going to contribute to a pleasant flavour! ✓ So the manufacturers of baking powder exploit the general principle that CO_2 gas is emitted when an acid comes into contact with a carbonate, by having sodium bicarbonate present, but also, in powder form, some acidic salts (such as citric acid). ✓ When the powder is dry, the reaction will not proceed. However, once water (or milk) is added to the cake mixture, the acidic salts begin to dissolve and react with the carbonate, producing CO_2 gas. ✓ The fizzing noise is known as effervescence – it is caused by the production of CO_2 bubbles which are rapidly produced and burst. ✓ Award a maximum of 10 marks for the manner in which the practical work was conducted: Did learners follow instructions closely? Was the protocol fair and well controlled? Did learners clean up after their work, etc.
3	15	1. The ENO effervesces when added to water because the sodium carbonate ✓ and sodium bicarbonate ✓ as well as the citric acid ✓ dissolves in the water ✓ and the carbonates react with the acid ✓ to produce CO_2 gas ✓ which bubbles up. ✓ 2. One burps after swallowing ENO, because the reaction continues in the liquid ✓ and more CO_2 is produced, ✓ which fills the stomach, ✓ causing one to burp to alleviate the excess gas in the stomach. ✓ 3. The ENO alleviates acid indigestion and heartburn because the carbonates are alkaline in nature ✓ (the opposite of acids) and they counter or neutralise the acids in the stomach. ✓ 4. The chemicals in the ENO release carbon dioxide ✓ when they combine in water. ✓
4	15	See diagram in Appendix of Assessment Tools.

Grade 9 Natural Sciences Worksheet