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90944



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Level 1 Science, 2015

90944 Demonstrate understanding of aspects of acids and bases

9.30 a.m. Tuesday 10 November 2015
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of acids and bases.	Demonstrate in-depth understanding of aspects of acids and bases.	Demonstrate comprehensive understanding of aspects of acids and bases.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Pull out Resource Booklet 90944R from the centre of this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Not Achieved

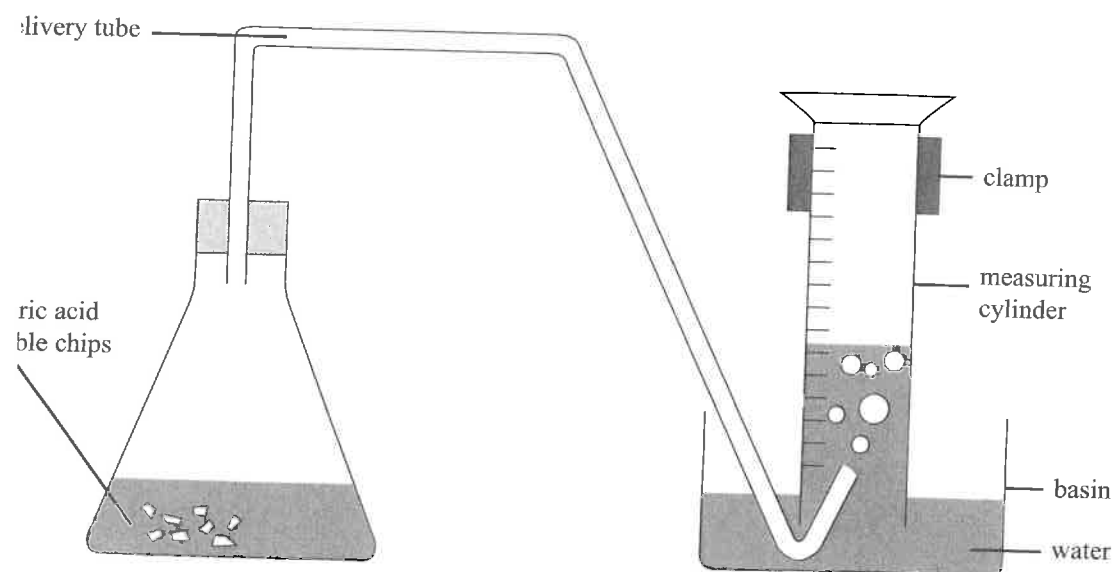
TOTAL

6

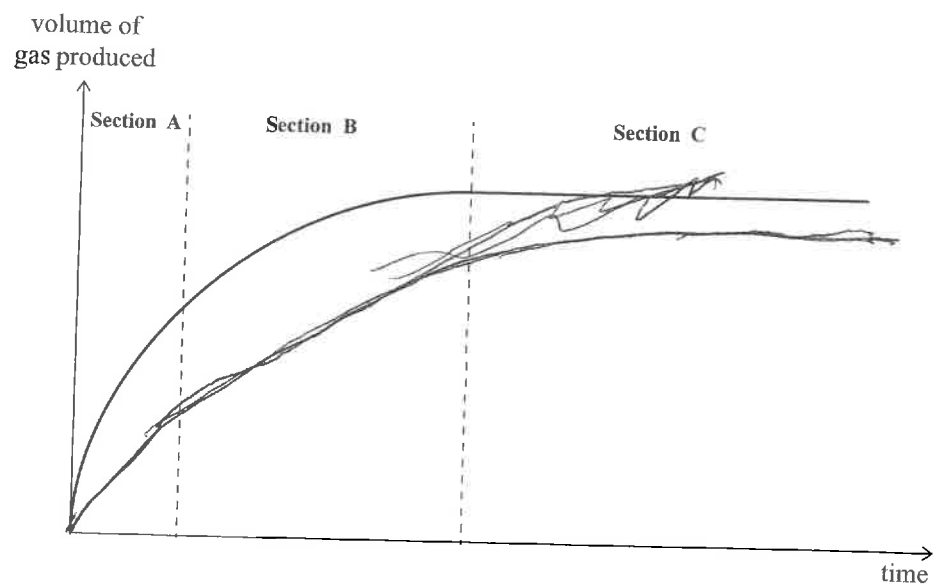
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ION ONE

Marble chips (calcium carbonate) were added to nitric acid in a conical flask. The temperature of the acid was 50°C . The flask was connected to an inverted measuring cylinder in a basin of water to measure the volume of gas produced, as shown in the diagram below.



The graph below shows the volume of gas produced against time.



Explain what is happening in terms of particle collisions and rate of reaction in each section of the graph.

Section A: There are lots of collisions in section A, most likely as it is hotter meaning particles are more energized and moving faster.

Section B: The amount of collisions is getting less and less, possibly as the temperature is dropping.

Section C: There are no collisions occurring.

- (b) The reaction was carried out again but this time at 20°C . The mass and size of the marble chips, and the concentration and volume of nitric acid used were kept the same.
- Draw a line on the graph that represents the reaction at 20°C .
 - Explain why you drew this line where you did, and explain if this means that the rate of reaction is slower, the same, or faster.

In your answer you should

- discuss why you drew your line with the slope that you did, and why you stopped the line at the point that you did
- explain the effect of temperature on reaction rate, in terms of particle collisions.

I placed the line below and at a less steep gradient as the particles wouldn't be as energized therefore it would take longer for all the collisions to take place.

There is more space for your answer to this question on the following page.

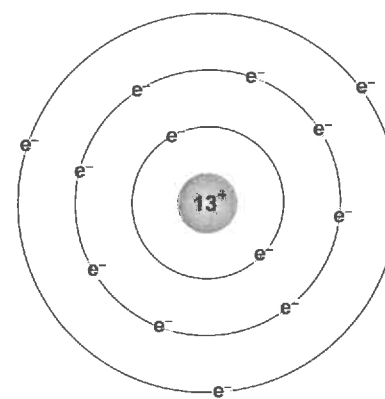
- (c) Write a word equation AND a balanced symbol equation for the reaction between nitric acid and calcium carbonate.

Word equation:

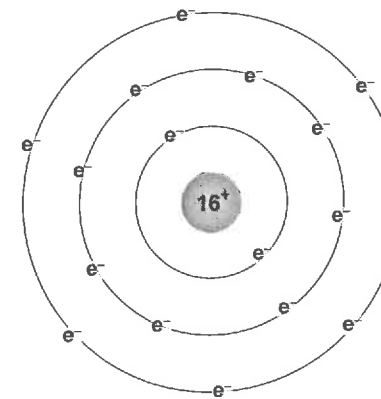
Balanced symbol equation:

QUESTION TWO

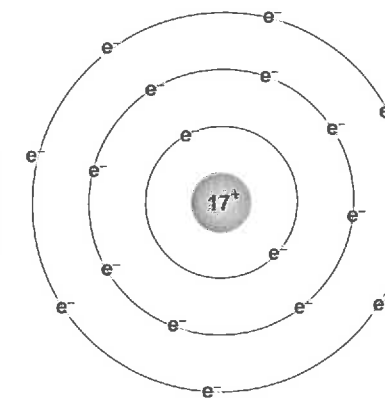
The diagrams below show models of three different atoms.



Aluminium



Sulfur



Chlorine

- (a) Each of these atoms can form ions, as listed below.

- Explain why each of the **ions** has the charge it does, in terms of electron arrangement and number of protons.
- Ions are charged atoms. Explain how each of the ions below reached the charge shown. You should discuss particles gained or lost by the atoms involved, and the reasons for this.

Aluminium ion, Al^{3+} : it is positively charged as it would be easier for it to lose 3 electrons to gain a full outer shell rather to gain 5.

Sulfide ion, S^{2-} : it is negatively charged as it is easier for this atom to gain three ~~to~~ 2 electrons than to lose 6 to get a full outer shell.

Chloride ion, Cl^- : it is negatively charged as it only needed to gain 1 electron to have a full outer shell.

(b) Explain why an ionic bond would **not** form between a sulfide ion and a chloride ion.

In your answer you should:

- describe an ionic bond
- refer to charges and electron arrangements of the ions involved.

As ~~2+~~ As the ions are both charged negatively?

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(c) Determine the ionic formulae of the compound that forms when aluminium combines with chlorine, AND when aluminium combines with sulfur.

In your answer you should:

- consider the ratio of ions in each formula, and explain how the ratio is related to the charge on the ions
- relate the ratio of ions in each formula to the number of electrons lost or gained by each atom when forming ions.

Aluminium and chlorine:

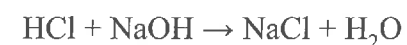
Aluminium and sulfur:

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QUESTION THREE

The chemical equation below represents the reaction between hydrochloric acid and sodium hydroxide:



- (a) Complete the table below to show the approximate pH for each of the three solutions.

	Colour when UI is added	pH
HCl	red	1
NaOH	purple	14
H ₂ O	green	7

- (b) Water is formed in the reaction above.

Explain what ions form water in this reaction, and where they come from.

You may use an equation but this is not required.

H^+ and OH^- the ions H^+ and OH^- form water

- (c) NaOH is gradually added to a solution of HCl with universal indicator present, until no further colour change occurs.

Discuss what is occurring in the beaker at each of the pH's shown, as the NaOH is added.

In your answer you should refer to:

- the colours that would occur at each pH
- the relative amounts of hydrogen and hydroxide present at each of the pH's shown.

pH = 1 (before any NaOH is added): this is ~~very~~ ^{strong} acidic acid
there are lots of hydrogen and hydroxides present.

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pH = 4: ~~less~~ still acidic but weaker ~~less~~
hydrogen and hydroxide present.

pH = 7: It is now neutral balanced amount
of acid and base

pH = 10: it is a weak base

pH = 13: strong base.

- (d) In a different chemical reaction, hydrochloric acid reacts with magnesium hydroxide.

Write a word equation and a balanced chemical equation for this reaction in the boxes below.

Word equation:

Balanced symbol equation:

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Not Achieved exemplar for 90944 2015		Total score	06
Q	Grade score	Annotation	
1	A3	<p>Candidate appreciated that the reaction occurred slower and finished at some point. They also mentioned that particles would not be moving as fast, less "energised" at lower temperatures.</p> <p>Candidate did not get to the Merit level - confused collisions of reactant particles with particle collisions. The number of particle collisions will stay the same it is just the frequency of effective collisions per unit time of <u>reactant</u> particle collisions that will diminish.</p>	
2	N1	<p>Here the candidate only talked about electrons in an atom and did not mention protons in this atom or the ratio of protons to electrons.</p>	
3	N2	<p>A mention of the correct pH for the colours in the table as well as a statement that at pH = 7 the solution is now neutral gained this candidate an N2.</p> <p>The other colours at pH 4 and 10 were not mentioned as well as it is H⁺ ions and OH⁻ ions that form water.</p>	