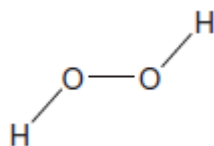


Q1.A hydrogen peroxide molecule can be represented by the structure shown.



- (a) Suggest a value for the H-O-O bond angle.

.....

(1)

- (b) Hydrogen peroxide dissolves in water.

- (i) State the strongest type of interaction that occurs between molecules of hydrogen peroxide and water.

.....

(1)

- (ii) Draw a diagram to show how one molecule of hydrogen peroxide interacts with one molecule of water.
Include all lone pairs and partial charges in your diagram.

(3)

- (c) Explain, in terms of electronegativity, why the boiling point of H_2S_2 is lower than H_2O_2 .

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.....
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.....
.....

(2)
(Total 7 marks)

Q2. The following table shows the electronegativity values of the elements from lithium to fluorine.

| | | | | | | | |
|-------------------|-----|-----|-----|-----|-----|-----|-----|
| | Li | Be | B | C | N | O | F |
| Electronegativity | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |

- (a) (i) State the meaning of the term *electronegativity*.

.....
.....
.....
(Extra space)
.....

(2)

- (ii) Suggest why the electronegativity of the elements increases from lithium to fluorine.

.....
.....
.....
(Extra space)

.....

(2)

- (b) State the type of bonding in lithium fluoride.
Explain why a lot of energy is needed to melt a sample of solid lithium fluoride.

Bonding

Explanation

.....

.....

(Extra space)

.....

(3)

- (c) Deduce why the bonding in nitrogen oxide is covalent rather than ionic.

.....

.....

(Extra space)

.....

(1)

- (d) Oxygen forms several different compounds with fluorine.

- (i) Suggest the type of crystal shown by OF_2

.....

(1)

- (ii) Write an equation to show how OF_2 reacts with steam to form oxygen and hydrogen fluoride.

.....

(1)

- (iii) One of these compounds of oxygen and fluorine has a relative molecular mass of 70.0 and contains 54.3% by mass of fluorine.

Calculate the empirical formula and the molecular formula of this compound. Show your working.

Empirical formula

.....

.....

.....

.....

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Molecular formula

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(4)

(Total 14 marks)

Q3.(a) Ammonia gas readily condenses to form a liquid when cooled.

- (i) Name the strongest attractive force between two ammonia molecules.

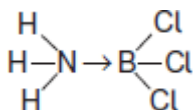
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(1)

- (ii) Draw a diagram to show how two ammonia molecules interact with each other in the liquid phase. Include all partial charges and all lone pairs of electrons in your diagram.

(3)

- (b) Ammonia reacts with boron trichloride to form a molecule with the following structure.



State how the bond between ammonia and boron trichloride is formed.

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.....

.....

(1)

(c) The following table shows the electronegativity values of some elements.

| | H | Li | B | C | O | F |
|-------------------|-----|-----|-----|-----|-----|-----|
| Electronegativity | 2.1 | 1.0 | 2.0 | 2.5 | 3.5 | 4.0 |

(i) Give the meaning of the term **electronegativity**.

.....

.....

.....

.....

(2)

(ii) Suggest the formula of an ionic compound that is formed by the chemical combination of two different elements from the table.

.....

(1)

(iii) Suggest the formula of the compound that has the least polar bond and is formed by chemical combination of two of the elements from the table.

.....

(1)

(Total 9 marks)

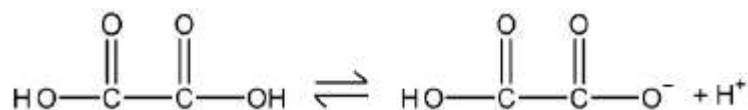
Q4. Which of these atoms has the highest electronegativity?

- A Na
- B Mg
- C Cl
- D Ar

(Total 1 mark)

Q5. Ethanedioic acid is a weak acid.

Ethanedioic acid acts, initially, as a monoprotic acid.



- (a) Use the concept of electronegativity to justify why the acid strengths of ethanedioic acid and ethanoic acid are different.

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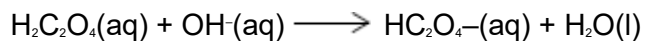
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(6)

- (b) A buffer solution is made by adding 6.00×10^{-2} mol of sodium hydroxide to a solution containing 1.00×10^{-1} mol of ethanedioic acid ($\text{H}_2\text{C}_2\text{O}_4$). Assume that the sodium hydroxide reacts as shown in the following equation and that in this buffer solution, the ethanedioic acid behaves as a monoprotic acid.



The dissociation constant K_a for ethanedioic acid is $5.89 \times 10^{-2} \text{ mol dm}^{-3}$.

Calculate a value for the pH of the buffer solution.

Give your answer to the appropriate number of significant figures.

pH =

(5)

- (c) In a titration, the end point was reached when 25.0 cm^3 of an acidified solution containing ethanedioic acid reacted with 20.20 cm^3 of $2.00 \times 10^{-2} \text{ mol dm}^{-3}$ potassium manganate(VII) solution.

Deduce an equation for the reaction that occurs and use it to calculate the original concentration of the ethanedioic acid solution.

Equation

Calculation

Original concentration = mol dm^{-3}

(4)

(Total 15 marks)

