2.23 Bond Energies, Cells and Fuel Cells: 10-minute Pack

AQA 8464 · Calculator allowed · about 10 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A molecule of hydrogen chloride, HCl, has an H-Cl bond enthalpy of 431 kJ per mole. Calculate the energy needed to break all the H-Cl bonds in 0.250 mol of HCl gas.

(a) Calculate the energy needed to break all H-Cl bonds in 0.250 mol HCl gas. **(2)**

(Total for Question 1 is 2 marks)

2 In a required practical to investigate the reactivity series, a student measures the emf of cells made with different metal electrodes in a solution of their own ions. Explain one control variable and one improvement the student could make to reduce random error in emf measurements.

(a) State one control variable and explain why it should be controlled. **(1)**

(b) Give one improvement to reduce random error and explain how it helps. **(1)**

(Total for Question 2 is 2 marks)

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3 A student makes a simple cell by connecting a magnesium electrode and a copper electrode, each dipped in electrolyte solution and joined by a wire and voltmeter. Magnesium is a much more reactive metal than copper.

(a) State which electrode is the negative electrode and give a brief explanation. **(1)**

(b) The student then makes a magnesium-iron cell (iron is less reactive than magnesium, but more reactive than copper). State, with a reason, which of the two cells (magnesium-copper or magnesium-iron) would produce the larger potential difference. **(3)**

(Total for Question 3 is 4 marks)

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Mark scheme · 2.23 Bond Energies, Cells and Fuel Cells: 10-minute Pack

Question 1

(a) substitutes: energy = 431 kJ mol^{-1} x 0.250 mol **M1**

(a) 107.75 kJ (allow 108.0 kJ) cao **A1**

(a) Answer: 108 kJ

Question 2

(a) control variable: concentration of the metal ion solutions and explanation that emf depends on concentration so must be kept constant **B1**

(a) Answer: Control variable: concentration of metal ion solutions, because emf depends on ion concentration and must be constant to compare cells.

(b) repeat measurements and take the mean, explanation that this reduces random variation and gives a more reliable emf value **B1**

(b) Answer: Repeat each emf measurement several times and use the mean, which reduces random variation and gives a more reliable value.

Question 3

(a) magnesium electrode is the negative electrode because magnesium is the more reactive metal and loses electrons more readily (is oxidised) **B1**

(a) Answer: Magnesium electrode is the negative electrode because magnesium is more reactive than copper and loses electrons more readily.

(b) identifies the magnesium-copper cell as producing the larger potential difference cao **M1**

(b) states that the size of the potential difference produced by a simple cell depends on the difference in reactivity between the two metals used **M1**

(b) explains that magnesium and copper are further apart in reactivity than magnesium and iron, so the magnesium-copper cell has the bigger reactivity difference and produces the bigger potential difference, oe **A1**

(b) Answer: The magnesium-copper cell would produce the larger potential difference, because the size of the potential difference depends on the difference in reactivity between the two metals, and magnesium and copper are further apart in reactivity than magnesium and iron.

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