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SPECA

GCSE Combined Science (AQA Trilogy) · Chemistry

Chemical Changes · Mark Scheme

For use with the Tiered Worksheet. Marking points are indicative, not exhaustive: award equivalent correct answers.

Section A: Foundation (Q1 to 23)

1) The metal gains oxygen when it reacts, and gaining oxygen is called oxidation (1) [1]

2) Loss of oxygen (1) [1]

3) Magnesium is more reactive than copper (1); copper is below hydrogen in the reactivity series so it cannot displace hydrogen from the acid, while magnesium (above hydrogen) can (1) [2]

4) A reddish-brown deposit of copper forms on the zinc, and the blue colour of the solution fades (1); zinc is more reactive than copper, so it displaces copper from the copper sulfate solution, forming zinc sulfate solution and copper metal (2) [3]

5) A, C, B (2 marks for fully correct order; 1 mark if only the most or least reactive is correctly placed) [2]

6) Gold is very unreactive (1), so it does not readily react with other elements to form compounds, unlike more reactive metals (1) [2]

7) Zinc is less reactive than carbon, so carbon can reduce (remove oxygen from) zinc oxide (1); aluminium is more reactive than carbon, so carbon cannot displace/reduce it from its oxide (1) [2]

8) Magnesium chloride (1); hydrogen (1) [2]

9) zinc + sulfuric acid → zinc sulfate + hydrogen (1 for reactants, 1 for products) [2]

10) salt + water (2, 1 for each correct term) [2]

11) salt + water + carbon dioxide (3, 1 for each correct term) [3]

12) Sodium nitrate (1) [1]

13) Copper sulfate (1) [1]

14) Add the insoluble metal oxide to the acid, warming gently, until no more solid reacts and excess solid remains (1); filter off the excess unreacted solid (1); gently heat/evaporate the resulting salt solution (e.g. using a water bath) to remove some water (1); leave the concentrated solution to cool and crystallise, then filter and dry the crystals (1) [4]

15) pH 7 is neutral (1); below pH 7 is acidic (1) [2]

16) Hydrogen ions, H^+ (1); hydroxide ions, OH^- (1) [2]

17) OH^- (1) [1]

18) pH 7: neutral (1); pH 12: alkaline (1) [2]

19) In the solid state, the ions are held in fixed positions in the lattice and cannot move (1); when molten or dissolved, the ions become free to move, allowing the substance to conduct electricity and be electrolysed (1) [2]

20) Positive ions move to the cathode (negative electrode) (1); negative ions move to the anode (positive electrode) (1) [2]

21) Lead forms at the cathode (1); bromine forms at the anode (1) [2]

22) Aluminium is more reactive than carbon, so carbon cannot reduce/displace it from its oxide, meaning electrolysis must be used instead (1-2); cryolite is mixed with the aluminium oxide to lower the melting point of the mixture, reducing the energy (and cost) needed (1) [3]

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23) Sodium chloride solution: hydrogen at the cathode (sodium is more reactive than hydrogen) (1), chlorine at the anode (halide ions are present) (1); copper sulfate solution: oxygen at the anode (no halide ions present, so water contributes the ions discharged instead) (1) [3]

Section B: Higher (Q24 to 31)

24) Oxidation is loss of electrons (1); reduction is gain of electrons (1) [2]

25) $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ (2, 1 for correct ions/formulae, 1 for balancing); zinc is oxidised, it loses electrons (1); copper ions are reduced, they gain electrons (1) [4]

26) Magnesium atoms lose electrons to form Mg^{2+} ions: oxidation (1-2); hydrogen ions gain electrons to form hydrogen gas (H_2): reduction (1); because electrons are transferred (lost by one species, gained by another), this is a redox reaction (1) [3]

27) A strong acid is completely ionised in solution, e.g. hydrochloric acid (1); a weak acid is only partially ionised in solution, e.g. ethanoic acid (1) [2]

28) "Strong/weak" describes the degree of ionisation: how much of the acid splits into ions in solution (1); "concentrated/dilute" describes how much acid is dissolved in a given volume of water, these are independent properties (1) [2]

29) pH 2 has the higher hydrogen ion concentration (1); it is 100 times higher, since each pH unit represents a tenfold change and there are two pH units of difference (10 × 10) (1) [2]

30) Cathode: $Pb^{2+} + 2e^- \rightarrow Pb$ (1); Anode: $2Br^- \rightarrow Br_2 + 2e^-$ (1) [2]

31) $2H^+ + 2e^- \rightarrow H_2$ (1) [1]

Total: 47 marks (Section A) + 18 marks (Section B) = 65 marks

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