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| **Describe the role of human activity on CO2 emissions** | States that human activity has increased CO2 levels | 1 mark |
| Describes how humans contribute towards CO2 emissions (e.g. combustion of fuels, deforestation) | 1 mark |
| Includes some form of evidence. e.g. “the production of electricity is the main source of CO2 emissions, accounting for 37% of all emissions.”  *OR*  Data about CO2 concentrations | 1 mark |
| **Explain the link between CO2 emissions and ocean acidification** | Equation:  CO2(g) + H2O(ℓ) ⇌ H2CO3(aq)  H2CO3(aq) ⇌ H+(aq) + HCO3-(aq) | 2 marks |
| Explains using appropriate principles how increasing [CO2] affects [H+] | 2 marks |
| Links increasing [H+] to decreasing pH | 1 mark |
| Provides evidence of changing ocean pH (e.g. pH has decreased from 8.2 to 8.1) | 1 mark |
| **Describe and explain the effects of ocean acidification on marine organisms** | Describes calcification process (e.g. marine organisms such as coral, shellfish, etc construct exoskeletons out of CaCO3 | 1 mark |
| Explains that ocean acidification removes CO32- ions from water, preventing calcification  CO32-(aq) + H+(aq) ⇌ HCO3-(aq)  *OR*  Explains that ocean acidification causes higher [H+] and this reacts with CaCO3(s) to dissolve it  CaCO3(s) + H+(aq) ⇌ Ca2+(aq) + HCO3-(aq) | 2 marks |
| Describes follow-on effects in marine ecosystems. *‘If X dies due to ocean acidification then this would have an effect on Y and Z’.* | 1 mark |
| Provides evidence of effects of ocean acidificiation. e.g. change in mass of coral. | 1 mark |
| **Describe the actions taken by Australian and international governments to reduce future CO2 emissions** | Describes at least one recent Australian initiative, such as:   * Renewable energy target * Emission trading scheme (ETS) * Direct action * Climate Change Authority * Clean Energy Finance Corporation | 1 mark |
| Describes role of IPCC | 1 mark |
| Describes role of Kyoto Protocol | 1 mark |
| **Quality of writing** | Characteristics of excellent answer:   * Well organized ideas that flow easily * Good use of vocabulary, including relevant scientific terms * Use of subheadings and paragraphs to effectively order ideas * Concise language – lack of needless repetition * Legible writing with minimal spelling errors | 3 marks |

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| **Concepts of oxidation and reduction**  (can be integrated into answers for each application) | Redox is a process involving a transfer of electrons   * Oxidation is loss of electrons * Reduction is gain of electrons | 1 mark |
| Electrolysis using external power source to drive a non-spontaneous reaction | 1 mark |
| Oxidation occurs at the anode, reduction occurs at the cathode | 1 mark |
| **Electrowinning** | Purpose: Obtain sample of metal from a metal salt | 1 mark |
| Half equations:   * Na+(ℓ) + e-🡪 Na(ℓ) * 2 Cℓ-(ℓ) 🡪 Cℓ2(g) + 2 e- | ½ mark ½ mark |
| Diagram, showing:   * Anode and cathode * Suitable electrolyte (molten salt) * Direction of ion flow * External power source and direction of electron flow | ½ mark ½ mark ½ mark  ½ mark |
| Industrial production requires products to be separated so they do not react together again | 1 mark |
| **Electrorefining** | Purpose: Purify of a metal (e.g. copper) | 1 mark |
| Anode half-equations:  Cu(s) 🡪 Cu2+(aq) + 2 e-  And reaction of at least two more reactive metals (Ni, Zn, Fe)  Cathode half-equation:  Cu2+(aq) + 2 e- 🡪 Cu(s) | ½ mark  1 mark  ½ mark |
| Diagram, showing:   * Anode (impure copper) and cathode (pure copper) * Suitable electrolyte (e.g. CuSO4(aq)) * Direction of ion flow * External power source and direction of electron flow | ½ mark ½ mark ½ mark  ½ mark |
| **Electroplating** | Purpose: Coat object in layer of another metal | 1 mark |
| Half-equations:   * Cu(s) 🡪 Cu2+(aq) + 2e- * Cu2+(aq) + 2e- 🡪 Cu(s) | ½ mark ½ mark |
| Diagram, showing:   * Anode and cathode * Suitable electrolyte (e.g. CuSO4(aq)) * Direction of ion flow * External power source and direction of electron flow | ½ mark ½ mark ½ mark  ½ mark |
| **Quality of writing** | Characteristics of excellent answer:   * Well organized ideas that flow easily * Good use of vocabulary, including relevant scientific terms * Use of subheadings and paragraphs to effectively order ideas * Concise language – lack of needless repetition * Legible writing with minimal spelling errors | 3 marks |