

- Recharging would require oxidation of the copper that had been produced (which may be possible) and reduction of the zinc ions which isn't possible as they aren't now in contact with the electrode to receive electrons from it.*/2
Thus the Daniell cell is a primary cell.

- 7c - The only species present in any appreciable concentration in 1 M Na₂SO₄ solution are Na⁺, SO₄²⁻ and H₂O. */2.
 - The possible anode reactions are the oxidation of SO₄²⁻ ions or H₂O. Water is oxidised to O₂ (along with the production of H⁺ ions) at the anode as SO₄²⁻ ions already have sulfur in its highest oxidation state. */2
 - Both H₂O and Na⁺ ions could be reduced at the cathode but Na⁺ ions are a weaker oxidant compared to water */2
 - sodium E° = -2.71V compared to water -0.83V */2 (Reason why water is stronger oxidant)
 (½ mark per relevant point) [2 + 2 + 2 = 6]

8a HgO(s) *

- b anode: Zn(s) + 2OH⁻(aq) → Zn(OH)₂(s) + 2e⁻ *
 cathode: HgO(s) + H₂O(l) + 2e⁻ → Hg(l) + 2OH⁻(aq) *
One mark off if the half equations are beside the wrong label but are otherwise correct.

- c K⁺ ions are spectator ions ⇒ no change in their amount. OH⁻ ions are consumed at the anode in the same numbers as they are produced at the cathode ⇒ no change in their amount either.
 Thus, there is no change in the overall amount of KOH present. *

- d Any one of: leakage of corrosive KOH electrolyte, toxicity of Hg and HgO, small size so easily swallowed * etc.
 [1 + 2 + 1 + 1 = 5]

- 9a Anode: Pb(s) + SO₄²⁻(aq) → PbSO₄(s) + 2e⁻ *
 Cathode: PbO₂(s) + 4H⁺(aq) + SO₄²⁻(aq) + 2e⁻ → PbSO₄(s) + 2H₂O(l) *

- b One of - concentration decreases/ density decreases/ pH increases *

- c Advantage: one of - rechargeable/ delivers large amounts of energy etc *
 Disadvantage: one of - bulky/ acid spillage/ heavy/ toxic *

[(1 + 1) + 1 + 2 = 5]

- 10a Oxidation: 2Cl⁻(aq) → Cl₂(aq) + 2e⁻ (Accept Cl₂(g)) *
 Reduction: 2H₂O(l) + 2e⁻ → H₂(g) + 2OH⁻(aq) *
 Overall: 2Cl⁻(aq) + 2H₂O(l) → Cl₂(aq) + H₂(g) + 2OH⁻(aq) * (consequential possible)
Oxidation and reduction reaction separation is not required just 2 half equations. Consequential 1 mark if half equations are incorrect but it is a correct addition of the half equations, provided that the half equations contain electrons and that they are not frivolous.

- b Acid neutralises the hydroxide ions produced during the electrolysis.

- ci. a structure to ensure that the hydrogen and chlorine do not mix. *
 cii. contamination due mixing of the gases or reaction of the hydrogen, chlorine and hydroxide ions are possible but these are commercially undesirable. Potentially a volatile reaction may occur. *

[3 + 1 + (1 + 1) = 6]

11a O₂(g) *

- b O₂(g) + 4H⁺(aq) + 4e⁻ → 2H₂O(l) **

[1 + 2 = 3]

END of ANSWERS