**Memo for Redox Chemistry Revision Worksheet (papers from 2008)**

**Question 1**

1.1.1 1 mol.dm-3 ✓ 25°✓ (2)

1.1.2 Anode✓ (1)

1.1.3 Lead Nitrate ✓ Pb(NO3)2 (1)

1.1.4 X ✓ (1)

**Metal x**

**Half cell**

**Lead**

**Half cell**

**Salt bridge**

**Electrons**

**V**

1.1.5 Electron direction✓

 Correct placement of half cells & salt bridge ✓

 Voltmeter & leads correctly placed.✓ (3)

1.1.6 Take a reading from the voltmeter ✓and substitute it as E°cell into the formula,

 E°cell = E°cat – E°an✓

 (Pb) (x)

 E°x = -0,13✓ – E°cell

 (voltmeter reading)

Compare the answer for E°x to values on SEP table to determine which metal it corresponds to. ✓ (4)

1.1.7 emf approaches zero.✓ (1)

1.1.8 emf increases✓ Forward reaction is favoured✓ because there are more Pb2+ ions to reduce ∴ electrons are transferred at a faster rate✓ (3)

**[16]**

1.2.1 Primary cell is not rechargeable. Secondary cell is rechargeable.✓

 e.g. Lead-acid accumulator (car battery); nickel-cadmium battery.✓ (2)

1.2.2 Chemical (potential) to electrical.✓ (1)

1.2.3 Zinc is **oxidised** to Zn2+ ions ✓ Zn → Zn2+ + 2e- ✓ (2)

1.2.4 It **increases the surface area of the electrode** ✓ (and lowers the internal resistance of the cell) ∴ more reactants in contact with the electrode ∴ **faster reaction rate** ✓∴ more electrons exchanged per second ∴ bigger current.✓ (3)

1.3.1 Zn + 2MnO2 🡪 ZnO + Mn2O3✓✓ (-1 if not simplified) (2)

1.3.2 emf depends on the particular redox reaction which depends on the chemicals inside the cell, which are the same for both cells.✓✓ (2)

1.3.3 Cell capacity is the ability of the battery to deliver a specific amount of current in a specific amount of time.✓✓ (2)

1.3.4 The D type battery is bigger ✓ ∴ it contains more electrolyte (chemicals).✓ (2)

1.3.5 W = V x I x t ✓

 = 1,5 x 0,8 x 3600✓

 = **4320 J** ✓ (3)

1.3.6 Amp-hours needed = 0,6 x 4 = 2,4 A.h✓

 Zinc-carbon batteries will need 2,4 = **3** ✓ Cost = 3 x R5 = **R15**✓

 0,8

 Alkaline battery has a capacity of 2,8 A.h ∴ only need **one**  Cost = **R9,50**✓

 ∴ cheaper to use one alkaline battery as opposed to 3 zinc-carbon batteries.✓ (5)

1.3.7 The **reaction rate will be slower at lower temperatures** ∴ chemicals not used up as quickly.✓✓ (2)

1.3.8 • Reduces waste that ends up in landfill sites (toxic chemicals)

 • Reduces global warming since not replaced as often ∴less transportation of batteries to retail outlets etc.

 • Reduces global warming since less energy used to manufacture them for same overall energy output as a rechargeable battery.

 • Less destruction of forests to provide packaging.

 • Less impact on air pollution (air acidification) because less of them are manufactured to produce the equivalent power of non-rechargeable batteries. **3 valid points** ✓✓✓(3) **[21]**

**Question 2**

2.1.1 Mg to Fe√√ (2)

2.1.2 Mg. (Better reducing agent)√ (1)

2.1.3 Decreases.√ Because Mg is oxidised to a soluble salt.√√ (3)

2.2.1 Temperature 25 0C,√ conc of ions 1 mol.dm-3 √and pressure of 1 atm.√ (3)

2.2.2 Any soluble√ copper salt√ eg. CuSO4, CuCl2 (2)

2.2.3 Completes cct√ and allows ions to flow to neutralize half cells.√ (2)

2.2.4.1 Cu→Cu2+ + 2 e-√√ (2)

2.2.4.2 Cl2 + 2 e- → 2 Cl-√√ (2)

2.2.4.3 Cu + Cl2 → 2Cl- + Cu2+√√ (-1 error) (2)

2.3 E0cell= E0cathode- E0anode

 = 1,36 – 0,34√

 = 1,02 V√ (2)

2.4 Chemically inert√ (1)

 **22 Marks**

**Question 3**

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**Question 4**

4.1 Cell capacity is a measure of the number of hours√ a cell can supply a certain amount of current before its voltage drops below an acceptable level. √ (2)

4.2 q = It√

 I = q/t= 50/5√= 10A√ (3)

4.3 20 0C.√ Lower temperature gives a greater capacity retention.√√ (3)

4.4 Increase in temperature speeds up redox rxn.√ √ This happens even when the cell is not in use. Amount of chemicals is thus now less√ to produce electricity and the life span of the cell is less.√ (4)

4.5 Secondary.√ It can be charged.√ (2)

4.6 Lead is the anode where oxidation occurs.√√ (2)

4.7.1 Pb + SO42- → PbSO4 + 2e-√ (1)

4.7.2 PbO2 + SO42- + 2H+ + 2e- →PbSO4 + 2H2O√ (1)

4.8 Pb + PbO2 + 2H2SO4 ⇌PbSO4 + 2H2O√ 1 mark for balanced√ (-1 error) (2)

4.9 Water is produced during the discharge process√, hence volume of electrolyte is increased√ and density is decreased. √ (3)

4.10

1. Policies need to be upheld in terms of standardizing the amount of chemicals in batteries. √√
2. Restrict amount of cadium and mercury.√√
3. Pay the extra money for recycling and disposing of batteries.√√
4. Don’t buy cheap batteries. Rather but more expensive ones so they last longer.√√ (8)

4.11 **Cons**

1. No environment protection controls.√
2. No technologies to dispose of batteries properly.√
3. Waste toxic to human body.√

 **Pros**

1. Foreign exchange and capital√
2. Jobs√
3. New technology can be found that will help with eliminating the problem of disposing of batteries.√ (6)
	1. It should be done under strict control and policing from environment agencies.√√ New technologies for waste disposal must be worked on.√√ This will create jobs and new scientific endeavours for our country.√√ Plus it will bring in much needed capital and foreign capital.√√ (6)

**Question 5**

5.1 Electrolysis – the decomposition of a substance (or production of a desired compound) by the addition of electrical energy

 Brine – aqueous solution of NaCl

5.2 Cl2 – disinfectant, pesticide, bleaching cloth and paper

 NaOH – extraction of Al, making dyes

 H2 – hydrogenation of Oil to make margarine, making ammonia, fuel

5.3 anode; oxidation

5.4 2 Cl- (aq) 🡪 Cl2 (g) + 2 e-

5.5 2 H2O (l) + 2 e- 🡪 H2 (g) + 2 OH- (aq)

5.6 Allows positive ions to pass through

5.7 Diaphragm cell – asbestos causes health problems including lung cancer and other lung diseases

 Mercury cell – products can be contaminated by mercury an environmental pollutant and poison

5.8 Cl2 and H2 react explosively

**Question 6**

6.1a) ✓ (If ⇋ arrows in 3.1a and b then ─1 max) (.1)

|  |  |  |  |
| --- | --- | --- | --- |
| O2 + 4H+ + 4e- | → | 2H2O |  |

6.1b) H2 → 2H+ + 2e ✓ (.1)

6.1c) E0cell  = 1,23 – 0 = 1,23 V ✓✓ (Accept answer only) (2)

6.1d) Increase the pressure of the gases ✓ (or increased temp) (1)

6.1e) Electrolytic when a voltage supply is applied across terminals ✓✓ (2)

6.1f) In the production of H2 or the electricity CO2 is produced. ✓✓ (2.)

6.2a) salt solution ✓ (.1)

6.2b) 2H2O + 2e → H­­2 + 2OH─ ✓ (-1 for ⇋ arrows)

 Out of H2 and Na+✓, the reaction with a higher (positive) Eo will be reduced. ✓ (3)

6.2c) Concentration of Cl─ is high. ✓ (1)

6.2d i) Cl2 ✓ ii) H2 ✓ iii) NaOH ✓ (.3)

6.2e) Chlorine - a disinfectant and used to make plastics (PVC).

 Sodium hydroxide - making soaps and paper pulp. (Possibly drain cleaner)

 (Round up, 1 out of 4 gets ✓ 3 out of four gets ✓✓) (.2)

6.2f) It is not efficient in terms of electricity consumption and therefore has a negative environmental impact. ✓✓ (2.)

 Or - The diaphragm is made from asbestos which could cause a lung disease.

6.3a) No✓ Voltage is dependent on type of chemical and concentrations only ✓ (or- Increasing the surface area will only increase the possible current or will lower internal resistance) (2)

6.3b) Lowering internal resistance. ✓ (Or to have less energy loss) (1)

6.3c) PbO2(s) + 2SO42─(aq) + 4H+(aq) + Pb(s) → 2PbSO4(s) + 2H2O(l) ✓✓ (2.)

 (allocate one of the marks if identified oxidation half the correct way around)

 (⇋ arrows must be penalised to a maximum of 2 for paper. Check 3.1a, b and 3.2b)

6.3d H2SO4(aq) decreases ✓ density decreases✓ (2.)

6.3e) It can be recharged.✓ (.1)

6.3f) reverse reaction in 3.2c takes place. ✓✓ (or- PbSO4 forms Pb and PbO2 for example)

 (2)

6.3gi) w = VQ = VIt ✓= (12)(1)(45×60×60)✓ = 1944000J✓ (units required in answer) (3)

6.3gii) P = w/t ✓

 21 = 1944000/t ✓

 ∴ t = 92571 seconds✓ or 25 hours 43min (3)

6.3h) Plastics does not biodegrade and lead is poisonous to humans and animals. ✓

 Suggest – recycling ✓ (2)

**Question 7**

7.1. Same temp, same battery make, same camera, use/no use of flash. Any 2✓✓ (2)

7.2. Zinc carbon: W = VQ = 1,5 x 950 x 10-3 ✓✓subs ✓conv = 1,425 J✓

 Li ion: = 1,44 J✓

 Alkaline: = 4,28 J✓ (6)

7.3. Alkaline✓ greater capacity✓ to charge flash (2)

7.4. Lithium ion takes most photos✓, but if this was done with no flash then perhaps alkaline would be better because they provide the most energy per hour✓.

 Lithium ion are very expensive, but can be recharged, so the money is spent only once✓

 Lithium ion is more economical in long run✓ so hypothesis correct ✓

 OR Alkaline more economical if taking pics with flash✓ part (b) of hypothesis false✓ (5)

7.5. Zn(s) + 2MnO2(s) + 2NH4+(aq) → Zn2+(aq) + Mn2O3(s) + H2O(l) + NH3(aq)

 ✓reactants ✓products ✓phases (3)

7.6. Any above zinc in table✓ greater reducing ability✓ (2)

7.7. The electrodes have a low surface area OR low concentration of electrolyte✓

 Electrodes far apart✓ (2)

7.8. Low reaction rate/ions do not move as freely✓ (1)

7.9. For example: Create a circuit with light bulb, battery, voltmeter. Put one set in fridge and one in heated room. Record time vs. voltage.

 OR Place voltmeter over battery with a light bulb in circuit. Take readings of V over 24 hours.

 ✓ = fair test

 ✓ = valid/comparative test

 ✓ = time frame given (3)

7.10. (i) = 1,5 (ii) = 1 (2)

7.11.

✓✓ = labels

✓ = scales

✓✓ = 2 correct plotted points

 (5)

7.12. When Kc is high, voltage is low ✓ Initially reactants are in higher concentration than products✓ So by LCP the forward reaction is favoured and products concentration increases and reactants decrease (Kc compared ✓). Kc value is initially low because of ratio products/reactants (ratio discussed✓) and increases as reactants are used up. This happens until the cell is flat or at 0 V ✓ (5)

7.13. rate is constant ✓ Not realistic✓ at the beginning of a reaction, the rate is quicker because of the large concentration of reactants✓ OR no time factor given ✓ (3)

7.14. Vcell = 0 V / Equilibrium is reached/ Reactants used up. Any 2 ✓✓ (2)

7.15. Find out where I can safely dispose of batteries in my area✓. Chemicals inside are not good for the environment✓ (2)

**Question 8**

8.2. Electrochemical ✓ Spontaneous reaction/ does not need electricity/ electrons move from anode to cathode. Any 1 =✓ (2)

8.3. anode: H2 → 2H+ + 2e- (x 2) balance = ✓

 Cathode: O2 + 4 H+ + 4e → 2 H2O ✓

 Net: 2H2 + O2 + 4 H+ → 2H2O + 4 H+ show protons = ✓

 Therefore: 2H2 + O2 → 2H2O (3)

8.4. E cell = E cathode – E anode

 = 1,77 – 0 ✓✓ = 1,77 V ✓ (3)

8.5. Electrolyte: free ions to maintain neutrality✓ zinc-copper pos and neg ions move in a liquid ✓ In fuel cell only pos move in a membrane✓ (3)

8.6. 6 points from article (*3 marks*), such as: fuel tank size; cost per litre; can’t travel far on 1 tank; have to keep H cool; takes long time to fill up; uses many litres per 100km; H stations only in Germany; fuel-cell cars operate at very low power.

 Discussing the points further with own ideas = *3 marks*, such as: H has to be kept at a high pressure, thus uses energy; have to use fossil fuels to create H; using up methane is better than letting it go into atm – greenhouse gas; can get 4 Hs from methane and only 2 from H2; Europe is looking after their own carbon footprint; countries like SA produce and sell them H2 and CH4- good 4 economy; fuel cell cars seem better, but have to still get H from somewhere.

 *3 marks* for opinion: 0 = no opinion given; 1= an opinion at end, but not linked to points raised; 2 = opinion just highlighted, has either view, or points not raised strongly enough; 3 = opinion strongly based on discussion points and highlights good and bad. (9)