**Unit 3 Chemistry Trial Exam Solutions**

**Section A**

1. B. This is an example of a fatty acid. It can react with an alcohol to form biodiesel.

2. C. 20 g ethanol = 592: 20 g butane = 994. Total = 1586 kJ

3. A. 2C4H10(g) + 13O2(g) 🡪 8CO2(g) + 10H2O(l)

4. B. 1.5 g ethane = 1.5/30 mol = 0.05 mol

 *n*(CO2) = 0.05 × 2 = 0.1 mol

 *V* = *n* × 24.8 = 0.1 24.8 = 2.48 L

5. A. Potato peel will have a high starch content. It will ferment to form ethanol.

6. D. The diagram is of a fuel cell in acid conditions. Oxygen will react at the cathode.

7. C. Note – the question asked for the reverse reaction. The activation energy for the reverse

 reaction is 250 kJ mol-1. The reverse reaction will be endothermic.

 Watch for the word **reverse** in bold print with energy profile diagrams.

8. C. The charge in option C is not balanced.

9. A. Lithium metal is oxidised in this reaction. Oxidation occurs at the anode.

10. C. During recharge, the Fe is oxidised to Fe2+. Oxidation occurs at the anode and the anode is

 positive for recharge.

11. D. There are two reactants – one is used at twice the rate of the other, hence a ratio of 2:1 is

 required.

12. B. 0.6 mol of NOCl is used up => 0.6 mol of NO is generated and 0.3 mol of Cl2. The total

 number of mole will be the remaining NOCl + other products = 1.2 + 0.6 + 0.3 = 2.1 mol.

13. A. The value of *K* is very low. Therefore the amount of product formed is low. The concentration

 of reactant will be higher than that of product.

 Always take note of the magnitude of ***K*** values provide.

14. C. Not all particles move faster at the higher temperature but most do.

15. B. A ball of magnesium will have a lower surface area than ribbon, so the initial rate of reaction

 must be slower. The amount of mass change will eventually be greater as the mass of magnesium

 was greater.

16. B. More NO is added, favouring the reverse reaction.

17. C. CuCl2(l) will produce a deposit of copper on the negative electrode and chlorine gas at he

 positive electrode.

18. D. Silver ions react at the cathode and water at the anode. The half-equation for the reaction of

 water is 2H2O(l) 🡪 O2(g) + 4H+(aq) + 4e- producing oxygen gas.

19. C. The reaction at the cathode is Ag+(aq) + e- 🡪 Ag(s)

20. D. *Q* = *It* = 8.4 × 12 × 60 = 6048 C

 *n*e = $\frac{6048}{96500}$ = 0.0627 mol

 *m* = 0.0627 × 107 = 6.7 g

 **Section B Short answer**

**Question 1** (13 marks)

**a. i**. Many possible answers such as fish and chip oil, animal bones, canola oil

 (2 marks)

 **ii**. Ethanol can be produced from plants more easily than methanol. Using ethanol makes

 all components of biodiesel renewable. (2 marks)

**b**. Glycerol is a polar liquid due to its many -OH groups, whereas biodiesel is non-polar. \*

 Both liquids will not mix with each other, so the lighter liquid can be poured from the

 heavier. (2 marks)

**c**. (2 marks)

|  |  |  |  |
| --- | --- | --- | --- |
| triglyceride | methanol | glycerol | biodiesel |
| 4.2 mol | 12.6 mol | 4.2 mol | 12.6 mol |

**d**. **i**. C19H34O2(l) + 26.5O2(g) 🡪 19CO2(g) + 17H2O(l) (2 marks)

 **ii**. *n*(CO2) = 1.8 × 19 = 34.2 mol

 *V* =  = 1770 L (3 marks)

**Question 2** ( 9 marks)

**a**. **i**. The amount of SO3 will drop. The reaction is exothermic so an increase in

 temperature favours the back reaction. (1 mark)

  **ii**. If the temperature is increased the rate of the forward reaction will increase due to

 more collisions and a higher percentage of successful collisions. (1 mark)

**b**.

 **i**.

 (2 marks)

 **ii**. *K* =  = 7.4 M-1  (3 marks)

 **c**. The SO2 concentration will be greater after equilibrium is re-established. The decrease in

 volume will favour the forward reaction but the original decrease in volume means the

 concentration is still greater than before the change. (2 marks)

**Question 3** (10 marks)

**a**. anode: H2(g) + 2OH-(aq) 🡪 2H2O(l) + 2e- (3 marks)

 cathode: O2(g) + 2H2O(l) + 4e- 🡪 4OH-(aq)

 overall: 2H2(g) + O2(g) 🡪 2H2O(l)

**b**. 1.23 V

**c**. The electrodes are platinum, which is expensive. They are porous also which adds to the

 expense. (2 marks)

**d**. The production of hydrogen is not simple. Considerable energy is used in making the

 hydrogen making the use of hydrogen not carbon neutral. (1 mark)

**e. i.** fuel cell and an electrolytic cell: both use a continuous supply of reactants (1 mark)

 **ii**. They are both galvanic cells. Oxidation will be at the anode, which is negative.

 (1 mark)

 **iii**. Direct reaction between hydrogen and oxygen will release thermal energy. This energy

 could be used to create steam to turn a turbine in the same fashion as a gas-fired power

 station. (1 mark)

**Question 4** (10 marks)

**a. i**. MnO4-(aq) + 8H+(aq) + 5e- 🡪 Mn2+(aq) + 4H2O(l) (1 mark)

  **ii**. Fe2+ (aq) 🡪 Fe3+(aq) + e- (1 mark)

 **iii**. MnO4-(aq) + 8H+(aq) + 5Fe2+ (aq) 🡪 Mn2+(aq) + 5Fe3+(aq) + 4H2O(l) (1 mark)

 **iv**. Mn+7 to Mn+2  (1 mark)

**b**.  **i**. cathode platinum anode platinum (2 marks)

 **ii**. From E0 table the value for Fe3+ is 0.77 V. MnO4- = 0.77 + 0.74 = 1.51 V (1 mark)

**c**.  **i**. PbO2(s) + SO42-(aq) + 4H+(aq) + 2e- 🡪 PbSO4(s) + 2H2O(l) (1 mark)

  **ii**. Pb(s) + SO42-(aq) 🡪 PbSO4(s) + 2e- (1 mark)

 **iii**. PbO2(s) + Pb(s) + 2H2SO4(aq) 🡪 2PbSO4(s) + 2H2O(l) (1 mark)

**Question 5** (11 marks)

**a. i**. oxidation: H2O2(l) 🡪 2H+(aq) + O2(g) + 2e- (3 marks)

 reduction: H2O2(l) + 2H+(aq) + 2e- 🡪 2H2O(l)

 overall: 2H2O2(l) 🡪 2H2O(g) + O2(g)

 **ii**. One of the products is oxygen gas. The gas passing quickly through the detergent

 creates a foam. (1 mark)

**b**.  **i**. the dependent variable: height of foam

 **ii**. the independent variable: temperature

 **iii.** a controlled variable: concentration, volume (3 marks)

**c. i**. Use the axes provided to graph the student’s results. (1 mark)

 **ii**. There is a linear correlation between temperature and height. The height increases

 with temperature. (1 mark)

 **iii**. As temperature increases the average speed of particles increases. The particles

 collide more and the % of successful collisions increases. (2 marks)

**Question 6** (10 marks)

**a**. anode: 2Cl-(aq) 🡪 Cl2(g) + 2e- (3 marks)

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

 overall: 2NaCl(aq) + 2H2O(l) 🡪 Cl2(g) + H2(g) + 2NaOH(aq)

**b**. The electrochemical series uses standard half-cells with concentrations of 1.0 M. At higher

 concentrations, the half-equation for Cl- ions comes into play. Cl- reacts instead of water at the

 anode (1 mark)

**c**. The balanced equation shows a ratio of 1:1 between the two gases so the representation is fair.

 Neither gas is very soluble in water. (2 marks)

**d**. *Q* = *It* = 3.8 × 4 × 60 × 60 = 54720 C (4 marks)

 *n*e =  = 0.567 mol

 *n*(H2) = ½ *n*e = 0.284 mol V(H2) = 0.284 × 24.8 = 7.03 L

 Volume of Cl2 is also 7.03 L. Total volume 14.1 L