**Unit 3 Chemistry 2020 Trial Exam Solutions**

**Section A**

1. B: Molecule is heptane. A C7 is a common component of petrol.

2. C: Mass in 1 litre is 850 g. Data book gives diesel as 45 kJ g-1. Q = 45 x 850 = 38250 density of a sample

 of petrodiesel is 0.85 g mL-1.

3. D: Fermentation of glucose to form bioethanol

4. C: ratio of fuel to CO2 is 1:4 matching the equation for the combustion of butane

5. A: n(S) = 3.2/32 = 0.1 = n(SO2). V = = 5 L

6. D: Slicing lengthwise will increase the surface area more than slicing across.

7. C: As the reaction proceeds, acid is used up, so the pH rises.

 8. B

9: C: Take note that the question asks for the reverse reaction.

10. A: From electrochemical series, H+ will react with Zn(s). The zinc is oxidised.

11. D: Zinc is oxidised – this will be at the anode. Hydrogen ions are reduced – at the cathode.

12. A: Add option A to the half-equation on the diagram and it will simplify to the required overall equation.

13. B: The presence of OH- ions indicate an alkaline environment. The presence of electrons shows it is a

 half-equation and the loss of electrons is oxidation.

14. A: For an endothermic reaction, K increases as temperature increases. This favours the blue colour.

 15. C: The precipitate is AgCl. Its formation lowers the Cl- concentration so the system moves in the reverse

 direction, favouring the pink colour.

16. D: This reaction has a very low K value- which can only happen if the amount of products is much lower than the

 amount of reactant.

17. B: The only metal more reactive than water is manganese. Refer to electrochemical series in Data Book.

18. B: n(Mg) = 2.43/24.3 = 0.1 mol n(e) = 0.2 Q = 0.2 x 96500 = 19300 C

 I = Q/t = 19300/3600 = 5.36 amp

19. D: The products are hydrogen and oxygen. The production of oxygen is oxidation and will occur at the positive

 anode.

20. A: The number of mole of hydrogen is half the number of mole of electrons. The number of mole of oxygen is a

 quarter. Altogether this is ¾ of the number of mole of electron.

 **Section B Short answer**

**Question**

**Question 1** (9 marks)

**a**.  **i**. Density of a gas is low- more compact if condensed to a liquid 1 mark

 **ii**. Fractional distillation. Natural gas heated, added to a column. The hot gas rises until each component

 condenses at different levels of the tower. Propane and ethane will condense before methane.

**b**. Natrual gas is absorbed on the surface of the coal. A well is drilled into the coal and water, sand or gas is used to

 shake it free. 2 marks

**c**. Waste is added to a digestor containing bacteria. The bacteria operate in anaerobic conditions to produce

 methane. 1 mark

**d**. **i**. CH4(g) + 2O2(g) 🡪 CO2(g) + 2H2O(l) 1 mark

 **ii**. chemical 🡪 thermal gas 🡪 thermal steam 🡪 mechanical 🡪 electrical 1 mark

 **iii**. S(s) + O2(g) 🡪 SO2(g) 1 mark

**Question 2** (7 marks)

 **a. i**. C2H6(g) + 3.5O2(g) 🡪 2CO2(g) + 3H2O(l) Δ*H* = -1560 kJ mol-1 2 marks



 ii. 2 marks

  **iii**. q= 4.18 × 1000 × 10 = 4.18 × 104 J mass = 4.18×104/51900 = 0.81 g 2 marks

**b**. C2H6(g) + 2.5O2(g) 🡪 2CO(g) + 3H2O(l) 1 mark

**Question 3** (9 marks)



 rate

 time

**a**. **i**. N2O4(g) ⇌ 2NO2(g). 1 mark

 **ii**. *K*c =  1 mark

 **iii**. The y and 2y reflect the stoichiometry of the equation. The NO2 will change by twice the N2O4.

 1 mark

 **iv**. brown intensity will increase with extra NO2 forming. 1 mark

**b**. endothermic – an increase in K when the temperature rises is consistent with an endothermic reaction.

 2 marks

**c**. see graph 3 marks

**Question 4**  (10 marks)

**a**. Anode: Al(s) + 3OH-(aq) 🡪 Al3+(aq) + 3e-  4 marks

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

 Overall: 4Al(s) + 3O2(g) + 6H2O(l) 🡪 4Al(OH)3(s)

 Approximate cell voltage: 0.4 - - 1.66 = 2.04 V

**b**. Oxygen is plentiful – replace the aluminium sheet whenever the cell slows 2 marks

**c**. Anode: H2(g) + 2e- 🡪 2H+(aq) + 2e-  4 marks

 Cathode: O2(g) + 4H+ (aq) + 4e- 🡪 2H2O(l)

 Overall: 2H2(g) + O2(g) 🡪 2H2O(l)

 Approximate cell voltage: 1.23 V

**Question 5** (10 marks)

**a**. Anode: 2Cl-(aq) 🡪 Cl2(g) + 2e- 4 marks

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

 Overall equation: 2H2O(l) + 2Cl-(aq) 🡪 Cl2(g) + H2(g) + 2OH-(aq)

 Products of this process: H2, Cl2, NaOH

**b**. Q = It = 49 × 4× 3600 = 7.06 × 106 C

 n(e) = /96500 = 7.31 mol

 n(Cl2) = 3.66 mol

 V = 127 L 4 marks

**c**. **i**. Na+(l) + e-  🡪 Na(l) 1 mark

 **ii**. 2H2O(l) + 2e- 🡪 O2(g) + 4H+(aq) + 4e-  1 mark

**Question 6** (8 marks)

**a**. Reactants: Mg/HCl or CaCO3/HCl 2 marks

 Equation: Mg(s) + 2HCl(aq) 🡪 MgCl2(aq) + H2(g)

**b**. Possible hypothesis: The reaction rate will increase with temperature.

 Procedure:

 Add 50 mL of 1.0 M HCl to the flask

 Heat contents to 20 C.

 Add 0.1 g of Mg

 Record time taken to produce 50 mL of gas

 Repeat procedure with the HCl at 25 0C, then 30, then 35 0C etc

 Graph of time taken (y axis) vs temperature. 6 marks

**Question 7**  (7 marks)

**a**. **i**. independent variable separation distance 3 marks

 **ii**. dependent variable current or voltage

 **iii**. a controlled variable temp or soln concentration

**b**. Zn(s) + Cu2+(aq) 🡪 Zn2+(aq) + Cu(s) 1 mark

**c**. The separation is not affecting the voltage greatly, but it is affecting the current. The manufacturer

 should make long, skinny batteries rather than wide ones where the electrodes are a long way apart.

 The higher the current the more flexible the cell is in applications it is suitable for. 3 marks