CSE CENTRE FOR STRATEGIC EDUCATION
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IARTV

CSE TEST – OCTOBER 2011

YEAR 12 – CHEMISTRY

Written test 2

SOLUTIONS BOOK

SECTION A – Multiple choice questions (20 marks)

1	**A**	5	**D**	9	**D**	13	**A**	17	**B**
2	**C**	6	**C**	10	**B**	14	**C**	18	**C**
3	**C**	7	**C**	11	**B**	15	**A**	19	**D**
4	**D**	8	**B**	12	**A**	16	**D**	20	**A**

1. The [HCl] drops exponentially as fewer decomposition collisions occur.
2. $K=\frac{[NO_2]^2}{[N_2O_4]}$ = 0.98 so $[NO_2]^2$ = 0.98 x (0.425/2) = 0.208 then $[NO_2] = \sqrt{0.208}$ = 0.456 M
3. HCl reacts with OH^- moving equilibrium position to the right, decreasing the amount of $Ca(OH)_2$.
4. Since the solution is already saturated no more solid will dissolve.
5. There are more particles on the right so increasing pressure will move the equilibrium to the left. Increasing temperature will move the equilibrium position to left in the endothermic direction.
6. 6. $c_2.v_2 = c_1.v_1$ so $[OH^-] = \frac{(2\times 0.005)\times 0.010}{0.10}$ = 0.001 M, pOH = -log(0.001) = 3 so pH = 11
7. E_A does not affect the rate, the number of successful collisions determines rate.
8. ΔH_{octane} = -5464 kJ mol^{-1} so n(octane) = 2495 / 5464 = 0.4566 mol, m(oct) = 0.4566 x 114 g

   $v = m/d$ = 0.4566 x 114 / 0.703 = 74.0 mL
9. Since the V_M is the same, the fuel with the highest energy density has the highest molar heat of combustion.
10. Oxidant is above the reductant in the electrochemical series.
11. Water is higher in the electrochemical series so it will react preferentially to Mn^{2+}.
12. 40/100 x 30 = 12 g. 12 x 63/100 = 7.56 g of C. $n(C)$ = 7.56 / 12 mol = $n(CO_2$

    $V(CO_2) = n$ x 24.5 = 7.56/12 x 24.5 L = 15 L.
13. CaO is a basic oxide and will react with acidic oxides of sulfur.
14. No reductant present in zinc ion / Pt cell to react.
15. Because fuel is continuously supplied, products must be continuously removed.
16. Oxidants accept electrons supplied from the positive cathode, C^+ oxidises B while B^+ oxidises A.
17. $n(e^-) = \frac{I.t}{F} = \frac{1.05\times 50\times 60}{96500}$ = 0.0326 mol. m(Cu) = (0.0326/2) x 63.5 = 1.04 g. Note magnesium will not be plated in aqueous solution as water is a stronger oxidant.
18. $n(Cl_2) = V / V_M$ = 2.24/22.4 = 0.1 mol. $n(e^-)$ = 2 x 0.1 mol.
19. In electrolysis cells the cathode is negative. NaOH would not produce chlorine gas.
20. H_2O is electrolysed to produce OH^- and $H_2(g)$. Na^+ ions migrate through the membrane to produce NaOH.

SECTION B – Short answer questions (55 marks)

Question 1 (6 + 2 = 8 marks)

Change	Increase	Decrease	No Change
a. Addition of NaOH(s) to the reaction vessel at constant temperature		✓	
b. Halving of the reaction vessel volume at constant temperature	✓		
c. Addition of a catalyst to the reaction vessel at constant temperature		**Note:** the change in volume overcomes the net shift to the left.	✓
d. Addition of helium gas			✓
e. Increasing the vessel temperature at constant volume	✓		
f. Addition of more CO(g) to the reaction vessel at constant temperature		✓	

g. e

h. c e

Question 2 (1 + 3 + 1 + 1 + 2 = 8 marks)

a. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

b.

Change	SO_2	O_2	SO_3
Initial mol of substance	1.56	0.86	0.00
Change in mol of substance	-1.48	-0.74	+1.48
Final mol of substance	0.08	0.12	1.48
Final concentration	0.04	0.06	0.74

c. $K = \dfrac{[SO_3]^2}{[SO_2]^2[O_2]}$

d. $K = \dfrac{[0.74]^2}{(0.04)^2(0.060)} = 5.70 \times 10^{-1}\ M^{-1}$

e. Although the rate would decrease the yield would increase with a larger K value.

Question 3 (1 + 2 + 2 = 5 marks)

a. $C_{57}H_{104}O_6(s) + 80O_2(g) \rightarrow 57CO_2(g) + 52H_2O(l)$

b. n_{fat} = 1.00 / 884 = 0.00113 mol *Energy* = *n* x 3351 = 3.79 kJ

c. *Energy* = 2.25 x 2000 = 4500 kJ
n = 4500 / 3351 = 1.343 mol *m* = *n* x *Mr* = 1.343 x 884 = 1.19 kg

Question 4 (2 + 1 + 1 + 3 + 2 = 9 marks)

a. nNH_4NO_3 = 2.43/80 = 0.0304 *E* = 25 x 0.0304 = 0.759 kJ. $\Delta T = E/CF$ = 759/295 = 2.57°C

b. 18.5 – 2.57 = 15.9 °C

c. decrease

d.

Reaction	Solution or bomb calorimeter	Energy released or absorbed
Magnesium metal is dissolved in sulfuric acid	Solution	Released
Iron is reacted with oxygen	Bomb	Released
Oxidation of glucose	Bomb	Released

e. $C_8H_{18}(l) + 12.5O_2(g) \rightarrow 8CO_2(g) + 9H_2O(l)$ $\Delta H = -5464$ kJ mol^{-1} from data booklet

$16CO(g) + 8O_2(g) \rightarrow 16CO_2(g)$ $\Delta H = 8 \times -556.0 = -4448.0$ kJ mol^{-1} I is 8 times equation in question

$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$ $\Delta H = -10928$ kJ mol^{-1} II 2 times equation above

$2C_8H_{18}(l) + 17O_2(g) \rightarrow 16CO(g) + 18H_2O(l)$ = II-I = -6480 kJ mol^{-1}

Question 5 (2 + 1 + 1 + 1 = 5 marks)

a. Any two of: less pollution due to fewer emissions; easy to transport fuel; can respond quickly to peak demand; more efficient as hot gases turn turbines not steam.

b. Coal is a cheaper fuel; there are large supplies of coal.

c. Less energy lost due to fewer energy transformations.

d. Gaseous methane and carbon dioxide fuel formed from breakdown of anaerobic digestion of organic materials

Question 6 (3 + 1 + 1 = 5 marks)

a.

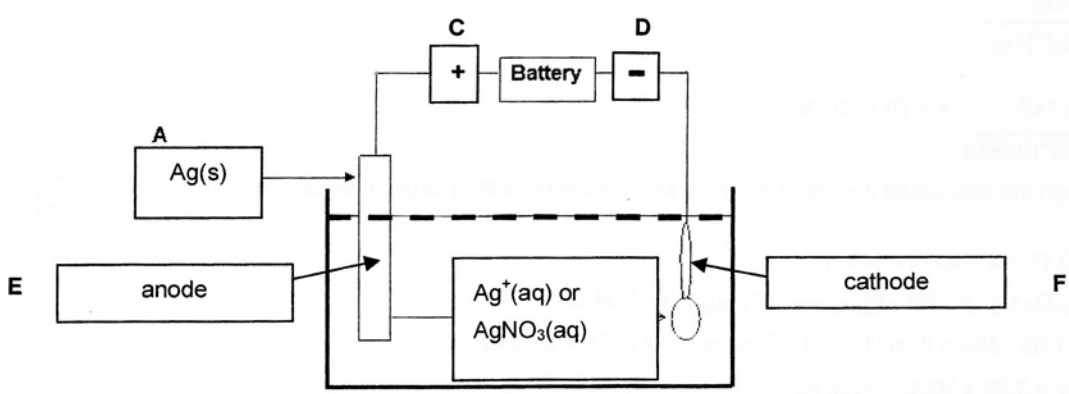
	Primary cell	Secondary cell	Fuel cell
Reactants are supplied continuously			✓
Cell reactions are able to be reversed		✓	
Redox reactions are involved at the anode and cathode	✓	✓	✓
Cells contain an electrolyte	✓	✓	✓
Products of discharge remain in contact with electrode		✓	
Mass of the cell remains constant during discharge	✓	✓	✓

b. $O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l)$

c. $C_2H_5OH(aq) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

Question 7 (1 + 1 + 1 + 1 + 1 = 5 marks)

a. → c.



d. $Ag^+(s) + e^- \rightarrow Ag(s)$

e. To prevent corrosion.

Question 8 (1 + 2 + 2 + 2 + 1 = 8 marks)

a. Using the Le Chatelier principle, an increase in pressure will shift the equilibrium to the side of the chemical equation that has fewer moles.

a. A lower temperature will lower the rate of the reaction and a higher temperature will lower the K value which will lower the yield.

b. A catalyst speeds up the chemical reaction and allows a lower more economical temperature to be used.

c. Any of: removal of product, multiple catalyst beds, increase pressure of steam.

d. Use of energy from the exothermic reaction and recycling of unreacted gases.

e. Any of: wearing of appropriate safety equipment, presence of fire extinguishers, use of hazchem signs.