Year 12 Chemistry Test ***SOLUTIONS***

Topic 4: Managing Resources

1.

(a) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

(b) $\Delta H = 2870 \text{ kJ mol}^{-1}$

$M_{C_4H_{10}} = 58.12 \text{ g mol}^{-1}$

kJ per gram $\therefore \frac{2870}{58.12} = 49.4 \text{ kJ g}^{-1}$

(c) $Q = mc_p\Delta T$

$= 1000 \times 4.18 \times 75$

$= 3.135 \times 10^5 \text{ J}$

$\times 2$ since 50% is lost = 6.27×10^5 J = 6.27×10^2 kJ

$\frac{6.27 \times 10^2}{49.4} = 12.7 \text{ g}$

(d)

(i) $C_6H_{12}O_6 \rightarrow 2C_2H_6O + 2CO_2$

(ii) It can be produced quickly (years to decades or even as quickly as it is used).

(iii) (examples: sunlight, wind)

(e) Advantage: Easily obtained/used for energy

Disadvantage: Less availability for use in chemical industry

(f) If the combustion is incomplete, it produces pollutants such as soot, CO, and unburnt methane. These can can create visual pollution, damage the respiratory system, or react with other molecules in the atmosphere and produce secondary pollutants.

-or-

The heat from combustion can allow nitrogen and oxygen molecules in the air to react, producing oxides of nitrogen. These contribute to photochemical smog, causing respiratory illness, reducing growth of plants, and creating secondary pollutants like ozone.

2.

(a) $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$

(b) Anode

(c) ←

(d) →

(e) Does not need replacing

(f) (examples: high purity fuels are required, expensive catalysts may be required to make the cell)

(g) (examples: less directly emitted pollutants, higher efficiency)

(h) (examples) **Development:** Existing fuel cell methods have been improved by using bacteria and plant roots to produce energy.

Application & Limitation: Plant MFCs could provide cheaper power for remote areas but are limited to use only at small scales.

3.

(a) Silver; it is less reactive and therefore less likely to lose electrons (become oxidised) to form compounds.

(b) Zinc is less reactive than aluminium. Carbon is not a strong enough reducing agent for aluminium.

(c)

(i) $Al^{3+} + 3e^- \rightarrow Al$

(ii) Cathode

(d) Melting an ionic substance requires very high temperatures which are expensive (high energy cost) to produce.

4.

(a) Nitrogen gas (N_2)

(b) It is water-soluble so it can be absorbed by plant roots.

5.

(a) Suspended clay particles have a negative surface charge and so will be attracted to Al^{3+} cations due to their high positive charge. The clay particles join together with the Al^{3+} ions to form larger sized particles which cannot stay in suspension.

(b) Oxidising action.

(c) Lower concentration.

6.

(a) The zeolite has negative surface charge throughout its porous inner surface. The Ca^{2+} and Mg^{2+} ions which cause water hardness are adsorbed to these sites and exchanged with water-soluble cations such as sodium or potassium.

(b) 4 -

(c) 2

(d) Phosphates contain phosphorus, a major plant nutrient (in a water-soluble form). The growth of algae is increased by additional nutrients in the water (eutrophication), and a layer is formed over the surface of bodies of water, causing underwater plants which photosynthesise to die. (The amount of oxygen available in the water is affected and marine animals suffocate. Toxins are released into the water making the water unusable).

(e) Reverse osmosis involves the water being forced at high pressure through a semi-permeable membrane. The salt dissolved in the water is not able to pass through the membrane, so the water output from the process has a lower concentration of salt.

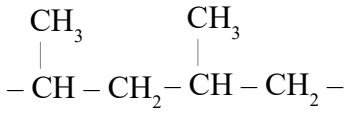
(f) (examples: the concentrated salts released into the environment may be harmful to marine organisms, marine organisms may be harmed during the pumping process)

7.

(a) (advantage examples: may be cheaper, or have a longer life than natural polymers)

(disadvantage examples: susceptible to UV degradation, litter problems if not biodegradable)

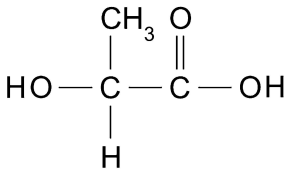
(b)



(c) Condensation

(d) It can be broken apart by hydrolysis.

(e)



(f) PLA chains are only attracted together by dispersion forces and dipole-dipole forces, which are relatively weak. This means heating is likely to allow the chains to separate and move, and return to their original condition when cooled.

(g) Thermoplastics are easier to recycle than thermosets because they can be melted and reformed, whereas thermoset polymers have highly cross-linked network structures and therefore will not soften when heated.

(h) Pinene is sourced from pine trees, so it is a renewable resource whereas capralactone, derived from fossil resources, is non-renewable. As supplies of crude oil are used up, the cost of plasticising PLA using caprolactone is likely to increase, whereas pinene supplies can be increased.

Pinene is a natural compound so it is more likely to be biodegradable. This will decrease the impact on the environment if the PLA is not recycled.

Since pinene is a waste product of the paper manufacturing industry, it can be obtained at a low cost while reducing the amount of waste going to landfill.