CAT 3 1994: **Sample Answers**

1. a. (i) All s^2p^4 or 6 valence electrons
(ii) s^2 outer shell or a partially filled d sub-shell

b. Increase from Mg to Sr due to the extra shells of electrons

c. $^{24}_{12}Mg^{2+}$

d. (i) $1s^22s^22p^63s^23p^1$
(ii) First 3 electrons are removed from the outer (3^{rd})shell Next three are removed from the next (2^{nd}) shell. The ionisation energy increases as the charge on the atom increases with the removal of sucessive electrons. The ionisation energy is also greater when the electrons are removed from a shell closer to the nucleus.

2. a. (i) the d subshell (10 electrons) is being systematically filled
(ii) see the periodic table for suitable answers

b. (i) Many examples possible: $FeCl_2$, $FeCl_3$ or MnO_2, $KMnO_4$ etc
(ii) Colour: $KMnO_4$ (purple), NaCl (colourless)
Magnetism: Fe, Ni (magnetic), Na, Mg (non magnetic)
Hardness and mp: Ti(hard, high mp), Na (soft, low mp)

3. a. (i) hydrolysis reaction
(ii) M(fatty acid) = 256 $gmol^{-1}$, n(fatty acid) = 150/256 = 0.586 mol
energy released = 10035 x 150/256 = 5880 kJ

b. glycogen

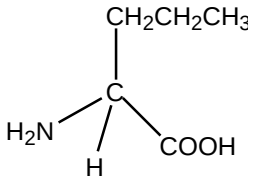
c. (i) energy released by 100g = 7.3 x 24 + 25.4 x 39 + 62.1 x 17 = 2200 kJ
(ii) some of the food may be indigestible eg cellulose
digestion may not be complete
(iii) preservatives, colouring, flavour enhancers, emulsifiers, anti oxidants etc

d. Bile emulsifies the fat, producing small drops of fat. Larger surface area is available for attack by digestive enzymes

4. a. (i) examples include-meat, fish, eggs, milk, soya beans.
(ii) hydrolysis
(iii) condensation
(iv) urea
(v) possible answers include- carbon dioxide, water, glycogen, glucose, fat, carbohydrate

b. essential amino acids-cannot be synthesised by humans, must be present in diet
non-essential amino acids-can be synthesised by humans.

c.



d. boiling causes denaturation, resulting in the enzyme being deactivated

5. a. Negative. The negative charge will attract the positive metal ions in the solution.

b. (i) Q = It = 2.24 x 3.00 x 60 x 60 = 24200 C
n(e) = Q/F = 24200/96500 = 0.251 mol
(ii) Change in mass = 36.60- 32.26 = 4.34g
n(Cr) = 4.34/52.0 = 0.0835 mol
(iii) charge on Cr = 0.251/0.0835 = 3.0 Hence Cr^{3+}

c. Water is reduced to H_2 before Al^{3+} is reduced to Al because H_2O is higher in the electrochemical series (is a stronger oxidant) than Al^{3+}

6. a. (i) graphite or platinum
(ii) positive
(iii) an inert electrolyte that does not react with either of the half-cells.
eg KNO_3, NH_4NO_3, KNO_3
(iv) electrons flow from right to left. Anions move from left to right and cations from right to left in the salt bridge.
(v) oxidation: $Sn(s) \rightarrow Sn^{2+}(aq) + 2e^-$
reduction: $Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$
overall reaction: $Sn(s) + Cl_2(g) \rightarrow Sn^{2+}(aq) + 2Cl^-(aq)$
(vi) primary cell cannot be recharged, secondary cell can be recharged

b. (i) Suitable metals include Au^+, Ag^+, Cu^{2+}
(ii) Reaction is too slow to observe. Conditions are non-standard

7. a. (i) all matter is made up from tiny atoms
atoms of different substances differ in size
(ii) atoms are not solid, they are mostly empty space
atoms can be broken down(sub atomic particles)

b. (i) atoms are now ordered by atomic number
(ii) atomic number was not known at that time

c. electron shells and sub shells
electron orbits, orbitals

d. (i) $^{92}_{36}Kr$
(ii) Fusion involves two smaller nuclei joining to give a larger nucleus
(iii) nuclear binding energy or the conversion of mass into energy