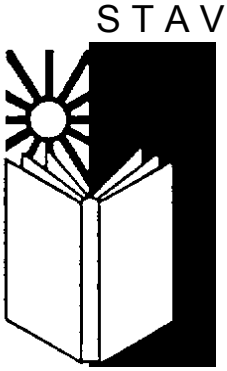

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SOLUTIONS

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Semester 2, 2001

SECTION A:

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

SECTION B:

Question 1

(a) $2CH_3OH\,(g) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(g)$ (1 mark)

$2C_8H_{18}(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$ (1 mark)

(b) ΔH methanol $= \frac{727}{32} = 22.7$ kJ g^{-1} (1 mark)

ΔH octane $= \frac{5450}{114} = 47.8$ kJ g^{-1} (1 mark)

(c) (i) Octane (1 mark)

Must show reasoning for answer given (1 mark)

For example, reference to the answer to part (b) where octane is shown to have a greater energy content per gram.

(ii) This assumes that the energy losses in using both as fuels for a car are the same. (1 mark)

Question 2

(a) CH_4 (1 mark)

The oxidation number of carbon becomes more positive going from –4 to +4. (1 mark)

(b) $CH_4(g) + 2H_2O(l) \rightarrow CO_2(g) + 8H^+(aq) + 8e^-$ (1 mark)

(c) charge flowing per day $= 5.00 \times (60 \times 60 \times 24)$ (1 mark)

$= 432{,}000$C (1 mark)

$n(e) = \frac{432{,}000}{96{,}500} = 4.47668$ mol (1 mark)

$n(CH_4) = \frac{1}{8} \times n(e) = \frac{1}{8} \times 4.47668$ mol (1 mark)

$V(CH_4) = \frac{1}{8} \times 4.47668 \times 24.5 = 13.710$ L (1 mark)

As only 70% efficient, $V(CH_4)$ actually required $= \frac{100}{70} \times 13.170 = 19.6$ L (1 mark)

(d) A fuel cell is an energy conversion device, able to continually supply energy, provided there is a supply of reactants. A battery is an energy storage device, able to produce electrical energy only for as long as there are reactants present.

(1 mark)

Question 3

(a) Stearic acid, $CH_3(CH_2)_{16}COOH$, is a saturated fatty acid and would therefore form a saturated triglyceride. (An explanation must be included to gain the mark).

(1 mark)

(b) For these essentially non-polar molecules the strength of dispersion forces formed between the molecules will determine whether they are solid or liquid.

(1 mark)

Soybean contains a significant amount of unsaturated fatty acids, so that triglyceride molecules made from them cannot arrange themselves as closely together allowing fewer dispersion forces to be formed, hence it is a liquid.

(1 mark)

(c) Perform an addition reaction with known amounts of each of these two fatty acids.

(1 mark)

The more unsaturated fatty acid, eleostearic acid, would require a greater amount of the reagent reacting with the fatty acid. For example, a known amount of bromine could be used to react with the fatty acids.

(1 mark)

The excess bromine could be determined by, for example, redox titration to enable the more unsaturated fatty acids to be identified.

Question 4

(a) Charge flowing = $I \times t = 1.40 \times (12.0 \times 60)$ (1 mark)

$= 1.01 \times 10^3$ C (1 mark)

(b) $n(Cu) = \dfrac{m(Cu)}{M(Cu)} = \dfrac{0.393}{63.5} = 6.19 \times 10^{-3}$ mol (1 mark)

(c) $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

$n(e^-) = 2 \times n(Cu) = 2 \times 6.19 \times 10^{-3} = 0.01238$ mol (1 mark)

$F = \dfrac{Q}{n(e^-)} = \dfrac{1.01 \times 10^3}{0.01238} = 81583 \text{ C} = 8.16 \times 10^4 \text{C}$ (1 mark)

(d) $N_A = \dfrac{8.16 \times 10^4}{1.60 \times 10^{-19}} = 5.10 \times 10^{23} \text{ mol}^{-1}$ (1 mark)

Question 5

(a) Zinc(s) (1 mark)

(b) (i) Sodium and zinc are the only reductants listed that are stronger than the conjugate reductant, Co, of the cobalt(II) ions. Sodium is not suitable because it is too reactive and would react with the water in the aqueous solution rather than cause the reduction of the cobalt(II) ions. (1 mark)

(ii) $Co^{2+}(aq) + 2e^- \rightarrow Co(s)$
$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$
$Co^{2+}(aq) + Zn(s) \rightarrow Co(s) + Zn^{2+}(aq)$ (1 mark)

(c) The ions of most transition elements contain a partially filled 3d subshell. This allows electron transitions between orbitals of the 3d subshell. (1 mark)
When these electrons return to their ground state they emit energy which is in the visible part of the electromagnetic spectrum. (1 mark)

Question 6

(a) Photosynthesis (1 mark)
$6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$ (1 mark)

(b) Respiration, an exothermic process. (both required for 1 mark). (1 mark)

(c) (i) Condensation reaction (½ mark)
(ii) Glucose (½ mark)

(d) (i) Combustion reaction (1 mark)
(ii) Advantage - provides a source of energy (1 mark)
Disadvantage - produces carbon dioxide which contributes to an enhanced greenhouse effect and hence climate change, or depletion of reserves of fossil fuels. (1 mark)

(e) Any 2 suitable examples such as potatoes, rice, bread, sugar, pasta, oats, etc. (1 mark)

Question 7

(a) (i) Sodium; structure consists of sodium cations, Na^+, in a regular arrangement surrounded by delocalised electrons. (1 mark)
The bonding is the result of the electrostatic attraction between the sodium cations and the delocalised electrons. (1 mark)
Chlorine; structure is simple molecules. (1 mark)
Covalent bonding between two chlorine atoms forming the chlorine molecule. (1 mark)
Dispersion forces between the molecules as they are non-polar. (1 mark)

(ii) Sodium; many metallic bonds between the particles in solid sodium which require a lot of energy to break sufficient of them to change state, hence it has a higher melting temperature than chlorine. (1 mark)
Chlorine molecules have only weak dispersion forces between them, which are relatively weak and so do not require much energy to break them apart, hence the low melting temperature of chlorine. (1 mark)

(b) The core charge of chlorine is greater than the core charge of sodium. (1 mark)
The result of this is that the outer shell electrons of chlorine are more strongly attracted to the nucleus than those of sodium, reducing the size of the chlorine atom. (1 mark)

(c) Example reaction equation: $Na_2O(s) + H_2O(l) \rightarrow 2NaOH(aq)$ (1 mark)

(d) Example reaction equation: $SO_3(aq) + H_2O(l) \rightarrow H_2SO_4(aq)$ (1 mark)

END OF SUGGESTED SOLUTIONS