Ongoing revision 9

1) Two chemical reactions occur as follows.
i. $CH_2CHCH_2CH_2CH_2CH_3 + Br_2 \rightarrow X$

and

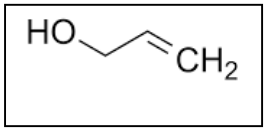
ii. 2-chlorohexane + NaOH(aq) $\rightarrow$ Y

a) What type of reaction is:
i. _____
ii. _____

b) What is substance:
i. X = _____

ii. Y = _____

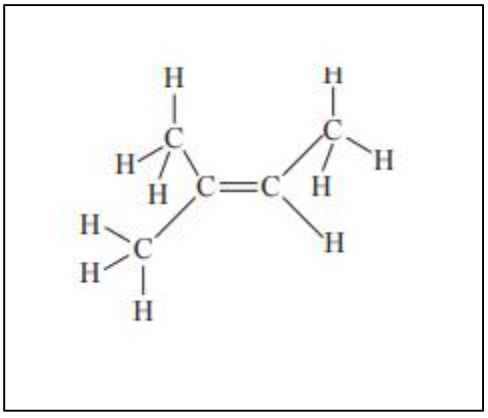
c) Write the IUPAC name for the molecule shown on the right.



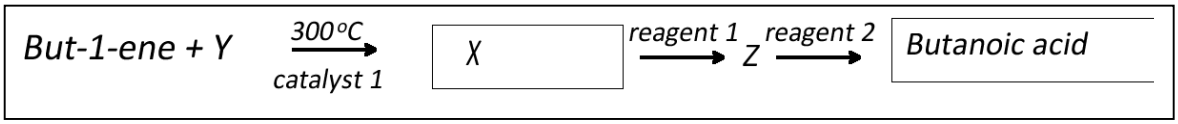
d) Draw the structural formula for the compound 4-methyl-pent-2-enoic acid

e) The molecule with the structural formula shown below reacts with hydrogen bromide, HBr, to form $C_5H_{11}Br$.

Draw all possible isomers of the product $C_5H_{11}Br$



f) Butanoic acid is formed from but-1-ene according to the reaction pathway below.



i. What is reactant Y _____
ii. What is catalyst 1 _____
iii. Give the name and structural formula of X _____
iv. What is reagent 1 _____
v. What is reagent 2 _____
vi. Give the structural formula of Z _____

2) Liquid octane was placed in a bomb calorimeter and ignited.
a) Write a balanced chemical equation for the combustion of liquid octane (C8H18) in excess oxygen.

b) Calculate the ΔH for the reaction represented by the equation above if 1.140 grams of pure octane (FM=114.23 amu) generated 5.098 kJ of heat energy when completely burnt.

c) Using the ΔH value in b) calculate the volume, in litres, of carbon dioxide produced at SLC, if an unknown mass of octane delivered 3100 kJ of energy

d) In a sealed 2.00 litre reaction vessel was placed 0.132 mol of octane gas and 2.874 mol of oxygen gas. The mixture was ignited and the amount of heat released was calculated at 51.00 kJ. If all the products are in the gaseous state:

i) give the expression for the equilibrium constant for this reaction

ii) calculate following at equilibrium.

i. $[C_8H_{18}]$ =

ii. $[CO_2]$ =

iii) What conditions favour maximum yield of CO_2?

3) The table on the right lists some of the properties of bio and petro diesels. ***Flashpoint*** is the lowest temperature at which a fuel vapour will ignite if exposed to a flame. A fuel with a higher flashpoint is safer than one with a lower flash point.

Fuel	Major component	Energy content (MJ/kg)	CO_2 emission (kg CO_2/kg of fuel)
petrodiesel	$C_{12}H_{26}$	43	3.17
biodiesel	$C_{19}H_{32}O_2$	38	2.52

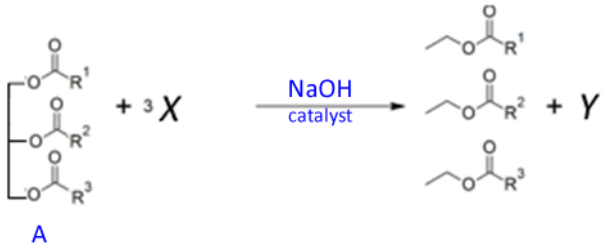
a) Describe and explain the difference in the safe handling, under the same conditions, of the two fuels.

b) Viscosity is an important physical property for fuels used in cold, Northern hemisphere climates. Describe and explain which fuel is best suited to cold climates.

c) Biodiesel is produced via the pathway shown on the right.

i. To which group of food molecules does "A" belong to?

ii. Name "X"



A

iii. Draw the structural formula of "Y".

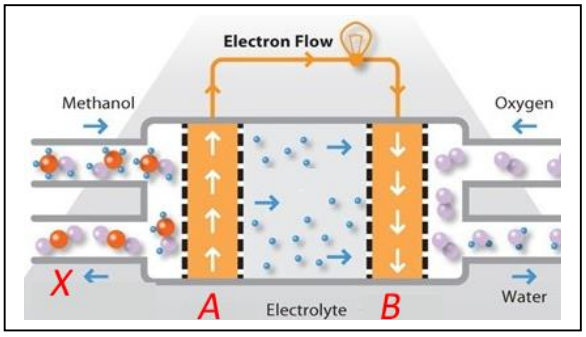
d) Which of the following molecules represent a:

1) $C_{12}H_{25}$ COOH
2) $C_{10}H_{19}COOH$
3) $C_{11}H_{19}COOH$
4) $C_8H_{16}O_2$

i. monounsaturated fatty acid
ii. poly unsaturated fatty acid
iii. saturated fatty acid

4) Methanol is an important fuel. Methanol fuel cells are used to generate electrical power to power computers and even electric vehicles.

a) Some say it is a more practical option than hydrogen. Explain why



b) What is the polarity of electrode "A"?

c) Write the equation to the reaction taking place at electrode "A"

d) Write the equation to the reaction taking place at electrode "B"

e) Write a balanced chemical equation to the overall reaction taking place in the fuel cell.

f) What moves from electrode "A" to electrode "B" through the electrolyte?

g) Using a suitable catalyst methanol can be synthesised from CO_2 and H_2 gases according to the equation below.

$CO_2(g) + 3H_2(g) \rightarrow CH_3OH(l) + H_2O(l)$.

Submarines can use methanol fuel cells to generate electricity to power the motors while submerged. Although submarines run on electric power when submerged they still have diesel engines on board to drive electric generators. Submarines require silent operation to remain concealed and electric power from fuel cells enable this quiet operation.

i. CO_2 can be recycled from the combustion of methanol in the fuel cell. Hydrogen gas must be generated by other means in order synthesise methanol fuel. Suggest a way the hydrogen gas can be generated whilst the submarine is at sea.

ii. Can the submarine use its diesel engines to generate electrical energy to power the motors while submerged in deep water? Explain your answer.

iii. Is methanol, generated in this way, considered a renewable fuel? Explain your answer.