

***RoshChem***

VCE Chemistry

# Fuels Questions

Name:

**Multiple choice questions****Question 1**

Which energy resource is sustainable?

- A. Coal
- B. Bioethanol
- C. Petro diesel
- D. Natural gas

**Question 2**

Which of the following equation represents the combustion of coal?

- A.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
- B.  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- C.  $2\text{C}_8\text{H}_{18}(\text{l}) + 25\text{O}_2(\text{g}) \rightarrow 16\text{CO}_2(\text{g}) + 18\text{H}_2\text{O}(\text{l})$
- D.  $\text{C}_2\text{H}_5\text{OH}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$

**Question 3**

Why biochemical fuels are carbon neutral?

- A. They do not release any carbon dioxide during combustion
- B. They release very little amount of carbon dioxide during combustion
- C. The carbon dioxide they release during combustion is absorbed by the plants
- D. They are made by a natural process

**Question 4**

Which of the following represents an example of biodiesel

- A.  $\text{C}_4\text{H}_{10}$
- B.  $\text{CH}_4$
- C.  $\text{CH}_3\text{COOH}$
- D.  $\text{CH}_3(\text{CH}_2)_{14}\text{COOCH}_3$

**Question 5**

Which of the chemicals is unlikely to present in a flask which used to synthesis biodiesel?

- A. Glycerol
- B. Methanol
- C. Sodium hydroxide
- D. Methane

**Question 6**

Which of the following can be a formula of perodiesel

- A.  $\text{CH}_3(\text{CH}_2)_{14}\text{COOCH}_3$
- B.  $\text{C}_{12}\text{H}_{26}$
- C.  $\text{CH}_3\text{COOH}$
- D. C

## Short Answer Questions

## Question 1

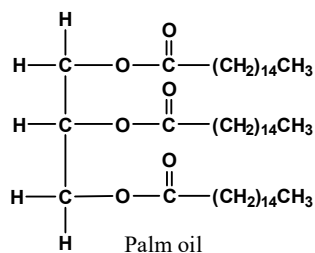
Coal, crude oil and natural gas are types of fossil fuels.

- Why are they called fossil fuels?
- Why fossil fuels are considered to be non-renewable?
- Give chemical equations to represent combustion of coal and natural gas.
- Black coal contains about 90% carbon and brown coal contains about 70% carbon.
  - Which type of coal contains most percentage of water?
  - If the same mass of black coal and brown coal undergo combustion, which type of coal can generate more heat? Explain your answer.

## Question 2

Biodiesel can be prepared by reacting palm oil with methanol in a process called transesterification. Sodium hydroxide or potassium hydroxide is the catalyst in this reaction. In this reaction palm oil is converted to glycerol and three long chain methylester molecules. These ester molecules are called biodiesel.

Structure of palm oil is shown below.



- Label the functional group present in palm oil.

- b. Give a chemical equation for the formation of biodiesel from palm oil.
- c. Give a chemical equation to represent the combustion of above biodiesel molecule.
- d. What is the functional group present in biodiesel?

**Question 3**

Biodiesel may be produced by reacting vegetable oil with methanol in the presence of a base catalyst. Since some vegetable oils contain mixtures of triglycerides, the reaction produces glycerol and a mixture of biodiesel molecules. An example for a biodiesel molecule derived from vegetable oil is  $C_{15}H_{30}O_2$ .

Unlike biodiesel, petrodiesel is produced from crude oil. It is not a pure substance and generally contains hydrocarbons and aromatic compounds. One such compound found in petrodiesel is  $C_{12}H_{26}$ .

- a. Are biodiesel and petrodiesel renewable? Explain your answer.
- b. Give the semistructural formula of biodiesel molecule,  $C_{15}H_{30}O_2$  and petrodiesel molecule,  $C_{12}H_{26}$
- c. Which of the above molecules contains a polar group?
- d. The viscosity and melting point of biodiesel is greater than that of petrodiesel. Explain the reason for this difference.
- e. The substances that absorb water easily are called hygroscopic. Which of the above fuels are more hygroscopic? Explain your answer.
- f.i. Fuels such as petrol and petrodiesel emit sulfur dioxide during combustion. Explain the reason for this.
- ii. What is the impact of this sulfur dioxide on the atmosphere?

g. Energy density is the energy released per gram of fuel. Petrol and the two forms of diesel have similar energy densities. However density of petrol is less than that of the two forms of diesel. Explain whether diesel or petrol can deliver more energy per litre.

h. The cloud point of a fuel is the lowest temperature at which crystals start to form and it is a measure of the performance of the fuel in cold climates. The cloud point of petrodiesel is between  $-15$  to  $5\text{ }^{\circ}\text{C}$  and that of biodiesel is  $-3$  to  $12\text{ }^{\circ}\text{C}$ .

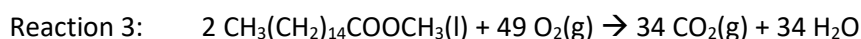
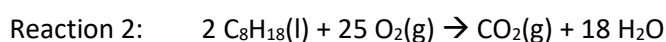
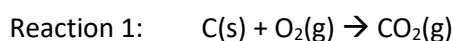
Which fuel can perform well in very cold climates? Explain your answer.

#### Question 4

a. Explain the difference between renewable and non renewable fuels giving examples.

b. Why are the  $\text{CO}_2$  emissions from the use of bioethanol not considered as problematic as those produced from the use of fossil fuels? Explain with relevant equations.

C. The equation below represents a reaction that takes place when a fuel undergoes combustion



i. Identify the fuel source that provides the fuel used in each reaction.

ii. Give one use of each fuel source written above.

c. Which of the fuel above is renewable? Explain

d. Give an equation to represent the formation of fuel shown in equation 3 from its raw material.

#### Question 5

Use the structures of petrodiesel and biodiesel to compare their physical properties.

Sample