



CHEMISTRY 2021

Unit 3

Key Topic Test 1 - Fuels

Recommended writing time*: 45 minutes

Total number of marks available: 50 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: C

Explanation:

0.100 GJ is equivalent to 100 MJ and 100 000000 J

Question 2

Answer: A

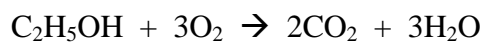
Explanation:

The energy content of ethanol is less than the energy content of petrol so you would expect to travel a shorter distance for a tank of fuel.

Question 3

Answer: C

Explanation:



Question 4

Answer: C

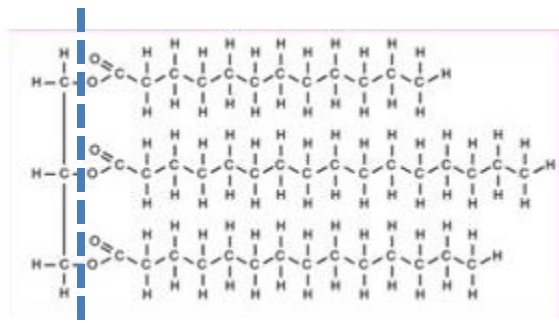
Explanation:

Hygroscopic means that the substance absorbs water.

Question 5

Answer: D

Explanation:



The triglyceride can be thought of having bonds broken along the dotted line. The hydroxyl group would add onto the backbone to form glycerol and the methyl group would add onto the side chain to form an ester.

Question 6

Answer: B

Explanation:

Triglycerides can be obtained from waste cooking oil.

Question 7

Answer: C

Explanation:

Using the energy content values in the data book, the correct order from lowest to highest energy content is; diesel, octane, methane, hydrogen.

Question 8

Answer: B

Explanation:

When glucose undergoes fermentation, ethanol and carbon dioxide is produced.



Question 9

Answer: A

Explanation:

Internal combustion engines are about 25% efficient, with most of the energy released as heat.

Question 10

Answer: D

Explanation:

Methane, ethanol, biodiesel and hydrogen can all be produced from renewable resources. Octane, natural gas and propane can only be obtained from non-renewable resources.

SECTION B: Short-answer questions

Question 1

- a. Wood can be regarded as renewable (although it is currently being consumed at a faster rate than it is being regrown) 1 mark
- b. i. $\text{CH}_{4(g)} + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$
- ii. $\text{C}_4\text{H}_{10(g)} + 4.5\text{O}_{2(g)} \rightarrow 4\text{CO}_{(g)} + 5\text{H}_2\text{O}_{(g)}$ 1 + 1 = 2 marks
- c. In cars, the conversion of chemical energy to heat energy is very efficient* but the conversion of heat energy to kinetic energy is very inefficient.* 2 marks
- Total 11 marks

Question 2

- a. $\text{C}_{10}\text{H}_{20}\text{O}_2$ and CH_3OH 2 marks
- b. $\text{C}_{11}\text{H}_{22}\text{O}_{2(l)} + 15.5\text{O}_{2(g)} \rightarrow 11\text{CO}_{2(g)} + 11\text{H}_2\text{O}_{(g)}$ (1 mark for correct chemicals and 1 mark for correct balancing) 2 marks
- c.
- i. Biodiesel is a polar molecule and forms dipole-dipole bonds between molecules which are stronger than the dispersion forces between petrodiesel molecules. 1 + 1 = 2 marks
- ii. Petrodiesel contains only hydrogen and carbon which has more chemical energy than fuels that also contain oxygen. 3 marks
- d. In cold areas, petrodiesel would be more suitable than biodiesel.* Biodiesel has a lower cloud point. Biodiesel has relatively stronger dipole-dipole bonds between chains while petrodiesel has relatively weaker dispersion forces between chains.* So biodiesel turns cloudy at a lower temperature and can solidify in fuel lines.* 2 marks
- e. Biodiesel is regarded as renewable* as it can be produced from vegetable oils which are grown from plants.* Total 11 marks

Question 3

- a. C_2H_5OH 1 mark
- b. C 1 mark
- c. $C_{19}H_{34}O_2$ 1 mark
- d. C_8H_{18} 1 mark
- e. C 1 mark
- f. $C_{19}H_{34}O_2, C_{17}H_{34}O_2$

Total 6 marks

Question 4

- a. chemical energy \rightarrow heat energy \rightarrow kinetic energy \rightarrow electrical energy (subtract one mark for each missing or incorrect transformation) 2 marks
- b. coal is readily available*, has a high energy value* and is easy to transport*. (any two points) 2 marks
- c. Solar panels are becoming cheaper to manufacture* and have increased in energy efficiency.* Many coal power stations are ageing and need to be replaced, which is expensive.* The sun is a renewable energy source so the use of solar energy does not contribute to the enhanced greenhouse effect.* Coal produces pollutants including carbon dioxide which contributes to the enhanced greenhouse effect.* (any 4 dot points)

4 marks

Total 8 marks

Question 5

- a. Fracking is carried out by drilling and forcing methane gas to the surface* using high pressure water.* 2 marks
- b. Waste decomposes in the absence of oxygen* in sealed conditions that traps the methane gas.* 2 marks
- c. Methane forms in the ground under high pressure and temperature, often with crude oil*. It is then separated (fractionally distilled) from the crude oil.* 2 marks
- d.
- i. Methane formed from decomposing waste is regarded as a biofuel.
 - ii. Fracking – the process may pollute underground water supplies (aquifers).*
Decomposing Waste – unwelcome smells may be released or the methane produced is collected rather than entering the atmosphere.*
Crude oil – oil spills and gas leaks can affect marine life.*
- 1 + 3 = 4 marks