**Unit 3: Topic Test -Introduction to fuels Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Mark out of 50: \_\_\_\_\_\_\_\_\_\_\_\_***

**SECTION A – Multiple-choice questions**

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| **Instructions for Section A**  Answer **all** questions.  Choose the response that is **correct** for the question.  A correct answer scores 1, an incorrect answer scores 0.  Marks are **not** deducted for incorrect answers.  If more than one answer is completed for any question, no mark will be given. |

**Question 1**

The best definition of a fuel is

**A**. a reactant in an exothermic reaction.

**B**. a carbon compound or an alkane.

**C**. a compound that releases significant amounts of energy easily.

**D**. a compound with a high level of stored energy.

**Question 2**

Which of the following pie charts is the best representation of Australia’s electricity generation mix in 2023?

A pie chart with different colors

Description automatically generatedA pie chart with different colored circles

Description automatically generatedA pie chart with different colored circles

Description automatically generatedA pie chart with text

Description automatically generated

**gas**

**wind/solar**

**coal**

**A**.  **B**.  **C**.  **D**.



**Question 3**

The photo on the right shows a large collection bag used

at a waste treatment plant.

The fuel collected at the site is best described as

**A**. natural gas

**B**. biogas

**C**. bioethanol

**D**. coal seam gas

**Question 4**

Which of the following is a correct thermochemical equation?

**A**. C2H6(g) + 3.5O2(g) 🡪 2CO2(g) + 3H2O(l) ∆H= -1560 kJ mol-1

**B**. 2C2H6(g) + 7O2(g) 🡪 4CO2(g) + 6H2O(g) ∆H= -1560 kJ mol-1

**C**. 2C2H6(g) + 7O2(g) 🡪 4CO2(g) + 6H2O(g) ∆H= -3120 kJ mol-1

**D**. 2C2H6(g) + 7O2(g) 🡪 4CO2(g) + 6H2O(l) ∆H= -3120 kJ

**Question 5**

An energy profile diagram is drawn below.

A diagram of a product curve

Description automatically generated

In the reaction represented by the diagram, the

**A**. enthalpy of the products is less than that of the reactants and energy is released to the surroundings.

**B**. enthalpy of the products is greater than that of the reactants and energy is released to the surroundings.

**C**. enthalpy of the products is less than that of the reactants and energy is absorbed from the surroundings.

**D**. enthalpy of the products is greater than that of the reactants and energy is absorbed from the surroundings.

**Question 6**

Which of the following food sources can provide the body with the greatest amount of energy?

**A**. 10 g of sugar and 5 g of peanut oil

**B**. 5 g of sugar, 5 g of protein and 5 g of peanut oil

**C**. 24 g of sugar

**D**. 12 g of peanut oil

**Question 7**

Which of the following is represented with a negative value?

**A**. the enthalpy of 2 mole of ethane undergoing combustion

**B**. the heat of combustion of 2 mole of ethane

**C**. the heat of combustion of 1 g of ethane

**D**. the amount of energy released when 2 mole of ethane undergoes combustion

**Question 8**

Select the correct statement about fermentation.

**A**. Fermentation converts any sugar into ethanol.

**B**. Fermentation will produce pure ethanol if the reaction is allowed to continue long enough.

**C**. Fermentation usually produces an ethanol solution of concentration around 12 (%v/v).

**D**. Fermentation requires oxygen gas.

**Question 9**

Compared to petrol, E10 fuel

**A**. has a higher energy density.

**B**. is more likely to absorb traces of water.

**C**. leads to more rapid engine deterioration.

**D**. emits a lower volume of gas per kilometre during combustion.

**Question 10**

Which of the following reactions produces the greatest amount of energy per mole of methane?

**A**. CH4(g) + O2(g) 🡪 CO(g) + H2O(g)

**B**. CH4(g) + 2O2(g) 🡪 CO2(g) + H2O(g)

**C**. CH4(g) + 2O2(g) 🡪 CO2(g) + H2O(l)

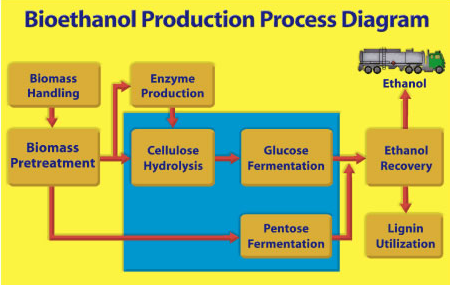
**D**. CH4(l) + 2O2(g) 🡪 CO2(g) + H2O(g)

**SECTION B- Short-answer questions**

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| **Instructions for Section B**  Questions must be answered in the spaces provided in this book.  To obtain full marks for your responses you should   * Give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks. * Show all workings in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.   Make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, H2(g); NaCl(s) |

**Question 1** (15 marks)

The flowchart below refers to the production of bioethanol from timber industry waste. The timber contains a high cellulose content, cellulose being a natural polymer formed from glucose monomers.



**a. i**. Write a thermochemical equation for the complete combustion of ethanol. 1 mark

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**ii**. Calculate the amount of energy released by the complete combustion of 92 g of ethanol. 2 marks

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**ii**. Write a balanced equation for the incomplete combustion of ethanol to form carbon monoxide and water.

1 mark

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**b**.  **i**. Draw the structure of a bioethanol molecule. 1 mark

**ii**. Will a molecule of ethanol produced from crude oil have the same structure and properties as a molecule

of biodiesel. Justify your answer. 2 marks

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**c**. **i**. The flowchart above shows biomass pretreatment and cellulose hydrolysis as the first steps.

Explain the purpose of these steps. 2 marks

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**ii**. Pentose is not a molecule you are likely to be familiar with. What conclusions can you draw about pentose

from this diagram? 2 marks

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**d**. **i**. Write a balanced equation for the fermentation of glucose. 1 mark

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**ii.** Once fermentation has occurred, bioethanol plants will run the solution into tall columns like the ones

shown here. Explain the purpose and principle behind these columns. 3 marks

A large industrial tower with multiple cylinders

Description automatically generated with medium confidence

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**Question 2** (6 marks)

**A graph of a graph

Description automatically generated**The energy profile diagram below is for the reaction between phosphorus, P4, and oxygen gas to form phosphorous pentoxide, P4O10.

**a**. In this reaction

**i**. the bonds broken are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**ii**. the bonds formed are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**iii**. the temperature of the surroundings will \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

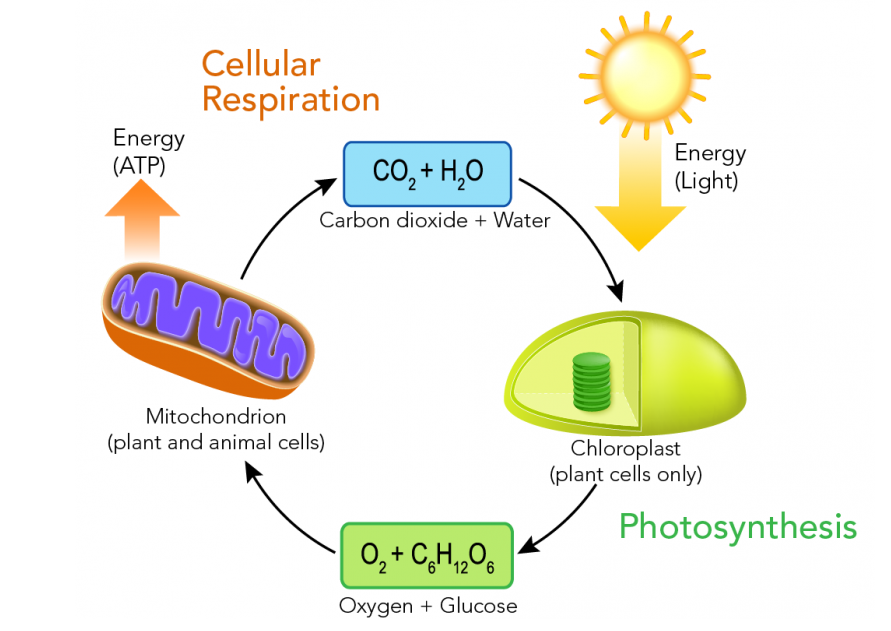
**iv**. the activation energy is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**b**. Write a thermochemical equation for the formation of phosphorus pentoxide. 2 marks

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**Question 3** (8 marks)

The diagram below shows some important processes in living things.

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**a. i.** Write a balanced equation for the photosynthesis process. 1 mark

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**ii**. What is the energy transformation occurring in this reaction? 1 mark

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**iii**. State two uses in the human body for glucose. 2 marks

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**b**. **i**. Write a balanced equation for the respiration process. 1 mark

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**ii**. What is the energy transformation in this reaction? 1 mark

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**iii**. Calculate the amount of energy released when 4 mole of glucose reacts. 1 mark

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**c**. Why does the combustion of 1.0 g of fats release more energy than the combustion of 1.0 g of sugar?

1 mark

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**Question 4** (11 marks)

**a**. **i**. Identify a potential source of biogas and explain how biogas is produced from this source. 2 marks

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**ii**. List three major components of biogas and their typical proportions. 2 marks

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**iii**. How is useful energy obtained from biogas? 1 mark

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**b**. Canola is grown in Australia, Canada and Europe and its oil is used as a source of biodiesel.

**i**. Describe the structure of a lipid molecule. 2 marks

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**ii**. What processing of plant oil is needed to convert it to biodiesel? 2 marks

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**iii**. The combustion of biodiesel produces CO2 emissions, yet biodiesel is considered a better option than

petrol or diesel. Discuss the impact upon the environment of a shift from fossil fuels to biodiesel.

2 marks

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**END OF KEY TOPIC TEST**