Section A

1. Choose the correct definition of a hydrocarbon.
   Tick (✓) **one** box.

   A. A molecule that contains carbon and water atoms only ☐

   B. A molecule that contains carbon and hydrogen atoms only ☐

   C. A molecule that contains a mixture of carbon and hydrogen atoms ☐

2. Complete the chemical formula for propane.

   C__H___

3. Choose the substance that hydrocarbons react with during combustion.
   Tick (✓) **one** box.

   A. Air ☐

   B. Oxygen ☐

   C. Carbon dioxide ☐

4. Complete the general equation for the complete combustion of alkanes:

   Alkane + _____ → _____ _____ + _____

5. Describe what is needed for complete combustion of alkanes to take place.

   _____
   _____
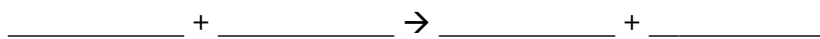
Section B

6. Methane is a common hydrocarbon that is used as a domestic fuel.

   a. Write a balanced symbol equation for the complete combustion of methane.
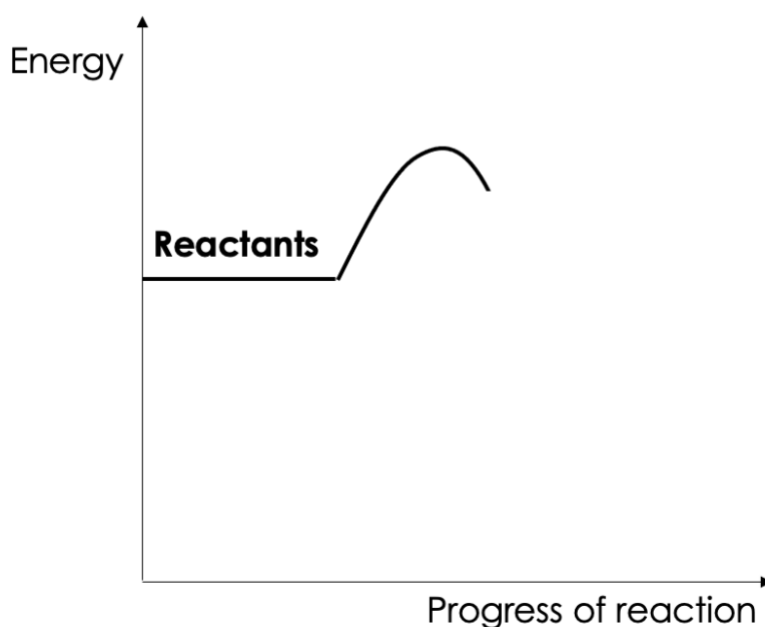
   _____ + _____ → _____ + _____

   b. Explain why the incomplete combustion of methane may be dangerous.

   _____
   _____
   _____

   c. Complete the reaction profile for the combustion of methane.

   d. Explain your answer to question c.

   _____
   _____
   _____

7. Petrol is used as a fuel in many cars. One of the compounds in petrol is octane (C_8H_{18}).

a. Complete the word equation for the reaction of octane that takes place in a car engine:

Octane + _____ → _____ + _____

b. Cars should use sulfur-free petrol. Explain why.

_____
_____
_____

c. Many scientists are concerned about one of the products of the complete combustion reaction of octane in car engines. Identify the product that is concerning scientists and explain why it is a concern.

_____
_____
_____
_____

The table below provides data on the composition of gases from the exhaust of a petrol engine.

Gas	Percentage
Nitrogen	67
Carbon dioxide	16
Carbon monoxide	1.5
Oxygen	0.5
Nitrogen oxides	0.15
Sulfur dioxide	0.02
Other gases	

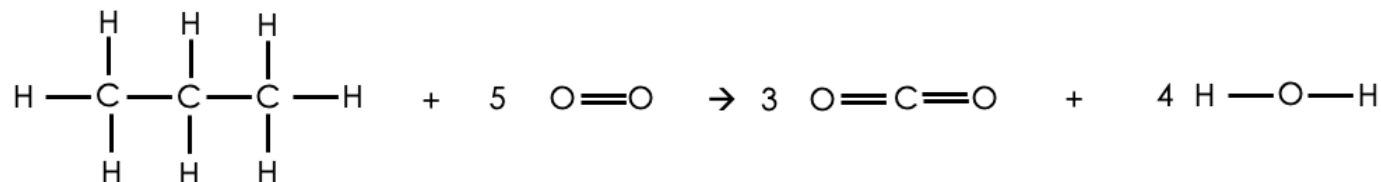d. Calculate the percentage of other gases present.

_____

e. Name the compound that makes up most of the other gases.

_____

Section C

8. Below shows the reaction between propane and oxygen. This reaction is exothermic as 2018 kJ/mol more energy is released when forming the bonds than is taken in to break the bonds in the reactants.

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H \quad + \quad 5 \ O=O \quad \rightarrow \quad 3 \ O=C=O \quad + \quad 4 \ H-O-H$$

Bond	Bond Energy (kJ/mol)
C-H	413
O=O	498
C=O	799
O-H	464

a. Use the information given to calculate the C-C bond energy.
b. Calculate the mass of carbon dioxide that would be made when 100 g of propane burns in 600 g of oxygen.
   Relative atomic masses:
   Carbon = 12
   Hydrogen = 1
   Oxygen = 16