



Base your answers to questions 10 on the information below and on your knowledge of chemistry.

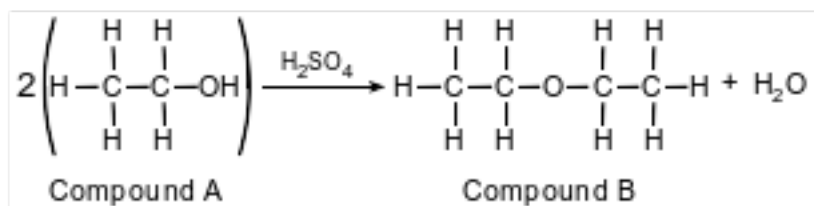
Crude oil, primarily a mixture of hydrocarbons, is separated into useful components in a fractionating tower. At the bottom of the tower, the crude oil is heated to about 400°C. The gases formed rise and cool. Most of the gases condense and are collected as liquid fractions. The table below shows the temperature ranges for collecting various hydrocarbon fractions.

Number of Carbon Atoms per Molecule	Temperature Range (°C)
1-4	below 40
5-12	40-200
12-16	200-300
16-20	300-370
>20	above 370

- 10 Determine the number of carbon atoms in one molecule of an alkane that has 22 hydrogen atoms in the molecule.

Base your answers to questions 11 on the information below and on your knowledge of chemistry.

The equation below represents an industrial preparation of diethyl ether.



- 11 Explain, in terms of elements, why compound B is not a hydrocarbon.

Base your answers to questions 12 on the information below and on your knowledge of chemistry.

Natural gas and coal are two fuels burned to produce energy. Natural gas consists of approximately 80% methane, 10% ethane, 4% propane, 2% butane, and other components.

The burning of coal usually produces sulfur dioxide,  $\text{SO}_2(\text{g})$ , and sulfur trioxide,  $\text{SO}_3(\text{g})$ , which are major air pollutants. Both  $\text{SO}_2(\text{g})$  and  $\text{SO}_3(\text{g})$  react with water in the air to form acids.

- 12 Draw a structural formula for the hydrocarbon that is approximately 2% of natural gas.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

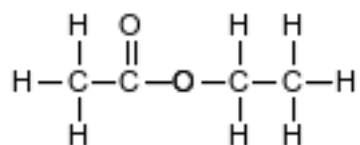
There are several isomers of C<sub>6</sub>H<sub>14</sub>. The formulas and boiling points for two of these isomers are given in the table below.

Isomer	Formula	Boiling Point at 1 atm (°C)
1	$  \begin{array}{cccccc}  & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\  &   &   &   &   &   &   \\  \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{H} \\  &   &   &   &   &   &   \\  & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $	68.7
2	$  \begin{array}{ccccccc}  & & & \text{H} & & & \\  & & &   & & & \\  & & & \text{H}-\text{C}-\text{H} & & & \\  & & &   & & & \\  & \text{H} & &   & & \text{H} & \text{H} \\  &   & &   & &   &   \\  \text{H} & -\text{C} & - & \text{C} & - & \text{C} & -\text{C}-\text{H} \\  &   & &   & &   &   \\  & \text{H} & & \text{H} & & \text{H} & \text{H} \\  & & & \text{H}-\text{C}-\text{H} & & & \\  & & &   & & & \\  & & & \text{H} & & &   \end{array}  $	49.7

13 Identify the homologous series to which these isomers belong.

Base your answers to questions 14 on the information below and on your knowledge of chemistry.

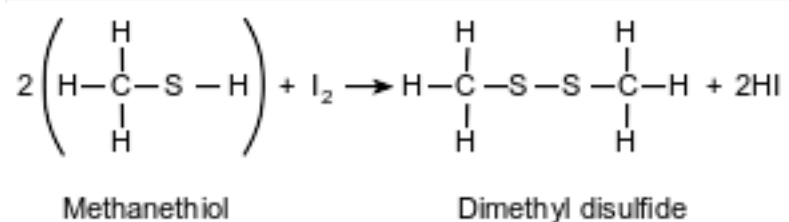
Ethyl ethanoate is used as a solvent for varnishes and in the manufacture of artificial leather. The formula below represents a molecule of ethyl ethanoate.



14 Determine the number of electrons shared in the bond between a hydrogen atom and a carbon atom in the molecule.

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

A thiol is very similar to an alcohol, but a thiol has a sulfur atom instead of an oxygen atom in the functional group. The equation below represents a reaction of methanethiol and iodine, producing dimethyl disulfide and hydrogen iodide.



15 State the number of electrons shared between the sulfur atoms in the dimethyl disulfide.

## Answer Keys

1 4

2 2

3 1

4 4

5 1

6 3

7 1

8 Allow 1 credit. Acceptable responses include, but are not limited to:

- Each molecule has a triple carbon-to-carbon bond,  $C\equiv C$ .
- The two C atoms share 6 electrons.
- Each molecule has a triple bond.
- Alkynes have a  $C\equiv C$ .

9 Allow 1 credit for  $C_nH_{2n}$ .

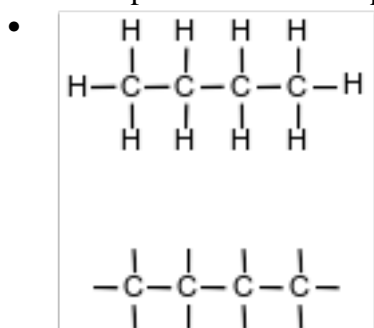
10 Allow 1 credit for 10 or ten.

11 Allow 1 credit. Acceptable responses include, but are not limited to:

- Hydrocarbons contain only carbon and hydrogen, but compound B also contains oxygen.
- Compound B contains carbon, hydrogen, and a different element.
- This compound includes oxygen.

12 Allow 1 credit.

- Examples of 1-credit responses:



13 Allow 1 credit. Acceptable responses include, but are not limited to:

- alkanes
- $C_nH_{2n+2}$

14 Allow 1 credit for 2 or two or 1 pair.

15 Allow 1 credit for 2 or two or 1 pair.