28 Two hydrocarbons, R–CH_3 and R'–CH_3, react separately with bromine in the presence of ultraviolet light. One of these hydrocarbons is unsaturated.

In each case, free radical substitution reactions occur.

R is $CH_3CHC(CH_3)$.

R' is $CH_3CH(CH_3)CH_2$.

Which row is correct?

	a propagation stage for the saturated hydrocarbon	a termination stage for the unsaturated hydrocarbon
A	$R–CH_2• + Br• \rightarrow R–CH_2Br$	$R'–CH_2• + Br• \rightarrow R'–CH_2Br$
B	$R–CH_2• + Br_2 \rightarrow R–CH_2Br + Br•$	$R'–CH_2• + Br_2 \rightarrow R'–CH_2Br + Br•$
C	$R'–CH_3 + Br• \rightarrow R'–CH_2• + HBr$	$2R–CH_2• \rightarrow R–CH_2CH_2–R$
D	$2R'–CH_2• \rightarrow R'–CH_2CH_2–R'$	$R–CH_3 + Br• \rightarrow R–CH_2• + HBr$

29 The fumes from the exhausts of petrol-burning cars contain the following pollutants.

1 unburnt hydrocarbons

2 nitrogen dioxide

3 carbon monoxide

Which pollutants are removed by oxidation in a catalytic converter?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

25 Two hydrocarbons, $CH_3CHC(CH_3)CH_3$ and $CH_3CH(CH_3)CH_2CH_3$, react separately with chlorine in the presence of ultraviolet light.

In each reaction, free-radical substitution occurs.

Which row is correct?

	identity of the hydrocarbon that can also undergo electrophilic addition	a termination stage of the free-radical substitution of the saturated hydrocarbon
A	$CH_3CHC(CH_3)CH_3$	$CH_3CH(CH_3)CH_2CH_2• + Cl• \rightarrow CH_3CH(CH_3)CH_2CH_2Cl$
B	$CH_3CHC(CH_3)CH_3$	$CH_3CHC(CH_3)CH_2• + Cl• \rightarrow CH_3CHC(CH_3)CH_2Cl$
C	$CH_3CH(CH_3)CH_2CH_3$	$CH_3CH(CH_3)CH_2CH_2• + Cl• \rightarrow CH_3CH(CH_3)CH_2CH_2Cl$
D	$CH_3CH(CH_3)CH_2CH_3$	$CH_3CHC(CH_3)CH_2• + Cl• \rightarrow CH_2CHC(CH_3)CH_2Cl$

3 The alkanes are a homologous series of organic molecules. Alkanes are generally unreactive and are commonly used as fuels.

(a) Define homologous series.

.....

..... [2]

(b) Give two reasons to explain the general unreactivity of alkanes.

1 .....

2 .....
[2]

(c) Alkanes with low relative molecular mass, M_r, are more useful than those found in heavier crude oil fractions.

Name the process that is used to obtain alkanes with low M_r from heavier crude oil fractions.

..... [1]

(d) Hexane, C_6H_{14}, has four structural isomers.

Fig. 3.1 shows hexane and two of its structural isomers.

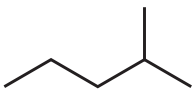
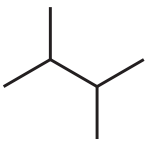
hexane	**A**	**B**	**C**	**D**
				

Fig. 3.1

(i) Complete Fig. 3.1 by drawing structures for **C** and **D**, the other two structural isomers of hexane. [2]

(ii) **A**, **B** and hexane have different boiling points.

Arrange **A**, **B** and hexane in order of increasing boiling point.

Explain your answer.

lowest ..... < ..... < ..... highest

.....

.....

.....
[3]

(e) Hexane can be converted into compounds **E** and **F** at high temperature and pressure. Fig. 3.2 shows the reaction scheme involving hexane, **E** and **F**.

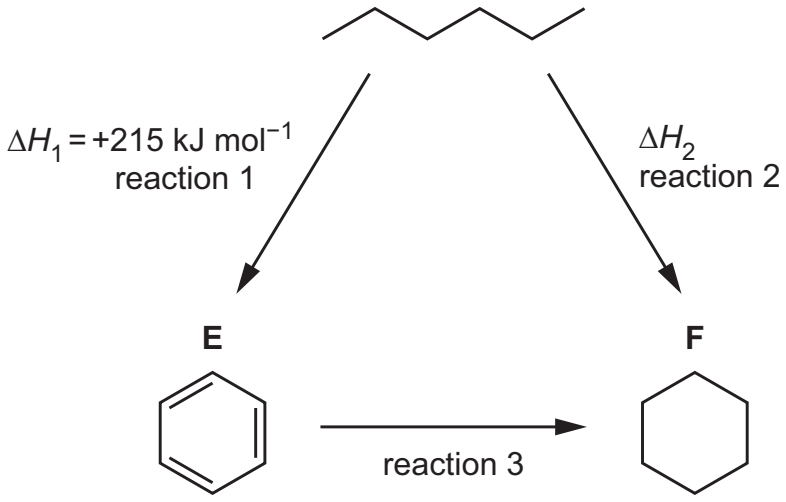


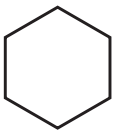
Fig. 3.2

(i) Identify a suitable reagent for reaction 3.

..... [1]

(ii) Use the data in Fig. 3.2 and in Table 3.1 to calculate the enthalpy change of reaction 2, ΔH_2.

Table 3.1

compound	enthalpy change of formation, ΔH_f / kJ mol^{-1}
	−156
	+48

ΔH_2 = ... kJ mol^{-1} [2]

(iii) Write an equation for the complete combustion of hexane.

..... [1]

[Total: 14]