WORKSHEET 11

ENERGY IN CHEMICAL REACTIONS

Syllabus reference 8.5.4

Answer the following questions. In questions 1–3 circle the correct answer.

1 Which of the following is *not* an indicator that a chemical reaction has taken place:
- **A** production of gas
- **B** formation of a precipitate
- **C** release or absorption of energy
- **D** solidification of a liquid

2 Which of the following represent(s) a chemical reaction:
- **A** ice cubes forming in the freezer
- **B** dry ice boiling off in a theatrical performance
- **C** exhaust gases produced from a running motor
- **D** fog vaporising on a sunny morning

3 In a combustion reaction:
- **A** oxygen is a product
- **B** heat is given out
- **C** oxygen is not usually required
- **D** carbon dioxide is a reactant

4 Read the following statements and identify them as true (T) or false (F). Rewrite the false statements so that they are true.

a Combustion is a process which produces carbon dioxide and water only.

b An exothermic reaction is one in which heat energy is released.

c All combustion reactions are endothermic.

d When bonds are broken, energy is released and when bonds are formed, energy is absorbed.

e Photosynthesis is an endothermic reaction.

f In an exothermic reaction, the energy of the reactants is greater than that of the products.

5 Write a balanced equation for the complete combustion of ethane (C_2H_6).

6 **a** Which of the following reactions are exothermic?

i $Zn(s) + Br_2(l) \rightarrow ZnBr_2(s) + 329\ kJ$

ii $PCl_5(g) + 93\ kJ \rightarrow PCl_3(g) + Cl_2(g)$

iii $Na_2S_2O_3.5H_2O(s) + 45\ kJ \rightarrow Na_2S_2O_3(aq)$

iv $Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s) + 63\ kJ$

b If these reactions were carried out in thermally insulated containers, for which ones would the temperature of the mixture increase as the reaction occurred?

7 Given the energy values in question 6, calculate the amount of heat released or absorbed (state which) when:

a 4.3 g zinc reacts with excess bromine

b 18.2 g phosphorus pentachloride is decomposed

8 **a** What is the difference between activation energy and ignition temperature?

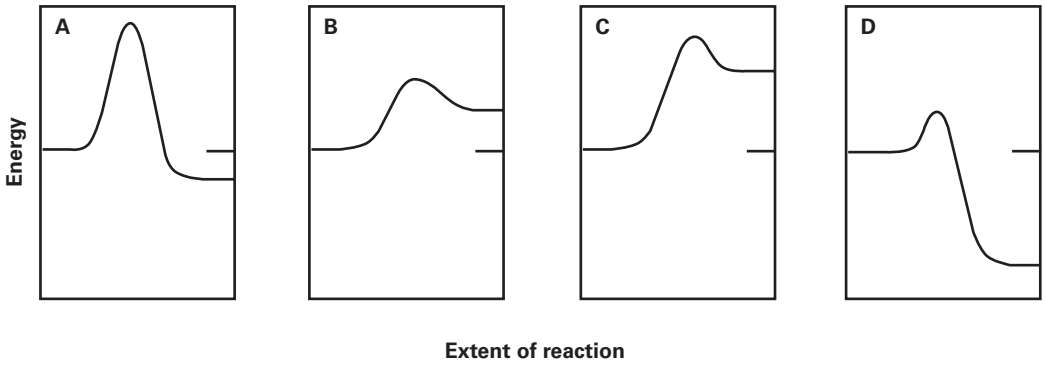
b What is the relationship between activation energy and ignition temperature?

9 Sketch energy profile diagrams for reactions having:

a Absorbed 45 kJ/mol; E_a = 75 kJ/mol

b Released 90 kJ/mol; E_a = 140 kJ/mol

10 Energy profiles for four reactions are shown below.



a Which reactions are exothermic and which endothermic?

b Which has the numerically greatest enthalpy change and which the least?

c Which has the greatest activation energy and which the least?

11 To burn a candle, a wick is needed. The high ignition temperature of candle wax means it will not continue to burn unless a heat source is present to vaporise some of the wax to a temperature above its flash point to allow combustion to continue. Using the information provided above identify the changes in state involved in combustion of a burning candle.

12 Complete the following table related to pollution from burning fossil fuels.

POLLUTANT	FORMULA	COMBUSTION REACTION	SOURCE OR CAUSE OF POLLUTANT	WAY/S IN WHICH POLLUTANT CAN BE MINIMISED OR AVOIDED
Carbon monoxide			Incomplete combustion of the fuel	
Sulfur dioxide		$S(s) + O_2(g) \rightarrow SO_2(g)$		Use low-sulfur coal, remove sulfur dioxide from effluent gas
Oxides of nitrogen	NO NO_2			

13 a What are particulates?

b What is the major source of particulates in the atmosphere?

c How is the emission of particulates minimised?