# Answers to end-of-chapter questions

## Chapter 7 How far? How fast?

**1** The methods used to prevent explosions from 'runaway reactions' are precisely the opposite to those changes that would speed up the rate of reaction. The changes used would need to have a 'dampening', or inhibitory, effect. The following changes would all result in a slowing down of a reaction:

- lowering the temperature
- adding water to dilute the reactants (see Workbook Exercise 7.6 for an example)
- lowering the pressure of a gas reaction.

Other methods are also possible.

**2** **a** hydrated iron sulfate → anhydrous iron sulfate + water [1]

**b** endothermic [1]; heat has to be applied (or words to that effect) [1] [2]

**c** pale green [1]

**d** It is a reversible reaction [1], hydrated iron sulfate is formed [1] and heat is also generated (reaction exothermic) which produces steam [1]. [3]

**e** reversible reaction [1]

**f** If water is added to anhydrous cobalt chloride [1], it changes colour from blue to pink [1]. [2]

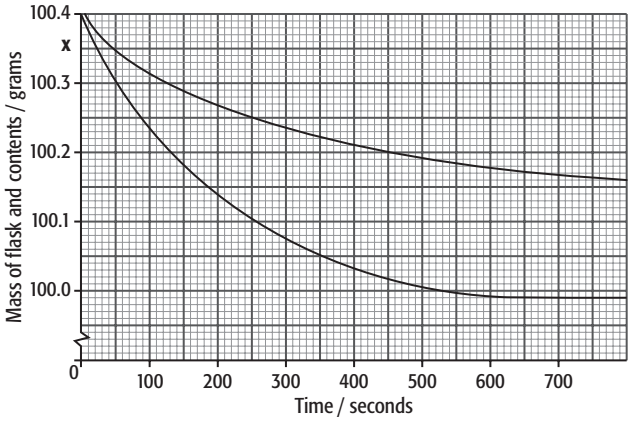
**[Total = 10]**

**3** **a** Carbon dioxide is given off. [1]

**b** **i** somewhere between 600 and 630 s [1]

**ii** **X** placed at the beginning of the curve (see graph below) [1]

**iii** sketch graph to the right of the printed curve [1] and levelling out above it [1] (see graph at the top of the next column) [2]




**c** **i** gets faster [1]

**ii** gets faster [1]

**d** combustion, small, large [3]

**e** **i** respiration [1]

**ii** a substance which speeds up a chemical reaction [1]

**[Total = 12]**

**4** **a** amount of manganese(IV) oxide and temperature [2]

**b** **i** the higher the concentration, the faster the reaction [1]

**ii** A lower concentration will produce less oxygen. [1]

**iii** 25 or 26 s [1]

36 or 37 $cm^3$ [1]

**c** magnesium oxide, copper(II) oxide, manganese(IV) oxide, lead(IV) oxide [1]

**[Total = 7]**

**5** **a** **i** fair test [1]; keep the amount of solution above the cross the same [1] [2]

**ii** value for gap: between 120 and 150 [1]

**iii** speed decreases [1] because lower concentration [1] means fewer collisions [1] [3]

**b** The reaction is faster [1] because higher temperature makes particles move more rapidly [1]; this means more collisions [1] and harder/more energetic collisions [1]. **[4]**

**[Total = 10]**

**6** **a** making fertiliser **[1]**

**b** Methane is reacted with steam/water:
$CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$ **[3]**

**c** High pressure increases the reaction rate because gas particles are closer together [2]. High pressure ensures that equilibrium is shifted to the right/forward [1] because the reaction has fewer molecules on the right [1] and so the forward reaction reduces pressure [1]. **[5]**

**d i** endothermic needs heat/energy to proceed; exothermic produces heat/energy **[1]**

**ii** first blank: endothermic; second blank: $6 \times 388 = 2328$; third blank: exothermic [2] The exothermic value (heat given out making bonds) of 2328 is greater than the endothermic value (the heat taken in to break bonds) of 944 + 1308 [1]. **[3]**

**[Total = 13]**

## Commentary

When answering questions on these topics, students should be aware of the following points:

- If asked whether a reaction is endothermic or exothermic, they should remember the following:
  - endothermic – heat is put in (e.g. you have to heat with a Bunsen to get a reaction)
  - exothermic – heat is given out (e.g. burning fuels and neutralisation reactions are always exothermic).
- When planning and describing experiments on rates of reaction, it is important that students understand the ideas of comparable experiments – the comparison must be 'fair'. Only one variable – concentration, temperature, etc. – should be changed from one experiment to the other. Everything else that might affect the rate must be kept constant.
- Students should practise drawing graphs and making conclusions from them.
- When plotting a graph of reaction rate, students must draw a **curve of best fit** through the points. They should not simply draw lines with a ruler from point to point.
- The effects of changing conditions on chemical equilibria are predictable, and students should be aware of how changes in temperature and pressure affect the amount of product in the equilibrium mixture.
- They should remember that the total volume of gas released by the same **amount** of metal is always the same. A common error is to think that powdered metal, when reacted with acid, gives off more gas than larger lumps of the same amount of metal.
- The total volume of gas released by an uncatalysed reaction is, eventually, exactly the same as for a catalysed reaction. The same amount of reactants is the important factor.
- A common mistake is to say that, in an equilibrium reaction, a catalyst increases the rate of the forward reaction more than the back reaction. One of the characteristics of equilibrium is that the backward and forward reactions go at the same speed. This applies to catalysed as well as uncatalysed reactions.