Reversible reactions

Question Paper

Level	O Level
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Chemical Reactions
Sub-Topic	Reversible Reactions
Booklet	Question Paper

Time Allowed: **19 minutes**

Score: **/16**

Percentage: **/100**

1 In which of these equilibria is the forward reaction favoured by an increase in pressure?

A $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

B $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

C $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$

D $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

2 Methanol is made in industry by a reaction between carbon monoxide and hydrogen.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H = -90\,kJ/mol$$

The process is usually carried out at a temperature of 400 °C.

Which row correctly shows the effect on both the position of the equilibrium and on the rate of the reaction of increasing the temperature to above 400 °C?

	position of equilibrium	rate of reaction
A	moves to left	decreases
B	moves to left	increases
C	moves to right	decreases
D	moves to right	increases

3 Chlorine can be manufactured by the following reaction.

$$4HCl(g) + O_2(g) \rightleftharpoons 2H_2O(g) + 2Cl_2(g) \qquad \Delta H \text{ is negative}$$

A mixture in dynamic equilibrium is formed.

Which change to the mixture will increase the amount of chlorine at equilibrium?

A adding a catalyst

B adding more $HCl(g)$

C decreasing the pressure

D increasing the temperature

4 When bismuth(III) chloride, $BiCl_3$, is added to water, a white precipitate of $BiOCl$ is formed.

$$BiCl_3(aq) + H_2O(l) \rightleftharpoons BiOCl(s) + 2HCl(aq)$$

If this reversible reaction is at equilibrium and hydrochloric acid is added, what will happen?

A The position of equilibrium moves to the left and more white precipitate is formed.

B The position of equilibrium moves to the left and the white precipitate disappears.

C The position of equilibrium moves to the right and more white precipitate is formed.

D The position of equilibrium moves to the right and the white precipitate disappears.

5 The following reversible reaction takes place in a closed vessel at constant temperature.

$$P(g) + Q(g) + R(g) \rightleftharpoons S(g) + T(g)$$

When the system has reached equilibrium, more T is added.

Which increases in concentration occur?

A P, Q, R and S

B P and Q only

C P, Q and R only

D S only

6 When a solution containing silver ions is added to a solution containing iron(II) ions, an equilibrium is set up.

$$Ag^+(aq) + Fe^{2+}(aq) \rightleftharpoons Ag(s) + Fe^{3+}(aq)$$

The addition of which substance would **not** affect the amount of silver precipitated?

A $Ag^+(aq)$ **B** $Fe^{2+}(aq)$ **C** $Fe^{3+}(aq)$ **D** $H_2O(l)$

7 The equation shows the formation of sulfur trioxide in the Contact process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -95\,kJ/mol$$

What would **decrease** the yield of sulfur trioxide in a given time?

A addition of more oxygen

B an increase in pressure

C an increase in temperature

D removal of $SO_3(g)$ from the reaction chamber

8 The equation shows a reversible reaction.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The forward reaction is endothermic.

Which of these changes will increase the yield of NO_2?

	pressure	temperature
A	decreased	decreased
B	decreased	increased
C	increased	decreased
D	increased	increased

9 In the Contact process for making sulfuric acid, one step involves the oxidation of sulfur dioxide to sulfur trioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic.

Which change would increase the amount of sulfur trioxide produced at equilibrium?

A adding a catalyst

B decreasing the pressure

C decreasing the temparature

D increasing the temperature

10 At 400 °C the reaction between hydrogen and iodine reaches an equilibrium.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H = -13\,kJ$$

Which change in conditions would increase the percentage of hydrogen iodide in the equilibrium mixture?

A a decrease in pressure

B a decrease in temperature

C an increase in pressure

D an increase in temperature

11 In the Haber process, nitrogen and hydrogen react to form ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92\,kJ$$

Which factor increases **both** the speed of reaction **and** the amount of ammonia produced?

A addition of a catalyst

B decreasing the temperature

C increasing the pressure

D increasing the temperature

12 The equation shows the reaction for the formation of sulphur trioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -197\,kJ$$

Which change in reaction conditions would produce more sulphur trioxide?

A adding more catalyst

B decreasing the pressure

C increasing the temperature

D removing some sulphur trioxide

13 The reversible reaction below has reached dynamic equilibrium.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

What does the term *dynamic equilibrium* mean?

A The reaction has stopped.

B The rate of the forward reaction is now zero.

C The concentrations of NO_2 and N_2O_4 are equal.

D The rates of the forward and backward reactions are equal.

14 Ammonia is made by a reversible reaction between nitrogen and hydrogen.

The equation for the reaction is shown.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H \text{ is negative}$$

What is the effect of increasing the pressure in this process?

A Less ammonia is formed.

B Less heat is produced.

C More ammonia is formed.

D The reaction slows down.

15 Nitrogen reacts with oxygen.

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g) \qquad \Delta H = +170\,\text{kJ/mol}$$

At equilibrium, which statement is true?

A The concentration of nitrogen present will change with time.

B The forward and backward reaction are taking place at the same rate.

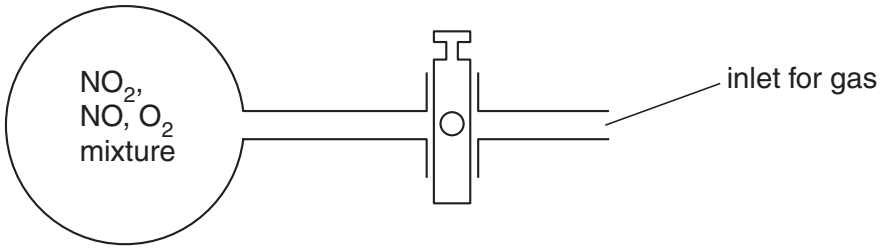
C The forward reaction releases heat energy.

D There are more molecules on the left hand side of the equation than on the right.

16 Nitrogen dioxide, NO_2, is a dark brown gas that decomposes as shown by the equilibrium equation.

$$\underset{\text{dark brown}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless}}{2NO(g) + O_2(g)}$$

The diagram shows a glass flask containing a mixture of the three gases.
The mixture is pale brown.



More oxygen is forced into the flask.

What colour change is seen in the mixture?

A there is no change

B it turns colourless

C it becomes darker brown

D it becomes a paler brown