

Chemical Equilibria

Question Paper

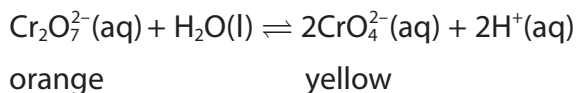
Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Chemical Equilibria
Booklet	Question Paper

Time Allowed:	30 minutes
Score:	/25
Percentage:	/100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1** An aqueous solution contains dichromate(VI) ions, $\text{Cr}_2\text{O}_7^{2-}$, and chromate(VI) ions, CrO_4^{2-} , in equilibrium. This solution is a pale orange colour.

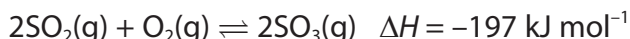


What would be seen when a few drops of concentrated sodium hydroxide solution are added to the equilibrium mixture?

- A** No visible change.
- B** The mixture turns green.
- C** The mixture turns a deeper orange.
- D** The mixture turns yellow.

(Total for Question 1 = 1 mark)

- 2** The following system was allowed to reach equilibrium at 450 °C.

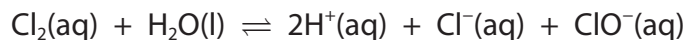


How would a decrease in pressure and an increase in temperature affect the equilibrium position?

	Shift in equilibrium position with a decrease in pressure	Shift in equilibrium position with an increase in temperature
<input type="checkbox"/> A	left	left
<input type="checkbox"/> B	left	right
<input type="checkbox"/> C	right	left
<input type="checkbox"/> D	right	right

(Total for Question 2 = 1 mark)

3 The chlorate(I) ion, $\text{ClO}^-(\text{aq})$, is formed when chlorine dissolves in water.

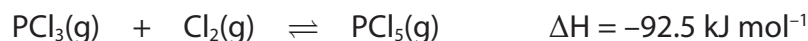


The concentration of chlorate(I) ions could be increased by the addition of

- A solid potassium hydroxide.
- B concentrated hydrochloric acid.
- C solid sodium chloride.
- D solid potassium sulfate.

(Total for Question 3 = 1 mark)

4 Consider the following equilibrium.

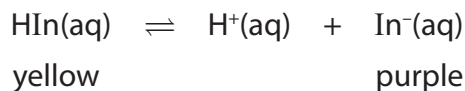


In which of the following would **both** the stated changes increase the amount of the product, PCl_5 , present at equilibrium?

- A Decreasing temperature and decreasing pressure.
- B Decreasing temperature and increasing pressure.
- C Increasing temperature and increasing pressure.
- D Increasing temperature and decreasing pressure.

(Total for Question 4 = 1 mark)

5 Consider the following simplified equilibrium for an indicator, HIn.

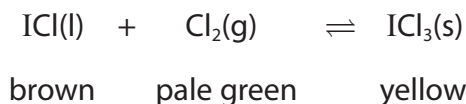


Addition of a few drops of sodium carbonate solution would

- A make the colour of the equilibrium mixture turn purple and then yellow.
- B make the colour of the equilibrium mixture paler.
- C make the equilibrium mixture more yellow.
- D make the equilibrium mixture more purple.

(Total for Question 5 = 1 mark)

- 6 The following equilibrium was established with all three substances present.



What would be the effect of increasing the pressure on this equilibrium system?

- A No change.
- B An increase in the amount of the brown liquid.
- C An increase in the amounts of the brown liquid and the pale green gas.
- D An increase in the amount of the yellow solid.

(Total for Question 6 = 1 mark)

- 7 In the Contact Process for the production of sulfuric acid, there is a step in which sulfur dioxide is oxidized to sulfur trioxide as shown below.



A high yield is obtained with the following conditions:

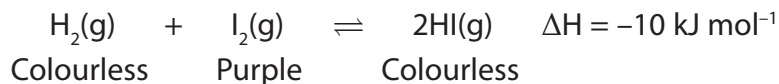
- 2 atm and 700 K
- 1:1 mole ratio of sulfur dioxide and oxygen
- catalyst vanadium(V) oxide, V_2O_5

In comparison with the conditions given above, which of the following would shift the equilibrium position to the right?

- A Lowering the pressure.
- B Increasing the temperature.
- C Increasing the excess of oxygen.
- D Using a more finely divided catalyst.

(Total for Question 7 = 1 mark)

8 Hydrogen and iodine gases were mixed at 300°C and allowed to reach equilibrium.



(a) What would you see if the equilibrium mixture was cooled to 250°C and equilibrium allowed to re-establish?

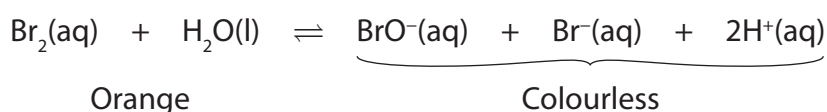
- A The mixture goes a darker purple. (1)
- B The colour gets lighter.
- C The mixture goes colourless.
- D No visible change.

(b) The equilibrium mixture at 300°C was compressed in a gas syringe to occupy a smaller volume. What would be seen immediately after this compression?

- A The mixture goes a darker purple. (1)
- B The colour gets lighter.
- C The mixture goes colourless.
- D No visible change.

(Total for Question 8 = 2 marks)

9 A concentrated solution of 'bromine water' is an orange colour. The following equilibrium exists in this solution.

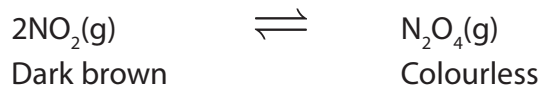


What would be the effect, if any, on the colour of the solution, if five drops of dilute sodium hydroxide solution were added to 5 cm³ of the bromine water?

- A The solution becomes a deeper orange.
- B The colour of the solution becomes lighter.
- C The solution goes colourless.
- D No visible change.

(Total for Question 9 = 1 mark)

10 Consider the following equilibrium.



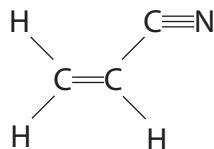
If the above equilibrium is initially set up so that the mixture is dark brown, then a gradual **decrease** in pressure would result in

- A no visible change.
- B a change to yellow.
- C a change to yellow then colourless.
- D a change to colourless.

(Total for Question 10 = 1 mark)

- 11 Poly(propenenitrile) is used in the manufacture of acrylic fibres for clothes. Poly(propenenitrile) is an addition polymer made from propenenitrile.

The structure of propenenitrile is shown.



- (a) Give a balanced equation, using displayed formulae, to show the formation of poly(propenenitrile) from propenenitrile.

(3)

- (b) Why does the reaction in (a) have an atom economy of 100%?

(1)

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- * (c) Propenenitrile is manufactured from propene, C_3H_6 , as shown in the following equation.



The process is carried out at a temperature of 450°C and a pressure of 2.5 atm, in the presence of a suitable catalyst.

State and explain the effect on the position of equilibrium when each of the following changes is made to these reaction conditions.

- (i) The temperature is increased.

(2)

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- (ii) The pressure is increased.

(2)

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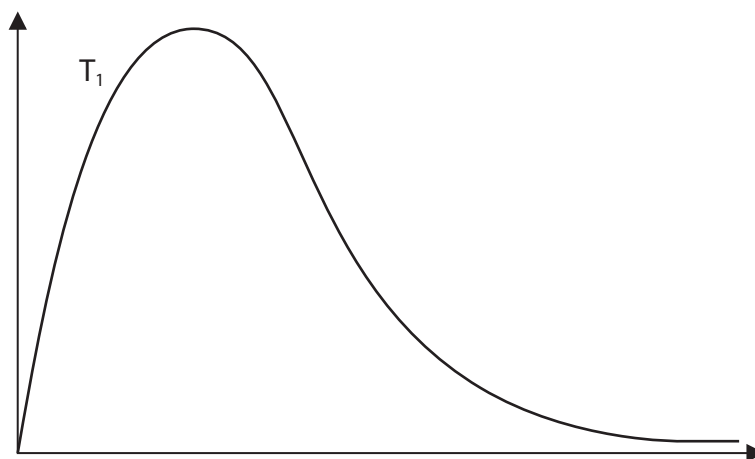
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(iii) Use the diagram below, with further labelling as necessary, to explain why the rate of a chemical reaction increases when a catalyst is added at temperature T_1 .

(2)



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(Total for Question 11 = 14 marks)