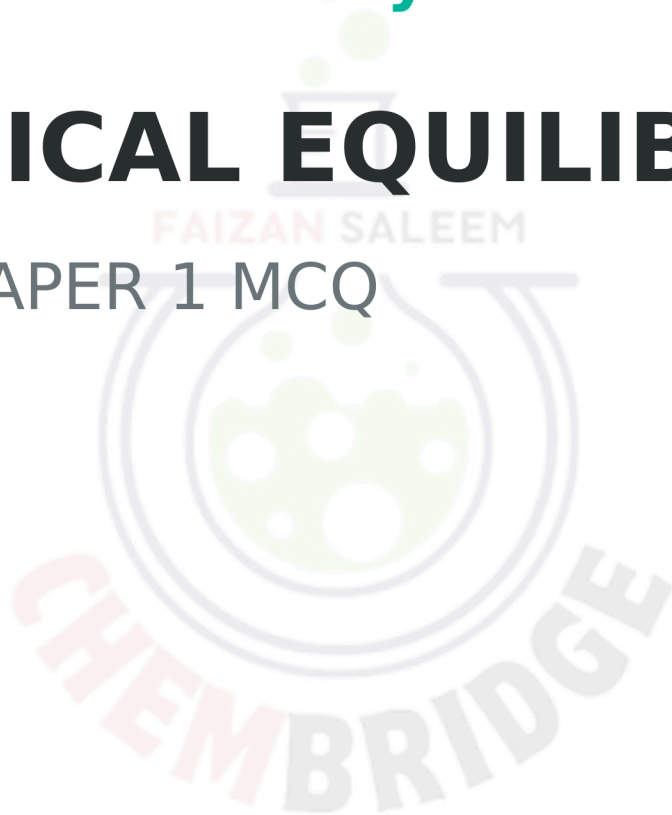




O-LEVEL Chemistry

CHEMICAL EQUILIBRIUM

5070 - PAPER 1 MCQ



2026 EDITION

Q1

5070/12/M/J/24 Q24

Reversible reactions - Easy

24 Which statement about water of crystallisation is correct?

- A The ratio of $\text{CoCl}_2 : \text{H}_2\text{O}$ in hydrated cobalt(II) chloride is 6 : 1.
- B The ratio of $\text{CuSO}_4 : \text{H}_2\text{O}$ in hydrated copper(II) sulfate is 1 : 5.
- C When a saturated solution is heated, the water that evaporates is called the water of crystallisation.
- D When white copper(II) sulfate is heated, blue crystals are formed.



Q2

5070/12/M/J/24 Q30

Reversible reactions - Easy

30 The presence of water can be confirmed by the use of either anhydrous cobalt(II) chloride or anhydrous copper(II) sulfate.

Which observation is correct if water is present?

- A Anhydrous cobalt(II) chloride turns from blue to white.
- B Anhydrous cobalt(II) chloride turns from pink to blue.
- C Anhydrous copper(II) sulfate turns from blue to pink.
- D Anhydrous copper(II) sulfate turns from white to blue.

Q3

5070/12/O/N/21 Q21

Dynamic equilibrium - Easy

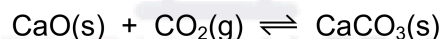
- 21 Which statement is correct for all reversible reactions that have reached dynamic equilibrium?
- A Introduction of a catalyst changes the position of the equilibrium.
 - B The number of moles of products equals the number of moles of reactants.
 - C The rate of the forward reaction equals the rate of the reverse reaction.
 - D When the reaction reaches the position of equilibrium the reaction stops.

Q4

5070/12/M/J/24 Q18

Dynamic equilibrium - Easy

- 18 The reaction between calcium oxide and carbon dioxide is reversible and the forward reaction is exothermic.



A mixture of calcium oxide and carbon dioxide is placed in a heated flask and the reaction reaches equilibrium.

Which statement about this equilibrium is correct?

- A Less calcium carbonate is produced if the pressure in the flask increases.
- B More calcium carbonate is produced when the temperature is increased.
- C The flask must be sealed if equilibrium is to be reached.
- D When equilibrium is reached, the reaction stops.

Q5

5070/11/O/N/24 Q16

Dynamic equilibrium - Easy

- 16 If calcium carbonate is heated in a closed container, it will decompose, forming calcium oxide and carbon dioxide. Calcium oxide and carbon dioxide can recombine to form calcium carbonate.

After some time, a position is reached where calcium carbonate is decomposing, and calcium oxide and carbon dioxide are recombining at the same rate.

What is this position called?

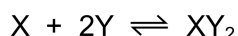
- A activation energy
- B backward reaction
- C equilibrium
- D neutralisation

Q6

5070/11/O/N/21 Q21

Dynamic equilibrium - Hard

21 Elements X and Y react together in a reversible reaction to form XY_2 .



1.0 mol of X is mixed with 1.0 mol of Y and the mixture is left to react until an equilibrium position is reached.

Which statements about this reaction are correct?

- 1 After the equilibrium position has been reached, the reaction stops.
- 2 At equilibrium there is more than 0.5 mol of X present.
- 3 At equilibrium there is less than 1.0 mol of XY_2 present.

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

Q7

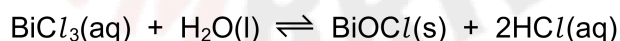
5070/11/M/J/24 Q19

Dynamic equilibrium - Hard

19 157.75 g of bismuth(III) chloride, $BiCl_3$, is used to make 500 cm³ of solution using distilled water.

The aqueous bismuth(III) chloride slowly becomes cloudy as it reacts with water to form insoluble $BiOCl$.

The reaction is reversible.



Which statements are correct?

- 1 The initial concentration of the bismuth(III) chloride solution is 1.0 mol/dm³.
- 2 At equilibrium, the rate of the forward reaction equals the rate of the reverse reaction.
- 3 When more hydrochloric acid is added, the position of equilibrium moves to the left.

[A_r: Bi, 209; Cl, 35.5]

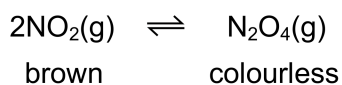
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

Q8

5070/12/M/J/21 Q21

Factors affecting equilibrium - Hard

- 21 Brown nitrogen dioxide reacts to form colourless dinitrogen tetroxide in a reversible reaction. The forward reaction is exothermic.



Which changes would make the equilibrium mixture darker in colour?

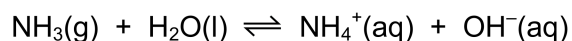
	temperature	pressure
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

Q9

5070/12/M/J/22 Q25

Factors affecting equilibrium - Hard

- 25 When ammonia gas is dissolved in water a reversible reaction takes place.



Which statements are correct?

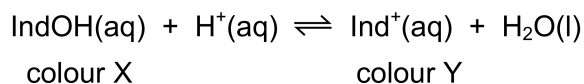
- 1 Ammonia is an alkali because it produces hydroxide ions in solution.
- 2 The pH of this solution is 7.
- 3 Adding hydroxide ions to the mixture at equilibrium produces more ammonia.

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

5070/11/M/J/23 Q16

Factors affecting equilibrium - Hard

16 Universal indicator contains several dyes. The reversible reaction of one dye, IndOH, is shown.



A few drops of universal indicator solution are added to 50 cm³ of water.

A few drops of dilute hydrochloric acid are added to the solution.

Which row describes what happens when the acid is added?

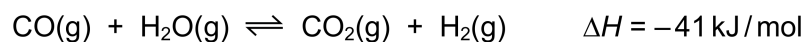
	pH	colour of solution shifts towards
A	decreases	colour X
B	decreases	colour Y
C	increases	colour X
D	increases	colour Y

Q11

5070/12/M/J/23 Q17

Factors affecting equilibrium - Hard

17 Hydrogen is made industrially by the reaction shown.

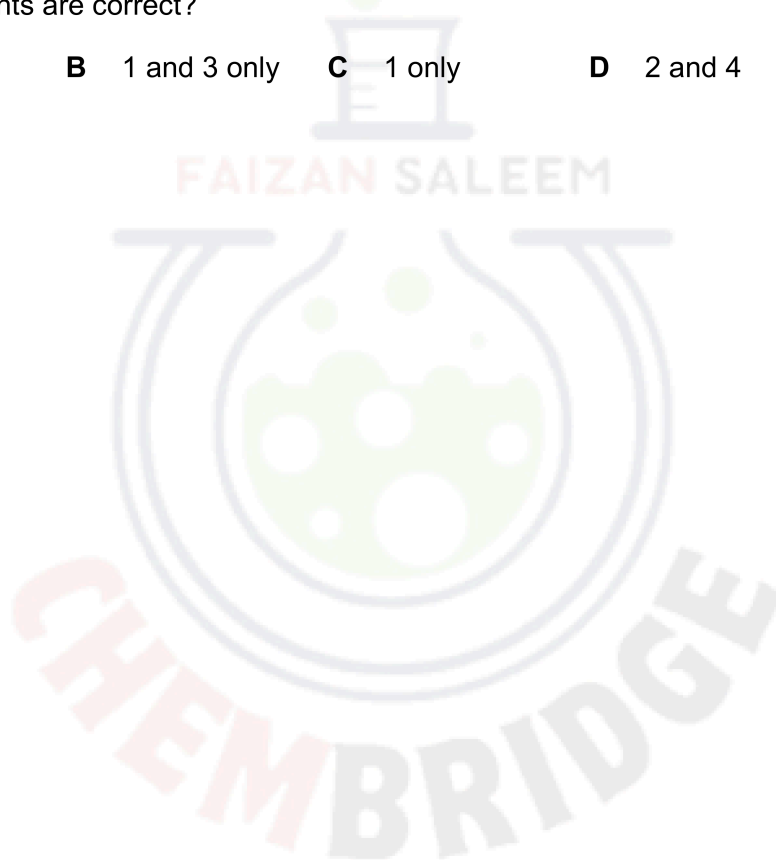


Statements about this industrial process are given.

- 1 A high pressure can be used to increase the rate of formation of hydrogen.
- 2 A high pressure can be used to shift the equilibrium to the right.
- 3 A high temperature can be used to increase the rate of formation of hydrogen.
- 4 A high temperature can be used to shift the equilibrium to the right.

Which statements are correct?

- A** 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 4



Q12

5070/11/M/J/25 Q18

Factors affecting equilibrium - Hard

18 In a closed flask, gases Q and R reach a dynamic equilibrium.



Which change will move the equilibrium to the right?

- A adding a catalyst
- B decreasing the temperature
- C increasing the pressure
- D increasing the volume of the flask

Q13

5070/11/O/N/22 Q32

Factors affecting equilibrium - Hard

32 A reversible reaction involves a solid reacting with hydrogen.

Which of the metals, aluminium and iron, would catalyse the reaction and what is their effect on the position of equilibrium?

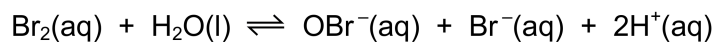
	act as a catalyst	position of equilibrium
A	both aluminium and iron	moves to the right
B	both aluminium and iron	no change
C	iron only	moves to the right
D	iron only	no change

Q14

5070/11/O/N/23 Q18

Factors affecting equilibrium - Hard

18 Aqueous bromine is an equilibrium mixture.



Aqueous bromine is orange in colour. The species on the right-hand side of the equation are colourless.

Changes are made to three separate portions of the equilibrium mixture.

Which row shows how the colour of the mixture changes when a small amount of each substance is added?

	adding sulfuric acid	adding solid sodium bromide	adding water
A	darker orange	darker orange	darker orange
B	darker orange	darker orange	paler orange
C	darker orange	paler orange	darker orange
D	paler orange	darker orange	paler orange

Q15

5070/12/M/J/21 Q25

Industrial equilibrium processes - Easy

- 25 Sulfuric acid is manufactured in the contact process. Several substances are involved in this process, including vanadium(V) oxide and water.

Which roles are played by vanadium(V) oxide and water in the contact process?

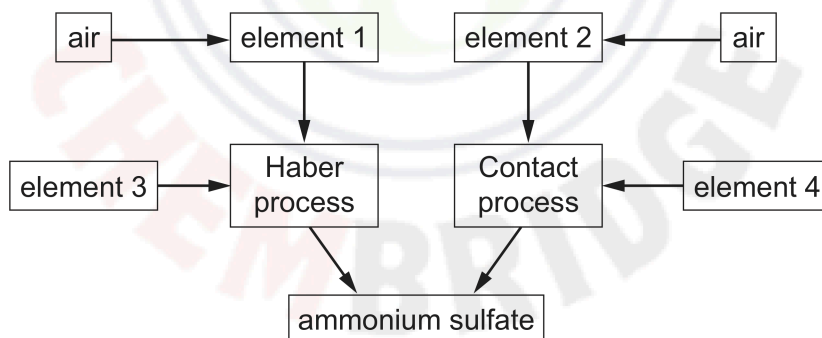
	vanadium(V) oxide	water
A	catalyst	reactant
B	catalyst	solvent
C	reactant	reactant
D	reactant	solvent

Q16

5070/12/M/J/22 Q29

Industrial equilibrium processes - Easy

- 29 The flow chart describes the preparation of ammonium sulfate.



What are elements 1–4?

	1	2	3	4
A	nitrogen	oxygen	hydrogen	sulfur
B	nitrogen	oxygen	hydrogen	oxygen
C	oxygen	nitrogen	hydrogen	sulfur
D	oxygen	nitrogen	sulfur	hydrogen

Q17

5070/12/M/J/23 Q18

Industrial equilibrium processes - Easy

18 The table refers to two important industrial gaseous reactions.

reaction	reactants	product	catalyst
1	hydrogen + nitrogen	ammonia	nickel
2	oxygen + sulfur dioxide	sulfur trioxide	vanadium(V) oxide

Which catalysts are correctly stated?

	reaction 1	reaction 2
A	no	no
B	no	yes
C	yes	no
D	yes	yes

Q18

5070/12/M/J/24 Q19

Industrial equilibrium processes - Easy

19 In the Haber process, hydrogen and nitrogen react to form ammonia in the presence of a catalyst.

Which reactant is obtained by fractional distillation and what is the catalyst used in the Haber process?

	obtained by fractional distillation	catalyst
A	hydrogen	nickel
B	hydrogen	iron
C	nitrogen	nickel
D	nitrogen	iron

Q19

5070/11/M/J/25 Q19

Industrial equilibrium processes - Easy

- 19 Which row shows the typical conditions used for the conversion of sulfur dioxide to sulfur trioxide in the Contact process?

	catalyst	pressure / kPa
A	iron	20 000
B	iron	200
C	vanadium(V) oxide	20 000
D	vanadium(V) oxide	200

Q20

5070/12/M/J/25 Q19

Industrial equilibrium processes - Easy

- 19 Which row gives the catalyst for each of the two processes?

	Contact process	Haber process
A	iron	iron
B	iron	nickel
C	vanadium(V) oxide	iron
D	vanadium(V) oxide	nickel

Q21

5070/11/O/N/21 Q26

Industrial equilibrium processes - Easy

- 26 The manufacture of sulfuric acid by the Contact process involves the use of three different raw materials.

How many of these raw materials are elements, how many are compounds and how many are mixtures?

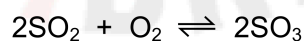
	elements	compounds	mixtures
A	0	3	0
B	1	2	0
C	1	1	1
D	2	0	1

Q22

5070/12/O/N/22 Q23

Industrial equilibrium processes - Easy

- 23 In the Contact process, sulfur is converted into sulfuric acid. A catalyst is added to the reaction mixture shown in the equation.



What is the purpose of the catalyst?

- A to lower the activation energy for the reaction
- B to oxidise the sulfur dioxide
- C to reduce the sulfur dioxide
- D to shift the equilibrium to the right

Q23

5070/12/O/N/22 Q31

Industrial equilibrium processes - Easy

31 Which set of conditions is used in the Contact process?

	temperature /°C	pressure /atm	catalyst
A	100–200	200	V ₂ O ₅
B	100–200	1–2	Fe
C	400–500	1–2	V ₂ O ₅
D	400–500	200	V ₂ O ₅

Q24

5070/12/O/N/23 Q17

Industrial equilibrium processes - Easy

17 Hydrogen is used as a reactant both in the Haber process and in its addition to alkenes.

Which row is correct?

	catalyst in the Haber process	product of addition of hydrogen to an alkene
A	iron	alkane
B	iron	alcohol
C	nickel	alkane
D	nickel	alcohol

Q25

5070/11/O/N/24 Q17

Industrial equilibrium processes - Easy

17 Which set of conditions is used in the Contact process?

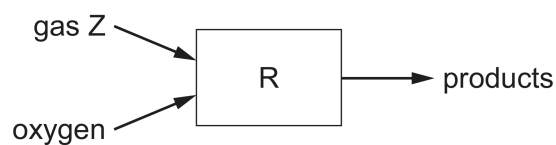
	temperature /°C	pressure /atm	catalyst
A	100	200	V ₂ O ₅
B	300	200	Fe
C	450	2	Fe
D	450	2	V ₂ O ₅

Q26

5070/12/O/N/24 Q19

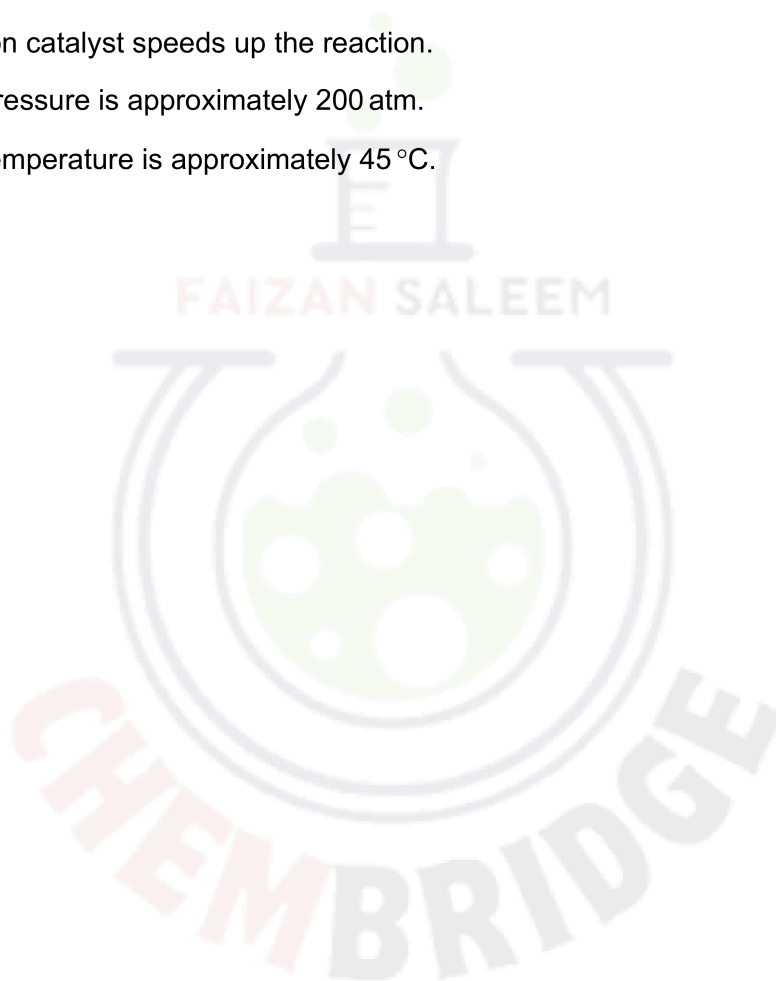
Industrial equilibrium processes - Easy

19 In the diagram, R represents one of the reactions in the Contact process.



Which statement is correct?

- A Gas Z is SO_2 .
- B In R, an iron catalyst speeds up the reaction.
- C In R, the pressure is approximately 200 atm.
- D In R, the temperature is approximately 45°C .

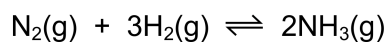


Q27

5070/11/M/J/21 Q21

Industrial equilibrium processes - Hard

21 The Haber process converts nitrogen and hydrogen into ammonia.



Which row is correct?

	change in condition	position of equilibrium
A	pressure is increased	moves to the left
B	pressure is reduced	no change
C	catalyst present	moves to the right
D	catalyst present	no change

Q28

5070/11/M/J/21 Q25

Industrial equilibrium processes - Hard

25 The Haber process is used to make ammonia at a temperature of 400 °C and a pressure of 20 000 kPa. The temperature is changed to 500 °C but the pressure is kept the same.

What will be the effects of this change on the production of ammonia?

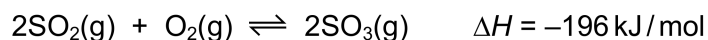
- A It is made at an increased rate and the position of the equilibrium moves to the left.
- B It is made at an increased rate and the position of the equilibrium moves to the right.
- C It is made at a decreased rate and the position of the equilibrium moves to the left.
- D It is made at a decreased rate and the position of the equilibrium moves to the right.

Q29

5070/11/M/J/22 Q20

Industrial equilibrium processes - Hard

20 Sulfur dioxide reacts with oxygen in the air.



The reaction is very slow if no catalyst is present.

Which statement explains this?

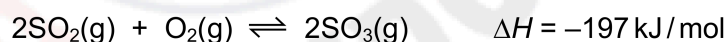
- A Air contains only 21% oxygen so there is not enough oxygen for all the sulfur dioxide to react.
- B Only a small proportion of the sulfur dioxide and oxygen molecules have enough energy to react, even at high temperatures.
- C The reaction is exothermic and so at high temperatures the equilibrium shifts to the left.
- D The reaction is reversible and so products turn back to reactants; this happens more quickly at high temperatures.

Q30

5070/11/M/J/23 Q15

Industrial equilibrium processes - Hard

15 The equation for a reaction in the Contact process is shown.



The conditions used are 450 °C, 2 atmospheres pressure and a catalyst.

What will be the effects when the temperature is reduced to 250 °C and the catalyst is removed?

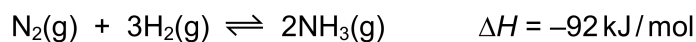
	percentage of SO ₃ in the equilibrium mixture	rate of the forward reaction
A	decrease	no change
B	decrease	decrease
C	increase	increase
D	increase	decrease

Q31

5070/12/O/N/21 Q25

Industrial equilibrium processes - Hard

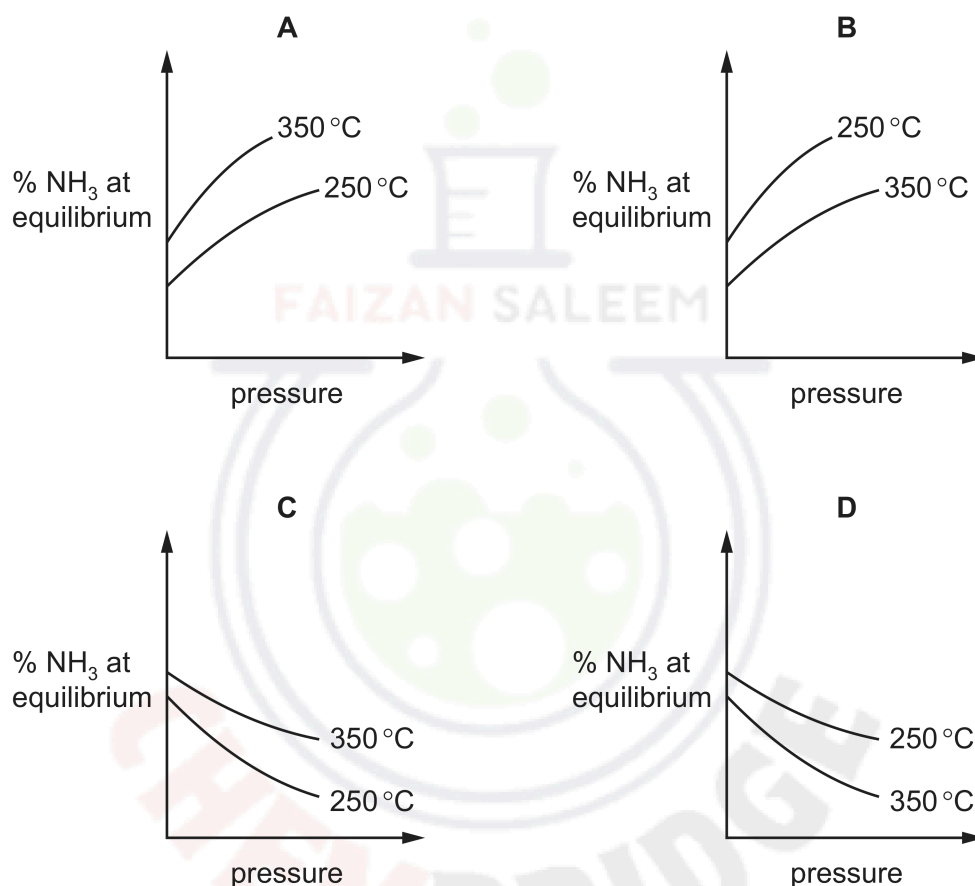
25 Ammonia is made by a reversible reaction.



A chemist investigates how the percentage of ammonia at equilibrium changes with pressure.

The experiment is carried out both at 250 °C and at 350 °C.

Which graph shows the chemist's results?

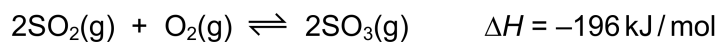


Q32

5070/11/O/N/22 Q26

Industrial equilibrium processes - Hard

26 The equation shows a reaction in the Contact process.



Which change would move the position of equilibrium to the left?

- A adding more O_2
- B increasing the pressure
- C increasing the temperature
- D removing SO_3 from the reacting mixture

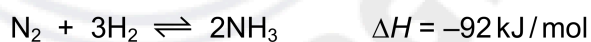
Also appears as: 5070/12/O/N/22 Q26

Q33

5070/12/O/N/24 Q18

Industrial equilibrium processes - Hard

18 Samples of nitrogen and hydrogen are reacted and allowed to reach equilibrium. The equation is shown.



The temperature is increased and a new equilibrium is established.

Which statement about the new equilibrium is correct?

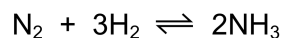
- A The amount of product increases.
- B The amount of product decreases.
- C The rate of the forward reaction is greater than the rate of the reverse reaction.
- D The rate of the forward reaction is less than the rate of the reverse reaction.

Q34

5070/11/O/N/25 Q16

Industrial equilibrium processes - Hard

16 The equation shows the reversible reaction between nitrogen and hydrogen to form ammonia.



The forward reaction is exothermic.

Which statement is correct when the temperature is increased?

- A The activation energy increases.
- B The equilibrium shifts to form more ammonia.
- C The rate of the forward reaction decreases.
- D The rate at which ammonia decomposes increases.

Q35

5070/12/O/N/25 Q17

Industrial equilibrium processes - Hard

17 Which statements about the Haber process for the manufacture of ammonia are correct?

- 1 At equilibrium, the concentrations of the reactants and products are no longer changing.
 - 2 Increasing the pressure moves the position of equilibrium to the right.
 - 3 Increasing the temperature moves the position of equilibrium to the left.
- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

MARKING SCHEME

Q	ANS	Paper Number
Q1	B	5070/12/M/J/24 Q24
Q2	D	5070/12/M/J/24 Q30
Q3	C	5070/12/O/N/21 Q21
Q4	C	5070/12/M/J/24 Q18
Q5	C	5070/11/O/N/24 Q16
Q6	D	5070/11/O/N/21 Q21
Q7	A	5070/11/M/J/24 Q19
Q8	C	5070/12/M/J/21 Q21
Q9	B	5070/12/M/J/22 Q25
Q10	B	5070/11/M/J/23 Q16
Q11	B	5070/12/M/J/23 Q17
Q12	D	5070/11/M/J/25 Q18
Q13	D	5070/11/O/N/22 Q32
Q14	B	5070/11/O/N/23 Q18
Q15	A	5070/12/M/J/21 Q25
Q16	A	5070/12/M/J/22 Q29
Q17	B	5070/12/M/J/23 Q18
Q18	D	5070/12/M/J/24 Q19
Q19	D	5070/11/M/J/25 Q19
Q20	C	5070/12/M/J/25 Q19
Q21	C	5070/11/O/N/21 Q26
Q22	A	5070/12/O/N/22 Q23
Q23	C	5070/12/O/N/22 Q31
Q24	A	5070/12/O/N/23 Q17

MARKING SCHEME

Q	ANS	Paper Number
Q25	D	5070/11/O/N/24 Q17
Q26	A	5070/12/O/N/24 Q19
Q27	D	5070/11/M/J/21 Q21
Q28	A	5070/11/M/J/21 Q25
Q29	B	5070/11/M/J/22 Q20
Q30	D	5070/11/M/J/23 Q15
Q31	B	5070/12/O/N/21 Q25
Q32	C	5070/11/O/N/22 Q26
Q33	B	5070/12/O/N/24 Q18
Q34	D	5070/11/O/N/25 Q16
Q35	A	5070/12/O/N/25 Q17

