

- 16** Hydrogen peroxide solution decomposes very slowly at room temperature to produce oxygen gas. This gas forms a rising foam when liquid detergent is added.

Five test-tubes are half-filled with hydrogen peroxide solution. A drop of liquid detergent is added to each one.

Different metal oxides are added to four of the test-tubes and the height of the foam formed after one minute is measured. The results are shown.

metal oxide	height of foam / cm
no metal oxide added	0.1
aluminium oxide	0.1
calcium oxide	0.2
copper(II) oxide	2.3
manganese(IV) oxide	5.4

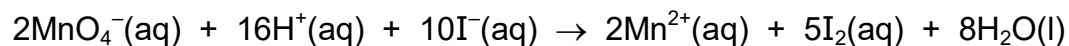
Which conclusion can be drawn from these results?

- A** Metal oxides do **not** affect the rate of this reaction.
- B** All metal oxides increase the rate of this reaction and act as catalysts.
- C** Manganese(IV) oxide is the best catalyst of the four metal oxides tested.
- D** Only transition element oxides increase the rate of this reaction.

- 17** Which equation represents one of the reactions in the Contact process?

- A** $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$
- B** $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{aq})$
- C** $2\text{SO}_3(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_4(\text{aq})$
- D** $2\text{SO}_3(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_4(\text{g})$

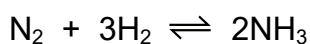
- 18** The ionic equation for the redox reaction between acidified manganate(VII) ions and iodide ions is shown.



Which row shows the changes in oxidation number for manganese and for iodine during this reaction?

	manganese		iodine	
	from	to	from	to
A	−2	+4	−1	0
B	−2	+4	−10	+5
C	+7	+2	−1	0
D	+7	+2	−10	+5

- 19** In the Haber process, nitrogen and hydrogen react to form ammonia.



The forward reaction is exothermic.

Which changes in pressure and temperature increase the yield of ammonia?

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

- 16 Aqueous sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$, reacts with dilute hydrochloric acid to form a yellow precipitate of sulfur.



The precipitate forms more quickly when the reactants are heated.

Which statements explain this observation?

- 1 The reacting particles collide more frequently.
- 2 The collisions between reacting particles have more energy.
- 3 The activation energy of the reaction is lower.

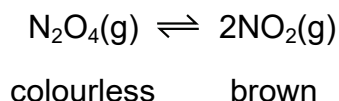
A 1 and 2 **B** 1 and 3 **C** 1 only **D** 2 and 3

- 17 Which statement about the conditions used in the Haber process and in the Contact process is correct?

- A** The typical pressure used in the Haber process is similar to that used in the Contact process.
- B** The typical temperature used in the Haber process is similar to that used in the Contact process.
- C** The Haber process uses a vanadium(V) oxide catalyst, and the Contact process uses an iron catalyst.
- D** Both processes produce an acidic gas.

- 18 The equation shows the equilibrium between dinitrogen tetroxide, N_2O_4 , and nitrogen dioxide, NO_2 .

The colours of the reactant and product are shown.



The forward reaction is endothermic.

Which statement is **not** correct?

- A** At equilibrium, the concentrations of the reactant and the product stay constant.
- B** At equilibrium, the rate of the forward reaction is equal to the rate of the reverse reaction.
- C** When the pressure is increased, a darker brown colour is seen.
- D** When the temperature is increased, a darker brown colour is seen.

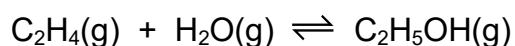
- 19 What is the oxidation number of chromium in the $\text{Cr}_2\text{O}_7^{2-}$ ion?

A -2 **B** -1 **C** +6 **D** +12

16 Which statement about reactions is correct?

- A** A reaction that is vigorous at room temperature has a high activation energy.
- B** If ΔH for a reaction is positive, bond making in the formation of the products is endothermic.
- C** In an exothermic reaction, the energy required to break bonds is less than the energy released to make bonds.
- D** Reactions with a positive enthalpy change always transfer thermal energy to the surroundings.

19 Ethanol is manufactured by the addition of steam to ethene.



The reaction conditions are 300 °C and 60 atm.

The forward reaction is exothermic.

Which rows describe the effect on the equilibrium yield of $\text{C}_2\text{H}_5\text{OH}$ when the stated change is made?

	change	equilibrium yield of $\text{C}_2\text{H}_5\text{OH}$
1	adding a catalyst	no change
2	decreasing the temperature	increases
3	decreasing the pressure	increases

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