



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Subsidiary Level

PHYSICAL SCIENCE

8780/01

Paper 1 Multiple Choice

October/November 2011

40 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data Booklet



READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any working should be done in this booklet.

This document consists of **16** printed pages.



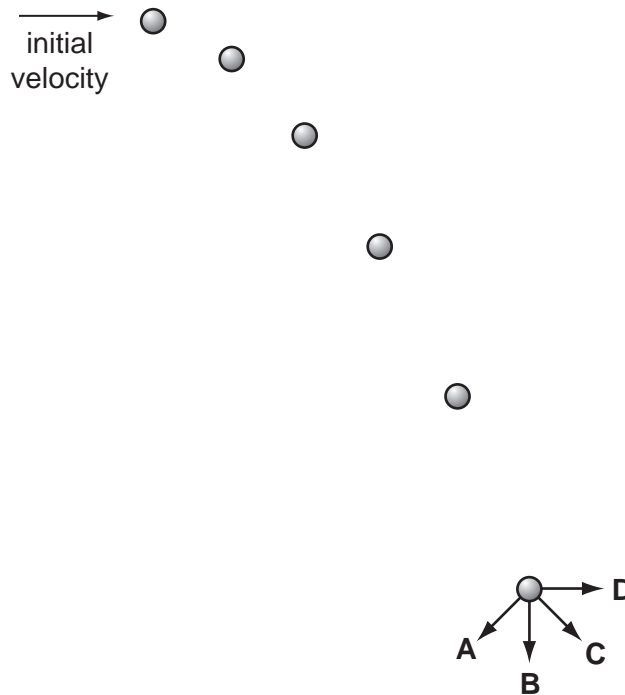
Relevant Data, Formulae and the Periodic Table are provided in the Data Booklet.

Section A

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

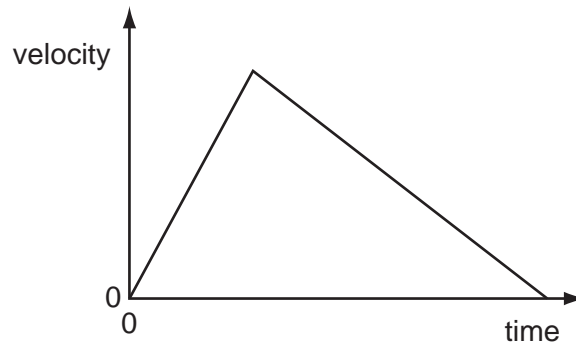
- 1 A sphere is projected horizontally in a vacuum. The diagram shows the positions of the sphere after equal time intervals.

Which arrow shows the direction of the resultant force on the sphere?

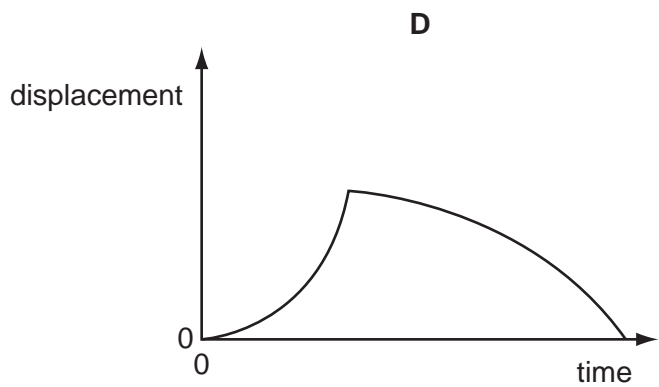
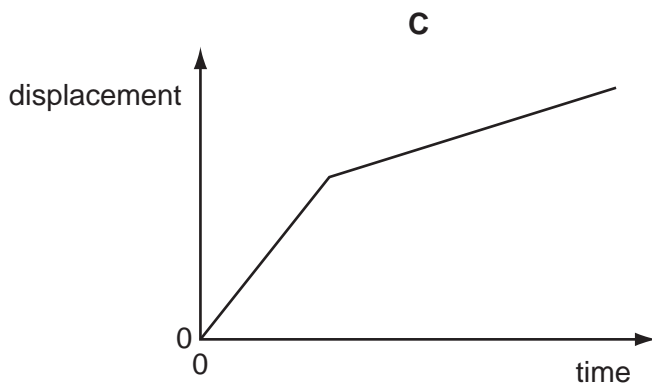
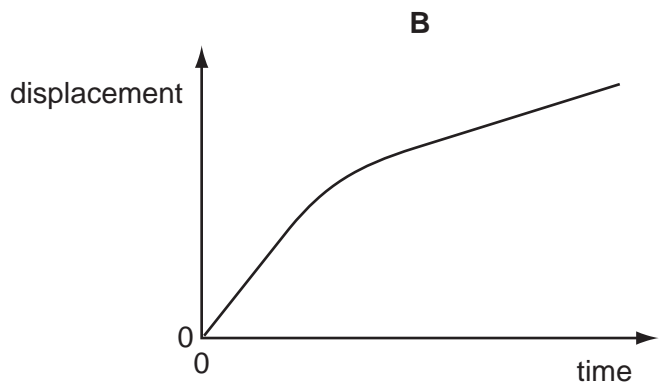
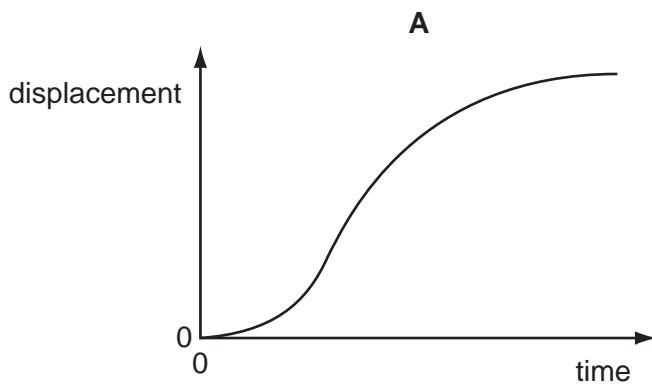


Space for working

2 The velocity-time graph represents a short journey.

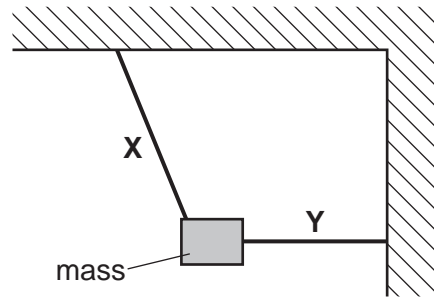


Which displacement-time graph represents the same journey?

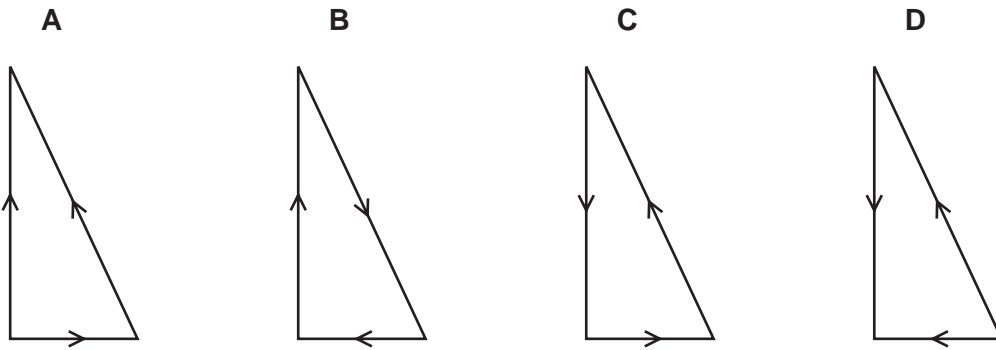


Space for working

- 3 A mass is suspended from a roof by cable **X**. It is then attached to a vertical wall by a second cable **Y**, as shown in the diagram.

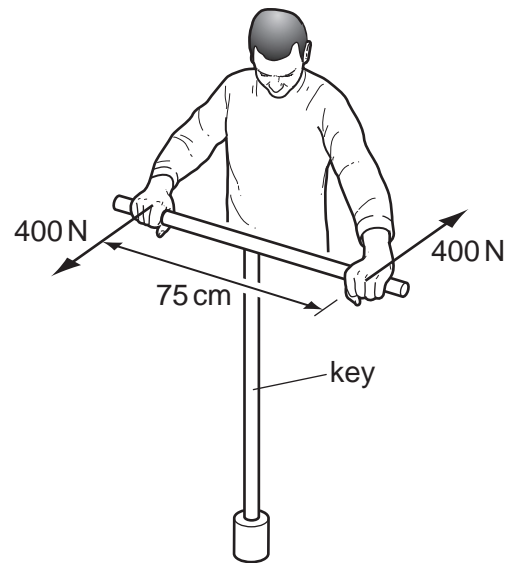


Which diagram correctly shows all the forces acting on the mass?



Space for working

- 4 The diagram shows a man using a key to open a valve to release water at a dam.

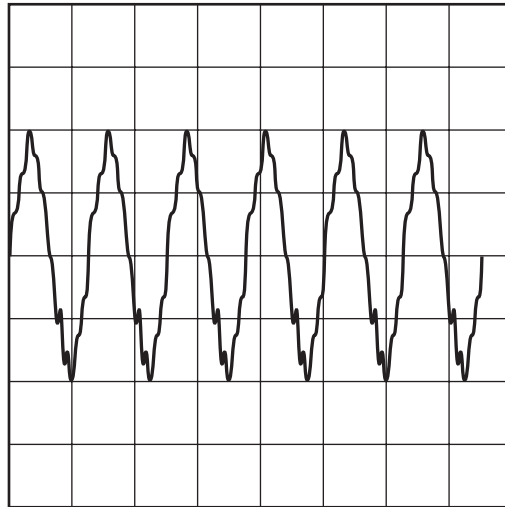


What is the torque produced by the couple on the key?

- A** 300 Nm **B** 600 Nm **C** 30 000 Nm **D** 60 000 Nm

Space for working

- 5 A sound wave is detected by a microphone connected to a cathode ray oscilloscope (c.r.o.). The trace is shown below.



The time base on the c.r.o. is set at 2 ms per division.

What is the frequency of the sound wave?

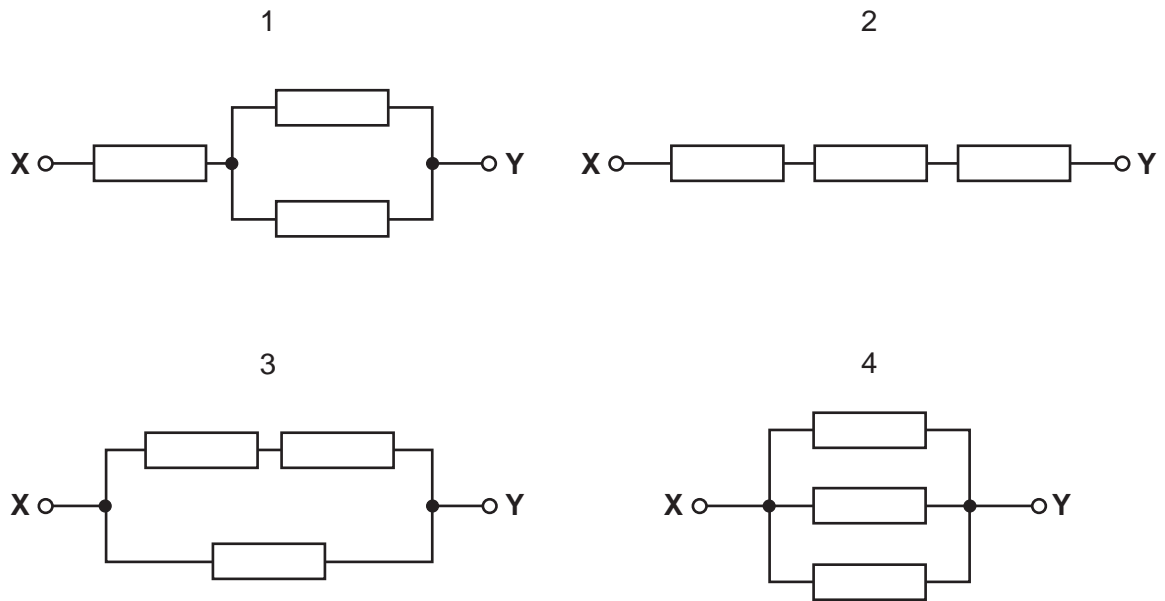
- A** 400 Hz **B** 800 Hz **C** 1600 Hz **D** 3000 Hz
- 6 When monochromatic light passes from air to glass its speed changes from $3.0 \times 10^8 \text{ m s}^{-1}$ to $2.0 \times 10^8 \text{ m s}^{-1}$.

What are the correct ratios of the wavelengths and the frequencies of the light in air and glass?

	wavelength in air : in glass	frequency in air : in glass
A	1 : 1	2 : 3
B	1 : 1	3 : 2
C	2 : 3	1 : 1
D	3 : 2	1 : 1

Space for working

7 Three identical resistors are connected to make four different networks.



The resistance between **X** and **Y** is measured for each network.

Which response gives the networks in the order of increasing resistance?

- A 3 → 1 → 2 → 4
- B 3 → 2 → 1 → 4
- C 4 → 1 → 3 → 2
- D 4 → 3 → 1 → 2

Space for working

- 8 When a charged sphere discharges to earth, a spark is formed. The discharge takes $30 \mu\text{s}$ and the average current is 2.4 mA .

What is the charge transferred from the sphere to earth?

- A $7.2 \times 10^{-8} \text{ C}$ B $1.4 \times 10^{-7} \text{ C}$ C 72 C D 80 C

- 9 An electric field exists between a pair of oppositely charged parallel metal plates.

Which changes to the potential difference and separation of the plates will give the greatest increase in the electric field strength between the plates?

	potential difference	separation
A	doubled	doubled
B	doubled	halved
C	halved	doubled
D	halved	halved

- 10 An oxygen nucleus, ${}^{16}_8\text{O}$, is subjected to neutron bombardment. It absorbs a neutron and emits a β -particle.

Which symbol represents the new nucleus, **X**, that is formed?

- A ${}^{15}_7\text{X}$ B ${}^{17}_7\text{X}$ C ${}^{17}_9\text{X}$ D ${}^{15}_9\text{X}$

Space for working

- 11 Which statement is correct?
- A In water molecules the bonding is less polar than in hydrogen sulfide molecules.
- B SiO_2 has a higher melting point than P_4O_{10} because of stronger van der Waals' forces.
- C The atomic radii of Period 3 elements increase from sodium to chlorine.
- D The first ionisation energy of Group II elements decreases from magnesium to barium.
- 12 In which of these species are just **two** lone pairs of electrons found?
- A NH_2^- B AlCl_3 C NH_3 D PCl_4^+
- 13 Which of these species has a pyramidal shape?
- A NH_2^- B AlCl_3 C NH_3 D PCl_4^+
- 14 The table shows data for the standard enthalpy change of combustion, ΔH_c^\ominus , of the four compounds ethene, ethane, propene and propane.

compound	M_r	$\Delta H_c^\ominus / \text{kJ mol}^{-1}$
ethene	28	-1410
ethane	30	-1560
propene	42	-2060
propane	44	-2220

The complete combustion of 2.5 g of one of these compounds releases exactly 130 kJ of energy.

Which compound is this?

- A ethene
- B ethane
- C propene
- D propane

Space for working

15 Which statement is correct?

- A A catalyst increases the reaction rate by giving molecules more energy, so that a higher proportion of them have activation energy.
- B As the temperature of a sample of gas is increased, the area under the Boltzmann distribution curve for that sample also increases.
- C The large increase in a reaction rate resulting from a small increase in the temperature is mainly due to the molecules colliding more frequently.
- D When the concentration of a reactant is increased, the reaction rate increases because the molecules collide more frequently.

16 Which statement is **not** correct?

- A If an aqueous solution of chlorine is added to aqueous sodium bromide, bromine is formed.
- B In the BOS process, sulfur is removed by reaction with magnesium.
- C Sulfur has a lower first ionisation energy than phosphorus because of repulsion between the paired electrons in a 3p orbital of sulfur.
- D The equation $2\text{CrO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ represents a redox reaction.

Space for working

17 Increasingly, attention is being paid to the environmental consequences of chemical processes.

Which process is carried out for environmental reasons **alone**?

- A catalysed reaction between carbon monoxide and oxides of nitrogen
- B fermentation of glucose
- C recycling of iron and aluminium
- D use of nitrate fertilisers

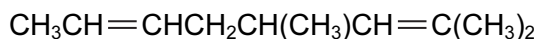
18 What are the products of the thermal decomposition of magnesium nitrate?

- A magnesium nitride and oxygen
- B magnesium oxide and nitrogen
- C magnesium oxide, nitrogen and oxygen
- D magnesium oxide, nitrogen dioxide and oxygen

19 How many different alkenes are formed when 2-methylbutan-2-ol is dehydrated?

- A 2 B 3 C 4 D 5

20 How many different cis-trans (geometric) isomers are possible for the structural formula shown?



- A 0 B 2 C 3 D 4

Space for working

Section B

For each of the questions in this section, one or more of the numbered statements 1 to 4 may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 only are correct	1 and 3 only are correct	2 and 4 only are correct	4 only is correct

No other combination of statements is used as a correct response.

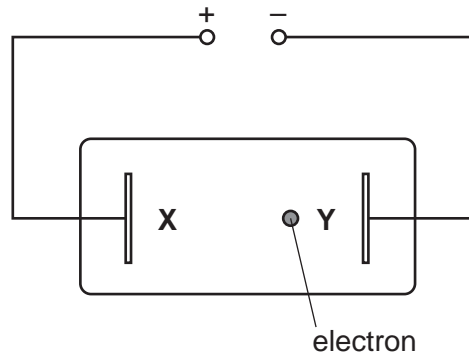
21 Four statements using prefixes to change the size of units are listed.

Which statements are correct?

- 1 $1 \text{ pF} = 10^{-6} \mu\text{F}$
- 2 $1 \text{ mm} = 10^{-3} \mu\text{m}$
- 3 $1 \text{ MJ} = 10^{12} \mu\text{J}$
- 4 $1 \text{ GW} = 10^{12} \text{ W}$

Space for working

22 The diagram shows a free electron moving between two electrodes in an evacuated tube.



Which statements are correct?

- 1 The potential energy of the electron at **X** is less than its potential energy at **Y**.
- 2 The kinetic energy of the electron at **X** is greater than its kinetic energy at **Y**.
- 3 The speed of the electron at **X** is greater than its speed at **Y**.
- 4 The force on the electron at **X** is greater than the force on it at **Y**.

23 A student makes four comments regarding energy changes during changes of state.

Which statements are correct?

- 1 When ice at 0°C changes to water at 0°C the molecules gain kinetic energy.
- 2 When water boils the molecules absorb energy from the surroundings.
- 3 When liquid water at 0°C changes to ice at 0°C the molecules gain potential energy.
- 4 When water vapour condenses the molecules lose potential energy.

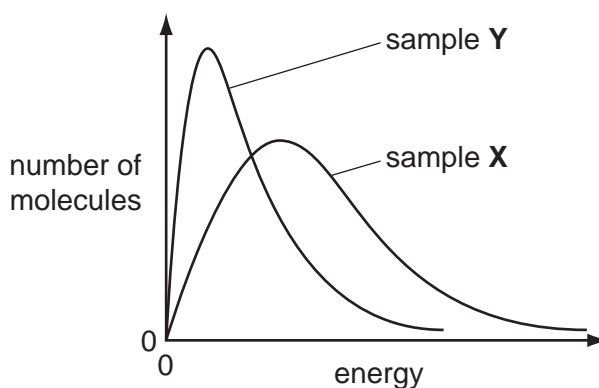
Space for working

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 only are correct	1 and 3 only are correct	2 and 4 only are correct	4 only is correct

No other combination of statements is used as a correct response.

- 24** The diagram shows Boltzmann distributions for two samples of oxygen. Each sample occupies the same volume and consists of one mole of gas.



Which statements are correct?

- 1 Sample **X** is at the higher temperature.
 - 2 The average energy of the molecules in sample **X** is greater than in sample **Y**.
 - 3 There are more collisions per unit time in sample **X** than in sample **Y**.
 - 4 There are more molecules in sample **X** than in sample **Y**.
- 25** Which pairs of nuclei have the same number of neutrons?
- 1 ${}^{40}_{18}\text{Ar}$ and ${}^{40}_{20}\text{Ca}$
 - 2 ${}^{32}_{16}\text{S}$ and ${}^{33}_{15}\text{P}$
 - 3 ${}^{20}_{10}\text{Ne}$ and ${}^{22}_{10}\text{Ne}$
 - 4 ${}^{16}_8\text{O}$ and ${}^{15}_7\text{N}$

Space for working

26 Methanol may be produced by the reaction between hydrogen and carbon monoxide.



Which changes would favour the formation of methanol gas in an equilibrium mixture containing hydrogen, carbon monoxide and methanol?

- 1 decreasing temperature
 - 2 increasing the pressure
 - 3 adding hydrogen gas to the mixture
 - 4 adding a catalyst to the mixture
- 27 Which substances will react with NaBH_4 to give propan-2-ol?
- 1 propane
 - 2 propanoic acid
 - 3 propanal
 - 4 propanone
- 28 Which statements about sulfuric acid, H_2SO_4 , are correct?
- 1 A 200 cm^3 sample of $0.200 \text{ mol dm}^{-3}$ sulfuric acid is exactly neutralised by the addition of 2.332 g of pure magnesium hydroxide.
 - 2 Hydrogen sulfide may be produced when concentrated sulfuric acid is added to solid sodium iodide.
 - 3 The oxidation number of sulfur in sulfuric acid is +6.
 - 4 The Haber process is one stage in the production of sulfuric acid.

Space for working

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 only are correct	1 and 3 only are correct	2 and 4 only are correct	4 only is correct

No other combination of statements is used as a correct response.

29 A reduction process involves a decrease in the oxidation number of an element.

In which reactions does the oxidation number of one of the atoms decrease from +6 to +4?

- 1** $2\text{IO}_3^- + 12\text{H}^+ + 10\text{Fe}^{2+} \rightarrow \text{I}_2 + 10\text{Fe}^{3+} + 6\text{H}_2\text{O}$
- 2** $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
- 3** $\text{Cr}_2\text{O}_7^{2-} + 3\text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Zn}^{2+} + 7\text{H}_2\text{O}$
- 4** $\text{SO}_4^{2-} + 2\text{I}^- + 4\text{H}^+ \rightarrow \text{I}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$

30 Which statements concerning the Brønsted-Lowry theory of acids and bases are correct?

- 1** All Brønsted-Lowry acids are solutions containing $\text{H}^+(\text{aq})$ ions.
- 2** A Brønsted-Lowry base is a proton acceptor.
- 3** Using concentrated reagents, nitric acid acts as a Brønsted-Lowry acid in the reaction $\text{HNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{NO}_3^+ + \text{HSO}_4^-$.
- 4** In the gas phase, hydrogen chloride acts as a Brønsted-Lowry acid in the reaction $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl}$.

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