

Q1

5070/12/M/J/21/Q6

Solid, Liquid &amp; Gas

- 6 Which statement about states of matter is correct?
- A When a liquid freezes it becomes a solid and energy is released to the surroundings.
  - B When a liquid reaches its boiling point it becomes a gas. This process is called evaporation.
  - C When a solid changes directly to a gas the process is called condensation.
  - D When a solid melts the particles get further apart and have less energy.

Q2

5070/12/M/J/23/Q1

Solid, Liquid &amp; Gas

- 1 A sample of iodine is at room temperature and pressure.
- Which statement about the particles in the sample is correct?
- A The particles are arranged in a giant lattice.
  - B The particles have zero kinetic energy.
  - C The particles move randomly through the solid.
  - D The particles vibrate about a fixed point.

Q3

5070/12/M/J/25/Q1

Solid, Liquid &amp; Gas

- 1 At temperature X, the volume of samples of hexane and pentane are **not** affected by changing the pressure from 1 atm to 2 atm.
- At temperature X, the pentane molecules are free to move.
- At temperature X, the hexane molecules are in fixed positions.
- What are the states of hexane and pentane at temperature X?

|   | hexane | pentane |
|---|--------|---------|
| A | liquid | solid   |
| B | liquid | gas     |
| C | solid  | liquid  |
| D | solid  | gas     |

Q4

5070/12/O/N/25/Q1

Solid, Liquid &amp; Gas

- 1 Separate samples of water and air each have a volume of  $30\text{ cm}^3$  at room temperature and pressure.

The pressure applied to both samples is increased by the same amount at room temperature.

Which row describes the volumes at the increased pressure?

|   | volume of water<br>/ $\text{cm}^3$ | volume of air<br>/ $\text{cm}^3$ |
|---|------------------------------------|----------------------------------|
| A | 20                                 | 3                                |
| B | 20                                 | 300                              |
| C | 30                                 | 3                                |
| D | 30                                 | 300                              |

Q5

5070/11/M/J/22/Q4

Solid, Liquid &amp; Gas

4 Which row correctly describes changes in the particles when a substance freezes?

|   | arrangement of the particles  | energy change in the particles |
|---|-------------------------------|--------------------------------|
| A | particles become more ordered | particles gain energy          |
| B | particles become more ordered | particles lose energy          |
| C | particles become less ordered | particles gain energy          |
| D | particles become less ordered | particles lose energy          |

Q6

5070/12/M/J/22/Q4

Solid, Liquid &amp; Gas

4 Which set of changes to the conditions increases the volume of a gas?

|   | pressure  | temperature |
|---|-----------|-------------|
| A | decreases | increases   |
| B | increases | decreases   |
| C | increases | unchanged   |
| D | unchanged | decreases   |

Q7

5070/11/M/J/23/Q1

Solid, Liquid &amp; Gas

1 In a change of state at constant temperature and pressure:

- energy is released as stronger forces of attraction form between the particles
- the average distance between the particles changes very little.

Which change of state is being described?

- A gas to liquid
- B liquid to gas
- C liquid to solid
- D solid to liquid

Q8

5070/11/O/N/24/Q1

Solid, Liquid &amp; Gas

- 1 Which row shows both a property of a gas and the correct explanation for this property?

|   | property                                                                   | explanation for the property                                                                           |
|---|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| A | Gases flow easily.                                                         | The bonds within the molecules are weak.                                                               |
| B | The pressure of a sample of gas increases when the volume is decreased.    | The particles collide more frequently with the walls of the container.                                 |
| C | The volume of a sample of gas increases when the temperature is increased. | The particles in a gas are far apart.                                                                  |
| D | The spread of perfume particles is due to diffusion.                       | Diffusion is the movement of particles from an area of low concentration to one of high concentration. |

Q9

5070/11/O/N/25/Q1

Solid, Liquid &amp; Gas

- 1 The pressure of a sample of air is reduced and its temperature remains constant.

Which row describes the changes in the volume of the air and the distance between the particles in the air?

|   | volume of air | distance between the particles in the air |
|---|---------------|-------------------------------------------|
| A | decreases     | decreases                                 |
| B | decreases     | increases                                 |
| C | increases     | decreases                                 |
| D | increases     | increases                                 |

Q10

5070/12/O/N/25/Q2

Solid, Liquid &amp; Gas

- 2 Why does a balloon full of helium gas become smaller as the temperature changes from 30 °C to 10 °C?
- A The gas condenses to a liquid and so takes up less space.
  - B The gas particles become smaller at lower temperatures.
  - C The gas particles diffuse through the balloon and escape.
  - D The gas particles move more slowly so reducing the pressure.

Q11

5070/12/M/J/25/Q2

Diffusion

- 2 A gas is produced by a chemical reaction at one side of a laboratory.

After a few minutes, the gas is detected at the other side of the laboratory.

Which process explains why the gas is detected at the other side of the laboratory?

- A condensation
- B diffusion
- C dissolving
- D evaporation

Q12

5070/11/O/N/22/Q4

Diffusion

- 4 Which gas diffuses the fastest at the same pressure?

- A nitrogen at 25 °C
- B nitrogen at 50 °C
- C oxygen at 25 °C
- D oxygen at 50 °C

Q13

5070/12/O/N/24/Q1

Diffusion

- 1 Helium gas and argon gas are mixed in a closed container at room temperature and pressure (r.t.p.).

What happens when the two gases are in the container?

- A Argon and helium atoms become evenly mixed throughout the container even though they have different masses.
- B Argon and helium atoms both move towards the bottom of the container. The argon atoms settle more quickly because they are larger and heavier.
- C Argon and helium atoms both move towards the bottom of the container. The helium atoms settle more quickly because they are smaller and lighter.
- D Argon atoms move to the bottom of the container because they are heavier. Helium atoms move to the top of the container because they are lighter.

Q14

5070/11/O/N/25/Q2

Diffusion

2 Which substance would diffuse most quickly?

- A carbon dioxide at  $0^{\circ}\text{C}$
- B carbon dioxide at  $25^{\circ}\text{C}$
- C neon at  $0^{\circ}\text{C}$
- D neon at  $25^{\circ}\text{C}$

Q15

5070/11/O/N/21/Q7

Diffusion

- 7 The rate of diffusion of carbon dioxide and methane is investigated at two different temperatures, one high and one low.

Which row correctly shows the gas that diffuses faster and the temperature at which diffusion takes place most rapidly?

|          | gas            | temperature |
|----------|----------------|-------------|
| <b>A</b> | carbon dioxide | high        |
| <b>B</b> | carbon dioxide | low         |
| <b>C</b> | methane        | high        |
| <b>D</b> | methane        | low         |

Q16

5070/12/O/N/21/Q7

Diffusion

- 7 A sample of gas is released at a particular point in a laboratory.

A detecting device is placed ten metres from the point where the gas is released. This device detects and records the time when the concentration of the gas is ten molecules in every million molecules of air.

The experiment is carried out with two gases at different temperatures.

In which experiment was the time recorded by the detector **greatest**?

|          | gas             | temperature of laboratory / °C |
|----------|-----------------|--------------------------------|
| <b>A</b> | SF <sub>6</sub> | 20                             |
| <b>B</b> | SF <sub>6</sub> | 40                             |
| <b>C</b> | CO <sub>2</sub> | 20                             |
| <b>D</b> | CO <sub>2</sub> | 40                             |

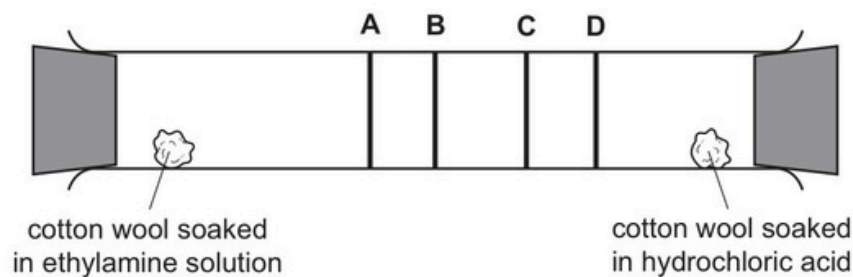
Q17

5070/11/M/J/22/Q5

Diffusion

- 5 Ethylamine gas,  $\text{C}_2\text{H}_5\text{NH}_2$ , and hydrogen chloride gas,  $\text{HCl}$ , react together to form a white solid, ethylamine hydrochloride.

At which position in the tube would a ring of solid white ethylamine hydrochloride form?



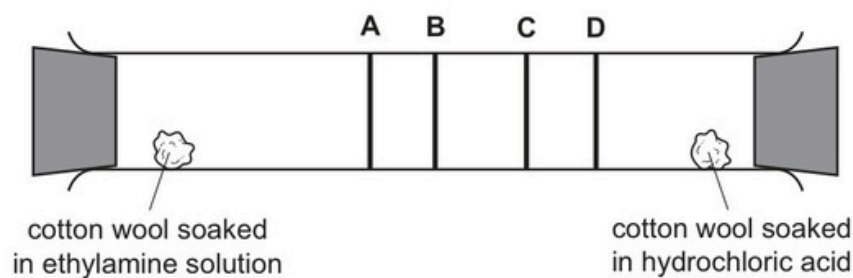
Q18

5070/12/M/J/22/Q5

Diffusion

- 5 Ethylamine gas,  $\text{C}_2\text{H}_5\text{NH}_2$ , and hydrogen chloride gas,  $\text{HCl}$ , react together to form a white solid, ethylamine hydrochloride.

At which position in the tube would a ring of solid white ethylamine hydrochloride form?



Q19

5070/11/O/N/23/Q2

Diffusion

- 2 Data about two compounds is given. Both compounds have a simple molecular structure.

| compound         | melting point / °C | boiling point / °C |
|------------------|--------------------|--------------------|
| H <sub>2</sub> S | −85                | −61                |
| PCl <sub>3</sub> | −112               | 76                 |

Two bottles are placed, close together, inside a large container at a temperature of 90 °C. One bottle contains 1.0 g of H<sub>2</sub>S, the other bottle contains 1.0 g of PCl<sub>3</sub>.

A detector is placed in the container 2.0 m away from the two bottles. The two bottles are opened at the same time.

Which row is correct?

|   | compound that reaches detector first | explanation                                              |
|---|--------------------------------------|----------------------------------------------------------|
| A | H <sub>2</sub> S                     | gases diffuse faster than liquids                        |
| B | H <sub>2</sub> S                     | H <sub>2</sub> S has a lower $M_r$ than PCl <sub>3</sub> |
| C | PCl <sub>3</sub>                     | gases diffuse faster than liquids                        |
| D | PCl <sub>3</sub>                     | PCl <sub>3</sub> has a lower $M_r$ than H <sub>2</sub> S |

Q20

5070/12/O/N/23/Q2

Diffusion

- 2 A crystal of sodium chloride is dropped into a beaker of water and the crystal dissolves.

There are four stages in this process.

- 1 The water molecules collide with the ions in the crystal lattice.
- 2 The ionic bonds in the crystal break.
- 3 The ions move randomly in all directions until they are evenly spread throughout the solution.
- 4 The ions continue to move randomly in all directions but remain evenly spread throughout the solution.

At which stages is diffusion occurring?

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

Q21

5070/11/O/N/24/Q2

Diffusion

- 2 When measured under the same conditions of temperature and pressure, which gas diffuses at the same rate as nitrogen?
- A ammonia,  $\text{NH}_3$
- B carbon monoxide,  $\text{CO}$
- C ethane,  $\text{C}_2\text{H}_6$
- D oxygen,  $\text{O}_2$

Q22

5070/11/M/J/25/Q1

Diffusion

- 1 Four gases are listed.

- 1  $\text{CH}_4$
- 2  $\text{NH}_3$
- 3  $\text{CO}_2$
- 4  $\text{N}_2$

What is the order of their rate of diffusion at room temperature and pressure?

|   | slowest | → |   |   | fastest |
|---|---------|---|---|---|---------|
| A | 1       | 2 | 4 | 3 |         |
| B | 2       | 1 | 3 | 4 |         |
| C | 3       | 4 | 2 | 1 |         |
| D | 4       | 1 | 3 | 2 |         |

Q23

5070/12/O/N/23/Q1

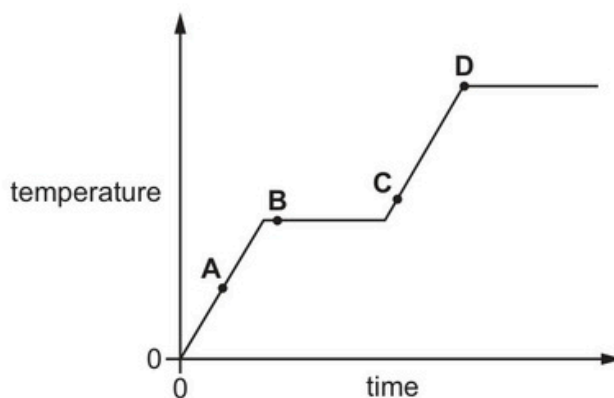
Heating &amp; Cooling Curves

- 1 A solid substance is placed in a flask.

The flask is gently heated and the temperature of the substance is recorded at regular time intervals.

The diagram shows a graph of temperature against time for this experiment.

At which point does the flask contain both a solid and a liquid?

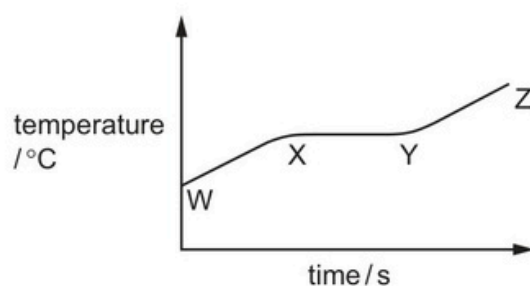


Q24

5070/11/M/J/24/Q1

Heating &amp; Cooling Curves

- 1 A scientist heats a sample of a liquid. The scientist measures the temperature of the sample and plots a graph of the temperature against time.



Which statements are correct?

- 1 Between points W and X, the temperature increases and the particles move faster.
- 2 Between points X and Y, there is no change in the temperature because energy is needed to change a liquid into a gas.
- 3 Between points Y and Z, the particles move further apart.

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

**Q25****5070/12/M/J/24/Q1**

Boiling, Melting &amp; Evaporation

- 1 Which physical changes are both exothermic?
- A condensation and evaporation
  - B evaporation and melting
  - C freezing and condensation
  - D melting and freezing

Q26

5070/12/O/N/22/Q4

Boiling, Melting &amp; Evaporation

- 4 Changes of state occur between solids, liquids and gases.



Which changes are occurring at P, Q, R and S?

|   | P          | Q          | R          | S          |
|---|------------|------------|------------|------------|
| A | boiling    | melting    | freezing   | condensing |
| B | condensing | freezing   | boiling    | melting    |
| C | freezing   | condensing | boiling    | melting    |
| D | melting    | boiling    | condensing | freezing   |

Q27

5070/12/O/N/21/Q4

Boiling, Melting &amp; Evaporation

- 4 An impure sample of compound X has a melting point of 120 °C.

X is purified and its melting point is measured again.

Which row is correct?

|   | method of purifying X | melting point of pure X / °C |
|---|-----------------------|------------------------------|
| A | crystallisation       | 115                          |
| B | distillation          | 115                          |
| C | crystallisation       | 125                          |
| D | distillation          | 125                          |

**MARKING SCHEME - SOLID, LIQUID & GAS - EASY**

| <b>Q</b>  | <b>Answer</b> | <b>Paper reference</b> |
|-----------|---------------|------------------------|
| <b>Q1</b> | <b>A</b>      | 5070/12/M/J/21/Q6      |
| <b>Q2</b> | <b>D</b>      | 5070/12/M/J/23/Q1      |

| <b>Q</b>  | <b>Answer</b> | <b>Paper reference</b> |
|-----------|---------------|------------------------|
| <b>Q3</b> | <b>C</b>      | 5070/12/M/J/25/Q1      |
| <b>Q4</b> | <b>C</b>      | 5070/12/O/N/25/Q1      |

**MARKING SCHEME - SOLID, LIQUID & GAS - HARD**

| <b>Q</b>  | <b>Answer</b> | <b>Paper reference</b> |
|-----------|---------------|------------------------|
| <b>Q5</b> | <b>B</b>      | 5070/11/M/J/22/Q4      |
| <b>Q6</b> | <b>A</b>      | 5070/12/M/J/22/Q4      |
| <b>Q7</b> | <b>C</b>      | 5070/11/M/J/23/Q1      |

| <b>Q</b>   | <b>Answer</b> | <b>Paper reference</b> |
|------------|---------------|------------------------|
| <b>Q8</b>  | <b>B</b>      | 5070/11/O/N/24/Q1      |
| <b>Q9</b>  | <b>D</b>      | 5070/11/O/N/25/Q1      |
| <b>Q10</b> | <b>D</b>      | 5070/12/O/N/25/Q2      |

## MARKING SCHEME - DIFFUSION - EASY

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q11 | B      | 5070/12/M/J/25/Q2 |
| Q12 | B      | 5070/11/O/N/22/Q4 |

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q13 | A      | 5070/12/O/N/24/Q1 |
| Q14 | D      | 5070/11/O/N/25/Q2 |

**MARKING SCHEME - DIFFUSION - HARD**

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q15 | C      | 5070/11/O/N/21/Q7 |
| Q16 | A      | 5070/12/O/N/21/Q7 |
| Q17 | A      | 5070/11/M/J/22/Q5 |
| Q18 | A      | 5070/12/M/J/22/Q5 |

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q19 | B      | 5070/11/O/N/23/Q2 |
| Q20 | C      | 5070/12/O/N/23/Q2 |
| Q21 | B      | 5070/11/O/N/24/Q2 |
| Q22 | C      | 5070/11/M/J/25/Q1 |

## MARKING SCHEME - HEATING & COOLING CURVES - EASY

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q23 | B      | 5070/12/O/N/23/Q1 |

| Q | Answer | Paper reference |
|---|--------|-----------------|
|---|--------|-----------------|

## MARKING SCHEME - HEATING & COOLING CURVES - HARD

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q24 | A      | 5070/11/M/J/24/Q1 |

| Q | Answer | Paper reference |
|---|--------|-----------------|
|---|--------|-----------------|

## MARKING SCHEME - BOILING, MELTING & EVAPORATION - EASY

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q25 | C      | 5070/12/M/J/24/Q1 |

| Q | Answer | Paper reference |
|---|--------|-----------------|
|---|--------|-----------------|

## MARKING SCHEME - BOILING, MELTING & EVAPORATION - HARD

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q26 | B      | 5070/12/O/N/22/Q4 |

| Q   | Answer | Paper reference   |
|-----|--------|-------------------|
| Q27 | C      | 5070/12/O/N/21/Q4 |