O-level chemistry

KINETIC THEORY

States that "mater is made of small particles that are in a continuous random motion"

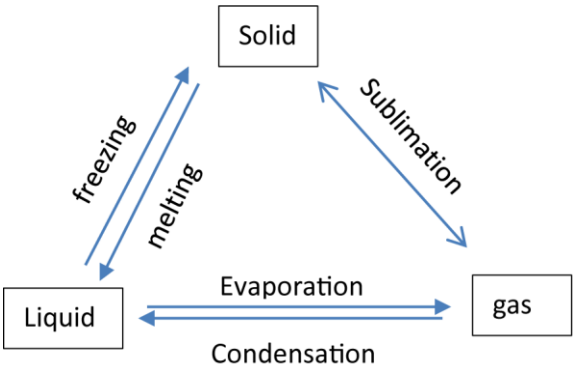
The particles move fastest in gases and slowest in solids. This is because the intermolecular forces in solids are stronger than in liquids than in gases.

When a solid is heated, the particles gain kinetic energy and turns into a liquid by a process called **melting** or into a gas by the process called **sublimation**.

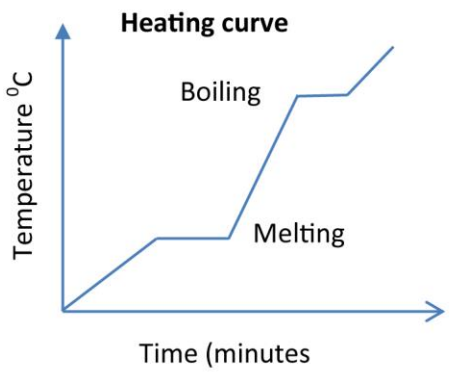
Heating a liquid turns it into a gas by the process called **evaporation**.

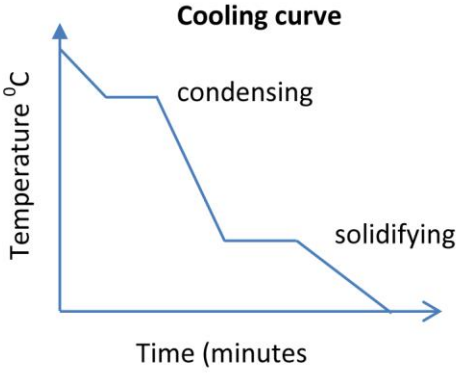
Cooling a gas turns into a solid by the process of **sublimation** or into a liquid by condensation and a liquid turns into a solid by **freezing** or **solidification**.

The summary for interconversion of phase of matter



Note that melting/solidification and boiling/condensing occur at constant temperatures. The characteristic heating and cooling curves are shown below;





Note that boiling and condensing occur at the same temperature

Also, melting and solidification/freezing occur at same temperature

Evidences of kinetic theory

1. Diffusion of gases.
   This is the movement of particles from areas of high concentrating to a region of low concentration.
2. Brownian motion
   This is the random movement of smoke particles in a glass cell as seen through a microscope.

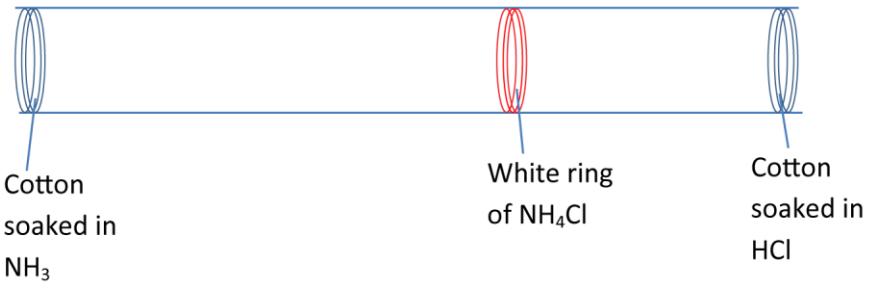
   Explanation
   Air particles are in random movement; these collide with smoke particles and cause them to move randomly.

   When temperature is increased, the kinetic energy of the air particles increase which increases the speed of smoke particles.

   The Brownian motion can be observed by the dust particles through light rays i

3. Formation of white fumes of ammonium chloride (NH_4Cl) from ammonia (NH_3) and hydrogen chloride gas (HCl) from hydrochloric acid (HCl)

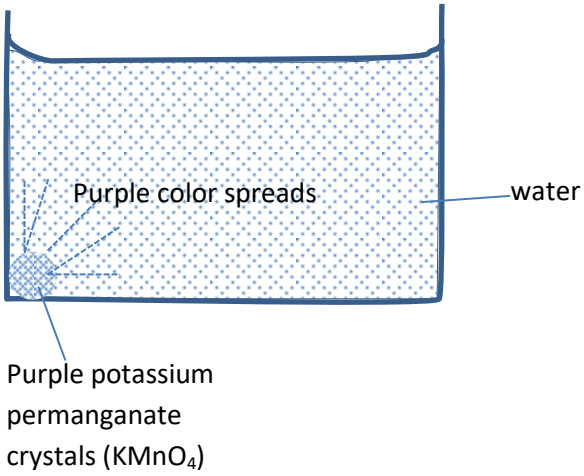
   When a cotton wool soaked in ammonia and another soaked in concentrated hydrochloric acid are placed in opposite end of a long glass tube, a white ring form in a tube near the side that contains cotton wool soaked in concentrated hydrochloric acid.



Conclusion

(i) Ammonia and hydrochloride acid contains particle that move to meet each other and react to form white fumes of ammonium chloride
(ii) Ammonia and hydrochloric acid are volatile i.e. can easily turn into vapour.
(iii) The white ring forms near the cotton wool soaked in HCl because ammonia molecules are lighter and therefore diffuse/move faster. Or ammonia molecule move a bigger distance than hydrogen chloride molecules in the same time.

4. Presence and movement of particles in liquids is demonstrated by diffusion of purple permanganate color in water



Exercise

SECTION A

Numbers 1 to 8 circle the correct alternative

1 Matter is
- A. Anything which has weight and occupies space.
- B. Anything that has mass and volume
- C. Anything that has volume and weight
- D. Anything that has density and weight

2. Which of the following substance can sublime
- A. sodium
- B. Sodium chloride
- C. Potassium nitrate
- D. iodine

3. Melting is a process by which
- A. a solid change directly to vapor
- B. a gas changes to solid
- C. a solid substance changes to liquid state
- D. liquid changes to solid

4. When ammonia gas was reacted with hydrogen chloride, a white ring was formed. The chemical name of the white ring is
- A. sodium chloride
- B. potassium chloride
- C. ammonium sulphate
- D Ammonium chloride

5. Which one of the following will not sublime when heated?
- A. Iron (III) chloride
- B. Iodine
- C. sodium chloride
- D. Ammonium chloride

6. Which one of the following substances does not sublime when heated?
- A. copper (II) oxide
- B. iron (III) chloride
- C. Iodine
- D. ammonium chloride

7. When a solid was heated, it changed to gas without passing through the liquid. State the change of state is called
- A. Vaporization
- B. Sublimation
- C. Condensation
- D. Distillation

8. The process by which water vapour changes into dew is called
   A. distillation
   B. Efflorescence
   C. Condensation
   D. evaporation

For question 9 one or more of the answers given may be correct. Read the question carefully and then indicate the correct answer according to the following

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

9. Pollen grains in water are in continuous motion	Because	Pollen grain collide with moving water molecules

Question 10 consist of an assertion (statement) on the left hand side and a reason on the right hand side.

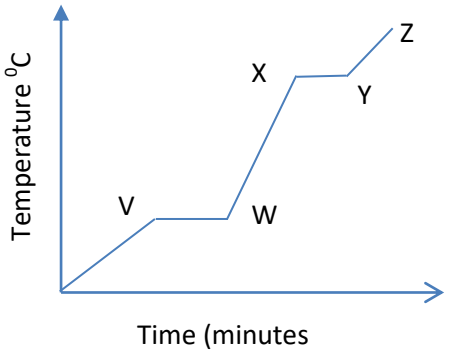
Select

B. If both assertion and reason are true statements and the reason is a correct explanation of the assertion.
C. If both assertion and reason are true statements and the reason is **not** a correct explanation of the assertion
D. If the assertion is true but the reason is not correct statement.
E. If the assertion is not correct but the reason is a correct statement.

Instruction summarized

Assertion	
A. True	**True and a correct explanation**
B. True	**True but not a correct explanation**
C. True	**Incorrect**
D. Incorrect	**Correct**

10. Which of the following statements is true about the kinetic theory of gases?
    1. Gas molecules consist of tiny particles
    2. Gas particles collide with one another
    3. Gas particles are in a state of continuous motion
    4. There is a large force of attraction between gas particles
11. The graph shows the physical changes which took place where a solid P was heated strongly



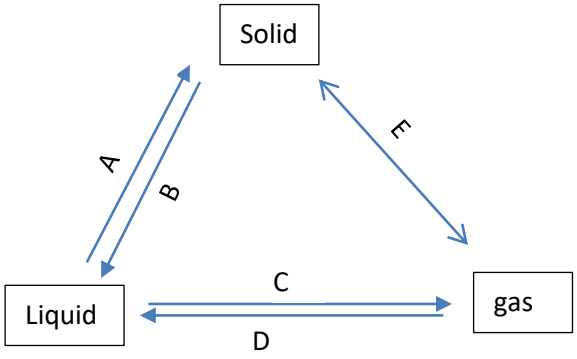
Which one of the following represents the boiling point of P?

A. V-W
B. V-X
C. X-Y
D. Y-Z

Section B

12. Tea was placed in a cup of hot water and allowed to stand.
(a) State what was observed
(b) Name the process that occurred
(c) State the process you have named in (b) demonstrates

13. The diagram below shows how state of matter can change under different conditions



(a) Name the change of states of matter represented by A, B, C, D and E.

(b) Name two substances which can undergo the change of state represented by E.

(c) State one conditions other than temperature that bring about the change of state represented by D.

14. During an experiment, a beam of light was passed through a dark room and the dust particles were seen moving in all directions.

(a) State

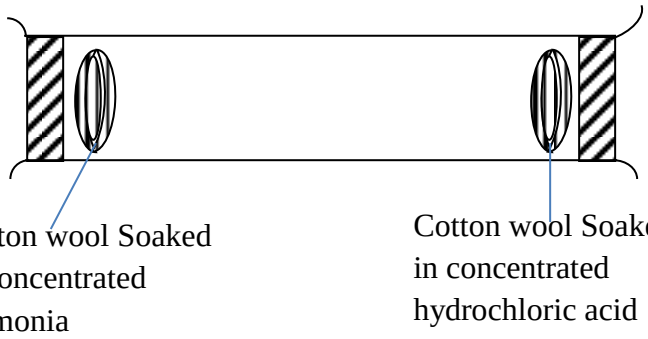
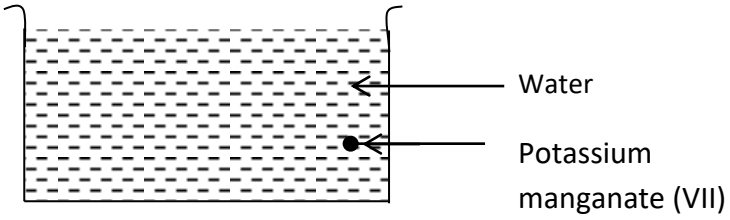
(i) Why the dust particles moved in all directions?

(ii) What the experiment indicated

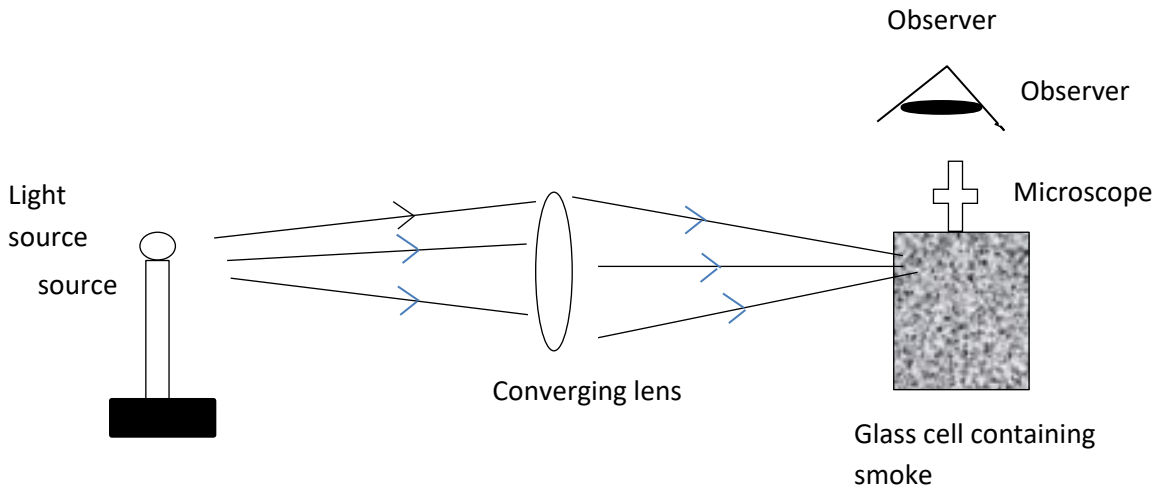
(b) The temperature of the room was increased

(i) State what was observed

(ii) Give a reason for your observation

15.			Two pieces of cotton wool were separately soaked in concentrated ammonia and concentrated hydrochloric acid and simultaneously used to seal the ends of a horizontal glass tube as shown below.  	
	(a)		Mark and label on the diagram the position where a white ring appeared	
	(b)		Explain why the white ring appeared in the position you have marked	
16.			A crystal of potassium manganate (VII) was placed at the corner in a trough of water as shown in the figure below and the experiment was allowed to stand for about 30 minutes.  	

	(a)		State what was observed after 30 minutes	
	(b)		Name the process that occurred	
	(c)		State the purpose of the experiment	
	(d)		Define the following terms.	
		(i)	Matter.	
		(ii)	Diffusion.	
17.			In an experiment, a student trapped smoke in a glass cell was illuminated from the side using intense light. She then looked through the glass cell using a microscope as shown below.	



i. State what would be observed in the glass cell.
ii. Explain your answer above.
iii. Sate what would be observed if the temperature in the glass cell increased.
iv. Give a reason for your answer above.

Marking guide

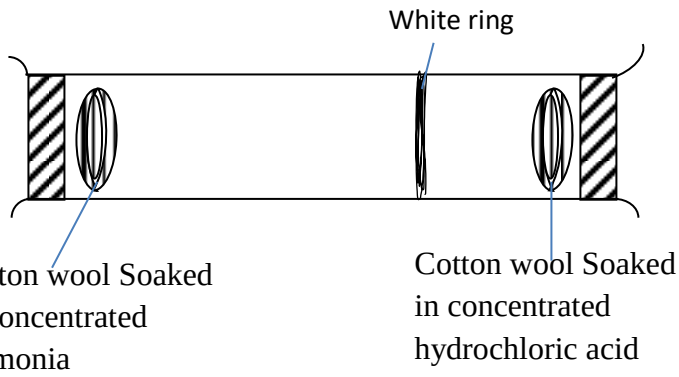
1	A	3	C	5	B	7	B	9	A	11	C
2	D	4	D	6	A	8	C	10	A		

12 (a) Brow color spread throughout the solution
(b) Diffusion
(c) Shows that a liquid contains particles in random motion

13 (a) A Freezing
B Melting
C Evaporation
D Condensation
E Sublimation
(b) Iodine
Ammonium chloride
Iron (III) chloride
(c) Pressure

14 (a) (i) Dust particles collide with air particles that is in random motion
(ii) Air contains particles in random motion
(b) (i) Dust particles move faster
(b) Air particles gained kinetic energy and moved faster

15 (a)



(b) Ammonia is lighter than hydrogen chloride gas and thus diffuses faster

16 (a) Purple color spreads through the whole solution
(b) Diffusion
(c) To show that water contains particles in constant random motion
(d) (i) Matter is anything that occupy space and has weight
(ii) Diffusion is movement of particles from a region of high concentration to a region of low concentration.

17 (i) Smoke particles are seen in random motion
(ii) Smoke particles collide with air particles in motion
(iii) Smoke particles move faster.
(iv) Air particles gain kinetic energy and move faster.