Section 3: Particle Model

ANSWER KEY

6.1	**Describe the arrangement and movement of particles in a solid.**	**Particles are close together in a regular structure and vibrate around a fixed position.**
6.2	**Describe the arrangement and movement of particles in a liquid.**	**Particles are randomly arranged, close together, but free to move past each other.**
6.3	**Describe the arrangement and movement of particles in a gas.**	**Particles are randomly arranged, spread out and move in random directions with a range of speeds.**
6.4	What is the name for the state change from solid to liquid?	Melting
6.5	What is the name for the state change from liquid to gas?	Evaporating/boiling
6.6	What is the name of the state change from gas to liquid?	Condensing
6.7	What is the name of the state change from liquid to solid?	Freezing
6.8	What is the name of the state change from solid to a gas?	Sublimation
6.9	What happens to mass during a state change?	Remains constant
6.10	What happens to the internal energy store of a system when you heat it?	It increases
6.11	**What two things can happen when you heat a system?**	**Its temperature can increase or its state can change.**
6.12	What is specific heat capacity?	The amount of energy required to increase the temperature of 1kg of a substance by 1°C
6.13	What is specific latent heat?	The amount of energy required to change the state of 1kg of a substance with no change in temperature
6.14	Define specific latent heat of fusion	The amount of energy involved in the change of state from a solid to a liquid
6.15	Define specific latent heat of vaporisation	The amount of energy involved in the change of state from a liquid to a gas
6.16	How does increasing the temperature of a gas at constant volume affect the pressure of the gas?	Pressure will increase

Section 3: Particle Model (Separates)

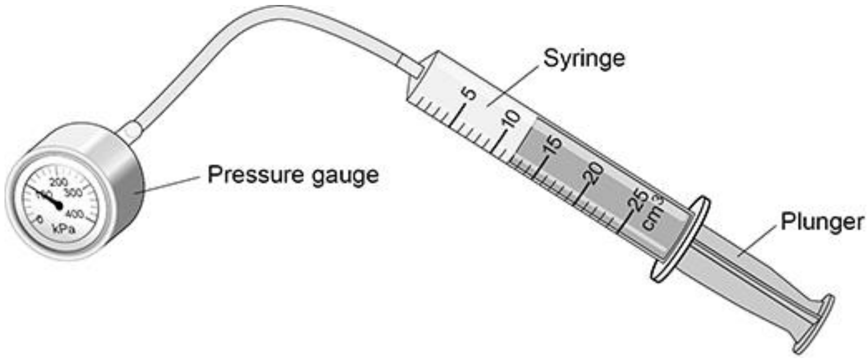
ANSWER KEY

1	**How does a gas' pressure affect its volume at constant temperature?**	**If the pressure is increased, volume will increase (expansion). If the pressure is decreased, volume will decrease (compression)**
2	(HT) How can doing work on a gas increase its temperature?	Work is done to increase the internal energy
3	If temperature is kept constant, but volume is increased, what will happen to gas' pressure?	It will decrease
4	If temperature is kept constant, but volume is decreased, what will happen to a gas' pressure?	It will increase
5	**What is the equation for a fixed mass of gas held at a constant temperature?**	**pV = constant** **pressure x volume = constant**

TRIPLE QUESTIONS

Q1. A teacher demonstrated the relationship between the pressure and the volume of a gas.

The figure below shows the equipment used.



(a) What is the range of the syringe? Tick (✓) **one** box.

From 0 to 1 cm^3 ☐

From 0 to 5 cm^3 ☐

From 0 to 25 cm^3 ☐

(1)

(b) The relationship between the pressure and volume of a gas is given by the equation:

pressure × volume = constant

Complete the sentence.

For this equation to apply, both the mass of gas and the ________________ of the gas must stay the same.

(1)

(c) The initial volume of the gas in the syringe was 12 cm^3.

The initial pressure of the gas in the syringe was 101 000 Pa.

Calculate the constant in the equation below.

pressure × volume = constant

____

____

____

Constant = ________________ Pa cm^3

(2)

(d) The teacher pulled the plunger slowly outwards and the gas expanded.

The new volume of the gas was 24 cm^3.

Calculate the new pressure in the gas.

The constant has the same value as in part (c)

____

____

____

____

____

New pressure = ________________ Pa

(3)

(e) Which change occurs when the plunger is pulled slowly outwards?

Tick (✓) **one** box.

The gas particles stop moving.	☐
There are more frequent collisions between the gas particles.	☐
There is more space between the gas particles.	☐

(1)

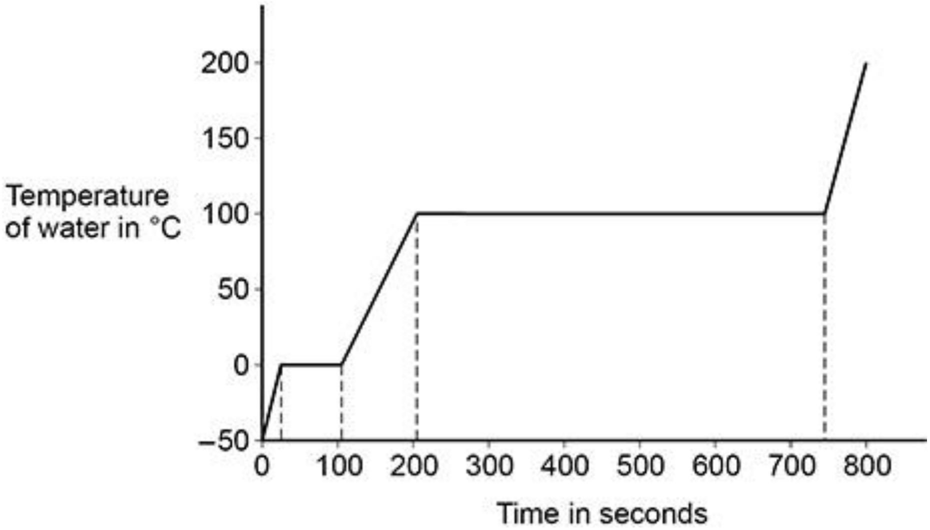
(Total 8 marks)

Q2. A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

The figure below shows the student's results.

The power output of the heater was constant.



(a) The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how the figure above shows this.

___

___

___

___

(2)

(b) The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how the figure above shows this.

___

___

___

___

(2)

(c) A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in the figure above would have been different.

1 ____

____

____

____

2 ____

____

____

____

(2)

(d) When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

____

____

____

____

____

____

____

Specific latent heat of vaporisation = ________________

Unit ___________

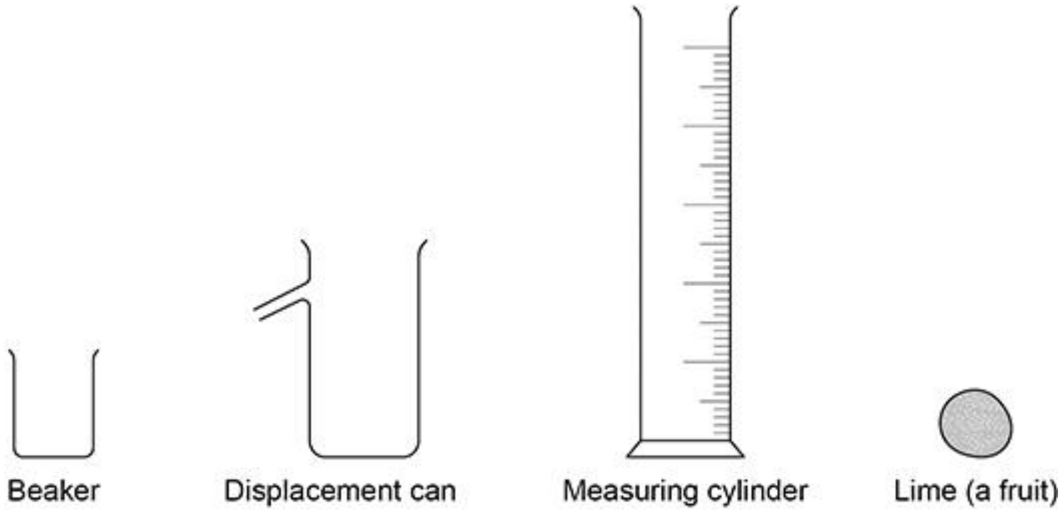
(5)

(Total 11 marks)

Q3. A student investigated the density of different fruits.

To determine the density of each fruit, the student measured the volume of each fruit.

The figure below shows the equipment the student could have used.



(a) Describe a method the student could have used to measure the volume of the lime.

____

____

____

____

____

____

____

____

____

____

____

____

(4)

(b) The student measured the volume of each fruit three times and then calculated a mean value.

The three measurements for a grape were

$2.1\ cm^3$ $2.1\ cm^3$ $2.4\ cm^3$

Calculate the mean value.

____

____

Mean value = _______________ cm^3

(2)

(c) What are the advantages of taking three measurements and calculating a mean value?

Tick (✓) **two** boxes.

Allows anomalous results to be identified and ignored.	☐
Improves the resolution of the volume measurement.	☐
Increases the precision of the measured volumes.	☐
Reduces the effect of random errors when using the equipment.	☐
Stops all types of error when using the equipment.	☐

(2)

(d) The mass of an apple was 84.0 g.

The volume of the apple was $120\ cm^3$.

Calculate the density of the apple.

Give your answer in g/cm^3.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

____

____

Density = _______________ g/cm^3

(2)

(Total 10 marks)

TRIPLE Mark schemes

Q1.

(a) 0 to 25 cm^3

1

(b) temperature

1

(c) 101 000 × 12 = constant

1

constant = 1 212 000 (Pa cm^3)

1

(d) p × 24 = 1 212 000

allow ecf from question (c)

1

$$p = \frac{1\,212\,000}{24}$$

1

p = 50 500 (Pa)

1

(e) there is more space between the gas particles

1

[8]

Q2.

(a) the gradient for ice is steeper than the gradient for water (liquid)

allow the temperature of the ice increased faster than the temperature of the water

1

which means that less energy is needed to increase the temperature by a fixed amount

1

(b) water took more time to vaporise than the ice took to melt

1

which means that less energy is needed to change the state from solid to liquid (than from liquid to vapour)

1

(c) any **two** from:

- ice/water would take more time to increase in temperature
  allow gradients would be less steep
- ice/water would take more time to change state
- the change in temperature with time would not be linear
  allow horizontal lines would be longer

2

(d) E = 69 000 (J)

1

69 000 = 0.030 × L

allow a correct substitution of an incorrectly/not converted value of E

1

$$L = \frac{69\ 000}{0.030}$$

allow a correct rearrangement using an incorrectly/not converted value of E

1

L = 2 300 000
or
L = 2.3 × 10^6

allow a correct calculation using an incorrectly/not converted value of E

1

J/kg

allow a unit consistent with their numerical answer

eg 2300 kJ/kg

1

[11]

Q3.

(a) **Level 2**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

3–4

Level 1: The method would not necessarily lead to a valid outcome. Some steps are identified, but the method is not fully logically sequenced.

1–2

No relevant content

0

Indicative content

- use a eureka/displacement can
- fill the eureka/displacement can with water
- fill the eureka/displacement can up to the spout
- place lime in eureka/displacement can
- collect water that overflows
- use a measuring cylinder to measure volume of water

OR

- use a measuring cylinder
- part fill the measuring cylinder with water
- measure the initial volume of water
- place lime in measuring cylinder
- record new volume of water
- volume of lime = new volume – initial volume

(b) mean = $\frac{(2.1+2.1+2.4)}{3}$

1

mean = 2.2 (cm^3)

1

(c) allows anomalous results to be identified and ignored

1

reduces the effect of random errors when using the equipment

1

(d) density = $\frac{84}{120}$

1

density = 0.70 (g/cm^3)

1

[10]