Week 2-3

Heating Processes

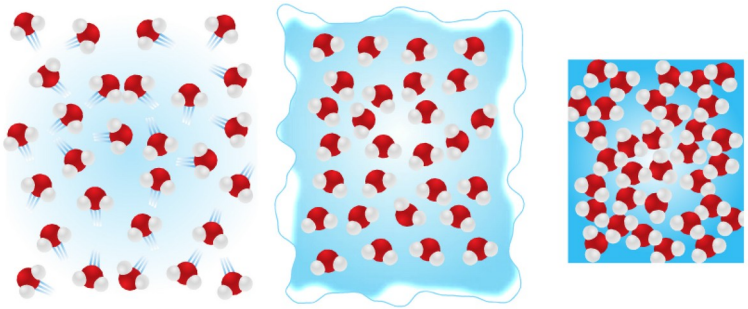
Heat:

Is the energy that is in the process of being transferred from on place to another due to a temperature difference.

Kinetic Particle Model:

We use it to explain the states of matter, and changes between state

-According to the kinetic particle model, all matter is made up of small particles that are in constant motion.



Gas (× 1600) Liquid (× 1.1) Solid (× 1)

Assumptions of Kinetic Particle model:

- All matter is made up of small particle in constant motion; they have kinetic energy
- Collisions between particles are perfectly elastic; the total kinetic energy before and after the collisions is the same
- Potential energy is stored in the 'springs' that connect the particles; potential energy depends on the distance between particles

Potential Energy:

Energy that is stored in a system due to the configuration and interaction within the system.
-the particles in a solid, have bonds that behave like springs and this is why **solid material has potential energy**

Kinetic Energy:

The energy a body possesses due to its motion, it can be in the form of translational, rotational or vibrational energy.

-in a **solid there is kinetic energy**, due to the atoms are all vibrating and moving about constantly.

Elastic Collision: (mostly for gas?)

A collision between two or more objects in which there is no loss of total kinetic energy.

-kinetic energy is transferred from one particle to another but isn't converted into potential.

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Internal Energy:

The sum of the kinetic energy of the particles in the system and the potential energy stored in the system.

Temperature:

Is a measure of the average kinetic energy of the particles in a body.

Thermal Equilibrium:

is the state of a system in which its heat flow is balanced with its surroundings, meaning the temperatures of the system and surroundings are the same. A system at a higher temperature will transfer heat to a system at a lower temperature when they are in contact, until their temperatures are equal.

-when two substances at different temperatures are mixed, the heat lost by one is equal to the heat gained by the other.

Specific Heat Capacity:

Is the amount of energy required to increase the temperature of one kilogram by one kelvin without a change of state

Substance	Specific heat capacity ($J kg^{-1} K^{-1}$)
Water	4200
Ethylene glycol (antifreeze)	2400
Cooking oil	2800
Ice	2100
Steam	2000
Air	1000
Aluminium	900
Soil	800
Crown glass	670
Iron	450
Copper	380
Lead	130

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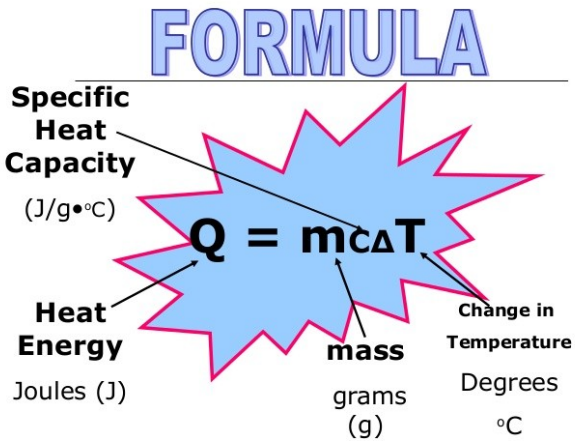
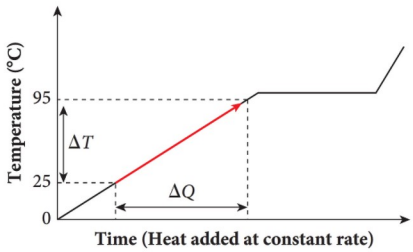


e.g

250 mL of pure water at 25°C is heated to 95°C.

a Sketch a heating curve for the water from 0°C to 100°C. Show on the graph the section relevant to this question. (2 marks)

b How much energy is needed to achieve this temperature change? (4 marks)

Answers	Logic	
a 	Draw correct graph and show section.	2 marks
b $\Delta Q = mc\Delta T$	Find energy by this formula.	1 mark
$\Delta Q = 0.250\,\text{kg} \times 4200\,\text{J kg}^{-1}\,\text{°C}^{-1} \times (95\,\text{°C} - 25\,\text{°C})$	Substitute known variables into the formula. Find *c* in list of specific heat constants.	2 marks
$\Delta Q = 7.35 \times 10^4\,\text{J}$	Calculate the correct answer.	1 mark

**make sure u write the assumptions.

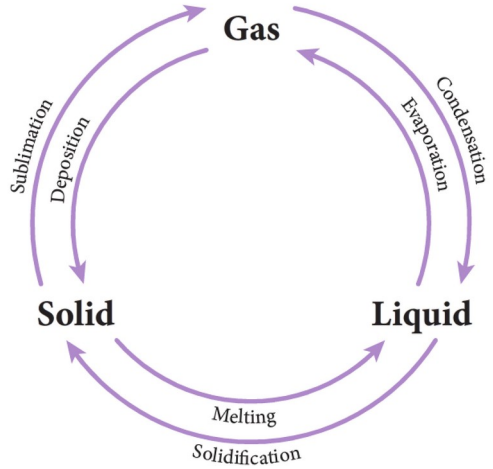
Law of Conservation Of energy:

In an isolated system, energy can neither be created nor destroyed. Energy can be transferred or transformed but the total energy of an isolated system remains constant. The total change in energy is zero.

Isolated System:

Is a system in which no energy or matter can enter or leave.

State Changes and Latent Heat And Power



Latent Heat:

The heat required to change the state of a substance at its melting or boiling point without a change in temperature.

The specific Latent Heat of Fusion:

Is the energy required to change the state of 1Kg of the substance from its solid form to its liquid form.

The specific Latent Heat of Vaporisation:

Is the heat required to change the state of 1kg of the substance from its liquid to gaseous stae.

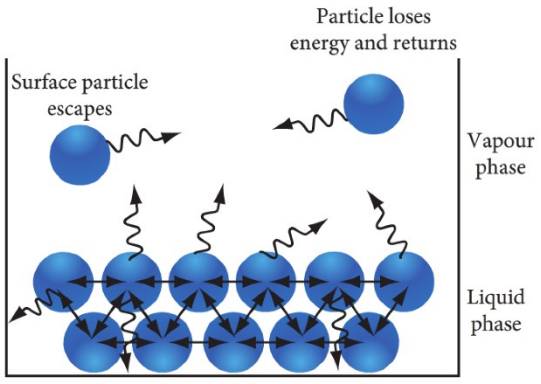


Table 1.5 Latent heats of fusion and vaporisation for a number of common substances. Unlike specific heat, $Jkg^{-1}°C^{-1}$, latent heat is given in $kJkg^{-1}$

Substance	Latent heat of fusion ($kJkg^{-1}$)	Latent heat of vaporisation ($kJkg^{-1}$)
Aluminium	390	10500
Alcohol (ethanol)	105	841
Copper	205	4800
Iron	276	6340
Lead	25	860
Silver	105	2350
Water	334	2260

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$$Q = mL$$

Q = Heat Change	(J or Nm)
m = mass	(kg)
L = specific latent heat	($J\ kg^{-1}$)

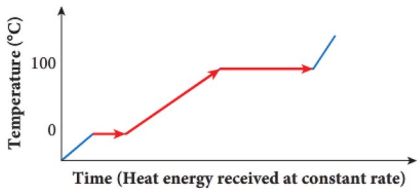
Example of calculations that have change of state:

2 A 2.5 kg iron barbecue plate at 328°C is too hot for cooking. It needs to be cooled to 200°C.

a This is to be done by placing the plate on a block of ice. Show what happens to the ice on a sketch of the heating curve for water from below 0°C to above 100°C. (3 marks)

b How much ice at 0°C is needed to use to cool the barbecue plate to the required 200°C? (6 marks)

2 a 1 mark



All the energy transferred to the ice from the plate goes into melting the ice, heating the water and converting it to steam. — Identify the correct line sections. — 2 marks

b Heat lost by iron = energy gained by the ice/water/steam — Use the correct equation. — 1 mark

$\Delta Q_{Fe} = \Delta Q_{ice\text{-}water} + \Delta Q_{water} + \Delta Q_{water\text{-}steam}$

$m_{Fe}c_{Fe}\Delta T = m_{ice}L_{fusion} + m_{water}c_{water}\Delta T + m_{water}L_{vaporisation}$

Mass of the ice, water and steam is the same.

$m_{Fe}c_{Fe}\Delta T = m_{ice/water/steam}(L_{fusion} + c_{water}\Delta T + L_{vaporisation})$ — Complete the correct algebraic steps. — 2 marks

$$m_{ice/water/steam} = \frac{m_{Fe}c_{Fe}\Delta T}{L_{fusion} + c_{water}\Delta T + L_{vaporisatio}}$$ — Substitute the correct values. — 2 marks

$$m_{ice/water/steam} = \frac{2.5\ kg \times 450\ J\,kg^{-1}\,°C^{-1} \times 128°C}{3.34 \times 10^5\ J\,kg^{-1} + (4.2 \times 10^3\ J\,kg^{-1}\,°C^{-1} \times 100°C) + 2.26 \times 10^6\ J\,kg^{-1}}$$

$m_{ice} = 4.78 \times 10^{-2}\ kg$ — Calculate the answer. — 1 mark

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Scientific Investigations:

Hypothesis:

Is a tentative explanation or prediction not yet confirmed by an experiment.

-e.g. “The height attained by a water rocket will increase with the amount of water attained in the rocket”.

-make sure you include you independent and dependent variables.

- is your hypothesis is true due to an experiment, you state that the experiment supports your hypothesis.

Estimating Uncertainties:

Sources include:

- Limit of reading of measuring device
- Precision of measuring device
- Variation of the measurand

Limit of Reading:

For analogue It is half the smallest division on the scale.

-e.g. For a liquid in a glass thermometer with a scale marked in degrees Celsius , the limit of reading is 0.5°C

For digital has a uncertainty of a whole division.

-e.g. For a digital thermometer that reads whole degrees has a uncertainty of 1°C

Conclusion

Is a *very* brief summary of the results and their implications. Say what you found out and what it means. A conclusion should be a few sentences long.