**4.3.2 Internal energy and energy transfers – Year 9 Physics Self Study**

**Facts**

1. Energy is stored inside a system by the particles (atoms and molecules) that make up the system. This is called **internal energy.**
2. Internal energy is the **total of kinetic energy and chemical potential energy** of all the particles that make up a system.
3. Heating increases the energy of the particles that make up the system.
4. This either raises the temperature of the system or produces a change of state.
5. If the temperature of a system changes the following equation can be used to calculate the change in thermal energy

**change in thermal energy = mass × specific heat capacity × temperature change**

**(in Joules) (in kg) (in J/kg°C) (in °C)**

**∆E   = m c ∆θ**

1. The **specific heat capacity** of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.
2. The energy needed for a substance to change state is called **latent heat**.
3. When a change of state happens, the temperature remains the same, until all of the substance has changed state.
4. The **specific latent heat** of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature.
5. The energy required for a change of state, can be calculated by the following equation:

**energy for a change of state = mass × specific latent heat**

**(in Joules) (in kg)  (in J/kg)**

**E =m L**

1. **Specific latent heat of fusion** is used when a substance changes state from solid to liquid
2. **Specific latent heat of vaporisation** is used when a substance changes state from liquid to gas

**Task 1: Watch free Science lessons and/or visit BBC Bitesize (https://www.bbc.co.uk/bitesize/guides/zcncjty/revision/1) and do a mind map for the following subtopics**

* GCSE Science Physics (9-1) AQA - Internal energy
* GCSE Science Physics (9-1) AQA – Energy transfers and state changes

**Task 2: Answer these Questions:**

1. What is internal energy?
2. What is the specific heat capacity of a substance?
3. State the equation used to calculate the change in thermal energy when there is a temperature change
4. An iron block has a mass of 2kg. The specific heat capacity of iron is 450J/kg°C. Calculate the energy stored when the temperature of the block is increased by 5°C.
5. What is specific latent heat?
6. State the equation used to calculate the energy needed for a state change.
7. What are the two types of specific latent heat?
8. In a kettle, 0.018 kg of water changes to steam. Calculate the amount of energy needed for this change.(Specific latent heat of vaporisation of water=2.3 × 106 J/kg.)

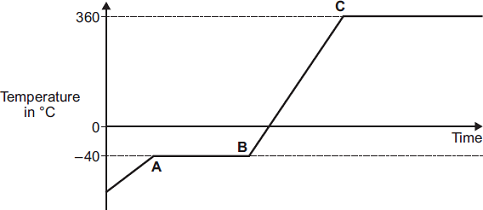
**Task 3**: Write the definitions for **specific heat capacity, specific latent heat of fusion** and **specific latent heat of vaporisation**. Draw the three states of matter and add arrows in between to show the changes of state. Label the arrows with the correct energy transfer word from the above definitions.

**Task 4:**

1. Rearrange the change in thermal energy equation to calculate the temperature change.
2. If the change in energy is 35000J and the specific heat capacity is 500J/kg°C, calculate the temperature change of a 2kg copper block.
3. If the change in energy is 25000J and the specific heat capacity is 450J/kg°C, calculate the temperature change of a 100g iron block.
4. Rearrange the change in thermal energy equation to calculate the mass of an object.
5. If 6720J of energy is required to change the temperature of a quantity of water by 8°C, calculate the mass of water. (specific heat capacity of water is 4200J/kg°C)
6. The energy transferred from water in a kettle to the surroundings in 2 hours is  
   46 200 J. The mass of water in the kettle is 0.50 kg. The specific heat capacity of water is 4200 J/kg °C. The initial temperature of the water is 100 °C. Calculate the temperature of the water in the kettle after 2 hours.

**Task 5: Exam Q**

The graph below shows how temperature varies with time for a substance as it is heated. The graph is **not** drawn to scale.



Explain what is happening to the substance in sections **AB** and **BC** of the graph (4 marks)

**Task 6: Extended writing with research**

Research and write down how the heat capacity of water help to regulate the climate and seasonal temperatures.