P5 Molecules and matter

Lessons TBAT	Key Knowledge	Practical	Assessment
Practically investigation the density of both regular and irregular objects Explain the changing states of matter Define and calculate the amount of internal energy stored in a substance. Explain the changes to a gases as their temperature changes	6.3.1 Changes of state and the particle model 6.3.1.1 Density of materials The density of a material is defined by the equation: density = mass/volume ρ = m/V density, ρ, in kilograms per metre cubed, kg/m3 mass, m, in kilograms, kg volume, V, in metres cubed, m^3 The particle model can be used to explain • the different states of matter • differences in density. Students should be able to recognise/draw simple diagrams to model the difference between solids, liquids and gases. Students should be able to explain the differences in density between the different states of matter in terms of the arrangement of atoms or molecules. 6.3.1.2 Changes of state Students should be able to describe how, when substances change	Required practical activity 17: use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects, and by a displacement technique for irregularly shaped objects. Dimensions to be measured using appropriate apparatus such as a ruler, micrometer or Vernier callipers. Required practical activity 14: an investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored. AT skills covered by this practical activity: physics AT 1 and 5.	End of topic test using past paper questions Maths focus

	state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved. Changes of state are physical changes which differ from chemical changes because the material recovers its original properties if the change is reversed. 6.3.2 Internal energy and energy transfers 6.3.2.1 Internal energy Energy is stored inside a system by the particles (atoms and molecules) that make up the system. This is called internal energy. Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system. Heating changes the energy stored within the system by increasing the energy of the particles that make up the system. This either raises the temperature of the system or produces a change of state. 6.3.2.2 Temperature changes in a system and specific heat capacity If the temperature of the system increases: The increase in temperature depends on the mass of the substance heated, the type of material and the energy input to the system. The following equation applies: change in thermal energy = mass × specific heat capacity × temperature change $\Delta E = m c \Delta \theta$	Key stage 3 Physical changes • conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving • similarities and differences, including density differences, between solids, liquids and gases • Brownian motion in gases • diffusion in liquids and gases driven by differences in concentration • the difference between chemical and physical changes Particle model • the differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density; the anomaly of ice-water transition • atoms and molecules as particles Energy in matter • changes with temperature in motion and spacing of particles • internal energy stored in materials

	change in thermal energy, ΔE, in joules, J mass, m, in kilograms, kg specific heat capacity, c, in joules per kilogram per degree Celsius, J/kg °C temperature change, Δθ, in degrees Celsius, °C. 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. 6.3.2.3 Changes of state and specific latent heat If a change of state happens: The energy needed for a substance to change state is called latent heat. When a change of state occurs, the energy supplied changes the energy stored (internal energy) but not the temperature. 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. energy f or a change o f state = mass × s peci f ic latent heat E = m L energy, E, in joules, J mass, m, in kilograms, kg specific latent heat, L, in joules per kilogram, J/kg Specific latent heat of fusion – change of state from solid to liquid Specific latent heat of vaporisation – change of state from liquid to	

	vapour Students should be able to interpret heating and cooling graphs that include changes of state. Students should be able to distinguish between specific heat capacity and specific latent heat. 6.3.3 Particle model and pressure 6.3.3.1 Particle motion in gases The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules. Changing the temperature of a gas, held at constant volume, changes the pressure exerted by the gas. Students should be able to: • explain how the motion of the molecules in a gas is related to both its temperature and its pressure • explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.	

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