P4.1 SS Mastery Quiz: Matter
Mark Scheme
Section A

Qu	Answer	Marks	Supporting information for fix-it tasks
1	C	1	Answering A or B shows students are not secure with the definition of internal energy and the relative energy of each state of matter. *To fix it, review the definition of internal energy and why gases have the highest internal energy.*
2	C	1	Answering A suggests a confusion that solids can be compressed because their particles are close together. This can sometimes be caused by a language issue where students think solids 'are compressed' because their particles are close together. *To fix it, review what it means for a substance to be compressed.* Answering B suggests the common misconception that liquids can be compressed. This is often caused by incorrect particle diagrams of liquids, showing gaps between the particles. *To fix it, explain why liquids cannot be compressed.*
3	A	1	Answering B or C show that students are not clear on the biggest problem with this diagram. Particles in a gas move at random speeds in random directions, but this diagram suggests a clear pattern. *To fix it, review the advantages and disadvantages of using a 2D particle model.*
4	B	1	Answering A suggests a misconception that it is the collision of particles in a gas with each other that causes pressure. *To fix it, use the PhET interactive animation here that shows visually the particles hitting the walls of the container and explain that this is causing the pressure. Then ask students to explain why adding more particles of gas to a container increases the pressure.* Answering C suggests a fundamental misconception that particles in a gas are sometimes stationary. *To fix it, recap descriptions of motion of particles in solids, liquids and gases and the ask student to compare the motion of particles in solids and gases.*
5	C	1	Answering A shows that students are not clear on what happens during a change of state. Answering B shows that students are not clear on the relationship between temperature and kinetic energy. *To fix it, review the definition of internal energy and how it can be affected by heating.*
6	B	1	Answering A suggests a misconception that a beaker allows volume to be measured accurately. *To fix it, show students a 100 ml measuring cylinder and a 100 ml beaker, then model how a beaker cannot be used to measure volume accurately. Then ask students to explain the different uses of a 100 ml measuring cylinder and 100 ml beaker.*

			Answering C suggests a gap in knowledge about the purpose of this practical. *To fix it, ask students to explain why the volume of a cube, but not an irregularly shaped rock, can be calculated by multiplying the length by width by height.*
7	D	1	Answering A or C shows that students have confused the relationship between mass and volume. Answering B shows students have almost got the correct symbol but are not secure with the significance of the /. *To fix it, review the definition of density and show students how the unit is derived.*
8	C	1	Answering A shows a lack of understanding of the relationship between mass, volume and density. Answering B shows that students have confused the terms mass and density. *To fix it, review the relationship between mass, volume and density. It can be useful for some students to see this modelled with a particle diagram (same number of particles because mass is equal), or with numerical values used.*
9	B	1	Answering A suggests a confusion of the BP of water and oxygen. *To fix it, recap that all substances have specific MPs and BPs. Then ask students to determine the state of oxygen, nitrogen and water at room temperature (18 ºC) when the MP and BP are given.* Answering C suggests the misconception that a lower thermal energy results when the temperature of a substance increases. *To fix it, reteach that temperature is a measure of the average kinetic energy of particles whereas thermal energy is a measure of the total kinetic energy of all particles. Then ask students to explain the difference between temperature and thermal energy.*
10 (Physics only)	A	1	Answering B suggests a misconception that the greater the height in the atmosphere, the greater the pressure. *To fix it, ask students to explain how density of air and pressure exerted varies depending on atmospheric height.* Answering C suggests a misconception that height doesn't affect atmospheric pressure. *To fix it, reteach why height affects atmospheric pressure, linking it to air density and then ask students to explain why it is harder to breathe at the top of a mountain.*
11 (Physics only)	C	1	Answering A show a rearranging error because the incorrect answer 4 is calculated by 400/100 which is p_2 / (p_1 x V_1). *To fix it, ask students to rearrange this equation to make each of the following the subject: p_1, V_1, p_2, V_2.* Answering B shows the error of simply calculating the initial volume multiplied by the initial pressure, rather than consider the constant.

			To fix it, reteach that $p_1 \times V_1 = p_2 \times V_2$ and then model how to carry out this calculation. Then give students more practice examples.
12 (Physics only, HT)	C	1	Answering A suggests a misconception that water is more dense near the surface. *To fix it, reteach that the converse of this is true – water is more less dense at the surface. Then ask students to explain why water at the bottom of ocean is more dense that water in a puddle.* Answering B suggests a misconception that the weight of an object affects the pressure exerted on it. *To fix it, ask students to state the three factors that affect the pressure acting on the fish in water (hint – equation for calculating pressure due to a column of liquid).*
13 (Physics only, HT)	B	1	Answering A suggests a misconception about the relationship between changing volume and the effect on pressure. Answering C suggests a misconception that changing the volume of a container does not affect pressure. *To fix both issues, use the PhET interactive animation here that shows visually the particles of gas hitting the walls of the container and model how changing the volume of the sealed container changes the pressure.*
14 (Physics only, HT)	A	1	Answering B suggests a misconception that a change in the force of gravity causes the greater pressure. *To fix it, recap that the gravitational field strength will be the same value if the experiment is conducted on Earth and does not explain why pressure is greater. Then ask students to link why a greater number of particles can cause greater pressure in a column of liquid.* Answering C suggests a misconception that it is density that explains why a greater height causes a greater pressure. This could be caused by thinking about the other factors in the equation to calculate pressure due to a column of liquid. *To fix it, ask students to explain how both height and density of the liquid affect the pressure at a certain point in a column of liquid.*
15 (Physics only, HT)	B	1	Answering A suggests a misconception that an object floats because of a downwards resultant force. In fact, the converse is true, and the resultant upwards force is upthrust. *To fix it, ask students to draw a labelled free body diagram of this toy boat, labelling all the forces.* Answering C suggests a misconception that sinking is caused by the resultant upwards force caused by the difference in pressure exerted on the object. *To fix it, ask students to write a definition for upthrust using information from this question.*
16 (Physics only, HT)	A	1	Answering B suggests an incorrect of substitution of the value of density, as pressure. This could be caused by confusing the similar looking symbols for pressure and density. It also shows an incorrect use of kilo Pa (kPa) instead of Pa. *To fix it, ask students to write out*

			the equation as symbols as shown on the equation sheet. Then ask students to annotate each symbol to describe what it represents and the units. Then give more practice questions. Answering C suggests an incorrect value for height because 5 m has been used instead the half way down value of 2.5 m. *To fix it, model how to carry out this calculation, focussing on how to deduce the height using information from the question. Then give students similar questions where the marble is either at the top, bottom or some fraction along the column.*

Section B

Qu	Answer	Supporting information ***Suggestions for fix-it tasks***
1	Density = mass / volume **[1]** Density = 18 / 45 **[1]** Density = 0.4 g/cm^3 **[1]**	A common error could be incorrectly recalling the equation to calculate density. *To fix it, ask students to write out several equations that they are expected to recall and then they can revise them either by making flashcards or a poster.* A common error could also be not including the correct units. *To fix it, model how to derive units in this example by using the units of mass and of volume. Then ask students to write out the units for mass, volume and density.*
2	This question is level assessed. Level 0 — 0 marks Level 1 — 1-2 marks Level 2 — 3-4 marks Level 3 — 5-6 marks Indicative content: Key steps are in bold. • **Measure the mass of the car** • in grams/kg • Using a (mass) balance (allow scales) • **Measure the volume of the car**	This question should be marked holistically. Typically, a level 0 answer will contain no (or possibly one) relevant point. A level 1 answer will contain few relevant points but would not allow density to be determined. A level 2 answer would not allow density to be determined but may if small changes were made to the method. Level 2 answers may be missing some key steps. A level 3 answer would allow density to be determined and must mention all the key steps. To achieve the highest level 3 mark, the answer should contain additional details.

	• Using a displacement/Eureka can • **By determining the volume of water displaced** • in mL/cm^3/L • **Determine density using mass/volume** • in g/cm^3, kg/m^3 or other correct combination of units	If the answer refers to measuring the length, breadth and height to determine volume, a maximum of level 1 can be achieved.
3	• (Particles in a solid are held in a) regular arrangement **[1]** • (Particles in a liquids are) randomly arranged **[1]** • Particles are held close together in both (states of matter) **[1]** • Forces (of attraction) between particles are stronger in solids (than liquids) **[1]**	A maximum of three marks should be awarded if answer is not comparative. Allow particles are closer in solids than liquids. The questions specifically asks about the arrangement of particles **not** the movement of particles, which is a common mistake.
4 (SS, HT)	Work is done on the air in the tyre **[1]** The temperature increases **[1]** (As temperature increases,) kinetic energy increases **[1]** Internal energy is the sum of kinetic and potential energy **[1]**	A common misconception here is to link the increase in mass of air to the internal energy. The increase in mass during the tyre inflation is not the focus of the question, instead students need to know that the work done on the air increases the internal energy because temperature has increased. *To fix it, ask students to explain why the internal energy of air increases as a balloon is blown up.*