Assessment Schedule – 2024

Chemistry and Biology: Demonstrate understanding of how the physical properties of materials inform their use (92023)

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of how the physical properties of materials inform their use involves: • describing the use of materials with reference to their physical properties • describing the physical properties of materials, with reference to the arrangement of particles and the relative strength of attractive forces between the particles.	*Explain how the physical properties of materials inform their use* involves: • explaining the physical properties and use of the materials in relation to the arrangement of particles and the relative strength of attractive forces between the particles.	*Evaluate how the physical properties of materials inform their use* involves: • evaluating how materials behave when used, by linking physical properties to the arrangement of particles in the materials and the relative strength of attractive forces between the particles.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0–6	7–12	13–18	19–24

Evidence – Question One

Part	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)	• Physical property: Hardness / softness For an outline of the car to be drawn, graphite / carbon must be soft. The pencil line is made of particles of graphite / carbon / layers of graphite that have been transferred to the paper. • Physical property: Electrical conduction Electrical conduction requires the movement of charged particles. Graphite is made up of layers with free moving / delocalised / mobile electrons between the layers, allowing the flow of the electrical current.	Describes the structure, relative strength of attractive forces, and the physical properties of graphite, and how these link to its use to draw the circuit or allow the circuit to operate.	Explains how the structure, relative strength of attractive forces between the atoms, and the physical properties of graphite make it suitable for use in the circuit.	Evaluates how the structure, relative strength of attractive forces between the atoms, and the physical properties of graphite enable the drawing of the circuit and the electrical conduction within the circuit.
(b)	Graphite is a 2D covalent network solid containing layers of carbon atoms. Each carbon atom in the layer is joined to three carbon atoms. The fourth electron of carbon moves / is delocalised / is mobile between the layers. The layers have weak forces of attractions between them. As the layers have weak attractive forces between them, the layers are transferred to the paper when a small force / little energy is applied. Graphite contains free moving / delocalised electrons, which enables the current to flow through the pencil line.			
(c)	• Three carbon atoms are held together with strong covalent bonds in layers, with the fourth electrons delocalised / free moving / mobile, held between the layers, allowing electrical conduction. Graphite can conduct electricity (3×10^5 σ (S / m) at 20 °C) as the electrons between the layers are delocalised / free moving / mobile, carrying the electrical energy between the battery and LED / around the circuit, allowing the LED to glow. • Three carbon atoms are held together with strong covalent bonds in layers, with the fourth electrons delocalised / free moving / mobile, held between the layers. The force of attractions between the layers are weak, allowing the layers to slide past each other. This makes graphite soft as the Moh value between 1 and 2 is low. • The layers are transferred / slide onto the paper when the pencil is rubbed against the paper. The attractive forces holding the layers together require a small amount of energy to transfer the layers to the paper. When the pencil is rubbed against the paper, these layers form the pencil line, which is drawn as an outline of the car.			

N1	N2	A3	A4	M5	M6	E7	E8
Identifies a physical property of graphite or names graphite as a 2D covalent network.	Identifies a physical property of graphite and names graphite as a 2D covalent network.	Describes a physical property of graphite or names graphite as a 2D covalent network. Attempts to describe the structure of graphite, and the relative strength of attractive forces. Attempts to link it to its usage in drawing or operating the circuit.	Describes a physical property of graphite linked to drawing of circuit or electrical conduction. Names graphite as a 2D covalent network. Describes the structure of graphite and the relative strength of attractive forces. Links the physical property to its usage in drawing or operating the circuit.	Explains the structure, relative strength of attractive forces, and how the physical properties of graphite make it suitable for use in drawing or operating the circuit. Some aspects of the explanation are incomplete.	Explains the structure, relative strength of attractive forces of graphite, and how the physical properties of graphite make it suitable for use in drawing and operating the circuit.	Evaluates the structure, relative strength of attractive forces between the atoms, and how a physical property of graphite enables the effective drawing of the circuit or the electrical conduction within the circuit. Link to evidence missing.	Evaluates the structure, relative strength of attractive forces between the atoms, and how the physical properties of graphite enable the effective drawing of the circuit or the electrical conduction within the circuit.

N0 = No response; no relevant evidence.

Evidence – Question Two

Part	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)	• Physical property: Density Carbon dioxide consists of discrete molecules with only very weak attractions between the molecules, allowing the molecules to move freely. Carbon dioxide is denser than air. The carbon dioxide molecules sink / fall downward, replacing the air (oxygen) around the fire thus smothering it / putting the fire out. • Physical property: Electrical conduction Carbon dioxide is an insulator as the molecules have no free moving / delocalised / mobile electrons or ions to carry the charge. Carbon dioxide will not allow live electrical current to flow to objects / people nearby potentially causing harm, e.g. electric shock. Carbon dioxide is a safe way of extinguishing an electrical fire.	Describes the structure, relative strength of attractive forces, and a physical property of carbon dioxide, and how this links to its use to safely put out an electrical fire.	Explains why carbon dioxide is used for a fire extinguisher / electrical fire, with reference to its structure, relative strength of attractive forces, and a physical property.	Evaluates the use of carbon dioxide to put out an electrical fire with reference to its structure, relative strength of attractive forces, and physical property.
(b)	Carbon dioxide is molecular substance. Carbon dioxide consists of discrete molecules containing non-metal atoms held together by strong covalent bonds but with only very weak attractions between the molecules, allowing the molecules to move freely in the gas state. As carbon dioxide is denser than air, it drops to the ground, smothering the fire. Carbon dioxide has no free moving / delocalised / mobile electrons in its structure so is unable to conduct electricity.			
(c)	Carbon dioxide consists of discrete molecules containing non-metal atoms held together by strong covalent bonds but with only very weak attractions between the molecules, allowing the molecules to move freely. The discrete molecules are denser / heavier than air particles. Carbon dioxide is more dense than air (the density of carbon dioxide is 1.98 kg / mL compared to air at 1.20 kg / mL). The carbon dioxide molecules sink to the ground, smothering / covering the flames to prevent oxygen / air from reaching the flames, extinguishing the flames of the electrical fire. As shown in the table, carbon dioxide is an insulator. The discrete molecules of carbon dioxide do not have any free moving charge particles / electrons / ions to carry a charge, are non-conductive. Carbon dioxide will stop the live electrical current from flowing to objects / people nearby, which could potentially cause harm, e.g. electric shock. The free-moving, dense carbon dioxide gas surrounds the source of the electrical fire, preventing the flow of charge through the air. Carbon dioxide is a safe way of extinguishing an electrical fire.			

N1	N2	A3	A4	M5	M6	E7	E8
Identifies the type of substance carbon dioxide is.	Identifies the type of substance carbon dioxide is and describes the structure.	Describes the structure, relative strength of attractive forces between or within the molecules, and a physical property of carbon dioxide. Attempts to link its use in a fire extinguisher / electrical fire.	Describes the structure, relative strength of attractive forces between or within the molecules, and physical properties of carbon dioxide. Links its use as a fire extinguisher / electrical fire.	Explains the structure, relative strength of all attractive forces, and how the physical properties of carbon dioxide make it suitable to put out fires. Some aspects of the explanation are incomplete.	Explains the structure, relative strength of all attractive forces, and how the physical properties of carbon dioxide make it suitable to put out fires.	Evaluates the structure, relative strength of all attractive forces, and how the physical properties of carbon dioxide make it suitable to put out fires. Link to evidence missing.	Evaluates the structure, relative strength of all attractive forces, and how the physical properties of carbon dioxide make it suitable to put out fires.

N0 = No response; no relevant evidence.

Evidence – Question Three

Part	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)	• Physical property: Malleability The fibre needs to be malleable to be able to be spun and knotted to make a kupenga. The fibres need to be able to be bent / flexible without breaking for kupenga to be made and used. • Physical property: Solubility in water As the kupenga will be in water, it needs to be insoluble (withstand the attractive forces of water to breaking it apart). The muka fibre has strong attractive forces within the chains and many weak attractive forces between the chains.	Describes the structure, relative strength of attractive forces, and the physical properties of muka fibre and how it links to its usage / suitability as a kupenga.	Explains how the physical properties of muka links to the structure of the polymer, muka, the relative strength of attractive forces between the polymer particles, and hence its use and suitability as a kupenga.	Evaluates the physical properties of muka, linking to the structure of the polymer, muka, the relative strength of attractive forces between the polymer particles, and hence its use and suitability as a kupenga.
(b)	A polymer is a large chain molecule made from repeating units with strong covalent bonds between atoms within the chain, but weaker attractions between the chains. Muka fibres can be spun or plaited to make the kupenga, as the forces of attraction between the chains are weak. The weak forces of attraction can be broken with little energy and re-form once the fibres have been worked, keeping the new shape, e.g. plaited or knotted / the weak forces of attraction between the muka polymer chain can easily be moved relative to each other so can easily change shape. To be used as a kupenga, muka fibre needs to be insoluble in water. The forces of attraction between the muka (fibre polymer) / kupenga and the water molecules are too weak to overcome the strong covalent bonds within the chains of muka and the many intermolecular forces holding the fibres / threads / chains of muka / kupenga together, resulting in muka (fibre polymer) being insoluble in water, allowing the kupenga to bring fish to the surface.			
(c)	• To be used as a kupenga, the fibre needs to be able to be plaited or woven and then knotted together. To be plaited or woven, the fibres / threads / chains in muka need to be able to slide past each other easily and be malleable / bend / be flexible. Muka has a low Young's modulus of 8.6, meaning muka is not brittle hence malleable. The long fibres / threads / chains of repeating units with strong covalent bonds have weaker forces of attraction between the fibres / threads / chains. The weaker forces of attraction require less energy to break these weak attractions so the fibres / threads / chains can slide and bend when a small force is applied, allowing the fibres / threads / chains to be worked into a kupenga. *OR* • For stones to be added to weigh down the kupenga, the fibres / threads / chains in muka need to be able to slide past each other easily and be			

	malleable / bend / flexible. Muka has a low Young's modulus of 8.6, meaning muka is not brittle hence malleable. The long fibres / threads / chains of repeating units with strong covalent bonds have weaker forces of attraction between the fibres / threads / chains. It requires less force energy to break these weak attractions so the fibres / threads / chains can slide and bend when a small force is applied, allowing the fibres / threads / chains to be flexible enough to have the stones tied and not break. *OR* • The muka polymer chains can slide past each other easily and are malleable / bendable / flexible. Muka has a low Young's modulus of 8.6, meaning muka is not brittle hence malleable. The long fibres / threads / chains of repeating units with strong covalent bonds have weaker attractions between the fibres / threads / chains. It requires less force to break these weak attractions so the fibres / threads / chains can slide and bend when a small force is applied, allowing the fibres / threads / chains to be flexible enough to allow the kupenga to flexible / malleable / bendable to allow the increasing load of fish to be caught in the net. *AND* • To be used in water, a kupenga needs to be insoluble. The table tells us that muka is insoluble. The forces of attraction between the muka (fibre polymer) / kupenga and the water molecules are too weak to overcome the strong covalent bonds within the chains of muka and the many intermolecular forces holding the fibres / threads / chains of muka / kupenga together resulting in muka (fibre polymer) being insoluble in water, allowing the kupenga to be placed in water to catch fish.			

N1	N2	A3	A4	M5	M6	E7	E8
Identifies a physical property of muka / chain with repeating units / strong covalent bonds within chain with weaker forces of attractions between chains.	Identifies a physical property of muka and the chain with repeating units / strong covalent bonds within chain with weaker forces of attractions between chains.	Describes the structure, relative strength of attractive forces within or between the chains, and the physical properties of muka. Attempts to links to use as a kupenga.	Describes the structure, relative strength of attractive forces within or between the chains, and the physical properties of muka. Links to use as a kupenga.	Explains the structure, relative strength of all attractive forces, and the physical properties of muka. Links to its use / suitability as a kupenga. Some aspects of the explanation are incomplete.	Explains the structure, relative strength of all attractive forces, and the physical properties of muka. Links to its use / suitability as a kupenga.	Evaluates the use of muka as a kupenga with specific evidence about its physical properties, structure, and relative strength of all attractive forces, and how that justifies its use and suitability as a kupenga. Response is weaker or link to data is missing.	Evaluates the use of muka as a kupenga with specific evidence about its physical properties, structure, and relative strength of all attractive forces, and how that justifies its use and suitability as a kupenga. Links to data.

N0 = No response; no relevant evidence.