Paper 2 Foundation

Question number	Answer	Mark
1(a)	D	**(1)**

Question number	Answer	Mark
1(b)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • gas X is carbon dioxide (1) • because the percentage of gas has fallen markedly (1)	**(2)**

Question number	Answer	Additional guidance	Mark
1(c)(i)	• 384 and 315 used from graph (1) • 384 – 315 = 69 (cm^3) (1)	Allow 384 to 385 in 2010 and 314 to 316 in 1960. Second mark consequential on values read from graph. Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
1(c)(ii)	An answer that provides a description by making reference to one of the following linked pairs: • burning/(complete) combustion (1) • of carbon compounds/(fossil) fuels/wood/rubbish/plastic (1) OR • respiration/gas exhaled/breathing/ decaying (1) • from plants/animals/organisms (1) OR • eruption (releases gas) (1) • from volcanic activity/volcanoes (1)	Allow any type of fuel except hydrogen. Allow heating limestone.	**(2)**

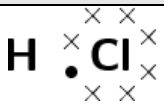
Question number	Answer	Mark
2(a)(i)	A	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	B	Allow boron.	**(1)**

Question number	Answer	Mark
2(a)(iii)	4	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)	Any temperature > 184 (°C).	Ignore units.	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)	astatine (1) + potassium bromide (1)	Allow products in either order.	**(2)**

Question number	Answer	Additional guidance	Mark
2(d)	 • One shared pair of electrons in molecule (1) • Rest of molecule correct, conditional on shared pair (1)	Allow any combination of dots and crosses.	**(2)**

Question number	Answer	Mark
3(a)	• carbon (1) • hydrogen (1)	**(2)**

Question number	Answer	Mark
3(b)(i)	propane + oxygen → carbon dioxide + water • LHS (1) • RHS (1)	**(2)**

Question number	Answer	Mark
3(b)(ii)	to {release/produce} {heat/energy}	**(1)**

Question number	Answer	Mark
3(c)	D	**(1)**

Question number	Answer	Mark
3(d)	C	**(1)**

Question number	Answer	Mark
4(a)	endothermic	**(1)**

Question number	Answer	Mark
4(b)(i)	Any one from: • beaker (1) • polystyrene cup (1) • conical flask (1)	**(1)**

Question number	Answer	Mark
4(b)(ii)	Stir the mixtures with the thermometer	**(1)**

Question number	Answer	Mark
4(b)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • order of reactivity from most reactive to least reactive magnesium, zinc, (iron), copper (1) • because the most reactive shows biggest temperature rise/least reactive shows lowest temperature rise (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • use magnesium, zinc and copper as powders (1) • so they have the same/similar size particles/surface area/shape (1)	allow other acceptable answers, e.g. use same mass / no moles of each	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(v)	1000 cm^3 contain $\frac{6.2 \times 1000}{50}$ (1) 1 dm^3 contains 124 ($g\,dm^{-3}$) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
5(a)	Measuring cylinder/burette/pipette	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)	• axes with linear scale that use more than half of each edge of the grid and labelled with units from the table (1). • all points correctly plotted to ± half a square (1). • single straight line passing through all points and the origin (1).	7 points plotted correctly (i.e. one error) (1) allow ecf from plotting error.	**(3)**

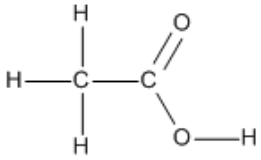
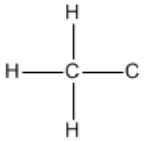
Question number	Answer	Mark
5(c)	A	**(1)**

Question number	Answer	Mark
5(d)	Line A on graph: • steeper curve/curve drawn to left of original (1) • levelling off at 82 cm^3 (1)	**(2)**

Question number	Answer	Mark
5(e)	An answer that combines the following points to provide a method: • suitable method of warming the solutions, e.g. water bath, Bunsen burner with tripod and gauze and measure the temperature of each solution using a thermometer (1) • use the same volumes of the solutions in each experiment (1) • measure the time for the precipitate to form (and obscure a cross placed under the reaction vessel) using a stop watch/clock (1)	**(3)**

Question number	Answer	Mark
6(a)	$C_5H_{11}OH$	**(1)**

Question number	Answer	Additional guidance	Mark
6(b)	(2 × 12) + (5 × 1) + 16 + 1 (1) = 46 (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
6(c)	 Structure to show 2 carbon atoms with 3 hydrogens joined to one of them (1)  Rest of structure correct (1)	Allow OH	**(2)**

Question number	Answer	Mark
6(d)(i)	Any two from: • mass/volume of water (1) • height of container above wick (1) • length of wick/height of flame (1) • the container needs to be the same {shape/size/material} (1) • same number of moles of alcohol (1)	**(2)**

Question number	Answer	Mark
6(d)(ii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • the same temperature rise is achieved (1) • using a lower mass of alcohol/propanol (1)	**(2)**

Question number	Answer	Mark
7(a)	B	**(1)**

Question number	Answer	Mark
7(b)	They (contain) same number of outer shell electrons/all have 1 electron in outer shell.	**(1)**

Question number	Answer	Additional guidance	Mark
7(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • all magnesium atoms have 12 protons (1) • however Mg-24 has 12 neutrons, Mg-25 has 13 neutrons, Mg-26 has 14 neutrons (1)	Ignore references to atomic number and to mass number/relative atomic mass. Allow magnesium atoms contain same number of protons but different numbers of neutrons (1)	**(2)**

Question number	Answer	Additional guidance	Mark
7(d)	An answer that combines the following points of understanding to provide a logical description: • (hydrogen produced as a gas so) there would be {effervescence/fizzing/ bubbles} (1) • calcium hydroxide produced as a solid so the water would {go cloudy/a white precipitate would form} (1)	Allow: • calcium would move (around) (1) • calcium would decrease in size/disappears/ dissolves (1)	**(2)**

Question number	Answer	Mark
7(e)	$Mg + H_2O \rightarrow MgO + H_2$ • LHS (1) • RHS (1)	**(2)**

Question number	Answer	Additional guidance	Mark
7(f)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • in calcium the outermost electron(s) {are further away from nucleus/experience(s) greater shielding} (from the nucleus) (as shown by the electronic configuration) (1) • therefore less attraction between nucleus and electron(s)/the electron(s) is/are easier to remove (1)	Allow answers in terms of why reactivity of magnesium is less than that of calcium.	**(2)**

Question number	Answer	Additional guidance	Mark
7(g)	• divides mass by relative atomic mass (1) • calculates simplest ratio (1) • expresses ratio correctly as empirical formula (1)	Example of calculation Ca : Br $\frac{0.2}{40}$: $\frac{0.8}{80}$ 0.005 : 0.01 1 : 2 empirical formula $CaBr^2$ formula alone scores max	**(3)**

Question number	Answer	Mark
8(a)	C	**(1)**

Question number	Answer	Mark
8(b)(i)	(oil well) C	**(1)**

Question number	Answer	Mark
8(b)(ii)	(oil well) A	**(1)**

Question number	Indicative content
***8(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** Answers must compare advantages of using hydrogen instead of diesel • plenty of water/raw material • limited supplies of crude oil • hydrogen produces only water as waste • diesel also produces carbon dioxide • carbon dioxide emissions may cause global warming • diesel undergoes incomplete combustion • diesel also produces carbon and/or carbon monoxide • carbon is formed as soot and makes objects dirty • carbon monoxide is a toxic gas • hydrogen can be obtained from the water produced. with disadvantages of using hydrogen instead of diesel • hydrogen gas has to be manufactured • energy/electricity is needed to produce hydrogen • producing electricity from non-renewable resources produces carbon dioxide • hydrogen is expensive to produce • problems of storage of large volumes of flammable gas • stronger/heavier/bigger fuel tanks needed • hydrogen is a gas and leaks easily if the fuel system is damaged • there are limited outlets for buying hydrogen.

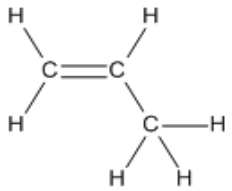
Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents a discussion with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents a discussion that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents a discussion that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
8(d)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • when the decane is heated it vaporises/turns to a gas (1) • decane vapour/gas breaks down as it comes in contact with hot porous pot (1) • large molecules of decane produce smaller molecules, including ethene (1)	Do not allow this point if ethene passes over hot porous pot.	**(3)**

Question number	Answer	Mark
8(d)(ii)	B	**(1)**

Question number	Answer	Mark
9(a)	C	**(1)**

Question number	Answer	Mark
9(b)	36 °C (±2)	**(1)**

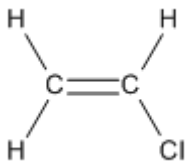
Question number	Answer	Mark
9(c)	• Molecular formula – C_2H_4 (1) • Structure (1) 	**(2)**

Question number	Answer	Mark
9(d)	$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$	**(1)**

Question number	Answer	Additional guidance	Mark
9(e)(i)	• Calculates relative molecular mass of C_4H_9OH (1) • Calculates mass of C_4H_9OH produced (1) • Final answer = 1.9 (kg) (1)	Example of calculation: relative molecular mass of C_4H_9OH = (4 × 12) + (9 × 1) + 16 + 1 = 74 mass of C_4H_9OH produced = (74 ÷ 56) × 1.4 Accept 1.85 (kg) Award full marks for use of moles/correct numerical answer without working.	**(3)**

Question number	Answer	Mark
9(e)(ii)	A	**(1)**

Question number	Answer	Mark
9(f)	• X and Y are both unsaturated/contain {multiple/double} bonds/alkenes (1) • Z is saturated/contains no {multiple/double} bonds/alkane (1)	**(2)**

Question number	Answer	Additional guidance	Mark
9(g)		Ignore bond angles.	**(1)**

Question number	Answer	Additional guidance	Mark
9(h)	Any **one** from the following points: polymer • is lighter/has a lower density (1) • is more resistant to shattering (1)	Ignore any reference to cost.	**(1)**

Question number	Answer	Additional guidance	Mark
10(a)	An answer that provides a description by making reference to: • test gas with moist (red) litmus paper (1) • turns blue (1)	Allow universal indicator paper/pH paper (1) and yellow to blue/purple (1).	**(2)**

Question number	Answer	Additional guidance	Mark
10(b)(i)	(copper sulfate(aq) + sodium hydroxide(aq) →) copper hydroxide(s) + sodium sulfate(aq) • sodium sulfate identified as a product (1) • (sodium sulfate)(aq) **and** copper hydroxide(s) both state symbols matched to the correct product (1)	allow Na_2SO_4 allow copper(II) hydroxide/ $Cu(OH)_2$	**(2)**

Question number	Answer	Mark
10(b)(ii)	white precipitate/ppt/solid	**(1)**

Question number	Indicative content
***10(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO3 (6 marks)** Any logical description of tests which result in identification of all four substances. Plans may include: • flame test • description of carrying out a flame test • if the flame is yellow/not lilac, sodium ions present • if the flame is lilac/not yellow, potassium ions present • add dilute {hydrochloric/nitric} acid to the solid • if bubbles of gas form then carbonate ions present • bubble gas through limewater • if limewater turns milky/cloudy, carbon dioxide present • make a solution of the crystals in water • add dilute nitric acid • (if no reaction with acid) add silver nitrate solution • if there is a white precipitate, chloride ions present • if there is a yellow precipitate, iodide ions present. Alternative test for halide ions: • make a solution of the crystals in water • add chlorine water • then cyclohexane • if the cyclohexane/top layer turns purple, iodide ions present.

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Analyses the scientific information but understanding and connections are flawed. (AO3) • An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	• Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. (AO3) • A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	• Analyses the scientific information and provide logical connections between scientific concepts throughout. (AO3) • A well-developed plan that synthesises relevant understanding coherently. (AO3)