cookie

Practice paper: mark scheme

GCSE Chemistry Higher, practice paper 1 (AQA style)

In the style of AQA GCSE Chemistry (8462) Paper 1 Higher

Practice paper written by cookie in the style of AQA GCSE Chemistry (8462) Paper 1 Higher. Not an AQA paper; not affiliated with or endorsed by AQA.

This mark scheme was written by cookie with its practice paper. Each row gives the answer, the marks and how they are given; where an answer is worded differently but means the same, give the mark.

Key

- Each line is one marking point, worth one mark unless it says otherwise.
- allow an answer that is also acceptable; do not accept an answer that gets no mark; ignore words that neither gain nor lose the mark
- Extended responses (6 marks) are marked by level: decide the level from the descriptors, then the mark within it.

Do it online, timed and marked:
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Question	Answer and marking	Marks
01.1	**Answer: B** B (1)	**1**
01.2	**Answer: 69.8** ((69 × 60.1) + (71 × 39.9)) ÷ 100 (1) 69.8 (1) *69.798 (not rounded to 1 decimal place) scores 1 mark. An answer of 69.8 with no working scores 2 marks. Do not accept 70.*	**2**
01.3	**Answer: 31 protons, 40 neutrons, 28 electrons** protons: 31 (1) neutrons: 40 (1) electrons: 28 (1) *Each number must be clearly linked to the correct particle.*	**3**
01.4	**Answer: Plum pudding: a ball of positive charge with electrons embedded in it. Nuclear: positive charge (and most of the mass) concentrated in a tiny central nucleus, mostly empty space, electrons outside the nucleus.** any two from: • in the nuclear model the positive charge is concentrated in a small nucleus / in the plum pudding model the positive charge is spread through the atom (1) • in the nuclear model most of the mass is in the nucleus (1) • in the nuclear model the atom is mostly empty space / the plum pudding model is a solid ball of positive charge (1) • in the nuclear model the electrons are outside the nucleus / in the plum pudding model the electrons are embedded in the positive charge (1) *Each difference must compare the two models, either explicitly or by clear implication. Ignore references to neutrons.*	**2**
02.1	**Answer: about 29 °C (any value from 20 °C to 35 °C)** any value from 20 to 35 (°C) (1)	**1**
02.2	**Answer: 2K(s) + 2H2O(l) → 2KOH(aq) + H2(g)** correct formulae: K + H2O → KOH + H2 (1) correctly balanced (1) correct state symbols (1) *Allow multiples. The state symbols mark may be awarded on an unbalanced equation with correct formulae. Do not accept H for H2.*	**3**
02.3	**Answer: Potassium's outer electron is further from the nucleus, so it is attracted less strongly and is lost more easily.** the outer electron in potassium is further from the nucleus / in a higher energy level / potassium atoms are larger (1) so there is less attraction between the nucleus and the outer electron (1) so the outer electron is lost more easily (1) *Allow 'more shielding' as an alternative to the first marking point. Answers must refer to the outer electron, not just 'electrons'. Do not accept 'gains electrons more easily'.*	**3**

02.4 **Answer: $Cl2 + 2Br^- \rightarrow 2Cl^- + Br2$** **2**

Cl2 and Br^- on the left and Cl^- and Br2 on the right (1)

correctly balanced (1)

State symbols not required. Allow Br- and Cl- written without superscripts. Ignore K^+ ions shown on both sides. Do not accept Cl or Br as atoms.

02.5 **Answer: Mendeleev left gaps for undiscovered elements and predicted their properties; gallium's properties matched his predictions for one of the gaps.** **2**

Mendeleev left gaps for elements that had not been discovered and predicted their properties (1)

gallium fitted a gap / its properties matched his predictions (1)

03.1 **Answer: A: very high melting point and does not conduct electricity when solid or molten** **2**

A (1)

very high melting point and does not conduct electricity (in either state) (1)

The reason mark depends on choosing A. Both parts of the reason (high melting point and not conducting) are needed for the second mark.

03.2 **Answer: Two electrons are transferred from magnesium to oxygen, forming Mg^{2+} and O^{2-} ions, both with the electronic structure 2,8.** **4**

electrons are transferred from magnesium to oxygen (1)

two electrons (are transferred) (1)

magnesium ions, Mg^{2+}, and oxide ions, O^{2-}, are formed (1)

both ions have a full outer shell / the electronic structure 2,8 / the electronic structure of a noble gas (1)

Any mention of sharing electrons or covalent bonds: maximum 2 marks. Allow 'magnesium loses two electrons and oxygen gains two electrons' for the first two marking points.

03.3 **Answer: 0.15 nm^{-1} (0.15 : 1)** **3**

surface area = 6 × 40 × 40 = 9600 (nm^2) (1)

volume = 40 × 40 × 40 = 64 000 (nm^3) (1)

ratio = 9600 ÷ 64 000 = 0.15 (per nm) (1)

Allow 0.15 : 1, 3 : 20 or 9600 : 64 000 for the third mark. Allow ecf from an incorrect surface area or volume for the third mark. A unit is not required.

03.4 **Answer: Extended response: see mark scheme.** **6**

Level 3 (5–6 marks): A detailed and coherent comparison of the structure and bonding of both diamond and graphite, with both hardness and electrical conductivity explained by linking them logically to the structure of each substance.

Level 2 (3–4 marks): The structure and bonding of both substances are described, and at least one property is explained for at least one substance. The reasoning may lack some detail or links.

Level 1 (1–2 marks): Simple, relevant statements about the structure or the properties of diamond or graphite, with little or no attempt to link structure to properties.

0 marks: No relevant content.

Indicative content:

• both are giant covalent structures (macromolecules) made only of carbon atoms

• both contain many strong covalent bonds between carbon atoms

• in diamond each carbon atom is covalently bonded to four other carbon atoms

• this forms a rigid three-dimensional lattice, so a lot of energy is needed to break the bonds and diamond is very hard
• diamond has no delocalised electrons (all four outer electrons are used in bonds), so it does not conduct electricity
• in graphite each carbon atom is covalently bonded to three other carbon atoms
• the atoms form layers of hexagonal rings
• there are no covalent bonds between the layers; the forces between layers are weak
• so the layers can slide over each other and graphite is soft and slippery
• each carbon atom in graphite has one delocalised electron (one outer electron not used in bonding)
• the delocalised electrons can move through the structure (along the layers) and carry charge, so graphite conducts electricity
Answers that describe graphite's electrons as 'free' should be read as delocalised. Any reference to ions or intermolecular forces in diamond limits the answer to Level 2. Weak forces between graphite layers must not be confused with weak covalent bonds.

04.1 **Answer: 164** **2**
40 + 2 × (14 + (3 × 16)) (1)
164 (1)
An answer of 164 with no working scores 2 marks.

04.2 **Answer: 2.80 g** **3**
moles of Ca(NO3)2 = 8.20 ÷ 164 = 0.0500 (1)
moles of CaO = 0.0500 (1)
mass of CaO = 0.0500 × 56 = 2.80 (g) (1)
Allow ecf from 04.1. Alternative method: 2 × 164 = 328 g gives 2 × 56 = 112 g (1); 8.20 × 112 ÷ 328 (1) = 2.80 g (1). Allow 2.8 g. An answer of 2.80 g with no working scores 3 marks.

04.3 **Answer: 3.0 dm^3** **3**
2 mol Ca(NO3)2 produces 5 mol of gas (4 NO2 + 1 O2) (1)
moles of gas = 0.0500 × 5 ÷ 2 = 0.125 (1)
volume = 0.125 × 24 = 3.0 (dm^3) (1)
Allow ecf from the number of moles in 04.2. If only the NO2 (2.4 dm^3) or only the O2 (0.6 dm^3) is counted, award 2 marks. Allow 3 dm^3 or 3000 cm^3.

05.1 **Answer: 45.9%** **3**
total Mr of reactants = 160 + (3 × 28) = 244 (1)
Mr of desired product = 2 × 56 = 112 (1)
atom economy = 112 ÷ 244 × 100 = 45.9 (%) (1)
Allow use of products: 112 + (3 × 44) = 244. An answer of 45.9% with no working scores 3 marks. Allow 45.90%.

05.2 **Answer: 85.0%** **4**
theoretical mass of iron = 40.0 × 112 ÷ 160 (1)
= 28.0 (kg) (1)
percentage yield = 23.8 ÷ 28.0 × 100 (1)
= 85.0 (%) (1)
Allow a moles method: 40 000 ÷ 160 = 250 mol Fe2O3, so 500 mol Fe, 500 × 56 = 28 000 g. Allow ecf from an incorrect theoretical mass for marking points 3 and 4.

Allow 85%.

05.3 **Answer: 2Al + 3Cl2 → 2AlCl3** **4**

moles of Al = 0.54 ÷ 27 = 0.020 (1)
moles of Cl2 = 2.13 ÷ 71 = 0.030 (1)
moles of AlCl3 = 2.67 ÷ 133.5 = 0.020 (1)
ratio 2 : 3 : 2, so 2Al + 3Cl2 → 2AlCl3 (1)
A balanced equation with no working scores the last mark only. Allow the ratio worked out by dividing by the smallest number of moles. Do not accept 2.13 ÷ 35.5 for Cl2 (that gives moles of Cl atoms), unless it is then correctly halved.

06.1 **Answer: A** **1**

A (1)

06.2 **Answer: A strong acid is completely ionised in aqueous solution; a weak acid is only partially ionised.** **2**

a strong acid is completely / fully ionised in aqueous solution (1)
a weak acid is only partially ionised (in aqueous solution) (1)
Allow 'dissociated' for 'ionised'. Answers about concentration (dilute or concentrated) score 0.

06.3 **Answer: It has decreased by a factor of 100.** **2**

(hydrogen ion concentration) decreases (1)
by a factor of 100 (1)
Allow 'is 1/100 of the original concentration' for 2 marks. 'Decreased by a factor of 10' scores 1 mark. 'Decreased by 2' scores 1 mark.

06.4 **Answer: ZnO + 2HCl → ZnCl2 + H2O** **2**

correct formulae: ZnO + HCl → ZnCl2 + H2O (1)
correctly balanced (1)
Ignore state symbols. Allow multiples. Do not accept ZnCl or Zn2Cl.

06.5 **Answer: Extended response: see mark scheme.** **6**

Level 3 (5–6 marks): A coherent, logically ordered method that would produce pure, dry crystals of zinc sulfate. Includes adding excess zinc oxide, removing the excess by filtration, and crystallising the solution.
Level 2 (3–4 marks): A method with the main steps in a sensible order that would produce zinc sulfate crystals, but with some detail missing (for example, excess not explained, or no drying step).
Level 1 (1–2 marks): Some relevant steps are given, but the method is incomplete or in an order that would not produce a pure, dry salt.
0 marks: No relevant content.
Indicative content:
• measure a known volume of dilute sulfuric acid (e.g. 50 cm^3 with a measuring cylinder) into a beaker
• warm the acid gently (do not boil) to speed up the reaction
• add zinc oxide a spatula at a time, stirring
• keep adding until zinc oxide is in excess / some solid remains undissolved
• this makes sure all the acid has reacted
• filter the mixture to remove the excess zinc oxide; keep the filtrate (zinc sulfate solution)
• heat the filtrate in an evaporating basin (over a water bath or gently with a Bunsen

burner) to evaporate some of the water
• stop heating when crystals start to form at the edge / the solution is saturated (point of crystallisation)
• leave the solution to cool so that crystals form
• filter off (or decant) the crystals and pat them dry between filter paper / leave in a warm place to dry
• wear eye protection (acid is an irritant)
Heating the solution to dryness instead of crystallising does not prevent Level 3 if the rest of the method is complete, but the answer must still remove excess solid by filtration. A titration method is not appropriate here because zinc oxide is insoluble.

07.1 **Answer: pink to colourless** **1**
pink to colourless (1)
Both colours needed, in the correct order. Allow 'purple' or 'magenta' for pink. Do not accept 'clear' for colourless.

07.2 **Answer: 22.45 cm^3** **2**
uses titrations 1, 3 and 4 only: (22.45 + 22.50 + 22.40) ÷ 3 (1)
22.45 (cm^3) (1)
Allow 22.5 cm^3. Including the rough titration or titration 2 scores 0 marks.

07.3 **Answer: 0.180 mol/dm^3** **4**
moles of H2SO4 = 0.100 × 22.45 ÷ 1000 = 0.002245 (1)
moles of NaOH = 2 × 0.002245 = 0.00449 (1)
concentration = 0.00449 ÷ (25.0 ÷ 1000) (1)
= 0.180 (mol/dm^3) (1)
Allow ecf from 07.2. If the 2 : 1 ratio is not used (answer 0.0898 mol/dm^3), award 3 marks. The fourth mark is for the answer given to 3 significant figures.

07.4 **Answer: 7.18 g/dm^3** **1**
0.180 × 40 = 7.2 (g/dm^3) (1)
Allow ecf from 07.3. Allow any answer from 7.18 to 7.2 (7.184 if the unrounded value is used).

08.1 **Answer: negative electrode: $Pb^{2+} + 2e^- \rightarrow Pb$; positive electrode: $2Br^- \rightarrow Br2 + 2e^-$** **2**
negative electrode: $Pb^{2+} + 2e^- \rightarrow Pb$ (1)
positive electrode: $2Br^- \rightarrow Br2 + 2e^-$ (1)
Allow $2Br^- - 2e^- \rightarrow Br2$. Allow charges written without superscripts (Pb2+, Br-). If the two equations are correct but on the wrong electrodes, award 1 mark.

08.2 **Answer: X: chlorine; Y: copper; Z: oxygen** **3**
X: chlorine / Cl2 (1)
Y: copper / Cu (1)
Z: oxygen / O2 (1)
Do not accept chloride for X. Do not accept 'O' for oxygen.

08.3 **Answer: Potassium is more reactive than hydrogen, so hydrogen ions (from water) gain electrons instead.** **2**

potassium is more reactive than hydrogen (1)
so hydrogen ions (from the water) are discharged / gain electrons (instead of potassium ions) (1)
Do not accept 'potassium reacts with water' as the reason.

08.4 **Answer: $4OH^- \rightarrow O2 + 2H2O + 4e^-$** **2**

OH^- on the left and O2, H2O and e^- on the right (1)
correctly balanced: $4OH^- \rightarrow O2 + 2H2O + 4e^-$ (1)
Allow $4OH^- - 4e^- \rightarrow O2 + 2H2O$. Allow $2H2O \rightarrow O2 + 4H^+ + 4e^-$ for 2 marks.

08.5 **Answer: Cryolite lowers the melting point (reducing energy costs); the carbon anodes react with oxygen to form carbon dioxide, so they wear away.** **2**

cryolite lowers the melting point (of the mixture), so less energy is needed (1)
the positive electrodes are carbon and react with the oxygen produced to form carbon dioxide (so they burn away) (1)
Allow 'dissolves aluminium oxide at a lower temperature'. Ignore 'cryolite makes it conduct'.

09.1 **Answer: The temperature increases (as sodium hydroxide is added).** **1**

the temperature (of the mixture) increases (1)
Allow 'energy is transferred to the surroundings'. Do not accept 'the temperature changes'.

09.2 **Answer: The highest reading is at 25 cm^3, but readings were only taken every 5 cm^3, so neutralisation could be anywhere between 20 cm^3 and 30 cm^3; plot a graph with two lines of best fit, or take readings at smaller intervals near 25 cm^3.** **2**

the highest temperature was recorded at 25 cm^3, but the readings were 5 cm^3 apart, so the exact volume could be between 20 cm^3 and 30 cm^3 / the conclusion is not certain (1)
the volume could be found more accurately by plotting a graph and extrapolating the two straight lines to where they cross / by repeating with smaller additions (e.g. 1 cm^3) near 25 cm^3 (1)
A bare 'the conclusion is correct' scores 0.

09.3 **Answer: −1272 kJ/mol** **4**

bonds broken = (12 × 391) + (3 × 498) = 6186 (kJ) (1)
bonds made = (2 × 945) + (12 × 464) = 7458 (kJ) (1)
energy change = 6186 − 7458 (1)
= −1272 (kJ/mol) (1)
Allow ecf for the third and fourth marks. +1272 scores 3 marks. Allow −1270 kJ/mol. An answer of −318 kJ/mol (per mole of ammonia) with correct working scores 4 marks.

09.4 **Answer: 568 kJ/mol** **3**

bonds broken = 436 + 158 = 594 (kJ) (1)
594 − 2x = −542, so 2x = 1136 (1)
H–F bond energy = 568 (kJ/mol) (1)
An answer of 1136 kJ/mol scores 2 marks. An answer of 52 kJ/mol (from 594 − 542) scores 1 mark. Allow ecf from an incorrect bonds broken total.

09.5 **Answer: B** **1**

B (1)

09.6 **Answer: 1.6 V, because the voltage depends on the difference in reactivity of the metals (2.7 − 1.1).** **2**

1.6 (V) (1)

the voltage depends on the difference in reactivity between the two metals: magnesium and zinc are closer in reactivity than magnesium and copper / 2.7 − 1.1 (1)

Allow any value from 1.5 V to 1.7 V for the first mark.

09.7 **Answer: $2H_2 \rightarrow 4H^+ + 4e^-$ and $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$** **2**

$2H_2 \rightarrow 4H^+ + 4e^-$ (1)

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ (1)

Allow $H_2 \rightarrow 2H^+ + 2e^-$. Allow $2H_2 - 4e^- \rightarrow 4H^+$. Electrodes do not need to be named.

Total: 100 marks