cookie

Practice paper

GCSE Double Award Science Higher, practice paper: Chemistry Unit C1 (CCEA style)

In the style of CCEA GCSE Science Double Award (2017) Unit C1: Chemistry, Higher Tier

Practice paper written by cookie in the style of CCEA GCSE Science Double Award (2017) Unit C1: Chemistry, Higher Tier. Not a CCEA paper; not affiliated with or endorsed by CCEA.

Time allowed: 1 hour

Total marks: 70

Name _____

Instructions

- Answer all eight questions in the spaces provided.
- You may use a scientific calculator.
- There is no Data Leaflet with this paper: relative atomic masses, and the formulae of any ions you may not know, are given in the questions that need them.
- Show your working in calculations: you may get marks for a correct method even if your final answer is wrong.
- Quality of written communication will be assessed in Question 4.
- This paper covers Unit C1: atomic structure; bonding and structures, including nanoparticles; symbols, formulae and equations; the Periodic Table, including Groups 1 and 7; quantitative chemistry; acids, bases and salts; chemical analysis.

Information

- The marks for each question are shown in brackets at the end of each part.
- The maximum mark for this paper is 70.

Do it online, timed and marked:
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Answer ALL questions. Write your answers in the spaces provided.

1 This question is about atoms, ions and isotopes.

(a) Complete the table to give the number of protons, neutrons and electrons in each particle.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
magnesium atom, Mg	12	26			
sulfide ion, S^{2-}	16	32			
calcium ion, Ca^{2+}	20	40			

(3)

(b) Write the electronic configuration of the sulfide ion, S^{2-}.

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(1)

(c) A sample of neon contains three isotopes. Their percentage abundances are shown in the table. Calculate the relative atomic mass of neon. Give your answer to one decimal place. Show your working out.

Isotope	neon-20	neon-21	neon-22
Percentage abundance	90.5	0.3	9.2

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(3)

(d) Explain why atoms of neon-20 and neon-22 have the same chemical properties.

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(1)

(Total for Question 1 is 8 marks)

2 Sodium and rubidium are both in Group 1 of the Periodic Table. Rubidium is two places below sodium in the group. The table gives the densities of some Group 1 metals and of water.

Substance	**lithium**	**sodium**	**potassium**	**rubidium**	**water**
Density in g/cm^3	0.53	0.97	0.86	1.53	1.00

(a) A student says that a small piece of rubidium dropped into water will float on the surface, as sodium does. Use the table to explain whether the student is right.

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(2)

(b) Rubidium reacts with water in a similar way to sodium, but more vigorously. Write the balanced symbol equation, including state symbols, for the reaction of rubidium with water.

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(3)

(c) A few drops of universal indicator were added to the solution formed when rubidium reacted with water. State the colour of the indicator and give the type of solution formed.

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(1)

(d) Write the half equation for the formation of a rubidium ion from a rubidium atom.

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(1)

(e) Explain why rubidium is more reactive than sodium.

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(3)

(Total for Question 2 is 10 marks)

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3 This question is about acids.

(a) A student used a pH meter to test solutions of nitric acid and ethanoic acid that had the same concentration. The nitric acid had a pH of 1.0 and the ethanoic acid had a pH of 2.9. Explain why the two acids have different pH values.

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(2)

(b)

(i) Potassium hydrogencarbonate reacts with dilute sulfuric acid to form potassium sulfate, water and carbon dioxide. The hydrogencarbonate ion is HCO_3^- and the sulfate ion is SO_4^{2-}. Write the balanced symbol equation for this reaction.

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(3)

(ii) Describe the test for carbon dioxide gas and give the result.

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(2)

(c) Write the ionic equation, including state symbols, for the neutralisation of an acid by an alkali.

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(2)

(Total for Question 3 is 9 marks)

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4 A student is given three halogen solutions (chlorine water, bromine water and iodine solution) and three colourless solutions (potassium chloride, potassium bromide and potassium iodide). Describe how she could use displacement reactions to find the order of reactivity of chlorine, bromine and iodine, and explain the order. In your answer you should:

• describe how she would carry out the experiment
• give the results she would expect, including any colour changes
• explain how the results show the order of reactivity, and why reactivity decreases down Group 7, in terms of electrons

Your written communication is marked in this question, including how well you use scientific terms.

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(Total for Question 4 is 6 marks)

5 This question is about covalent molecules and the structures of substances.

(a) In a molecule of ammonia, NH_3, give the number of shared pairs of electrons and the number of lone pairs of electrons in the outer shell of the nitrogen atom.

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(2)

(b) Carbon disulfide, CS_2, has the same type of bonding as carbon dioxide. Sulfur is in Group 6. Describe the covalent bonds in a molecule of carbon disulfide and give the total number of electrons shared in the molecule.

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(2)

(c) The table gives some properties of four substances, W, X, Y and Z. Use the information to classify the structure of each substance as giant ionic lattice, molecular covalent, giant covalent or metallic.

Substance	**Melting point in °C**	**Conducts electricity when solid**	**Conducts electricity when molten**	**Dissolves in water**
W	770	no	yes	yes
X	−63	no	no	no
Y	1710	no	no	no
Z	1455	yes	yes	no

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(4)

(d) Explain why substance X has a low melting point.

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(2)

(Total for Question 5 is 10 marks)

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6 Diamond and graphite are allotropes of carbon. This question is about forms of carbon and about nanoparticles.

(a) Diamond is used in the tips of drills for cutting through rock. Explain, in terms of its structure and bonding, why diamond is very hard.

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(b) Graphite powder is used to lubricate stiff locks. Explain, in terms of its structure, why graphite can be used as a lubricant.

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(c)

(i) A sun cream contains particles of zinc oxide that are 0.000 000 035 m across. (1 nm = 0.000 000 001 m.) Show that these particles are nanoparticles.

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(1)

(ii) Give one possible risk of using nanoparticles in sun creams.

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(1)

(Total for Question 6 is 6 marks)

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7 A student used paper chromatography to find out which colourings were in a green ink. The table shows the Rf values of four colourings, P, Q, R and S, in the solvent the student used.

Colouring	**P**	**Q**	**R**	**S**
Rf value	0.20	0.44	0.68	0.82

(a)

(i) The green ink separated into three spots. One spot stayed on the base line. The other two spots moved 2.5 cm and 8.5 cm from the base line. The solvent front moved 12.5 cm from the base line. Calculate the Rf values of the two spots that moved, and use them to identify which of the colourings P, Q, R and S are in the ink.

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(3)

(ii) Suggest why one spot stayed on the base line.

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(iii) The base line was drawn in pencil, not in ink. Explain why.

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(1)

(b)

(i) Propanone and water mix completely. The table gives their boiling points. Name the method the student should use to obtain pure propanone from a mixture of propanone and water, and explain why this method works.

Liquid	**Boiling point in °C**
propanone	56
water	100

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(2)

(ii) The student collected the distillate as three fractions. Fraction 1 was collected while the thermometer read 56 °C; fraction 2 while the reading rose from 57 °C to 99 °C; fraction 3 while it read 100 °C. Which fraction is a mixture? Give a reason for your answer.

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(1)

(Total for Question 7 is 8 marks)

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8 Aluminium chloride can be made by passing dry chlorine gas over heated aluminium. The balanced symbol equation for the reaction is: $2Al + 3Cl_2 \rightarrow 2AlCl_3$. (Relative atomic masses (Ar): Al = 27; Cl = 35.5)

(a) Calculate the relative formula mass (Mr) of aluminium chloride, $AlCl_3$.

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(1)

(b) Calculate the percentage by mass of aluminium in aluminium chloride. Give your answer to one decimal place. Show your working out.

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(2)

(c)

(i) In an experiment, 4.05 g of aluminium was heated in 14.20 g of chlorine. Calculate the number of moles of aluminium and the number of moles of chlorine molecules, Cl_2, used.

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(2)

(ii) Use your answers to (c)(i) and the balanced symbol equation to show that chlorine is the limiting reactant.

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(iii) Calculate the mass of aluminium left over when the reaction is complete.

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(2)

(iv) Calculate the maximum mass of aluminium chloride that could be made in this experiment.

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(d) The student obtained 15.6 g of aluminium chloride. Calculate the percentage yield. Give your answer to one decimal place.

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(2)

(Total for Question 8 is 13 marks)

END OF QUESTIONS