



Rewarding Learning

General Certificate of Secondary Education
2021–2022

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C1

Higher Tier



[GDW22]

GDW22

THURSDAY 24 FEBRUARY 2022, MORNING

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **3(a)**.

A Data Leaflet, which includes a Periodic Table of the elements is provided.



- 1 (a) A bottle of medicine called “CoughEase” has some information on the label.

Contains (per 5ml):	
Honey	0.50 g
Syrup	3.75 ml
Glycerol	0.25 ml
Citric acid	0.025 g
Lemon	0.0005 ml

Use the information above to describe fully why CoughEase can be described as a formulation.

[3]

- (b) A mystery powder found at the scene of a crime is thought to contain traces of a metal ion.

Complete the sentences below which set out how you would carry out a flame test on the powder to identify the metal ion.

Dip a _____ wire into _____
to clean it.

Using the wire, pick up some of the powder and hold it in a blue Bunsen burner flame.

A _____ colour will show the presence of sodium ions.

A crimson colour will show the presence of _____ ions.

[4]





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(Questions continue overleaf)



2 (a) The table below gives information about five atoms or ions.

Atom/ion	Number of protons	Number of neutrons	Number of electrons
A	18	22	18
B	20	22	20
C	21	20	20
D	20	20	20
E	19	22	18

Which two atoms or ions A, B, C, D or E are isotopes? Explain your answer, referring to information provided in the table.

The atoms or ions which are isotopes are _____ and _____.

Explanation: _____

_____ [3]



- (b) Silicon has three naturally occurring isotopes.
Use the information in the table below to calculate the relative atomic mass of silicon to **two decimal places**.

Show your working out.

Mass number	Relative abundance
28	92.23%
29	4.68%
30	3.09%

[3]

[Turn over



3 (a) The modern Periodic Table has been developed over many years.

Describe:

- the key features of Mendeleev's Periodic Table including how he arranged the elements
- the main differences between the modern Periodic Table and the one developed by Mendeleev.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

the key features of Mendeleev's Periodic Table including how he arranged the elements:

the main differences between the modern Periodic Table and the one developed by Mendeleev:

[6]



- (b) (i) When potassium reacts with water it disappears, heat is released, and a gas is evolved causing fizzing.

Give two **other** different observations associated with this reaction.

1 _____

2 _____ [2]

- (ii) Explain why the **alkali metals** have similar chemical properties.

_____ [2]

- (c) The table below gives information about observations made during some reactions of four halogens (W, X, Y and Z) with solutions of halides. The halogens used are fluorine, chlorine, bromine and iodine, but not in that order in the table.

halogen	with sodium chloride solution	with sodium bromide solution	with sodium iodide solution
W	no reaction	colourless to orange	colourless to dark brown
X	no reaction	no reaction	no reaction
Y	colourless to greenish yellow	colourless to orange	colourless to dark brown
Z	no reaction	no reaction	colourless to dark brown

- (i) Identify halogens X and Z.

X is _____ Z is _____ [2]

- (ii) Predict how many of the halogens W, X, Y or Z could displace astatine from sodium astatide.

_____ [1]

[Turn over



- 4 (a) Give the formula of the ion which is always formed when an acid dissolves in water.

_____ [1]

- (b) What would you **see** when some sodium hydrogen carbonate powder is added to dilute hydrochloric acid?

1 _____

2 _____

3 _____ [3]

- (c) Ethanoic acid is a weak acid. Sodium hydroxide is a strong alkali. The table below shows the composition of four solutions (J, K, L and M) containing ethanoic acid.

solution	volume of ethanoic acid/cm ³	volume of water/cm ³
J	50	50
K	75	25
L	25	75
M	0	100

- (i) Which solution J, K, L or M will have the lowest pH? Explain your answer.

Solution _____

Explanation: _____

_____ [2]

- (ii) Explain fully, in terms of particles, why sodium hydroxide is described both as **strong** and as an **alkali**.

_____ [2]





20GDW2209

5 (a) Read the passage below and answer the questions which follow.

Titanium dioxide and zinc oxide nanoparticles are added to sun creams.

These nanoparticles are able to scatter visible light which makes the sun creams transparent and not white like other sun creams. The nanoparticles are also very good at filtering out UV rays.

Sun creams which contain nanoparticles feel lighter on the skin. This means that they are easy to spread and give good coverage of the skin. They do not need to be reapplied as often as other sun creams.

There is some concern that if nanoparticles penetrate the outer skin layer they may cause potential cell damage but there is little evidence to support this.

- (i)** Explain fully, using the information above, why each of the following properties of nanoparticles is considered to be an advantage when used in sun creams:

Their ability to scatter visible light is an advantage because

They are very good at filtering UV rays which is an advantage because

_____ [2]

- (ii)** Give one potential disadvantage, mentioned in the passage, of using nanoparticles in sun creams.

_____ [1]

- (iii)** What size are nanoparticles? Circle the correct answer.

0 – 1 nm 1 – 10 nm 10 – 100 nm 1 – 100 nm [1]



(b) Describe the structure of graphene.

[2]

[Turn over



- 6 This question is about relative formula masses, moles and percentage of an element by mass in a compound.

- (a) Calculate the relative formula mass of the following compounds:
(relative atomic masses: H = 1, C = 12, N = 14, O = 16, Ca = 40, Zn = 65)

zinc nitrate $\text{Zn}(\text{NO}_3)_2$

calcium hydrogencarbonate $\text{Ca}(\text{HCO}_3)_2$

_____ [2]

- (b) Calculate, to one decimal place, the percentage of sulfur by mass in sodium sulfate, Na_2SO_4 . Sodium sulfate has a relative formula mass of 142.
(relative atomic masses: O = 16, Na = 23, S = 32)

_____ [2]



- (c) The relative formula mass of ethanoic acid $\text{C}_2\text{H}_4\text{O}_2$ is 60.
Calculate the number of moles in 2.52 g of ethanoic acid. Give your answer to two decimal places.

_____ [2]

- (d) The equation for the reaction of magnesium hydroxide with nitric acid is:



A student added 3 moles of magnesium hydroxide to 1 mole of nitric acid.

Which reactant is in excess?

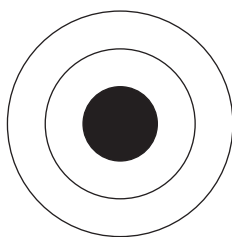
Calculate the number of moles of magnesium nitrate formed.

_____ [2]

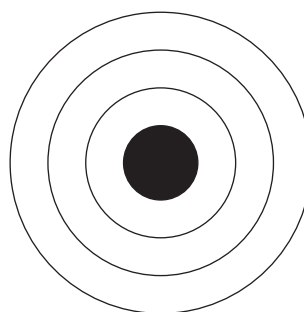
[Turn over



- 7 (a) (i) Complete the diagrams below to show all the electrons in a lithium atom and in a sulfur atom.



lithium atom



sulfur atom

[2]

- (ii) Explain, in terms of the electrons involved, how atoms of lithium and sulfur react to form the compound lithium sulfide.

[4]

- (b) Six compounds are listed below:

sodium iodide

water

carbon dioxide

calcium carbonate

hydrogen sulfide

magnesium fluoride

How many of these compounds would you expect to have ionic bonding?

[1]



- (c) (i) In the space below draw a dot and cross diagram to show the bonding in a molecule of methane, (CH_4). **All the electrons** should be shown.

[3]

- (ii) Draw a dot and cross diagram to show the bonding in a molecule of oxygen, O_2 . **Only the outer electrons** need to be shown.

[2]

[Turn over]



8 Use the list of substances given below to answer the questions that follow.

sodium chloride iodine diamond
brass nitrogen zinc

(a) Choose a substance from the list which

is an alloy: _____

has van der Waals' forces between its molecules: _____

conducts electricity when molten but not when solid: _____

has a molecular covalent structure and sublimes: _____ [4]

(b) Rewrite the word equation given below as a balanced symbol equation and also as an ionic equation.

bromine + sodium iodide → sodium bromide + iodine

balanced symbol equation:

ionic equation:

_____ [6]

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20GDW2217

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13196



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Question Number	Marks
1	
2	
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8	

Total Marks	
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Examiner Number

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