



INTERNATIONAL ORDINARY LEVEL
CHEMISTRY

International
Ordinary Level

MASS CLASS

CHEMISTRY - PAST PAPERS WORK BOOK

Leading International School Senior Teacher

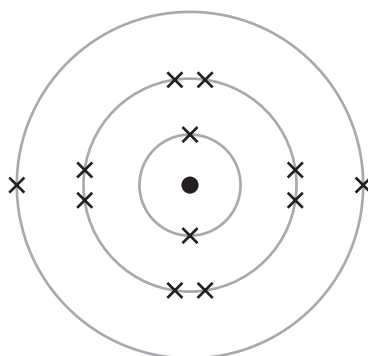
RUVINI WANNIARACHCHI

University of Kelaniya (BSc.MIT)

Chartered Institute of Personnel Management (PQHRM)

1 The diagram represents an atom of element Z.

Z is not the symbol of the element.



(a) (i) Give the number of the group to which element Z belongs.

(1)

2

(ii) Give the number of the period to which element Z belongs.

(1)

3

(iii) Give the formula of the compound that forms when Z reacts with fluorine.

(1)



(b) One mole of Z contains 6.0×10^{23} atoms.

Calculate the number of electrons in one mole of atoms of element Z.

Give your answer in standard form.

(2)

$$\begin{aligned} 12 \times 6.0 \times 10^{23} \\ = 7.2 \times 10^{24} \end{aligned}$$

number of electrons = 7.2×10^{24}



(c) A sample of element Z contains three isotopes. The table shows the numbers of particles in the nucleus of each isotope and the percentage abundance of each isotope.

Isotope	Number of protons	Number of neutrons	Percentage abundance
1	12	12	79.0
2	12	13	10.0
3	12	14	11.0

Use the information in the table to calculate the relative atomic mass (A_r) of element Z.

Give your answer to one decimal place.

(4)

$$(79.0 \times 24 + 10.0 \times 25 + 11.0 \times 26) / 100$$

$$A_r = 24.3$$

(d) Deduce the name of element Z.

(1)

Magnesium



2 Caffeine is a stimulant found in coffee, tea and some soft drinks.

(a) The molecular formula of caffeine is $C_8H_{10}N_4O_2$

(i) Determine the number of atoms in one molecule of caffeine.

(1)

24

(ii) Calculate the relative formula mass (M_r) of caffeine.

(2)

$$(12 \times 8) + (1 \times 10) + (14 \times 4) + (16 \times 2) = 194$$

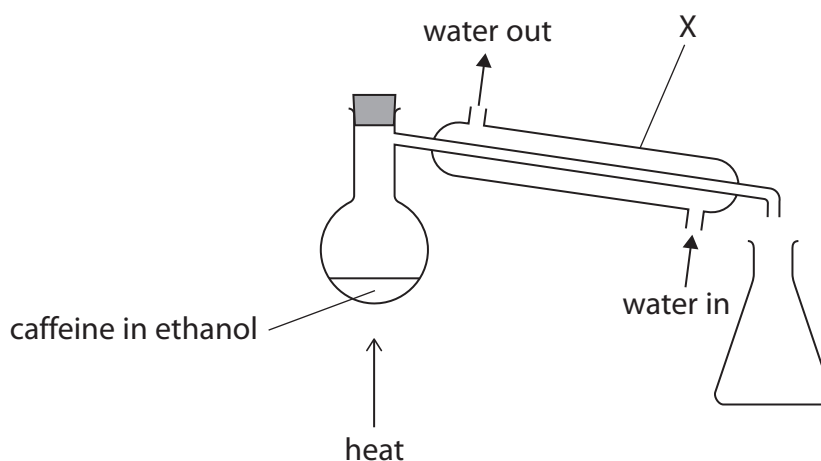
$$M_r = 194$$

(iii) Give the empirical formula for caffeine.

(1)



(b) Ethanol can be obtained from a solution of caffeine in ethanol using this apparatus.



(i) Give the name of the method of separation shown in the diagram.

(1)

simple distillation

(ii) Describe what happens to the ethanol vapour in apparatus X.

(2)

The condenser - X cools the (ethanol) vapour.

So it condenses or forms liquid (ethanol).



(c) Calcium bromide is an ionic compound.

The table shows the formulae and melting points of caffeine and calcium bromide.

Name	Formula	Melting point in °C
caffeine	$C_8H_{10}N_4O_2$	235
calcium bromide	$CaBr_2$	730

The relative formula mass of calcium bromide is similar to the relative formula mass of caffeine.

Explain why calcium bromide has a much higher melting point than caffeine.

(5)

Calcium bromide is a giant (ionic)

lattice/structure with many/strong electrostatic attractions

between (oppositely charged) ions.

Caffeine has a simple molecular structure and weak intermolecular forces.

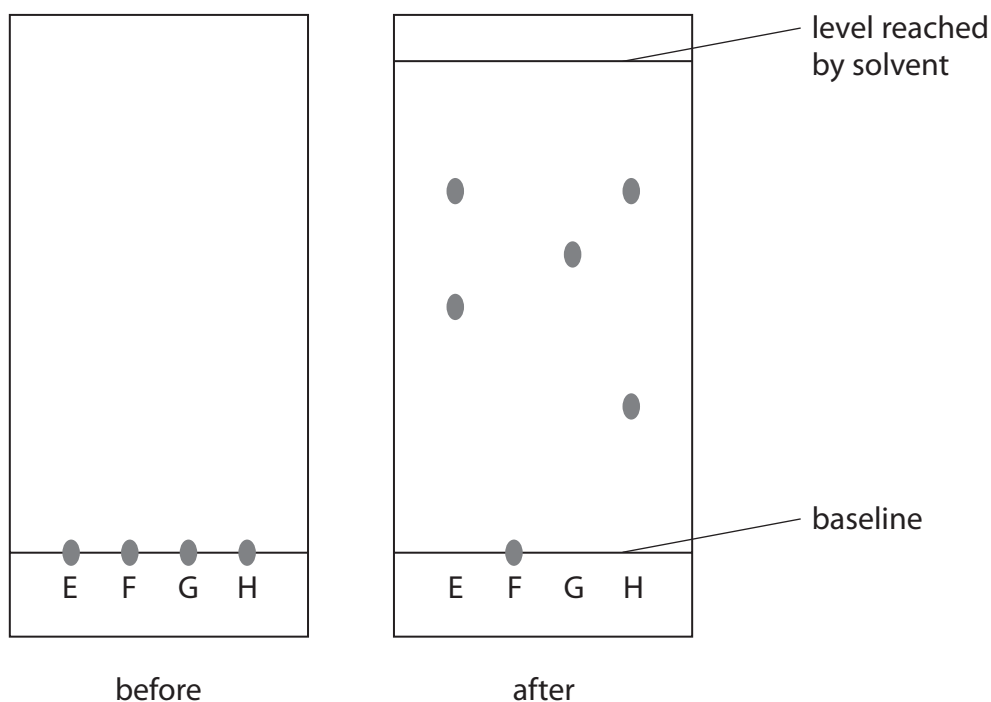
More energy is needed to break the electrostatic attractions in

calcium bromide than to overcome the intermolecular forces in caffeine



- 3 A student uses paper chromatography in an experiment to separate the dyes in four different felt tip pens, E, F, G and H.

The diagram shows the appearance of the paper before and after the experiment.



- (a) (i) The chromatography paper is placed in a solvent. Explain why the spots on the baseline are placed above the level of the solvent.

(2)

They will not dissolve/diffuse into the solvent.

So that the dyes can travel up the paper.

- (ii) Explain which two felt tip pens contain the same dye.

(2)

E and H

Both have a spot at the same level



(iii) The student thought that both F and G contained only one dye.

Explain why the student can only be certain about one of these dyes.

(2)

The student can only be certain about G containing one dye as only one spot.

As F is insoluble/not moved, so he cannot tell how many dyes it has.

(b) Calculate the R_f value for the dye in G.

Show your working.

(3)

$$39 / 65 = 0.6$$

$$R_f \text{ value} = 0.6$$

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4 The table gives some information about three substances, X, Y and Z.

Substance	Melting point	Conducts electricity when solid	Conducts electricity when molten	Type of bonding	Type of structure
X	low	no	no	covalent	simple molecular
Y	high	no	no	covalent	giant (covalent)
Z	high	no	yes	ionic	giant (ionic) lattice

(a) Complete the table by giving the missing information.

(4)

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

(2)

X has weak intermolecular forces.

So little energy needed to overcome the forces.

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5 This question is about the three halogens, bromine, chlorine and iodine.

(a) Give the number of protons and the number of neutrons in an atom of iodine-127

(2)

number of protons

53

number of neutrons

$127 - 53 = 74$

(b) A sample of bromine contains two isotopes.

- Br-79 with relative abundance 52.8%
- Br-81 with relative abundance 47.2%

Calculate the relative atomic mass (A_r) of this sample of bromine.

Give your answer to three significant figures.

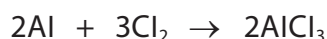
(3)

$$(79 \times 52.8 + 81 \times 47.2) / 100 \\ = 79.9$$

$$A_r = 79.9$$

(c) Aluminium reacts with chlorine to form aluminium chloride.

This is the equation for the reaction.



Calculate the minimum mass of chlorine needed to form 26.7 g of aluminium chloride.

[for Cl_2 , $M_r = 71$ for AlCl_3 , $M_r = 133.5$]

(3)

213 g of Cl_2 produces 267 g of AlCl_3

mass of $\text{Cl}_2 = 26.7 / 267 \times 213$

= 21.3 g

minimum mass of chlorine = g

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(d) A student mixes the following pairs of solutions.

Pair 1 bromine solution and potassium chloride solution

Pair 2 bromine solution and potassium iodide solution

Explain how the student can use the results of these experiments to show the order of reactivity of the three halogens, bromine, chlorine and iodine.

Include observations in your answer.

(6)

Pair 1

No reaction. So no change in colour . Stays yellow or orange.

Bromine cannot displace chlorine. Bromine does not react with chloride ions to produce chlorine. Therefore chlorine is more reactive than bromine.

Pair 2

Turns brown. Bromine displaces iodine. Produce iodine. Therefore bromine is more reactive than iodine.

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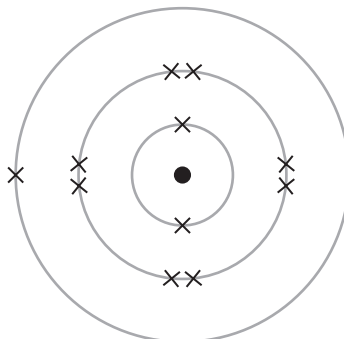
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P 7 1 9 5 0 A 0 1 9 3 2

Turn over ►

- 6 The diagram shows the electronic configuration of an atom of an element.



- (a) Name the part of the atom that contains the protons and neutrons. (1)

nucleus

- (b) Give the number of protons in this atom. (1)

11

- (c) Give the number of the group that contains this element. (1)

1

- (d) Give the number of the period that contains this element. (1)

3

- (e) Give the charge on the ion formed from this atom. (1)

+ 1

7 (a) The box shows some changes of state.

boiling	condensation	evaporation
freezing	melting	sublimation

The table lists some physical changes.

Complete the table using words from the box to show the change of state for each physical change.

(4)

Physical change	Change of state
water to ice	freezing
steam to water	condensation
solid wax to liquid wax	melting
iodine crystals to iodine vapour	sublimation

(b) A student plans to obtain salt crystals from a mixture of salt and sand.

The student adds pure water to the mixture to dissolve the salt.

(i) State two things the student could do to make the salt dissolve quickly.

(2)

1 **Heat**

2 **Stir / mix**

(ii) State what the student should do next to separate the sand from the salt solution.

(1)

Filter



(iii) Describe how the student can obtain pure dry crystals of salt from the salt solution.

(4)

Heat the solution to evaporate some of the water.
Leave it cool to turn solution to crystallise.
Pour off excess liquid or filter to obtain crystals.
Place in an oven to dry the crystals.

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8 This question is about copper and copper compounds.

(a) A sample of copper contains two isotopes.

- Cu-63 with relative abundance 69.5%
- Cu-65 with relative abundance 30.5%

(i) State what is meant by the term **isotopes**.

(2)

Atoms of the same element with the same number of protons
and different number of neutrons

(ii) Calculate the relative atomic mass (A_r) of this sample of copper.

Give your answer to three significant figures.

(3)

$$(63 \times 69.5) + (65 \times 30.5) = 6361$$

$$6361/100 = 63.61$$

A_r of copper = 63.6

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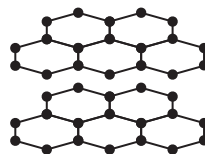


9 Diamond and graphite are giant covalent structures made of carbon atoms.

The diagram shows their structures.



Diamond



Graphite

(a) Discuss the differences between diamond and graphite.

Refer to structure and bonding, electrical conductivity and hardness in your answer.

(6)

diamond has a tetrahedral structure.

graphite has a hexagonal (structure) and it has layers.

diamond does not conduct electricity.

graphite conducts electricity.

diamond has no delocalised electrons.

graphite has delocalised electrons.

diamond is hard and graphite is soft.

In diamond the strong (C-C) bonds need to be broken.

In graphite the layers can slide over and graphite has weak forces between layers.

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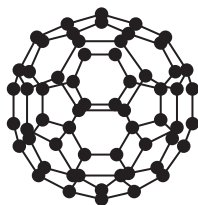
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(b) C_{60} fullerene is a simple molecular substance made of 60 carbon atoms.

The diagram shows its structure.



The table shows the approximate melting points of diamond, graphite and C_{60} fullerene.

Substance	Approximate melting point in $^{\circ}C$
diamond	4000
graphite	3600
C_{60} fullerene	600

Explain why C_{60} fullerene has a much lower melting point than diamond and graphite.

(4)

C_{60} fullerene has weak forces between the molecules.

Less energy is needed to break bonds.

Diamond and graphite have many strong covalent bonds between atoms

So large amount of energy is needed to break the (covalent) bonds.



P 7 0 9 4 5 A 0 2 1 2 8

10 (a) Table 1 gives some information about three subatomic particles.

(i) Complete Table 1 by giving the missing information.

(3)

Subatomic particle	Relative mass	Relative charge
electron	0.0005	-1
proton	1	+1
neutron	1	0

Table 1

(ii) Give the name of the part of the atom containing protons and neutrons.

(1)

nucleus

(b) Table 2 shows the numbers of protons, neutrons and electrons in the species U, V, W, X, Y and Z.

Species	Number of protons	Number of neutrons	Number of electrons
U	8	10	8
V	9	10	10
W	11	12	10
X	11	12	11
Y	12	12	12
Z	12	13	12

Table 2

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Use the information in Table 2 to answer these questions.

Each species may be used once, more than once or not at all.

- (i) Give the letter of the species that has six electrons in its outer shell. (1)

U

- (ii) Give the mass number of Z. (1)

25

- (iii) Give the letter of the species that is a positive ion. (1)

W

- (iv) Give the letters of the two species that are isotopes of the same element. (1)

Y and Z

- (c) A sample of neon contains two isotopes, ^{20}Ne and ^{22}Ne

The relative abundances of the two isotopes in the sample are



Calculate the relative atomic mass of this sample of neon.

Give your answer to one decimal place. (3)

$$(91.2 \times 20) + (8.80 \times 22) = 2017.6$$

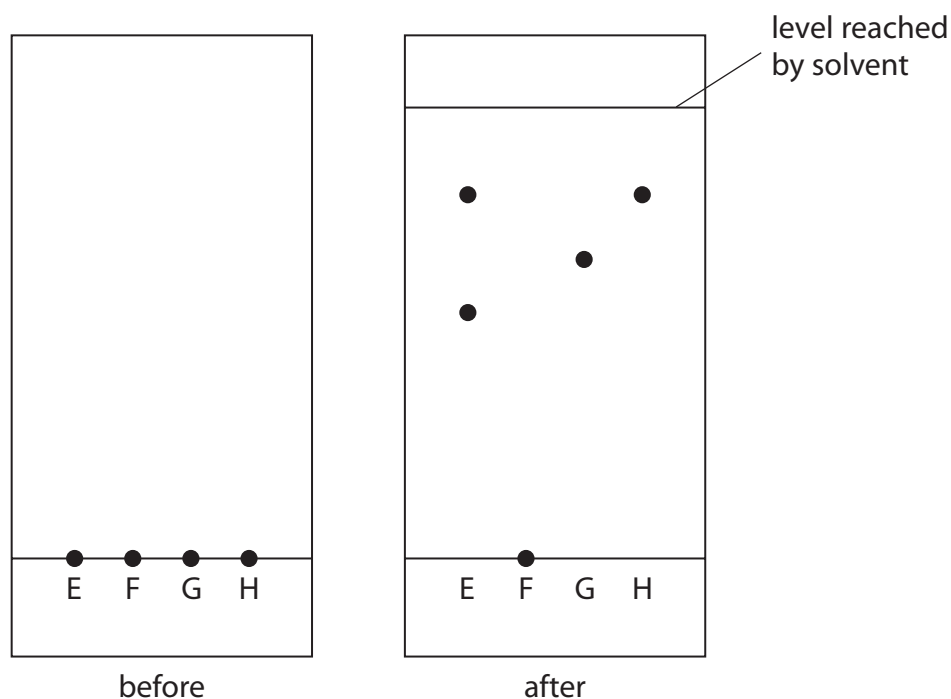
$$2017.6 \div 100 = 20.176 \\ = 20.2$$

relative atomic mass = 20.2



- 11 A student uses paper chromatography in an experiment to separate the dyes in four different food colourings, E, F, G and H.

The diagram shows the appearance of the paper before and after the experiment.



- (a) (i) Describe how the student should complete the experiment after putting a spot of each food colouring on the paper.

(3)

Pour some solvent into a beaker - chromatography tank.

Place the paper in the solvent so that the food colourings are above the level of the solvent.

Leave the paper until the solvent reaches the level shown in the diagram or has moved to near the top of the paper.

Take the paper out and leave to dry.

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(ii) Deduce the number of dyes in food colouring H.

(1)

1

(iii) Suggest why food colouring F does not move during the experiment.

(1)

F

It does not dissolve in the solvent.

(iv) Explain which two food colourings contain the dye that is likely to be the most soluble in the solvent.

(2)

E and H

They contain a dye that moved the furthest distance up the paper.
It is closest to the solvent front.
It has the greatest R_f value.

f

(b) Determine which food colouring contains a dye with R_f value closest to 0.67

Show your working.

(3)

Distance moved by solvent = 59-61mm
Distance moved by the dye = 37-41mm

Distance moved by the dye \div distance moved by the solvent = 0.67

The dye in food colouring G

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P 6 6 0 5 6 A 0 9 2 8

12 This question is about some of the Group 1 elements and their compounds.

(a) A teacher adds a small piece of lithium to water in a trough.

(i) Give three observations that are made when lithium reacts with water.

(3)

1 effervescence/bubbles/fizzing

2 moves

3 floats

(ii) After the reaction has finished, the teacher adds a few drops of universal indicator to the solution in the trough.

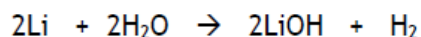
Explain the colour of the universal indicator after it is added to the solution.

(2)

The universal indicator turns purple/blue
Because OH⁻/hydroxide ions are present

(iii) Write a chemical equation for the reaction of lithium with water.

(2)



(b) A student does a flame test to see if a white solid contains sodium ions.

She cleans a platinum wire before using it for the flame test.

(i) Explain why the student needs to clean the platinum wire.

(2)

To remove any other ions/chemicals.

So that they do not interfere with/mask the colour of the flame

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(ii) Which of these is the colour of the flame if the solid contains sodium ions? (1)

- A green
- B lilac
- C red
- D yellow

(c) Potassium sulfate (K_2SO_4) is an ionic compound.

(i) Give the formula of each ion in potassium sulfate. (1)

potassium ion K^+ and SO_4^{2-} sulfate ion K^+ and SO_4^{2-}

(ii) The melting point of potassium sulfate is 1069°C .

Explain why potassium sulfate has a high melting point.

Refer to structure and bonding in your answer.

(4)

Potassium sulfate has a giant (ionic) structure /lattice.

Electrostatic attraction between oppositely charged ions.

Ionic bonds or forces / attractions between ions are strong.

A large amount of energy is needed to overcome the forces/break the bonds.

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13 This question is about chemical elements.

Use the Periodic Table to help you answer this question.

(a) (i) Identify the element with atomic number 5

(1)

Boron/B

(ii) Give the symbol of a metallic element in Period 3

(1)

Na /Mg /Al

(iii) Identify the element whose atoms contain 14 protons.

(1)

Silicon/Si

(iv) Identify the element whose atoms have the electronic configuration 2.5

(1)

Nitrogen/N

(v) Give the name of the compound formed between oxygen and the element with atomic number 13

(1)

Aluminium oxide

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(b) The position of an element in the Periodic Table can be used to predict its properties.

(i) Which group contains elements that are all unreactive?

(1)

- A Group 2
- B Group 5
- C Group 6
- D Group 0

(ii) Which of these is the least reactive element in Group 1?

(1)

- A caesium
- B lithium
- C potassium
- D sodium

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P 6 2 0 4 5 A 0 5 3 6

14 (a) The boxes list changes that may happen in a laboratory and the names of some changes.

Draw one straight line from each change to its correct name.

(3)

Change

Name of change

		•	diffusion
ice turns into water	•	•	dissolving
solid carbon dioxide turns directly into a gas	•	•	evaporation
a solute is stirred into a solvent	•	•	freezing
		•	melting
		•	sublimation

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15 Halon 1301 is a compound used in some fire extinguishers.

Halon 1301 has the percentage composition by mass of

C 8.05% Br 53.69% F 38.26%

(a) Show, by calculation, that the empirical formula of this compound is CBrF_3

(2)

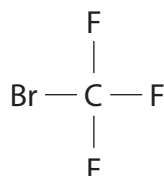
$$\text{C } 8.05 \div 12 \quad \text{OR} \quad 0.671$$

$$\text{Br } 53.69 \div 80 \quad \text{OR} \quad 0.671$$

$$\text{F } 38.26 \div 19 \quad \text{OR} \quad 2.01$$

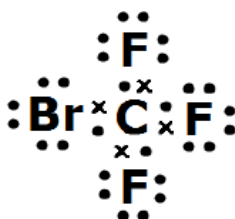
divide all numbers by 0.671
to obtain ratio 1 : 1 : 3)

(b) The diagram shows the displayed formula of a molecule of Halon 1301.



Draw a dot-and-cross diagram to show all the outer electrons in this molecule.

(2)



(c) The boiling point of Halon 1301 is -58°C .

Explain why Halon 1301 has a low boiling point.

(2)

The intermolecular forces (of attraction) are weak

Therefore little energy is required to overcome the forces



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