STUDENT:	TEACHER:

UNIT 1 — MAY EXAM

CHEMISTRY

Written test 1

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks	Suggested times (minutes)
A	20	20	20	20
B	10	10	50	50
				Total 70

Instructions

- Students are permitted to bring into the test room: pens, pencils, highlighters, erasers, sharpeners, rulers and a scientific calculator.
- Write your name in the space provided above.
- All written responses must be in English.
- Marks are awarded for correct setting out.
- Significant figures are considered as part of a correct numerical answer.

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Section A

Question 1.

Dimitri Mendeleev made a major contribution to the creation of a periodic table. He relied on the experimental data from a diverse range of sources.

He particularly used:

A. atomic number and chemical property data.

B. nuclear charge and physical property data.

C. relative atomic mass and chemical property data.

D. trends across periods and down groups.

Question 2.

Which of the two chemists contributed chemical research data that complemented or explained each others' results?

A. James Chadwick and Frederick Soddy

B. John Dalton and Neils Bohr

C. Ernest Rutherford and Marie Curie

D. John Dalton and Marie Curie

Question 3.

Which of the following could represent a positive metal ion?

	Atomic number	*Electron configuration*
A.	10	$1s^2 2s^2 2p^6$
B.	12	$1s^2 2s^2 2p^6$
C.	16	$1s^2 2s^2 2p^6 3s^2 3p^6$
D.	19	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

Question 4.

Two elements, Q and R, have the following electron configurations:

Q $1s^2 2s^2 2p^6 3s^2 3p^2$

R $1s^2 2s^2 2p^6 3s^2 3p^4$

The likely formula for the compound formed between Q and R is:

A. Q_2R_3

B. QR

C. QR_2

D. Q_2R

Question 5.

A certain neutral atom has the electron configuration $1s^2 2s^2 2p^5$. The electron configuration of the next *anion* in the same group in the periodic table would be:

A. $1s^2 2s^2 2p^4$

B. $1s^2 2s^2 2p^6$

C. $1s^2 2s^2 2p^6 3s^2 3p^5$

D. $1s^2 2s^2 2p^6 3s^2 3p^6$

Question 6.

Group 17 elements consist of fluorine, chlorine, bromine and iodine. The iodide ion with mass number 127 has 54 electrons. It follows that:

A. iodine has an atomic number of 53.

B. an iodide ion is a cation.

C. the iodide ion has 55 protons in its nucleus.

D. an iodine atom has 73 neutrons in its nucleus.

Question 7.

What is the percentage composition of propene?

A. C = 92.3% H = 7.7%

B. C = 81.2% H = 18.2%

C. C = 85.7% H = 14.3%

D. C = 82.8% H = 17.2%

Question 8.

In order to explain the malleable nature of metals, which of the following statements about metals is the most appropriate?

A. Metals have charged particles that are free to move.

B. Metals reflect light.

C. The forces between particles are strong.

D. The forces between particles readjust when the particles move.

Question 9.

An orbital is a region in space around a nucleus in which an electron is most likely to be found. Orbitals have a definite shape. What is the number of orbitals in the *d* sub-shell?

A. 2

B. 5

C. 10

D. 14

Question 10.

Which of the two trends listed increase as you go down the alkaline metal group?

A. Metallic character and ionic radius

B. Valency and metallic character

C. Ionic radius and reactivity

D. Non-metallic character and period number

Question 11.

Which of the following materials is an example of a network lattice exhibiting largely covalent bonding?

A. Copper

B. Graphite

C. Carbon dioxide

D. Potassium chloride

Question 12.

Which of the following is the third member of the alkene homologous series?

A. Ethene

B. Propene

C. But-1-ene

D. Propane

Question 13.

The likely type of bonding between the elements phosphorus and chlorine is:

A. covalent.

B. ionic.

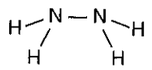
C. giant covalent lattice.

D. none of the above; they will not form compounds together.

Question 14.

The molecule that contains a non-polar covalent bond is:

A. 

B. 

C. H—Cl

D. O=C=O

Question 15.

In a thermosetting cross-linked polymer, the *major* force holding the chains together is:

A. covalent bonding.

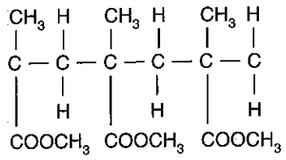
B. dispersion forces.

C. hydrogen bonding.

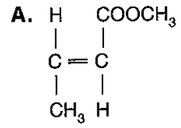
D. polar bonding.

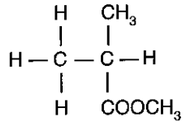
Question 16.

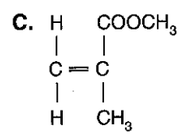
A polymer used in the manufacture of artificial eyes has the structure:

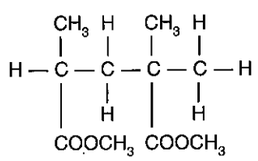


The monomer(s) for this polymer would be:

A. 

B. 

C. 

D. 

Question 17.

Which one of the following contains only unsaturated molecules in the same homologous series?

A. CH_4, C_2H_4, C_3H_6

B. C_4H_8, C_6H_{12}, $C_{10}H_{20}$

C. C_2H_6, C_3H_8, C_4H_{10}

D. C_2H_6, C_3H_8, C_4H_8

Question 18.

The melting temperatures of some common molecular substances are given below:

Substance	*Melting temperature (°C)*
Br_2	–7
Cl_2	–101
N_2O_4	–10
HBr	–85

Of the four substances listed, the one in which the forces *between* the molecules is greatest is:

A. Br_2

B. Cl_2

C. N_2O_4

D. HBr

Question 19.

The number of possible isomers for the hydrocarbon C_4H_9F is:

A. 2

B. 3

C. 4

D. 5

Question 20.

Polyvinyl alcohol, PVA, is produced from the monomer vinyl alcohol, $CH_2{=}CHOH$. Polyvinyl chloride is produced from the monomer vinyl chloride, $CH_2{=}CHCl$. In terms of polymerisation:

A. Both are formed by condensation from polymerisation and both are water-soluble.

B. Both are formed by addition polymerisation and both are not water-soluble.

C. PVC is formed by condensation polymerisation and is water-soluble.

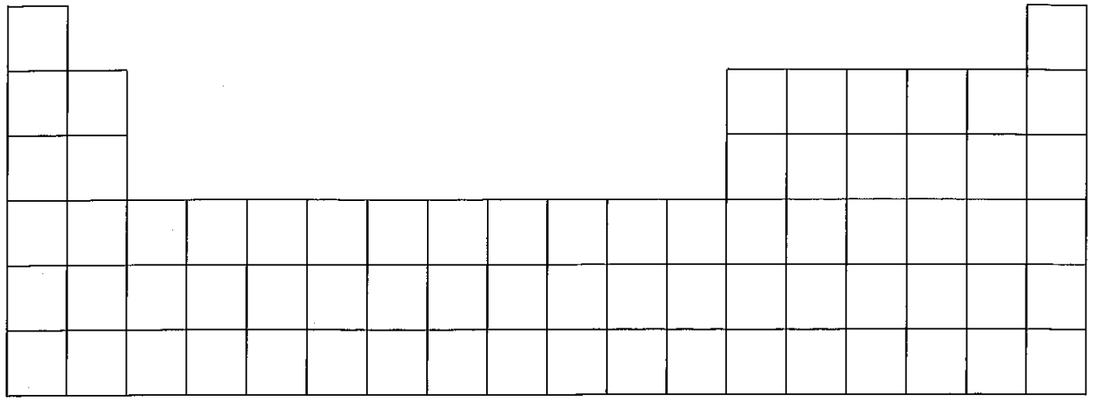
D. PVA is formed by addition polymerisation and is water-soluble.

End of Section A

Section B

Question 1.

Periodic table of the elements



Use the clues given for each element to place it in its correct position in the outline of the periodic table given above.

i. Element A is period 5, group 2.

ii. Atoms of element B have 21 protons in their nuclei.

iii. Element C is a noble gas (group 18) found in period 5.

iv. Element D is a non-metal with 1 electron in its outer shell.

v. Element E is in period 3 and forms ionic oxides with empirical formula EO.

vi. Atoms of element M form singly charged anions with electron configuration $1s^22s^22p^63s^23p^6$.

6 marks

Question 2.

The relative atomic mass of rubidium is 85.47. The relative isotopic masses of its two isotopes are 84.94 and 86.94.

a. Calculate the percentage abundance of the *heavier* isotope.

b. Sketch the mass spectrum of the element rubidium.

5 marks

Question 3.

a. Write the appropriate (systematic) chemical names for:

i. $CH_3CH_2(OH)CH_2CH_3$ _____

ii. $Fe(HCO_3)_2$ _____

iii. Na_3PO_4 _____

iv. $CH_3CHCHCH_3$ _____

4 marks

b. Write the appropriate chemical formulae for:

i. silver oxide _____

ii. ammonium sulfate _____

iii. aluminium carbonate _____

iv. 2-methylbut-1-ene _____

4 marks

Question 4.

a. Write the ground state electron configuration of:

i. the chemically stable ion of chlorine _____

ii. a neutral atom with 15 protons _____

iii. the period 4, group 3 element _____

b. Classify the following electron configurations as excited state or ground state:

i. $1s^2 2s^1$ _____

ii. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$ _____

5 marks

Question 5.

Many insects have become resistant to DDT because they produce an enzyme that can convert it to the relatively harmless compound DDE. Analysis of DDE shows that it consists of 52.9% carbon, 2.5% hydrogen and the rest chlorine.

a. Calculate the empirical formula of DDE.

_____

_____

_____

_____

_____

_____

3 marks

b. If the molar mass of DDE is about 320 g, determine the molecular formula of DDE.

_____

_____

_____

2 marks

Question 6.

Draw the three-dimensional valence structure of the following molecules, showing both bonding and non-bonding electron pairs. Classify each as polar or non-polar, showing all working.

(*Hint:* Use an electron dot structure to help you determine the valence structure.)

a. A molecule of carbon dioxide gas

b. A molecule of ammonia containing the elements nitrogen and hydrogen

c. A molecule of acetic acid (ethanoic acid), CH_3COOH

6 marks

Question 7.

Low-quality diamonds are used in mining machinery. Describe the type of bonding and crystal structure exhibited by diamond and relate this to the uses mentioned.

2 marks

Question 8.

Trinitrotoluene (TNT), $C_7H_5N_3O_6$, is a pale yellow crystalline solid used extensively as an explosive. Given the M(r) of TNT is 227 and Avogadro's constant = 6.0×10^{23}:

a. Calculate the mass of 2.50 mol of $C_7H_5N_3O_6$.

b. Calculate the mass of 6.0×10^{26} molecules of TNT.

c. Calculate the amount (mol) of O_2 molecules contained in 0.20 mol of TNT.

d. Calculate the mass of a single TNT molecule.

e. Calculate the mass of TNT that contains 12.0×10^{23} carbon atoms.

5 marks

Question 9.

The metal copper conducts electricity in both solid and liquid states, whereas the ionic compound sodium chloride conducts electricity in the liquid state only. Explain why this is observed by describing and comparing the type(s) of bonding exhibited in metals and ionic compounds.

4 marks

Question 10.

Nanotechnology tackles problems on a molecular level. It is often a component of surface chemistry. One common example is the waterproofing of fabric using graphene, which is a two-dimensional lattice of carbon nanotubes.

a. Explain the bonding between two carbon nanotubes.

b. Explain in terms of bonding why this example of nanotechnology provides an effective water proofing effect. Use a diagram to explain your answer.

4 marks

End of Section B

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ANSWER BOOK

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A	20	20	20	20
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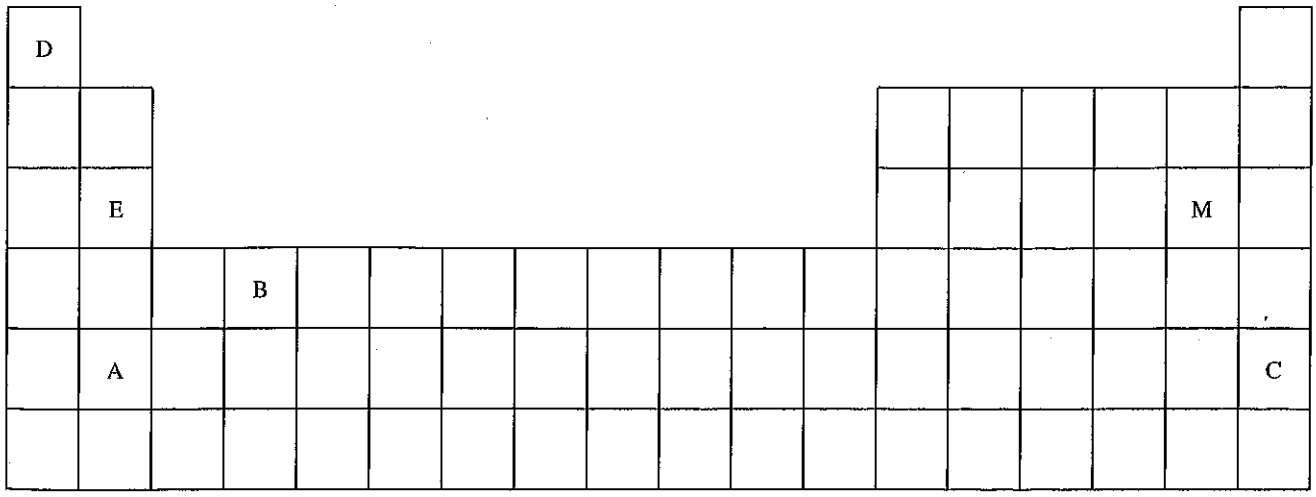
Section A

1. C	5. D	9. B	13. A	17. B
2. A	6. A	10. D	14. B	18. A
3. B	7. C	11. B	15. A	19. A
4. C	8. D	12. C	16. C	20. D

Section B

Question 1.



6 marks

Question 2.

a. $$85.47 = \frac{A\% \times 84.94 + B\% \times 86.94}{100}$$

$$8547 = A\% \times 84.94 + (100 - A\%) \times 86.94$$

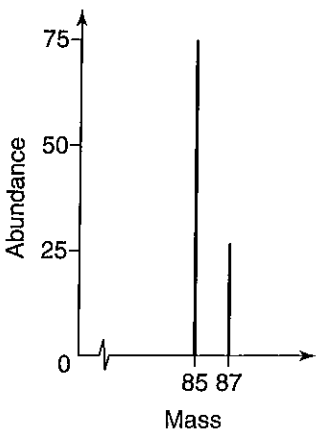
$$8547 - 8694 = -2A\%$$

$$A\% = 73.5$$

Correct answer = 26.5%

3 marks

b.



2 marks

Question 3.

a. i. $CH_3CH_2(OH)CH_2CH_3$ butan-2-ol

ii. $Fe(HCO_3)_2$ iron(II) hydrogen carbonate

iii. Na_3PO_4 sodium phosphate

iv. $CH_3CHCHCH_3$ but-2-ene

4 marks

b. i. silver oxide Ag_2O

ii. ammonium sulfate $(NH_4)_2SO_4$

iii. aluminium carbonate $Al_2(CO_3)_3$

iv. 2-methylbut-1-ene $CH_2{=}C(CH_3)CH_2CH_3$

4 marks

Question 4.

a. i. $1s^2 2s^2 2p^6 3s^2 3p^6$

ii. $1s^2 2s^2 2p^6 3s^2 3p^3$

iii. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$

b. i. Ground state

ii. Excited state

5 marks

Question 5.

a. Empirical formula of DDE: $C_7H_4Cl_2$

3 marks

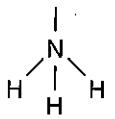
b. Molecular formula $C_{14}H_8Cl_4$

2 marks

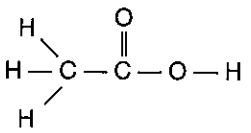
Question 6.

a. O═C═O

b.



c.



6 marks

Question 7

Diamond has strong non-polar infinite three-dimensional covalent bonding in a tetrahedral lattice. The strong bonds cause extreme hardness, hence it is used as an abrasive.

2 marks

Question 8.

a. Mass of 568 g

b. Mass of 227 kg

c. 0.6 mol

d. 3.77×10^{-22} g

e. 64.6 g

5 marks

Question 9.

Metal copper is a lattice of cations in a 'sea' of electrons. This metallic bonding allows the free electrons to act as a current. The infinite three-dimensional lattice of NaCl has strong ionic bonding and there are no free ions to conduct charge in the solid state.

4 marks

Question 10.

a. Hydrophobic bonding is weak and is associated with non-polar molecules having weak dispersion forces between them.

b. The high surface tension water molecules will not wet the graphene because of its low surface tension.

4 marks

End of Section B

Section A

Question 1.

Dimitri Mendeleev made a major contribution to the creation of a periodic table. He relied on the experimental data from a diverse range of sources.

He particularly used:

A. atomic number and chemical property data.

B. nuclear charge and physical property data.

C. relative atomic mass and chemical property data.

D. trends across periods and down groups.

Question 2.

Which of the two chemists contributed chemical research data that complemented or explained each others' results?

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B. John Dalton and Neils Bohr

C. Ernest Rutherford and Marie Curie

D. John Dalton and Marie Curie

Question 3.

Which of the following could represent a positive metal ion?

	Atomic number	*Electron configuration*	
A.	10	$1s^2 2s^2 2p^6$	$10p^+$ $10e^-$ = neutral
B.	12	$1s^2 2s^2 2p^6$	$12p^+$ $10e^-$ = 2^+ ion ←
C.	16	$1s^2 2s^2 2p^6 3s^2 3p^6$	$16p^+$ $18e^-$ = 2^- ion
D.	19	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$	$19p^+$ $19e^-$ = neutral

Question 4.

Two elements, Q and R, have the following electron configurations:

Q $1s^2 2s^2 2p^6 3s^2 3p^2$ 4 valence e^-, make 4 bonds } both

R $1s^2 2s^2 2p^6 3s^2 3p^4$ 6 valence e^-, make 2 bonds } non-metals

∴ covalent

The likely formula for the compound formed between Q and R is:

A. Q_2R_3

B. QR

R = Q = R

C. QR_2

D. Q_2R

Question 9.

The metal copper conducts electricity in both solid and liquid states, whereas the ionic compound sodium chloride conducts electricity in the liquid state only. Explain why this is observed by describing and comparing the type(s) of bonding exhibited in metals and ionic compounds.

see solutions - but 4 marks means 4 things to tell.

4 marks

Question 10.

Nanotechnology tackles problems on a molecular level. It is often a component of surface chemistry. One common example is the waterproofing of fabric using graphene, which is a two-dimensional lattice of carbon nanotubes.

a. Explain the bonding between two carbon nanotubes.

dispersion forces.

b. Explain in terms of bonding why this example of nanotechnology provides an effective water proofing effect. Use a diagram to explain your answer.

4 marks

End of Section B

Question 5.

A certain neutral atom has the electron configuration $1s^2 2s^2 2p^5$. The electron configuration of the next *anion* in the same group in the periodic table would be:

$1s^2 2s^2 2p^5$ = Fluorine next in same group is Cl = $1s^2 2s^2 2p^6 3s^2 3p^5$ becomes the Cl^- anion so add 1 e^-

A. $1s^2 2s^2 2p^4$

B. $1s^2 2s^2 2p^6$

C. $1s^2 2s^2 2p^6 3s^2 3p^5$

(D.) $1s^2 2s^2 2p^6 3s^2 3p^6$

Question 6.

Group 17 elements consist of fluorine, chlorine, bromine and iodine. The iodide ion with mass number 127 has 54 electrons. It follows that:

Halogens make 1^- anions 54 e^- in the ion means 53 p^+ in the atom.

(A.) iodine has an atomic number of 53.

B. an iodide ion is a cation.

C. the iodide ion has 55 protons in its nucleus.

D. an iodine atom has 73 neutrons in its nucleus.

Question 7.

What is the percentage composition of propene?

Propene = C_3H_6

1 mole weighs: $3 \times 12 + 6 \times 1 = 42g$

$C\% = \frac{3 \times 12g}{42g} \times 100 = 85.7\%$

A. C = 92.3% H = 7.7%

B. C = 81.2% H = 18.2%

(C.) C = 85.7% H = 14.3%

D. C = 82.8% H = 17.2%

Question 8.

In order to explain the malleable nature of metals, which of the following statements about metals is the most appropriate?

see your notes

A. Metals have charged particles that are free to move.

B. Metals reflect light.

C. The forces between particles are strong.

(D.) The forces between particles readjust when the particles move.

Question 9.

An orbital is a region in space around a nucleus in which an electron is most likely to be found. Orbitals have a definite shape. What is the number of orbitals in the *d* sub-shell?

dont mind too much

A. 2

(B.) 5

C. 10

D. 14

Question 10.

Which of the two trends listed increase as you go down the alkaline metal group?

A. Metallic character and ionic radius

B. Valency and metallic character

C. Ionic radius and reactivity

D. Non-metallic character and period number

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Which of the following materials is an example of a network lattice exhibiting largely covalent bonding?

A. Copper

See notes

B. Graphite

C. Carbon dioxide

D. Potassium chloride

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Which of the following is the third member of the alkene homologous series?

A. Ethene

no methene.

B. Propene

C. But-1-ene

D. Propane

Question 13.

The likely type of bonding between the elements phosphorus and chlorine is:

A. covalent.

Both non-metals
∴ covalent.

B. ionic.

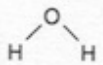
C. giant covalent lattice.

D. none of the above; they will not form compounds together.

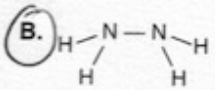
Question 14.

The molecule that contains a non-polar covalent bond is:

A.



B.



The N—N bond non-polar.

C. H—Cl

D. O—C—O

Question 15.

In a thermosetting cross-linked polymer, the *major* force holding the chains together is:

A. covalent bonding. see notes.

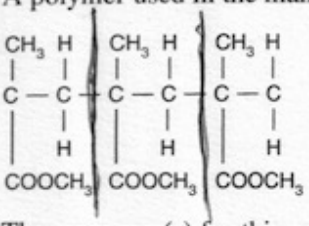
B. dispersion forces.

C. hydrogen bonding.

D. polar bonding.

Question 16.

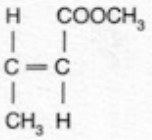
A polymer used in the manufacture of artificial eyes has the structure:

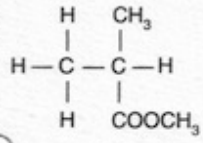


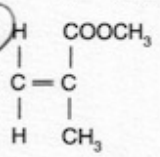
look for repeating pattern

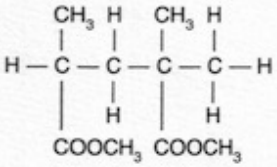
then put in a double bond.

The monomer(s) for this polymer would be:

A.


B.


C.


D.


Question 17.

Which one of the following contains only unsaturated molecules in the same homologous series?

A. CH_4, C_2H_4, C_3H_6

B. C_4H_8, C_6H_{12}, $C_{10}H_{20}$

C. C_2H_6, C_3H_8, C_4H_{10}

D. C_2H_6, C_3H_8, C_4H_8

unsaturated = double bond

$= C_n H_{2n}$

Question 18.

The melting temperatures of some common molecular substances are given below:

Substance	*Melting temperature (°C)*
Br_2	–7
Cl_2	–101
N_2O_4	–10
HBr	–85

Of the four substances listed, the one in which the forces *between* the molecules is greatest is:

A. Br_2

B. Cl_2

C. N_2O_4

D. HBr

Strong Intermolecular forces means a higher M.P

Question 19.

The number of possible isomers for the hydrocarbon C_4H_9F is:

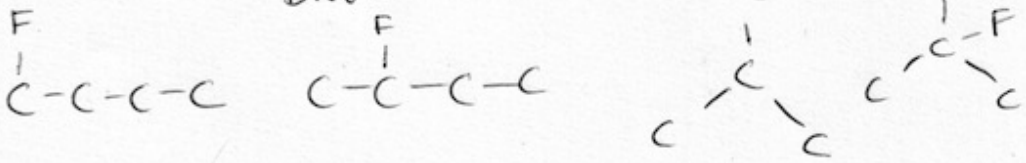
A. 2

B. 3

C. 4

D. 5

Draw them.



Question 20.

Polyvinyl alcohol, PVA, is produced from the monomer vinyl alcohol, $CH_2{=}CHOH$. Polyvinyl chloride is produced from the monomer vinyl chloride, $CH_2{=}CHCl$. In terms of polymerisation:

A. Both are formed by condensation from polymerisation and both are water-soluble.

B. Both are formed by addition polymerisation and both are not water-soluble.

C. PVC is formed by condensation polymerisation and is water-soluble.

D. PVA is formed by addition polymerisation and is water-soluble.

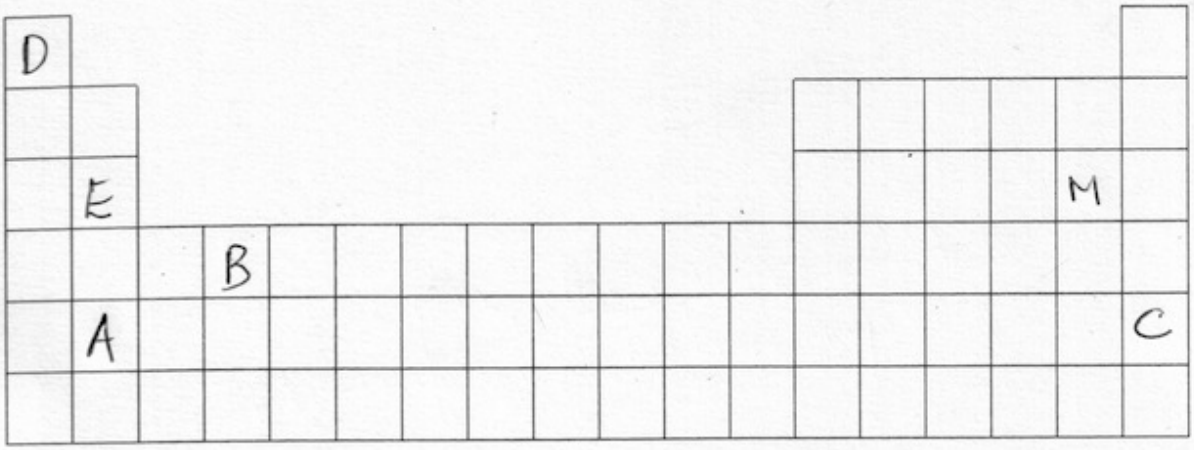
- O-H allows for H-bonding so it can dissolve
- C=C double bond for addition polymerisation

End of Section A

Section B

Question 1.

Periodic table of the elements



Use the clues given for each element to place it in its correct position in the outline of the periodic table given above.

i. Element A is period 5, group 2.
ii. Atoms of element B have 21 protons in their nuclei.
iii. Element C is a noble gas (group 18) found in period 5.
iv. Element D is a non-metal with 1 electron in its outer shell.
v. Element E is in period 3 and forms ionic oxides with empirical formula EO.
vi. Atoms of element M form singly charged anions with electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6$.

↑ Halogens.

6 marks

Question 2.

The relative atomic mass of rubidium is 85.47. The relative isotopic masses of its two isotopes are 84.94 and 86.94.

a. Calculate the percentage abundance of the *heavier* isotope.

$$A_r = \frac{x \times I_1 + (100-x) \times I_1}{100}$$

$$85.47 = \frac{x \times 84.94 + (100-x) \times 86.94}{100}$$

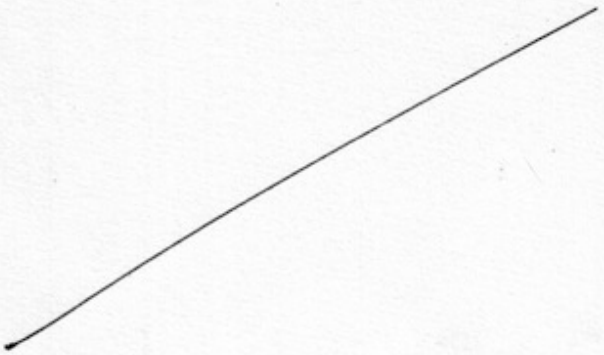
$$8547 = x\,84.94 + 8694 - 86.94x$$

$$8547 - 8694 = -2x$$

$x = 73.5\%$ for isotope weighing 84.94

∴ heavier isotope abundance = 26.5%.

b. Sketch the mass spectrum of the element rubidium.

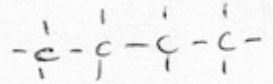


5 marks

Question 3.

a. Write the appropriate (systematic) chemical names for: DRAW THEM!

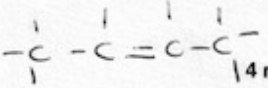
i. $CH_3CH_2(OH)CH_2CH_3$ butan-2-ol



ii. $Fe(HCO_3)_2$ iron (II) hydrogen carbonate ionic

iii. Na_3PO_4 Sodium phosphate ionic

iv. $CH_3CHCHCH_3$ but-2-ene



4 marks

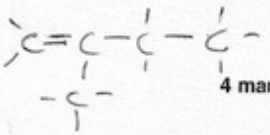
b. Write the appropriate chemical formulae for:

i. silver oxide Ag_2O ionic

ii. ammonium sulfate $(NH_4)_2SO_4$ ionic

iii. aluminium carbonate $Al_2(CO_3)_3$ ionic

iv. 2-methylbut-1-ene $CH_2=C(CH_3)CH_2CH_3$



4 marks

Question 4.

a. Write the ground state electron configuration of: Cl^{17} → ion $18e^-$

i. the chemically stable ion of chlorine $1s^2 2s^2 2p^6 3s^2 3p^6$

ii. a neutral atom with 15 protons (neutral $p^+ = e^-$) $1s^2 2s^2 2p^6 3s^2 3p^3$

iii. the period 4, group 3 element $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

↑ e^- in 4 shell

b. Classify the following electron configurations as excited state or ground state:

i. $1s^2 2s^1$ Ground

ii. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$ Excited.

↑ d filled before 4s!

5 marks

Question 5.

Many insects have become resistant to DDT because they produce an enzyme that can convert it to the relatively harmless compound DDE. Analysis of DDE shows that it consists of 52.9% carbon, 2.5% hydrogen and the rest chlorine.

a. Calculate the empirical formula of DDE.

$52.9 + 2.5 = 55.4\%$
$100\% - 55.4\% = 44.6\%$ Cl

	C	H	Cl
(m)	52.9	2.5	44.6
(n)	$= \frac{52.9}{12}$	$= \frac{2.5}{1}$	$= \frac{44.6}{35.45}$
	$= \frac{4.4}{1.3}$	$= \frac{2.5}{1.3}$	$= \frac{1.3}{1.3}$
	$= 3.4$	$= 2$	1
double	$= 7$	4	2

$\therefore C_7H_4Cl_2$

3 marks

b. If the molar mass of DDE is about 320 g, determine the molecular formula of DDE.

Empirical formulae $M = (7 \times 12) + (4 \times 1) + (2 \times 35.45)$
$= 84 + 4 + 70.9 = 158.9$ g/mol

$\therefore 320 / 158.9 = 2$ $\therefore$ double EF

$\Rightarrow C_{14}H_8Cl_4$

2 marks

Question 6.

Draw the three-dimensional valence structure of the following molecules, showing both bonding and non-bonding electron pairs. Classify each as polar or non-polar, showing all working.

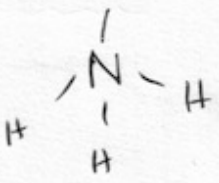
(*Hint:* Use an electron dot structure to help you determine the valence structure.)

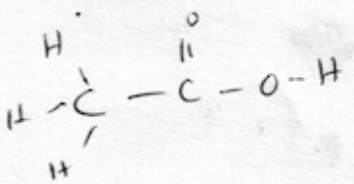
a. A molecule of carbon dioxide gas

b. A molecule of ammonia containing the elements nitrogen and hydrogen

c. A molecule of acetic acid (ethanoic acid), CH_3COOH

a. O=C=O (C 4 bonds ← central atom; O 2 bonds ← put either side) NON POLAR

b.  (N 3 bonds ← central atom; H 1 bond ← put around) POLAR

c.  POLAR.

6 marks

Question 7.

Low-quality diamonds are used in mining machinery. Describe the type of bonding and crystal structure exhibited by diamond and relate this to the uses mentioned.

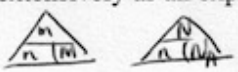
made of C–C covalent bonds in all dimensions. Arranged in a lattice. Covalent bonds very strong, therefore diamonds are hard.

2 marks

atleast 2 points need to be made.

Question 8.

Trinitrotoluene (TNT), $C_7H_5N_3O_6$, is a pale yellow crystalline solid used extensively as an explosive. Given the M(r) of TNT is 227 and Avogadro's constant = 6.0×10^{23}:



a. Calculate the mass of 2.50 mol of $C_7H_5N_3O_6$.

$m = n \times M$

$= 2.5 \times 227 = 568\,g$

$M = (7\times12) + (5\times1) + (3\times14) + (6\times16)$

$= 84 + 5 + 42 + 96$

$= 227\,g/mol$

b. Calculate the mass of 6.0×10^{26} molecules of TNT.

$n = N/N_A = \frac{6.0\times10^{26}}{6.0\times10^{23}} =$

$m = n \times M = \times 227 =$

$= 227\,kg$

c. Calculate the amount (mol) of O_2 molecules contained in 0.20 mol of TNT.

3 lots of "O_2's" in TNT ($C_7H_5N_3O_6$)

$\therefore 0.2 \times 3 = 0.6$ mol

d. Calculate the mass of a single TNT molecule.

$n = N/N_A = 1/6.02\times10^{23} = 1.66\times10^{-24}$

$m = n \times M = 1.66\times10^{-24} \times 227 = 3.77\times10^{-22}\,g$

e. Calculate the mass of TNT that contains 12.0×10^{23} carbon atoms.

12.0×10^{23} = 2 mol C atoms, but TNT has 7 mol of C atoms so if you multiply mass of TNT by scale factor of $\frac{2}{7} = 64.6\,g$.

5 marks