

STUDENT:

TEACHER:

CSE TEST – MAY 2009

YEAR 11 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	23
B	7	7	60	67
			Total 80	90

- Students are permitted to bring into the test room: pens, pencils, highlighters, erasers, sharpeners, rulers and a scientific calculator.
- Students are **NOT** permitted to bring into the test room: blank sheets of paper and/or white out liquid/tape.

Materials

- Question and answer book of 15 pages and a copy of the Periodic Table.
- Answer sheet for multiple choice questions.

Instructions

- Write your **name** in the space provided above **and** on the multiple choice answer sheet.
- All written responses must be in English.

At the end of the test

- Place the answer sheet for multiple choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or other electronic communication devices into the test room.

SECTION A – Multiple choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0. Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

The $^{32}_{16}\text{S}^{2-}$ and $^{27}_{13}\text{Al}^{3+}$ ions **both** have

- A. the same number of electrons.
- B. the same number of electron shells.
- C. the electron configuration of an inert gas.
- D. the same electron configuration as an atom of argon.

Question 2

The electron configuration $1s^2 2s^2 2p^4 3s^2 3p^6 3d^5 4s^2$ is **most likely** to be that of

- A. an atom of the element vanadium in the ground state.
- B. a negative ion of titanium in an excited state.
- C. a positive ion of chromium in the ground state.
- D. an atom of the element vanadium in an excited state.

Question 3

Which one of the following elements is most likely to have been discovered first?

- A. Sodium
- B. Iron
- C. Gold
- D. Fluorine

Question 4

The most likely formula for the compound formed from an element X in Group 2 and an element Y in Group 5 is

- A. X_2Y_3 .
- B. X_2Y_5 .
- C. X_5Y_2 .
- D. X_3Y_2 .

Question 7

Methanol, CH_3OH , and ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, are the first two members of the alkanol homologous series.

- a. What is the relationship between successive members of a homologous series?

 1 mark

- b. Predict the name and semi-structural formula of the third member of this homologous series

 2 marks

Total 3 marks

END OF SECTION B

END OF QUESTION BOOK

- b. Suggest a formula for the reagent X.

1 mark

- d. Give the name of compound Y and draw its structural formula.

2 marks

- e. Give the name of compound Z and draw its structural formula.

2 marks

- e. When but-2-ene burns in excess air the products are carbon dioxide and water. Write a balanced equation for this reaction.

2 marks

- f. For each of the four compounds mentioned above, Y, Z, but-2-ene and 2-bromobutane, state whether they are saturated or unsaturated and explain what is meant by these two terms.

Y:

Z:

But-2-ene:

2-bromobutane:

Saturated / unsaturated:

3 marks

Total 11 marks

Question 5

The number of nitrogen atoms in 0.25 mol of ammonium nitrate (NH_4NO_3) is

- A. 1.5×10^{23}
 B. 3.0×10^{23}
 C. 4.5×10^{23}
 D. 6.0×10^{23}

Question 6

Which one of the following compounds is likely to have the **lowest** solubility in water?

- A. Ethane, C_2H_6
 B. Sodium Chloride, NaCl
 C. Ethanol, $\text{C}_2\text{H}_5\text{OH}$
 D. Hydrogen Chloride, HCl

Question 7

Which of the following pairs of compounds are **not** isomers?

- A. $\text{CH}_3\text{OC}_2\text{H}_5$ and $\text{C}_3\text{H}_7\text{OH}$
 B. $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 C. $\text{CH}_2=\text{CHCH}_2\text{CH}_3$ and $\text{CH}_2=\text{C}(\text{CH}_3)_2$
 D. $\text{CH}_2\text{Cl}(\text{CH}_2)_4\text{CH}_3$ and $\text{CH}_3\text{CHCl}(\text{CH}_2)_2\text{CH}_3$

Question 8

What mass of oxygen gas, O_2 , has the same number of atoms as 12.0 g of carbon?

- A. 8.0 g.
 B. 12.0 g.
 C. 16.0 g.
 D. 32.0 g.

Question 9

3.00 mol of phosphorus molecules, P_4 , has a mass of

- A. 31.0 g.
 B. 93.0 g.
 C. 124 g.
 D. 372 g.

Question 10

Which one of the following contains the smallest number of mole of hydrogen atoms?

- A. 3.0 g of C_2H_6
 B. 2.0 g of C_3H_8
 C. 0.4 g of H_2
 D. 1.6 g of CH_4

Question 11

Galactose has the empirical formula CH_2O and a molar mass of 180 g mol^{-1} . The molecular formula of galactose is

- A. CH_2O
 B. $\text{C}_2\text{H}_4\text{O}_2$
 C. $\text{C}_4\text{H}_8\text{O}_4$
 D. $\text{C}_6\text{H}_{12}\text{O}_6$

Question 12

Which one of the following alternatives contains species that are isotopes?

- A. $^{12}_6\text{C}$, $^{13}_6\text{C}$, $^{14}_6\text{C}$
 B. $^{40}_{18}\text{Ar}$, $^{40}_{19}\text{K}$, $^{40}_{20}\text{Ca}$
 C. $^{23}_{11}\text{Na}^+$, $^{24}_{12}\text{Mg}^{2+}$, $^{27}_{13}\text{Al}^{3+}$
 D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$, $\text{CH}_3\text{CH}(\text{Cl})\text{CH}_2\text{CH}_3$, $(\text{CH}_3)_2\text{CHCH}_2\text{Cl}$

Question 13

Metal Q forms a positive ion. In which of the following compounds is Q present as the Q^{3+} ion?

- A. $\text{Q}(\text{NO}_3)_2$
 B. $\text{Q}_2(\text{SO}_4)_3$
 C. QCO_3
 D. Q_3N_2

Question 14

Many compounds can be formed from two different elements. Which one of the following pairs of elements reacts to form a compound with ionic bonding?

- A. Magnesium and sulfur
 B. Fluorine and iodine
 C. Iron and chromium
 D. Hydrogen and oxygen

- b. State **two** properties of diamond and **two** properties of graphite, and explain how these properties are determined by their chemical bonding.

Diamond

Property 1

Property 2

Explanation

2 marks

Graphite

Property 1

Property 2

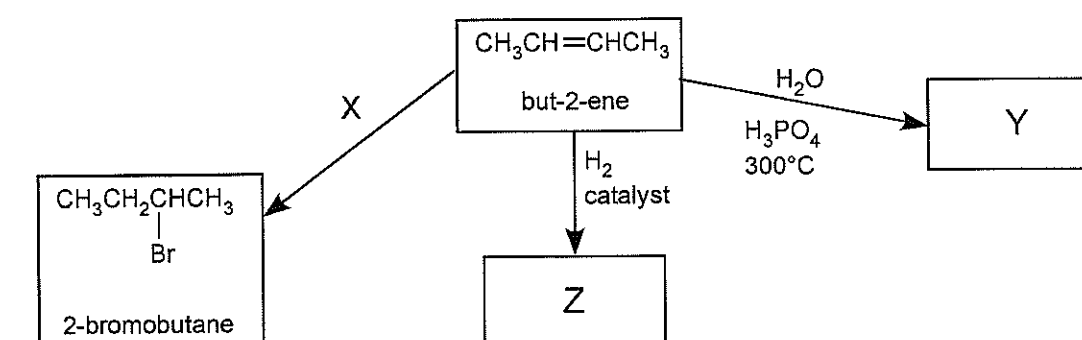
Explanation

2 marks

Total 8 marks

Question 6

Some reactions of the alkene, but-2-ene, are shown in the flow chart below.



- a. What name is given to the type of reactions shown by but-2-ene?

1 mark

- e. If the student had not washed the remaining zinc how would this have affected the ratio $n(I) : n(Zn)$?

2 marks

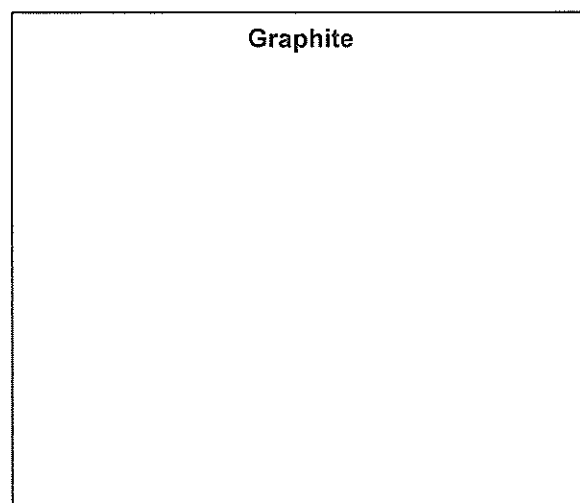
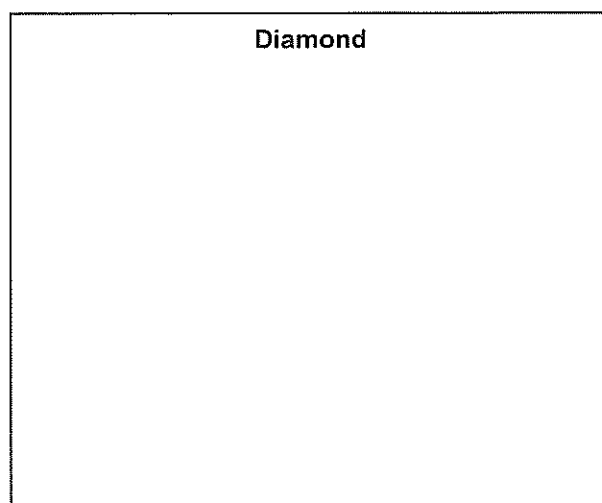
Total 8 marks**Question 5**

Diamond and graphite are allotropes of carbon and some of their properties are summarised in the table below.

Substance	State at SLC	Electrical conductor
Diamond	Very hard, high melting point solid	No
Graphite	Soft, high melting point solid used as lubricant	Yes

- a. Draw labelled diagrams of the diamond and graphite structures which show the arrangement of carbon atoms in the covalent lattice and the types of chemical bonds present.

Include 12 carbon atoms in each diagram.



4 marks

Question 15

Which one of the following processes causes iron to become malleable rather than brittle?

- A. Rapid cooling of the hot metal.
- B. Slow cooling of the hot metal.
- C. Work hardening by hammering or bending.
- D. Adding a large percentage of carbon when producing the alloy, steel.

Question 16

In which one of the following alternatives are all the compounds alkenes?

- A. C_2H_4 , C_3H_6 , C_4H_8
- B. C_2H_6 , C_3H_8 , C_4H_{10}
- C. C_2H_2 , C_2H_4 , C_2H_6
- D. C_3H_6 , C_4H_{10} , C_6H_{12}

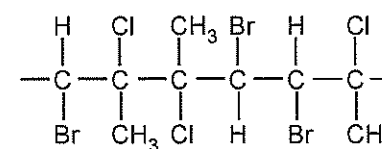
Question 17

The most appropriate name for the compound $\begin{array}{ccccccc} CH_3 & -CH- & CH_2- & CH- & CH_3 \\ & | & & | \\ & CH_2-CH_3 & & CH_3 \end{array}$ is

- A. 2-ethyl-4-methylpentane.
- B. 2,4-dimethylhexane.
- C. 3,5-dimethylhexane.
- D. 2,4-dimethylhexene.

Question 18

A section of a polymer is shown below



The monomer used to make this polymer is

- A. $\begin{array}{cc} Br & CH_3 \\ & \diagdown \quad \diagup \\ & C=C \\ & \diagup \quad \diagdown \\ H & Cl \end{array}$
- B. $\begin{array}{cc} Br & CH_3 \\ & \diagdown \quad \diagup \\ & C=C \\ & \diagup \quad \diagdown \\ Cl & H \end{array}$
- C. $\begin{array}{cc} CH_3 & Cl \\ & \diagdown \quad \diagup \\ & C=C \\ & \diagup \quad \diagdown \\ H & Br \end{array}$
- D. $\begin{array}{cc} Br & Cl \\ & \diagdown \quad \diagup \\ & C=C \\ & \diagup \quad \diagdown \\ CH_3 & H \end{array}$

Question 19

Which of the following liquids would be expected to have the **highest** surface energy?

- A. Mercury, Hg
- B. Octane, C₈H₁₈
- C. Water, H₂O
- D. Dichloromethane, CH₂Cl₂

Question 20

Which of the following is **not** a common property of nanoparticles?

- A. A high surface area to volume ratio.
- B. The ability to act as catalysts.
- C. Particle size of about 10³ nm.
- D. Behaviour which differs from that of large particles of the same substance.

END OF SECTION A

- c. Give one more property for each of calcium, bromine and calcium bromide that is consistent with the bonding you have described.

Calcium:

Bromine:

Calcium bromide:

3 marks

Total 9 marks

Question 4

A student determines the empirical formula of zinc iodide by the following method. 3.694 g of iodine, I₂, and 2.573 g of zinc were placed in a flask with a small amount of ethanol. The mixture was gently heated until the reaction commenced. When all the iodine colour had disappeared the flask was cooled. The ethanol was carefully poured from the remaining zinc which was then washed with water and dried. 1.628 g of zinc remained.

- a. Calculate the amount, in moles, of iodine atoms reacted

1 mark

- b. Calculate the mass of zinc reacted

1 mark

- c. Determine the empirical formula of zinc iodide.

3 marks

- d. Why was the remaining zinc washed with water before being dried?

1 mark

Question 3

The element calcium is a solid at room temperature. In comparison the element bromine has a higher relative atomic mass than calcium but at room temperature it is a liquid, with a low boiling temperature. Some information about calcium and bromine is given below. When calcium reacts with bromine, calcium bromide, CaBr_2 , is formed. This compound is a solid at room temperature which has high melting and boiling temperatures.

	Relative atomic mass	Melting temperature ($^{\circ}\text{C}$)	Boiling temperature ($^{\circ}\text{C}$)
Calcium	40.1	838	1490
Bromine	79.9	-7.0	58

- a. Describe the bonding that is present in these two elements to account for the differences in their melting and boiling temperatures.

Calcium:

2 marks

Bromine:

2 marks

- b. Describe how the electron arrangements of calcium and bromine have changed when calcium bromide is formed.

2 marks

SECTION B – Short answer questions

Instructions for Section B

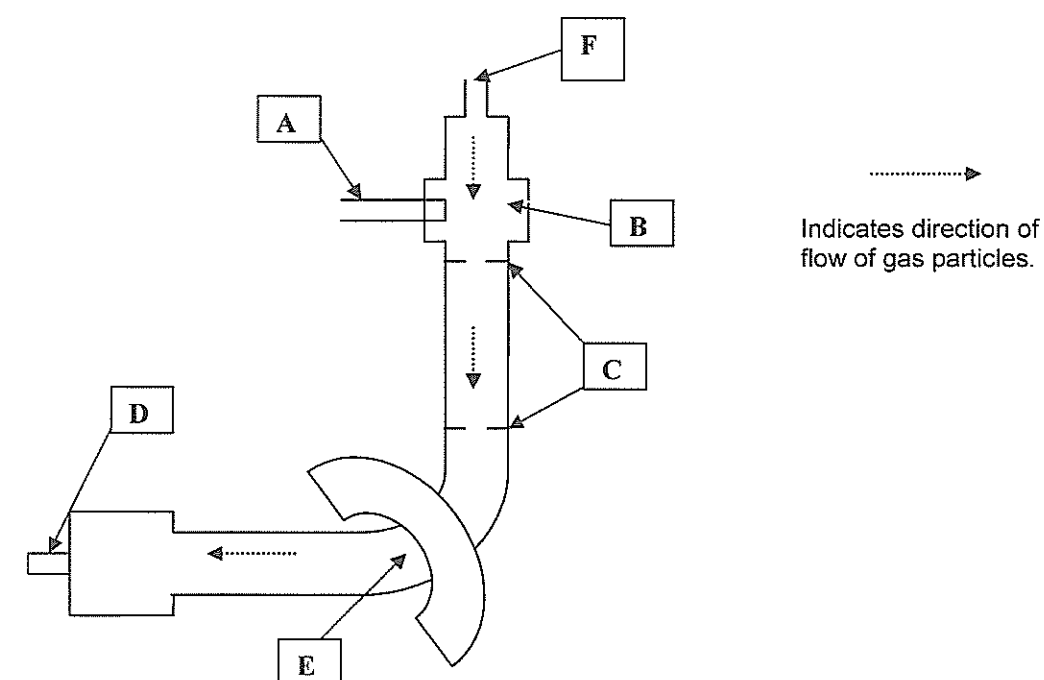
Answer **all** questions in the spaces provided.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$

Question 1

a.



The diagram shows a simplified cross section of a **mass spectrometer**.

After each statement below, write the letter indicating the place as shown on the diagram where each process occurs.

- | | | |
|------|--|-------|
| i. | Sample gas at low pressure | _____ |
| ii. | Electric field separates particles by charge | _____ |
| iii. | Ions are collected | _____ |
| iv. | Filament supplies bombarding electrons | _____ |
| v. | Element sample is injected. | _____ |
| vi. | Magnetic field separates particles by mass | _____ |

3 marks

- b. A mass spectrum of bromine, Br₂, has five peaks corresponding to particles with the following relative masses.

Particle	Relative mass
1.	78.918
2.	80.916
3.	157.836
4.	159.834
5.	161.832

- i Write the symbols, showing mass number and atomic number, for the two isotopes of bromine.

_____ and _____

1 mark

- ii Explain the presence of five peaks in the mass spectrum of bromine.

3 marks

- c. Calculate the percentage abundance of each of the naturally occurring isotopes of bromine.

State your answer to three significant figures.

3 marks

Total 10 marks

Question 2

Elements A and B have the ground state electron configurations shown below:



- | | A | B | |
|---|--------------------------|--------------------------|---------|
| a. How many full electron shells does each element have? | _____ | _____ | 2 marks |
| b. In which Period does each element occur? | _____ | _____ | 2 marks |
| c. In which Group does each element occur? | _____ | _____ | 2 marks |
| d. Which element has the higher electronegativity?
Tick appropriate box ☐ | ☐ | ☐ | 1 mark |
| e. Which element has the larger radius?
Tick appropriate box ☐ | ☐ | ☐ | 1 mark |
| f. Which element has the higher ionisation energy?
Tick appropriate box ☐ | ☐ | ☐ | 1 mark |
| g. State two other properties exhibited by each element. | | | |

Element A

1 mark

Element B

1 mark

Total 11 marks

Year 11 Chemistry - Periodic table of the elements

1 H 1.0 Hydrogen	2 He 4.0 Helium										
3 Li 6.9 Lithium	4 Be 9.0 Beryllium										
11 Na 23.0 Sodium	12 Mg 24.3 Magnesium	13 Al 27.0 Aluminium	14 Si 28.1 Silicon	15 P 31.0 Phosphorus	16 S 32.1 Sulphur	17 Cl 35.5 Chlorine	18 Ar 39.9 Argon	36 Kr 83.8 Krypton	54 Xe 131.3 Xenon	86 Rn (222) Radon	118 Uuo
19 K 39.1 Potassium	20 Ca 40.1 Calcium	21 Sc 44.9 Scandium	22 Ti 47.9 Titanium	23 V 50.9 Vanadium	24 Cr 52.0 Chromium	25 Mn 54.9 Manganese	26 Fe 55.9 Iron	27 Co 58.9 Cobalt	28 Ni 58.7 Nickel	29 Cu 63.6 Copper	30 Zn 65.4 Zinc
37 Rb 85.5 Rubidium	38 Sr 87.6 Strontium	39 Y 88.9 Yttrium	40 Zr 91.2 Zirconium	41 Nb 92.9 Niobium	42 Mo 95.9 Molybdenum	43 Tc 98.1 Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57 La 138.9 Lanthanum	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury
87 Fr (223) Francium	88 Ra (226) Radium	89 Ac (227) Actinium	104 Rf (261) Rutherfordium	105 Db (262) Dubnium	106 Sg (266) Seaborgium	107 Bh (264) Bohrium	108 Hs (277) Hassium	109 Mt (268) Meitnerium	110 Ds (271) Darmstadtium	111 Rg (272) Roentgenium	112 Uub
63 Eu 152.0 Europium	64 Gd 157.2 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth
90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np (237.0) Neptunium	94 Pu (244) Plutonium	95 Am (243) Americium	96 Cm (247) Curium	97 Bk (247) Berkelium	98 Cf (251) Californium	99 Es (252) Einsteinium	100 Fm (257) Fermium	101 Md (258) Mendelevium
											102 No (259) Nobelium
											103 Lr (262) Lawrencium

CENTRE FOR STRATEGIC EDUCATION – YEAR 11 CHEMISTRY 2009
Written Test 1 – May

ANSWER SHEET

STUDENT NAME:

INSTRUCTIONS:

Use a **PENCIL** for **ALL** entries. For each question, shade the box which indicates your answer.
All answers must be completed like **THIS** example:
Marks will not be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer – **DO NOT** cross it out.

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

YEAR 11 CHEMISTRY

Written test 1

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DATA Book

Directions to students

This data sheet is for your reference.

You may keep this data book.