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About O Level

(PURE) CHEMISTRY

(TOPICAL)

About Thinking Process

When solving problems, we first analyse the questions and then gather relevant information until we are able to determine the answers. But for presentation reason, we need to organise, rearrange and then present ONLY the required workings and solutions.

Thinking process reveals the extra but relevant information which is not required as part of the solutions.

About MCQ with HELPs

Explanations are given so that students know exactly why the answer is the right one.

period	2012 to 2022
contents	June & November, Paper 1 & 2, Worked Solutions
form	Topic By Topic
compiled for	O Levels
special features	Thinking Process, MCQ with HELPs

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Topic 3 *Bonding: The Structure Of Matter*

MCQ Section

1. Four substances have the following electrical properties.

substance	property
W	does not conduct under any conditions
X	conducts only in aqueous solution
Y	conducts in both the molten and solid states
Z	conducts in both the molten and aqueous states

What are these four substances?

	W	X	Y	Z
A	HC*l*	S	NaC*l*	Pb
B	Pb	HC*l*	NaC*l*	S
C	S	HC*l*	Pb	NaC*l*
D	S	NaC*l*	HC*l*	Pb

[J12/P1/Q9]

2. Which substance will conduct electricity without being chemically changed?

A sodium chloride solution
B solid iron
C solid sodium chloride
D solid sulfur

[J12/P1/Q15]

3. Two particles have the compositions shown.

	electrons	neutrons	protons
X	4	6	5
Y	6	4	5

Which statement about X and Y is correct?

A They are both positively charged.
B They are particles of the same element.
C They have the same mass number.
D They have the same number of nucleons.

[N12/P1/Q4]

4. Which of the following is **not** a mixture?

A ethanol
B petrol
C steel
D tap water

[N12/P1/Q4]

5. Carbon and silicon are both in Group IV of the Periodic Table, but at room temperature CO_2 is a gas whereas SiO_2 is a solid.
Which statement explains this?

A Covalent bonding is weaker in CO_2.
B Covalent bonds in CO_2 are double bonds and in SiO_2 the covalent bonds are single bonds.
C CO_2 is a covalent compound and SiO_2 is ionic.
D CO_2 is a simple covalent molecule and SiO_2 is a macromolecule.

[N12/P1/Q7]

6. Which substance has metallic bonding?

	conducts electricity		state of substance formed on reaction with oxygen
	when solid	when liquid	
A	✓	✓	solid
B	✓	✓	gas
C	×	✓	no reaction
D	×	×	solid

[N12/P1/Q10]

1. **C** Sulphur being a non metal will not conduct under any conditions. HC*l* can only conduct as a solution of it's ions. Lead being a metal will conduct in both molten and solid states. NaC*l* will conduct both in molten form and as an aqueous solution of it's ions.

2. **B** Iron, being a metal has a sea of delocalized electrons which can conduct electricity without chemically changing Iron.

3. **B** X and Y have the same proton number, therefore they are particles of the same element.
Option **A** is not correct as Y is not positively charged since it has more electrons then protons.
Options **C** & **D** are not correct as mass number of X = 5+6 = 11, and mass number of Y= 4 + 5 = 9. The number of neutrons of both particles is also different.

4. **A** Fact.

5. **D** Intermolecular forces are much weaker in a simple covalent molecule like CO_2 as compared to giant macromolecular structures like SiO_2. Thus CO_2 is a gas whereas SiO_2 is a solid at room temperature and pressure.

6. **A** A substance with metallic bonding will conduct in both solid and molten (liquid) forms and will form a solid on reaction with oxygen.

7. Naturally-occurring bromine has a relative atomic mass of 80 and consists entirely of two isotopes of relative atomic masses 79 and 81.

What can be deduced about naturally-occurring bromine from this information only?

A Bromine contains the two isotopes in equal proportions.

B Bromine has different oxidation states.

C Bromine isotopes have different numbers of protons.

D Bromine is radioactive.

[J13/P1/Q5]

8. Silicon carbide, SiC, has a structure similar to diamond. Boron nitride, BN, has a structure similar to graphite. Bronze is an alloy of copper and tin.

Which statements about SiC, BN and bronze are correct?

1 All are bonded covalently.

2 All except silicon carbide conduct electricity when solid.

3 All have high melting points.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

[J13/P1/Q6]

9. Sodium is in Group I of the Periodic Table.

When sodium combines with chlorine, what happens to each sodium atom?

A It gains one electron from one chlorine atom.

B It shares one electron with one chlorine atom.

C It transfers one electron to one chlorine atom.

D It transfers two electrons to one chlorine atom.

[J13/P1/Q8]

10. Hydrogen and sulfur react to form the compound hydrogen sulfide.
Which row shows the type of bonding between hydrogen and sulfur and the electrical conductivity of liquid hydrogen sulfide?

	type of bonding	electrical conductivity in the liquid state
A	covalent	good
B	covalent	non-conductor
C	ionic	good
D	ionic	non-conductor

[J13/P1/Q9]

11. Which elements exist as diatomic molecules at room temperature?

A hydrogen, oxygen, helium

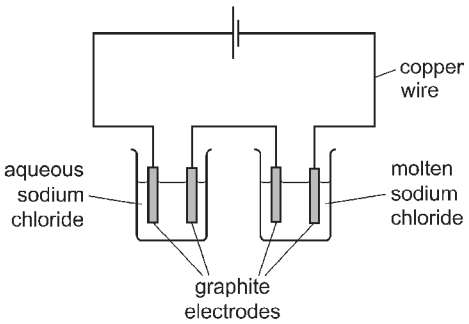
B nitrogen, chlorine, neon

C nitrogen, oxygen, fluorine

D oxygen, chlorine, helium

[N13/P1/Q2]

12. The diagram shows the electrolysis of aqueous sodium chloride and of molten sodium chloride.



Which substance in the diagram has both positive ions and mobile electrons?

A aqueous sodium chloride

B copper wire

C graphite electrodes

D molten sodium chloride

[N13/P1/Q5]

13. Substance X has a simple molecular structure and substance Y has a giant molecular structure.

Which row is correct?

	X could be	Y could be
A	an element only	an element only
B	an element only	an element or a compound
C	an element or a compound	an element only
D	an element or a compound	an element or a compound

[N13/P1/Q6]

Thinking Process

MCQ Answers

7. **A** The relative atomic mass of naturally occurring bromine is the exact average of the relative atomic masses of both isotopes.

8. **C** Atoms in Bronze are not bonded covalently .

9. **C** An ionic bond is formed between the atoms of sodium and chlorine. The sodium atom donates an electron and the chlorine atom accepts that electron for achieving stable state configuration .

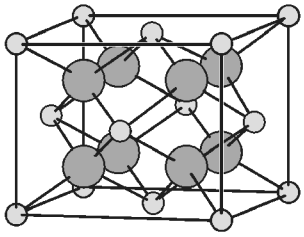
10. **B** Hydrogen sulfide has the formula H_2S and has covalent bonding between its atoms. It is a bad conductor of electricity due to the absence of free electrons .

11. **C** Noble gases do not exist as diatonic molecules at room temperature and pressure.

12. **B** Copper wire has metallic bonding which consists of positively charged metal ions surrounded by a sea of delocalized electrons.

13. **D** X could be iodine (an element) or water (a compound).
Similarly Y could be diamond (an element) or silica (a compound).

14. The diagram shows the structure of an ionic compound.



What is a possible formula for this compound?

A CaF_2 **B** $NaCl$
C SO_2 **D** MgO

[N13/P1/Q9]

15. Ionic compounds have high melting points because of the strong attraction between oppositely charged ions.

Which compound has the lowest melting point?

A $(Al^{3+})_2(O^{2-})_3$
B $Mg^{2+}O^{2-}$
C $Na^{+}Cl^{-}$
D $(Fe^{3+})_2(O^{2-})_3$

[N13/P1/Q29]

16. An ion X^+ has 23 nucleons and 10 electrons.

What does the nucleus of X contain?

	protons	neutrons
A	9	14
B	10	13
C	11	12
D	13	10

[J14/P1/Q6]

17. Which element exists as a macromolecule?

A carbon **B** hydrogen
C oxygen **D** sodium

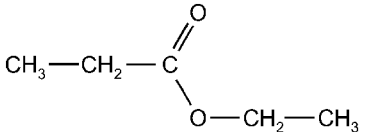
[J14/P1/Q7]

18. Which substance can conduct electricity by the movement of ions?

A copper
B graphite
C mercury
D sodium chloride

[J14/P1/Q8]

19. The diagram shows the molecule ethyl propanoate.



Consider **all** the electrons in a molecule of ethyl propanoate.

How many electrons **not** involved in bonding are there in the molecule?

A 8 **B** 10
C 18 **D** 22

[J14/P1/Q9]

20. In which solid can layers of atoms slide over each other?

A diamond **B** graphite
C haematite **D** silica

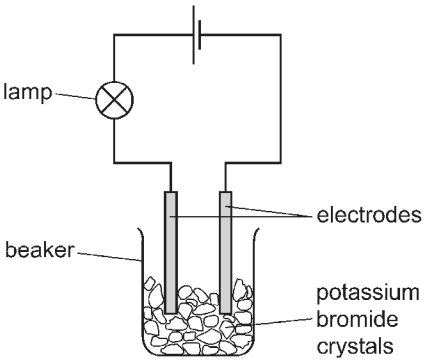
[J14/P1/Q27]

21. Which gas is **neither** an element **nor** a compound?

A ammonia
B chlorine
C air
D carbon monoxide

[N14/P1/Q5]

22. The experiment shown is used to test potassium bromide crystals.



The lamp does not light.

Distilled water is then added to the beaker and the lamp lights.

Which statement explains these results?

A Electrons are free to move in the solution when potassium bromide dissolves.
B Metal ions are free to move when potassium bromide melts.

Thinking Process

MCQ Answers

14. A For $NaCl$ and MgO, the ionic compound must have an equal number of anions and cations. SO_2 is a covalent compound.

15. C The greater the charge, the stronger the ionic bond, and thus, the higher the melting point. Al_2O_3, MgO, and Fe_2O_3 have greater number of charges than $NaCl$, causing it to have the lowest melting point.

16. C X^+ has 10 electrons. Therefore X has 11 electrons, 11 protons and 23 – 11 = 12 neutrons.

17. A Carbon exists as a macromolecule in the form of diamond.

18. D Sodium chloride, in molten form, conducts electricity by the movement of ions. Copper, gra-phite and mercury conduct electricity by the movement of electrons.

19. D Carbon, hydrogen and oxygen have 6, 1 and 8 electrons respectively.
Number of electrons not involved in bonding are:

2 in CH_3—

2 in — CH_2 —

(2 + 6) in —C(=O)—

6 in — O —

2 in — CH_2 —

2 in — CH_3

Therefore, total number of electrons not involved in bonding = 2 + 2 + 8 + 6 + 2 + 2 = 22

20. B Fact.

C Metal ions are free to move when potassium reacts with water.

D Oppositely charged ions are free to move in the solution when potassium bromide dissolves.

[N14/P1/Q8]

23. How many electrons are used in covalent bonding in the N_2 molecule?

A 2 **B** 4

C 6 **D** 10

[N14/P1/Q9]

24. Propene, $CH_3CH = CH_2$, has a very low boiling point because of the weakness of the

A C – C bond.

B C = C bond.

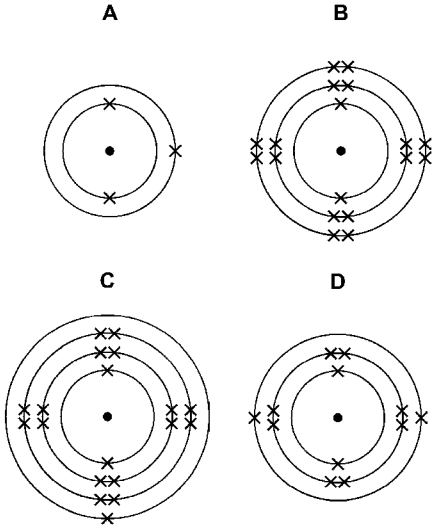
C C – H bond.

D intermolecular forces.

[N14/P1/Q10]

25. The diagram shows the arrangement of electrons in the atoms of four different elements.

Which is the **least** reactive of the four elements?



[N14/P1/Q26]

26. Which molecules all contain one or more double covalent bonds?

A chlorine, nitrogen and methane

B chlorine, oxygen and ethene

C oxygen, hydrogen chloride and ethene

D oxygen, carbon dioxide and ethene

[J15/P1/Q3]

27. The metals Cr, Co, Fe and Mn are all transition elements.

Which particles have the same number of electrons?

A Co^{2+} and Cr

B Co^{2+} and Fe^{3+}

C Cr and Mn^{2+}

D Fe^{3+} and Mn^{2+}

[J15/P1/Q4]

28. Which substance has metallic bonding?

	conducts electricity		state of product formed on reaction with oxygen
	when solid	when liquid	
A	✓	✓	solid
B	✓	✓	gas
C	×	✓	no reaction
D	×	×	solid

[J15/P1/Q5]

29. Which compound contains only eight covalent bonds?

A

B

C

D

[J15/P1/Q6]

30. What happens when sodium chloride melts?

A Covalent bonds in a giant lattice are broken.

B Electrons are released from atoms.

C Electrostatic forces of attraction between ions are overcome.

D Molecules are separated into ions.

[J15/P1/Q9]

Thinking Process

MCQ Answers

21. C Air is a mixture of different compounds but is not a compound itself.

22. D Solid Potassium bromide is an ionic compound which contains fixed oppositely charged ions, which are not free to move. Thus it cannot conduct electricity.

23. C Each Nitrogen atom shares it's 3 valence shell electrons to form a covalent bond. Hence a total of 6 electrons are used in the covalent bond.

24. D Propene has a simple molecular structure with weak intermolecular forces of attraction. It therefore has a low melting and boiling point.

25. B Option B has a stable electronic configuration and is thus the least reactive.

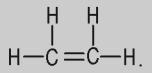
26. D Chlorine molecule contains single bond (Cl—Cl).

Hydrogen chloride contains single bond (H—Cl).

Oxygen contains O=O.

Carbon dioxide contains O=C=O.

Ethene contains



27. D

Particles : Electron

CO^{2+} : 57

Cr : 52

Fe^{3+} : 53

Mn^{2+} : 53

Hence, Fe^{3+} and Mn^{2+} have same number of electrons.

Topic 3 *Atomic Structure / Chemical Bonding*

THEORY Section

Question 1

Choose from the following particles to answer the questions below.

$^{8}_{4}\mathrm{Be}$

$^{14}_{6}\mathrm{C}$

$^{40}_{20}\mathrm{Ca}$

$^{37}_{17}\mathrm{Cl}^{-}$

$^{39}_{19}\mathrm{K}^{+}$

$^{24}_{12}\mathrm{Mg}^{2+}$

$^{20}_{10}\mathrm{Ne}$

$^{17}_{8}\mathrm{O}$

$^{16}_{8}\mathrm{O}^{2-}$

$^{32}_{16}\mathrm{S}^{2-}$

$^{28}_{14}\mathrm{Si}^{4-}$

Each particle can be used once, more than once or not at all.
Which particle

(a) has only eight electrons, [1]

(b) is attracted to the cathode during electrolysis, [1]

(c) has only four electrons in its outer shell, [1]

(d) has only eight neutrons, [1]

(e) has only ten protons, [1]

(f) has four occupied electron shells? [1]

[J12/P2/Q1]

Solution

(a) $^{17}_{8}\mathrm{O}$

(b) $^{39}_{19}\mathrm{K}^{+}$

(c) $^{14}_{6}\mathrm{C}$

(d) $^{16}_{8}\mathrm{O}^{2-}$

(e) $^{20}_{10}\mathrm{Ne}$

(f) $^{40}_{20}\mathrm{Ca}$

COMMENT on **ANSWER**

"(b) $^{24}_{12}\mathrm{Mg}^{+2}$ is also attracted to the cathode during electrolysis.

(d) $^{14}_{6}\mathrm{C}$ also has 14 – 6 = 8 neutrons."

Question 2

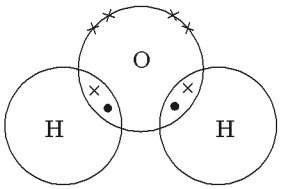
Draw a 'dot-and-cross' diagram for a molecule of water.

Show only the outer shell electrons. [2]

[N12/P2/Q1(c)]

Solution

(a)

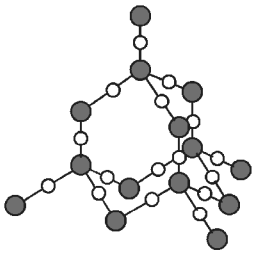


Key:
- • electron of hydrogen
- × electron of oxygen

Question 3

Glass contains silicon(IV) oxide and a number of metal oxides.

(a) The structure of silicon(IV) oxide is shown below.



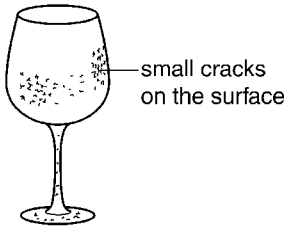
Key:
- silicon atom
- oxygen atom

(i) Describe **two** similarities in the structure of silicon(IV) oxide and diamond. [2]

(ii) Explain why silicon(IV) oxide has a high melting point. [2]

(iii) Explain why silicon(IV) oxide does not conduct electricity. [1]

(b) Old wine glasses often appear cloudy because they have many small cracks on their surface.



The cracks are caused by differences in the rate of diffusion of sodium ions and hydrogen ions in the glass.

(i) Explain the meaning of the term *diffusion*. [1]

(ii) Suggest why sodium and hydrogen ions do not diffuse at the same rate. [1]

(c) Sodium oxide is an ionic compound.
Draw a 'dot-and-cross' diagram to show

- the arrangement of the outer shell electrons,
- the charges on the ions and
- the formula of sodium oxide. [3]

[N12/P2/Q7]

Solution

(a) (i) 1. Both have a tetrahedral arrangement of atoms.
2. Both have giant macromolecular structures.

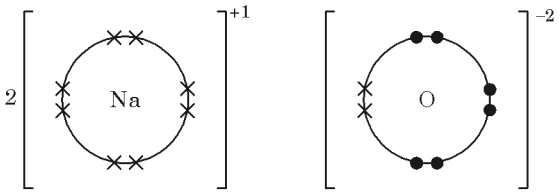
(ii) Silicon (IV) oxide contains strong covalent bounds which require a lot of energy to be broken.

(iii) Silicon (IV) oxide contains no free electrons as all electrons are occupied in making covalent bonds.

(b) (i) Diffusion refers to random movement of molecules or particles in any direction.

(ii) Both the sodium and hydrogen ions have different masses causing them to diffuse at different rates.

(c)



Question 4

Silicon is an element in Group IV of the Periodic Table.

(a) Give the electronic configuration for a silicon atom. [1]

(b) Silicon has three naturally occurring isotopes.
Complete the following table for two of these isotopes.

isotope	^{28}Si	^{30}Si
number of protons		
number of electrons		
number of neutrons		

[3]

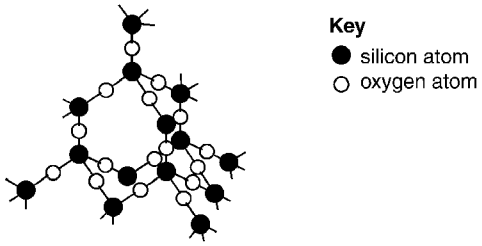
(c) Silicon reacts with chlorine on heating to form silicon(IV) chloride, $SiCl_4$.
Construct an equation for this reaction. [1]

(d) Silicon(IV) chloride is a simple molecular compound.

(i) Suggest **two** physical properties of silicon(IV) chloride other than solubility. [2]

(ii) Draw a 'dot-and-cross' diagram for silicon(IV) chloride.
You only need to show the outer shell electrons for each atom. [2]

(e) Silicon(IV) chloride reacts with water to form silicon(IV) oxide.
Part of the structure of silicon(IV) oxide is shown below.



Explain, in terms of structure and bonding, why silicon(IV) oxide has a very high melting point. [2]

[N13 / P2 / Q3]

Solution

(a) 2, 8, 4.

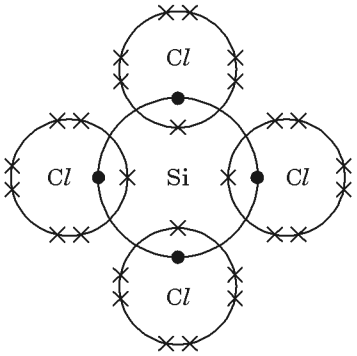
(b)

isotope	^{28}Si	^{30}Si
number of protons	**14**	**14**
number of electrons	**14**	**14**
number of neutrons	**14**	**16**

(c) $Si + 2Cl_2 \longrightarrow SiCl_4$

(d) (i) 1. It has a low melting and boiling point.
2. It is a bad conductor of heat and electricity.

(ii)



(e) Silicon(IV) oxide has a giant macromolecular structure with many strong covalent bonds. Breaking these bonds requires a lot of energy, which causes Silicon(IV) oxide to have a very high melting point.

Question 5

Astatine, At, is an element in Group VII of the Periodic Table.

The table shows some information about two isotopes of astatine.

symbol	number of protons	number of electrons	number of neutrons
$^{210}_{85}At$	.....	.....	.....
$^{211}_{85}At$	.....	.....	.....

(a) (i) Complete the table. [2]

(ii) What is meant by the term *isotopes*? [1]

(b) Astatine forms a diatomic molecule with the same type of bonding as in a chlorine molecule.
Draw the 'dot-and-cross' diagram for an astatine molecule.
Only draw the outer shell electrons. [1]

(c) Astatine reacts with magnesium to form magnesium astatide, $MgAt_2$, which contains Mg^{2+} and At^- ions.

(i) Describe how a magnesium ion and an astatide ion are formed from a magnesium atom and an astatine atom. [2]

(ii) Predict **two** physical properties of magnesium astatide. [2]