

I am able to:

- Describe how positive and negative ions are formed.
- Give the formulae of the ions formed by the following elements: Li Ba Al Br O N
- State the formulae (with charges) of the following ions: nitrate sulphate hydroxide ammonium carbonate hydrogencarbonate phosphate(V)
- Work out the formulae of the following ionic compounds:

Lithium fluoride	Sodium hydrogencarbonate	Iron(II) phosphate
magnesium chloride	Calcium nitrate	Sodium carbonate
ammonium sulfate	Barium hydroxide	Copper(II) nitrate

- Classify each of the following as having mainly ionic or mainly covalent bonding:
CO₂ CaS PCl₃ OF₂ MgO

6 Explain what is meant by *ionic bonding*.

7 Describe the structure of ionic compounds

8 Explain why ionic compounds

- have high melting point,
- are non-volatile
- are often soluble in water
- do not conduct electricity when solid
- conduct electricity when molten or in aqueous solution

9 Explain what is meant by a *covalent bond*

10 Draw Lewis structures for:

O ₂	C ₂ H ₂	SO ₄ ²⁻
HCN	SO ₂	N ₂ H ₄
CO ₂	NH ₄ ⁺	ClF ₃
C ₂ H ₄	CO ₃ ²⁻	PCl ₅

11 State and explain the differences in bond length and bond energy in

- C₂H₆, C₂H₄ and C₂H₂
- N₂, N₂H₄ and N₂H₂

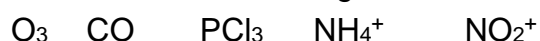
12 Explain in which of the following the central atom has an expanded octet:



13 Understand what is unusual about the Lewis structures for BCl₃ and BeCl₂

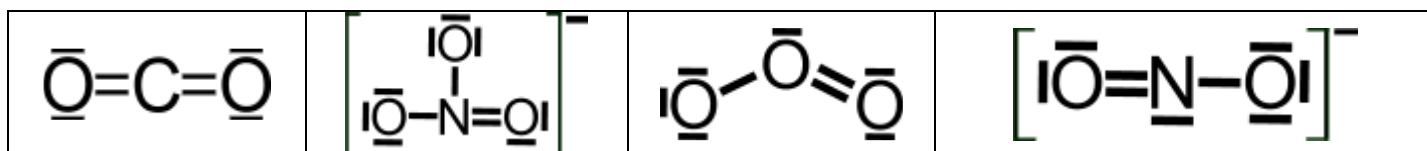
14 Explain what is meant by the term *coordinate covalent bond*

15 Explain which of the following contain coordinate covalent bonds



16 Explain what *formal charge* is.

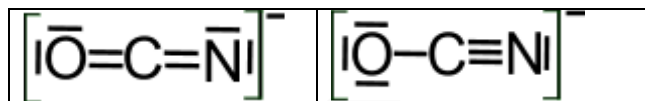
17 Work out the formal charge on each atom in each of the following



18 Draw at least 2 Lewis structures for each of the following and use formal charge to decide which is the preferred structure

- (a) SO_2 (b) XeO_4 (c) SO_4^{2-}

19 Explain why formal charge cannot be used to deduce which of the Lewis structures shown for OCN^- is preferred.



20 Explain the valence shell electron pair repulsion theory for predicting shapes of molecules.

21 Predict the electron domain geometry, shape and bond angles of:

CH_4	H_2O	C_2H_4	SO_2	H_3O^+	CO_3^{2-}
NH_3	CO_2	C_2H_2	NH_4^+	BF_3	PCl_3

22 Predict the electron domain geometry, shape and bond angles of:

XeF_4	XeOF_4	SO_4^{2-}	ClF_3	SF_4^{2-}
PCl_5	BrF_5	SF_4	SF_6	I_3^-

23 Explain what is meant by *electronegativity*

24 State and explain which of the following bonds is most polar: H-C H-Cl H-F

25 Explain which of the following molecules is/are polar:

N_2	NH_3	SO_2	XeF_4
CO	CO_2	CH_2Cl_2	PCl_5

26 Explain the meaning of the term *hybridisation*.

27 Predict the type of hybridisation present on the central atom in:

CH_4	BF_3	HCN	H_2O	SO_2	CO_3^{2-}	NH_3	CO_2	C_2H_4
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28 Predict the hybridisation of the O atoms in CO_2 SO_2 CO

29 Explain covalent bonding in terms of orbitals

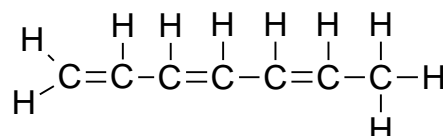
30 Explain, using diagrams, what is meant by σ and π bonds.

31 Work out the number of σ and π bonds in: C_2H_4 , HCN , C_2H_2 , N_2H_4 , CO

32 In the organic molecule shown work out

(a) the number of σ and π bonds

(b) the number of C atoms that are sp^2 hybridised



33 Explain what is meant by a resonance structure

34 Draw two resonance structures for O_3 and explain why the structure of ozone cannot be described by just one of them.

35 Explain what is meant by delocalisation of electrons and explain why a delocalised bonding scheme is necessary to describe the structure of ozone.

- 36 Explain why UV radiation of shorter wavelength is required to dissociate O_2 than O_3
- 37 Write equations to show the mechanism of ozone depletion as catalysed by CFCs and NO_x .
- 38 Draw resonance structures for each of the following
 CO_3^{2-} C_6H_6 CH_3COO^- NO_2^- NO_3^-
- 39 Explain why a delocalised bonding scheme is necessary to describe the structure of molecules/ions in 38.
- 40 Explain whether the C-O bond length in CO_3^{2-} or CH_3COO^- is longer

- 41 Use the resonance structures shown here to predict a C-O bond length for OCN^-



Bond	Bond length / pm
C-O	143
C=O	122
C≡C	113

- 42 Explain which of the following contain delocalised electrons
 H_2SO_4 PO_4^{3-} CH_3COOH H_2O_2 NO_2^+ SO_3^{2-} H_2CO_3 HCO_3^-
- 43 Explain the origin of London (dispersion) forces.
- 44 Explain what van der Waals forces are.
- 45 For each of the following pairs, explain in terms of intermolecular forces, which has the higher boiling point.
- Cl_2 or Br_2
 - CH_3Cl or CH_3Br
 - $CH_3CH_2CH_3$ or CH_3OCH_3
 - CH_3CH_2OH or CH_3OCH_3
 - NH_3 or PH_3

- 46 Draw a diagram to show the hydrogen bonding between molecules of water.

- 47 Explain which of the following will have hydrogen bonding between molecules

HF	HCl	CH_3F	CH_3OH	N_2H_4
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- 48 Explain why covalent molecular compounds:
- have low melting and boiling points
 - are volatile
 - do not conduct electricity when liquid
 - tend to be soluble in organic solvents

- 49 Explain which of the following chlorides will have the lowest boiling point



- 50 Explain which of the following chlorides will be the best conductor of electricity in the liquid state



- 51 Explain the relative solubilities of ionic and covalent substances in polar and non-polar solvents.

52 Describe the structure and bonding of

- Diamond
- Graphite
- Graphene
- C₆₀ buckminsterfullerene

53 Describe the structure and bonding of silicon dioxide

54 Explain why diamond has a much higher melting/boiling point than C₆₀ buckminsterfullerene

55 Explain why graphite and graphene are better conductors of electricity than diamond and C₆₀ fullerene.

56 Explain what is meant by *metallic bonding*.

57 Explain why metals conduct electricity and are malleable.

58 Explain why magnesium has a higher melting point than sodium

59 Explain what an *alloy* is.

60 Explain why alloys tend to be stronger than pure metals.