Q1.

Which molecule is **not** able to form a co-ordinate bond with another species?

A BH_3 ⬭

B CH_4 ⬭

C NH_3 ⬭

D H_2O ⬭

(Total 1 mark)

Q2.

Which species has a square planar shape?

A NH_4^+ ⬭

B SF_4 ⬭

C XeF_4 ⬭

D PCl_4^+ ⬭

(Total 1 mark)

Q3.

Which bond has the most unsymmetrical electron distribution?

A H–O ⬭

B H–S ⬭

C H–N ⬭

D H–P ⬭

(Total 1 mark)

Q4.

Which statement about inorganic ionic compounds is **always** correct?

A They dissolve in water to give neutral solutions. ⬭

B They release energy when they melt. ⬭

C They contain metal cations. ⬭

D They form giant structures. ⬭

(Total 1 mark)

Q5.

Which species has a lone pair of electrons on the central atom?

A CO_2 ⬭

B SO_2 ⬭

C PCl_6^- ⬭

D SO_4^{2-} ⬭

(Total 1 mark)

Q6.

In which substance do covalent bonds break when it melts?

A hexane ⬭

B ice ⬭

C iodine ⬭

D silicon dioxide ⬭

(Total 1 mark)

Q7.

In which molecule are all the atoms in the same plane?

A CH_3CHO ⬭

B CH_3NH_2 ⬭

C C_6H_5Cl ⬭

D $C_6H_5CH_3$ ⬭

(Total 1 mark)

Q8.

Which molecule has a permanent dipole?

A BF_3 ⬭

B NH_3 ⬭

C $SiCl_4$ ⬭

D SO_3 ⬭

(Total 1 mark)

Q9.

Which substance contains delocalised electrons?

A cyclohexane ⬭

B graphite ⬭

C iodine ⬭

D sodium chloride ⬭

(Total 1 mark)

Q10.

Which polymer has hydrogen bonding between the polymer chains?

A Kevlar ⬭

B PVC ⬭

C poly(phenylethene) ⬭

D Terylene ⬭

(Total 1 mark)

Q11.

This question is about shapes of molecules and ions.

Draw the shape of NCl_3 and of NCl_4^+

Include any lone pairs of electrons that influence the shape.

Name the shape of NCl_3

State and explain the bond angle in NCl_4^+

Shape of NCl_3 **Shape of NCl_4^+**

Name of shape of NCl_3

_____

Bond angle in NCl_4^+

_____

Explanation of bond angle in NCl_4^+

_____

_____

_____

_____

_____

(Total 5 marks)

Q12.

Which compound contains a co-ordinate bond?

A HF ⬭

B NH_3 ⬭

C $CHCl_3$ ⬭

D NH_4Cl ⬭

(Total 1 mark)

Q13.

This question is about pentan-2-ol and pent-1-ene.

(a) The boiling point of pentan-2-ol is 119 °C
The boiling point of pent-1-ene is 30 °C

Explain why pentan-2-ol has a higher boiling point than pent-1-ene.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Pent-1-ene is formed by the elimination of water from pentan-2-ol.

State the reagent and condition for this reaction.

Outline the mechanism for this reaction.

Reagent _____

Condition _____

Outline of mechanism

(5)
(Total 8 marks)

Q14.

The melting point of XeF_4 is higher than the melting point of PF_3

Explain why the melting points of these two compounds are different.

In your answer you should give the shape of each molecule, explain why each molecule has that shape and how the shape influences the forces that affect the melting point.

(Total 6 marks)

Q15.

Which has a bond angle of 109.5°?

A C (diamond) ⬭

B C (graphite) ⬭

C NH_2^- ⬭

D NH_3 ⬭

(Total 1 mark)

Q16.

This question is about compounds that contain fluorine.

(a) Sodium fluoride contains sodium ions (Na^+) and fluoride ions (F^-).
Na^+ and F^- have the same electron configuration.

Explain why a fluoride ion is larger than a sodium ion.

_____

_____

_____

_____

_____

_____

(2)

(b) Explain, in terms of structure and bonding, why the melting point of sodium fluoride is high.

_____

_____

_____

_____

_____

_____

_____

(2)

(c) The ion H_2F^+ is formed when hydrogen fluoride gains a proton as shown in the equation

$$HF + H^+ \rightarrow H_2F^+$$

Name the type of bond formed when HF reacts with H^+
Explain how this bond is formed.

Type of bond

_____

Explanation

_____

_____

_____

_____

_____

(2)

(d) Fluoroantimonic acid contains two ions, SbF_6^- and H_2F^+

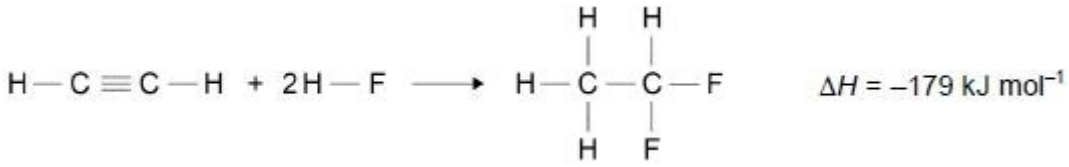
Draw the shape of the SbF_6^- ion and the shape of the H_2F^+ ion. Include any lone pairs that influence the shape.

Name the shape of each ion.

	SbF_6^-	H_2F^+
Shape		
Name of shape		

(4)

(e) Hydrogen fluoride reacts with ethyne (C_2H_2) as shown in the equation. All compounds are in the gaseous state.



The table shows some mean bond enthalpy data.

Bond	C–H	C≡C	H–F	C–C
Mean bond enthalpy / kJ mol^{-1}	412	837	562	348

Use the data in the table above to calculate a value for the bond enthalpy of a C–F bond in the product.

C–F bond enthalpy _____ kJ mol^{-1}

(3)

(Total 13 marks)

Q17.

Which substance has delocalised electrons?

A graphite ○

B iodine ○

C sodium chloride ○

D tetrachloromethane ○

(Total 1 mark)

Q18.

Which change occurs when water is vaporised?

A An exothermic change occurs. ○

B Covalent bonds are broken. ○

C Intermolecular forces are overcome. ○

D The total energy of the molecules decreases. ○

(Total 1 mark)

Q19.

Which compound has the highest boiling point?

A $CH_3CH_2CH_2Br$ ○

B $CH_3CH_2CH_2F$ ○

C CH_3CH_2CHO ○

D CH_3CH_2COOH ○

(Total 1 mark)

Q20.

This question is about structure and bonding.

(a) Draw a diagram to show the strongest type of interaction between two molecules of ethanol (C_2H_5OH) in the liquid phase.

Include all lone pairs and partial charges in your diagram.

(3)

(c) Methoxymethane (CH_3OCH_3) is an isomer of ethanol.

The table shows the boiling points of ethanol and methoxymethane.

Compound	**Boiling point / °C**
ethanol	78
methoxymethane	−24

In terms of the intermolecular forces involved, explain the difference in boiling points.

(3)

(c) Draw the shape of the $POCl_3$ molecule and the shape of the ClF_4^- ion. Include any lone pairs of electrons that influence the shapes.

In a $POCl_3$ molecule the oxygen atom is attached to the phosphorus atom by a double bond that uses two electrons from phosphorus.

Name each shape.

Suggest a value for the bond angle in ClF_4^-

Shape of $POCl_3$ Shape of ClF_4^-

Name of shape of $POCl_3$ _____

Name of shape of ClF_4^- _____

Bond angle in ClF_4^- _____

(5)

(Total 11 marks)

Q21.

Which is **not** responsible for conduction of electricity?

A The sodium ions in molten sodium chloride ⬭

B The electrons between layers of carbon atoms in graphite ⬭

C The bonding electrons in a metal ⬭

D The lone pair electrons on water molecules ⬭

(Total 1 mark)

Q22.

This question is about compounds containing fluorine.

(a) Draw the shape of a molecule of krypton difluoride (KrF_2).
Include in your answer any lone pairs of electrons that influence the shape.
Name the shape produced by the atoms in a KrF_2 molecule and suggest a bond angle.

Name of shape

_____

Bond angle

_____

(3)

(b) There are two lone pairs of electrons on the oxygen atom in a molecule of oxygen difluoride (OF_2).

Explain how the lone pairs of electrons on the oxygen atom influence the bond angle in oxygen difluoride.

_____

_____

_____

_____

_____

_____

_____

(2)

(c) Silicon tetrafluoride (SiF_4) is a tetrahedral molecule.

Deduce the type of intermolecular forces in SiF_4
Explain how this type of intermolecular force arises and why no other type of intermolecular force exists in a sample of SiF_4

Intermolecular forces in SiF_4

_____

Explanation

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q23.

Which row shows the bonding in ammonium chloride?

	Covalent	**Dative covalent**	**Ionic**	
A	✓	✗	✗	⬭
B	✓	✓	✗	⬭
C	✓	✓	✓	⬭
D	✗	✗	✓	⬭

(Total 1 mark)

Q24.

Which molecule does **not** have a permanent dipole?

A CH_3Br ⬭

B CH_2Br_2 ⬭

C $CHBr_3$ ⬭

D CBr_4 ⬭

(Total 1 mark)

Q25.

This question is about intermolecular forces.

(a) Give the meaning of the term electronegativity.

_____

_____

_____

(1)

(b) Explain how permanent dipole-dipole forces arise between hydrogen chloride molecules.

_____

_____

_____

_____

_____

_____

(2)

(c) Complete the table by naming the shape of each molecule.

Place a tick (✓) in the final column if the molecule has a permanent dipole.

Molecule	**Name of shape**	**Tick (✓) if molecule has a permanent dipole**
SiH_4		
PH_3		
$BeCl_2$		
CH_3Cl		

(4)

(Total 7 marks)

Q26.

Which is the correct crystal structure for the substance named?

	Substance	**Structure**	
A	Iodine	Simple molecular	⬭
B	Diamond	Ionic	⬭
C	Sodium chloride	Giant covalent	⬭
D	Graphite	Metallic	⬭

(Total 1 mark)

Q27.

Which compound has the highest boiling point?

A $CH_3CH_2CH_2OH$ ⬭

B CH_3CH_2CHO ⬭

C CH_3COCH_3 ⬭

D CH_3COOCH_3 ⬭