**Questions**

**Q1.**

Which of these carbon structures is represented by the diagram below?



   **A**     Graphite

   **B**     Diamond

   **C**     A fullerene

   **D**     A carbon nanotube

**(Total for question = 1 mark)**

**Q2.**

This question is about bond angles.

**A**    90°

**B**    104°

**C**    107°

**D**    109.5°

Select, from A to D above, the most likely value for the bond angle of

(a) HCH in methane, CH4.

**(1)**

   **A**

   **B**

   **C**

   **D**

(b) FSF in sulfur hexafluoride, SF6.

**(1)**

   **A**

   **B**

   **C**

   **D**

(c) FOF in oxygen difluoride, OF2.

**(1)**

   **A**

   **B**

   **C**

   **D**

**(Total for question = 3 marks)**

**Q3.**

      The oxygen atom in a molecule of water has two bonding pairs and two lone pairs of electrons. Based on the electron-pair repulsion theory, the H–O–H bond angle is most likely to be

   **A**       180°

   **B**       109.5°

   **C**       107°

   **D**       104.5°

**(Total for question = 1 mark)**

**Q4.**

What is the FBF bond angle in boron trifluoride, BF3?

   **A**    180°

   **B**    120°

   **C**    109.5°

   **D**    90°

**(Total for Question = 1 mark)**

**Q5.**

Which of these bond angles is the smallest?

   **A**     HNH in NH3

   **B**     HCH in CH4

   **C**     HOH in H2O

   **D**     OCO in CO2

**(Total for question = 1 mark)**

**Q6.**

Which of the following bond angles occur in a molecule of ethanol, C2H5OH?

   **A**     90° and 180°

   **B**     104.5° and 180°

   **C**     104.5° and 109.5°

   **D**     109.5° and 120°

**(Total for question = 1 mark)**

**Q7.**

The diagram below shows a dot and cross diagram of nitric acid.



      (a) Identify which of the labelled sets of electrons represents a dative covalent bond.

**(1)**

   **A**

   **B**

   **C**

   **D**

      (b) In terms of orbital overlap, the double bond is

**(1)**

   **A**      A π bond.

   **B**      two σ bonds.

   **C**      two π bonds.

   **D**      A σ bond and a π bond.

**(Total for question = 2 marks)**

**Q8.**

Buckminsterfullerene has the formula C60. Its structure is shown below.



The bonding in buckminsterfullerene is similar to the bonding in graphite.

Which of the following is true?

   **A**     All the bond angles in buckminsterfullerene are 120°.

   **B**     The melting temperature of buckminsterfullerene is higher than that of graphite.

   **C**     There are delocalized electrons in buckminsterfullerene.

   **D**     On complete combustion, buckminsterfullerene forms carbon dioxide and water.

**(Total for question = 1 mark)**

**Q9.**

What is the total number of electrons in the covalent bonds in a beryllium chloride molecule, BeCl2?

   **A**    2

   **B**    4

   **C**    6

   **D**    8

**(Total for Question = 1 mark)**

**Q10.**Fullerenes, graphite and diamond are all forms of carbon. Fullerenes dissolve in petrol, but diamond and graphite do not. This is because

   **A**    the bonds between the carbon atoms in fullerenes are weaker than in diamond or graphite.

   **B**    diamond and graphite are giant structures but fullerenes are molecular.

   **C**    there are delocalized electrons in diamond and graphite but not in fullerenes.

   **D**    there are covalent bonds in diamond and graphite, but not in fullerenes.

**(Total for Question = 1 mark)**

**Q11.**

This question concerns the shapes of the hydrides of Group 5 elements.

(a)  What is the approximate H—N—H bond angle in the ammonium ion, NH?

**(1)**

   **A**    90°

   **B**    104.5°

   **C**    107°

   **D**    109.5°

(b)  Suggest the shape of the phosphine molecule, PH3.

**(1)**

   **A**    Trigonal planar

   **B**    Trigonal pyramidal

   **C**    Trigonal bipyramidal

   **D**    Octahedral

**(Total for question = 2 marks)**

**Q12.**

Consider the Maxwell-Boltzmann distribution of energies for a gas shown below. *E*a represents the activation energy.



The shaded area of the diagram indicates the total number of particles that

   **A**    do have enough energy to react.

   **B**    do not have enough energy to react.

   **C**    do have enough energy to react in the presence of a catalyst.

   **D**    do not have enough energy to react in the presence of a catalyst.

**(Total for question = 1 mark)**

**Q13.**Which of the following molecules has a linear shape and bond angles of 180°?

   **A**    CH4

   **B**    H2O

   **C**    CO2

   **D**    SF6

**(Total for Question = 1 mark)**

**Q14.**

Which statement best describes the shape and bond angles in the molecule SF6?

   **A**     Octahedral, 90° and 180°

   **B**     Trigonal bipyramidal, 90° and 180°

   **C**     Octahedral, 90° and 120°

   **D**     Trigonal bipyramidal, 90° and 120°

**(Total for question = 1 mark)**

**Q15.**

Which of the following molecules is linear?

   **A**    CO2

   **B**    C2H4

   **C**    H2O

   **D**    NH3

**(Total for Question = 1 mark)**

**Q16.**

      The shape of a molecule of boron trifluoride, BF3, is

   **A**       trigonal planar.

   **B**       pyramidal.

   **C**       tetrahedral.

   **D**       T–shaped.

**(Total for question = 1 mark)**

**Q17.**Which of the following molecules has the smallest bond angle?

   **A**    H2O

   **B**    NH3

   **C**    CH4

   **D**    SF6

**(Total for Question = 1 mark)**

**Q18.**

Which of the following molecules is linear?

   **A**     Carbon dioxide, CO2

   **B**     Sulfur dioxide, SO2

   **C**     Water, H2O

   **D**     Methanal, HCHO

**(Total for question = 1 mark)**

**Q19.**

This question concerns the shapes of molecules and ions:

**A**      linear

**B**      trigonal planar

**C**      pyramidal

**D**      tetrahedral

Select from **A** to **D** the shape of

 (a) boron trichloride, BCl3

**(1)**

   **A**

   **B**

   **C**

   **D**

(b) the ammonium ion, NH4+

**(1)**

   **A**

   **B**

   **C**

   **D**

(c) carbon dioxide, CO2

**(1)**

   **A**

   **B**

   **C**

   **D**

**(Total for question = 3 marks)**

**Mark Scheme**

**Q1.**



**Q2.**



**Q3.**



**Q4.**



**Q5.**



**Q6.**



**Q7.**



**Q8.**



**Q9.**



**Q10.**



**Q11.**



**Q12.**



**Q13.**



**Q14.**



**Q15.**



**Q16.**



**Q17.**



**Q18.**



**Q19.**

