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1. **A** What is the shape of NO_2^+ ?
A Linear **C** Trigonal planar
B Bent **D** Tetrahedral

2. **D** Which of the following is polar?
A CO_2 **B** CCl_4 **C** BF_3 **D** PCl_3

3. **A** Which of the following molecules exhibit(s) hydrogen bonding?
I NH_3 **II** CH_3NH_2 **III** HF **IV** CH_3F
A I, II and III only **C** I and III only
B IV only **D** III and IV only

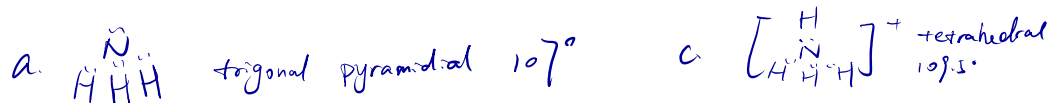
4. **C** In which of the following are the molecules arranged in order of increasing boiling point (lowest first)?
A NH_3 N_2 Br_2
B H_2O H_2S H_2Se
C CH_3Cl CH_2Cl_2 CHCl_3
D C_4H_{10} C_3H_8 $\text{C}_2\text{H}_5\text{OH}$

5. **A** What is the F–B–F bond angle in BF_4^- ?
A 109.5° **B** 107° **C** 120° **D** 90°

6. **B** Which of the following will be the worst conductor of electricity?
A Mg(s) **C** $\text{MgCl}_2(\text{l})$
B $\text{SiCl}_4(\text{l})$ **D** C(graphite,s)

7. **D** When the compounds C_2H_6 , C_2H_4 , C_2H_2 and C_6H_6 are arranged in order of increasing C–C bond lengths (shortest first) the correct order is:
A C_2H_6 C_2H_4 C_2H_2 C_6H_6
B C_6H_6 C_2H_4 C_2H_2 C_2H_6
C C_2H_2 C_6H_6 C_2H_4 C_2H_6
D C_2H_2 C_2H_4 C_6H_6 C_2H_6

8.



b. NH_3 is polar because the dipoles cannot be canceled d. H-bond

Ammonia, NH_3 , reacts with hydrogen ions, H^+ , to form ammonium ions, NH_4^+ . large attraction between H^+

- (a) Draw a Lewis (electron dot) structure of ammonia and state its shape and bond angle. (3) and lone pair of N.
 (b) Predict and explain whether the ammonia molecule is polar. (2)
 (c) Draw a Lewis (electron dot) structure of the ammonium ion and state its shape and bond angle. (3) larger repulsion between lone pair and bonding pair
 (d) State the name of the bond that forms between ammonia and the hydrogen ion, and explain its formation. (2)
 (e) Explain why the bond angle in ammonia is different from the bond angle in the ammonium ion. e. NH_3 bond pair 3 lone pair 1 ED Geometry tetrahedral molecular geometry trigonal pyramidal bond angle 107°

9.	NH_4	4	0	tetrahedral	tetrahedral	109.5°
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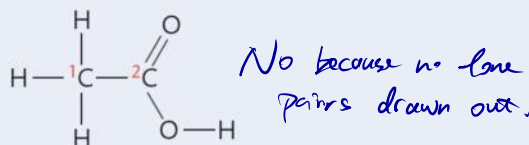
VSEPR theory can be used to predict the shapes of molecules.

- (a) Explain the application of VSEPR theory in the following, including in your answers full Lewis (electron dot) structures, the name of the shape of the molecule and bond angles present.

- (i) PH_3 $\begin{array}{c} \text{P} \\ \cdot \\ \text{H} \cdot \text{H} \cdot \text{H} \end{array}$ trigonal pyramidal 107°
 (ii) H_2O $\begin{array}{c} \text{H} \cdot \text{O} \cdot \text{H} \\ \cdot \\ \cdot \end{array}$ V-shape 104.5°
 (iii) C_2H_6 $\text{H}_3\text{C}-\text{CH}_3$ tetrahedral 109.5°
 (iv) CH_3CHO $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{H}$ trigonal planar 120° (12)

- (b) Only one of the molecules in (a) is able to form intermolecular hydrogen bonding. State which molecule this is, and describe the features it possesses which make it possible for it to form hydrogen bonds. b. H_2O , because ΔEN between H and O is big and.

10. H will be 99% positive, create large attraction between H-O
 The structure of ethanoic acid is shown below.



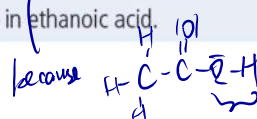
- (a) Comment on whether or not this representation is a Lewis (electron dot) structure. (3)

- (b) Predict the bond angles around each of the two carbon atoms labelled 1 and 2
 C1 bond angle: 109.5° C2 bond angle: 119° (2)

- (c) Compare and contrast the bonds between the carbon atom and the two oxygen atoms in the molecule. One is single bond while the other one is double bond. (2)

- (d) When ethanoic acid ionizes it loses a hydrogen ion and forms the ethanoate ion CH_3COO^- . The length of single bond is larger and smaller strength. (3)

Explain why in this structure, the carbon-oxygen bonds are different from either of the carbon-oxygen bonds in ethanoic acid.



ΔEN is big. H is 99% positive, easy to form H^+ and CH_3COO^- .