

1 The bond angle in beryllium chloride,  $\text{BeCl}_2$ , is most likely to be

- A  $90^\circ$
- B  $104.5^\circ$
- C  $120^\circ$
- D  $180^\circ$

(Total for Question = 1 mark)

2 Copper(II) ions combine with three molecules of 1,2-diaminoethane,  $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ , to form a complex ion.

A bond angle,  $\text{N} - \text{Cu} - \text{N}$ , in this complex is

- A  $120^\circ$
- B  $109.5^\circ$
- C  $107^\circ$
- D  $90^\circ$

(Total for Question = 1 mark)

3 Which of the following does **not** have a central metal ion having six bonds and an oxidation state of +2?

- A  $[\text{Cu}(\text{C}_2\text{O}_4)_3]^{4-}$
- B  $[\text{Co}(\text{CN})_5(\text{H}_2\text{O})]^{3-}$
- C  $[\text{Fe}(\text{CN})_6]^{3-}$
- D  $[\text{Zn}(\text{OH})_4(\text{H}_2\text{O})_2]^{2-}$

(Total for Question = 1 mark)

4 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,  $\text{NH}_4^+$ ?

(1)

- A  $90^\circ$
- B  $104.5^\circ$
- C  $107^\circ$
- D  $109.5^\circ$

(b) Suggest the shape of the phosphine molecule,  $\text{PH}_3$ .

(1)

- A Trigonal planar
- B Trigonal pyramidal
- C Trigonal bipyramidal
- D Octahedral

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

5 Which of the following molecules is polar?

- A  $\text{CO}_2$
- B  $\text{SO}_2$
- C  $\text{SO}_3$
- D  $\text{O}_2$

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

6 Which of the following molecules has the smallest bond angle?



(Total for Question = 1 mark)

7 A charged rod is held beside a stream of liquid coming from a burette. Which of the following liquids would NOT be significantly deflected?



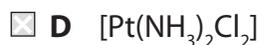
(Total for Question = 1 mark)

8 Which of the following molecules has a linear shape and bond angles of  $180^\circ$ ?



(Total for Question = 1 mark)

9 Which of the following is **not** planar?



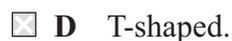
(Total for Question = 1 mark)

10 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



(Total for Question 1 mark)

11 The shape of a molecule of boron trifluoride,  $\text{BF}_3$ , is



(Total for Question 1 mark)

12 What is the FBF bond angle in boron trifluoride,  $\text{BF}_3$ ?

- A  $180^\circ$
- B  $120^\circ$
- C  $109.5^\circ$
- D  $90^\circ$

(Total for Question 1 mark)

13 Which of the following molecules is linear?

- A  $\text{CO}_2$
- B  $\text{C}_2\text{H}_4$
- C  $\text{H}_2\text{O}$
- D  $\text{NH}_3$

(Total for Question 1 mark)

14 Which of the following molecules is **non-polar**?

- A  $\text{CH}_3\text{Cl}$
- B  $\text{CH}_2\text{Cl}_2$
- C  $\text{CHCl}_3$
- D  $\text{CCl}_4$

(Total for Question 1 mark)

15 This question is about bond angles.

A  $90^\circ$

B  $104^\circ$

C  $107^\circ$

D  $109.5^\circ$

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

(a) HCH in methane,  $\text{CH}_4$ .

(1)

A

B

C

D

(b) FSF in sulfur hexafluoride,  $\text{SF}_6$ .

(1)

A

B

C

D

(c) FOF in oxygen difluoride,  $\text{OF}_2$ .

(1)

A

B

C

D

(Total for Question = 3 marks)

16 Which of the following molecules is polar?

- A Carbon dioxide,  $\text{CO}_2$
- B Beryllium chloride,  $\text{BeCl}_2$
- C Ammonia,  $\text{NH}_3$
- D Boron trifluoride,  $\text{BF}_3$

(Total for Question = 1 mark)

17 Which of these bond angles is the smallest?

- A HNH in  $\text{NH}_3$
- B HCH in  $\text{CH}_4$
- C HOH in  $\text{H}_2\text{O}$
- D OCO in  $\text{CO}_2$

(Total for Question = 1 mark)

18 Which statement best describes the shape and bond angles in the molecule  $\text{SF}_6$ ?

- A Octahedral,  $90^\circ$  and  $180^\circ$
- B Trigonal bipyramidal,  $90^\circ$  and  $180^\circ$
- C Octahedral,  $90^\circ$  and  $120^\circ$
- D Trigonal bipyramidal,  $90^\circ$  and  $120^\circ$

(Total for Question = 1 mark)

19 An electric field can affect the direction of a stream of some liquids. Which of these liquids would be affected by an electric field?

- A 1-chloropropane
- B Pentane
- C Tetrachloromethane
- D Cyclopentane

(Total for Question = 1 mark)

20 Which of these bond angles is the **largest**?

- A Cl—B—Cl in  $\text{BCl}_3$
- B H—N—H in  $\text{NH}_3$
- C Cl—Be—Cl in  $\text{BeCl}_2$
- D H—O—H in  $\text{H}_2\text{O}$

(Total for Question = 1 mark)

21 Which of the following molecules is **not** polar?

- A HCl
- B  $\text{CH}_3\text{Cl}$
- C  $\text{CHCl}_3$
- D  $\text{CCl}_4$

(Total for Question = 1 mark)

22 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,  $\text{BCl}_3$

(1)

- A
- B
- C
- D

(b) the ammonium ion,  $\text{NH}_4^+$

(1)

- A
- B
- C
- D

(c) carbon dioxide,  $\text{CO}_2$

(1)

- A
- B
- C
- D

**(Total for Question 3 marks)**

23 Tetrachloromethane,  $\text{CCl}_4$ , is a

- A polar molecule with polar bonds.
- B polar molecule with non-polar bonds.
- C non-polar molecule with polar bonds.
- D non-polar molecule with non-polar bonds.

(Total for Question = 1 mark)

24 Which of the following bond angles occur in a molecule of ethanol,  $\text{C}_2\text{H}_5\text{OH}$ ?

- A  $90^\circ$  and  $180^\circ$
- B  $104.5^\circ$  and  $180^\circ$
- C  $104.5^\circ$  and  $109.5^\circ$
- D  $109.5^\circ$  and  $120^\circ$

(Total for Question = 1 mark)

25 Which of the following molecules is linear?

- A Carbon dioxide,  $\text{CO}_2$
- B Sulfur dioxide,  $\text{SO}_2$
- C Water,  $\text{H}_2\text{O}$
- D Methanal,  $\text{HCHO}$

(Total for Question = 1 mark)

26 Which of the following molecules contains polar bonds but is **not** a polar molecule?

- A Chlorine,  $\text{Cl}_2$
- B Hydrogen chloride,  $\text{HCl}$
- C Trichloromethane,  $\text{CHCl}_3$
- D Tetrachloromethane,  $\text{CCl}_4$

(Total for Question = 1 mark)