CHEM11611
EXAM 2 Fall 2020

NAME _____

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31. A B C D E
32. A B C D E
33. A B C D E
34. A B C D E

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Part 1 contains 34 multiple choice questions worth 3 points each (or 102 total points).

1. The Lewis structure of N_2H_2 shows _____.

   A. a nitrogen-nitrogen triple bond
   B a nitrogen-nitrogen single bond
   C. each nitrogen has one nonbonding electron pair
   D. each nitrogen has two nonbonding electron pairs
   E. each hydrogen has one nonbonding electron pair

2. What is the maximum number of double bonds that a hydrogen atom can form?

   A. 0 B. 1 C 2
   D. 3 E. 4

3. The most electronegative atom of the ones listed below is _____.

   A. B B. Al C. Ga
   D. In E Tl

4. When the Lewis structure for BrO_2^- is drawn correct, the central Br atom has _____ bonding regions and _____ lone pairs.

   A. 2, 0 B. 2, 1 C. 2, 2
   D. 2, 3 E. 2, 4

5. Which compound below is ionic?

   A. CF_4 B. SO_3 C. H_2S
   D. $BaCl_2$ E. $C_{12}H_{22}O_{11}$

6. The proper name for Cr_2S_3 is _____

   A. chromium(III) sulfide. B. chromium(III) trisulfide.
   C. chromium sulfide. D. dichromium sulfide.
   E. chromium(III) trisulfide.

7. Which information below is NOT shown in Lewis structures of molecules?

A. how atoms are arranged in space
B. the number of bonding pairs of electrons between atoms
C. nonbonding electrons on atoms
D. the order in which atoms are linked
E. the number of valence electrons in the molecule

8. Acetonitrile (CH_3CN) is an important industrial chemical. Among other things, it is used to make plastic moldings, which have multiple uses, from car parts to Lego bricks. Which statement below about acetonitrile is FALSE?

A. Acetonitrile has 16 valence electrons in its Lewis structure.
B. Acetonitrile has one triple bond.
C. Acetonitrile has one pair of nonbonding electrons.
D. All atoms satisfy the octet rule in acetonitrile.
E. One carbon atom and the nitrogen atom have nonzero formal charges.

9. You synthesize a new radon compound in which the central radon atom is bonded to four fluorine atoms and two oxygen atoms. How many valence electrons does its Lewis structure contain?

A. 48 B. 32 C. 28
D. 12 E. 8

10. Resonance structures indicate that _____

A. there is more than one allotropic form of a compound.
B. more than one ionic form of a compound exists.
C. a molecule's electronic structure is an average of all possible Lewis structures.
D. more than one isotopic form of an element exists in the molecule.
E. the molecule jumps back and forth between two or more different electronic structures.

11. Nitrite (NO_2^-) is an important nutrient in the eutrophic zone of the ocean. Which set of resonance structures below best describes the bonding in this ion?

a) 

b) 

c) 

d) 

A. a B. b C. c
D. d E. none of these

12. Which property below is typically used to predict the type of bond that forms between two elements?

A. electronegativity B. ionization energy
C. atomic radius D. electron affinity
E. atomic mass

13. For molecules with only one central atom, how many lone pairs on the central atom guarantees molecular polarity?

A. 1 B. 2 C. 1 or 2
D. 3 E. 1 or 3

14. The sp^3d^2 atomic hybrid orbital set accommodates _____ electron domains.

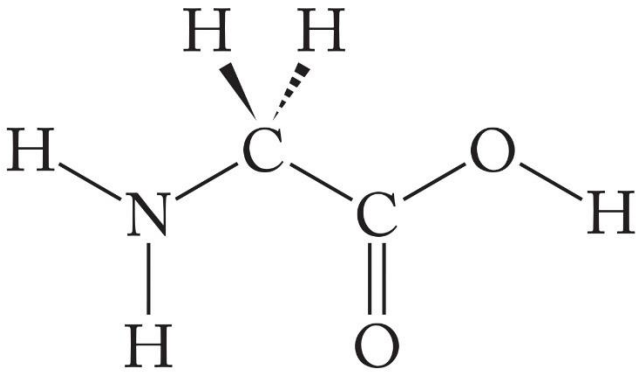
A. 2 B. 3 C. 4
D. 5 E. 6

15. When four atomic orbitals are mixed to form hybrid orbitals, how many hybrid orbitals are formed?

A. one B. six C. three
D. four E. five

16. Consider the molecular structure shown below.

Finish the Lewis structure by putting in any lone pairs and answer the following question. What is the angle formed by the N – C – C bond in this structure?



A. 90^o B. 109.5^o C. 120^o
D. 180^O E. 360^o

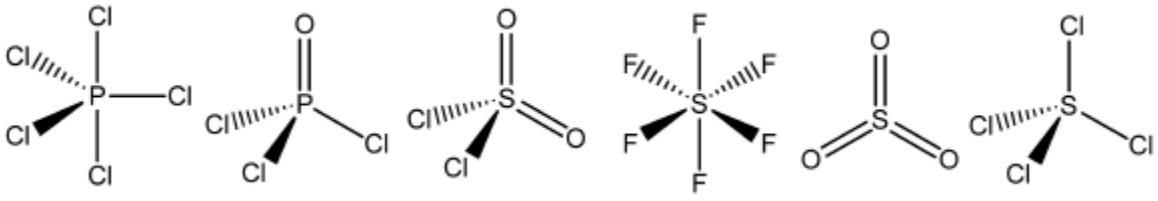
17. What is the steric number of the central sulfur atom in SCl_2?

A. 2 B. 3 C. 4
D. 5 E. 6

18. Determine the molecular geometry of the chlorite ion, ClO_2^-.

A linear B. bent C. trigonal bipyramid
D. tetrahedral E. trigonal bipyramid

19. Which of these molecules have a dipole moment?



A. PCl_5 and $SiCl_4$ B. $POCl_3$, SO_2Cl_2, and SO_3
C. $POCl_3$ and SO_2Cl_2 D. PCl_5, $POCl_3$, $SOCl_2$, SO_3, and $SiCl_4$
E. PCl_5, SF_6, SO_3, and $SiCl_4$

20. Which statement below regarding valence bond theory is TRUE?

A. Hybrid orbitals cannot contain lone pairs of electrons.
B. A single bond is a sigma bond with a localized electron pair.
C. A double bond can be described as two π bonds occupied by four electrons.
D. The magnetic properties of a molecule are readily explained.
E. There is no provision for atoms with expanded octets.

21. Which statement regarding a π bond between two carbon atoms is TRUE?

A. The region of high electron density lies along the bond axis connecting the nuclei of the two atoms.
B. It can be described by the overlap of *sp* hybrid orbitals from each atom.
C. It can be described by the overlap of sp^2 hybrid orbitals from each atom.
D. It can be described by the overlap of a *p* atomic orbital from one atom with an sp^2 hybrid orbital from the other atom.
E. It can be described by the overlap of *p* atomic orbitals from each atom.

22. What is the hybridization of sulfur in $SOCl_2$?

A. sp^2 B. sp^3 C. sp^3d
D. sp E. sp^3d^2

23. There are _____ σ bonds and _____ π bonds in $H_3C\text{-}CH_2\text{-}CH{=}CH\text{-}CH_2\text{-}C{\equiv}CH$.

A. 14, 2 B. 10, 3 C. 12, 2
D. 13, 2 E. 16, 3

24. For the molecule $CH_3CH{=}CHCH_3$, the local molecular geometry around the second carbon atom from the end and its hybridization are _____

A. trigonal bipyramidal and *sp*. B. trigonal planar and sp^3.
C. trigonal planar and sp^2. D. tetrahedral and sp^3.
E. linear and *sp*.

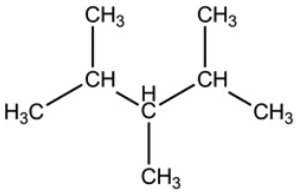
25. In liquids, the attractive intermolecular forces are _____.

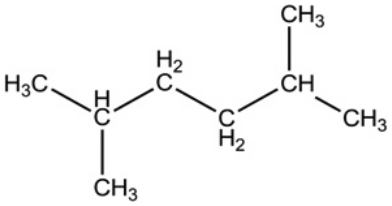
A. very weak compared with kinetic energies of the molecules
B. strong enough to hold molecules relatively close together
C. strong enough to keep the molecules confined to vibrating about their fixed lattice points
D. not strong enough to keep molecules from moving past each other
E. strong enough to hold molecules relatively close together but <u>not</u> strong enough to keep molecules from moving past each other

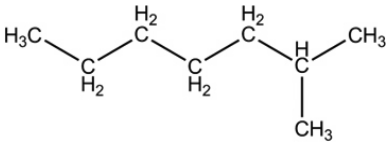
26. Dispersion forces are due to

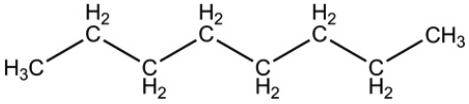
A. permanent dipoles.
B. temporary dipoles
C. hydrogen bonding
D. ionic interactions
E. protons

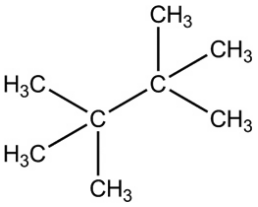
27. Which molecule below exhibits the greatest dispersion forces?

A. 

B. 

C. 

D. 

E. 

28. Ion–dipole forces always require

A. an ion and a water molecule.
B. a cation and a water molecule.
C. an anion and a polar molecule.
D. an ion and a polar molecule.
E. a polar and a nonpolar molecule.

29. When sodium chloride dissolves in water, how do the water molecules orient around the ions?

A. Water molecules are randomly oriented around the ions.
B. The hydrogen atoms point toward both the sodium and the chloride ions.
C. The oxygen atoms point toward both the sodium ions and the chloride ions.
D. The hydrogen atoms point toward the sodium ions, and the oxygen atoms point toward the chloride ions.
E. The oxygen atoms point toward the sodium ions, and the hydrogen atoms point toward the chloride ions.

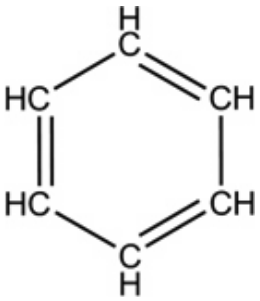
30. For a molecule to exhibit dipole–dipole interactions, it must

A. have a temporary dipole moment.
B. have a hydrogen bound to an oxygen, nitrogen, or fluorine.
C. have a permanent dipole moment.
D. be an ion.
E. have three or more atoms.

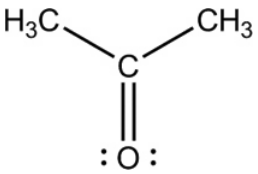
31. Which compound below will exhibit hydrogen bonding with itself in the liquid state?

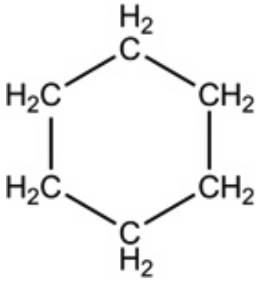
A. CH_3OCH_3 B. CH_3COCH_3 C. $CH_3CH_2NH_2$
D. H_2CO E. CH_3F

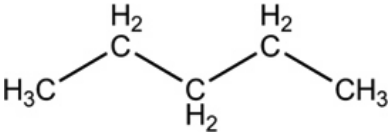
32. Which solvent below could involve ion–dipole interactions with Na^+?

A. 

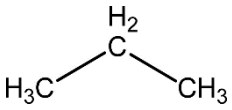
B. CCl_4

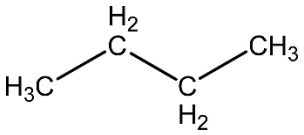
C. 

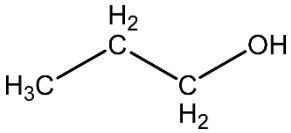
D. 

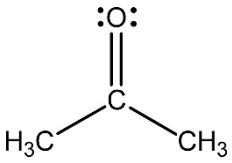
E. 

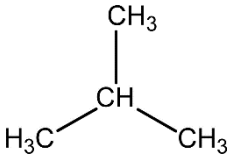
33. Which substance below would you predict to have the highest boiling point?

A. 

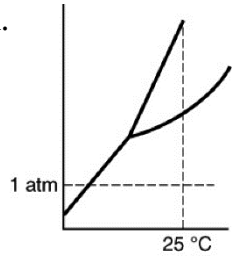
B. 

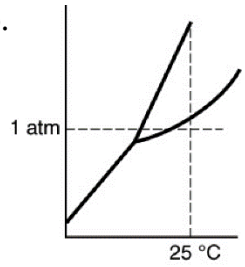
C. 

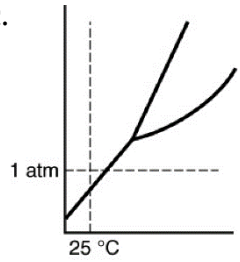
D. 

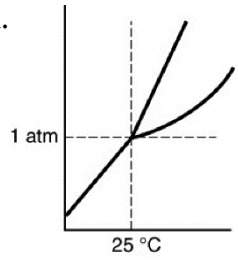
E. 

34. As predicted by the phase diagram below, which substance will exist only as a solid at 25°C and 1 atm?

a. 

b. 

c. 

d. 

A. a B. b C. c
D. d E. none of these

USEFUL AND USELESS INFORMATION

Formal Charge = # valence electrons - # un-bonded electrons – ½(bonded electrons)