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2.3-105

Which of the following decrease when electrons condense around nuclei ?

- (a) only the energy of the particles
- (b) only the entropy of the particles
- (c) only the free energy of the particles
- (d) all of the above

2.3-110

Condensation is

- (a) energy-driven only
- (b) entropy-driven only
- (c) both of the above
- (d) neither of the above

2.3-115

An atom of ${}^1_9\text{F}$ has how many electrons?

(a) 19

(b) 9

(c) 28

(d) 10

2.3-120

Which of the following is true?

(a) noble gas atoms generally occur in molecules

(b) a noble gas atom has a smaller radius than an atom with either one more or one less proton and electron

(c) noble gas atoms lose and gain electrons easily

(d) none of the above

2.3-125

Which of the following atoms has the smallest size?

- (a) Cl
- (b) Se
- (c) S
- (d) Br

2.3-130

Which of the following atoms has the largest size?

- (a) Na
- (b) K
- (c) Ca
- (d) Mg

2.3-135

The element with 118 protons has not yet been observed. It should be a

- (a) halogen
- (b) noble gas
- (c) chalcogen
- (d) alkali metal

2.3-140

Which of the following is NOT a property of non-metals

- (a) brittleness
- (b) poor electrical conductivity
- (c) poor heat conductivity
- (d) luster

2.3-145

Which of the following elements has the greatest metallic character?

- (a) Si
- (b) C
- (c) Al
- (d) B

2.3-150

Which of the following has the least metallic character?

- (a) As
- (b) P
- (c) S
- (d) Se

2.3-155

Which of the following atoms has the greatest propensity to lose an electron?

- (a) Ca
- (b) Ba
- (c) K
- (d) Cs

2.3-160

Which of the following atoms has the greatest propensity to gain an electron?

- (a) Br
- (b) Se
- (c) S
- (d) Cl

2.3-205

The sulfide ion is isoelectronic with which noble gas?

- (a) He (b) Ne (c) Ar (d) Kr

2.3-210

Which two atoms form isoelectronic ions?

(a) Br and Cl

(b) Na and K

(c) K and Cl

(d) Na and Cl

2.3-215

Which two atoms do NOT form isoelectronic ions?

(a) Mg and N

(b) O and N

(c) Be and N

(d) Mg and Na

2.3-220

Which of the following ions is NOT isoelectronic with a noble gas?

- (a) Mg^{+2} (b) Ca^{+}
(c) O^{-2} (d) Br^{-}

2.3-230

The following species are all isoelectronic with Ne (i.e., all have 10 electrons). Which has the largest radius?

(a) O^{2-}

(b) F^-

(c) Na^+

(d) Mg^{2+}

Which has the smallest?

2.3-235

Which atom has the smallest radius?

- (a) S (b) Cl (c) Ar (d) K

2.3-240

Aluminum forms the compound Al_2X_3 .
X must be a member of which group?

- (a) IV (b) V (c) VI (d) VII

2.3-245

Nitrogen forms the compound X_3N . X must be a member of which group?

- (a) I (b) II (c) III (d) IV

2.3-250

In binary compounds, the common ratio of alkali metals to halides is ?

(a) 2:1 (b) 1:1 (c) 1:2 (d) 1:3

of alkali metals to chalcogens ?

of alkali earth metals to chalcogens ?

of boron family members to halogens ?

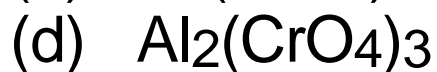
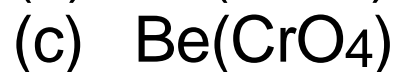
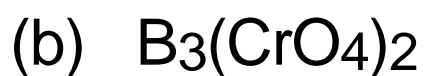
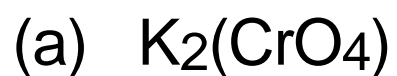
2.3-255

Which of the following is NOT a correct formula for a compound?



2.3-260

Which of the following is NOT a correct formula for a CrO_4^{2-} (chromate) compound?



2.3-310

"Valence" electrons are those in the outermost shell. Which of the following atoms has 1 valence electron?

- (a) Ca (b) P (c) Li (d) F

2.3-320

The number of valence electrons in Be is

- (a) 2 (b) 3 (c) 4 (d) 6

in Sr ?

2.3-325

The number of valence electrons in N is

- (a) 2 (b) 3 (c) 5 (d) 15

In As?

2.3-330

The number of valence electrons in Br is

- (a) 17 (b) 7 (c) 5 (d) 1

2.3-340

What is the maximum number of valence electrons in any atom?

- (a) 2 (b) 8 (c) 10 (d) 18

2.3-411

How many electrons are involved in the bond X-Y ?

- (a) 1 (b) 2 (c) 3 (d) 4

2.3-412

How many electrons are involved in the bond
 $X=Y$?

- (a) 2 (b) 4 (c) 6 (d) 8

2.3-413

How many electrons are involved in the bond
 $X \equiv Y$?

- (a) 3 (b) 4 (c) 5 (d) 6

2.3-421

Which bond is the shortest ?

(a) C-C

(b) C=C

(c) C≡C

2.3-422

Which bond is the shortest ?

(a) C-H

(b) N-H

(c) O-H

2.3-423

Which bond is the shortest ?

(a) C-C

(b) N-N

(c) N-C

2.3-424

Which bond is the shortest ?



2.3-430

If the octet rule is satisfied, the number of lone pairs on the X atom in the structure -X is

(a) 0 (b) 1 (c) 2 (d) 3

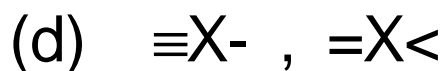
in -X- ?

in >X- ?

in >X< ?

2.3-440

If the octet rule is satisfied, the number of lone pairs on the X atom is the same in which pair of structures ?



2.3-450

If the octet rule is satisfied, the number of lone pairs on the X atom is different in which pair of structures ?

- (a) $-X$, $=X$ (b) $=X-$, $>X-$
(c) $-X-$, $=X$ (d) $=X=$, $>X<$

2.3-461

If X is a chalcogen, in which of the following octet structures does X have a non-zero formal charge ?

- (a) $-X-$ (b) $-X$ (c) $=X$

What is the formal charge ?

- (a) -2 (b) -1 (c) +1 (d) +2

2.3-462

If X is a member of the nitrogen family, in which of the following octet structures does X have a non-zero formal charge ?

- (a) $-X<$ (b) $=X<$
(c) $-X=$ (d) $\equiv X$

What is the formal charge ?

- (a) -2 (b) -1 (c) +1 (d) +2

2.3-463

If X is a member of the carbon family, in which of the following octet structures does X have a non-zero formal charge ?

- (a) $-X<$ (b) $>X<$
(c) $=X=$ (d) $\equiv X-$

What is the formal charge ?

- (a) -2 (b) -1 (c) +1 (d) +2

2.3-470

Carbon monosulfide (CS) was discovered in interstellar space in 1971. With $4+6=10$ available valence electrons, octets are achieved on both atoms with the structure



What is the formal charge on the carbon?

- (a) -2 (b) -1 (c) +1 (d) +2

What is the formal charge on the sulfur?

- (a) -2 (b) -1 (c) +1 (d) +2

2.3-481

If X has zero formal charge in the octet structure -X-, then X is a member of which family ?

- | | |
|---------------|--------------|
| (a) carbon | (b) nitrogen |
| (c) chalcogen | (d) halogen |

2.3-482

If X has zero formal charge in the octet structure $=X^-$, then X is a member of which family ?

- | | |
|---------------|--------------|
| (a) carbon | (b) nitrogen |
| (c) chalcogen | (d) halogen |

2.3-483

If X has zero formal charge in the octet structure $=X<$, then X is a member of which family ?

- | | |
|---------------|--------------|
| (a) carbon | (b) nitrogen |
| (c) chalcogen | (d) halogen |

2.3-484

If X has zero formal charge in the octet structure $-X$, then X is a member of which family ?

- | | |
|---------------|--------------|
| (a) carbon | (b) nitrogen |
| (c) chalcogen | (d) halogen |

2.3-490

The central atom in CHFCl_2 is

- | | | | |
|-----|----|-----|---|
| (a) | H | (c) | C |
| (b) | Cl | (d) | F |

2.3-510

Hydrogen cyanide (HCN) was discovered in interstellar space in 1970.

The total number of valence electrons needed for each atom in HCN to have its own noble gas configuration is

- (a) 10 (b) 24 (c) 18 (d) 8

The total number of valence electrons available in HCN is

- (a) 10 (b) 14 (c) 18

2.3-520

Since the 10 valence electrons available in hydrogen cyanide (HCN) is 8 short of the 18 required for separate noble gas configurations, the number of bonding pairs required in HCN is

- (a) 8 (b) 4 (c) 2

2.3-530

The arrangement of the 4 bonding pairs of electrons in HCN is

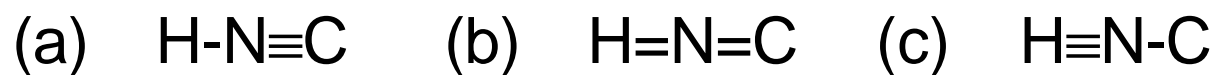
- (a) $\text{H-C}\equiv\text{N}$ (b) $\text{H}=\text{C}=\text{N}$ (c) $\text{H}\equiv\text{C}-\text{N}$

The lone pair containing the remaining two valence electrons is on the

- (a) H (b) N (c) C

2.3-540

Hydrogen isocyanide (HNC) was discovered in interstellar space in 1971. Like hydrogen cyanide (HCN), it has 10 valence electrons available and 18 needed to form separate noble gas configurations. How are the 4 pairs of bonding electrons distributed?



2.3-550

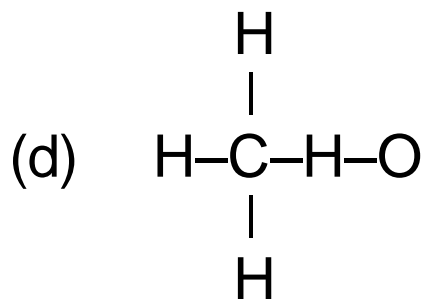
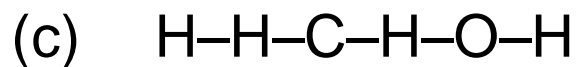
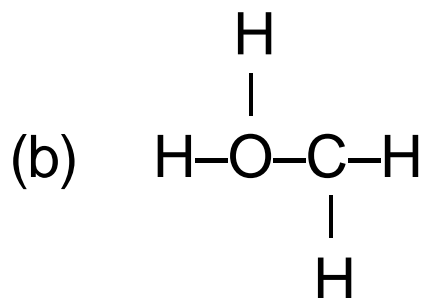
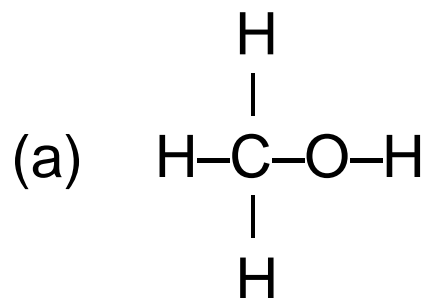
Compared to $\text{H-C}\equiv\text{N}$, $\text{H-N}\equiv\text{C}$ is

(a) more (b) less

stable.

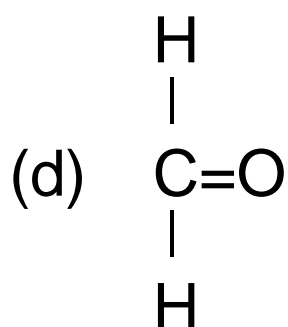
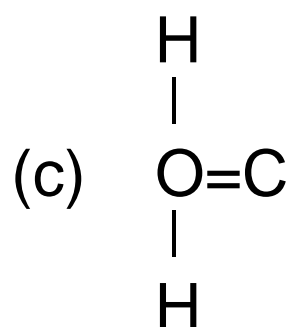
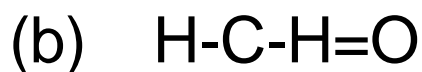
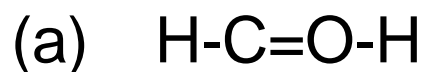
2.3-561

Methanol (CH_4O) was discovered in interstellar space in 1970. How are the 5 bonding pairs of electrons arranged?



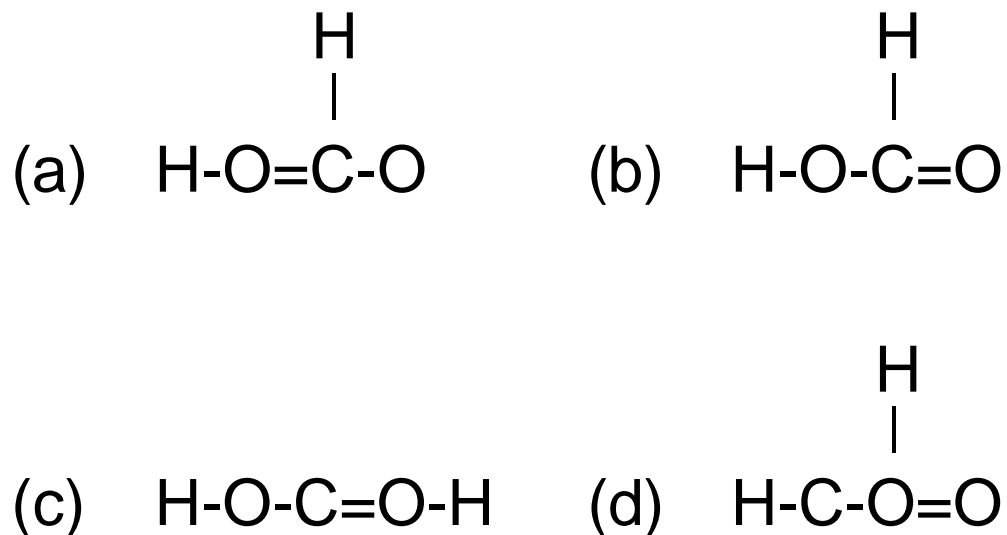
2.3-562

Formaldehyde (CH₂O) was discovered in interstellar space in 1969. How are the 4 bonding pairs of electrons arranged?



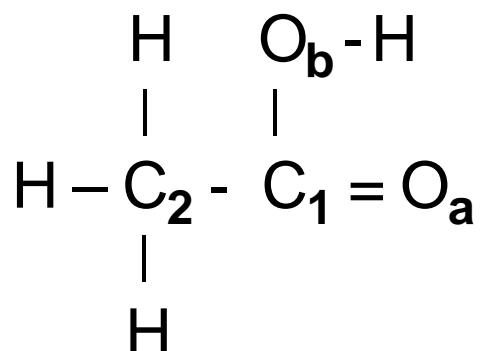
2.3-563

Formic acid (CH_2O_2) was discovered in interstellar space in 1970. How are the 5 bonding pairs of electrons arranged?



2.3-580

Acetic acid ($C_2H_4O_2$) was discovered in interstellar space in 1996. It has 24 valence electrons and its Lewis structure is



How many lone pairs are there?

- (a) 2 (b) 3 (c) 4 (d) 5

Where do they belong?

- (a) one on each C and one on each O
(b) three on O_a and one C_1
(c) two on each O

2.3-610

Hydroxyl (HO) was discovered in interstellar space in 1963. It has an odd number (7) of valence electrons, so one atom will have less than a full noble gas set. Which atom is that?

(a) O

(b) H

2.3-620

In ICl_3 the number of valence electrons around the central I atom is

- (a) 6 (b) 8 (c) 10 (d) 12

2.3-630

In which of the following compounds is every atom surrounded by eight valence electrons?

- (a) IF_5 (b) C_2H_4 (c) SiF_4 (d) NO_2

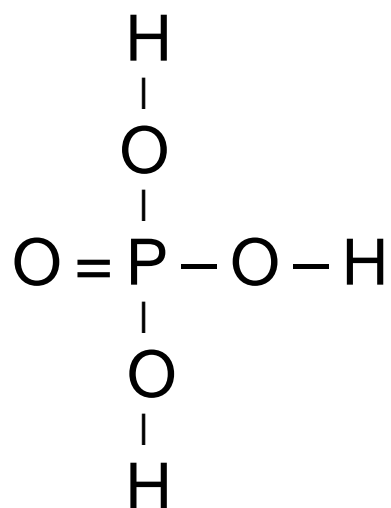
2.3-640

PO_4^{-3} has how many resonance structures?

- (a) 1 (b) 2 (c) 3 (d) 4

2.3-651

H_3PO_4 has the structure

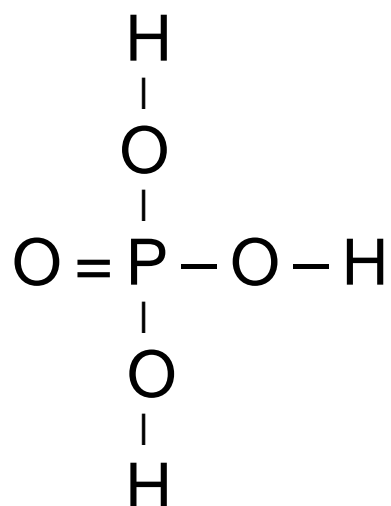


How many resonance structures are needed to describe H_2PO_4^- ?

- (a) 1 (b) 2 (c) 3 (d) 4

2.3-652

H₃PO₄ has the structure

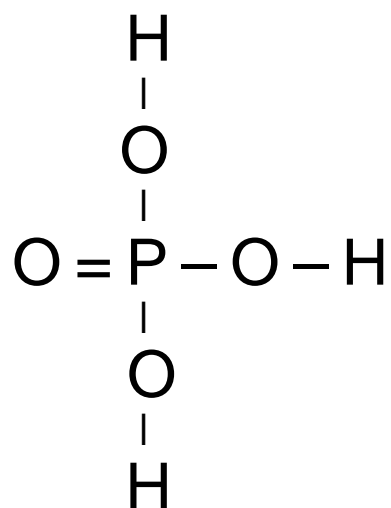


How many resonance structures are needed to describe HPO₄⁻² ?

- (a) 1 (b) 2 (c) 3 (d) 4

2.3-653

H₃PO₄ has the structure



How many resonance structures are needed to describe PO₄⁻³ ?

- (a) 1 (b) 2 (c) 3 (d) 4

2.3-710

If the octet rule is satisfied, the steric number of the X atom in the structure $-X\equiv$ is

- (a) 2 (b) 3 (c) 4 (d) 5

The bond angle will be about

- (a) 180° (b) 120°
(c) 109.5° (d) 90°

2.3-720

If the octet rule is satisfied, the steric number of the X atom in the structure $-X=$ is

- (a) 2 (b) 3 (c) 4 (d) 5

The bond angle will be about

- (a) 180° (b) 120°
(c) 109.5° (d) 90°

To be more precise, the bond angle will be

- (a) $>120^\circ$ (b) $=120^\circ$ (c) $<120^\circ$

2.3-730

If the octet rule is satisfied, the steric number of the X atom in the structure $-X-$ is

- (a) 2 (b) 3 (c) 4 (d) 5

The bond angle will be about

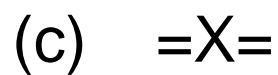
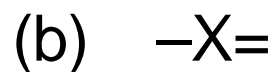
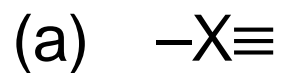
- (a) 180° (b) 120°
(c) 109.5° (d) 90°

To be more precise, it is

- (a) $>109.5^\circ$ (b) $=109.5^\circ$ (c) $<109.5^\circ$

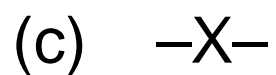
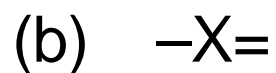
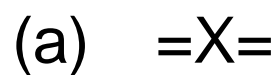
2.3-740

If the octet rule is satisfied, which of the following structures will be bent at the X atom?



2.3-745

If the octet rule is satisfied, which of the following structures will not be bent at the X atom?



2.3-760

Carbonly sulfide (OCS) was discovered in interstellar space in 1971. It's structure is

- (a) linear (b) bent

2.3-770

In the hydrocarbon C_3H_m x-ray diffraction (which doesn't "see" H's) finds a C–C–C bond angle of about 120° . The value of m must be

- | | | | |
|-----|---|-----|----|
| (a) | 4 | (b) | 6 |
| (c) | 8 | (d) | 10 |

2.3-820

If the octet rule is satisfied in each case, in which pair is the steric number of the X atoms different?



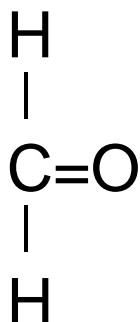
2.3-825

If the octet rule is satisfied in each case, in which pair is the steric number of the X atoms the same?



2.3-840

Formaldehyde

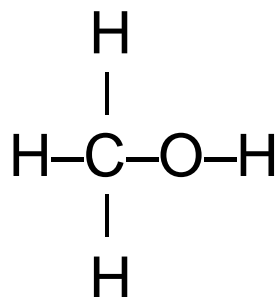


was discovered in interstellar space in 1969.
The HCO bond angle is about

- (a) 180° (b) 120°
(c) 109.5° (d) 90°

2.3-850

Methanol

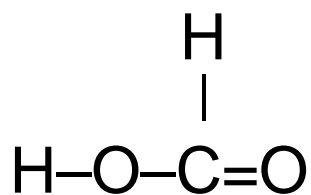


was discovered in interstellar space in 1970.
The HCO bond angle is about

- | | | | |
|-----|---------------|-----|-------------|
| (a) | 180° | (b) | 120° |
| (c) | 109.5° | (d) | 90° |

2.3-860

Formic acid



was discovered in interstellar space in 1970.
The OCO bond angle is about

- (a) 180° (b) 120°
(c) 109.5° (d) 90°

2.3-870

In cubane (C_8H_8 , first synthesized in 1964) each C atom is bonded to 3 other C atoms and one H atom.

The C-C-C bond angle that would minimize electron pair repulsion is about

- | | |
|-------------------|-----------------|
| (a) 180° | (b) 120° |
| (c) 109.5° | (d) 90° |

Since the C atoms are at the corners of a cube, the C-C-C bond angles are actually

- | | |
|-------------------|-----------------|
| (a) 180° | (b) 120° |
| (c) 109.5° | (d) 90° |

2.3-910

In PCl_3 the steric number of the central P atom is

- (a) 3 (b) 4 (c) 5 (d) 6

It's structure is

- (a) planar (b) pyramidal (c) T-shaped

The bond angles are

- (a) 120°
(b) between 109.5° and 120°
(c) 109.5°
(d) between 109.5° and 90°

2.3-920

In ICl_3 the steric number of the central I atom is

- (a) 3 (b) 4 (c) 5 (d) 6

It's structure is

- (a) planar (b) pyramidal (c) T-shaped

The bond angles are

- (a) 120°
(b) 109.5°
(c) 90°