CHEM 1211
Mock Exam 2 KEY

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Fall 2019

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Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. [redacted]

a) 4.41×10^{14} sec^{-1}.

[redacted]

You must be comfortable with the equation $c = f \lambda$; Where c is equal to the speed of light (m/s), f is equal to the frequency (in sec^{-1} or Hz) and λ is equal to the frequency (in nm).
You must know that the speed of light is a constant (2.998×10^{8} m/s).
$c = f \lambda \rightarrow (2.998 \times 10^{8} \text{ m/s}) = f (680 \times 10^{-9} \text{ m})$
$f = 4.41 \times 10^{14}$ sec^{-1}

2. [redacted]

d) 6.63×10^{-26} J.

[redacted]

Be comfortable with the equation $E = hf$, where energy is equal to Planck's constant multiplied by the frequency. Depending on the information given, another version of the equation is $E = hc/\lambda$.
You must know that Planck's constant (h) is equal to 6.626×10^{-34}. You are given the information that the station operates at 100.1 MHz, thus you need to convert this to just Hx.
1001. MHz = 100.1×10^{6} Hz. Now plug into equation and solve!
$E = (6.626 \times 10^{-34})(100.1 \times 10^{6} \text{ Hz}) = 6.63 \times 10^{-26}$ J.

3. [redacted]

[redacted]

e) I and III.

For answering questions such as this, you need to be comfortable with the rules and limitations of what each quantum number can represent.

The quantum numbers			The number of the quantum states	
n	l	ml	In the subshell	In the coat
1	0 (s)	0	2	2
2	0 (s) 1 (p)	0 -1,0,+1	2 6	8
3	0 (s) 1 (p) 2 (d)	0 -1,0,+1 -2,-1,0,+1,+2	2 6 10	18
4	0 (s) 1 (p) 2 (d) 3 (f)	0 -1,0,+1 -2,-1,0,+1,+2 -3,-2,-1,0,+1,+2,+3	2 6 10 14	32

Use the energy diagram below to answer questions 4 and 5:

4. [redacted]

b) n4 → n3.

[redacted]

First, you must understand the relationship between wavelength, frequency, and energy. Frequency and energy are directly related (ie greater frequency = more energy) and wavelength and energy are inversely related (ie greater wavelength = less energy). If the question is asking you for longest wavelength then you would select the answer that gives emission of the least amount of energy. Because emission is going down levels, the answer that would give you the least amount of energy is n4 → n3.

5. [redacted]

d) $1.599 \times 10^{14}\ sec^{-1}$.

[redacted]

You must know how to apply the energy of an electron transition formula and Ryberg's constant:
$E = -Rh\ (1/n_i^2 - 1/n_f^2)$

$E = -2.179 \times 10^{-18}\ J\ ((1/3^2) - 1/4^2)) = -1.0592 \times 10^{-19}\ J$

$E = h\ f \rightarrow f = E/h$

$f = (1.0592 \times 10^{-19}\ J)/(6.626 \times 10^{-34}) = \underline{1.599 \times 10^{14}\ sec^{-1}.}$

6. [redacted]

b) Angular momentum.

[redacted]

All orbitals in a given subshell will not necessarily have the same value for their principal and magnetic quantum numbers.

7. [redacted]

b) Kr > Br > Se > Ge > Ga.

[redacted]

First ionization energy increases as you go up and to the right on the periodic table. You must know all of your periodic table trends in order to do well on this exam!

8. [redacted]

d) Cl.

Electron affinity increases as you go up and to the right on the periodic table. You must know all of your periodic table trends in order to do well on this exam!

9. [redacted]

b) $[Ar]3d^{10}4s^1$

Remember the exceptions you learned for electron configuration! Elements in the columns involving chromium and copper will steal an electron from the s orbital to fill their d orbitals. The question also asks for noble gas configuration and we know that the noble we need to use for this question is Argon.

10. [redacted]

b) Be^{2+}

Having a 2+ charge, Be will lose two electrons from its normal electron configuration [He] $2s^2$. These electrons will be lost from the 2s shell, causing the configuration to be identical to Helium, a noble gas.

11. [redacted]

e) None of the above.

The electron configuration of the Cu+ ion is $1s^22s^22p^63s^23p^63d^{10}$.
The electron configuration for Nickel is $1s^22s^22p^63s^23p^64s^23d^8$
The electron configuration Zinc is $1s^22s^22p^63s^23p^64s^23d^{10}$
The electron configuration Ga+ is $1s^22s^22p^63s^23p^64s^23d^{10}$
The electron configuration Argon is $1s^22s^22p^63s^23p^6$

Based on this, none of the atoms/ions match the Cu+ electron configuration.

12. Which atom would have the most unpaired electrons in its ground state?

[redacted]

d) Chromium, Cr.

[redacted]

Oxygen: 2 unpaired electrons.
Nitrogen: 3 unpaired electrons.
Arsenic: 3 unpaired electrons.
Chromium: 6 unpaired electrons.
Nickel: 2 unpaired electrons.

13. [redacted]

[redacted]

e) O2-, F-, Ne, Na+

Isoelectric series = same number of electrons. Only the atoms/ions in option e have the same number of electrons.

14. [redacted]

[redacted]

c) III only.

[redacted]

Copper (II) sulfite → Cu^{2+} SO_3^{2-} → $CuSO_3$, so 1:1 ratio.

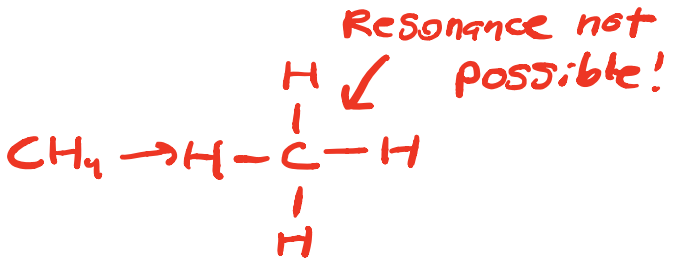
Barium hydroxide → Ba^{2+} OH^- → $BaOH_2$, so 1:2 ratio.
Iron (II) nitrate → Fe^{2+} NO_3^- → $Fe(NO_3)_2$, so 1:2 ratio.
Magnesium carbonate → Mg^{2+} CO_3^{2-} → $MgCO_3$, so 1:1 ratio.

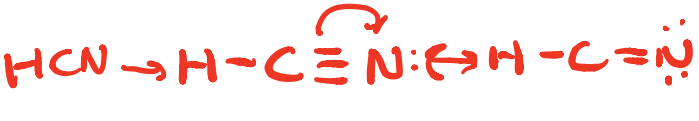
Note: Please memorize your polyatomic ions! It will be hard to answer questions like this if you don't!

15. [redacted]

a) CH_4

[redacted]

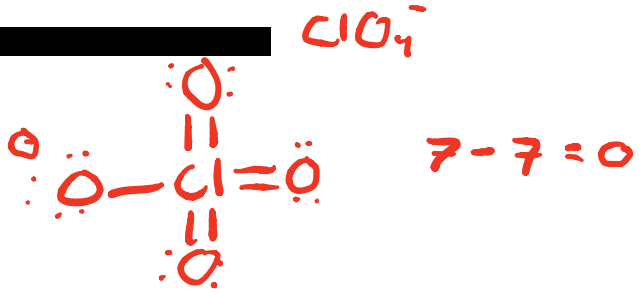




Based on the Lewis structures of O_3 and HCN, they can exhibit resonance. CH4 is completely made up of single bonds, one of the reasons that is does not exhibit resonance.

16. [redacted]

d) 0



To answer a question like this, you must know the polyatomic ions and the charges associated with them!

17. [redacted]

b) CO_2

[redacted]

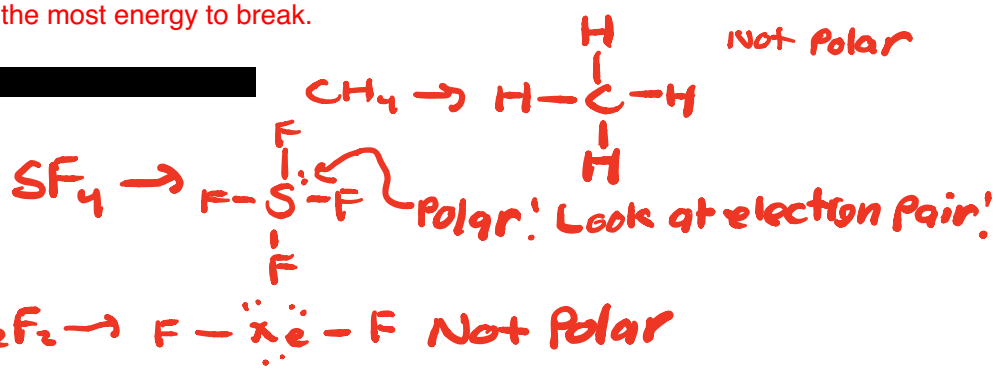
Shortest wavelength = highest frequency = highest energy

Double bonds are shorter and thus harder to break. Because of the double bonds present in CO_2, we know that this molecule will require the most energy to break.

18. [redacted]

a) SF_4

[redacted]

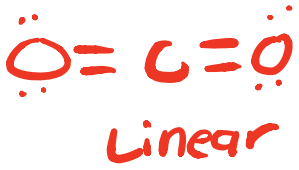


By drawing out the Lewis structures, you will see that the only polar molecule in the list is SF_4.

19. [redacted]

a) Linear.

[redacted]



Based on the molecular geometry rules that you learned, CO2 is linear. If you are having problems with questions like these, look over the geometry chart provided in the exam review!

20. [redacted]

a) N-F < C-F < B-F < H-F

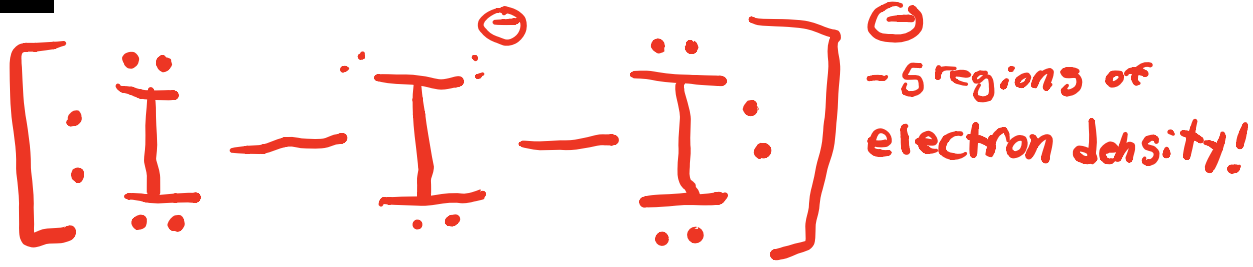
[redacted]

The greater the electronegativity is between two atoms, the more polar the bond is. N-F has the least difference in electronegativity, while the difference between H-F is the greatest.

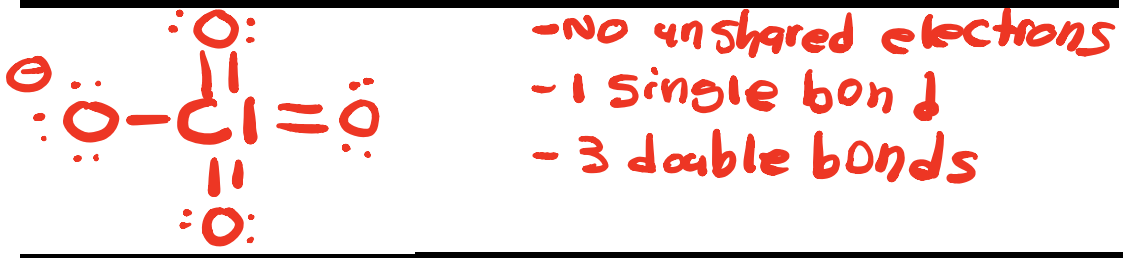
Free Response Practice:

21. [redacted]

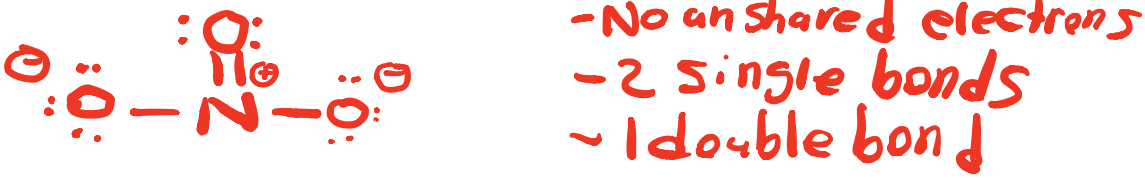
a) [redacted]



b) [redacted]



c) [redacted]



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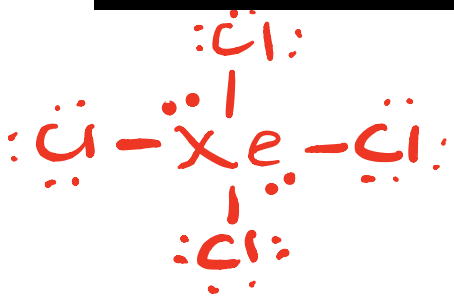
d) [redacted]



· electron geometry: Octahedral

· molecular geometry: Square Planar

· Non-Polar

22. [redacted]

a) [redacted]

3

b) [redacted]

c) [redacted]

11

3

d) [redacted]

0

e) [redacted]

0

23. [redacted]

a) [redacted]

bent; Polar

b) [redacted]

Linear; non-Polar

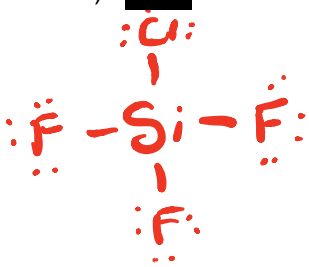
c) [redacted]

bent; Polar

d) [redacted]

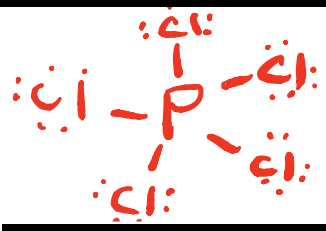
linear; non-Polar

e) [redacted]



Tetrahedral, different atoms; Polar

24. [redacted]



a) [redacted]

Trigonal bipyramidal

[redacted]

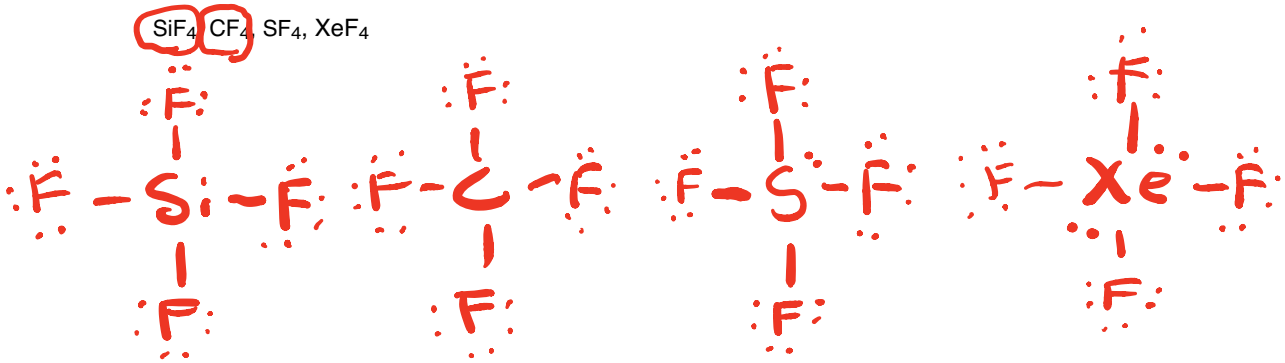
Trigonal bipyramidal

c) [redacted]

No!

25. [redacted]

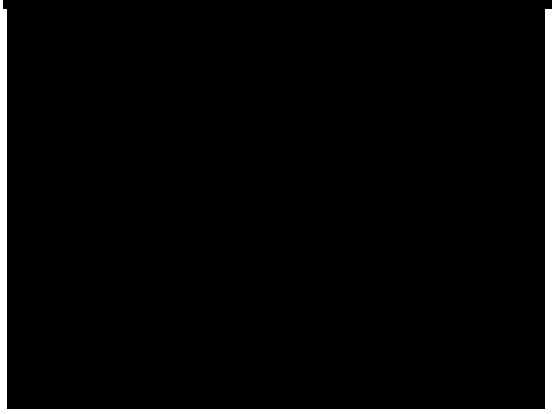
SiF_4, CF_4, SF_4, XeF_4



26. [redacted]

The C-O bonds each have dipole moments; but they cancel each other out so there is no net dipole.

27. [redacted] e:



A: (6-5) = +1

B: (4-4) = 0

C: (5-7) = -3

28. [redacted]

[redacted]	[redacted]
[redacted]	Yes
[redacted]	No
[redacted]	No
[redacted]	No
[redacted]	Yes

29. [redacted]

a) [redacted]

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

b) [redacted]

$[Kr] 5s^1 4d^5$

Note: I chose condensed for MO to demonstrate it.

30. [redacted]

a) [redacted]

4 → 5

b) [redacted]

1 → 5

c) [redacted]

5 → 1

