MC FR
12 pts 19pt = 31 pts

1/2

AP Chem - Unit5 - MC Test

1) A O has smallest Radius ∴ greatest Attraction for its e's

2) A " ∴ require the most energy to remove

3) B Ba has highest Energy level, n=6, filled ∴ its Attraction for its e's is weakest & radius largest

4) D S^{-2}, Cl^-, K^+ All have electron config same as Argon

5) C A huge jump in IE occurs at IE_3. suggesting the 3rd e is Being removed from core energy level

6) D ANS: D
PES is used to determine the energies of core electrons.

DIF: Easy OBJ: 1.15 NAT: 4.1 TOP: Spectroscopy
KEY: IR spectroscopy | PES | UV spectroscopy | mass spectroscopy

7) D ANS: D
The Pauli exclusion principle *technically* states that no two electrons can have the same four quantum numbers. BUT, quantum numbers are no longer in the course, so we need to modify his principle to state that *no two electrons within an orbital may have the same spin*. (Apologies to the Austrian physicist Wolfgang Pauli.) So, answer choice D is a double offender!

DIF: easy OBJ: Apply the Pauli exclusion principle. (Example 8.1)
TOP: atomic theory | electronic structure of atoms
KEY: electron configuration | Pauli exclusion principle

8) C ANS: C
There is a HUGE jump in ionization energy from the 3rd IE to the 4th IE. So? Such an increase indicates that the inner core of electrons has been disrupted meaning the *entire* valence was removed at the 3rd ionization, so this element most likely makes a +3 ion and is Al.

DIF: Hard OBJ: 1.5 NAT: 6.2 TOP: Periodicity
KEY: ionization energy NOT: 35% answered correctly

9) C ANS: C
There is a HUGE jump in ionization energy from the 3rd to the 4th. Such an increase indicates that the core has been disrupted meaning the entire valence was removed at the 3rd ionization, so this element most likely makes a +3 ion and is Al and has 3 valence electrons.

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10) D

ANS: D
The electrons associated with the least amount of energy are loosely held by the nucleus, thus easy to remove. Why, they are simply farther from the nucleus, thus less tightly held. Those would the be 4*s* electrons of Ca (20 total electrons).

DIF: Medium OBJ: 1.6 NAT: 5.1 TOP: PES
KEY: PES | atomic structure | electron configuration | energy

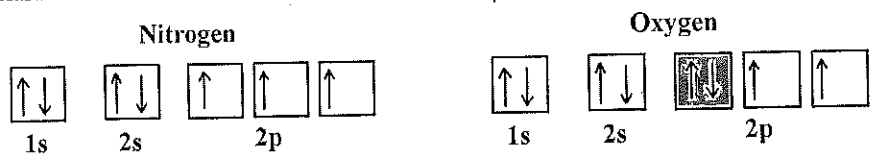
11) D

ANS: D
The electrons associated with the least amount of energy are loosely held by the nucleus, thus easy to remove. Why, they are simply farther from the nucleus, thus less tightly held. Those would the be 4*s* electrons of Ca (20 total electrons).

DIF: Medium OBJ: 1.6 NAT: 5.1 TOP: PES
KEY: PES | electron configuration | ionization energy | energy | periodicity

12) D

ANS: D
Examine their orbital notations below:



The *first-pairing* of electrons in the *p* orbital of oxygen makes that *p* electron EASIER to remove despite oxygen's larger Z_{eff}.

DIF: Moderate OBJ: 1.9 NAT: 6.4 TOP: Periodicity
KEY: chemistry| general chemistry | atomic theory | periodicity of the elements | periodic properties | ionization energy

AP Chem - Unit 5 - Test - FR

1) A)

Both N & F have their valence e's at Energy level 2 1pt

$n=2$ N $1s^2 2s^2 2p^3$

F $1s^2 2s^2 2p^5$

However, N has a less effective nuclear charge (Z_{eff}) than F (7 protons to 9). This means N does not have as great an attraction for its valence electrons as F does ∴ it takes less energy to remove an e from N than F 1pt

B) Both O & N have their valence electrons @ $n=2$ 1pt

O $1s^2 2s^2 2p^4$ ↑↓ ↑ ↑

N $1s^2 2p^2 p^3$ ↑ ↑ ↑

even though O has a greater effective nuclear charge (Z_{eff}) than N (8 protons to 7), O has paired electrons in its $2p^4$ orbital. These paired electrons experience e-e repulsions ∴ it takes less energy to remove, hence the lower 1st ionization energy 1pt

C) The 1st Ionization energy of I would be <u>less</u> than F 1pt

I: $[Kr]5s^2 4d^{10} 5p^5$

F: $1s^2 2s^2 2p^5$

The electron being removed from the F atom is in 2P orbital for I the e removed is in 5P orbital. The 5p orbital is farther away from, & their electrons not as attracted to, the nucleus as in the 2p orbital, ∴ takes less energy to remove it. 1pt

AP Chem - Unit 5 - Test - FR

1) cont:

D) Atoms of I would have largest Atomic Radius.
[AR] $5s^2 4d^{10} 5p^5$

The 5p orbital is farther away from, & not as Attracted to, the nucleus as the 2P orbitals where the other elements have their valence e's are located, +1

∴ the Atoms of I are larger & would have a Bigger atomic Radius.

2) Given:

d = 495 nm Break Cl-Cl Bond

$C = 3.00 \times 10^{17}$ nm/s

1/1

i) $\nu = ?$ $C = \lambda\nu$

$\nu = \frac{C}{\lambda} = \frac{3.00 \times 10^{17} \text{ nm/s}}{495 \text{ nm}}$ +1pt

$\boxed{\nu = 6.06 \times 10^{14} \text{ Hz } (1/s)}$ 1pt

ii) E = ? J $E = h\nu$

$h = 6.626 \times 10^{-34}$ Js $E = (6.626 \times 10^{-34} \text{ J}\cdot\text{s})(6.06 \times 10^{14} \frac{1}{s})$ 1pt

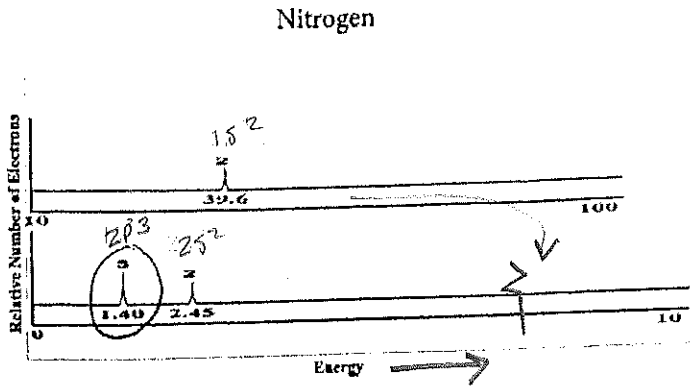
$\boxed{E = 4.02 \times 10^{-19} \text{ J}}$ 1pt

iii) $(4.02 \times 10^{-19} \text{ J})\left(\frac{6.022 \times 10^{23}}{\text{mole}}\right)\left(\frac{1 \text{ kJ}}{1000 \text{ J}}\right) = \boxed{242 \text{ kJ/mol}}$

1pt 1pt 1pt

AP Chem - Unit 5 - Test - FR

3) A) i)



1pt

ii) 1.40 KJ 1pt

B) N $1s^2 2s^2 2p^3$ N^{-1} $1s^2 2s^2 2p^2$

↑ ↑ ↑ ↑ ↑ _

2nd Ionization energy would be greater 1pt
After the Removal of the 1st electron, their are more proton's vs e^- ∴ There is a greater Attraction Btwn p & e ∴ more energy to Remove 2nd e

C) P N in same family N
[Ne] $3s^2 3p^3$ [He] $2s^2 2p^3$ P

1pt P has more energy Levels than N, ∴ P has an increased distance from the nucleus and increased shielding by full principal E levels means it requires less E to remove an electron. The Coulombic Attraction for
1pt P is lower than N due to the larger distance Btwn the P & e in P compared to N