

CIRCLE THE SINGLE CORRECT ANSWER (3pts each- 2 pts Bonus)

1. Which of the following represents a pair of isotopes?

- A) $^{14}_6\text{C}$, $^{14}_7\text{N}$
- B) ^1_1H , ^2_1H
- C) $^{14}_7\text{N}$, $^{15}_8\text{O}$
- D) $^{60}_{27}\text{Co}$, $^{60}_{31}\text{P}$
- E) $^{31}_{15}\text{P}$, $^{31}_{15}\text{P}^{3-}$

same Z but different A

2. An ion is formed

- I. by either adding protons to or subtracting protons from the atom.
- II. by either adding electrons to or subtracting electrons from the atom.
- III. by either adding neutrons to or subtracting neutrons from the atom.

- A) Only I is true.
- B) Only II is true.
- C) Only III is true.
- D) All of the statements are true.
- E) Two of the statements are true.

3. Which element does *not* belong to the family or classification indicated?

- A) I, halogen
- B) Kr, noble gas
- C) Co, transition metal
- D) K, alkali metal
- E) As, lanthanides

As is in group 5A

4. Which of the following is *not* the correct name for the formula given?

- A) Fe_2O_3 iron(III) oxide
- B) PBr_5 phosphorus pentabromide
- C) CoO cobalt(II) oxide
- D) CaSO_4 calcium sulfite
- E) HClO hypochlorous acid

it is calcium sulfate.

5. Write the names of the following acids:

a) HNO_3

nitric acid.

b) H_2SO_3

sulfurous acid.

6. For a new element, 67.16% is an isotope with mass 280.8 amu, 2.76% is an isotope with mass 283.7 amu, and 30.08% is an isotope with mass 284.8 amu. Calculate the average atomic mass of this new element.

- A) 282.1 amu
- B) 283.1 amu
- C) 313.4 amu
- D) 280.8 amu
- E) 849.3 amu

$$\text{Average} = \frac{67.16 \times 280.8}{100} + \frac{2.76 \times 283.7}{100} + \frac{30.08 \times 284.8}{100}$$

7. A sample of iron weighing 16.8 g contains how many moles of iron atoms?

- A) 0.0874 moles
- B) 0.301 moles
- C) 0.646 moles
- D) 0.132 moles
- E) 3.32 moles

$$n = \frac{m}{M}$$

$$M_{\text{Fe}} =$$

8. A single atom of an element weighs 5.81×10^{-23} g. Identify the isotope.

- A) ^{80}Br
- B) ^{35}Cl
- C) ^{103}Rh
- D) ^{82}Se
- E) none of these

$$m = \frac{M}{N_A} \quad ; \quad N = \frac{m}{N_A} \Rightarrow N_0 = m N_A$$

$$N = \frac{m N_A}{M}$$

9. How many molecules of ammonia are present in 3.7 g of ammonia?

- A) 2.2×10^1
- B) 2.2×10^{24}
- C) 3.6×10^{25}
- D) 1.3×10^{23}
- E) 4.5×10^{23}

$$m = \frac{M}{N_A} \quad ; \quad m = \frac{N}{N_A}$$

$$\Rightarrow \frac{N}{N_A} = \frac{m}{M}$$

$$N = \frac{m N_A}{M}$$

$$M_{\text{NH}_3} = 12,01 + 3(1,008)$$

$$= 17,036 \text{ g/mol}$$

10. An oxybromate compound, NaBrO_x , where x is a whole number, is analyzed and found to contain 52.95% bromine.

What is x?

- A) 0
- B) 1
- C) 2
- D) 3
- E) 4

$$\frac{\text{mass of Br}}{\text{Molar compound mass}} \times 100 = 52,95 \Rightarrow \text{compound mass}$$

$$M = M_{\text{Na}} + M_{\text{Br}} + x M_{\text{O}}$$

$$\Rightarrow x M_{\text{O}} = 48,007 \text{ g}$$

$$M_{\text{O}} = 16$$

$$\boxed{x = 3}$$

11. Light has a wavelength of 6.0×10^2 nm. What is the energy of a photon of this light?

- A) 1.10×10^{-19} J
- B) 3.31×10^{-19} J
- C) 2.71×10^{18} J
- D) 3.68×10^{-20} J
- E) 1.33×10^{-18} J

$$\lambda = 6 \times 10^2 \text{ nm} = 6 \times 10^{-7} \text{ m}$$

$$E = h \nu$$

$$\boxed{E = \frac{hc}{\lambda}}$$

$$\lambda \nu = c$$

$$\nu = \frac{c}{\lambda}$$

12. What is the wavelength of light that is emitted when an excited electron in the hydrogen atom falls from the $n = 5$ level to the $n = 2$ level?

- A) 5.12×10^{-7} m
 B) 4.34×10^{-7} m
 C) 6.50×10^{-7} m
 D) 5.82×10^{-7} m
 E) none of these

$\Delta E = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) = -4.578 \times 10^{-19}$

$|\Delta E| = h\nu$
 $= h \frac{c}{\lambda}$
 $\Rightarrow \lambda = \frac{hc}{|\Delta E|}$

$\nu = \frac{c}{\lambda}$

13. In Bohr's atomic theory, when an electron moves from one energy level to another energy level more distant nucleus,

- A) energy is emitted.
 B) energy is absorbed.
 C) no change in energy occurs.
 D) light is emitted.
 E) none of these

14. How many electrons in an atom can have the quantum numbers $n = 3, l = 1$?

- A) 10
 B) 2
 C) 6
 D) 18
 E) 32

number of electrons = $2(2l+1)$

$2l+1 =$ number of orbitals
 we have 3 orbitals each one can
 hold $2e^- \Rightarrow$ number of electrons = 6

The number of orbitals having a given value of l is equal to

- A) $2l+1$
 B) $2n+2$
 C) $3l$
 D) $l+m_l$
 E) the number of lobes in each orbital

number of orbital = $2l+1$

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16. Which of the following combinations of quantum numbers is not allowed?
(Combinations are listed in the following order: n, l, m_l, m_s)

- A) 1 1 0 -1/2
B) 3 0 0 -1/2
C) 3 1 1 1/2
D) 5 3 1 -1/2
E) 3 2 0 1/2

$0 \leq l < n$

$l = n - 1 \Rightarrow 2 \neq 1$
Disallowed

17. How many electrons can be described by the quantum number $n = 4$?

- A) 8
B) 10
C) 2
D) 18
E) 32

number of $e^- = 2n^2$

32

18. What is the electron configuration for the barium atom ($Z=56$)?

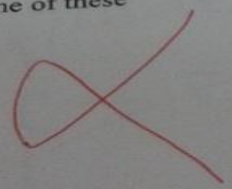
- A) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
B) $[\text{Xe}] 6s^2$
C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
E) none of these

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$
 $4p^6 5s^2 5p^6 6s^2$
 $[\text{Xe}] 6s^2$

19. What is the electron configuration of Cr^{3+} ? ($\text{Cr}: Z=24$)

- A) $[\text{Ar}] 4s^2 3d^1$
B) $[\text{Ar}] 4s^1 3d^2$
C) $[\text{Ar}] 3d^3$
D) $[\text{Ar}] 4s^2 3d^4$
E) none of these

$2 \text{Cr}^{3+} = 2 \text{Cr} - 3 = 9$
 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$
 $[\text{Ar}] 4s^2 3d^1$

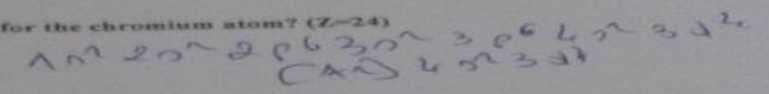


- A) Ba
- B) K
- C) Si
- D) P
- E) Cl

is an atom of group 5A each atom contains 5 valence electrons needs 3 electrons to complete its valence shell

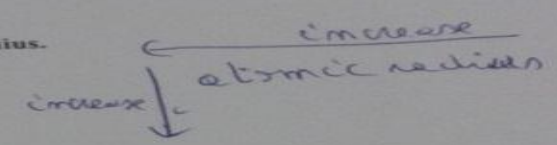
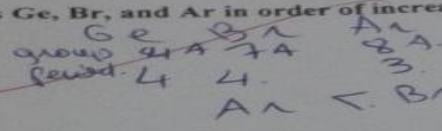
21. What is the electron configuration for the chromium atom? (Z=24)

- A) [Ar] 4s²3d⁴
- B) [Ar] 4s¹3d⁵
- C) [Kr] 4s²3d⁴
- D) [Kr] 4s¹3d⁵
- E) none of these



22. Place the elements Ge, Br, and Ar in order of increasing atomic radius.

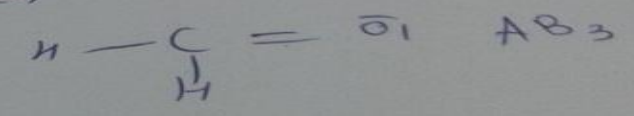
- A) Ge, Br, Ar
- B) Ar, Br, Ge
- C) Br, Ar, Ge
- D) Ge, Ar, Br
- E) Br, Ge, Ar



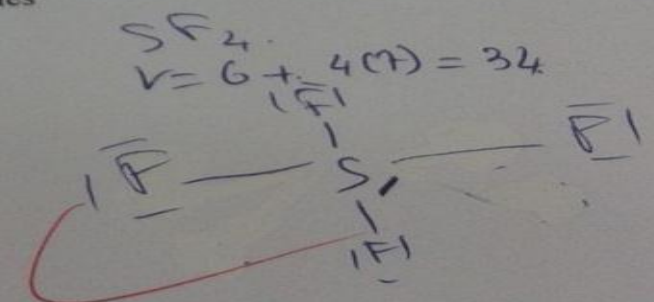
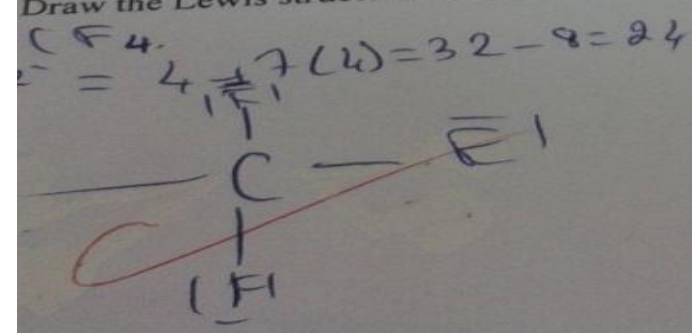
23. The bond angles about the carbon atom in the formaldehyde molecule, H₂C=O, are about

- A) 120°
- B) 60°
- C) 109°
- D) 180°
- E) 90°

$V_e = 2 + 4 + 6 = 12$

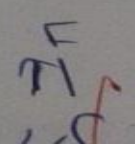


24. Consider the following compounds: CF₄, SF₄, XeF₄
 Draw the Lewis structure for each of the above molecules



Does CF₄ molecule has a dipole moment?

Explain



25. Which of the following has the largest radius?

- A) O²⁻
- B) F
- C) Ne
- D) Na⁺
- E) Mg²⁺

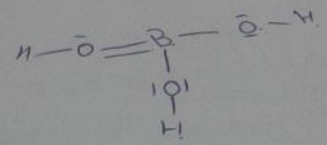
O: groupe 6, 2e period
 F: groupe 7a, 2e period
 Ne: groupe 8a, 2e period
 Na: groupe 1a, 3e period
 Mg: groupe 2a, 3e period
 vs
 but the radius of cation < radius of atom
 radius of anion > radius of atom

6

26. The Lewis structure for H₃BO₃ is

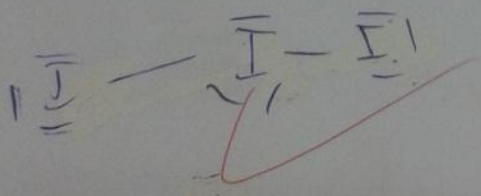
- A)
- B)
- C)
- D)
- E)

$$V = 3(1) + 3 + 3(6) = 3 + 3 + 18 = 24 - 12 = 12$$



27. Draw first the Lewis structure for I₃⁻ and state how many electrons are around the central iodine atom

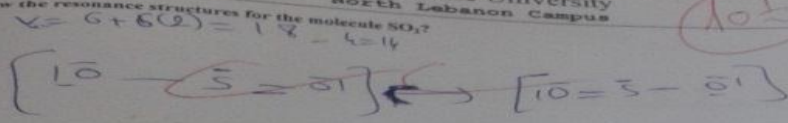
$$V_c = (7 \times 3) + 1 = 22 - 4 = 18$$



~~FC = number of valence e
 number of bond
 of unsat e
 = 7 - 3 - 2 = 2
 iodine has~~

there is 10 electrons around the central
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28. Draw the resonance structures for the molecule SO_2 ?



10.5 + 11

29. Which of the following Lewis structures best describes BF_3 ?

- A)
- B)
- C)
- D)
- E)

all

all

FC = number of valence electrons - number of bonds - number of unpaired electrons

A) $FC = 3 - 3 - 0 = 0$

B) $FC = 3 - 4 - 0 = -1$
But B is in an irregular shell and only needs 6 valence electrons.

C) $FC = F$ does not obey the octet rule

D) B has 10 electrons and this is impossible

E) F does not obey the octet rule.

Select the correct molecular structure for NH_3 .

- A) linear
- B) bent
- C) pyramidal
- D) tetrahedral
- E) none of these

$V = 5 + 1(3) = 8$

