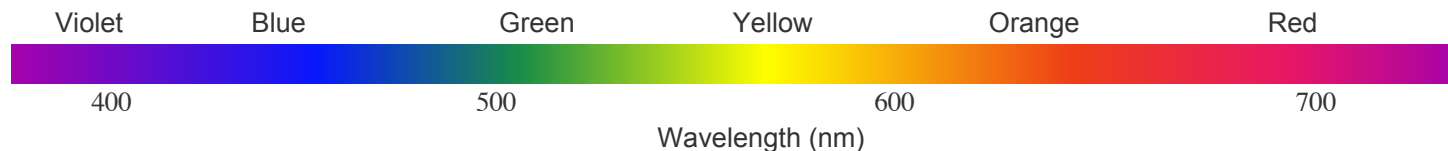


Student Name: _____

Student ID#: _____

Potentially Useful Information



Light: $\lambda\nu = c$, $E_{\text{photon}} = h\nu$, $c = 2.99792 \times 10^8 \text{ m s}^{-1}$

$N_A = 6.02214 \times 10^{23} \text{ mol}^{-1}$

Photoelectric Effect: $E_{\text{kin}}(e^-) = h\nu - \Phi = h\nu - h\nu_0$

$h = 6.62608 \times 10^{-34} \text{ J s}$

Matter: $p = mv$, $E_{\text{kin}} = \frac{mv^2}{2} = \frac{p^2}{2m}$

$R = 3.28984 \times 10^{15} \text{ Hz}$

Wave/Matter: $\lambda_{\text{deBroglie}} = \frac{h}{p}$

$R_\infty = hR = 2.17987 \times 10^{-18} \text{ J}$

Particle 1D box: $E_n = \frac{h^2 n^2}{8mL^2}$; $n = 1, 2, 3, \dots$

$R_\infty/\text{mole} = 1312 \text{ kJ/mol}$

H atom, 1-electron ion: $E_n = -\left(\frac{Z^2}{n^2}\right)R_\infty$; $n = 1, 2, 3, \dots$

$m_e = 9.10938 \times 10^{-31} \text{ kg}$

Orbital Nodes: Total = $n - 1$, Angular = ℓ , Radial = $n - 1 - \ell$

	H	Na	K	Rb	Cl	Br	I
Ionization Energy [IE] (kJ/Mole)	1312	496	419	403	1251	1140	1008
Electron Affinity [EA] (kJ/Mole)	73	53	48	47	349	325	295

You may verify that the IE of atomic H corresponds to UV light with a photon wavelength of 91 nm.

For graders use only

MC Score	
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Students Name _____

1) Which compound has the lowest percentage of iodine by mass?

- A) IF_3 B) BaI_2 C) FeI_3 D) AlI_3 E) CaI_2

2) A Nickel solution is green. What color will the solution be through a green colored lens?

- A) white B) black C) blue D) red E) green

3) One mole of carbon atoms reacts to form C_{60} , buckminsterfullerene molecules. How many moles of C_{60} are formed?

- A) 6.0×10^{23} B) 1.0×10^{22} C) 60 D) 1.0 E) 1.7×10^{-2}

4) Which species has seven protons, seven electrons, and eight neutrons?

- A) ^{15}N B) ^{14}N C) $^{14}\text{N}^+$ D) ^{30}P E) $^{30}\text{P}^+$

5) Hydrogen has two stable isotopes, ^1H and ^2H , and carbon has two stable isotopes, ^{12}C and ^{13}C . Which isotopic species of methane (CH_4) will give a peak at mass 19 in a mass spectrometer?

- A) $^{12}\text{C}^1\text{H}_4$ B) $^{12}\text{C}^1\text{H}_2^2\text{H}_2$ C) $^{12}\text{C}^1\text{H}^2\text{H}_3$ D) $^{13}\text{C}^1\text{H}^2\text{H}_3$ E) $^{13}\text{C}^2\text{H}_4$

6) An oxide of titanium (Ti) contains 40.0% oxygen by weight. The empirical formula is:

- A) TiO_2 B) TiO C) Ti_2O_3 D) Ti_2O E) Ti_3O_2

7) The radiation absorbed in the transition from $n = 2$ to $n = 3$ in a neutral hydrogen atom has a wavelength of 657 nm. What would be the wavelength of radiation absorbed in the transition from $n = 1$ to $n = 3$?

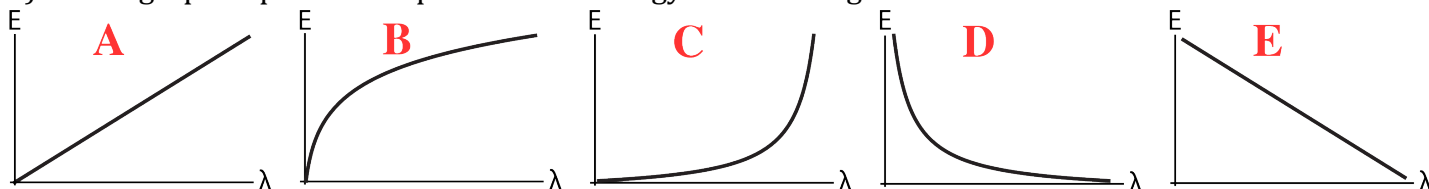
- A) 103 nm B) 657 nm C) 1051 nm D) 1314 nm E) 4205 nm

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8) The $n = 3$ to $n = 2$ emission in H is at $\lambda = 657.0$ nm. At what wavelength (in nm) is the $n = 6$ to $n = 4$ emission in He^+ .

- A) 103 B) 328.5 C) 657.0 D) 2628 E) 5256

9) Which graph depicts the dependence of energy on wavelength?



10) If the De Broglie wavelength of electrons moving at speed 300 m/s is 0.06 nm. Which of the following has the shortest De Broglie wavelength?

- A) IR light B) UV Light C) 1 nm X-rays
D) electrons at 3 m/s E) electrons at 30 m/s

11) Which transitions in hydrogen correspond to the absorption of light with the longest wavelength?

- A) $1 \rightarrow 2$ B) $2 \rightarrow 3$ C) $3 \rightarrow 4$ D) $2 \rightarrow 4$ E) $3 \rightarrow 5$

12) The ionization energy of H(1s) is 1312 kJ/mole. What is the ionization energy of $\text{He}^+(2s)$ in kJ/mole?

- A) 328 B) 656 C) 1312 D) 2624 E) 5248

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13) How many radial nodes are there in a 3p atomic orbital?

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

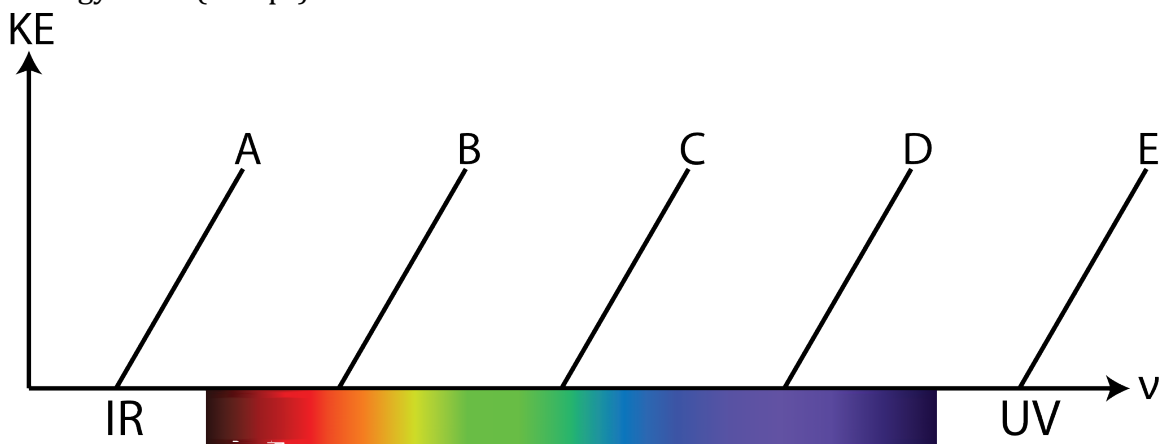
14) Which species can have the electron configuration $1s^2 2s^2 2p^4 3s^1$?

- A) O^+ B) O^- C) F^+ D) F^- E) Ne

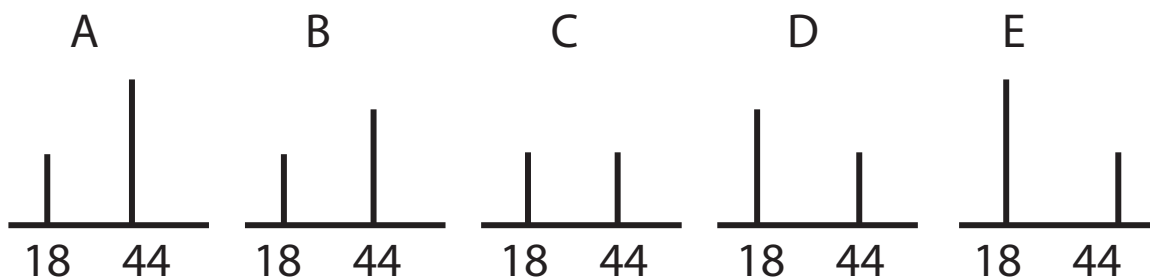
15) Which has the lowest ionization energy?

- A) $H(1s^1)$ B) $H(2p^1)$ C) $He^+(3p^1)$ D) $He(1s^1 2p^1)$ E) $He(1s^1 3p^1)$

16) The ionization energy of $H(3p^1)$ corresponds to infrared light. Which spectrum corresponds to the ionization energy of $He(1s^1 3p^1)$?



17) Which mass spectrum depicts the combustion products of acetylene (C_2H_2) with O_2 ?



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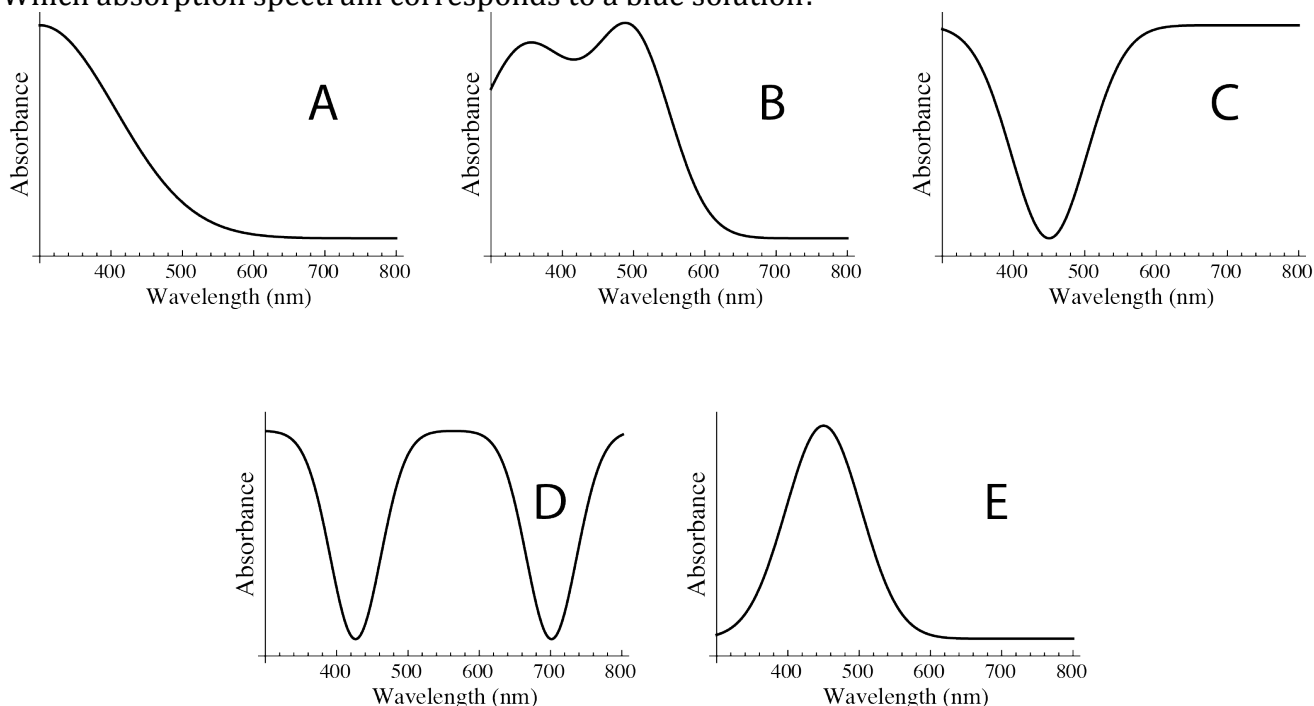
18) 1 g of a hydrocarbon reacts with excess O_2 to form H_2O and 3 grams CO_2 . What is the empirical formula of the hydrocarbon?

- A) CH_4 B) CH_2 C) CH D) C_3H_8 E) C_2H_5

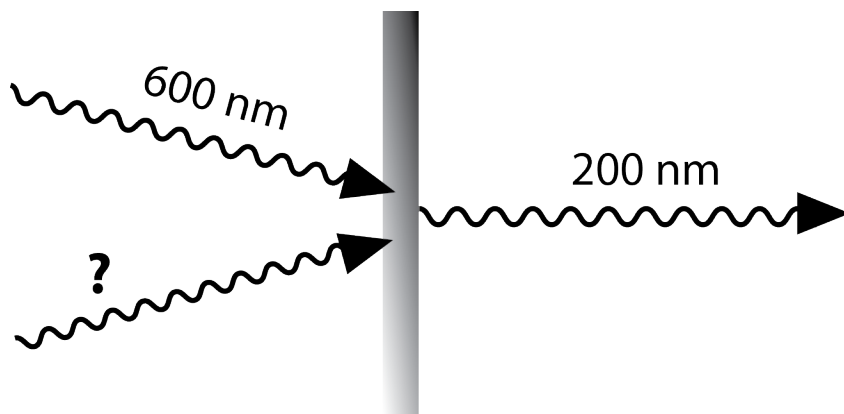
19) Which element has the ground state electron configuration $[Ar]3d^{10}4s^24p^2$

- A) Si B) Ar C) Ge D) Kr E) Bk

20) Which absorption spectrum corresponds to a blue solution?



21) Two photons of light hit a material that redistributes their energy. One photon is emitted from the material at 200 nm. One of the incident photons has a wavelength of 600 nm. What is the wavelength, X , of the other incident photon?



- A) 200 nm
B) 300 nm
C) 400 nm
D) 600 nm
E) 800 nm

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22) Which of these atoms would become more paramagnetic by gaining an electron?

A) C

B) N

C) O

D) F

E) Na

23) Recall the notation $\ell = 0$ (s), $\ell = 1$ (p), $\ell = 2$ (d), $\ell = 3$ (f), $\ell = 4$ (g). Which of the following is not a possible electron configuration for Argon?

A) $1s^2 2p^6 3d^{10}$

B) $1s^2 2p^6 4d^{10}$

C) $1s^2 3d^6 4f^{10}$

D) $1s^2 4d^6 4f^{10}$

E) $1s^2 4f^6 4g^{10}$

24) What is the maximum number of electrons that can occupy the $n = 4$ shell?

A) 4

B) 8

C) 16

D) 32

E) 64

25) Which of the following states for a particle in a 1D box has the highest energy?

A) $n = 1, L = 1$

B) $n = 1, L = 2$

C) $n = 2, L = 1$

D) $n = 2, L = 3$

E) $n = 3, L = 2$

26) When 686.0 g of the lead oxide Pb_3O_4 is heated, decomposition occurs producing 16.0 g of O_2 gas and 670.0 g of a different lead oxide. What is the empirical formula of this second oxide?

A) PbO

B) Pb_2O

C) PbO_2

D) Pb_2O_3

E) $Pb_{1.5}O$