Sample Exam Questions

1. Identify the SI Units for each of the following:

Area of a trapezoid → _____ Density →_____

2. The first 8 ionization energies of element "X" are shown below (in aJ).

IE_1	IE_2	IE_3	IE_4	IE_5	IE_6	IE_7	IE_8
1.68	3.17	4.84	8.24	10.42	35.32	42.23	49.60

How many valence electrons does X have? Briefly justify your answer.

What group does X belong to?

Clearly explain why the difference between IE_3 and IE_4 is greater than the difference between IE_2 and IE_3.

3. What is meant by particle-wave duality and why is it important? Be specific.

4. What is meant by "quantization of energy"?

5. Determine the **energy and frequency** of the photon needed to move an electron from the ground state of a hydrogen atom to the 7^{th} energy level. Report your answer in SI units.

Energy _____

Frequency _____

6. Write the ground state electron configuration for each of the following. You may use shorthand notation for part b and c. Circle the valence electrons on each atom.

   a. Silicon

   b. Silver (Z=47)

   c. Bismuth (Z=83)

7. Consider potassium:

   a. Three stable isotopes of potassium exist. Using the data in the table, determine the natural abundance of the ^{41}K.

Isotope	Exact Mass (amu)	Natural Abundance
Potassium-39	38.96	
Potassium-40	39.96	0.012 %
Potassium-41	40.96	

   b. How many neutrons are present in the nucleus of the ^{41}K?

   c. How many protons are present in the nucleus of the ^{41}K?

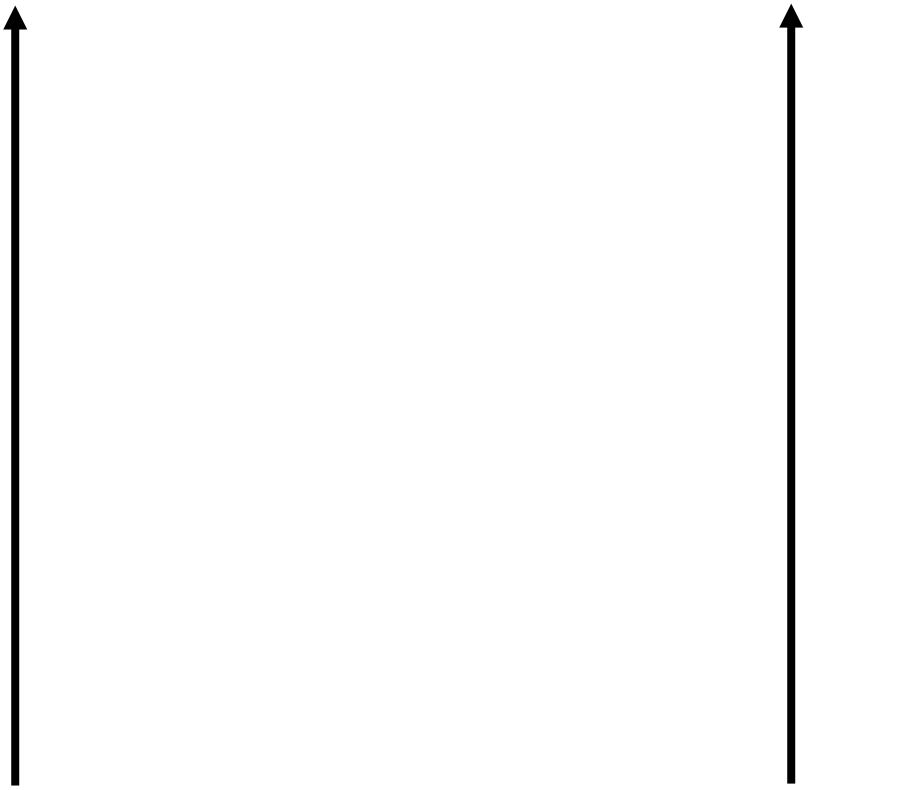
   d. Determine the electron configuration of potassium.

      Long form:

      Condensed:

   e. When a photon with a wavelength of 285.64 nm strikes a potassium atom, an electron is ejected with no kinetic energy. What is the threshold energy of potassium?

f. Show a **complete** orbital energy diagram for the ground state and first excited state of a potassium atom. Make sure to label all orbitals and show all electrons.



Ground State **First Excited State**

g. The radius of ^{41}K is 243 pm. Calculate the density in SI units.

Equations and constants:

$E = h\nu$ $\quad c = \lambda\nu$ $\quad h = 6.626x10^{-34}Js$ $\quad c = 2.998x10^{8}ms^{-1}$

$E_n = \frac{-2.18x10^{-18}J}{n^2}$

$\Delta E = E_{final} - E_{initial}$

$E_K = \frac{1}{2}mv^2$

$E_{potential} \propto \frac{q_1 q_2}{r}$

$m_{electron} = 9.109x10^{-31}kg$

$m_{proton} = 1.673x10^{-27}kg$

$m_{neutron} = 1.675x10^{-27}kg$

$\lambda_{debroglie} = \frac{h}{2v}$

$V_{sphere} = \frac{4}{3}\pi r^3$

$A_{circle} = \pi r^2$

1																		
Hydrogen **1** **H** 1.01																		Helium **2** **He** 4.00
	2											**13**	**14**	**15**	**16**	**17**		
Lithium **3** **Li** 6.94	Beryllium **4** **Be** 9.01											Boron **5** **B** 10.81	Carbon **6** **C** 12.01	Nitrogen **7** **N** 14.01	Oxygen **8** **O** 16.00	Fluorine **9** **F** 19.00	Neon **10** **Ne** 20.18
Sodium **11** **Na** 22.99	Magnesium **12** **Mg** 24.31		**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	Aluminum **13** **Al** 26.98	Silicon **14** **Si** 28.09	Phosphorus **15** **P** 30.97	Sulfur **16** **S** 32.07	Chlorine **17** **Cl** 35.45	Argon **18** **Ar** 39.95
Potassium **19** **K** 39.10	Calcium **20** **Ca** 40.08		Scandium **21** **Sc** 44.96	Titanium **22** **Ti** 47.88	Vanadium **23** **V** 50.94	Chromium **24** **Cr** 52.00	Manganese **25** **Mn** 54.94	Iron **26** **Fe** 55.85	Cobalt **27** **Co** 58.93	Nickel **28** **Ni** 58.69	Copper **29** **Cu** 63.55	Zinc **30** **Zn** 65.39	Gallium **31** **Ga** 69.72	Germanium **32** **Ge** 72.61	Arsenic **33** **As** 74.92	Selenium **34** **Se** 78.96	Bromine **35** **Br** 79.90	Krypton **36** **Kr** 83.80
Rubidium **37** **Rb** 85.47	Strontium **38** **Sr** 87.62		Yttrium **39** **Y** 88.91	Zirconium **40** **Zr** 91.22	Niobium **41** **Nb** 92.91	Molybdenum **42** **Mo** 95.94	Technetium **43** **Tc** (98)	Ruthenium **44** **Ru** 101.07	Rhodium **45** **Rh** 102.91	Palladium **46** **Pd** 106.42	Silver **47** **Ag** 107.87	Cadmium **48** **Cd**	Indium **49** **In** 114.82	Tin **50** **Sn** 118.71	Antimony **51** **Sb** 121.76	Tellurium **52** **Te** 127.60	Iodine **53** **I** 126.90	Xenon **54** **Xe** 131.29
Cesium **55** **Cs** 132.91	Barium **56** **Ba** 137.33	**57-70** *****	Lutetium **71** **Lu** 174.97	Hafnium **72** **Hf** 178.49	Tantalum **73** **Ta** 180.95	Tungsten **74** **W** 183.84	Rhenium **75** **Re** 186.21	Osmium **76** **Os** 190.23	Iridium **77** **Ir** 192.22	Platinum **78** **Pt** 195.08	Gold **79** **Au** 196.97	Mercury **80** **Hg** 200.59	Thallium **81** **Tl** 204.38	Lead **82** **Pb** 207.20	Bismuth **83** **Bi** 208.98	Polonium **84** **Po** (209)	Astatine **85** **At** (210)	Radon **86** **Rn** (222)
Francium **87** **Fr** (223)	Radium **88** **Ra** (226)	**89-102** ******	Lawrencium **103** **Lr** (262)	Rutherfordium **104** **Rf** (267)	Dubnium **105** **Db** (268)	Seaborgium **106** **Sg** (271)	Bohrium **107** **Bh** (272)	Hassium **108** **Hs** (270)	Meitnerium **109** **Mt** (276)	Darmstadtium **110** **Ds** (281)	Roentgenium **111** **Rg** (280)	Copernicium **112** **Cn** (285)	Ununtrium **113** **Uut** (284)	Ununquadium **114** **Uuq** (289)	Ununpentium **115** **Uup** (288)	Ununhexium **116** **Uuh** (293)	Ununseptium **117** **Uus** (294?)	Ununoctium **118** **Uuo** (294)

*lanthanides	Lanthanum **57** **La** 138.91	Cerium **58** **Ce** 140.12	Praseodymium **59** **Pr** 140.91	Neodymium **60** **Nd** 144.24	Promethium **61** **Pm** (145)	Samarium **62** **Sm** 150.36	Europium **63** **Eu** 151.97	Gadolinium **64** **Gd** 157.25	Terbium **65** **Tb** 158.93	Dysprosium **66** **Dy** 162.50	Holmium **67** **Ho** 164.93	Erbium **68** **Er** 167.26	Thulium **69** **Tm** 168.93	Ytterbium **70** **Yb** 173.04
**actinides	Actinium **89** **Ac** (227)	Thorium **90** **Th** 232.04	Protactinium **91** **Pa** 231.04	Uranium **92** **U** 238.03	Neptunium **93** **Np** (237)	Plutonium **94** **Pu** (244)	Americium **95** **Am** (243)	Curium **96** **Cm** (247)	Berkelium **97** **Bk** (247)	Californium **98** **Cf** (251)	Einsteinium **99** **Es** (252)	Fermium **100** **Fm** (257)	Mendelevium **101** **Md** (258)	Nobelium **102** **No** (259)