Worksheet 2.4
Spectroscopy

BE SURE TO INCLUDE ALL WORK AND UNITS!

1. The emission spectrum for helium is given below

a. Draw energy diagrams to help you construct a step-by-step description for the processes involved in the production of an emission spectrum. Be sure to include both the processes by which energy is absorbed and emitted.

b. Draw an energy diagram to compare the possible electron transitions that would produce the red emission line at the left of the spectrum and the blue line at the far right of the diagram.

c. Explain why we use energy diagrams to illustrate electron transitions, rather than using a Bohr model of the atom.

2a. You can calculate the deBroglie wavelength of any object from the equation $\lambda = h/mv$. If you are given the mass in kg and the velocity in m/s, using the fact that $1J = 1kg.m^2/s^2$, show what units you would get for λ.

b. The mass of a neutron is 1.6749×10^{-27} kg. How fast would it have to travel to be diffracted by a sheet of aluminum foil (the spacing between Al atoms in aluminum foil is about 300 pm)

c. If we had a 145 g baseball what speed would the baseball have to move at to have the same wavelength as the neutron above?

Helpful Equations and Constants:

$$E = h\nu$$

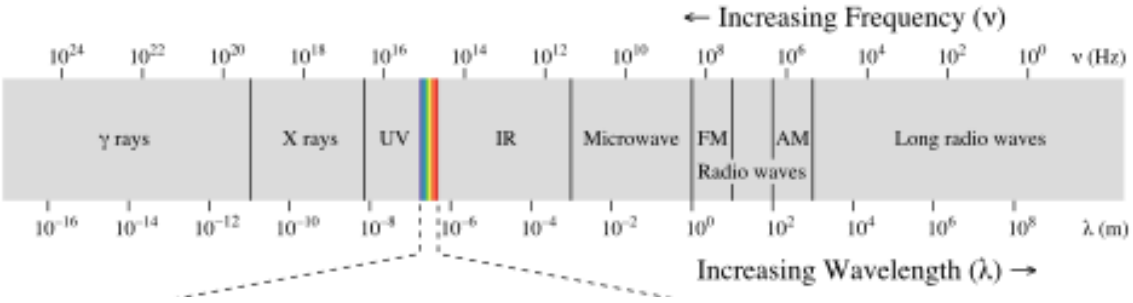
$$c = \lambda\nu$$

$$h = 6.626 \times 10^{-34}\, J \cdot s$$

$$c = 3.0 \times 10^{8}\, \frac{m}{s}$$

$1J = 1kg.m^2/s^2$

$1\ pm = 1 \times 10^{-12}\ m$



PERIODIC TABLE OF THE ELEMENTS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1A												3A	4A	5A	6A	7A	8A
1	1 H 1.008	2A																2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	3B	4B	5B	6B	7B	8B			1B	2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.19	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (267)	105 Db (268)	106 Sg (271)	107 Bh (270)	108 Hs (277)	109 Mt (278)	110 Ds (281)	111 Rg (281)	112 Cn (285)	113 Aug 2003 (286)	114 Fl (289)	115 Feb 2004 (289)	116 Lv (293)	117 Apr 2010 (294)	118 Oct 2006 (294)

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

For elements Tc, Pm, and those beyond Bi, a number in parentheses is the mass number (not the atomic mass) of the most stable or the only known isotope.