

4) **[2 marks]** The electron in a hydrogen-like atom may take several different paths as it relaxes from $n=5$ down to $n=2$. It may, for example, relax to $n=4$, then to $n=3$, then to $n=2$, each time emitting the appropriate photon as it does so. How many different photons may be produced as the electron relaxes via its various paths from $n=5$ to $n=2$?

5) **[3 marks]** The second line in the Balmer series of hydrogen (caused by an electron in $n=4$ relaxing directly to $n=2$) may be reproduced by an electron relaxing from “ n ” directly to “ $n/2$ ” in a Be^{3+} ion. What is the value of “ n ”?

6) **[4 marks]** The table to follow lists sets of four quantum numbers. If the set listed is impossible, indicate why it is impossible.

n	l	m_l	m_s	Reason (if impossible)
43	17	-9	$+\frac{1}{2}$	
2	2	0	$-\frac{1}{2}$	
3	2	$+\frac{1}{2}$	$+\frac{1}{2}$	
2	1	0	$-\frac{1}{2}$	

7) [4 marks] How many:

- a) Orbitals are there in the $n=200$ shell? _____
- b) Electrons in a full $n=5$ shell may have $m_l = 2$? _____
- c) "p" electrons are in a (neutral) atom of Fe? _____
- d) "s" electrons are in an H^+ ion? _____

8) [4 marks] Fill in the indicated information:

atom or ion	<i>full</i> ground state electron configuration	# of unpaired electrons
Zn		
Cr^{+1}		
Fe^{+2}		
La^{+3}		

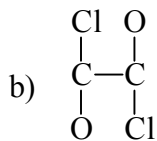
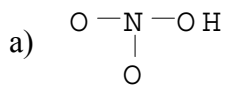
- 9) [9 marks] Arrange the following in order from the lowest value of the indicated property to the highest. In the case where the indicated property is normally negative, order the indicated atoms or ions from least negative to most negative.

radius:	O, F, Cl	_____	_____	_____
radius:	Ca ²⁺ , Cl ⁻ , Ar	_____	_____	_____
1 st IP:	Kr, Cl, O	_____	_____	_____
2 nd IP:	Na, Mg, Ca	_____	_____	_____
EA:	Cl, F, Ne	_____	_____	_____
Paramagnetic:	Cr, N, F	_____	_____	_____
Metallic:	Cs, V, Ga	_____	_____	_____
Bond strength:	C-C, C-O, C-N	_____	_____	_____
Bond length:	C-I, C-O, C≡C	_____	_____	_____

10) [8 marks] Fill in the indicated information. The central atom is underlined.

Molecule	Lewis Structure	Shape (name)
H ₂ <u>C</u> O		
<u>P</u> F ₃		
<u>I</u> Cl ₃		
<u>C</u> lO ₂ ⁻		

11) [6 marks] For the compounds below, draw two resonance structures. One of the resonance structures should be a “good” one, and one not as “good.” Circle the “good” structure. Neither of the compounds below is cyclic. Be sure to include formal charges on the structures you draw.



Useful Formulae and Constants

$$E = h\nu; \nu = \frac{c}{\lambda}$$

$$E_n = -2.1798719 \times 10^{-18} \frac{Z^2}{n^2} \text{ J}$$

$$c = 2.99792458 \times 10^8 \text{ m/s}$$

$$h = 6.6260755 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$N_A = 6.0221367 \times 10^{23} \text{ mol}^{-1}$$

$$1 \text{ eV} = 96485.309 \text{ J/mol}$$

$$\text{T (Tera)} \equiv \times 10^{12}$$