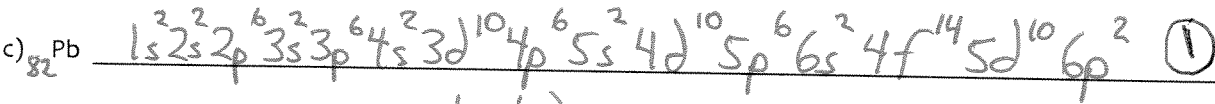
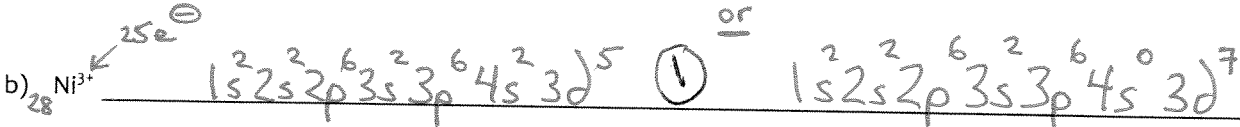
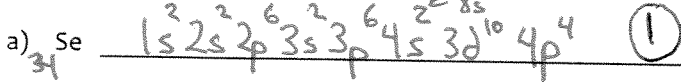


Units must be included in answers where necessary. Show all your work! All the goodies you could possibly want are included on the last page.

Total marks = 31

1. Give the electronic configuration for:

[3 marks]



2. Calculate the wavelength of the light <sup>absorbed</sup> emitted by a hydrogen atom when its electron is excited from the  $n = 1$  to the  $n = 3$  principal energy level.

[2 marks]

$$\Delta E = -2.178 \times 10^{-18} \text{ J} \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$\uparrow$  3                       $\uparrow$  1

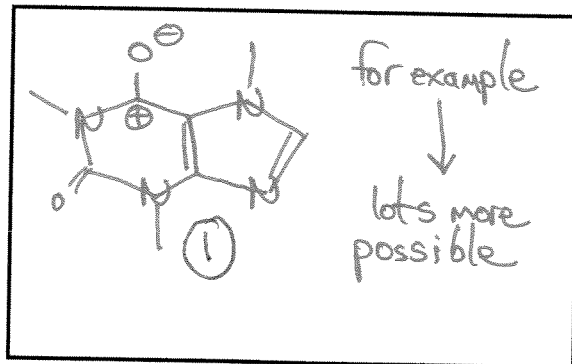
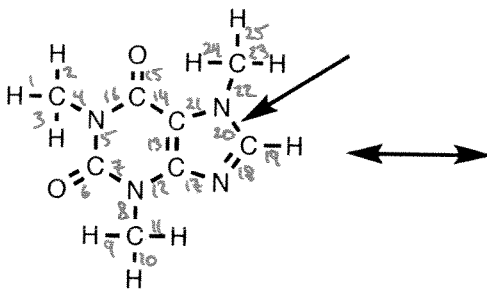
$$\lambda = 1.03 \times 10^{-7} \text{ m}$$
 ①

$$E = 1.94 \times 10^{-18} \text{ J}$$
 ①

$$E = \frac{hc}{\lambda} = \frac{6.6262 \times 10^{-34} \text{ J s} (3.00 \times 10^8 \text{ m s}^{-1})}{\lambda}$$

3. Consider the structure of caffeine shown below.

[4 marks]



a) How many sigma bonds are in this molecule? 25 ①

b) How many pi bonds? 4 ①

c) Describe the arrowed bond in terms of atomic orbital overlap (e.g.  $sp^3-p$ )  $sp^3-sp^2$  ①

d) Fill in the above box.

4. Circle the element/ion that:

[4 marks]

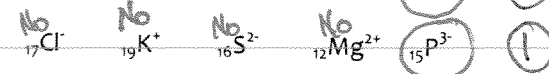
a. has the **largest** atomic radius:



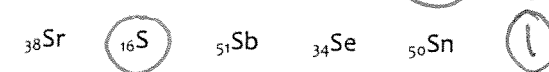
b. has the **greatest** ionization energy:



c. has the **largest** ionic radius:



d. is the **most** electronegative



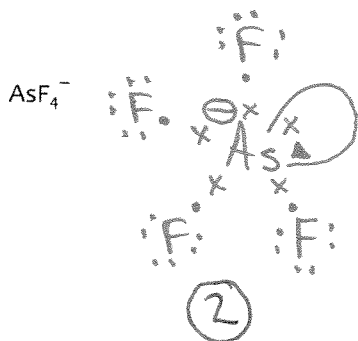
5. For the two compounds below:

[12 marks]

- Draw the Lewis structure. Determine all formal (atomic) charges for the structure.
- Name the electronic geometry (EG).
- Name the molecular geometry (MG).
- Name the hybridization on the central atom.
- State whether the molecule is polar.

Electronegativities: As 2.0, Cl 3.0, F 4.0, O 3.5, H 2.1, lone pair 3.7

Formula	Lewis Structure	EG name	MG name	Hybridization	Polar? (Y or N)
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Trigonal Bipyramidal

See-saw

$sp^3d$

Y

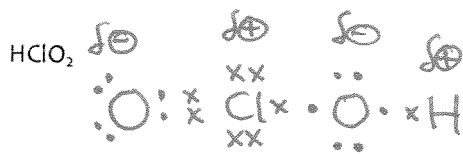
(1)

(1)

(1)

(1)

(2)



Tetrahedral

Bent (Angular)

$sp^3$

Y

(1)

(1)

(1)

(2)

(1)

6. Calculate the wavelength of a ball (mass = 0.10 kg) travelling at a  $\frac{1}{10}$  the speed of light.

[1 mark]

De Broglie

$$\lambda = \frac{h}{mv}$$

$$= \frac{6.6262 \times 10^{-34} \text{ J s}}{(0.10 \text{ kg})(3.00 \times 10^7 \text{ ms}^{-1})}$$

$$\lambda = 2.2 \times 10^{-40} \text{ m}$$

①

7. How many electrons can exist at:

[3 marks]

a)  $n = 4$  and  $l = 2$  10 ①

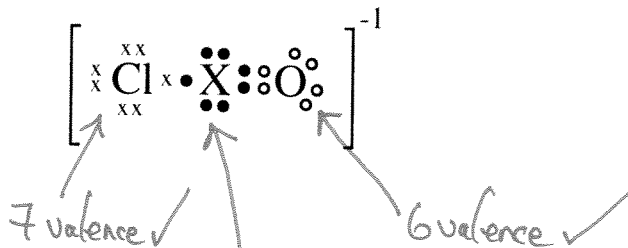
b)  $n = 4, l = 4, m_l = -2, m_s = \frac{1}{2}$  0 ①

c)  $n = 4$  and  $m_l = 2$  4 ①

$n=4, l=3$   
 $m_l = -3, -2, -1, 0, 1, 2, 3$   
 $= -2, -1, 0, 1, 2$   
 $= -1, 0, 1$   
 $= 0$

8. Identify the unknown element X which could exist in the Lewis structure below. Explain your reasoning. [2 marks]

$\therefore n=4, m_l=2$   
 gives 4f & 4d  
 of one type of orbital



Valence which includes extra electron  
 $\therefore$  normally 6 valence electrons ①

(could be S, Se, Te or Po) ①  
 but not O (exceeds octet rule)