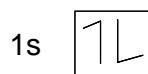


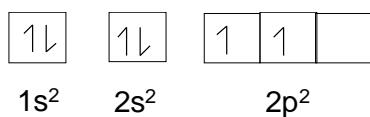
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Homework 1.2 Answers

1 a) According to the aufbau principle, electrons fill orbitals in order of increasing energy.  
As the 4s orbital has lower energy than the 3d orbitals, electrons will fill the 4s before the 3d orbitals.

b) The Pauli exclusion principle states that no two electrons can have the same values for all four quantum numbers, i.e. the two electrons in an atom of helium that occupy the 1s orbital adopt opposite spins:



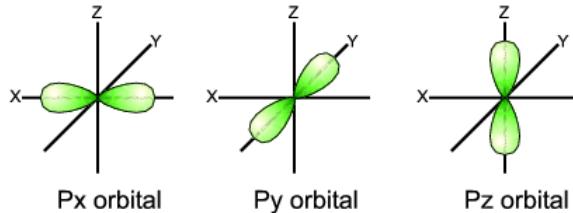
c) According to Hund's rule, electrons occupy degenerate orbitals singly and with parallel spins. This can be illustrated using the example of carbon below:



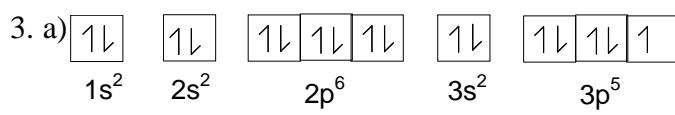
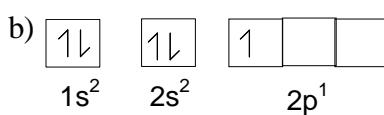
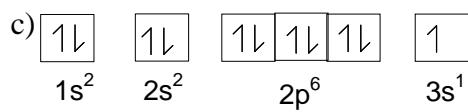
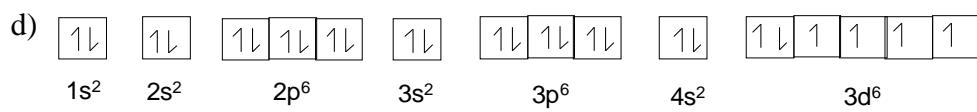
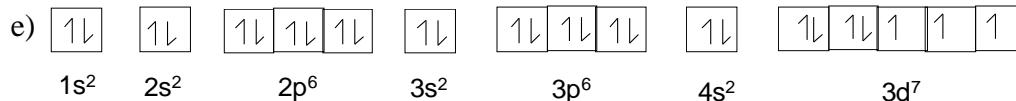
The two electrons in the 2p orbitals have filled singly and with parallel spins.

d) i) A d-orbital ( $dx^2-y^2$  although you do not need to know the individual names)  
ii) Orbitals with equal energy.

iii)

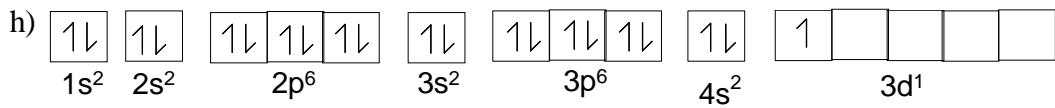
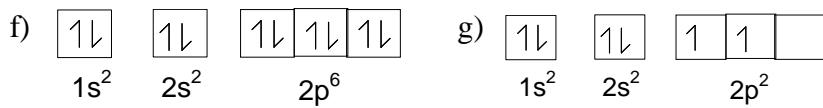


2. a) 1s<sup>2</sup> 2s<sup>2</sup>   b) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>5</sup>   c) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup>   d) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 4s<sup>2</sup> 3d<sup>2</sup>  
e) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup>   f) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 4s<sup>2</sup> 3d<sup>8</sup>  
g) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 4s<sup>2</sup> 3d<sup>10</sup>   h) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>4</sup>   i) 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>3</sup>

3. a)   
1s<sup>2</sup>      2s<sup>2</sup>      2p<sup>6</sup>      3s<sup>2</sup>      3p<sup>5</sup>      b)   
1s<sup>2</sup>      2s<sup>2</sup>      2p<sup>1</sup>  
c)   
1s<sup>2</sup>      2s<sup>2</sup>      2p<sup>6</sup>      3s<sup>1</sup>  
d)   
1s<sup>2</sup>      2s<sup>2</sup>      2p<sup>6</sup>      3s<sup>2</sup>      3p<sup>6</sup>      4s<sup>2</sup>      3d<sup>6</sup>  
e)   
1s<sup>2</sup>      2s<sup>2</sup>      2p<sup>6</sup>      3s<sup>2</sup>      3p<sup>6</sup>      4s<sup>2</sup>      3d<sup>7</sup>



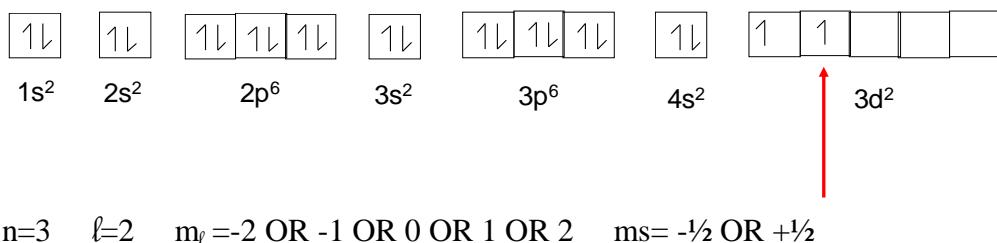
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4. a) manganese    b) sulfur    c) nickel

5.  $n=3$      $l=1$      $m_l=-1$  OR  $1$  OR  $1$      $ms=-\frac{1}{2}$  OR  $+\frac{1}{2}$

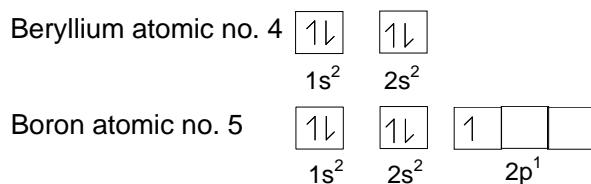
6. To help write the set of four quantum numbers for titanium it may help to look at its orbital box notation.



$n=3$      $l=2$      $m_l=-2$  OR  $-1$  OR  $0$  OR  $1$  OR  $2$      $ms=-\frac{1}{2}$  OR  $+\frac{1}{2}$

7. a) The general trend for the first ionisation energy of period 2 elements is that it increases with increasing atomic number.

b) The first ionisation energy for beryllium is higher than boron because beryllium has a completely filled orbital whilst boron does not. Due to this the beryllium atom is slightly more stable and therefore more energy is required to remove an electron. This can be illustrated below:



AH UNIT 1 MS FORM QUICK QUIZ 1 –COMMENTS

3

Which one of the following metal salts will emit radiation of the lowest frequency when placed in a Bunsen burner? Use page 15 of the data booklet. \*

(1 Point)

- Potassium chloride
- Copper (II) chloride
- Calcium chloride
- Barium chloride

As the question asks for the lowest frequency then you have to look at the flame colour table on page 15 and pick the metal with the highest wavelength.



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Remember, the lower the frequency, the higher the wavelength.

5

Which of the following statements about atomic emission spectroscopy is incorrect? \*  
(1 Point)

- Each element provides a characteristic spectrum.
- Visible light is used to promote electrons to higher energy levels. ✓
- The lines arise from electron transitions between one energy level and another.
- The quantity of the element can be determined from the intensity of radiation transmitted.

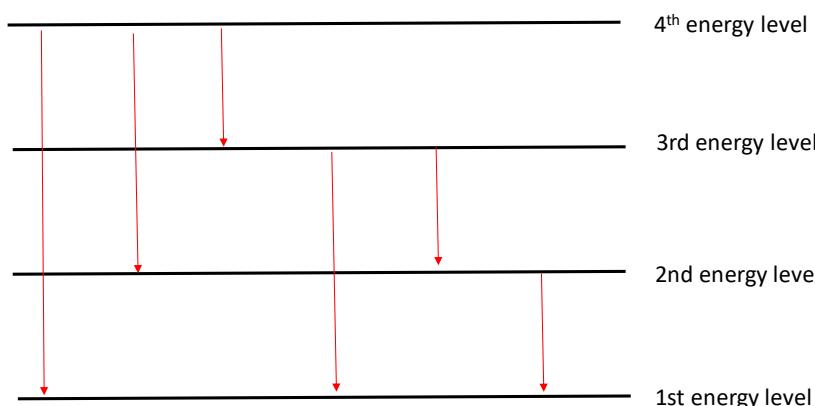
When you look at the position of visible light on the electromagnetic spectrum you will see that it is of relatively low energy and would not have enough energy to excite electrons. A source of energy such as heat or electric would be required to promote electrons to higher energy levels.

10

In the emission spectrum of hydrogen, there are many lines. How many of these lines are caused by all the possible electron transitions between the four lowest energy levels of the hydrogen atom? \*

(1 Point)

- 3
- 4
- 6 ✓
- 10



This diagram helps to illustrate that there are 6 possible transitions.

