

# HL Atomic Structure Multiple-Choice Questions

1. Which row is correct for the relative masses of subatomic particles?

	Particle	Relative mass	Particle	Relative mass
A	Electron	1	Proton	1/2000
<b>B</b>	Proton	1	Neutron	1
C	Neutron	1/2000	Proton	1
D	Electron	1	Neutron	1/2000

2. What is the number of protons present in a  $^{58}\text{Co}^{2+}$  ion?

- A 58                      B 31                      C 29                      **D 27**

3. What is the number of electrons present in a  $^{79}\text{Se}^{2-}$  ion?

- A 79                      B 34                      **C 36**                      D 32

4. What is the number of neutrons present in a  $^{238}\text{U}^{3+}$  ion?

- A 146**                      B 92                      C 143                      D 238

5. Which of the following condensed electron configurations is **not** correct?

- A Mg:  $[\text{Ne}] 3s^2$                       **B Fe:  $[\text{Ar}] 3d^6$**   
 C Cu:  $[\text{Ar}] 4s^1 3d^{10}$                       D Br:  $[\text{Ar}] 3d^{10} 4s^2 4p^5$

6. The condensed electron configuration for  $^{24}\text{Cr}$  is

- A  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$                       B  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$   
 C  $[\text{Ar}] 4s^2 3d^4$                       **D  $[\text{Ar}] 4s^1 3d^5$**

7. In the emission spectrum of deuterium the frequency of the convergence limit in the series where the electron falls down to  $n=1$  is  $3.29 \times 10^{15}$  Hz. The value of Planck's constant is  $6.63 \times 10^{-34}$  Js. The ionization energy of deuterium in  $\text{kJ mol}^{-1}$  is given by.

- A  $\frac{3.29 \times 10^{15} \times 6.63 \times 10^{-34}}{6.02 \times 10^{23} \times 1000}$   
**B  $\frac{3.29 \times 10^{15} \times 6.63 \times 10^{-34} \times 6.02 \times 10^{23}}{1000}$**   
 C  $\frac{6.63 \times 10^{-34}}{3.29 \times 10^{15} \times 6.02 \times 10^{23} \times 1000}$   
 D  $\frac{3.29 \times 10^{15} \times 6.63 \times 10^{-34} \times 1000}{6.02 \times 10^{23}}$

8. Which of the following is an f-block element and a lanthanoid?

- A Uranium                      **B Europium**  
 C Hafnium                      D Rutherfordium

9. Which of the following is the symbol of a d block element?

- A C                      **B Co**                      C Cf                      D Ce

10. The condensed electron configuration for a copper atom is:

- A  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$                       B  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^1$   
 C  $[\text{Ar}] 4s^2 3d^9$                       **D  $[\text{Ar}] 4s^1 3d^{10}$**

# HL Atomic Structure Multiple-Choice Questions

11. Which of the following atoms does not contain any unpaired electrons?  
 A F      **B Mg**      C Na      D O
12. Which of the following is correct?  
 A The first ionization energy of B is higher than that of Be  
 B The second ionization energy of Mg is lower than the first ionization energy of Na  
**C The first ionization energy of N is higher than the first ionization energy of O**  
 D The fourth ionization energy of Al is lower than the fourth ionization energy of Si
13. What is the electron configuration of  $\text{Cu}^{2+}$ ?  
 A  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$       **B  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$**   
 C  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^8$       D  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$
14. Rhenium has two naturally occurring isotopes,  $^{185}\text{Re}$  and  $^{187}\text{Re}$ . The relative atomic mass of Rhenium is 186.2. What are the natural abundances of these isotopes?  
**A 40 %  $^{185}\text{Re}$  and 60 %  $^{187}\text{Re}$**       B 60 %  $^{185}\text{Re}$  and 40 %  $^{187}\text{Re}$   
 C 12 %  $^{185}\text{Re}$  and 88 %  $^{187}\text{Re}$       D 88 %  $^{185}\text{Re}$  and 12 %  $^{187}\text{Re}$
15. Which of the following would produce a line in the visible emission spectrum of hydrogen:  
 A A photon is emitted as an electron falls from outside the atom to the level with  $n=1$   
 B A photon is absorbed as an electron is promoted from level  $n=1$  to level  $n=2$   
**C A photon is emitted as an electron falls from level  $n=5$  to level  $n=2$**   
 D A photon is emitted as an electron falls from level  $n=7$  to level  $n=3$
16. Which of the following transitions in a hydrogen atom would produce a line of the highest frequency in the emission spectrum?  
 A  $n=5 \rightarrow n=4$       B  $n=4 \rightarrow n=3$       C  $n=3 \rightarrow n=2$       **D  $n=2 \rightarrow n=1$**
17. Which of the following electronic transitions in a hydrogen atom would produce a line of the shortest wavelength in the emission spectrum?  
 A  $n=7 \rightarrow n=2$       B  $n=9 \rightarrow n=3$       **C  $n=2 \rightarrow n=1$**       D  $n=5 \rightarrow n=2$
18. The graph shows  $\log_{10}$  (ionisation energy) removal of the first 6 electrons from an element.
- 
- The element could be  
**A Si**      B Al      C N      D K
19. Which of the following statements about first ionisation energy is not correct?  
**A First ionisation energy increases across regularly across Period 2**  
 B First ionisation energy decreases down Group 17  
 C Helium has a higher first ionisation energy than hydrogen  
 D The first ionisation energy of oxygen is higher than that of sulfur

# HL Atomic Structure Multiple-Choice Questions

20. Which of the following statements is correct
- A The maximum number of electrons in the 3d subshell is 6  
**B The maximum number of electrons in the 5f subshell is 14**  
 C The maximum number of electrons in the 5<sup>th</sup> shell is 32  
 D It is not possible for an atom to have more electrons in p orbitals than in d orbitals

21. Which of the following atoms/ions does **not** have exactly 2 unpaired electrons?

A S                      B Ni<sup>2+</sup>                      **C Cr<sup>3+</sup>**                      D Ti<sup>2+</sup>

22. A line in the emission spectrum of magnesium has wavelength 0.313 μm. The energy of the photon (in J) emitted is given by:

A  $E = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{0.313}$   
 B  $E = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{3.13 \times 10^{-6}}$   
 C  $E = 6.63 \times 10^{-34} \times 3.13 \times 10^{-10}$   
**D  $E = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{3.13 \times 10^{-7}}$**

23. The first ionisation energies of 4 successive elements in the periodic table are:

736 kJ mol<sup>-1</sup>                      577 kJ mol<sup>-1</sup>                      786 kJ mol<sup>-1</sup>                      1060 kJ mol<sup>-1</sup>

These elements could be:

A Na, Mg, Al, Si                      **B Mg, Al, Si, P**                      C S, Cl, Ar, K                      D Si, P, S, Cl

24. The first 7 successive ionisation energies for an element are:

	Ionisation energy / kJ mol <sup>-1</sup>
1	966
2	1950
3	2730
4	4850
5	6020
6	12300
7	15400

The element is:

A Ga                      B Ge                      **C As**                      D Se

25. Which of the following orbital diagrams is correct for an atom with electron configuration 3d<sup>3</sup> in its ground state?

A 

↑↓	↑			
----	---	--	--	--

**B**

↑		↑		↑
---	--	---	--	---

C 

↑	↓	↑		
---	---	---	--	--

D 

↑	↓	↓		
---	---	---	--	--