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Chapter 2: Atoms: the foundations of life

Test Bank

Type: multiple response question
Title: Chapter 02 - Question 01
1) An atom's nucleus contains which of the following particles? Select all that apply.
Feedback: An atom's nucleus contains only two subatomic particles, while the third occupies the volume of space around the nucleus. One of these options is not a subatomic particle, but a species that results when an atom gains or loses one or more electrons.
Page reference: section 2.5, p.31
a. Ions
*__b.__ Protons
c. Electrons
*__d.__ Neutrons

Type: multiple choice question
Title: Chapter 02 - Question 02
2) Which of the following is the chemical symbol for sodium?
a. Si
Feedback: No, Si is the chemical symbol for silicon. Look at the periodic table on page i to find the correct answer.
b. S
Feedback: No, S is the chemical symbol for sulfur. Look at the periodic table on page i to find the correct answer.
c. Sn
Feedback: No, Sn is the chemical symbol for tin. Look at the periodic table on page i to find the correct answer.
*__d.__ Na
Feedback: Yes, Na is the chemical symbol for sodium. Some chemical symbols bear seemingly little relation to the names of the elements they represent!
e. Sr
Feedback: No, Sr is the chemical symbol for strontium. Look at the periodic table on page i to find the correct answer.

Type: multiple choice question
Title: Chapter 02 - Question 03
3) Which of the following is the chemical symbol for potassium?
a. Pb
Feedback: No, Pb is the chemical symbol for lead. Look at the periodic table on page i to find the correct answer.
b. P
Feedback: No, P is the chemical symbol for phosphorus. Look at the periodic table on page i to find the correct answer.
c. Po
Feedback: No, Po is the chemical symbol for polonium. Look at the periodic table on page i to find the correct answer.
*__d.__ K
Feedback: Yes, K is the chemical symbol for potassium. Some chemical symbols bear seemingly little relation to the names of the elements they represent!
e. Pt
Feedback: No, Pt is the chemical symbol for platinum. Look at the periodic table on page i to find the correct answer.

Type: multiple choice question
Title: Chapter 02 - Question 04
4) An oxygen ion carries what electrical charge?
a. -1

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Feedback: No, an oxygen atom must gain more than one electron to achieve a full valence shell, and become a stable ion. Look at section 2.3, page 23 to find out about the formation of ions.
b. +1
Feedback: No, an oxygen atom *gains* electrons to achieve a full valence shell, so it forms a *negatively* charged ion. Look at section 2.3, page 23 to find out about the formation of ions.
c. +2
Feedback: No, an oxygen atom *gains* electrons to achieve a full valence shell, so it forms a *negatively* charged ion. Look at section 2.3, page 23 to find out about the formation of ions.
d. No charge
Feedback: No, an ion is a charged particle by definition. Look at section 2.3, page 23 to find out about the formation of ions.
***e.** -2
Feedback: Yes, oxygen must gain two electrons to achieve a full valence shell, and become a stable ion, so it carries a charge of -2.

Type: multiple choice question
Title: Chapter 02 - Question 05
5) Which of the following carries a negative charge?
a. Nucleus
Feedback: No, a nucleus carries a positive charge overall. Look at section 2.2, page 21 to find out about the electrical charges associated with atoms and sub-atomic particles.
b. Proton
Feedback: No, a proton carries a *positive* charge. Look at section 2.2, page 21 to find out about the electrical charges associated with atoms and sub-atomic particles.
c. Neutron
Feedback: No, a neutron carries no electrical charge. Look at section 2.2, page 21 to find out about the electrical charges associated with atoms and sub-atomic particles.
***d.** Electron
Feedback: Yes, an electron carries a negative charge. Look at section 2.2, page 21 to find out about the electrical charges associated with atoms and sub-atomic particles.
e. Atom
Feedback: No, an atom carries no electrical charge overall, despite comprising negatively-charged electrons and positively-charged protons. An atom must always contain an equal number of electrons and protons, such that their negative and positive charges cancel each other out. Look at section 2.2, page 21 to find out more.

Type: multiple response question
Title: Chapter 02 - Question 06
6) Which of the following is not an element? Select all that apply.
Feedback: Carbon dioxide and water are both molecules comprising more than one element (carbon and oxygen, and hydrogen and oxygen respectively). Nitrogen and oxygen are single elements.
Page reference: section 2.1, page 18
a. Oxygen
***b.** Water
c. Nitrogen
***d.** Carbon dioxide

Type: matching question
Title: Chapter 02 - Question 07
7) Match the following particles to the electrical charges they carry.
Feedback: Look at section 2.2, page 21 if you need a reminder of the charges on these subatomic particles.
a. Proton = Positive
b. Electron = Negative
c. Neutron = Neutral

Type: multiple choice question

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Title: Chapter 02 - Question 08
8) An element's mass number tells us which of the following?
a. The number of protons in an atom of that element.
Feedback: No, this is represented by an atom's *atomic* number. Look at section 2.2, page 21 to find out about an element's mass number.
b. The number of protons + electrons in an atom of that element.
Feedback: No, the mass number *does* tell us the sum of the number of two subatomic particles, but *not* protons + electrons. Look at section 2.2, page 22 find out about an element's mass number.
c. The number of electrons in an atom of that element.
Feedback: No, this is represented by an atom's atomic number. Look at section 2.2, page 22 to find out about an element's mass number.
***d.** The number of protons + neutrons in an atom of that element.
Feedback: Yes, the mass number represents the *sum* of the number of protons and the number of neutrons present in an atom of a given element.
e. The number of neutrons in an atom of that element.
Feedback: No, the mass number represents the sum of the number of neutrons *plus* the number of one other subatomic particle. Look at section 2.2, page 22 to find out about an element's mass number.

Type: multiple choice question
Title: Chapter 02 - Question 09
9) An atom of fluorine has an atomic number of 9 and a mass number of 19. Which of the following statements is correct?
***a.** An atom of fluorine has 9 protons, 9 electrons, and 10 neutrons.
Feedback: Yes, the atomic number is equal to both the number of protons in an atom *and* the number of electrons in an atom. (An atom must have an equal number of protons and electrons.) The mass number tells us the sum of the number of protons + the number of neutrons in an atom. We already know that there are 9 protons in the atom, so there must be (19-9) (that is, 10) neutrons in the atom. See section 2.2, page 21 for more information.
b. An atom of fluorine has 9 protons, 9 electrons, and 9 neutrons.
Feedback: No – you're only half way there. The atomic number is equal to both the number of protons in an atom *and* the number of electrons in an atom – in this case, 9 of each. You got this bit right. However, the mass number tells us the sum of the number of protons + the number of neutrons in an atom. We already know that there are 9 protons in the atom, so there must be (19-9) (that is, 10) neutrons in the atom. See section 2.2, page 21 for more information.
c. An atom of fluorine has 9 protons, 10 electrons, and 9 neutrons.
Feedback: No, the atomic number is equal to both the number of protons in an atom and the number of electrons (not neutrons) in an atom. So this atom has 9 protons, 9 electrons, and 10 neutrons. See section 2.2, page 21 for more information.
d. An atom of fluorine has 10 protons, 9 electrons, and 9 neutrons.
Feedback: No, the atomic number is equal to both the number of *protons* in an atom and the number of electrons in an atom (not the number of neutrons). So this atom has 9 protons, 9 electrons, and 10 neutrons. See section 2.2, page 21 for more information.
e. An atom of fluorine has 9 protons, 9 electrons, and 19 neutrons.
Feedback: No – you're only half way there. The atomic number is equal to both the number of protons in an atom *and* the number of electrons in an atom – in this case, 9 of each. You got this bit right. However, the mass number tells us the sum of the number of protons + the number of neutrons in an atom, not just the number of neutrons. We already know that there are 9 protons in the atom, so there must be (19-9) (that is, 10) neutrons in the atom. See section 2.2, page 21 for more information.

Type: multiple response question
Title: Chapter 02 - Question 10
10) An element's atomic number tells us which of the following? Select any that apply.
Feedback: The atomic number tells us about the number of protons and electrons in an atom of a given element, but we need to refer to the mass number to deduce the number of neutrons.

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Page reference: section 2.2, page 21
***a.** The number of protons in an atom of that element.
b. The number of neutrons in an atom of that element.
***c.** The number of electrons in an atom of that element.

Type: multiple choice question
Title: Chapter 02 - Question 11
11) Which of the following statement is correct?
a. An atom always has the same number of protons and neutrons.
Feedback: No, the number of protons and *electrons* must be the same, in order for an atom to have no overall electrical charge. See section 2.2, page 22 for more details.
***b.** An atom always has the same number of protons and electrons.
Feedback: Yes, an atom must have the same number of protons and electrons for it to have no overall electrical charge. See section 2.2, page 22 for more details.
c. An atom always has the same number of electrons and neutrons.
Feedback: No, it the number of electrons and *protons* that must be the same (in order for an atom to have no overall electrical charge). See section 2.2, page 22 for more details.
d. An atom always has the same number of protons, neutrons and electrons.
Feedback: No, while atoms of a given element must always have the same number of protons and electrons (in order to carry no overall electrical charge), they may have different numbers of neutrons. Atoms of the same element that possess different numbers of neutrons are called **isotopes**. See section 2.2 and 2.4 for more details.

Type: multiple choice question
Title: Chapter 02 - Question 12
12) Which of the following statements is correct?
a. The three isotopes of carbon contain the same number of protons and neutrons, but different numbers of electrons.
Feedback: No, different isotopes of a given element must have the *same* number of protons and electrons, as explained in section 2.4, page 27.
***b.** The three isotopes of carbon contain the same number of protons and electrons, but different numbers of neutrons.
Feedback: Yes, isotopes of a given element must have the same number of protons and electrons, but they can have different numbers of neutrons. We find out more about isotopes in section 2.4, page 27.
c. The three isotopes of carbon contain the same number of electrons and neutrons, but different numbers of protons.
Feedback: No, different isotopes of a given element must have the same number of *protons* and electrons. We find out about isotopes in section 2.4, page 27.
d. The three isotopes of carbon contain the same number of protons, neutrons, and electrons.
Feedback: No, different isotopes of a given element must have the same number of protons and electrons, but have different numbers of neutrons. Look back at section 2.4, page 27 to remind yourself about isotopes.
e. The three isotopes of carbon contain the same number of protons, but different numbers of electrons and neutrons.
Feedback: No, different isotopes of a given element must have the same number of protons *and* electrons. Look at section 2.4, page 27 to remind yourself about isotopes.

Type: multiple choice question
Title: Chapter 02 - Question 13
13) The 3d sub-shell comprises how many orbitals?
a. One
Feedback: No, it is the series of s sub-shells (1s, 2s, 3s etc.) that comprise only one orbital. Look at section 2.5, page 32 to find the right answer.
b. Two
Feedback: No, none of the sub-shells contain two orbitals. Look at section 2.5, page 32 to find the right answer.
c. Three

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Feedback: No, it is the series of p sub-shells (2p, 3p etc.) that comprise two orbitals. Look at section 2.5, page 32 to find the right answer.
d. Four
Feedback: No, none of the sub-shells comprise four orbitals. Look at section 2.5, page 32 to find the right answer.
*__e.__ Five
Feedback: Yes, the 3d sub-shell comprises three d orbitals, as explained in section 2.5, page 32.

Type: matching question
Title: Chapter 02 - Question 14
14) Rank the following sub-shells in order of energy, with 1 being the lowest-energy, and 4 being the highest-energy
Feedback: The *shells* increase in energy according to numerical value: 1, 2, 3 etc. The *sub-shells* increase in energy in the following order: s<p<d<f. So the 2s and 2p sub-shells are of a higher energy than the 1s sub-shell (shell 2 I higher-energy than shell 1); and the 2p sub-shell is of a higher energy than the 2s sub-shell (p is higher energy than s). See section 2.5 for more details.
a. 2s = **2**
b. 3p = **4**
c. 2p = **3**
d. 1s = **1**

Type: multiple choice question
Title: Chapter 02 - Question 15
15) Shell 2 can hold a maximum of how many electrons?
a. 2
Feedback: No, shell 2 is composed of a total of *four* orbitals (one s orbital, and three p orbitals). Each orbital can hold a maximum of two electrons, so shell 2 can hold a maximum of 8 (4 × 2) electrons. See section 2.5 for more details.
b. 4
Feedback: No, shell 2 is composed of a total of *four* orbitals (one s orbital, and three p orbitals). Each orbital can hold a maximum of two electrons, so shell 2 can hold a maximum of 8 (4 × 2) electrons. See section 2.5 for more details.
c. 6
Feedback: No, shell 2 is composed of a total of *four* orbitals (one s orbital, and three p orbitals). Each orbital can hold a maximum of two electrons, so shell 2 can hold a maximum of 8 (4 × 2) electrons. See section 2.5 for more details.
*__d.__ 8
Feedback: Yes, shell 2 is composed of a total of *four* orbitals (one s orbital, and three p orbitals). Each orbital can hold a maximum of two electrons, so shell 2 can hold a maximum of 8 (4 × 2) electrons. See section 2.5 for more details.
e. 10
Feedback: No, shell 2 is composed of a total of *four* orbitals (one s orbital, and three p orbitals). Each orbital can hold a maximum of two electrons, so shell 2 can hold a maximum of 8 (4 × 2) electrons. See section 2.5 for more details.

Type: multiple response question
Title: Chapter 02 - Question 16
16) Noting that chlorine has an atomic number of 17, which of the following statements are **false**? Select any that apply.
Feedback: The atomic number tells us that an atom of chlorine contains 17 electrons. When arranged into shells and subshells this gives the electronic configuration $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$, such that chlorine's valence shell (the outermost shell to be occupied) is shell 3.

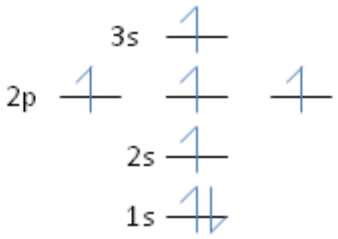
If we look at this outer shell we notice that it requires one more electron to be filled (to become $3s^2$ $3p^6$). When acquiring an additional electron in this way, chlorine becomes a chloride ion, carrying a charge of -1.

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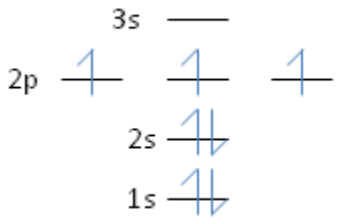
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Page reference: We discuss electronic configurations in section 2.6, page 36, and the formation of ions in section 2.3, page 23.
a. An atom of chlorine has 17 electrons.
***b.** Chlorine's valence shell is shell 2.
c. The electronic configuration for chlorine is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
d. Chlorine must gain 1 electron to achieve a full valence shell.
***e.** The chloride ion carries a charge of +1

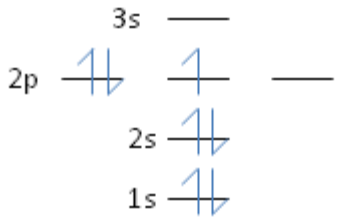
Type: multiple choice question
Title: Chapter 02 - Question 17
17) Nitrogen has an atomic number of 7. Which of the following correctly depicts the electronic configuration of an atom of nitrogen?



a.
Feedback: No, the Aufbau principle states that shell 2 will fill completely before any sub-shells in shell 3 become occupied. See section 2.6, page 37 for more details.



***b.**
Feedback: Yes, Hund's rule dictates that each orbital in a sub-shell will become partially filled before any one orbital becomes completely filled – so each 2p orbital becomes occupied by one electron before any of the orbitals accepts a second electron. See section 2.6, page 37 for more details.



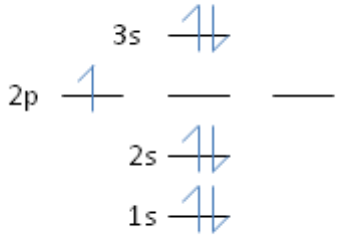
c.
Feedback: No, Hund's rule dictates that each orbital in a sub-shell will become partially filled before any one orbital becomes completely filled – so each 2p orbital becomes occupied by

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just one electron before any of the orbitals accepts a second electron. See section 2.6, page 37 for more details.



d.
Feedback: No, the Aufbau principle states that shell 2 will fill completely before any sub-shells in shell 3 become occupied. See section 2.6, page 37 for more details.

Type: matching question
Title: Chapter 02 - Question 18
18) Rank the following elements according to how readily they will form anions, with 1 = least readily, and 4 = most readily.
Feedback: As we move across the periodic table from left to right, ionization energies increase: it takes more energy to extract an electron to form a positively-charged ion (a cation). So, elements on the left of the periodic table form cations more readily than those on the right, which form negatively-charged anions more readily.
Page reference: section 2.3, page 25
a. Iron = 3
b. Zinc = 2
c. Calcium = 1
d. Bromine = 4

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