

Joe Perfect

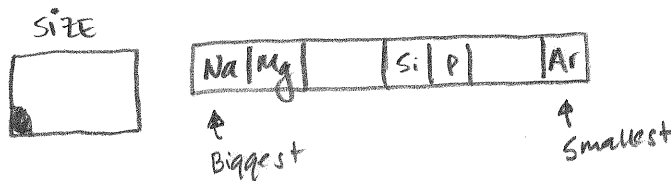
## Practice Test - Chapter 7 Periodic Properties of the Elements

Target 1: I can explain how the periodic table was developed.

- Why did Mendeleev leave blank spaces on his periodic table?
  - Not all elements in the same family have similar properties.
  - Not all elements in the same row have similar properties.
  - There were more metals than nonmetals discovered at the time.
  - He guessed that there were some elements yet undiscovered.
  - Most elements on the periodic table are solids at room temperature.
- Our current periodic table is arranged according to increasing \_\_\_\_\_.
  - atomic mass
  - atomic number
  - mass number
  - isotopic number

Target 2: I can list and explain the periodic trends associated with atomic size and ionic size.

- Of the following, which gives the correct order for the atomic radius for Mg, Na, P, Si and Ar?
  - Mg > Na > P > Si > Ar
  - Ar > Si > P > Na > Mg
  - Si > P > Ar > Na > Mg
  - Na > Mg > Si > P > Ar
  - Ar > P > Si > Mg > Na



- The elements in which of the following have most nearly the same atomic radius?
  - Be, B, C, N → this is next best answer ... and you could argue that it is correct.
  - C, P, Se, I
  - Ne, Ar, Kr, Xe
  - Cr, Mn, Fe, Co → Transition elements most similar in size. (generally)
  - Mg, Ca, Sr, Ba
- In which of the following atoms is the 1s orbital the smallest?
  - Cl
  - F
  - Br
  - I
  - The 1s orbital is always the same size!

→ Has more pt in nucleus ... will "pull in" the 1s orbital more effectively than the rest.

6. Circle the TWO true statements below.
- An oxygen atom is slightly bigger than a nitrogen atom because an atom of oxygen has more electrons than nitrogen.
  - An atom of chlorine is bigger than an atom of fluorine because chlorine has more energy levels and more shielding effect.
  - An atom of calcium is bigger than an ion of calcium ( $\text{Ca}^{2+}$ ) because a calcium atom has more energy levels and more shielding effect.
  - The nitride ion ( $\text{N}^{3-}$ ) is bigger than the nitrogen atom as the nitride ion has more energy levels.
  - The oxide ion ( $\text{O}^{2-}$ ) and the fluoride ion ( $\text{F}^-$ ) are the same size as they have the same number of electrons and the same number of energy levels.

Target 3: I can list and explain the periodic trends associated with the reactivity of metals and nonmetals.

7. Which element below is more reactive than lithium and magnesium but less reactive than potassium?
- a. Na      b. Rb      c. Cs      d. Be      e. Fr
8. Which two of the following do **not** correctly rank the elements in order from most reactive to least reactive?
- a. O, C, Si      b. K, Rb, Na      c. Na, Al, Au      d. Br, Cl, F      e. N, P, Ne
- Rb, K, Na*      *F, Cl, Br*
9. Which **one** of the following is the reason why Rb is more reactive than Sr?
- a. Rb has less protons in the nucleus. *Since Sr has more pt, it pulls its e- more tightly!*
- b. Rb is larger and thus has a greater effective nuclear charge.
- c. Sr has a smaller first ionization energy and a greater nuclear charge.
- d. Sr has a smaller first ionization energy and a greater effective nuclear charge.
- e. Sr has a greater electron affinity due to a greater shielding effect.
10. Why is oxygen more reactive than sulfur? Choose all that apply.
- Oxygen has less protons in its nucleus.
  - Oxygen is smaller and therefore has less shielding effect.
  - Oxygen experiences less electron:electron repulsions among its valence electrons.
  - Oxygen is a slightly larger atom and therefore can attract e- more easily.
  - Oxygen has 2 common allotropes,  $\text{O}_2$  and  $\text{O}_3$ .
11. Which of the following statements is/are TRUE?
- Gold is one of the most reactive elements on the periodic table.
  - Smaller metals tend to be more reactive than larger metals.
  - Transition metals are generally more reactive than 2A metals.
  - Argon is slightly more reactive than neon.
  - You would expect a reaction to occur between  $\text{Cl}_2(\text{g})$  and  $\text{NaBr}(\text{aq})$ .



Target 4: I can list and explain the periodic trends associated with ionization energy. This includes explaining the common anomalies within the trends.

12. Which one of the following arrangements of ionization energy is correct?  
a. Na < Rb    **b. C < N**    c. Cl < S    d. S < Te    e. He < H
13. Ionization energies generally increase from left to right across a period. There is an exception to this trend with regards to nitrogen and oxygen. The reason that oxygen has a lower first ionization energy than nitrogen is that \_\_\_\_\_.  
a. nitrogen is a larger atom than oxygen  
b. there is more shielding effect in nitrogen  
c. there is less shielding effect in nitrogen  
d. nitrogen has more electron-electron repulsions due to the paired p electrons  
**e. nitrogen has less electron-electron repulsions due to the unpaired p electrons**
14. Which one of the following elements has the largest second ionization energy?  
**a. Na**    b. Mg    c. Al    d. Si    e. P
15. Consider the following data regarding the first six ionization energies (kJ/mol) of a particular period 3 element:

IE <sub>1</sub> = 1012	IE <sub>2</sub> = 1900	IE <sub>3</sub> = 2910	IE <sub>4</sub> = 4960	IE <sub>5</sub> = 6270	IE <sub>6</sub> = 22,200
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- The identity of this element is \_\_\_\_\_.  
a. Si    **b. S**    c. P    d. Cl    e. Mg

Target 5: I can explain the variations in electron affinities among the elements.

16. Which of the following elements has the most exothermic electron affinity?  
a. S    **b. Cl**    c. Se    d. Br    e. C
17. Which of the following correctly represents the electron affinity of bromine?  
a.  $\text{Br(g)} \rightarrow \text{Br}^+(\text{g}) + \text{e}^-$   
**b.  $\text{Br(g)} + \text{e}^- \rightarrow \text{Br}^-(\text{g})$**   
c.  $\text{Br}_2(\text{g}) + \text{e}^- \rightarrow \text{Br}^-(\text{g})$   
d.  $\text{Br}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Br}^-(\text{g})$   
e.  $\text{Br}^+(\text{g}) + \text{e}^- \rightarrow \text{Br(g)}$

18. Some elements (such as neon) have a positive electron affinity. The positive electron affinity of neon indicates that \_\_\_\_\_.
- a. the  $\text{Ne}^-$  ion is unstable and does not readily form.
  - b. the  $\text{Ne}^-$  ion is stable and will easily form.
  - c. neon is a gas at room temperature. Gaseous atoms do not accept electrons.
  - d. neon has a greater electron affinity than ionization energy.
  - e. neon has an orange flame test.

**Target 6: I can describe the periodic trends in metallic and nonmetallic behavior.**

19. Of the elements below, \_\_\_\_\_ is the most metallic.
- a. sodium
  - b. barium
  - c. magnesium
  - d. calcium
  - e. cesium
20. Metals can be \_\_\_\_\_ at room temperature.
- a. liquid only
  - b. solid only
  - c. solid or liquid *All solids except Hg*
  - d. solid, liquid, or gas
  - e. liquid or gas
21. Which TWO statements below are true statements?
- a. Metallic character generally increases down a family and decreases from left to right across a period.
  - b. Metal oxides are basic. *← for metals ... not nonmetals*
  - c. Nonmetals are generally lustrous and are poor conductors.
  - d. Compounds composed entirely of nonmetals are usually ionic compounds.
  - e. Aluminum and silicon are examples of metalloids.
22. The series that correctly lists from left to right a halogen, an alkaline earth metal, a transition metal, and an active metal is \_\_\_\_\_.
- a. Cl, K, V, Mg
  - b. Br, Ba, Cr, Na
  - c. O, Ca, Ce, Al
  - d. F, Sr, Fe, Sn
  - e. S, Sr, Si, Sn

Target 7: I can describe the general physical and chemical behavior of the alkali metals and the alkaline earth metals. I can also explain how their chemistry relates to their position in the periodic table.

23. Element M reacts with chlorine to form a compound with the formula  $MCl_2$ . It is more reactive than Mg and smaller than Ba. This element is \_\_\_\_.
- a. Sr      b. K      c. Na      d. Ra      e. Al
24. Which of these oxides is the most basic?
- a.  $K_2O$       b.  $Al_2O_3$       c.  $CO_2$       d. MgO      e.  $N_2O_3$
25. Which of the following is the least reactive?
- a. Mg      b. Sr      c. Ca      d. Ba      e. Cs
26. Why is calcium more reactive than magnesium?
- a. Calcium has more protons in its nucleus and therefore holds its electrons more tightly.
- b. Calcium has less protons in its nucleus and therefore holds its electrons more weakly.
- c. Calcium is bigger and experiences more shielding effect and therefore loses its valence electrons more easily.
- d. Calcium is smaller and experiences less shielding effect and therefore loses its valence electrons more easily.
- e. Magnesium is actually more reactive than calcium.

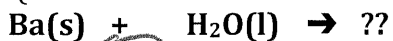
Target 8: I can write balanced net ionic equations for simple reactions between the active metals (1A and 2A) and nonmetals. I can also write the equations between metals and water.

27. Which one of the following substances is always produced when an active metal reacts with water?
- a. NaOH      b.  $H_2O$       c.  $CO_2$       d.  $H_2$       e.  $O_2$
28. The metal calcium reacts with molecular oxygen to form a compound. Which **one** of the following statements is false regarding the compound containing oxygen and calcium?
- a. Its formula is CaO.
- b. It is an ionic compound.
- c. It is a solid at room temperature.
- d. When added to acid, it reacts to produce a salt and water.
- e. When added to water, it forms an acidic solution.





29. What is the coefficient of water when the following equation is completed and balanced? (Balance with whole numbers as small as possible.)



- a. 1      **b. 2**      c. 3      d. 4      e. 5

30. Which alkaline earth metal will not react with liquid water or with steam?

- a. Be**  
 b. Mg  
 c. Ca  
 d. Ba  
 e. They all will react with liquid water and steam.

31. Which of the following generalizations CANNOT be made with regard to reactions of all alkali metals? (The symbol "M" represents any one of the alkali metals.)

- a.**  $\text{M}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{MO}_2(\text{s})$   $\rightarrow$  should be  $\text{H}_2\text{O}$   
 b.  $2\text{M}(\text{s}) + 2\text{H}_2\text{O} \rightarrow 2\text{MOH}(\text{aq}) + \text{H}_2(\text{g})$   
 c.  $2\text{M}(\text{s}) + \text{H}_2(\text{g}) \rightarrow 2\text{MH}(\text{s})$   
 d.  $2\text{M}(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{MCl}(\text{s})$   
 e.  $2\text{M}(\text{s}) + \text{S}(\text{s}) \rightarrow \text{M}_2\text{S}(\text{s})$

FLAME TESTS  
 Na = yellow  
 K = violet  
 Cu: Ba = green

32. The elements \_\_\_\_\_ could be used to produce a red or crimson color in fireworks.

- a) Mg or Ba      b) Cu      **c) Ca, Sr, or Li**      d) Ba      e) Na or K

Target 9: I can list the properties of hydrogen and oxygen.

33. Which one of the following has an allotropic form?

- a. N      **b. O**      c. Fe      d. Cl      e. H

34. Which of the following is the peroxide ion?

- a.  $\text{O}^{1-}$       b.  $\text{O}^{2-}$       **c.  $\text{O}_2^{2-}$**       d.  $\text{O}^{2-}$       e.  $\text{O}^{3-}$

35.  $\text{KO}_2$  is called \_\_\_\_\_.

- a. potassium oxide      **c. potassium superoxide**  
 b. potassium peroxide      d. potassium hydroxide

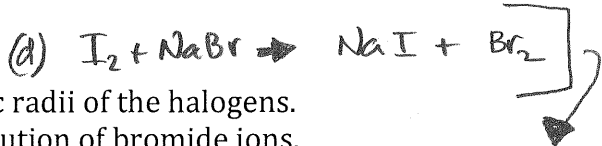
Target 10: I can list the properties of the halogen family and the noble gas family.

36. Which **one** of the following characteristics is common to elemental sulfur, chlorine, nitrogen, and carbon?

- a. They are gaseous elements at room temperature.
- b. They have oxides that form acids when added to water.
- c. They form ionic oxides.
- d. They react readily with hydrogen at room temperature.

37. Which one of the following statements concerning the characteristics of the halogens is false?

- a. The first ionization energies decrease as the atomic numbers of the halogens increase.
- b. Fluorine is the best oxidizing agent.
- c. Fluorine atoms have the smallest atomic radii of the halogens.
- d. Iodine liberates free bromine from a solution of bromide ions.
- e. The halogens have the most exothermic electron affinities of all families.



This reaction will NOT take place as  $I_2$  is less reactive than  $Br_2$ .

38. Chlorine is more apt to exist as an anion than sodium. This is because \_\_\_\_\_.

- a. chlorine is bigger than sodium
- b. chlorine has a greater ionization energy than sodium
- c. chlorine has a greater electron affinity than sodium
- d. chlorine is a gas and sodium is a solid
- e. chlorine is more metallic than sodium

39. Which element is a solid at room temperature?

- a.  $Cl_2$
- b.  $F_2$
- c.  $Br_2$
- d.  $I_2$
- e.  $H_2$

40. Of the hydrogen halides, only \_\_\_\_\_ is weak acid.

- a. HCl
- b. HBr
- c. HF
- d. HI
- e) They are all weak acids.

41. List the noble gases that are known to form compounds: \_\_\_\_\_

Ar, Kr, Xe

42. Name the halogen!

- a) Which halogen is rare and radioactive? At
- b) Which halogen has more industrial uses than any others? Cl
- c) Which halogen is a liquid at room temperature? Br
- d) Which halogen, as an ion, strengthens your teeth? F
- e) Which halogen is added to water in order to produce a disinfectant? Cl

# CHAPTER 7 PRACTICE TEST SHORT ANSWER... KEY

① (a) Nonmetals (such as halogens) have high first ionization energies & high/negative/exothermic  $e^-$  affinities. Nonmetals hold onto their  $e^-$  relatively strongly due to their smaller size & greater  $Z_{\text{eff}}$  than their same period metal counterparts. For the same reasons, nonmetals tend to attract  $e^-$  into its valence shell easily (exothermic  $e^-$  affinity).

(b) The NOBLE GASES are an exception. They do have a high  $IE_1$ , but do not have a high affinity to take on  $e^-$ .

②

	$I_1$	$I_2$	$I_3$	(kJ/mol)	
Ca	590	1145	4912		Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
Ar	1520	2666	3931		Ar: $1s^2 2s^2 2p^6 3s^2 3p^6$

(a) The reason why  $I_1$  &  $I_2$  are lower for Ca than Ar is that Ca does not hold onto its valence  $e^-$  as tightly. There are 2 reasons (possibly more!) for this:

- 1- Ca experiences more shielding effect
- 2- Ca valence  $e^-$  are farther from nucleus
- 3- Ar has a particularly stable  $e^-$  configuration (octet)

(b) Removing the 3<sup>rd</sup>  $e^-$  from Ca is much more difficult than removing the first 2 $e^-$ . The first 2 $e^-$  ( $4s^2$ ) experience a much greater shield effect (the 18 core  $e^-$ ) than removing an  $e^-$  from  $n=3$  shell (only 10 core  $e^-$ ). You do not  $\rightarrow$



2b continued...

see as dramatic of a jump between  $I_2$  &  $I_3$  for Ar as the  $e^-$  are being removed from  $n=3$  shell ... the shielding effect is the SAME for both  $I_2$  &  $I_3$ .

(3) a)  $\left. \begin{array}{l} \text{Be } 1s^2 2s^2 \\ \text{Li } 1s^2 2s^1 \end{array} \right\}$  Be experiences a greater  $Z_{\text{eff}}$  due to more pt in nucleus. (SHIELDING EFFECT is same for both!)

(b)  $\left. \begin{array}{l} \text{F } 1s^2 2s^2 2p^5 \\ \text{Cl } 1s^2 2s^2 2p^6 3s^2 3p^5 \end{array} \right\}$  Cl is bigger due to ...  
(A) it contains 1 more energy level,  
(B) it's valence  $e^-$  experience more shielding effect

(c)  $\left. \begin{array}{l} \text{Ag: } [\text{Kr}] 5s^1 4d^{10} \\ \text{Au: } [\text{Xe}] 6s^1 4f^{14} 5d^{10} \end{array} \right\}$  Even though Au has an extra energy shell (which is why you would think it is sig. larger),

Au has 79 pt & Ag only has 47pt. Au has a MUCH greater nuclear charge than Ag! This much higher nuclear charge practically offsets the fact that gold has an extra energy shell.

(4) SHIELDING EFFECT  $\Rightarrow$  the blocking of the pull of the nucleus on its valence  $e^-$  by its core (inner)  $e^-$ .

(a) The greater the shielding effect, the smaller the I.E.

(b) Metals react by LOSING  $e^-$  forming positive ions.  
Metals with greater shielding effect (BIG METALS) tend to be more reactive as the nucleus cannot pull on its valence  $e^-$  as strongly.

(c) Nonmetals react by GAINING  $e^-$  forming anions.  
Nonmetals with small shielding effect are more reactive as they are better able to attract  $e^-$ .

(5)  $H^-$  ion:  $1s^2$  ( $Z=1$ ) } The  $H^-$  is bigger as its  $Z_{eff}$   
He atom:  $1s^2$  ( $Z=2$ ) } is small due to having 1 less  
pt in nucleus. (Shielding effect  
same in each particle.)

(6) Given:

$X(s)$  colorless

$X + O_2 \rightarrow$  GAS

$X + H_2O \rightarrow$  Acidic

Answer:

• sulfur as a solid is yellow (see fig. 7.16 p. 267)

•  $Si + O_2 \rightarrow SiO_2$  (sand!) solid

•  $C(\text{diamond}) + O_2 \rightarrow CO_2(g)$  colorless

• P has 3 allotropes... all colored.

• B is BLACK solid

BEST GUESS... CARBON!

