

## 10.9: Exercises

### 10.2: The Electromagnetic Spectrum

1. The laser on a Blu-ray player has a wavelength of 405 nm. In what region of the electromagnetic spectrum is this radiation?

**Answer**

Ultra-violet (UV)

2. Choose the correct word for the following statement. Blue light has a (longer or shorter) wavelength than red light.

**Answer**

shorter

3. Choose the correct word for the following statement. Yellow light has a (higher or lower) frequency than blue light.

**Answer**

lower

4. Choose the correct word for the following statement. Green light has a (larger or smaller) energy than red light.

**Answer**

larger

5. If "light A" has a longer wavelength than "light B", then "light A" has \_\_\_\_\_ "light B".
- a. a lower frequency than
  - b. a higher frequency than
  - c. the same frequency as

**Answer**

a lower frequency than

6. If "light C" has a shorter wavelength than "light D", then "light C" has \_\_\_\_\_ "light D".
- a. a larger energy than
  - b. a smaller energy than
  - c. the same energy as

**Answer**

a larger energy than

7. If "light E" has a higher frequency than "light F", then "light E" has \_\_\_\_\_ "light F".
- a. a longer wavelength than
  - b. a shorter wavelength than
  - c. the same wavelength as

**Answer**

a shorter wavelength than

8. If "light G" has a higher frequency than "light H", then "light G" has \_\_\_\_\_ "light H".
- a. a larger energy than
  - b. a smaller energy than
  - c. the same energy as

**Answer**

a larger energy than

9. If "light J" has larger energy than "light K", then "light J" has \_\_\_\_\_ "light K".
- a. a shorter wavelength than
  - b. a longer wavelength than
  - c. the same wavelength as

**Answer**

a shorter wavelength than

10. Which of the following statements is true?
- a. The frequency of green light is higher than the frequency of blue light and the wavelength of green light is longer than the wavelength of blue light.
  - b. The frequency of green light is higher than the frequency of blue light and the wavelength of green light is shorter than the wavelength of blue light.
  - c. The frequency of green light is lower than the frequency of blue light and the wavelength of green light is shorter than the wavelength of blue light.
  - d. The frequency of green light is lower than the frequency of blue light and the wavelength of green light is longer than the wavelength of blue light.
  - e. The frequency of green light is the same as the frequency of blue light and the wavelength of green light is shorter than the wavelength of blue light.

**Answer**

Statement d is true.

11. As the wavelength of electromagnetic radiation increases:
- a. its energy increases.
  - b. its frequency increases.
  - c. its speed increases.
  - d. more than one of the above statements is true.
  - e. none of the above statements is true.

**Answer**

e. none of the above statements is true.

### 10.3: Emission Spectra

12. The light produced by a red neon sign is due to the emission of light by excited neon atoms. Qualitatively describe the spectrum produced by passing light from a neon lamp through a prism.

**Answer**

The spectrum consists of colored lines, at least one of which (probably the brightest) is red.

13. The spectra of hydrogen and of magnesium are shown in [Section 10.3](#). What causes the lines in these spectra? Why are the colors of the lines different? Suggest a reason for the observation that the spectrum of magnesium is more complicated than the spectrum of hydrogen.

**Answer**

The lines are caused by electrons dropping to lower energy levels. The colors are different because the electrons have different energies possible in the hydrogen and magnesium. One reason why the spectrum of magnesium could be more complicated is because it has more electrons than hydrogen.

### 10.4: The Bohr Model

14. According to the Bohr model, electrons in an atom can only have certain, allowable energies. As a result, we say that the energies of these electrons are \_\_\_\_\_.

**Answer**

quantized

15. What does it mean to say that the energy of the electrons in an atom is quantized?

**Answer**

Quantized energy means that the electrons can possess only certain discrete energy values; values between those quantized values are not permitted.

16. How are the Bohr model and the Rutherford model of the atom similar? How are they different?

**Answer**

Both have a small, heavy nucleus with the electrons moving around it. The Rutherford model has the electrons moving in orbits, much like a miniature solar system. However, the electrons will lose energy as they travel and move closer and closer to the nucleus. The amount of energy will change as they get closer to the nucleus so they will not emit discrete lines. The Bohr model also has the electrons moving in orbits. However, they are confined to specific energy values and only absorb or emit energy as they jump between levels, creating discrete line spectra.

### 10.6: Valence Electrons

17. How many valence electrons are in one atom of the following elements?

- a. nitrogen
- b. calcium
- c. xenon
- d. boron

**Answer**

- a. 5
- b. 2
- c. 8
- d. 3

18. How many valence electrons are in one atom of elements in the following groups?

- a. group VIA or 16
- b. group IA or 1
- c. group VIIA or 17
- d. group IVA or 14

**Answer**

- a. 6
- b. 1
- c. 7
- d. 4

### 10.7: Periodic Trends

19. Describe the atomic size trend for the rows in the Periodic Table.

**Answer**

Atoms get smaller as one moves from left to right across a row on the periodic table due to an increase in the number of protons.

20. Describe the atomic size trend for the columns on the Periodic Table.

**Answer**

Atoms get larger as one moves down a column on the periodic table because the valence electrons are in higher energy levels which are farther from the nucleus.

21. Which of the following would be smaller?

- a. In or Ga
- b. K or Cs
- c. Te or Po

**Answer**

- a. Ga
- b. K
- c. Te

22. Explain in your own words why Iodine is larger than Bromine.

**Answer**

Iodine is larger than bromine because it is farther down on the periodic table. Thus, its valence electrons are in a higher energy level that is farther from the nucleus.

23. Which of the following would have the largest atomic radii?

- a. Si
- b. C
- c. Sn
- d. Pb

**Answer**

Pb

24. Arrange the following in order of increasing atomic radii: Tl, B, Ga, Al, In.

**Answer**

$B < Al < Ga < In < Tl$

25. Arrange the following in order of increasing atomic radii: Ge, Sn, C.

**Answer**

$C < Ge < Sn$

26. Which of the following would be larger?

- a. Rb or Sn
- b. Ca or As

**Answer**

- a. Rb
- b. Ca

27. Place the following in order of increasing atomic radii: Mg, Cl, S, Na.

**Answer**

$Cl < S < Mg < Na$

28. Which of the following would have the largest atomic radii?

- a. Sr
- b. Sn
- c. Rb
- d. In

**Answer**

Rb

29. Which of the following would have the smallest atomic radii?

- a. K
- b. Kr

- c. Ga
- d. Ge

**Answer**

Kr

30. Place the following elements in order of increasing atomic radii: In, Ca, Mg, Sb, Xe.

**Answer**

$\text{Mg} < \text{Ca} < \text{Xe} < \text{Sb} < \text{In}$

31. Place the following elements in order of decreasing atomic radii: Al, Ge, Sr, Bi, Cs.

**Answer**

$\text{Cs} > \text{Bi} > \text{Sr} > \text{Ge} > \text{Al}$

32. Which of the following would have the largest ionization energy?

- a. Na
- b. Al
- c. H
- d. He

**Answer**

He

33. Which of the following would have the smallest ionization energy?

- a. K
- b. P
- c. S
- d. Ca

**Answer**

K

34. Place the following elements in order of increasing ionization energy: Na, O, Ne, K.

**Answer**

$\text{K} < \text{Na} < \text{O} < \text{Ne}$

35. Place the following elements in order of decreasing ionization energy: N, Si, P, Mg, He.

**Answer**

$\text{He} > \text{N} > \text{P} > \text{Si} > \text{Mg}$

36. Based on their positions in the periodic table, predict which has the smallest atomic radius: Mg, Sr, Si, Cl, I.

**Answer**

Cl

37. Based on their positions in the periodic table, predict which has the largest atomic radius: Li, Rb, N, F, I.

**Answer**

Rb

38. Based on their positions in the periodic table, predict which has the largest first ionization energy: Mg, Ba, B, O, Te.

**Answer**

O

39. Based on their positions in the periodic table, predict which has the smallest first ionization energy: Li, Cs, N, F, I.

**Answer**

Cs

40. Based on their positions in the periodic table, rank the following atoms in order of increasing metallic character: F, Li, N, Rb

**Answer**

$F < N < Li < Rb$

41. Based on their positions in the periodic table, rank the following atoms in order of increasing metallic character: Mg, O, S, Si

**Answer**

$O < S < Si < Mg$

42. Based on their positions in the periodic table, list the following atoms in order of decreasing metallic character: Mg, Ca, Rb, Cs.

**Answer**

$Cs > Rb > Ca > Mg$

43. Based on their positions in the periodic table, list the following atoms in order of decreasing metallic character: Sr, Ca, Si, Cl.

**Answer**

$Sr > Ca > Si > Cl$

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