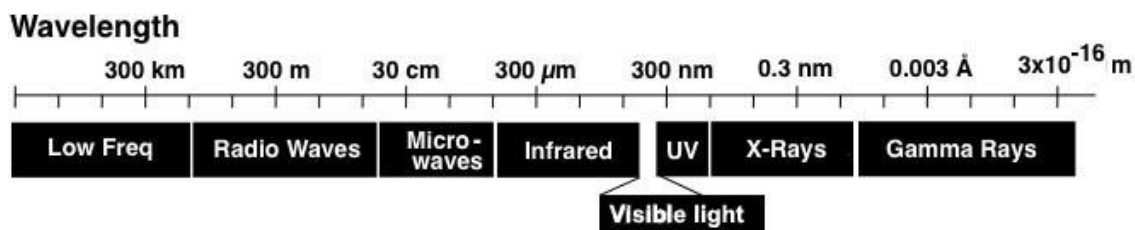


1. Which type of electromagnetic radiation has the **highest** energy?



- A. radio waves
B. microwaves
C. visible light
D. gamma rays

2. One of the local radio stations broadcasts Wildcats basketball games at a frequency of 98.1 MHz. What is the **wavelength** of these electromagnetic waves?

- A. 6.50×10^{-26} J
B. 3.06 m
C. 6.12 m
D. 3.06×10^6 m

3. A photon

- A. is a particle of light.
B. is a packet of electrons.
C. has a constant energy regardless of frequency.
D. has a constant energy regardless of wavelength.

4. Four photons of different wavelengths strike a metal surface with the outcomes described below. Which photon has the **largest** energy?

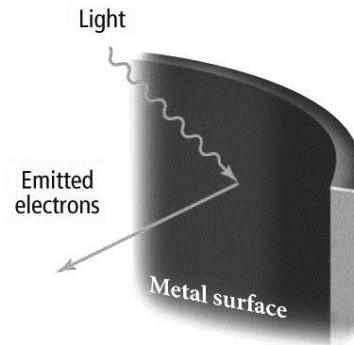
Photon A causes emission of an electron with 2.06×10^{-18} J of kinetic energy.

Photon B causes emission of an electron with 5.37×10^{-20} J of kinetic energy.

Photon C causes emission of multiple electrons with 5.37×10^{-20} J of kinetic energy.

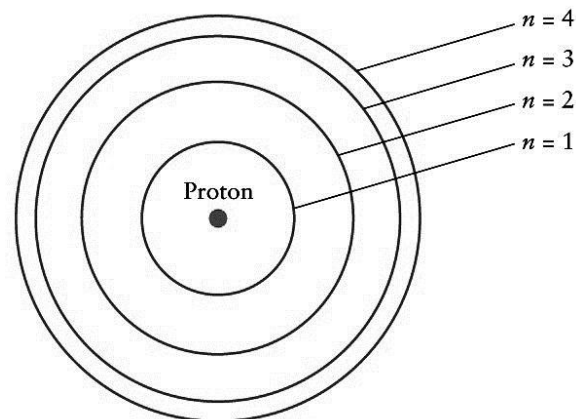
Photon D does not cause an electron to be emitted.

- A. photon A
B. photon B
C. photon C
D. photon D



-
5. Which of the following statements is **true** about atomic spectroscopy?
- A. An emission spectrum for an element is composed of continuous white light.
 - B. An emission spectrum for an element is composed of a series of bright, discrete lines.
 - C. In the absorption and emission spectra for a particular element, the absorption and emission lines occur at different wavelengths.
 - D. Neither absorption nor emission spectra can be used to identify an element.
-

6. Which of these transitions in a hydrogen atom emits the **lowest** energy photon?



- A. $n = 4$ to $n = 3$
 - B. $n = 2$ to $n = 1$
 - C. $n = 3$ to $n = 2$
 - D. $n = 3$ to $n = 1$
-
7. What is the de Broglie wavelength of an electron traveling at a speed of 1.09×10^6 m/s? The mass of an electron is 9.11×10^{-31} kg.
- A. 6.67×10^{-13} m
 - B. 6.67×10^{-10} m
 - C. 275 m
 - D. 3.63×10^{-3} m
-

8. The concept of complementary properties is central to Heisenberg's uncertainty principle. Which of the following is a **true** statement?
- A. We can precisely know both the position and velocity of an electron.
 - B. The mass of an electron cannot be determined precisely.
 - C. Complementary properties are not applicable to the description of the behavior of electrons.
 - D. The more accurately we know the position of an electron, the less accurately we know its velocity.
-

-
9. Which statement is **false**?
- A. An atomic orbital is a probability distribution map of where electrons are likely to be found.
 - B. An atomic orbital is specified by the three quantum numbers n , l , m_l .
 - C. Atomic orbitals contain all of their electron density within well-defined borders.
 - D. The size and energy of an atomic orbital are determined by the same quantum number in a hydrogen atom.
-

10. Which value of n corresponds to the **smallest** principal electron shell?
- A. 0
 - B. 1
 - C. 2.3
 - D. 4
-

11. How many **total** electrons can be present in an $l = 2$ subshell?
- A. 14
 - B. 10
 - C. 6
 - D. 5
-

12. How many **orbitals** in an atom have the quantum numbers $n = 2$ and $m_l = 1$?
- A. 1
 - B. 2
 - C. 3
 - D. 4
-

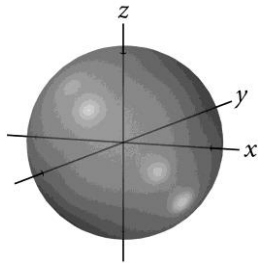
13. Which of the following corresponds to an atomic orbital that **cannot** exist?
- A. $6s$
 - B. $2d$
 - C. $4f$
 - D. $2p$
-

14. What wavelength of light is emitted when a transition from the $n = 4$ excited state to the ground state occurs in a hydrogen atom?
- A. 433 nm
B. 122 nm
C. 97.3 nm
D. 8.56 nm

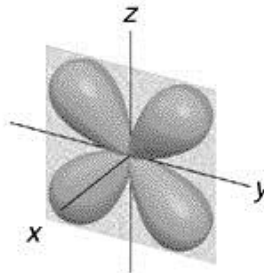
15. Which of the following is an allowed set of quantum numbers (n, l, m_l)?
- A. 2, 2, 1
B. 2, 1, -2
C. 4, 3, -2
D. 3, 0, 1

16. Which figure represents an atomic orbital with $l = 2$?

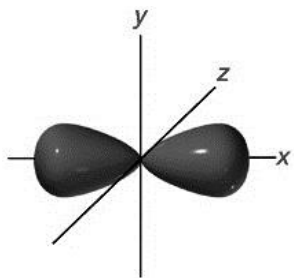
A.



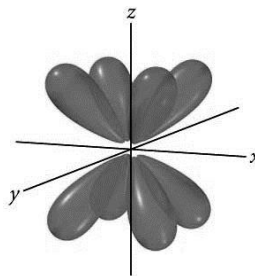
C.



B.



D.



17. Which of the following sets of quantum numbers, $[n, l, m_l, m_s]$, are not allowed for two electrons in the same atom?
- A. $[3, 2, 2, +1/2]$ and $[3, 2, 2, -1/2]$
B. $[3, 1, -1, -1/2]$ and $[3, 1, 1, +1/2]$
C. $[2, 1, 0, +1/2]$ and $[2, 0, 0, +1/2]$
D. $[2, 1, 1, -1/2]$ and $[2, 1, 1, -1/2]$

18. How many **unpaired** electrons are in the ground-state electron configuration of a sulfur atom?

- A. 0
B. 1
C. 2
D. 3





19. Which of the following statements is **true**?

- A. Electrons in the same principal shell do not effectively shield each other.
B. Electron shielding increases the effective nuclear charge experienced by a valence electron.
C. The force experienced between two electrons is attractive because both have negative charges.
D. The electrons in the outermost principal shell efficiently shield the core electrons from the charge of the nucleus.

20. Which of the following **correctly** describes the effects at play in multielectron atoms?

- A. Because of penetration, the subshells of each principal shell are degenerate.
B. Penetration does not play a role in the energy of orbitals in multielectron atoms.
C. For a given principal shell, the d orbitals penetrate more effectively than the p orbitals, which penetrate more effectively than s orbitals, making the energy ordering of the orbitals $s < p < d$.
D. For a given principal shell, the s orbital penetrates more effectively than the p orbitals, causing the s orbital to experience more of the nuclear charge and have a lower energy.

21. Which of the following is an **allowed** arrangement of electrons in a set of p orbitals?

- A. 
B. 
C. 
D. 

22. How many **valence** electrons does a ground-state carbon atom possess?

A. 4

C. 2

B. 0

D. 6

23. What is the electron configuration for a ground-state molybdenum atom?

A. $[\text{Kr}]5s^24d^4$

C. $[\text{Kr}]5s^14d^5$

B. $[\text{Kr}]4d^6$

D. $[\text{Kr}]5s^24d^5$

24. Which statement is **true**?

A. Main-group elements in the same row have the same number of valence electrons.

B. The ground-state valence electron configuration for Group 1 metals is ns^1 .

C. There are ten columns in the transition element block corresponding to filling the p orbitals.

D. The ground-state valence electron configuration for the halogens is $ns^2 np^6$.

25. Electrons in the outermost principal energy level of which of the following atoms experiences the **largest** effective nuclear charge?

A. P

C. Cl

B. Na

D. Si

26. Which of the following atoms or ions has the **largest** radius?

A. O^{2-}

C. Na^+

B. F^-

D. Ne

27. Which element in the third period could have the following ionization energies (kJ/mol)?

1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
1012	1907	2914	4964	6273	21267	25431

- A. Si C. S
B. Cl D. P

28. Which of the following statements is **false**?

- A. Most groups (columns) of the periodic table have a weak or indefinite trend in electron affinity.
B. Electron affinity generally becomes more negative as we move to the right across a period (row) in the periodic table.
C. Electron affinity of an atom is the energy change associated with the atom gaining an electron in the gaseous state.
D. Electron affinities are usually positive because the process of an atom gaining an electron requires energy.

29. What is the electron configuration of a ground-state Fe³⁺ ion?

- A. [Ar]4s²3d³ C. [Ar]4s¹3d⁴
B. [Ar]4s²3d⁹ D. [Ar]3d⁵

30. What is the identity of the element with the following characteristics?

- Its atomic radius is smaller than that of sodium.
- Its outermost electrons are shielded by 10 core electrons.
- Its most common ion has a larger radius than the neutral atom.
- It is more metallic than chlorine.

- A. S C. Mg
B. F D. N

CHE 105 Exam 3 Spring 2015 Key

1. D
2. B
3. A
4. A
5. B
6. A
7. B
8. D
9. C
10. B
11. B
12. A
13. B
14. C
15. C
16. C
17. D
18. C
19. A
20. D
21. C
22. A
23. C
24. B
25. C
26. A
27. D
28. D
29. D
30. A