$c = \lambda \cdot \nu$

$E = h\nu$

Chapter 6 Homework

Part A Multiple choice (Select the one that is best in each case. 1 point/question)

B.
1. Of the following, _____ radiation has the longest wavelength and _____ radiation has the greatest energy.

ultraviolet   visible   infrared

A) ultraviolet, infrared
B) infrared, ultraviolet
C) ultraviolet, ultraviolet
D) visible, ultraviolet
E) ultraviolet, visible

D.
2. Which one of the following is the correct electron configuration for a ground-state nitrogen atom?

N
$1s^2 \, 2s^2 \, 2p^3$

A)

1s	2s	2p		
↑↓	↑↓	↑↓	↑	

B)

1s	2s	2p		
↑↓	↑↑↓	↑	↑	↑

C)

1s	2s	2p		
↑↑↓	↑↓	↑	↑	↑

D)

1s	2s	2p		
↑↓	↑↓	↑	↑	↑
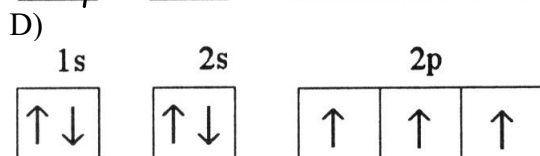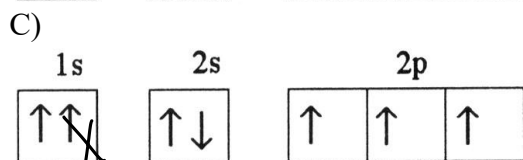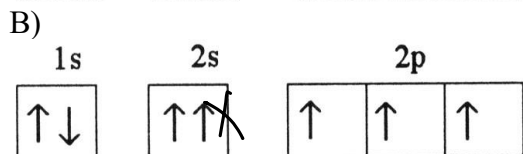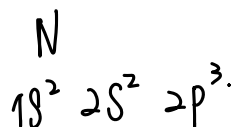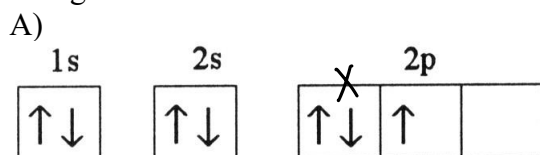
E) None of the above is correct.

D.
3. Which one of the following orbitals can hold two electrons?
A) $2p_x$ ∪
B) $3s$ ∪
C) $4d_{xy}$ ∪
D) all of the above
E) none of the above

A.
4. Which of the following is a valid set of four quantum numbers? (n, l, m_l, m_s)
A) 2, 1, 0, +1/2
B) 2, 2, 1, −1/2
C) 1, 0, 1, +1/2
D) 2, 1, 2, +1/2
E) 1, 1, 0, −1/2

$n. \quad n \geq 1.$
$l. \quad 0 \leq l \leq n-1$
$m_l. \quad -l \leq m_l \leq l.$
$m_s \quad \pm \frac{1}{2}.$

C.
5. The photoelectric effect is _____.
A) the total reflection of light by metals giving them their typical luster
B) the production of current by silicon solar cells when exposed to sunlight
C) the ejection of electrons by a metal when struck with light of sufficient energy
D) the darkening of photographic film when exposed to an electric field
E) a relativistic effect

- 1 -

D. 6. Which quantum number determines the energy of an electron in a hydrogen atom?
A) *l*   B) *E*   C) m_l D) *n*   E) *n* and *l*

→ energy level. discrete.

B. 7. A spectrum containing only _____ wavelengths is called a line spectrum.
A) Rydberg   B) specific   C) continuous   D) visible   E) invariant

one elt. ⟷ one line.

C. 8. The wavelength of an electron whose velocity is 1.7×10^4 m/s and whose mass is 9.1×10^{-28} g is _____ m.
A) 4.3×10^{-2} B) 12   C) 4.3×10^{-8} D) 4.3×10^{-11} E) 2.3×10^{-7}

$$E = h\nu = pc = mv \cdot \lambda\nu \qquad \lambda = \frac{h}{mv}.$$

D. 9. All of the orbitals in a given subshell have the same value as the _____ quantum number.
A) principal ✓ — *energy level.*
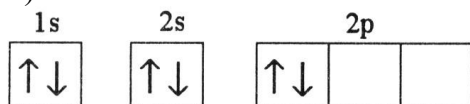B) angular momentum — *shape.*
C) magnetic — *3-dim orientation of the orbital.*
D) A and B
E) B and C

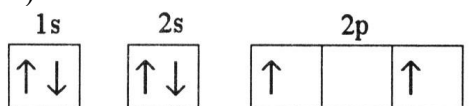**C.** 10. Which electron configuration represents a violation of the Pauli exclusion principle?
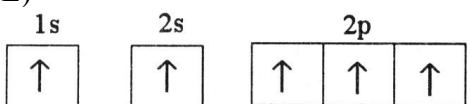
A)
1s 2s 2p
[↑↓] [↑↓] [↑↓][ ][ ]

B)
1s 2s 2p
[↑↓] [↑] [ ][ ][ ]

C)
1s 2s 2p
[↑↓] [↑↑] [↑][ ][ ]

D)
1s 2s 2p
[↑↓] [↑↓] [↑][ ][↑]

E)
1s 2s 2p
[↑] [↑] [↑][↑][↑]

C. 11. According to the Heisenberg Uncertainty Principle, it is impossible to know precisely both the position and the _____ of an electron.
A) mass   B) color   C) momentum   D) shape   E) charge

E. 12. In a p_x orbital, the subscript *x* denotes the _____.
A) energy of the electron
B) spin of the electrons
C) probability of the shell
D) size of the orbital
E) axis along which the orbital is oriented

s p d
0 1 2
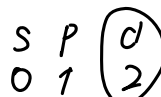
A 13. Which one of the following is **not** a valid value for the magnetic quantum number of an electron in a 4d subshell?   *n=4   0 ≤ l ≤ 3*
A) 3   B) 2   C) 0   D) 1   E) –1   *l = 2*

$$-3 \le -l \le m_l \le l \le 3 \qquad -2 \le \ \le 2$$

Chapter 6 Homework

D. 14. A $4p_z$ orbital in a many-electron atom is degenerate with _____ .
A) $5s$ B) $3p_z$ C) $4d_{xy}$ D) $4p_x$ E) $4d_{z^2}$

D 15. The valence shell of the element X contains 2 electrons in a $5s$ subshell. Below that shell, element X has a partially filled $4d$ subshell. What type of element is X?
A) main group element 主族 (S区、p区)
B) chalcogen 硫族 (O, S)
C) halogen 卤族 (F, Cl).
D) transition metal ⎯⎯⎯⎯⎯⎯⎯→ 过渡金属. (拥有一个部分填充的 d 里层)
E) alkali metal 碱金属. (Li, Na)

Part B Short questions (Write legibly and show all work for all steps in the problem)

16. **(4 points)** What is the energy (in kJ/mol) of one mole of yellow photons that have a wavelength of 527 nm?

17. **(8 points)** Using the periodic table as a guide, write the condensed electron configuration and determine the number of unpaired electrons for the ground state of **(a)** C, **(b)** Zn, **(c)** I, **(d)** Cu.

18. **(3 points)** All of the subshells in a given shell have the same energy in the hydrogen atom. In a many-electron atom, the subshells in a given shell do not have the same energy. Why?

Name: _P?, P?_   Student ID: _12311410_ Instructor: Score:

Part A Multiple choice   (15 points)

1-5 _B D D A C_

6-10 _D B C D C_

11-15 _C E A D D._

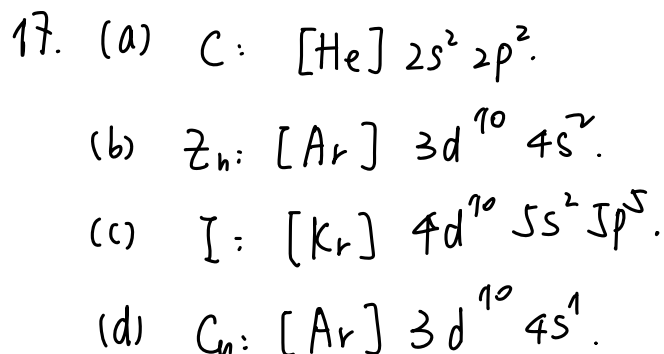## Part B Short questions   (15 points)

16. **(4 points)** What is the energy (in kJ/mol) of one mole of yellow photons that have a wavelength of 527 nm?

16.

$$E_k = N_A \times \left(h \nu \right)$$

$$= N_A \times h \times \frac{c}{\lambda}$$

$$= 6.02 \times 10^{23} \times 6.626 \times 10^{-34} \, J \cdot s \times \frac{3 \times 10^8 \, m/s}{527 \times 10^{-9} \, m.}$$

$$= 227 \, kJ/mol.$$

17. **(8 points)** Using the periodic table as a guide, write the <u>condensed electron configuration</u> and determine the number of unpaired electrons for the ground state of **(a)** C, **(b)** Zn, **(c)** I, **(d)** Cu.

17. (a)   C : $[He] \, 2s^2 \, 2p^2.$

(b) Zn : $[Ar] \, 3d^{10} \, 4s^2.$

(c)   I : $[Kr] \, 4d^{10} \, 5s^2 \, 5p^5.$

(d) Cu : $[Ar] \, 3d^{10} \, 4s^1.$

18. **(3 points)** All of the subshells in a given shell have the same energy in the hydrogen atom. In a many-electron atom, the subshells in a given shell do not have the same energy. Why?

18. ① In the hydrogen atom:

we only have 1 electron, whose energy is only

determined by its average distance from the single proton nucleus.

⇒ the energy only depends on the principle quantum

number, which means the shell the electron is,

② In a many-electron atom:

- Shielding: inner-shell electrons may block the attractive force of the nucleus from reaching the outer-shell electrons.

- penetration: Obitals which have different shapes affect how close an electron may appear near the nucleus.