Physics 07 **HW CH 28 Quantum Atomic Physics**

Name_____

1) If the maximum possible accuracy in measuring the position of a particle increases, the maximum possible accuracy in measuring its velocity will
A) increase. B) decrease. C) not be affected.

2) If the maximum possible accuracy in measuring the lifetime of a particle increases, the maximum possible accuracy in measuring its energy will
A) increase. B) decrease. C) not be affected.

3) The orbital angular momentum quantum number can take which of the following values for any given value of the principal quantum number, n?
A) $\ell = 0, 1, 2, \ldots, (n - 1)$
B) $\ell = 1, 2, 3, 4, \ldots$
C) $\ell = 1, 2, 3, 4, \ldots, (n + 1)$
D) $\ell = 0, 1, 2, \ldots, n$
E) $\ell = 0, 1, 2, \ldots$

4) According to the quantum mechanical model of the hydrogen atom, if the orbital angular momentum quantum number is ℓ, there will be how many permitted magnetic quantum numbers?
A) $2\ell - 1$ B) $\ell/2$ C) $2\ell + 1$ D) 3ℓ E) 2ℓ

5) According to the quantum mechanical model of the hydrogen atom, if the principal quantum number is n, how many different orbital angular momentum quantum numbers are permitted?
A) $2n$ B) n C) $n/2$ D) $4n$ E) $3n$

6) What is the atomic number of a neutral atom that has an electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$?
A) 11 B) 20 C) 14 D) 5

7) If $\ell = 4$, which one of the following is a possible quantum number for n?
A) 4 B) 2 C) 3 D) 0 E) 8

8) If $n = 5$, which one of the following is *not* an allowed magnetic quantum number m_1?
A) 5 B) 2 C) 4 D) 0

9) In its ground state, the quantum numbers (n, ℓ, m_1, m_s) for hydrogen are, respectively,
A) 1, 0, 0, ±1/2. B) 1, 1, 1, 1. C) 1, 0, 0, 0. D) 1, 1, 1, ±1/2.

10) Consider ground–state helium having two electrons in orbit. If one of the electrons has quantum numbers (n, ℓl, m_1, m_s) of 1, 0, 0, –1/2 respectively, the quantum numbers for the other electron will be
A) 1, 1, 1, +1/2. B) 1, 1, 0, –1/2.
C) 1, 0, 0, +1/2. D) none of the given answers.

11) The elements in the periodic table that have completely filled shells or subshells are referred to as
A) alkali metals. B) noble gases.
C) transition elements. D) halogens.

12) A tiny dust particle of mass 8.50 μg is being observed under a microscope. Its position is determined to be within a space of 0.0060 mm. ($h = 6.626 \times 10^{-34}$ J • s)
(a) Find the uncertainty in its speed implied by the uncertainty in its position.
(b) Assuming the dust particle is moving at the speed in part (a), how many years would it take for the particle to move 1.0 mm?

13) A molecule of roughly spherical shape has a mass of 1.80×10^{-25} kg and a diameter of 0.6 nm. If the uncertainty in the measured position of the molecule is equal to the molecular diameter, what is the minimum uncertainty in the speed of the molecule? ($h = 6.626 \times 10^{-34}$ J • s)
A) 100 m/s B) 10 m/s C) 1 m/s D) 0.01 m/s E) 0.1 m/s

14) A 10–g bouncy ball is confined in a 8.3–cm–long box. What is its minimum energy? ($h = 6.626 \times 10^{-34}$ J • s)
A) 3.2×10^{-46} J B) 1.3×10^{-20} J C) 8.1×10^{-65} J D) 9.4×10^{-75} J

15) A baseball has mass 143 g and a speed of 45 m/s, with the speed known to within 0.10%. What is the minimum uncertainty in the position of the baseball? ($h = 6.626 \times 10^{-34}$ J • s)
A) 1.4×10^{-32} m
B) 1.6×10^{-32} m
C) 1.4×10^{-30} m
D) 1.8 nm
E) 1.6×10^{-30} m

16) The excited state of a certain atom is 3.2 eV ± 0.21 eV. ($h = 6.626 \times 10^{-34}$ J • s, 1eV = 1.60×10^{-19} J)
(a) What is the average lifetime of this state, in femtoseconds?
(b) If the excited energy were doubled (to 6.4 eV ± 0.21 eV), how would the lifetime be affected?

17) An atom has completely filled inner shells and a single valence electron in an excited p state. The filled inner shells have an orbital momentum equal to zero. What is the magnitude of the orbital angular momentum of the atom?
A) $1.4 \frac{h}{2\pi}$ B) $2.0 \frac{h}{2\pi}$ C) $1.0 \frac{h}{2\pi}$ D) $1.7 \frac{h}{2\pi}$ E) $1.2 \frac{h}{2\pi}$

18) An atom has completely filled inner shells and a single valence electron in an excited p state. The filled inner shells have an orbital momentum equal to zero. When a magnetic field is applied, what are the possible angles between the magnetic field and the orbital angular momentum?
A) 45°, 90°
B) 45°
C) 45°, 90°, 135°
D) 90°
E) 45°, 135°

19) What is the minimum angle between the z–axis (or any other axis you choose) and the orbital angular momentum of an electron in the $n = 4$ state?
A) 30.0° B) 45.0° C) 60.0° D) 41.4°

20) Consider the $n = 10$ shell.
(a) What is the largest value of the angular momentum quantum number, ℓ, in this shell?
(b) How many electrons can be placed in this shell?

21) An atom with atomic number 6 is in its ground state. How many electrons are in its outermost shell?

22) Write out the electron configuration for the ground state of an atom with 15 electrons.

23) Which one of the following is the correct electronic configuration for carbon, which has 6 electrons?
A) $1s^1\ 2p^1$ B) $1s^1\ 2s^1\ 2p^1$ C) $1s^1\ 2s^2\ 2p^1$ D) $1s^2\ 2s^2\ 2p^2$ E) $1s^2\ 2s^2\ 2p^4$

24) A hydrogen atom is in the 6*h* state. Which one of the following is *not* a magnetic quantum number for that state?
A) 0 B) 1 C) 4 D) 6 E) 2

25) In a hydrogen atom, an electron with $n = 7$ can exist in how many different quantum states?
A) 98 B) 6 C) 7 D) 15

26) How many *unique* quantum states correspond to the lowest possible energy level of an electron in the hydrogen atom?
A) 0 B) 1 C) 4 D) 2 E) 3

27) How many 2*d* electron states can an atom have?
A) 0 B) 10 C) 4 D) 8 E) 6

28) How many possible sets of electron states (or quantum numbers) are there in the 5*f* subshell?
A) 10 B) 8 C) 14 D) 2

29) The values of n and ℓ for a 4*f* subshell are
A) $n = 4$, $\ell = 4$.
B) $n = 4$, $\ell = 3$.
C) $n = 3$, $\ell = -3$.
D) $n = 4$, $\ell = 2$.
E) $n = 3$, $\ell = 3$.

30) Neon has 10 electrons. What is the value of Z of the next higher element that has chemical properties very similar to those of neon?
A) 19 B) 18 C) 17 D) 11 E) 36

Answer Key
Testname: CH28_QUANTUM_ATOM

1) B
2) B
3) A
4) C
5) B
6) C
7) E
8) A
9) A
10) C
11) B
12) (a) 2.1×10^{-21} m/s (b) 1.5×10^{10} y
13) C
14) C
15) B
16) (a) 3.1 fs (b) unchanged since the uncertainty is still ± 0.21 eV
17) A
18) C
19) A
20) (a) 9 (b) 200
21) 4
22) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
23) D
24) D
25) A
26) D
27) A
28) C
29) B
30) B