

Name _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Ham radio operators often broadcast on the 6-meter band. The frequency of this electromagnetic radiation is _____ MHz.
- A) 50 B) 20 C) 2.0 D) 200 E) 500
- 2) What is the frequency of light (s^{-1}) that has a wavelength of 1.23×10^{-6} cm?
- A) 2.44×10^{16} B) 1.04×10^{-13} C) 9.62×10^{12} D) 3.69 E) 4.10×10^{-17}
- 3) The wavelength of a photon that has an energy of 5.25×10^{-19} J is _____ m.
- A) 4.21×10^{-24} B) 2.38×10^{23} C) 2.64×10^6 D) 3.79×10^7 E) 3.79×10^{-7}
- 4) The frequency of a photon that has an energy of 3.7×10^{-18} J is _____ s^{-1} .
- A) 5.4×10^{-8} B) 5.6×10^{15} C) 1.8×10^{-16} D) 2.5×10^{-15} E) 2.5×10^{15}
- 5) A mole of red photons of wavelength 725 nm has _____ kJ of energy.
- A) 6.05×10^{-3} B) 2.74×10^{-19} C) 4.56×10^{-46} D) 227 E) 165
- 6) Of the following transitions in the Bohr hydrogen atom, the _____ transition results in the emission of the highest-energy photon.
- A) $n = 6 \rightarrow n = 1$ B) $n = 1 \rightarrow n = 6$ C) $n = 3 \rightarrow n = 6$ D) $n = 6 \rightarrow n = 3$ E) $n = 1 \rightarrow n = 4$
- 7) Using Bohr's equation for the energy levels of the electron in the hydrogen atom, determine the energy (J) of an electron in the $n = 4$ level.
- A) -5.45×10^{-19} B) -1.84×10^{-29} C) -1.36×10^{-19} D) $+1.84 \times 10^{-29}$ E) -7.34×10^{18}
- 8) The lines in the emission spectrum of hydrogen result from _____.
- A) electrons given off by hydrogen as it cools
B) decomposing hydrogen atoms
C) electrons given off by hydrogen when it burns
D) energy given off in the form of visible light when an electron moves from a higher energy state to a lower energy state
E) protons given off when hydrogen burns
- 9) When the electron in a hydrogen atom moves from $n = 6$ to $n = 2$, light with a wavelength of _____ nm is emitted.
- A) 657 B) 93.8 C) 411 D) 434 E) 487
- 10) What is the De Broglie wavelength (m) of a 2.0 kg object moving at a speed of 50 m/s?
- A) 1.5×10^{35} B) 3.8×10^{34} C) 2.6×10^{-35} D) 5.3×10^{-33} E) 6.6×10^{-36}

- 11) All of the orbitals in a given electron shell (energy level) have the same value of the _____ quantum number.
A) spin B) principal C) azimuthal D) magnetic E) psi
- 12) All of the orbitals in a given subshell (energy sublevel) have the same value of the _____ quantum number.
A) azimuthal B) magnetic C) principal D) A and B E) B and C
- 13) There are _____ possible values for the magnetic quantum number of an electron in a 5f subshell.
A) 7 B) 3 C) 14 D) 5 E) 1
- 14) Which of the subshells below do not exist due to the constraints upon the azimuthal quantum number?
A) 2p
B) 2s
C) 2d
D) all of the above
E) none of the above
- 15) _____-orbitals are spherically symmetrical.
A) d B) g C) p D) f E) s

16) Which sketch represents an orbital with the quantum numbers $n = 3, l = 0,$ and $m_l = 0$?

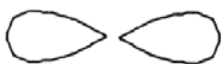
A)



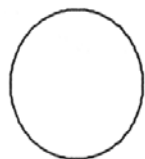
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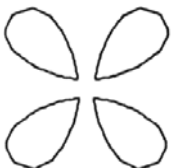
C)



D)

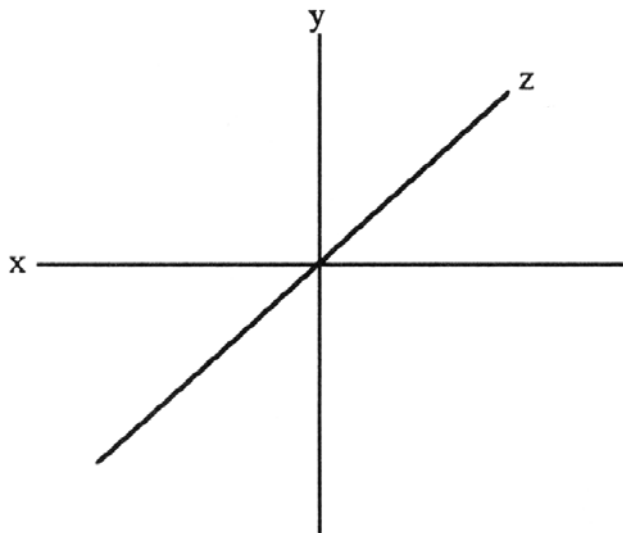


E)



SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) On the axes below, draw the general shape of a p_y orbital.



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) Each p-orbital can accommodate a maximum of _____ electrons.

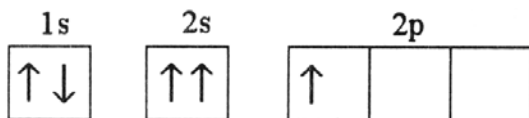
- A) 5 B) 3 C) 1 D) 2 E) 6

19) Which one of the following represents an acceptable possible set of quantum numbers (in the order n, l, m_l, m_s) for an electron in an atom?

- A) 2, 1, 0, 0 B) 2, 2, 0, 1/2 C) 2, 0, 2, +1/2 D) 2, 0, 1, -1/2 E) 2, 1, -1, 1/2

20) Which electron configuration represents a violation of the Pauli exclusion principle?

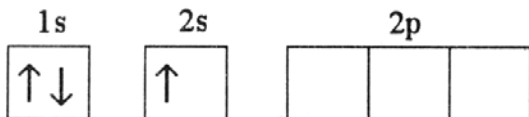
A)



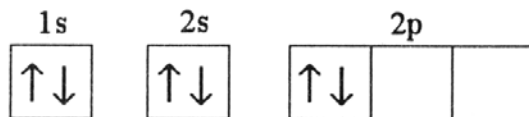
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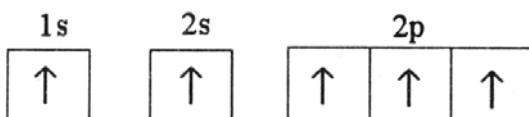
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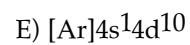
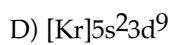
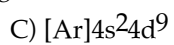
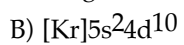
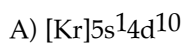
D)



E)

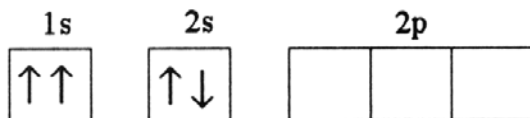


21) The electron configuration of a ground-state Ag atom is _____.

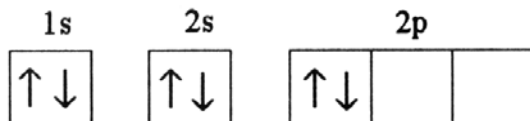


22) Which electron configuration denotes an atom in its ground state?

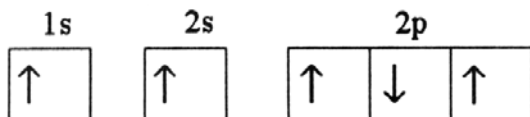
A)



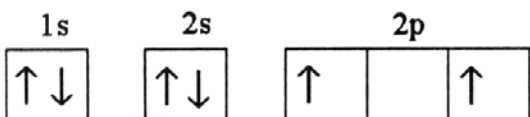
B)



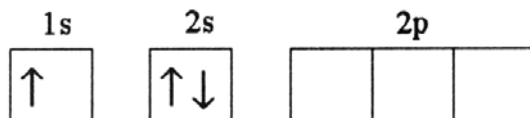
C)



D)



E)



23) The ground state electron configuration of Fe is _____.

- A) $1s^2 2s^2 3s^2 3p^6 3d^6$
- B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^6$
- C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
- D) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
- E) $1s^2 2s^2 3s^2 3p^{10}$

24) Which one of the following configurations depicts an excited carbon atom?

- A) $1s^2 2s^2 2p^3$
- B) $1s^2 2s^2 2p^2$
- C) $1s^2 2s^2 3s^1$
- D) $1s^2 2s^2 2p^1$
- E) $1s^2 2s^2 2p^1 3s^1$

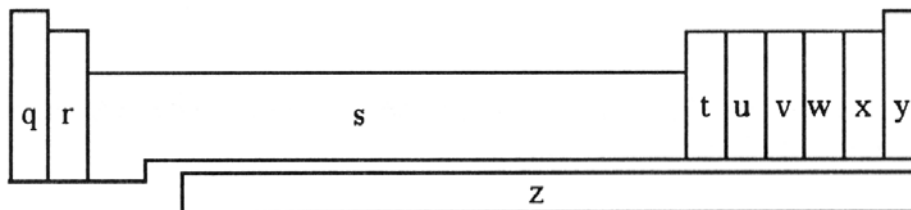
Consider the following electron configurations to answer the questions that follow:

- (i) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$
- (ii) $1s^2 2s^2 2p^6 3s^2 3p^5$
- (iii) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$
- (iv) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$
- (v) $1s^2 2s^2 2p^4 3s^1$

25) An example of an electron configuration of a transition metal is _____.

- A) (i)
- B) (ii)
- C) (iii)
- D) (iv)
- E) (v)

- 26) An example of an excited state electron configuration for fluorine is _____.
- A) (i) B) (ii) C) (iii) D) (iv) E) (v)
- 27) Elements in group _____ have a np^6 electron configuration in the outer shell.
- A) 4A B) 7A C) 5A D) 6A E) 8A



- 28) The electron configuration of the valence electrons of an atom in its ground state is ns^2np^1 . This atom is a group _____ element.
- A) q B) r C) s D) t E) y
- 29) In which set of elements would all members be expected to have very similar chemical properties?
- A) S, Se, Si B) O, S, Se C) Ne, Na, Mg D) N, O, F E) Na, Mg, K
- 30) Atomic radius generally increases as we move _____.
- A) up a group and from right to left across a period
 B) down a group; the period position has no effect
 C) up a group and from left to right across a period
 D) down a group and from right to left across a period
 E) down a group and from left to right across a period
- 31) The atomic radius of main-group elements generally increases down a group because _____.
- A) effective nuclear charge increases down a group
 B) the principal quantum number of the valence orbitals increases
 C) effective nuclear charge decreases down a group
 D) effective nuclear charge zigzags down a group
 E) both effective nuclear charge increases down a group and the principal quantum number of the valence orbitals increases
- 32) Screening by core electrons in atoms is _____.
- A) more efficient than that by valence electrons
 B) responsible for a general decrease in atomic radius going down a group
 C) essentially identical to that by valence electrons
 D) less efficient than that by valence electrons
 E) both essentially identical to that by valence electrons and responsible for a general decrease in atomic radius going down a group
- 33) Which one of the following has the smallest radius?
- A) P B) Na C) Br D) Cl E) Fe

- 34) Which one of the following atoms has the largest radius?
A) Co B) Sr C) I D) Ca E) Ba

Consider the following electron configurations to answer the questions that follow:

- (i) [Kr] 5s¹
(ii) [Ne] 3s² 3p⁵
(iii) [Ar] 4s² 3d¹⁰ 4p⁴
(iv) [Ne] 3s² 3p⁶
(v) [Ar] 4s¹
- 35) The electron configuration of the atom that is expected to have the lowest first ionization energy is _____.
A) (i) B) (ii) C) (iii) D) (iv) E) (v)
- 36) The electron configuration of the atom that is expected to have the highest first ionization energy is _____.
A) (i) B) (ii) C) (iii) D) (iv) E) (v)
- 37) Of the choices below, which gives the order for first ionization energies?
A) Cl > S > Al > Ar > Si
B) S > Si > Cl > Al > Ar
C) Al > Si > S > Cl > Ar
D) Cl > S > Al > Si > Ar
E) Ar > Cl > S > Si > Al
- 38) The first ionization energies of the elements _____ as you go from left to right across a period of the periodic table, and _____ as you go from the bottom to the top of a group in the table.
A) increase, increase
B) increase, decrease
C) decrease, increase
D) decrease, decrease
E) are completely unpredictable
- 39) _____ have the lowest first ionization energies of the groups listed.
A) Transition elements
B) Halogens
C) Alkaline earth metals
D) Alkali metals
E) Noble gases
- 40) Which of the following has the largest second ionization energy?
A) P B) Al C) Mg D) Na E) Si

- 41) Which of the following correctly represents the second ionization of calcium?
- A) $\text{Ca}^+(\text{g}) \rightarrow \text{Ca}^{2+}(\text{g}) + \text{e}^-$
 B) $\text{Ca}(\text{g}) \rightarrow \text{Ca}^+(\text{g}) + \text{e}^-$
 C) $\text{Ca}^-(\text{g}) + \text{e}^- \rightarrow \text{Ca}^{2-}(\text{g})$
 D) $\text{Ca}^+(\text{g}) + \text{e}^- \rightarrow \text{Ca}(\text{g})$
 E) $\text{Ca}^+(\text{g}) + \text{e}^- \rightarrow \text{Ca}^{2+}(\text{g})$
- 42) Which ion in the isoelectronic series below has the smallest radius in a crystal?
- A) O^{2-} B) N^{3-} C) Na^+ D) Al^{3+} E) F^-
- 43) Which of the following sets contains species that are isoelectronic?
- A) Cl, Ar, K B) F^- , Ne, Na^+ C) F, Ne, Na D) Al^{3+} , S^{2-} , Ar E) P^{3-} , S^{2-} , Ar^-
- 44) Of the following elements, _____ has the most negative electron affinity.
- A) Be B) N C) F D) Li E) Na
- 45) Sodium is much more apt to exist as a cation than is chlorine. This is because _____.
- A) chlorine is a gas and sodium is a solid
 B) chlorine is more metallic than sodium
 C) chlorine has a greater ionization energy than sodium does
 D) chlorine has a greater electron affinity than sodium does
 E) chlorine is bigger than sodium
- 46) Of the elements below, _____ is the most metallic.
- A) sodium B) barium C) calcium D) cesium E) magnesium

Answer Key

Testname: CH_07_PRAC_TEST.TST

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

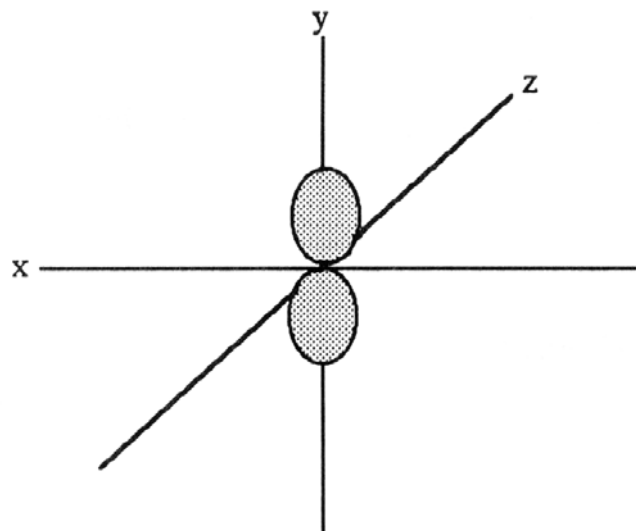
- 1) A
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- 2) A
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- 3) E
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- 4) B
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- 5) E
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- 6) A
ID: chem9b 6.1-32
- 7) C
ID: chem9b 6.1-33
- 8) D
ID: chem9b 6.1-41
- 9) C
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- 10) E
ID: chem9b 6.1-51
- 11) B
ID: chem9b 6.1-61
- 12) D
ID: chem9b 6.1-62
- 13) A
ID: chem9b 6.1-65
- 14) C
ID: chem9b 6.1-68
- 15) E
ID: chem9b 6.1-86
- 16) D
ID: chem9b 6.1-87

Answer Key

Testname: CH_07_PRAC_TEST.TST

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17)



ID: chem9b 6.1-90

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) D

ID: chem9b 6.1-95

19) E

ID: chem9b 6.1-103

20) A

ID: chem9b 6.1-105

21) A

ID: chem9b 6.1-121

22) D

ID: chem9b 6.1-122

23) D

ID: chem9b 6.1-124

24) E

ID: chem9b 6.1-130

25) C

ID: chem9b 6.1-134

26) E

ID: chem9b 6.1-135

27) E

ID: chem9b 6.1-162

28) D

ID: chem9b 6.1-163

29) B

ID: chem9b 7.1-2

Answer Key

Testname: CH_07_PRAC_TEST.TST

- 30) D
ID: chem9b 7.1-7
- 31) B
ID: chem9b 7.1-10
- 32) A
ID: chem9b 7.1-11
- 33) D
ID: chem9b 7.1-14
- 34) E
ID: chem9b 7.1-15
- 35) A
ID: chem9b 7.1-25
- 36) D
ID: chem9b 7.1-26
- 37) E
ID: chem9b 7.1-27
- 38) A
ID: chem9b 7.1-28
- 39) D
ID: chem9b 7.1-35
- 40) D
ID: chem9b 7.1-37
- 41) A
ID: chem9b 7.1-44
- 42) D
ID: chem9b 7.1-47
- 43) B
ID: chem9b 7.1-49
- 44) C
ID: chem9b 7.1-58
- 45) C
ID: chem9b 7.1-65
- 46) D
ID: chem9b 7.1-73

AP Chemistry Practice Test
 Ch. 7 - Atomic Structure
 and Periodicity

① $\lambda = 6 \text{ m}$ $c = \lambda \nu \Rightarrow \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \frac{\text{m}}{\text{s}}}{6 \text{ m}}$
 $= 5 \times 10^7 \frac{1}{\text{s}} = 5 \times 10^7 \text{ Hz} \times \frac{1 \text{ MHz}}{1 \times 10^6 \text{ Hz}} = 5 \times 10^1 \text{ MHz}$
 $M = \text{mega} = 1,000,000 \times$

② $1.23 \times 10^{-6} \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = 1.23 \times 10^{-8} \text{ m} \Rightarrow c = \lambda \nu \Rightarrow \nu = \frac{c}{\lambda} = \frac{3 \times 10^8 \frac{\text{m}}{\text{s}}}{1.23 \times 10^{-8} \text{ m}}$

$= 2.44 \times 10^{16} \frac{1}{\text{s}}$

③ $E = 5.25 \times 10^{-19} \text{ J}$ $E = h\nu \Rightarrow \nu = \frac{E}{h}$
 $\nu = \frac{5.25 \times 10^{-19} \text{ J}}{6.626 \times 10^{-34} \text{ J s}} = 7.92 \times 10^{14} \frac{1}{\text{s}}$

$c = \lambda \nu$
 $\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \frac{\text{m}}{\text{s}}}{7.92 \times 10^{14} \frac{1}{\text{s}}} = 3.79 \times 10^{-7} \text{ m}$

④ $E = h\nu$
 $\nu = \frac{E}{h} = \frac{3.7 \times 10^{-18} \text{ J}}{6.626 \times 10^{-34} \text{ J s}} = 5.6 \times 10^{15} \frac{1}{\text{s}}$

⑤ $725 \text{ nm} \times \frac{1 \text{ m}}{10^9 \text{ nm}} = 7.25 \times 10^{-7} \text{ m}$

$c = \lambda \nu \Rightarrow \nu = \frac{c}{\lambda} = \frac{3 \times 10^8 \frac{\text{m}}{\text{s}}}{7.25 \times 10^{-7} \text{ m}} = 4.14 \times 10^{14} \frac{1}{\text{s}}$

$E = h\nu$
 $E = (6.626 \times 10^{-34} \text{ J s}) (4.14 \times 10^{14} \frac{1}{\text{s}})$
 $= 2.74 \times 10^{-19} \text{ J}$

$\frac{2.74 \times 10^{-19} \text{ J}}{1 \text{ photon}} \times \frac{6.02 \times 10^{23} \text{ photons}}{1 \text{ mol}} \times \frac{1 \text{ kJ}}{1000 \text{ J}} = 165 \frac{\text{kJ}}{\text{mol}}$

⑥ emission = light energy given off = electron relaxes from high n to low n.
 $n=6 \rightarrow n=1$ will give off more energy than $n=6 \rightarrow n=3$
 The other choices describe absorption (low n \rightarrow high n) of energy.

(7) $E_4 = \frac{-2.178 \times 10^{-18}}{4^2} = -1.36 \times 10^{-19} \text{ J}$

(8) D

(9) $E_6 = \frac{-2.178 \times 10^{-18}}{36} = -6.05 \times 10^{-20} \text{ J}$

$E_2 = \frac{-2.178 \times 10^{-18}}{4} = -5.445 \times 10^{-19}$

n=6 → n=2
initial final

$\Delta E = E_2 - E_6 = (-5.445 \times 10^{-19}) - (-6.05 \times 10^{-20}) = -4.84 \times 10^{-19} \text{ J} \rightarrow 4.84 \times 10^{-19} \text{ J}$
energy given off as light

$E = h\nu = (6.626 \times 10^{-34} \text{ Js})(\nu) = -4.84 \times 10^{-19} \text{ J}$

$\nu = \frac{4.84 \times 10^{-19} \text{ J}}{6.626 \times 10^{-34} \text{ Js}} = 7.30 \times 10^{14} \frac{1}{s}$

$c = \lambda\nu \rightarrow \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \frac{m}{s}}{7.30 \times 10^{14} \frac{1}{s}} = 4.11 \times 10^{-7} \text{ m} \times \frac{10^9 \text{ nm}}{1 \text{ m}} = 411 \text{ nm}$

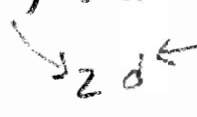
(10) $\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34} \text{ Js}}{(2.0 \text{ kg})(50 \frac{m}{s})} = \frac{6.626 \times 10^{-34} \text{ kg} \cdot \frac{m}{s}}{(2.0 \text{ kg})(50 \frac{m}{s})} = 6.626 \times 10^{-36} \text{ m} = 6.6 \times 10^{-36} \text{ m}$

(11) B

(12) E

(13) $m_l =$ orbital type. 5f sublevel has 7 orbitals. when $l=3$, $m_l = -3, -2, -1, 0, 1, 2, 3$
7 values

(14) C. 2d doesn't exist. "sublevel d" means "l=2".
when $n=2$, l can equal 0 or 1, so, the 2nd energy level has only s ($l=0$) and p ($l=1$) sublevels.
when $n=2$, l cannot equal 2.



(15) s

(16) $n=3$ - 2nd energy level

$l=0$ - s sublevel

$m_l=0$ - there's only one orbital in an s-sublevel

$y \rightarrow \bigcirc \leftarrow$ that's supposed to be a sphere



(17) \rightarrow Note: axes in your book are slightly different, e.g.,

(18) z; and this is true for any orbital

(19) a - $m_s \neq 0$ ever b - when $n=2, l \neq 2$ c - when $l=0, m_l \neq 2$

d - when $l=0, m_l \neq 1$ e - correct

(20) A - two e-'s have the same 4 quantum #'s

(21) A - exceptional configuration

(22) A - forbidden B, C, E - excited D - correct

(23) $[Ar] 4s^2 3d^6$ or $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ or ... $3d^6 4s^2$

(24) C has 6 e-'s B is correct ground state (E) is the correct answer - $1s^2 2s^2 2p^1 3s^1$

(25) C (26) E (27) "8A" = 18 (28) D ex: $Al = [Ne] 3s^2 3p^1$

(29) E - same family (30) D (31) B (32) A (33) D (34) E

(35) A (36) D (37) E (38) A (39) D (40) D (41) A (42) D (43) B $\rightarrow 10e^- / s$ each

(44) C (45) C - weird wording on this one (46) D $\rightarrow Cs$ is bigger than Na

\rightarrow all have 10 e-'s, but Al has 13pt