South Pasadena • AP Chemistry

Name _____
Period ___ Date ___/___/___

7 • Atomic Structure

PRACTICE TEST

$c = \lambda\upsilon$	$E = h\upsilon$	$E = \frac{hc}{\lambda}$	$E_n = -\frac{Rhc}{n^2}$	$\lambda = \frac{h}{mv}$	$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

$c = 2.998 \times 10^8$ m/s $h = 6.626 \times 10^{-34}$ J·s $Rhc = 2.18 \times 10^{-18}$ J $R = 1.0974 \times 10^7$ m^{-1}

mass of an electron = 9.11×10^{-31} kg

1. What wavelength corresponds to a frequency of 8.22×10^9 Hz? $\lambda = \frac{c}{\upsilon} = \frac{3.00 \times 10^8 \text{ m/s}}{8.22 \times 10^9 \text{ s}^{-1}}$

   a) 0.307 m d) 0.110 m
   b) 0.0365 m e) 27.4 m
   c) 0.122 m

   $= 0.03649$ m

2. A radio station transmits at 110 MHz (110×10^6 Hz). What wavelength is this radio wave?

   a) 3.65×10^{-5} m c) 3.81×10^{-5} m
   b) 3.30 m d) 2.73 m

   $\lambda = \frac{c}{\upsilon} = \frac{3.00 \times 10^8 \text{ m/s}}{110 \times 10^6 \text{ s}^{-1}} = 2.73$ m

3. Which one of the following is NOT a proper unit for frequency?

   a) Hz c) $m \cdot s^{-1}$ velocity
   b) s^{-1} d) $\frac{1}{\text{sec}}$

   U1067 B-V B-G R20

4. Calculate the wavelength of the fourth line in the Balmer series (the visible series) of the hydrogen spectrum. $n = 6, 5, 4$ $n = 2$

   a) 0.12334 m d) 4.1029×10^{-7} m
   b) 24.373 m c) 36.559 m
   c) 2.7353×10^{-7} m

   See Scratch Paper

5. What is the relationship between the energy of a photon of light and its frequency?

   a) $E = \nu$ d) $E = \frac{1}{h\nu}$
   b) $E = \frac{h}{\nu}$ e) $E = \frac{\nu}{h}$
   c) $E = h\nu$

6. What is the energy needed to raise an electron in the hydrogen atom from the second energy level to the third energy level?

   a) 1.52×10^4 J d) 4.48×10^{-19} J
   b) 3.63×10^{-19} J e) 3.03×10^{-19} J
   c) 2.18×10^{-19} J

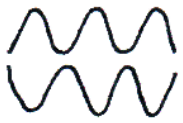
   See Scratch Paper

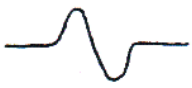
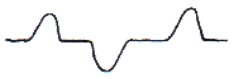
7. What is the de Broglie wavelength of an electron moving at 80.0% the speed of light.

   a) 3.03×10^{-12} m c) 3.30×10^{11} m
   b) 2.42×10^{-12} m d) 1.59×10^{-25} m

   See scratch paper

8. What resultant is expected from the interference of the two waves shown below?



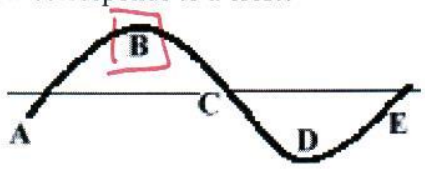
   a) 
   c)
   b) 
   d) 

9. Which quantum number determines the type of **subshell** occupied by an electron (s, p, d, f, etc.)?

   a) n c) m_l
   b) l d) q

   $l = 0$ "s"
   $l = 1$ "p"
   $l = 2$ "d"
   etc.

10. What position on the traveling wave shown below corresponds to a crest?



a) A (b) B c) C d) D e) E

11. How many orbitals make up the **4d** subshell?

a) 0 b) 1 c) 3 (d) 5 e) 7

12. The value of ℓ that is related to the following orbital is:

p-orbital

a) 0 (b) 1 c) 2 d) 3 e) 4

13. Which of the following sets of quantum numbers is possible for a **3d** electron?

a) $n = 3, \ell = 3, m_\ell = -2, m_s = +\frac{1}{2}$

b) $n = 2, \ell = 1, m_\ell = +1, m_s = -\frac{1}{2}$

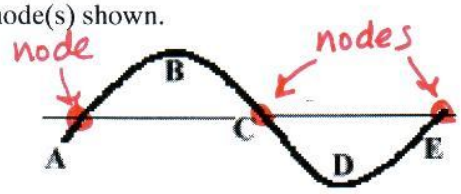
c) $n = 3, \ell = 1, m_\ell = 0, m_s = -\frac{1}{2}$

(d) $n = 3, \ell = 2, m_\ell = -2, m_s = +\frac{1}{2}$

e) $n = 4, \ell = 1, m_\ell = +1, m_s = +\frac{1}{2}$

ℓ=
s 0
p 1
d 2
f 3

14. If this were a standing wave, there are 3 node(s) shown.



a) 1 b) 2 (c) 3 d) 4 e) 5

15. When ℓ = 2, the possible values of m_ℓ are

a) 0, 1
b) 0, 1, 2
c) +1, 0, -1
(d) +2, +1, 0, -1, -2
e) +2, 0, -2

16. The red line in the hydrogen spectrum is the result of an electron moving from?

a) n=2 → n=5 d) n=4 → n=2
(b) n=3 → n=2 e) n=2 → n=3
c) n=2 → n=1

17. Who explained that light has both particle and wave character?

a) Thomson d) Bohr
b) Rutherford e) de Broglie
(c) Einstein

↖ the photoelectric effect

18. Which energy level of the hydrogen atom is not involved in the Balmer Series of visible lines?

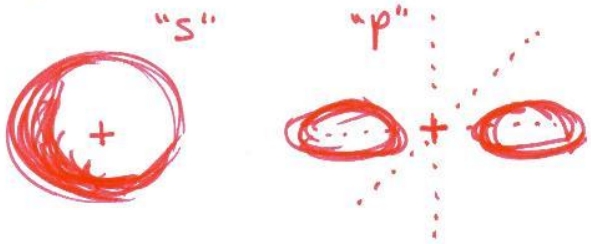
(a) 1 b) 2 c) 3 d) 4 e) 5

3→2 4→2 5→2 6→2

19. Which of the following best supports the concept that electrons in atoms have quantized energies?

a) The photoelectric effect
b) The alpha particle scattering experiment
(c) The emission spectrum of hydrogen — only contain lines
d) The wave-particle duality of an electron
e) The charge/mass ratio of an electron

20. Draw an "s" orbital and a "p" orbital.



Scratch Paper

4. $n=6 \rightarrow n=2$

$$E = E_2 - E_6$$

$$= \frac{-2.18\times10^{-18}\,J}{2^2} - \frac{-2.18\times10^{-18}\,J}{6^2}$$

$$= (-5.45\times10^{-19}) - (-6.06\times10^{-20})\,J$$

$$= \boxed{-4.84\times10^{-19}\,J}$$

$$E = \frac{hc}{\lambda} \qquad \lambda = \frac{hc}{E} = \frac{(6.626\times10^{-34}\,J\cdot s)(3.00\times10^{8}\,m\cdot s^{-1})}{4.84\times10^{-19}\,J}$$

$$= \boxed{4.11\times10^{-7}\,m}$$

or use the Rydberg equation, $n=6$.

6. $n=3 \rightarrow n=2$

$$E = E_3 - E_2$$

$$= \frac{-2.18\times10^{-18}\,J}{3^2} - \frac{-2.18\times10^{-18}\,J}{2^2}$$

$$= (-2.42\times10^{-19}\,J) - (-5.45\times10^{-19}\,J)$$

$$= \boxed{3.03\times10^{-19}\,J}$$

7. $$\lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}\,J\cdot s}{(9.11\times10^{-31}\,kg)(.80)(3.00\times10^{8}\,m\cdot s^{-1})}$$

$$= \boxed{3.03\times10^{-12}\,m}$$

$J = kg\cdot m^2\cdot s^{-2}$

$$\frac{kg\cdot m^2\cdot s^{-2}\cdot s}{kg\cdot m\cdot s^{-1}}$$