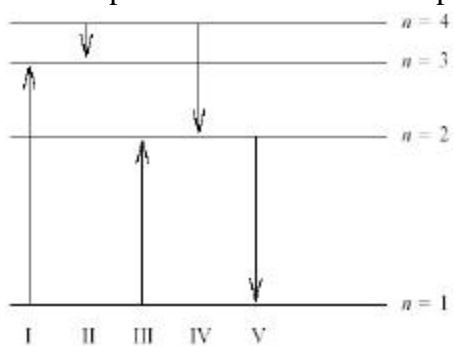


1. A photoelectric experiment is performed with monochromatic light. In order to increase the maximum kinetic energy of escaping electrons, we should: 50/3
- A. increase the intensity of the light falling on the photoelectric material.
  - B. increase the frequency of the light falling on the photoelectric material.
  - C. increase the work function of the photoelectric material.
  - D. *either* of A. or C.
  - E. *either* of B. or C.
2. A metal surface is illuminated by light of wavelength 310 nm. If the work function of the metal is 2.46 eV, what is the maximum kinetic energy of emitted photoelectrons? (For convenience, note that a photon of wavelength 1240 nm has an energy of 1 eV.) 50/4
- A. 1.46 eV
  - B. 1.54 eV
  - C. 2.54 eV
  - D. 4 eV
  - E. 6.46 eV
3. When you throw a baseball through an open window, it does not "diffract" because: 52/3
- A. It has an extremely large de Broglie wavelength.
  - B. It has an extremely small de Broglie wavelength.
  - C. It is smaller than the window.
  - D. There is a very large uncertainty in its momentum.
  - E. None of the above.
4. A free electron and a free proton have the same kinetic energy. This means that, compared to the matter wave associated with the proton the matter wave associated with the electron has: 53/3
- A. a shorter wavelength and a greater frequency.
  - B. a longer wavelength and a greater frequency.
  - C. a shorter wavelength and the same frequency.
  - D. a longer wavelength and the same frequency.
  - E. a shorter wavelength and a smaller frequency.

5. The probability that an electron of energy  $E$  tunnels through a certain barrier is 0.90. If the width 56/1 of the potential barrier is doubled, but its height is kept the same, what is now the probability that an electron of energy  $E$  can tunnel through this barrier?

- A. 0.86
- B. 0.81
- C. 0.66
- D. 0.45
- E. 0.12

6. The figure shows the energy levels for an electron in a certain atom. Of the transitions shown, 59/3 which represents the *emission* of a photon with the most energy?



- A. I
- B. II
- C. III
- D. IV
- E. V

7. A particle of mass  $m$  is confined in an infinite potential well of width  $L$ . It absorbs a photon and thereby is raised to a higher energy state. Which of the following could possibly be the energy of that absorbed photon? 59/4
- A.  $\frac{h^2}{8mL^2}$
  - B.  $\frac{h^2}{4mL^2}$
  - C.  $\frac{h^2}{2mL^2}$
  - D.  $\frac{2h^2}{mL^2}$
  - E.  $\frac{h^2}{16mL^2}$
8. The energy of a particle in a one-dimensional trap with zero potential energy in the interior and infinite potential energy at the walls is proportional to ( $n =$  quantum number): 59/9
- A.  $n$
  - B.  $1/n$
  - C.  $1/n^2$
  - D.  $\sqrt{n}$
  - E.  $n^2$
9. An electron is confined to a one dimensional region  $0 < x < L$ , bounded by an infinite potential. Determine the probability of finding the electron in the  $n = 4$  state in the region  $L/8 < x < 3L/8$ . 60/3
- A. 0
  - B. 1/8
  - C. 1/4
  - D. 3/8
  - E. 3/4

10. What are the wavelength limits of the Balmer series? 64/14
- A. 364 - 656 nm
  - B. 364 - 820 nm
  - C. 656 - 820 nm
  - D. 102 - 656 nm
  - E. 102 - 820 nm
11. The number of states in a subshell with orbital quantum number  $\ell = 3$  is: 68/3
- A. 2
  - B. 3
  - C. 7
  - D. 9
  - E. 14
12. Which of the following  $(n, \ell, m_\ell, m_s)$  combinations is impossible for an electron in an atom? 71/5
- A. 3, 1, 1,  $-1/2$
  - B. 6, 2, 0,  $1/2$
  - C. 3, 2,  $-2, -1/2$
  - D. 3, 1,  $-2, 1/2$
  - E. 1, 0, 0,  $-1/2$
13. Magnesium has atomic number 12, hydrogen has atomic number 1, and helium has atomic number 2. In the nuclear reaction  ${}^{24}\text{Mg} + {}^2\text{H} \rightarrow ( ) + {}^4\text{He}$  the missing quantity is: 84/1
- A.  ${}^{23}\text{Na}$  ( $Z = 11$ )
  - B.  ${}^{22}\text{Na}$  ( $Z = 10$ )
  - C.  ${}^{21}\text{Na}$  ( $Z = 11$ )
  - D.  ${}^{21}\text{Na}$  ( $Z = 10$ )
  - E.  ${}^{22}\text{Na}$  ( $Z = 11$ )

14. Light of wavelength 121.6 nm is emitted by a hydrogen atom. What transition of the atom is responsible for this: 87/1
- A.  $n = 4$  to  $n = 2$
  - B.  $n = 4$  to  $n = 3$
  - C.  $n = 2$  to  $n = 1$
  - D.  $n = 1$  to  $n = 0$
  - E.  $n = \infty$  to  $n = 2$
15. A beam of x-rays of frequency  $f$  is incident upon a substance that scatters the beam in various directions. If we measure the frequency of the scattered x-rays at  $\theta = 90$  degrees, we will find: 87/2
- A. X-rays with frequency less than  $f$ .
  - B. X-rays with frequency greater than  $f$ .
  - C. X-rays with frequency  $f$ .
  - D. X-rays with a wide range of frequencies.
  - E. X-rays with frequencies equal to  $f/2$ ,  $f/4$ ,  $f/6$ , etc. only.
16. What deBroglie wavelength is expected for a beam of electrons that have a kinetic energy of 100 eV? 87/3
- A. 1.2 mm
  - B. 0.12 mm
  - C. 1.2 nm
  - D. 0.12 nm
  - E. 12 nm
17. An electron is in the  $n = 2$ ,  $l = 1$ ,  $m_l = 0$ ,  $m_s = +1/2$  state. Which of the following states is not allowed for another electron in the same atom? 87/4
- A.  $n = 2$ ,  $l = 1$ ,  $m_l = 0$ ,  $m_s = -1/2$
  - B.  $n = 2$ ,  $l = 1$ ,  $m_l = -1$ ,  $m_s = +1/2$
  - C.  $n = 2$ ,  $l = 1$ ,  $m_l = 1$ ,  $m_s = -1/2$
  - D.  $n = 2$ ,  $l = 1$ ,  $m_l = 0$ ,  $m_s = +1/2$
  - E.  $n = 2$ ,  $l = 2$ ,  $m_l = 0$ ,  $m_s = +1/2$

18. Comparing two laser light sources (both single wavelength), the energy of an emitted photon is: 87/5
- A. higher for the light source with shorter wavelength.
  - B. higher for the light source with smaller frequency.
  - C. higher for the light source with higher intensity.
  - D. higher for the light source with higher speed of light.
  - E. higher for the light source with higher power.
19. Find the total binding energy of the  $^{12}_6\text{C}$  nucleus, given the atomic mass  $^{12}_6\text{C} = 12.000000$  u. 87/6
- A. 127.6 MeV
  - B. 104.6 MeV
  - C. 931.5 MeV
  - D. 92.2 MeV
  - E. 89.1 MeV
20. A museum is trying to determine the age of a painting by radioactive dating using the  $^{14}\text{C}$  in the paint. The test result shows that the paint contains 96% of the normal atmospheric abundance of  $^{14}\text{C}$ . How old is the paint? (half life = 5700 years) 87/7
- A. 100 years
  - B. 180 years
  - C. 250 years
  - D. 340 years
  - E. 4100 years
21. When  $^{14}_6\text{C}$  nucleus decays by a  $\beta$  decay, how much energy is released? 87/8  
(atomic mass  $^{14}_6\text{C} = 14.003242$  u,  $^{14}_7\text{N} = 14.003074$  u)
- A. 0 KeV
  - B. 0.156 KeV
  - C. 355 KeV
  - D. 156 KeV
  - E. -355 KeV

22. How many possible electron states are there in the  $n = 4$  and  $l = 3$  subshell? 87/9
- A. 10
  - B. 14
  - C. 18
  - D. 22
  - E. 6
23. According to the conservation law, which of the following nuclear reactions is not allowed? 87/10
- A.  ${}^{14}_6\text{C} \rightarrow {}^{14}_6\text{N} + \mathbf{g}$
  - B.  ${}^{14}_7\text{N} + {}^4_2\text{He} \rightarrow {}^{17}_8\text{O} + {}^1_1\text{H}$
  - C.  ${}^7_4\text{Be} + \mathbf{b} \rightarrow {}^7_3\text{Li} + \nu$
  - D.  $n + {}^{10}_5\text{B} \rightarrow {}^7_3\text{Li} + {}^4_2\text{He}$
  - E. a, c, and d
24. Which of the following electron ground state configurations is allowed? 87/11
- A.  $1s^2 1p^4$
  - B.  $1s^2 2s^2 2p^6 2d^{10}$
  - C.  $1s^2 2s^2 2p^6 3s^1$
  - D.  $1s^2 2s^2 2p^6 3d^{10}$
  - E.  $1s^2 2s^2 2p^6 2d^1$
25. What is the Q value for the nuclear reaction  ${}^3_2\text{He} + {}^3_2\text{He} \Rightarrow {}^4_2\text{He} + {}^1_1\text{H} + {}^1_1\text{H}$ ? 87/12  
(atomic mass  ${}^3_2\text{He} = 3.016029\text{u}$  and  ${}^4_2\text{He} = 4.002602\text{u}$ )
- A. -13.4 MeV
  - B. +13.4 MeV
  - C. -12.9 MeV
  - D. +12.9 MeV
  - E. 0

26. An electron drops from an excited state of a hydrogen atom to the ground state ( $n = 1$ ), and emits light. Which process generates light of the longest wavelength?
- A. dropping from  $n = 2$  state
  - B. dropping from  $n = 3$  state
  - C. dropping from  $n = 4$  state
  - D. dropping from  $n = 5$  state
  - E. dropping from  $n = 100$  state

Answer Key for Test "214Fa04FL.tst", 12/6/2004

No. in Q-Bank	No. on Test	Correct Answer
50	3	1 B
50	4	2 B
52	3	3 B
53	3	4 D
56	1	5 B
59	3	6 E
59	4	7 D
59	9	8 E
60	3	9 C
64	14	10 A
68	3	11 E
71	5	12 D
84	1	13 E
87	1	14 C
87	2	15 C
87	3	16 D
87	4	17 D
87	5	18 A
87	6	19 D
87	7	20 D
87	8	21 D
87	9	22 B
87	10	23 A
87	11	24 C
87	12	25 D
87	13	26 A

Statistics for Test "214Fa04FL.tst". Total questions: 26

<u>Key Word</u>	<u>Total</u>	<u>Difficulty Level</u>	<u>Total</u>	<u>None</u>	<u>Total</u>
None	5	None	19	Free Format	0
MFa02	0	<40 Very Hard	1	True or False	0
FFa02	3	40-60 Hard	2	Multiple Choice	26
MSp03	0	60-80 Medium	3	Matching	0
FSp03	0	80-90 Easy	1		
MSu03	0	90-100 Very Easy	0		
FSu03	4				
MFa03	0				
FFa03	0				
MSp04	0				
FSp04	0				
MSu04	0				
FSu04	1				
MFa04	0				
FFa04	13				