

Chapter 40: ALL ABOUT ATOMS

1. The magnitude of the orbital angular momentum of an electron in an atom is what multiple of $\hbar$? (ℓ is a positive integer.)
- A. 1
 - B. $1/2$
 - C. $\sqrt{\ell(\ell+1)}$
 - D. $2\ell+1$
 - E. ℓ^2

ans: C

Section: 40–4; Difficulty: E

2. The magnetic quantum number m_ℓ is most closely associated with what property of an electron in an atom?
- A. Magnitude of the orbital angular momentum
 - B. Energy
 - C. z component of the spin angular momentum
 - D. z component of the orbital angular momentum
 - E. Radius of the orbit

ans: D

Section: 40–4; Difficulty: E

3. The quantum number m_s is most closely associated with what property of the electron in an atom?
- A. Magnitude of the orbital angular momentum
 - B. Energy
 - C. z component of the spin angular momentum
 - D. z component of the orbital angular momentum
 - E. Radius of the orbit

ans: C

Section: 40–4; Difficulty: E

4. Possible values of the principal quantum number n for an electron in an atom are:
- A. only 0 and 1
 - B. only 0, 1, 2, $\dots$, ∞
 - C. only 0, 1, $\dots$, $\ell-1$
 - D. only $1/2$ and $-1/2$
 - E. only 1, 2, 3, $\dots$, ∞

ans: E

Section: 40–4; Difficulty: E

5. The number of values of the orbital quantum number ℓ associated with the principal quantum number $n = 3$ is:
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 7

ans: C

Section: 40–4; Difficulty: E

6. The number of possible values of the magnetic quantum number m_ℓ associated with a given value of the orbital quantum number ℓ is:
- A. 1
 - B. 2
 - C. ℓ
 - D. 2ℓ
 - E. $2\ell + 1$

ans: E

Section: 40–4; Difficulty: E

7. An atom is in a state with orbital quantum number $\ell = 2$. Possible values of the magnetic quantum number m_ℓ are:
- A. 1, 2
 - B. 0, 1, 2
 - C. 0, 1
 - D. $-1, 0, 1$
 - E. $-2, -1, 0, 1, 2$

ans: E

Section: 40–4; Difficulty: E

8. An electron is in a quantum state for which the magnitude of the orbital angular momentum is $6\sqrt{2}\hbar$. How many allowed values of the z component of the angular momentum are there?
- A. 7
 - B. 8
 - C. 16
 - D. 17
 - E. 20

ans: D

Section: 40–4; Difficulty: M

9. An electron is in a quantum state for which there are seven allowed values of the z component of the angular momentum. The magnitude of the angular momentum is:

A. $\sqrt{3}\hbar$
B. $\sqrt{7}\hbar$
C. $\sqrt{9}\hbar$
D. $\sqrt{12}\hbar$
E. $\sqrt{14}\hbar$

ans: D

Section: 40–4; Difficulty: M

10. The number of states in a subshell with orbital quantum number $\ell = 3$ is:

A. 2
B. 3
C. 7
D. 9
E. 14

ans: E

Section: 40–4; Difficulty: E

11. The number of states in a shell with principal quantum number $n = 3$ is:

A. 3
B. 9
C. 15
D. 18
E. 25

ans: D

Section: 40–4; Difficulty: M

12. An electron in an atom is in a state with principal quantum number $n = 4$. The possible values of the orbital quantum number ℓ are:

A. 1, 2, 3
B. 1, 2, 3, 4
C. $-3, -2, -1, 0, 1, 2, 3$
D. 0, 1, 2, 3
E. 0, 1, 2

ans: D

Section: 40–4; Difficulty: E

13. Space quantization means that:

A. space is quantized
B. L_z can have only certain discrete values
C. $\vec{L}$ and $\vec{\mu}$ are in the same direction
D. $\vec{L}$ and $\vec{\mu}$ are in opposite directions
E. an electron has a magnetic dipole moment

ans: B

Section: 40–4; Difficulty: E

14. An electron in an atom is in a state with $\ell = 3$ and $m_\ell = 2$. The angle between $\vec{L}$ and the z axis is:
- A. 48.2°
 - B. 60°
 - C. 30°
 - D. 35.3°
 - E. 54.7°

ans: E

Section: 40–4; Difficulty: M

15. An electron in an atom is in a state with $\ell = 5$. The minimum angle between $\vec{L}$ and the z axis is:
- A. 0°
 - B. 18.0°
 - C. 24.1°
 - D. 36.7°
 - E. 33.6°

ans: C

Section: 40–4; Difficulty: M

16. In the relation $\mu_z = -m_\ell\mu_B$, the quantity μ_B is:
- A. the Bohr magneton
 - B. the component of the dipole moment along the magnetic field
 - C. the permeability of the material
 - D. a friction coefficient
 - E. none of the above

ans: A

Section: 40–4; Difficulty: E

17. The electron states that constitute a single shell for an atom all have:
- A. the same value of n
 - B. the same value of ℓ
 - C. the same value of n and the same value of ℓ
 - D. the same value of ℓ and the same value of m_ℓ
 - E. the same set of all four quantum numbers

ans: A

Section: 40–4; Difficulty: E

18. The electron states that constitute a single subshell for an atom all have:
- A. only the same value of n
 - B. only the same value of ℓ
 - C. only the same value of n and the same value of ℓ
 - D. only the same value of ℓ and the same value of m_ℓ
 - E. the same set of all four quantum numbers

ans: C

Section: 40–4; Difficulty: E

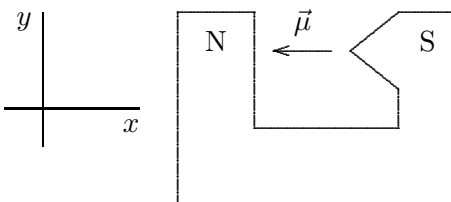
19. The total number of electron states with $n = 2$ and $\ell = 1$ for an atom is:
- A. two
 - B. four
 - C. six
 - D. eight
 - E. ten
- ans: C
Section: 40–4; Difficulty: E
20. The possible values for the magnetic quantum number m_s of an electron in an atom:
- A. depend on n
 - B. depend on ℓ
 - C. depend on both n and ℓ
 - D. depend on whether there is an external magnetic field present
 - E. are $\pm 1/2$
- ans: E
Section: 40–4; Difficulty: E
21. The Stern-Gerlach experiment makes use of:
- A. a strong uniform magnetic field
 - B. a strong non-uniform magnetic field
 - C. a strong uniform electric field
 - D. a strong non-uniform electric field
 - E. strong perpendicular electric and magnetic fields
- ans: B
Section: 40–5; Difficulty: E
22. The magnetic field $\vec{B}$ is along the z axis in a Stern-Gerlach experiment. The force it exerts on a magnetic dipole with dipole moment $\vec{\mu}$ is proportional to:
- A. μ_z^2
 - B. B^2
 - C. dB/dz
 - D. d^2B/dz^2
 - E. $\int B dz$
- ans: C
Section: 40–5; Difficulty: E
23. A magnetic dipole $\vec{\mu}$ is placed in a strong uniform magnetic field $\vec{B}$. The associated force exerted on the dipole is:
- A. along $\vec{\mu}$
 - B. along $-\vec{\mu}$
 - C. along $\vec{B}$
 - D. along $\vec{\mu} \times \vec{B}$
 - E. zero
- ans: E
Section: 40–5; Difficulty: E

24. The force exerted on a magnetic dipole as it moves with velocity $\vec{v}$ through a Stern-Gerlach apparatus is:
- proportional to v
 - proportional to $1/v$
 - zero
 - proportional to v^2
 - independent of v

ans: E

Section: 40–5; Difficulty: E

25. A magnetic dipole is placed between the poles of a magnet as shown. The direction of the associated force exerted on the dipole is:



- positive x
- positive y
- negative x
- negative y
- into or out of the page

ans: C

Section: 40–5; Difficulty: E

26. To observe the Zeeman effect one uses:
- a strong uniform magnetic field
 - a strong non-uniform magnetic field
 - a strong uniform electric field
 - a strong non-uniform electric field
 - mutually perpendicular electric and magnetic fields

ans: B

Section: 40–5; Difficulty: E

27. The Pauli exclusion principle is obeyed by:
- all particles
 - all charged particles
 - all particles with spin quantum numbers of $1/2$
 - all particles with spin quantum numbers of 1
 - all particles with mass

ans: C

Section: 40–7; Difficulty: E

28. No state in an atom can be occupied by more than one electron. This is most closely related to:

A. the wave nature of matter
B. the finite value for the speed of light
C. the Bohr magneton
D. the Pauli exclusion principle
E. the Einstein-de Haas effect

ans: D

Section: 40–7; Difficulty: E

29. Electrons are in a two-dimensional square potential energy well with sides of length L . The potential energy is infinite at the sides and zero inside. The single-particle energies are given by $(h^2/8mL^2)(n_x^2 + n_y^2)$, where n_x and n_y are integers. At most the number of electrons that can have energy $8(h^2/8mL^2)$ is:

A. 1
B. 2
C. 3
D. 4
E. any number

ans: B

Section: 40–8; Difficulty: M

30. Five electrons are in a two-dimensional square potential energy well with sides of length L . The potential energy is infinite at the sides and zero inside. The single-particle energies are given by $(h^2/8mL^2)(n_x^2 + n_y^2)$, where n_x and n_y are integers. In units of $(h^2/8mL^2)$ the energy of the ground state of the system is:

A. 0
B. 10
C. 19
D. 24
E. 48

ans: C

Section: 40–8; Difficulty: M

31. Five electrons are in a two-dimensional square potential energy well with sides of length L . The potential energy is infinite at the sides and zero inside. The single-particle energies are given by $(h^2/8mL^2)(n_x^2 + n_y^2)$, where n_x and n_y are integers. In units of $(h^2/8mL^2)$ the energy of the first excited state of the system is:

A. 13
B. 22
C. 24
D. 25
E. 27

ans: B

Section: 40–8; Difficulty: M

32. Electrons are in a two-dimensional square potential energy well with sides of length L . The potential energy is infinite at the sides and zero inside. The single-particle energies are given by $(h^2/8mL^2)(n_x^2 + n_y^2)$, where n_x and n_y are integers. The number of single-particle states with energy $5(h^2/8mL^2)$ is:

A. 1
B. 2
C. 3
D. 4
E. 5

ans: B

Section: 40–8; Difficulty: M

33. Six electrons are in a two-dimensional square potential energy well with sides of length L . The potential energy is infinite at the sides and zero inside. The single-particle energies are given by $(h^2/8mL^2)(n_x^2 + n_y^2)$, where n_x and n_y are integers. If a seventh electron is added to the system when it is in its ground state the least energy the additional electron can have is:

A. $2(h^2/8mL^2)$
B. $5(h^2/8mL^2)$
C. $10(h^2/8mL^2)$
D. $13(h^2/8mL^2)$
E. $18(h^2/8mL^2)$

ans: C

Section: 40–8; Difficulty: M

34. When a lithium atom is made from a helium atom by adding a proton (and neutron) to the nucleus and an electron outside, the electron goes into an $n = 2, \ell = 0$ state rather than an $n = 1, \ell = 0$ state. This is an indication that electrons:

A. obey the Pauli exclusion principle
B. obey the minimum energy principle
C. undergo the Zeeman effect
D. are diffracted
E. and protons are interchangeable

ans: A

Section: 40–9; Difficulty: E

35. When a lithium atom in its ground state is made from a helium atom by adding a proton (and neutron) to the nucleus and an electron outside, the electron goes into an $n = 2, \ell = 0$ state rather than an $n = 3, \ell = 0$ state. This is an indication that electrons:

A. obey the Pauli exclusion principle
B. obey the minimum energy principle
C. undergo the Zeeman effect
D. are diffracted
E. and protons are interchangeable

ans: B

Section: 40–9; Difficulty: E

36. If electrons did not have intrinsic angular momentum (spin) but still obeyed the Pauli exclusion principle, the states occupied by electrons in the ground state of helium would be:

- A. $(n = 1, \ell = 0); (n = 1, \ell = 0)$
- B. $(n = 1, \ell = 0); (n = 1, \ell = 1)$
- C. $(n = 1, \ell = 0); (n = 2, \ell = 0)$
- D. $(n = 2, \ell = 0); (n = 2, \ell = 1)$
- E. $(n = 2, \ell = 1); (n = 2, \ell = 1)$

ans: C

Section: 40–9; Difficulty: M

37. The minimum energy principle tells us that:

- A. the energy of an atom with a high atomic number is less than the energy of an atom with a low atomic number
- B. the energy of an atom with a low atomic number is less than the energy of an atom with a high atomic number
- C. when an atom makes an upward transition the energy of the absorbed photon is the least possible
- D. the ground state configuration of any atom is the one with the least energy
- E. the ground state configuration of any atom is the one with the least ionization energy

ans: D

Section: 40–9; Difficulty: E

38. Which of the following (n, ℓ, m_ℓ, m_s) combinations is impossible for an electron in an atom?

- 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, $-1/2$

ans: D

Section: 40–9; Difficulty: E

39. Which of the following subshells cannot exist?

- A. 3p
- B. 2p
- C. 4d
- D. 3d
- E. 2d

ans: E

Section: 40–9; Difficulty: E

40. For any atom other than hydrogen and helium all electrons in the same shell have:
- A. the same energy
 - B. the same magnitude of angular momentum
 - C. the same magnetic quantum number
 - D. the same spin quantum number
 - E. none of the above
- ans: E
Section: 40–9; Difficulty: E
41. The states being filled from the beginning to end of the lanthanide series of atoms are:
- A. $n = 3, \ell = 2$ states
 - B. $n = 4, \ell = 1$ states
 - C. $n = 4, \ell = 2$ states
 - D. $n = 4, \ell = 3$ states
 - E. $n = 5, \ell = 2$ states
- ans: D
Section: 40–9; Difficulty: E
42. The most energetic electron in any atom at the beginning of a period of the periodic table is in:
- A. an $\ell = 0$ state
 - B. an $\ell = 1$ state
 - C. an $\ell = 2$ state
 - D. an $n = 0$ state with unspecified angular momentum
 - E. an $n = 1$ state with unspecified angular momentum
- ans: A
Section: 40–9; Difficulty: E
43. The most energetic electron in any atom at the end of a period of the periodic table is in:
- A. an $\ell = 0$ state
 - B. an $\ell = 1$ state
 - C. an $\ell = 2$ state
 - D. an $n = 0$ state with unspecified angular momentum
 - E. an $n = 1$ state with unspecified angular momentum
- ans: B
Section: 40–9; Difficulty: E
44. The group of atoms at the ends of periods of the periodic table are called:
- A. alkali metals
 - B. rare earths
 - C. transition metal atoms
 - D. alkaline atoms
 - E. inert gas atoms
- ans: E
Section: 40–9; Difficulty: E

45. The group of atoms at the beginning of periods of the periodic table are called:
- A. alkali metal atoms
 - B. rare earth atoms
 - C. transition metal atoms
 - D. alkaline atoms
 - E. inert gas atoms
- ans: A
Section: 40–9; Difficulty: E
46. Suppose the energy required to ionize an argon atom is i , the energy to excite it is e , and its thermal energy at room temperature is t . In increasing order, these three energies are:
- A. i, e, t
 - B. t, i, e
 - C. e, t, i
 - D. i, t, e
 - E. t, e, i
- ans: C
Section: 40–9; Difficulty: E
47. The ionization energy of an atom in its ground state is:
- A. the energy required to remove the least energetic electron
 - B. the energy required to remove the most energetic electron
 - C. the energy difference between the most energetic electron and the least energetic electron
 - D. the same as the energy of a K_α photon
 - E. the same as the excitation energy of the most energetic electron
- ans: B
Section: 40–9; Difficulty: E
48. The effective charge acting on a single valence electron outside a closed shell is about Ne , where N is:
- A. the atomic number of the nucleus
 - B. the atomic mass of the atom
 - C. usually between 1 and 3
 - D. half the atomic number
 - E. less than 1
- ans: C
Section: 40–9; Difficulty: E
49. An electron in a K shell of an atom has the principal quantum number:
- A. $n = 0$
 - B. $n = 1$
 - C. $n = 2$
 - D. $n = 3$
 - E. $n = \infty$
- ans: B
Section: 40–10; Difficulty: E

50. An electron in an L shell of an atom has the principal quantum number:
- A. $n = 0$
 - B. $n = 1$
 - C. $n = 2$
 - D. $n = 3$
 - E. $n = \infty$
- ans: C
Section: 40–10; Difficulty: E
51. The most energetic photon in a continuous x-ray spectrum has an energy approximately equal to:
- A. the energy of all the electrons in a target atom
 - B. the kinetic energy of an incident-beam electron
 - C. the rest energy, mc^2 , of an electron
 - D. the total energy of a K-electron in the target atom
 - E. the kinetic energy of a K-electron in the target atom
- ans: B
Section: 40–10; Difficulty: E
52. Two different electron beams are incident on two different targets and both produce x rays. The cutoff wavelength for target 1 is shorter than the cutoff wavelength for target 2. We can conclude that:
- A. target 2 has a higher atomic number than target 1
 - B. target 2 has a lower atomic number than target 1
 - C. the electrons in beam 1 have greater kinetic energy than those in beam 2
 - D. the electrons in beam 1 have less kinetic energy than those in beam 2
 - E. target 1 is thicker than target 2
- ans: C
Section: 40–10; Difficulty: E
53. A photon with the smallest wavelength in the continuous x-ray spectrum is emitted when:
- A. an electron is knocked from a K shell
 - B. a valence electron is knocked from the atom
 - C. the incident electron becomes bound to the atom
 - D. the atom has the greatest recoil energy
 - E. the incident electron loses all its energy in a single decelerating event
- ans: E
Section: 40–10; Difficulty: E

54. Radiation with the minimum wavelength as well as the K x-ray lines are detected for a certain target. The energy of the incident electrons is then doubled, with the result that
- A. the minimum wavelength increases and the wavelengths of the K lines remain the same
 - B. the minimum wavelength decreases and the wavelengths of the K lines remain the same
 - C. the minimum wavelength and the wavelengths of the K lines all increase
 - D. the minimum wavelength and the wavelengths of the K lines all decrease
 - E. the minimum wavelength increases and the wavelengths of the K lines all decrease

ans: B

Section: 40–10; Difficulty: M

55. Characteristic K x-radiation of an element occurs when:
- A. the incident electron is absorbed by a target nucleus
 - B. the incident electron is scattered by a target atom without an energy loss
 - C. an electron is ejected from an outer shell of a target atom
 - D. an electron in a target atom makes a transition to the lowest energy state
 - E. the incident electron goes into the lowest energy state

ans: D

Section: 40–10; Difficulty: E

56. The K_α x rays arising from a cobalt ($Z = 27$) target have a wavelength of about 179 pm. The atomic number of a target that gives rise to K_α x rays with a wavelength one-third as great (≈ 60 pm) is:
- A. $Z = 9$
 - B. $Z = 10$
 - C. $Z = 12$
 - D. $Z = 16$
 - E. $Z = 46$

ans: E

Section: 40–10; Difficulty: M

57. In connection with x-ray emission the symbol K_α refers to:
- A. an alpha particle radiation
 - B. an effect of the dielectric constant on energy levels
 - C. x-ray radiation from potassium
 - D. x-ray radiation associated with an electron going from $n = \infty$ to $n = 1$
 - E. x-ray radiation associated with an electron going from $n = 2$ to $n = 1$

ans: E

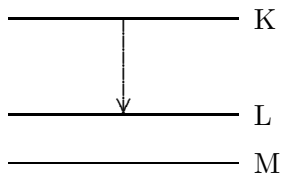
Section: 40–10; Difficulty: E

58. In connection with x-ray emission the symbol L_β refers to:
- A. a beta particle radiation
 - B. an atomic state of angular momentum $h/2\pi$
 - C. the inductance associated with an orbiting electron
 - D. x-radiation associated with an electron going from $n = 4$ to $n = 2$
 - E. none of the above

ans: D

Section: 40–10; Difficulty: E

59. The transition shown gives rise to an x-ray. The correct label for this is:



- A. K_{α}
- B. K_{β}
- C. L_{α}
- D. L_{β}
- E. KL

ans: A

Section: 40–10; Difficulty: E

60. In a Moseley graph:

- A. the x-ray frequency is plotted as a function of atomic number
- B. the square of the x-ray frequency is plotted as a function of atomic number
- C. the square root of the x-ray frequency is plotted as a function of atomic number
- D. the x-ray frequency is plotted as a function of the square root of atomic number
- E. the square root of the x-ray frequency is plotted as a function of atomic mass

ans: C

Section: 40–10; Difficulty: E

61. In calculating the x-ray energy levels the effective charge of the nucleus is taken to be $Z - b$, where Z is the atomic number. The parameter b enters because:

- A. an electron is removed from the inner shell
- B. a proton is removed from the nucleus
- C. the quantum mechanical force between two charges is less than the classical force
- D. the nucleus is screened by electrons
- E. the Pauli exclusion principle must be obeyed

ans: D

Section: 40–10; Difficulty: E

62. The ratio of the wavelength of the K_{α} x-ray line for Nb ($Z = 41$) to that of Ga ($Z = 31$) is:

- A. $9/16$
- B. $16/9$
- C. $3/4$
- D. $4/3$
- E. 1.15

ans: A

Section: 40–10; Difficulty: M

63. In a laser:
- A. excited atoms are stimulated to emit photons by radiation external to the laser
 - B. the transitions for laser emission are directly to the ground state
 - C. the states which give rise to laser emission are usually very unstable states that decay rapidly
 - D. the state in which an atom is initially excited is never between two states that are involved in the stimulated emission
 - E. a minimum of two energy levels are required.

ans: D

Section: 40–11; Difficulty: E

64. Photons in a laser beam have the same energy, wavelength, polarization direction, and phase because:
- A. each is produced in an emission that is stimulated by another
 - B. all come from the same atom
 - C. the lasing material has only two quantum states
 - D. all photons are alike, no matter what their source
 - E. none of the above

ans: A

Section: 40–11; Difficulty: E

65. A laser must be pumped to achieve:
- A. a metastable state
 - B. fast response
 - C. stimulated emission
 - D. population inversion
 - E. the same wavelength for all photons

ans: D

Section: 40–11; Difficulty: E

66. Photons in a laser beam are produced by:
- A. transitions from a metastable state
 - B. transitions to a metastable state
 - C. transitions from a state that decays rapidly
 - D. splitting of other photons
 - E. pumping

ans: A

Section: 40–11; Difficulty: E

67. Which of the following is essential for laser action to occur between two energy levels of an atom?
- A. the lower level is metastable
 - B. the upper level is metastable
 - C. the lower level is the ground state
 - D. there are more atoms in the lower level than in the upper level
 - E. the lasing material is a gas
- ans: B
Section: 40–11; Difficulty: E
68. Which of the following is essential for laser action to occur between two energy levels of an atom?
- A. the lower level is metastable
 - B. there are more atoms the upper level than in the lower level
 - C. there are more atoms in the lower level than in the upper level
 - D. the lower level is the ground state
 - E. the lasing material is a gas
- ans: B
Section: 40–11; Difficulty: E
69. Population inversion is important for the generation of a laser beam because it assures that:
- A. spontaneous emission does not occur more often than stimulated emission
 - B. photons do not split too rapidly
 - C. more photons are emitted than are absorbed
 - D. photons do not collide with each other
 - E. photons do not make upward transitions
- ans: C
Section: 40–11; Difficulty: E
70. A metastable state is important for the generation of a laser beam because it assures that:
- A. spontaneous emission does not occur more often than stimulated emission
 - B. photons do not split too rapidly
 - C. more photons are emitted than are absorbed
 - D. photons do not collide with each other
 - E. photons do not make upward transitions
- ans: A
Section: 40–11; Difficulty: E

71. Electrons in a certain laser make transitions from a metastable state to the ground state. Initially there are 6×10^{20} atoms in the metastable state and 2×10^{20} atoms in the ground state. The number of photons that can be produced in a single burst is about:
- A. 2×10^{20}
 - B. 3×10^{20}
 - C. 4×10^{20}
 - D. 6×10^{20}
 - E. 8×10^{20}

ans: C

Section: 40–11; Difficulty: M

72. In a helium-neon laser, the laser light arises from a transition from a _____ state to a _____ state.
- A. He, He
 - B. Ne, Ne
 - C. He, Ne
 - D. Ne, He
 - E. N, He

ans: B

Section: 40–11; Difficulty: E

73. The purpose of the mirrors at the ends of a helium-neon laser is:
- A. to assure that no laser light leaks out
 - B. to increase the number of stimulated emissions
 - C. to absorb some of the photons
 - D. to keep the light used for pumping inside the laser
 - E. to double the effective length of the laser

ans: B

Section: 40–11; Difficulty: E

74. A group of electromagnetic waves might
- I. be monochromatic
 - II. be coherent
 - III. have the same polarization direction

Which of these describe the waves from a laser?

- A. I only
- B. II only
- C. III only
- D. I and II only
- E. I, II, and III

ans: E

Section: 40–11; Difficulty: E

75. A laser beam can be sharply focused because it is:
- A. highly coherent
 - B. plane polarized
 - C. intense
 - D. circularly polarized
 - E. highly directional

ans: E

Section: 40–11; Difficulty: E

76. The “e” in laser stands for:
- A. electric
 - B. emf
 - C. energy
 - D. emission
 - E. entropy

ans: D

Section: 40–11; Difficulty: E