

תידון המדע הירושלמי תשס"ח - Jerusalem Science Contest 2008-2009

Electromagnetic and Ionizing radiation

Exam 9 — Chapter 32- The Atom and the Quantum

Name: _____

Date: _____

Raw Score: _____

Percentage Score: _____ %

Proctor for this Examinaton: _____ Form: _____

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

- 1) As one moves across a period in the periodic table,
 - A) the atomic radius increases for elements in periods 1-5 and decreases for elements in periods 6 and 7.
 - B) the atomic radius decreases for elements in periods 1-5, but increases for elements in periods 6 and 7.
 - C) the atomic radius increases
 - D) the atomic radius remains unchanged.
 - E) none of the preceding

- 2) In the Schrödinger equation, $H\psi = E\psi$, the symbol H is known as the
 - A) Laplacian operator
 - B) Lagrangian operator
 - C) Hamiltonian operator
 - D) Eigenfunction
 - E) none of the preceding

- 3) Every orbital in a subshell must be singly occupied by one electron before it can be occupied by a second electron. This is known as
 - A) Hund's rule
 - B) the Aufbau principle
 - C) the Pauli exclusion principle
 - D) Feynman's rule
 - E) none of the preceding

- 4) What is the maximum number of emission lines that can occur from an electron in the fourth excited state ($n=5$) returning to the ground state ($n=1$).
A) 10 B) 4 C) 8 D) 12 E) 6

- 5) The most likely position for finding an electron is
 - A) is only determined via the Schrödinger equation.
 - B) at a distance from the nucleus equal to the atomic radius.
 - C) unknown
 - D) at a distance from the nucleus of one half of the atomic radius.
 - E) none of the preceding

- 6) In quantum mechanics the wave function ψ is the
- A) electron density of an orbital
 - B) eigenvalue
 - C) energy level of an electron
 - D) probability amplitude.
 - E) none of the preceding
- 7) The symbol ψ^2 represents the
- A) eigenvalue
 - B) probability amplitude
 - C) probability density function
 - D) eigenfunction
 - E) none of the preceding
- 8) Niels Bohr suggested a new model of the atom in which the energy of light emission
- A) is due to electrons accelerating around the nucleus of an atom.
 - B) is equal to the difference in energy between an electron in a higher energy level and that same electron in a lower energy level.
 - C) can be correlated with the distance of an electron from the nucleus.
 - D) is equal to the energy difference between two electrons in different orbitals.
 - E) none of the preceding
- 9) Sir William Crookes, inventor of the Crookes tube showed that
- A) an electron beam is deflected by a magnetic field
 - B) an electron beam is deflected by an electric field
 - C) a high voltage passed between two electrodes in a vacuum produced a glowing beam of light.
 - D) all of the preceding
 - E) none of the preceding
- 10) What is the maximum number of electrons that can be in a completely filled f orbital
- A) 12
 - B) 2
 - C) 6
 - D) 8
 - E) none of the preceding
- 11) If hydrogen has an emission line at 2.7×10^{14} Hz and a second line at 4.6×10^{14} Hz, which of the following is also a possible emission line for the hydrogen atom?
- A) 3.7×10^{14} Hz
 - B) 1.2×10^{15} Hz
 - C) 1.7×10^{14} Hz
 - D) 7.3×10^{14} Hz
 - E) none of the preceding
- 12) What quantum values can an electron spin have?
- A) $-1/2$ and $+1/2$
 - B) $-1, 0, +1$
 - C) $-1, +1$
 - D) $-3, -2, -1, 0, 1, 2, 3$
 - E) none of the preceding

- 13) What atomic emanation was fired at a zinc sulfide screen in Rutherford's experiments?
- A) beta particle
 - B) gamma ray
 - C) proton
 - D) alpha particle
 - E) neutron
- 14) A major failing of the Bohr model of the atom was that
- A) it could not account for the emission of visible photons from an excited atom.
 - B) it could not explain the quantization of atomic energy levels.
 - C) it could not be verified mathematically.
 - D) it failed to account for isotopic effects.
 - E) none of the preceding
- 15) The "plum pudding" model of the atom, disproven by Ernest Rutherford, is attributed to which of the following individuals?
- A) Joseph John Thomson
 - B) Henri Becquerel
 - C) Walter Ritz
 - D) Pierre Curie
 - E) Robert Millikan
- 16) Bohr was able to show that X-rays from heavier elements
- A) result from electrons at a higher energy level falling into "holes" left by electrons ejected at lower energies.
 - B) are produced when a high-energy electron collides with a proton.
 - C) are a natural form of radioactive decay.
 - D) result from neutron bombardment of atomic nuclei.
 - E) none of the preceding
- 17) When the circumference of an electron's orbit is equal to an integral multiple of its wavelength,
- A) the electron is in a 'p' orbital
 - B) an in phase standing wave is formed through constructive interference.
 - C) electron excitation occurs.
 - D) an out of phase, destructively interfering wave is formed.
 - E) none of the preceding
- 18) The quantum mechanical principle that no two fermions can simultaneously occupy the same quantum state (i.e., no two electrons in the same atom can share the same set of four quantum numbers) is known as
- A) the Aufbau principle
 - B) Feynman's rule
 - C) the Pauli exclusion principle
 - D) Hund's rule
 - E) none of the preceding

- 19) What was surprising about Rutherford's results?
- A) The radiation stream passed cleanly through atoms of gold, showing they are mostly empty space.
 - B) Particles could not penetrate the dense gold atoms and were all deflected back to the source.
 - C) The stream was deflected slightly, showing that the atom consists of particles.
 - D) Fluorescence was observed on the same side of the screen as the source, indicating particles had bounced off of something considerably more massive than themselves.
 - E) none of the preceding
- 20) The first person to quantitatively express the relationship between the emission lines of a hydrogen atom was
- A) Ernest Rutherford
 - B) Johann Jakob Balmer
 - C) Walter Ritz
 - D) Niels Bohr
 - E) Johannes Rydberg
- 21) What was accurately measured in Robert Millikan's classic oil drop experiment?
- A) the mass of a proton
 - B) the mass and charge of an electron
 - C) the mass and charge of a proton
 - D) the size of an electron
 - E) none of the preceding
- 22) As one moves down a group in the periodic table of elements,
- A) the atomic radius remains unchanged.
 - B) the atomic radius increases for metals, but decreases for non-metals.
 - C) the atomic radius increases in size.
 - D) the atomic radius decreases in size.
 - E) none of the preceding
- 23) The principal quantum number, n , represents
- A) the shape of the orbital
 - B) the electron spin
 - C) the size of the orbital
 - D) the orientation of the orbital in a magnetic field
 - E) none of the preceding
- 24) The rule stating that electrons fill orbitals of the lowest energy, before higher energy orbitals can be filled is known as
- A) the Aufbau principle
 - B) the Pauli exclusion principle
 - C) Hund's rule
 - D) Feynman's rule
 - E) none of the preceding
- 25) The angular momentum or azimuthal quantum number, l , represents
- A) the shape of the orbital
 - B) the orientation of the orbital in a magnetic field
 - C) the electron spin
 - D) the size of the orbital
 - E) none of the preceding