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| 1. When ignited, a uranium compound burns with a green flame. The wavelength of the light given off by this flame is greater than that of   |  |  |  | | --- | --- | --- | |  | a. | red light | |  | b. | infrared light | |  | c. | radio waves | |  | d. | ultraviolet light | |  | e. | gamma rays |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 2. Which form of electromagnetic radiation has the longest wavelengths?   |  |  |  | | --- | --- | --- | |  | a. | gamma rays | |  | b. | microwaves | |  | c. | radio waves | |  | d. | infrared radiation | |  | e. | x-rays |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 3. Which of the following frequencies corresponds to light with the longest wavelength?   |  |  |  | | --- | --- | --- | |  | a. | 3.00 × 1013 s–1 | |  | b. | 4.12 × 105 s–1 | |  | c. | 8.50 × 1020 s–1 | |  | d. | 9.12 × 1012 s–1 | |  | e. | 3.20 × 109 s–1 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 4. Which of the following are incorrectly paired?   |  |  |  | | --- | --- | --- | |  | a. | wavelength – λ | |  | b. | frequency – ν | |  | c. | speed of light – *c* | |  | d. | hertz – s–1 | |  | e. | x-rays – shortest wavelength |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 5. When a strontium salt is ignited, it burns with a red flame. The frequency of the light given off by this flame is greater than   |  |  |  | | --- | --- | --- | |  | a. | yellow light | |  | b. | infrared light | |  | c. | ultraviolet light | |  | d. | radio waves | |  | e. | x-rays |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 6. A line in the spectrum of atomic mercury has a wavelength of 256 nm. When mercury emits a photon of light at this wavelength, the frequency of this light is   |  |  |  | | --- | --- | --- | |  | a. | 8.54 × 10–16 s–1 | |  | b. | 7.76 × 10–19 s–1 | |  | c. | 1.17 × 1015 s–1 | |  | d. | 76.7 s–1 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 7. What is the wavelength of a photon of red light (in nm) whose frequency is 4.55 × 1014 Hz?   |  |  |  | | --- | --- | --- | |  | a. | 659 nm | |  | b. | 1.52 × 106 nm | |  | c. | 152 nm | |  | d. | 455 nm | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 8. The SI unit for frequency is cycles per second.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 9. Yellow light can have a wavelength of 599 nm. The energy of a photon of this light is   |  |  |  | | --- | --- | --- | |  | a. | 1.19 × 10–31 J | |  | b. | 5.99 × 10–7 J | |  | c. | 3.32 × 10–19 J | |  | d. | 5.01 × 1014 J | |  | e. | 3.02 × 1018 J |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 10. Consider an atom traveling at 1% of the speed of light. The de Broglie wavelength is found to be 1.46 × 10–3 pm. Which element is this?   |  |  |  | | --- | --- | --- | |  | a. | Be | |  | b. | Zr | |  | c. | Na | |  | d. | Fe | |  | e. | P |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | de Broglie relation | general chemistry | quantum mechanics | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 11. Which one of the following types of radiation has the shortest wavelength, the greatest energy, and the highest frequency?   |  |  |  | | --- | --- | --- | |  | a. | Ultraviolet radiation. | |  | b. | Infrared radiation. | |  | c. | Visible red light. | |  | d. | Visible blue light. | |  | e. | None, because short wavelength is associated with low energy and low frequency, not high energy and high frequency. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 12. What is the energy of a photon of blue light that has a wavelength of 475 nm?   |  |  |  | | --- | --- | --- | |  | a. | 4.75 × 10–7 J | |  | b. | 4.18 × 10–19 J | |  | c. | 6.31 × 1014 J | |  | d. | 9.44 × 10–32 J | |  | e. | 2.39 × 10–32 J |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/8/2017 12:52 AM | | *DATE MODIFIED:* | 3/8/2017 2:12 AM | |

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| 13. How many of the following is/are *incorrect*?      i. The importance of the equation *E* = *mc*2 is that energy has mass.     ii. Electromagnetic radiation can be thought of as a stream of particles called photons.    iii. Electromagnetic radiation exhibits wave properties.    iv. Energy can only occur in discrete units called quanta.   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 1 | |  | c. | 2 | |  | d. | 3 | |  | e. | 4 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| From the following list of observations, choose the one that most clearly supports the following conclusion:   |  |  | | --- | --- | | a) | emission spectrum of hydrogen | | b) | the photoelectric effect | | c) | scattering of alpha particles by metal foil | | d) | diffraction | | e) | cathode "rays" | |

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| 14. Electrons have wave properties.   |  |  |  | | --- | --- | --- | |  | a. | observation a | |  | b. | observation b | |  | c. | observation c | |  | d. | observation d | |  | e. | observation e |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-1 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 15. Electromagnetic radiation has wave characteristics.   |  |  |  | | --- | --- | --- | |  | a. | observation a | |  | b. | observation b | |  | c. | observation c | |  | d. | observation d | |  | e. | observation e |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-1 | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 16. Electrons in atoms have quantized energies.   |  |  |  | | --- | --- | --- | |  | a. | observation a | |  | b. | observation b | |  | c. | observation c | |  | d. | observation d | |  | e. | observation e |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-1 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum effects and photons | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 17. Spacing between atoms in a crystal is on the same order as the de Broglie wavelength of accelerated electrons.   |  |  |  | | --- | --- | --- | |  | a. | observation a | |  | b. | observation b | |  | c. | observation c | |  | d. | observation d | |  | e. | observation e |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-1 | | *KEYWORDS:* | atomic theory | Chemistry | de Broglie relation | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 18. Diffraction results when light is scattered from a regular array of points or lines.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 19. All matter exhibits either particulate or wave properties exclusively.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 20. The four lines observed in the visible emission spectrum of hydrogen tell us that:   |  |  |  | | --- | --- | --- | |  | a. | The hydrogen molecules they came from have the formula H4. | |  | b. | We could observe more lines if we had a stronger prism. | |  | c. | There are four electrons in an excited hydrogen atom. | |  | d. | Only certain energies are allowed for the electron in a hydrogen atom. | |  | e. | The spectrum is continuous. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 21. In an investigation of the electronic absorption spectrum of a particular element, it is found that a photon having λ = 500 nm provides just enough energy to promote an electron from the second quantum level to the third. From this information, we can deduce   |  |  |  | | --- | --- | --- | |  | a. | the energy of the *n* = 2 level | |  | b. | the energy of the *n* = 3 level | |  | c. | the sum of the energies of *n* = 2 and *n* = 3 | |  | d. | the difference in energies between *n* = 2 and *n* = 3 | |  | e. | all of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| Consider the following portion of the energy-level diagram for hydrogen:   |  |  |  |  | | --- | --- | --- | --- | |  | *n* = 4 |  | –0.1361 × 10–18 J | |  | *n* = 3 |  | –0.2420 × 10–18 J | |  | *n* = 2 |  | –0.5445 × 10–18 J | |  | *n* = 1 |  | –2.178 × 10–18 J | |

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| 22. For which of the following transitions does the light emitted have the longest wavelength?   |  |  |  | | --- | --- | --- | |  | a. | *n* = 4 to *n* = 3 | |  | b. | *n* = 4 to *n* = 2 | |  | c. | *n* = 4 to *n* = 1 | |  | d. | *n* = 3 to *n* = 2 | |  | e. | *n* = 2 to *n* = 1 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-2 | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 23. In the hydrogen spectrum, what is the wavelength of light associated with the *n* = 3 to *n* = 1 electron transition?   |  |  |  | | --- | --- | --- | |  | a. | 3.97 × 10–25 nm | |  | b. | 8.21 × 102 nm | |  | c. | 9.75 × 106 cm | |  | d. | 1.94 × 10–18 m | |  | e. | 1.03 × 10–7 m |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *PREFACE NAME:* | Ref 7-2 | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 2/16/2017 6:26 AM | |

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| 24. The wavelength of light associated with the *n* = 2 to *n* = 1 electron transition in the hydrogen spectrum is 1.216 × 10–7 m. By what coefficient should this wavelength be multiplied to obtain the wavelength associated with the same electron transition in the Li2+ ion?   |  |  |  | | --- | --- | --- | |  | a. | 1/9 | |  | b. | 1/7 | |  | c. | 1/4 | |  | d. | 1/3 | |  | e. | 1 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 25. When a hydrogen electron makes a transition from *n* = 3 to *n* = 1, which of the following statements is *true*?   |  |  | | --- | --- | | I. | Energy is emitted. | | II. | Energy is absorbed. | | III. | The electron loses energy. | | IV. | The electron gains energy. | | V. | The electron cannot make this transition. |  |  |  |  | | --- | --- | --- | |  | a. | I, IV | |  | b. | I, III | |  | c. | II, III | |  | d. | II, IV | |  | e. | V |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 2/20/2017 2:05 AM | |

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| 26. What is the wavelength of light that is emitted when an excited electron in the hydrogen atom falls from *n* = 5 to *n* = 2?   |  |  |  | | --- | --- | --- | |  | a. | 2.30 × 106 m | |  | b. | 4.34 × 10–7 m | |  | c. | 4.57 × 10–19 m | |  | d. | 3.65 × 10–7 m | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 2/16/2017 6:30 AM | |

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| 27. Which of the following is a reasonable criticism of the Bohr model of the atom?   |  |  |  | | --- | --- | --- | |  | a. | It makes no attempt to explain why the negative electron does not eventually fall into the positive nucleus. | |  | b. | It does not adequately predict the line spectrum of hydrogen. | |  | c. | It does not adequately predict the ionization energy of the valence electron(s) for elements other than hydrogen. | |  | d. | It does not adequately predict the ionization energy of the first energy level electrons for one-electron species for elements other than hydrogen. | |  | e. | It shows the electrons to exist outside of the nucleus. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 28. When an electron in a 2*p* orbital of a particular atom makes a transition to the 2*s* orbital, a photon of approximate wavelength 646.3 nm is emitted. The energy difference between these 2*p* and 2*s* orbitals is   |  |  |  | | --- | --- | --- | |  | a. | 3.07 × 10–28 J | |  | b. | 3.07 × 10–19 J | |  | c. | 3.07 × 10–17 J | |  | d. | 1.28 × 10–31 J | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/8/2017 2:17 AM | | *DATE MODIFIED:* | 3/8/2017 2:38 AM | |

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| 29. The energy of the light emitted when a hydrogen electron goes from *n* = 2 to *n* = 1 is what fraction of its ground-state ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | 3/4 | |  | b. | 1/2 | |  | c. | 1/4 | |  | d. | 1/8 | |  | e. | 1/9 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 30. In Bohr's atomic theory, when an electron moves from one energy level to another energy level more distant from the nucleus:   |  |  |  | | --- | --- | --- | |  | a. | Energy is emitted. | |  | b. | Energy is absorbed. | |  | c. | No change in energy occurs. | |  | d. | Light is emitted. | |  | e. | None of these. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 31. Which of the following is *incorrect*?   |  |  |  | | --- | --- | --- | |  | a. | The emission spectrum of hydrogen contains a continuum of colors. | |  | b. | Diffraction produces both constructive and destructive interference. | |  | c. | All matter displays both particle and wavelike characteristics. | |  | d. | Niels Bohr developed a quantum model for the hydrogen atom. | |  | e. | The lowest possible energy state of a molecule or atom is called its ground state. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 32. Which of the following statements is (are) true?   |  |  | | --- | --- | | I. | An excited atom can return to its ground state by absorbing electromagnetic radiation. | | II. | The energy of an atom is increased when electromagnetic radiation is emitted from it. | | III. | The energy of electromagnetic radiation increases as its frequency increases. | | IV. | An electron in the n = 4 state in the hydrogen atom can go to the n = 2 state by emitting electromagnetic radiation at the appropriate frequency. | | V. | The frequency and wavelength of electromagnetic radiation are inversely proportional to each other. |  |  |  |  | | --- | --- | --- | |  | a. | II, III, IV | |  | b. | III, V | |  | c. | I, II, III | |  | d. | III, IV, V | |  | e. | I, II, IV |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 2/27/2017 11:44 PM | |

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| 33. Bohr's model correctly describes the hydrogen atom and other small atoms.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 34. A gamma ray of wavelength 1.00 × 10–8 cm has enough energy to remove an electron from a hydrogen atom.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 35. Which of the following statements best describes the Heisenberg uncertainty principle?   |  |  |  | | --- | --- | --- | |  | a. | The exact position of an electron is always uncertain. | |  | b. | The velocity of a particle can only be estimated. | |  | c. | It is impossible to accurately know both the exact location and momentum of a particle. | |  | d. | The location and momentum of a macroscopic object are not known with certainty. | |  | e. | The location and momentum of a particle can be determined accurately, but not the identity of the particle. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | Heisenberg's uncertainty principle | quantum mechanics | wave functions | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 36. Which of the following best describes an orbital?   |  |  |  | | --- | --- | --- | |  | a. | space where electrons are unlikely to be found in an atom | |  | b. | space which may contain electrons, protons, and/or neutrons | |  | c. | the space in an atom where an electron is most likely to be found | |  | d. | small, walled spheres that contain electrons | |  | e. | a single space within an atom that contains all electrons of that atom |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 37. Which of the following is *not* determined by the principal quantum number, *n*, of the electron in a hydrogen atom?   |  |  |  | | --- | --- | --- | |  | a. | The energy of the electron. | |  | b. | the minimum wavelength of the light needed to remove the electron from the atom. | |  | c. | The size of the corresponding atomic orbital(s). | |  | d. | The shape of the corresponding atomic orbital(s). | |  | e. | All of the above are determined by *n*. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | principal quantum number | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 38. How many *f* orbitals have the value *n* = 3?   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 3 | |  | c. | 5 | |  | d. | 7 | |  | e. | 1 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 39. How many *d* orbitals have *n* = 4?   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 5 | |  | c. | 10 | |  | d. | 7 | |  | e. | 18 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 40. If *n* = 2, how many orbitals are possible?   |  |  |  | | --- | --- | --- | |  | a. | 3 | |  | b. | 4 | |  | c. | 2 | |  | d. | 8 | |  | e. | 6 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 41. A given set of *p* orbitals consists of \_\_\_\_\_\_ orbitals.   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | 5 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 42. Which of the following is an incorrect designation for an atomic orbital?   |  |  |  | | --- | --- | --- | |  | a. | 1*s* | |  | b. | 3*d* | |  | c. | 1*p* | |  | d. | 4*f* | |  | e. | 6*s* |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 43. The number of orbitals having a given value of *l* is equal to   |  |  |  | | --- | --- | --- | |  | a. | 2*l* + 1 | |  | b. | 2*n* + 2 | |  | c. | 3*l* | |  | d. | *l* + *ml* | |  | e. | the number of lobes in each orbital |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | angular momentum quantum number | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 44. The magnetic quantum number is related to the orientation of the orbital in space relative to the other orbitals in the atom.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | magnetic quantum number | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 45. Consider the following representation of a 2*p*-orbital:  Which of the following statements best describes the movement of electrons in a *p*-orbital?   |  |  |  | | --- | --- | --- | |  | a. | The electrons move along the outer surface of the *p*-orbital, similar to a “figure 8” type of movement. | |  | b. | The electrons move within the two lobes of the *p*-orbital, but never beyond the outside surface of the orbital. | |  | c. | The electrons are concentrated at the center (node) of the two lobes. | |  | d. | The electrons are only moving in one lobe at any given time. | |  | e. | The electron movement cannot be exactly determined. |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.7 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | Heisenberg's uncertainty principle | quantum mechanics | wave functions | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 46. A point in the wave function where the amplitude is zero defines   |  |  |  | | --- | --- | --- | |  | a. | the node | |  | b. | the excited state | |  | c. | the amplitude of the wave function | |  | d. | the frequency of radiation | |  | e. | none of the above |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.7 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | wave functions | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 47. The size of an orbital is arbitrarily defined.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.7 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic orbital shapes | atomic theory | Chemistry | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 48. How many electrons in an atom can have the quantum numbers *n* = 3, *l* = 2?   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 5 | |  | c. | 10 | |  | d. | 18 | |  | e. | 6 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 49. How many electrons can be described by the quantum numbers *n* = 2, *l*= 2, *ml* = 2?   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 2 | |  | c. | 6 | |  | d. | 10 | |  | e. | 14 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 50. How many electrons can be contained in all of the orbitals with *n* = 4?   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 8 | |  | c. | 10 | |  | d. | 18 | |  | e. | 32 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 51. What is the *l* quantum number for a 4*d* orbital?   |  |  |  | | --- | --- | --- | |  | a. | 3 | |  | b. | 2 | |  | c. | 1 | |  | d. | 0 | |  | e. | more than one of the above |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 52. Which of the following could not be a valid *ml* quantum number for a 4*d* orbital?   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 0 | |  | c. | –1 | |  | d. | 1 | |  | e. | 4 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 53. How many electrons in an atom can have the quantum numbers *n* = 4, *l* = 2?   |  |  |  | | --- | --- | --- | |  | a. | 14 | |  | b. | 12 | |  | c. | 5 | |  | d. | 10 | |  | e. | 6 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 54. Which of the following combinations of quantum numbers (*n*, *l*, *ml*, *ms*) do *not* represent permissible solutions of the Schrödinger equation for the electron in the hydrogen atom (i.e., which combination of quantum numbers is *not* allowed)?   |  |  |  | | --- | --- | --- | |  | a. | 9, 8, -4, 1/2 | |  | b. | 8, 2, 2, 1/2 | |  | c. | 6, -5, -1, 1/2 | |  | d. | 6, 5, -5, 1/2 | |  | e. | All are allowed. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 55. If *l* = 3, how many electrons can be contained in all the possible orbitals?   |  |  |  | | --- | --- | --- | |  | a. | 7 | |  | b. | 6 | |  | c. | 14 | |  | d. | 10 | |  | e. | 5 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 56. Which of the following combinations of quantum numbers is not allowed?   |  |  |  | | --- | --- | --- | |  | a. | *n* = 1, *l* = 1, *ml* = 0, *ms* = | |  | b. | *n* = 3, *l* = 0, *ml* = 0, *ms* = - | |  | c. | *n* = 2, *l* = 1, *ml* = -1, *ms* = | |  | d. | *n* = 4, *l* = 3, *ml* = -2, *ms* = - | |  | e. | *n* = 4, *l* = 2, *ml* = 0, *ms* = |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 57. The small, but important, energy differences between 3*s*, 3*p*, and 3*d* orbitals are due mainly to   |  |  |  | | --- | --- | --- | |  | a. | the number of electrons they can hold | |  | b. | their principal quantum number | |  | c. | the Heisenberg uncertainty principle | |  | d. | the penetration effect | |  | e. | Hund's rule |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.9 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 58. Who was the first chemist to recognize patterns in chemical properties of the elements?   |  |  |  | | --- | --- | --- | |  | a. | Mendeleev | |  | b. | Newlands | |  | c. | Meyer | |  | d. | Dobereiner | |  | e. | Bohr |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 59. Mendeleev is given the most credit for the concept of a periodic table of the elements because:   |  |  |  | | --- | --- | --- | |  | a. | He had the longest history of research in elemental properties. | |  | b. | He emphasized its usefulness in predicting the existence and properties of unknown elements. | |  | c. | His representation of the table was the most understandable. | |  | d. | His periodic table was arranged in octaves. | |  | e. | He grouped elements into triads of similar properties. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | Mendeleev's predictions | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 60. Which of the following was not an elemental property usually predicted by Mendeleev for as-yet-unknown elements?   |  |  |  | | --- | --- | --- | |  | a. | electron configuration | |  | b. | atomic mass | |  | c. | density | |  | d. | boiling point | |  | e. | chemical behaviour |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | Mendeleev's predictions | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 2/7/2017 4:04 AM | |

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| 61. Which of the following atoms or ions has three unpaired electrons?   |  |  |  | | --- | --- | --- | |  | a. | N | |  | b. | O | |  | c. | Al | |  | d. | S2– | |  | e. | Ti2+ |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | aufbau principle | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 62. The electron configuration for the barium atom is:   |  |  |  | | --- | --- | --- | |  | a. | 1*s*22*s*22*p*63*s*23*p*64*s*23*d*10 | |  | b. | [Xe]6*s*2 | |  | c. | 1*s*22*s*22*p*63*s*23*p*64*s*1 | |  | d. | 1*s*22*s*22*p*63*s*23*p*64*s*2 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | aufbau principle | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 63. The electron configuration for the carbon atom is:   |  |  |  | | --- | --- | --- | |  | a. | 1*s*22*s*22*p*2 | |  | b. | [He]2*s*4 | |  | c. | [Ne]2*s*22*p*2 | |  | d. | 1*s*22*p*4 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | aufbau principle | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 64. The complete electron configuration of tellurium is   |  |  |  | | --- | --- | --- | |  | a. | 1*s*22*s*22*p*63*s*23*p*64*s*23*d*104*p*65*s*24*d*105*d*105*p*4 | |  | b. | 1*s*22*s*22*p*63*s*23*p*64*s*23*d*104*d*104*p*4 | |  | c. | 1*s*22*s*22*p*63*s*23*p*64*s*24*p*65*s*24*d*105*d*105*p*4 | |  | d. | 1*s*22*s*22*p*63*s*23*p*64*s*23*d*104*p*65*s*24*d*105*p*4 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | aufbau principle | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 65. Which of the following statements about quantum theory is *incorrect*?   |  |  |  | | --- | --- | --- | |  | a. | The energy and position of an electron cannot be determined simultaneously. | |  | b. | Lower energy orbitals are filled with electrons before higher energy orbitals. | |  | c. | When filling orbitals of equal energy, two electrons will occupy the same orbital before filling a new orbital. | |  | d. | No two electrons can have the same four quantum numbers. | |  | e. | All of these are correct. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 66. Which of the following statements is *true*?   |  |  |  | | --- | --- | --- | |  | a. | The exact location of an electron can be determined if we know its energy. | |  | b. | An electron in a 2*s* orbital can have the same *n*, *l*, and *ml* quantum numbers as an electron in a 3*s* orbital. | |  | c. | Ni has two unpaired electrons in its 3*d* orbitals. | |  | d. | In the buildup of atoms, electrons occupy the 4*f* orbitals before the 6*s* orbitals. | |  | e. | Only three quantum numbers are needed to uniquely describe an electron. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 67. Which of the following statements is *false*?   |  |  |  | | --- | --- | --- | |  | a. | An orbital can accommodate at most two electrons. | |  | b. | The electron density at a point is proportional to ψ2 at that point. | |  | c. | The spin quantum number of an electron must be either + or –. | |  | d. | A 2*p* orbital is more penetrating than a 2*s*; i.e., it has a higher electron density near the nucleus and inside the charge cloud of a 1*s* orbital. | |  | e. | In the usual order of filling, the 6*s* orbital is filled before the 4*f* orbital. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 68. The statement that "the lowest energy configuration for an atom is the one having the maximum number of unpaired electrons allowed by the Pauli principle in a particular set of degenerate orbitals" is known as   |  |  |  | | --- | --- | --- | |  | a. | the aufbau principle | |  | b. | Hund's rule | |  | c. | Heisenberg uncertainty principle | |  | d. | the Pauli exclusion principle | |  | e. | the quantum model |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | Hund's rule | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 69. An element has the electron configuration [Kr] 5*s*24*d*105*p*2. The element is a(n)   |  |  |  | | --- | --- | --- | |  | a. | nonmetal | |  | b. | transition element | |  | c. | metal | |  | d. | lanthanide | |  | e. | actinide |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 70. An element *E* has the electron configuration [Kr] 5*s*24*d*105*p*2. The formula for the fluoride of *E* is most likely   |  |  |  | | --- | --- | --- | |  | a. | EF14 | |  | b. | EF4 | |  | c. | EF | |  | d. | EF6 | |  | e. | EF8 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 71. An element with the electron configuration [Xe] 6*s*24*f*145*d*7 would belong to which class on the periodic table?   |  |  |  | | --- | --- | --- | |  | a. | transition elements | |  | b. | alkaline earth elements | |  | c. | halogens | |  | d. | rare earth elements | |  | e. | none of the above |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 72. All halogens have the following number of valence electrons:   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 3 | |  | c. | 0 | |  | d. | 7 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/1/2017 1:28 AM | |

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| 73. Ti has \_\_\_\_\_\_\_\_\_\_ in its d orbitals.   |  |  |  | | --- | --- | --- | |  | a. | one electron | |  | b. | two electrons | |  | c. | three electrons | |  | d. | four electrons | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 74. Germanium has \_\_\_\_\_\_\_\_\_\_ in its 4p orbitals.   |  |  |  | | --- | --- | --- | |  | a. | one electron | |  | b. | two electrons | |  | c. | three electrons | |  | d. | four electrons | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 75. Fe has \_\_\_\_\_\_\_\_\_\_ that is (are) unpaired in its d orbitals.   |  |  |  | | --- | --- | --- | |  | a. | one electron | |  | b. | two electrons | |  | c. | three electrons | |  | d. | four electrons | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | magnetic properties of atoms | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| Nitrogen has five valence electrons. Consider the following electron arrangements.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 2s |  | 2p | |  | | a) | ↑↓ |  | ↑ | ↑ | ↑ | |  |  |  |  |  |  | | b) | ↑ |  | ↑↓ | ↑ | ↓ | |  |  |  |  |  |  | | c) | ↑ |  | ↑↑ | ↑ | ↑ | |  |  |  |  |  |  | | d) | ↑↓ |  | ↑ | ↑ |  | |  |  |  |  |  |  | | e) | ↑↓ |  | ↑↓ | ↑ | ↑ | |

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| 76. Which represents the ground state for N?   |  |  |  | | --- | --- | --- | |  | a. | option a | |  | b. | option b | |  | c. | option c | |  | d. | option d | |  | e. | option e |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-3 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | orbital diagram | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 77. Which represents the ground state for the N– ion?   |  |  |  | | --- | --- | --- | |  | a. | option a | |  | b. | option b | |  | c. | option c | |  | d. | option d | |  | e. | option e |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-3 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | orbital diagram | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 78. In which group do all the elements have the same number of valence electrons?   |  |  |  | | --- | --- | --- | |  | a. | P, S, Cl | |  | b. | Ag, Cd, Ar | |  | c. | Na, Ca, Ba | |  | d. | P, As, Se | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 79. An atom of fluorine contains nine electrons. How many of these electrons are in *s* orbitals?   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 4 | |  | c. | 6 | |  | d. | 8 | |  | e. | none |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | aufbau principle | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 80. How many unpaired electrons are there in an atom of sulfur in its ground state?   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 1 | |  | c. | 2 | |  | d. | 3 | |  | e. | 4 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | magnetic properties of atoms | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 81. Of the following elements, which has occupied *d* orbitals in its ground-state neutral atoms?   |  |  |  | | --- | --- | --- | |  | a. | Ba | |  | b. | Ca | |  | c. | Si | |  | d. | P | |  | e. | Cl |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 82. Of the following elements, which needs three electrons to complete its valence shell?   |  |  |  | | --- | --- | --- | |  | a. | Ba | |  | b. | Ca | |  | c. | Si | |  | d. | P | |  | e. | Cl |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 83. Which of the following electron configurations is correct?   |  |  |  | | --- | --- | --- | |  | a. | Ga:    [Kr]4*s*23*d*104*p*1 | |  | b. | Mo:    [Kr]5*s*24*d*5 | |  | c. | Ca:    [Ar]4*s*13*d*10 | |  | d. | Br:    [Kr]4*s*23*d*104*p*7 | |  | e. | Bi:    [Xe]6*s*24*f*145*d*106*p*3 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 84. 1*s*22*s*22*p*63*s*23*p*64*s*23*d*7 is the correct electron configuration for which of the following atoms?   |  |  |  | | --- | --- | --- | |  | a. | Br | |  | b. | Co | |  | c. | I | |  | d. | Rh | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 85. Which of the following atoms has three electrons in *p* orbitals in its valence shell?   |  |  |  | | --- | --- | --- | |  | a. | Ba | |  | b. | Ga | |  | c. | V | |  | d. | Bi | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 86. How many of the following electron configurations for the species in their ground state are correct?   |  |  |  | | --- | --- | --- | | I. | Ca: | 1*s*22*s*22*p*63*s*23*p*64*s*2 | | II. | Mg: | 1*s*22*s*22*p*63*s*1 | | III. | V: | [Ar]3*s*23*d*3 | | IV. | As: | [Ar]4*s*23*d*104*p*3 | | V. | P: | 1*s*22*s*22*p*63*p*5 |  |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | 5 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 87. The number of unpaired electrons in the outer subshell of a Cl atom is   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 1 | |  | c. | 2 | |  | d. | 3 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 88. For which of the following elements does the electron configuration for the lowest energy state show a partially filled *d* orbital?   |  |  |  | | --- | --- | --- | |  | a. | Ti | |  | b. | Rb | |  | c. | Cu | |  | d. | Ga | |  | e. | Kr |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 89. Which of the following electron configurations is different from that expected?   |  |  |  | | --- | --- | --- | |  | a. | Ca | |  | b. | Sc | |  | c. | Ti | |  | d. | V | |  | e. | Cr |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | exceptions to the aufbau principle | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 90. Which of the following have 10 electrons in the *d* orbitals?   |  |  |  | | --- | --- | --- | |  | a. | Mn | |  | b. | Fe | |  | c. | Cu | |  | d. | Zn | |  | e. | two of the above |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 91. Which of the following is the highest energy orbital for a silicon atom?   |  |  |  | | --- | --- | --- | |  | a. | 1*s* | |  | b. | 2*s* | |  | c. | 3*s* | |  | d. | 3*p* | |  | e. | 3*d* |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 92. When electron configurations differ from expected, it is because orbitals want to be half-filled.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | exceptions to the aufbau principle | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 93. Copper exhibits the expected electron configuration.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | exceptions to the aufbau principle | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 94. Which of the following processes represents the ionization energy of bromine?   |  |  |  | | --- | --- | --- | |  | a. | Br(*s*) Br+(*g*) + e– | |  | b. | Br(*l*) Br+(*g*) + e– | |  | c. | Br(*g*) Br+(*g*) + e– | |  | d. | Br(*s*) Br+(*s*) + e– | |  | e. | Br2(*g*) Br2+(*g*) + e– |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 95. Order the elements S, Cl, and F in terms of increasing ionization energy.   |  |  |  | | --- | --- | --- | |  | a. | S, Cl, F | |  | b. | Cl, F, S | |  | c. | F, S, Cl | |  | d. | F, Cl, S | |  | e. | S, F, Cl |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 96. Order the elements S, Cl, and F in terms of increasing atomic radii.   |  |  |  | | --- | --- | --- | |  | a. | S, Cl, F | |  | b. | Cl, F, S | |  | c. | F, S, Cl | |  | d. | F, Cl, S | |  | e. | S, F, Cl |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 97. Which of the following atoms would have the largest second ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | Mg | |  | b. | Cl | |  | c. | S | |  | d. | Ca | |  | e. | Na |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 98. The first ionization energy of Mg is 735 kJ/mol. The second ionization energy is   |  |  |  | | --- | --- | --- | |  | a. | 735 kJ/mol | |  | b. | less than 735 kJ/mol | |  | c. | greater than 735 kJ/mol | |  | d. | More information is needed to answer this question. | |  | e. | None of these. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 99. Which of the following exhibits the correct orders for both atomic radius and ionization energy, respectively? (smallest to largest)   |  |  |  | | --- | --- | --- | |  | a. | S, O, F, and F, O, S | |  | b. | F, S, O, and O, S, F | |  | c. | S, F, O, and S, F, O | |  | d. | F, O, S, and S, O, F | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 100. Choose the element with the highest ionization energy.   |  |  |  | | --- | --- | --- | |  | a. | Na | |  | b. | Mg | |  | c. | Al | |  | d. | P | |  | e. | S |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 101. Which of the following concerning second ionization energies is true?   |  |  |  | | --- | --- | --- | |  | a. | That of Al is higher than that of Mg because Mg wants to lose the second electron, so it is easier to take the second electron away. | |  | b. | That of Al is higher than that of Mg because the electrons are taken from the same energy level, but the Al atom has one more proton. | |  | c. | That of Al is lower than that of Mg because Mg wants to lose the second electron, thus the energy change is greater. | |  | d. | That of Al is lower than that of Mg because the second electron taken from Al is in a p orbital, thus it is easier to take. | |  | e. | The second ionization energies are equal for Al and Mg. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 102. Consider a planet where the temperature is so high that the ground state of an electron in the hydrogen atom is *n* = 4. What is the ratio of ionization energy for hydrogen on this planet compared to that on Earth?   |  |  |  | | --- | --- | --- | |  | a. | 1 : 4 | |  | b. | 4 : 1 | |  | c. | 1 : 16 | |  | d. | 16 : 1 | |  | e. | 1 : 1 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 103. Consider the following orderings.   |  |  | | --- | --- | | I. | Na+ < Mg2+ < Al3+ < Si4+ | | II. | Be < Mg < Ca < Sr | | III. | I < Br < Cl < F | | IV. | Al < Si < P < Cl |   Which of these give(s) a correct trend in ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | III | |  | b. | II, IV | |  | c. | I, IV | |  | d. | I, III, IV | |  | e. | none of them |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodic table | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 104. List the following atoms in order of increasing ionization energy: Li, Na, C, O, F.   |  |  |  | | --- | --- | --- | |  | a. | Li < Na < C < O < F | |  | b. | Na < Li < C < O < F | |  | c. | F < O < C < Li < Na | |  | d. | Na < Li < F < O < C | |  | e. | Na < Li < C < F < O |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 105. Consider the ionization energy (IE) of the magnesium atom. Which of the following is *not* true?   |  |  |  | | --- | --- | --- | |  | a. | The IE of Mg is lower than that of sodium. | |  | b. | The IE of Mg is lower than that of neon. | |  | c. | The IE of Mg is lower than that of beryllium. | |  | d. | The IE of Mg is higher than that of calcium. | |  | e. | The IE of Mg is lower than that of Mg+. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 106. Of the following elements, which has the lowest first ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | Ba | |  | b. | Ca | |  | c. | Si | |  | d. | P | |  | e. | Cl |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 107. Of the following elements, which is most likely to form a negative ion with charge 1–?   |  |  |  | | --- | --- | --- | |  | a. | Ba | |  | b. | Ca | |  | c. | Si | |  | d. | P | |  | e. | Cl |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron affinity | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 108. Which of the following atoms has the largest ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | O | |  | b. | Li | |  | c. | Ne | |  | d. | Be | |  | e. | K |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 109. Which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | The first ionization potential of H is greater than that of He. | |  | b. | The ionic radius of Fe+ is larger than that of Fe3+. | |  | c. | The ionization energy of S2– is greater than that of Cl–. | |  | d. | The atomic radius of Li is larger than that of Cs. | |  | e. | All are false. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 110. Which of the following statements is *false*?   |  |  |  | | --- | --- | --- | |  | a. | A sodium atom has a smaller radius than a potassium atom. | |  | b. | A neon atom has a smaller radius than an oxygen atom. | |  | c. | A fluorine atom has a smaller first ionization energy than an oxygen atom. | |  | d. | A cesium atom has a smaller first ionization energy than a lithium atom. | |  | e. | All are true. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 111. The statement that the first ionization energy for an oxygen atom is lower than the first ionization energy for a nitrogen atom is   |  |  |  | | --- | --- | --- | |  | a. | consistent with the general trend relating changes in ionization energy across a period from left to right, because it is easier to take an electron from an oxygen atom than from a nitrogen atom | |  | b. | consistent with the general trend relating changes in ionization energy across a period from left to right, because it is harder to take an electron from an oxygen atom than from a nitrogen atom | |  | c. | inconsistent with the general trend relating changes in ionization energy across a period from left to right, due to the fact that the oxygen atom has two doubly-occupied 2*p* orbitals and nitrogen has only one | |  | d. | inconsistent with the general trend relating changes in ionization energy across a period from left to right, due to the fact that oxygen has one doubly-occupied 2*p* orbital and nitrogen does not | |  | e. | incorrect |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 112. Sodium losing an electron is an \_\_\_\_\_\_\_\_ process and fluorine losing an electron is an \_\_\_\_\_\_\_ process.   |  |  |  | | --- | --- | --- | |  | a. | endothermic, exothermic | |  | b. | exothermic, endothermic | |  | c. | endothermic, endothermic | |  | d. | exothermic, exothermic | |  | e. | more information needed |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 113. Which of the following statements is true about the ionization energy of Mg+?   |  |  |  | | --- | --- | --- | |  | a. | It will be equal to the ionization energy of Li. | |  | b. | It will be equal to and opposite in sign to the electron affinity of Mg. | |  | c. | It will be equal to and opposite in sign to the electron affinity of Mg+. | |  | d. | It will be equal to and opposite in sign to the electron affinity of Mg2+. | |  | e. | None of the above. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 114. Which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | The krypton 1*s* orbital is smaller than the helium 1*s* orbital because krypton's nuclear charge draws the electrons closer. | |  | b. | The krypton 1*s* orbital is larger than the helium 1*s* orbital because krypton contains more electrons. | |  | c. | The krypton 1*s* orbital is smaller than the helium 1*s* orbital because krypton's *p* and *d* orbitals crowd the *s* orbitals. | |  | d. | The krypton 1*s* orbital and helium 1*s* orbital are the same size because both *s* orbitals can only have two electrons. | |  | e. | The krypton 1*s* orbital is larger than the helium 1*s* orbital because krypton's ionization energy is lower, so it's easier to remove electrons. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 115. Which of the following statements are *false*?   |  |  | | --- | --- | | I. | It takes less energy to add an electron to nitrogen than to carbon because nitrogen will be closer to achieving a noble gas configuration. | | II. | It takes more energy to add an electron to fluorine than to oxygen because the radius of fluorine is smaller and more repulsion would occur in the *p*-orbitals. | | III. | It takes more energy to add an electron to nitrogen than to carbon because of the extra repulsions that would occur in the 2*p* orbitals. | | IV. | Less energy is released in adding an electron to iodine than to chlorine because the radius of iodine is larger and the electron is added at a distance further from the nucleus. |  |  |  |  | | --- | --- | --- | |  | a. | II, III | |  | b. | I, II, IV | |  | c. | III only | |  | d. | I, II | |  | e. | All of the above are false statements. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron affinity | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/1/2017 3:27 AM | |

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| 116. The second ionization energy for calcium is smaller than the first ionization energy.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 117. Ionization energy increases with an increasing number of electrons.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 118. When examining the electromagnetic spectrum, why is it more harmful to be exposed to x-rays than radio waves over a period of time? In your explanation, include the concepts of frequency, waves, and energy. Also, draw transverse waves to assist in your explanation.   |  |  | | --- | --- | | *ANSWER:* | X-rays have a shorter wavelength (in the 10–10 m range) and therefore a higher frequency (since *c* = λν). This means that the number of waves that penetrate your body over a period of time will be greater than the number of radio waves that hit your body in that same period of time (since radio waves have a longer wavelength and lower frequency). Refer to the picture below:  **X rays**                      shorter λ, higher ν  **Radio Waves**                      longer λ, lower ν Since more x-ray waves penetrate your body, you are being exposed to more energy in the form of radiation, which can be harmful. See Sec 7.1 and 7.2 of Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 119. Photogray lenses incorporate small amounts of silver chloride in the glass of the lens. The following reaction occurs in the light, causing the lenses to darken:                AgCl → Ag + Cl The enthalpy change for this reaction is 3.10 × 102 kJ/mol. Assuming all this energy is supplied by light, what is the maximum wavelength of light that can cause this reaction?   |  |  | | --- | --- | | *ANSWER:* | 3.86 × 10–7 m  Enthalpy change per AgCl = (3.10 × 102 kJ/mol)(1 mol/6.022 × 1023 molecules)(1000 J/1kJ) = 5.15 × 10–19 J/molecule *E* = *hc*/λ, therefore λ = *hc*/*E* l = (6.626 × 10–34 J s)(2.998 × 108 m/s) / (5.15 × 10–19 J) = 3.86 × 10–7 m (or 386 nm) | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 120. Electromagnetic radiation can be viewed as a stream of "particles" called \_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | photons | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 121. \_\_\_\_\_\_\_\_\_\_ results when light is scattered from a regular array of points or lines.   |  |  | | --- | --- | | *ANSWER:* | Diffraction | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.2 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 122. How does the Bohr theory explain the emission and absorption spectra of hydrogen?   |  |  | | --- | --- | | *ANSWER:* | The Bohr model assumes the electron can occupy circular orbits with specific energies at corresponding specific distances from the nucleus. The electron can move from one orbital (energy level) to another by releasing or absorbing the amount of energy corresponding to the difference in energy between the two orbitals. The observed emission and absorption spectra show only the discrete emissions or absorptions for these energy differences.  See Sec. 7.4 of Zumdahl, *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 123. A specific wave function is called a(n) \_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | orbital | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.5 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | wave functions | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 124. The \_\_\_\_\_\_\_\_\_\_ quantum number is related to the size and energy of the orbital.   |  |  | | --- | --- | | *ANSWER:* | principal (or *n*) | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | principal quantum number | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 125. Consider the following sets of quantum numbers. Which set(s) represent(s) impossible combinations?   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | *n* | *l* | *ml* | |  | Set a | 1 | 0 | 1 | |  | Set b | 3 | 3 | 0 | |  | Set c | 2 | 1 | 1 | |  | Set d | 3 | 2 | –2 | |  | Set e | 3 | 1 | –2 | |  | Set f | 2 | 0 | 0 |  |  |  | | --- | --- | | *ANSWER:* | Sets a, b, and e represent impossible combinations.  Set a is impossible because *ml* can only have values from -*l* to +*l*. If *l* is 0, *ml* can only be 0. Set b is impossible because *l* can only have values from 0 to *n*-1. When *n* = 3, *l* may be only 0, 1, or 2. Set e is impossible because *ml* can only have values from -*l* to +*l*. If *l* is 1, *ml* can only be -1, 0, or +1. See Sec. 7.6 in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 126. A hydrogen 3*s* wave function has \_\_\_\_\_\_\_\_\_\_ (how many?) nodal planes and \_\_\_\_\_\_\_\_\_\_ (how many?) radial nodes (not counting *r* = 0).   |  |  | | --- | --- | | *ANSWER:* | 0 nodal planes and 2 radial nodes  Since *s* orbitals are spherical, so the nodes are also spherical surfaces. For *s* orbitals, the number of nodes is given by *n*-1. See Sec. 7.7 in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 7.7 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic orbital shapes | atomic theory | Chemistry | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 127. Areas of zero probability of finding an electron are called \_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | nodes (or nodal surfaces) | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.7 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic orbital shapes | atomic theory | Chemistry | general chemistry | quantum mechanics | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 128. The \_\_\_\_\_\_\_\_\_\_\_\_ states that in a given atom no two electrons can have the same set of four quantum numbers.   |  |  | | --- | --- | | *ANSWER:* | Pauli exclusion principle | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | Pauli exclusion principle | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 129. How many electrons in an atom can have the following quantum numbers?  a) *n* = 3 b) *n* = 2, *l* = 0 c) *n* = 2, *l* = 2, *ml* = 0  d) *n* = 2, *l* = 0, *ml* = 0, *ms* = 1/2   |  |  | | --- | --- | | *ANSWER:* | a) 18; b) 2; c) 0; d) 1  a) The *n* = 3 level consists of an *s*, three *p*, and five *d* orbitals, each of which may contain 2 electrons, for a total of 18 electrons. b) *n* = 2, *l* = 0 describes the 2*s* orbital, which may contain 2 electrons. c) This set of quantum numbers is impossible, since when *n* = 2, *l* can only be 0 or 1. d) This set of four quantum numbers describes one specific electron in the 2*s* orbital. See Sec. 7.6 and 7.8 in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 130. Give the quantum numbers for the last electron in:  a) gold b) magnesium c) iodine  d) cadmium   |  |  | | --- | --- | | *ANSWER:* | a) gold: 5, 2, 2,   (into a 5*d*-orbital) b) magnesium: 3, 0, 0,   (into a 3*s*-orbital) c) iodine: 5, 1, 1,   (into a 5*p*-orbital) d) cadmium: 4, 2, 2,   (into a 4*d-*orbital) | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| Given the following electronic configuration of neutral atoms, identify the element and state the number of unpaired electrons in its ground state: |

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| 131. [Ar]4*s*13*d*5   |  |  | | --- | --- | | *ANSWER:* | The element is Cr with six unpaired electrons in its ground state. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-4 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | exceptions to the aufbau principle | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 132. [Ne]3*s*23*p*5   |  |  | | --- | --- | | *ANSWER:* | The element is Cl with one unpaired electron in its ground state. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-4 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 133. [Kr]5*s*24*d*105*p*4   |  |  | | --- | --- | | *ANSWER:* | The element is Te with two unpaired electrons in its ground state. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-4 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 134. [Ar]4*s*13*d*10   |  |  | | --- | --- | | *ANSWER:* | The element is Cu with one unpaired electron in its ground state. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-4 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | exceptions to the aufbau principle | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 135. [He]2*s*22*p*3   |  |  | | --- | --- | | *ANSWER:* | The element is N with three unpaired electrons in its ground state. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-4 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| Write the electron configuration for the following: |

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| 136. P   |  |  | | --- | --- | | *ANSWER:* | 1*s*22*s*22*p*63*s*23*p*3 or [Ne]3*s*23*p*3 | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-5 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 137. Ag   |  |  | | --- | --- | | *ANSWER:* | 1*s*22*s*22*p*63*s*23*p*64*s*23*d*104*p*65*s*14*d*10 or [Kr]5*s*14*d*10 | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-5 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 138. S2–   |  |  | | --- | --- | | *ANSWER:* | 1*s*22*s*22*p*63*s*23*p*6 or [Ne]3*s*23*p*6 | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-5 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 139. I   |  |  | | --- | --- | | *ANSWER:* | 1*s*22*s*22*p*63*s*23*p*64*s*23*d*104*p*65*s*24*d*105*p*5 or [Kr]5*s*24*d*105*p*5 | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-5 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 140. K+   |  |  | | --- | --- | | *ANSWER:* | 1*s*22*s*22*p*63*s*23*p*6 or [Ar] | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-5 | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 141. The \_\_\_\_\_\_\_\_\_\_ electrons are in the outermost principal quantum level of an atom.   |  |  | | --- | --- | | *ANSWER:* | valence | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 142. In general, the ionization energy and electron affinity involve more energy from \_\_\_\_\_\_\_\_\_\_ (left to right or right to left) in a period of the periodic table. Why?   |  |  | | --- | --- | | *ANSWER:* | The increase is from left to right because of the increase in nuclear charge. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 143. In general, the ionization energy and electron affinity involve more energy from \_\_\_\_\_\_\_\_\_ (top to bottom or bottom to top) in a family of the periodic table. Why?   |  |  | | --- | --- | | *ANSWER:* | The increase is from bottom to top because the electrons being removed or added are closer to the nucleus. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 144. For the set of elements Be, B, C, and N, which element has the smallest ionization energy? Explain any deviation from the expected pattern.   |  |  | | --- | --- | | *ANSWER:* | B has the smallest ionization energy. This is a deviation from the expectation that ionization energy increases from left to right across a row on the periodic table. In boron, the outermost electron is in a higher *p* sublevel, and the filled 2*s* orbital just below it provides some shielding from the nuclear charge. See Sec. 7.12 in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 145. For the set of elements Li, O, Ne, and Na, which element has the largest atomic radius? Explain any deviation from the expected pattern.   |  |  | | --- | --- | | *ANSWER:* | Na has the largest atomic radius. There is no deviation from the expected pattern.  Atomic radius is larger toward the left-hand end of a row, and increases as you go down a column. See Sec. 7.12, especially Fig. 7.35, in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| Choose the atom or ion using a periodic table. |

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| 146. Larger first ionization energy, Li or Be   |  |  | | --- | --- | | *ANSWER:* | Be | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 147. Larger first ionization energy, Na or Rb   |  |  | | --- | --- | | *ANSWER:* | Na | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 148. Larger first ionization energy, Be or B   |  |  | | --- | --- | | *ANSWER:* | Be | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 149. Larger first ionization energy, C or N   |  |  | | --- | --- | | *ANSWER:* | N | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 150. Larger second ionization energy, Na or Mg   |  |  | | --- | --- | | *ANSWER:* | Na | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 151. Larger atomic radius, P or Sb   |  |  | | --- | --- | | *ANSWER:* | Sb | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 152. Larger atomic radius, N or O   |  |  | | --- | --- | | *ANSWER:* | N | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 153. Larger atomic or ionic radius, F or F–   |  |  | | --- | --- | | *ANSWER:* | F– | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 154. Larger atomic or ionic radius, Mg or Mg2+   |  |  | | --- | --- | | *ANSWER:* | Mg | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 155. Larger atomic radius, Fe2+ or Fe3+   |  |  | | --- | --- | | *ANSWER:* | Fe2+ | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-6 | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 156. The calcium atom is much larger than the calcium ion, while the fluorine atom is much smaller than the fluorine ion. Explain this natural occurrence.   |  |  | | --- | --- | | *ANSWER:* | A cation has a larger proton to electron ratio than the corresponding neutral atom, so the remaining electrons are more closely held. An anion has a smaller proton to electron ratio than its corresponding neutral atom, so the electrons can not be held as closely. See Sec. 7.12 of Zumdahl, *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic radius | atomic theory | Chemistry | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| Consider the graph below to answer the next two questions: |

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| 157. Explain why argon has the highest ionization energy.   |  |  | | --- | --- | | *ANSWER:* | Argon has the highest ionization energy because the electrons in the valence shell are more tightly bound due to the higher nuclear charge. (NOTE: A common misconception among students is to say that argon has the highest ionization energy because it has a “filled outer valence shell.”) See Sec. 7.12 in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-7 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 158. Explain the ionization energy difference between sodium and potassium.   |  |  | | --- | --- | | *ANSWER:* | Potassium has a slightly lower ionization energy than sodium because the electron being removed from potassium is farther from the nucleus (the electron is in a higher energy level) so it is not as tightly bound. See Sec. 7.12 in Zumdahl *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 7-7 | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 159. Which has these types of electromagnetic radiation arranged in order of decreasing frequency?   |  |  |  | | --- | --- | --- | |  | a. | visible, ultraviolet, x-ray | |  | b. | radiowaves, visible, ultraviolet | |  | c. | ultraviolet, visible, infrared | |  | d. | x-ray, visible, ultraviolet | |  | e. | gamma, microwave, visible |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 160. Which has these types of electromagnetic radiation arranged in order of increasing wavelength?   |  |  |  | | --- | --- | --- | |  | a. | visible, ultraviolet, x-ray | |  | b. | radiowaves, visible, ultraviolet | |  | c. | ultraviolet, visible, infrared | |  | d. | x-ray, visible, ultraviolet | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:35 PM | | *DATE MODIFIED:* | 3/4/2016 4:35 PM | |

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| 161. Which has these types of electromagnetic radiation arranged in order of decreasing energy?   |  |  |  | | --- | --- | --- | |  | a. | visible, ultraviolet, x-ray | |  | b. | radiowaves, visible, ultraviolet | |  | c. | ultraviolet, visible, infrared | |  | d. | x-ray, visible, ultraviolet | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electromagnetic radiation | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 162. The first three levels of the hydrogen atom are shown below with their energies in J.  Which answer contains all the possible photons that could be generated by transitions among the three levels and no others?  ​  n                        E (J)  3 \_\_\_\_\_\_\_\_       -2.42 x 10-19  2 \_\_\_\_\_\_\_\_       -5.45 x 10-19  1 \_\_\_\_\_\_\_\_       -2.18 x 10-18  ​   |  |  |  | | --- | --- | --- | |  | a. | one photon, E = 1.94 x 10-18 J | |  | b. | two photons, E = 1.94 x 10-18 J and 1.64 x 10-18 J | |  | c. | two photons, E = 3.03 x 10-19 J and 1.64 x 10-18 J | |  | d. | photons, E = 3.03 x 10-19 J, 1.94 x 10-18 J and 1.64 x 10-18 J |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/1/2017 4:02 AM | |

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| 163. The energy of the light emitted when a hydrogen electron goes from *n* = 3 to *n* = 1 is what fraction of its ground-state ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | 2/3 | |  | b. | 1/3 | |  | c. | 10/9 | |  | d. | 8/9 | |  | e. | 1/9 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic line spectra | atomic theory | Bohr theory | Chemistry | general chemistry | light | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 164. In the quantum theory, the magnetic orbital momentum quantum number is most directly associated with which property of orbitals?   |  |  |  | | --- | --- | --- | |  | a. | energy | |  | b. | size | |  | c. | orientation | |  | d. | shape |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | magnteic quantum number | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 2/8/2017 6:12 AM | |

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| 165. In the quantum theory, the angular orbital momentum quantum number is most directly associated with which property of orbitals?   |  |  |  | | --- | --- | --- | |  | a. | energy | |  | b. | size | |  | c. | orientation | |  | d. | shape |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | angular quantum number | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 2/8/2017 6:12 AM | |

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| 166. Select a correct set of quantum numbers (n, l, ml, ms) for the highest energy electron in the ground state of tin, Sn   |  |  |  | | --- | --- | --- | |  | a. | 5, 1, 2, +1/2 | |  | b. | 5, 2, -1, 1/2 | |  | c. | 5, 1, 1, 1 | |  | d. | 5, 1, 0, +1/2 | |  | e. | 5, 2, 0, -1/2 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | quantum mechanics | quantum numbers | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 167. The ground state electron configuration for Te is:   |  |  |  | | --- | --- | --- | |  | a. | [Kr]5s24d105p4 | |  | b. | [Kr]5s25p64d8 | |  | c. | [Kr]5s25d105p4 | |  | d. | [Kr]5s24f14 | |  | e. | [Kr]5s25d105p6 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | aufbau principle | Chemistry | electron configuration | electronic structure of atoms | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/1/2017 4:14 AM | |

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| 168. Select the correct electron configuration for Cu.   |  |  |  | | --- | --- | --- | |  | a. | [Ar]4s23d9 | |  | b. | [Ar]4s13d10 | |  | c. | [Ar]4s24p63d3 | |  | d. | [Ar]4s24d9 | |  | e. | [Ar]3d10 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.11 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron configuration and the periodic table | electronic structure of atoms | exceptions to the aufbau principle | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 169. Which of the following equations correctly represents the process involved in the electron affinity of X?   |  |  |  | | --- | --- | --- | |  | a. | X+(g) + e-  =>  X(g) | |  | b. | X+(g) + Y-(g)  =>  XY(g) | |  | c. | X(g) + e-  =>  X-(g) | |  | d. | X(g) => X+(g) + e- | |  | e. | X+(g)  =>  X+(aq) |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | electron affinity | general chemistry | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 170. Which of the following lists of atoms are arranged in order of INCREASING first ionization energy?   |  |  |  | | --- | --- | --- | |  | a. | Li < O < N < F | |  | b. | Li < N < O < F | |  | c. | F < O < N < Li | |  | d. | Na < Sr < O < F | |  | e. | Ca > Cs > S > Se |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 171. Which of the following lists of atoms are arranged in order of DECREASING atomic radius?   |  |  |  | | --- | --- | --- | |  | a. | Li > O > N > F | |  | b. | Li > N > O > F | |  | c. | F > O > N > Li | |  | d. | Na > Sr > O > F | |  | e. | Ca < Cs < S < Se |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 7.12 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | atomic theory | Chemistry | general chemistry | ionization energy | periodic properties | periodicity of the elements | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:36 PM | | *DATE MODIFIED:* | 3/4/2016 4:36 PM | |

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| 172. A one electron species, X+m, where m is the charge of the one electron species and X is the element symbol, loses its one electron from its ground state when it absorbs 3.49 x 10-17 J of energy. Using the prior information, the charge of the one electron species is   |  |  |  | | --- | --- | --- | |  | a. | +8 | |  | b. | +2 | |  | c. | +3 | |  | d. | +1 | |  | e. | +5 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 1:52 AM | | *DATE MODIFIED:* | 3/8/2017 1:55 AM | |

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| 173. Below is the electromagnetic radiation spectrum, please notice the units of wavelengths!  What type of electromagnetic radiation is emitted for the transition of an electron from the  n = 6 to the n = 3 energy level in a hydrogen atom?   |  |  |  | | --- | --- | --- | |  | a. | microwave | |  | b. | infrared | |  | c. | visible (Vis.) | |  | d. | ultraviolet (UV) | |  | e. | X-ray |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 1:57 AM | | *DATE MODIFIED:* | 3/8/2017 2:03 AM | |

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| 174. The Table below shows the names of the different emission series in the hydrogen spectrum.  If an electron emits 1.82 x 10-19 J of energy when it moves from the energy level n = 6 to a lower energy level; to what series will the emission line belong?   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Initial energy level (ni) occupied by electron** | 2,3,4,…. | 3,4,5,…. | 4,5,6,…. | 5,6,7,…. | | **Final energy level (nf) occupied by electron** | 1 | 2 | 3 | 4 | | **Name of Emission Series** | **Lyman** | **Balmer** | **Paschen** | **Brackett** |  |  |  |  | | --- | --- | --- | |  | a. | Lyman | |  | b. | Balmer | |  | c. | Paschen | |  | d. | Brackett | |  | e. | None of the Series given |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 2:04 AM | | *DATE MODIFIED:* | 3/8/2017 3:08 AM | |

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| 175. The figure below represents part of the line emission spectrum for Li+2 in the gas phase. **All the lines result from electronic transitions from excited states to the n = 3 state**. Line B has a wavelength of 142.5 nm. Which of the following transitions would be the electronic transition that resulted in **line A**?     |  |  |  | | --- | --- | --- | |  | a. | 6 ➝ 3 | |  | b. | 5 ➝ 3 | |  | c. | 4 ➝ 3 | |  | d. | 6 ➝ 2 | |  | e. | 6 ➝ 5 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 3:09 AM | | *DATE MODIFIED:* | 3/8/2017 3:49 AM | |

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| 176. Below is the electromagnetic radiation spectrum, please notice the units of wavelengths!  A Li+2ion loses its one electron from its ground state when it absorbs a certain amount of energy. What type of electromagnetic radiation is associated with this energy absorption?   |  |  |  | | --- | --- | --- | |  | a. | x-ray | |  | b. | visible (Vis.) | |  | c. | UV | |  | d. | microwave | |  | e. | infrared |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 3:55 AM | | *DATE MODIFIED:* | 3/8/2017 4:01 AM | |

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| 177. The one electron species, X+m, where m is the charge of the one electron species, loses its one electron from its ground state when it absorbs 7.84 x 10-17 J of energy. What is the complete ground state electron configuration of an **electrically neutral** atom of element X?   |  |  |  | | --- | --- | --- | |  | a. | 1s22s22p2 | |  | b. | 1s1 | |  | c. | 1s22s1 | |  | d. | 1s22s22p1 | |  | e. | 1s22s2 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 4:07 AM | | *DATE MODIFIED:* | 3/8/2017 4:11 AM | |

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| 178. Which of the following combination of quantum numbers, I-IV, is/are allowed **and** which of   the orbital(s) labeled (i) to (iv) has the l value given in the combination of quantum numbers  **labeled I**?  I.  n = 2; l = 0; ml = -1  II.  n = 4; l = 3; ml = -1  III.  n = 3; l = 1; ml = 0  IV.  n = 5; l = 2; ml = +3  ​  **Allowed combination of quantum numbers               Orbital with l value given in I**   |  |  |  | | --- | --- | --- | |  | a. | IV only                                                                                   (ii) only | |  | b. | I and IV                                                                                  (i) only | |  | c. | III only                                                                                   (iii) only | |  | d. | I-IV                                                                                     (iii) and (iv) | |  | e. | II and III                                                                                  (i) only |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 4:12 AM | | *DATE MODIFIED:* | 3/8/2017 4:22 AM | |

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| 179. Select which of the statements, I-IV, are **true**.  I. 5f atomic orbitals exist in the quantum mechanical model of the atom.  ​  II. 4g atomic orbitals exist in the quantum mechanical model of the atom.  ​  III. Six electrons in an atom can have the quantum numbers, n = 4 and l = 1.  ​  IV. The five 4d atomic orbitals are different in energy but have the same orientation about the x,         y, and z axes.   |  |  |  | | --- | --- | --- | |  | a. | II and IV | |  | b. | I only | |  | c. | IV only | |  | d. | I and III | |  | e. | I, III and IV |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 4:25 AM | | *DATE MODIFIED:* | 3/8/2017 4:27 AM | |

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| 180. Which ion in pairs i-iv has the **larger** ionic radius?  Pair    i) O2- or S2-           ii) Fe2+ or Fe3+          iii) S2- or K+         iv) P3- or N3-  ​  Pair: i)       ii)          iii)      iv)   |  |  |  | | --- | --- | --- | |  | a. | S2-        Fe2+     S2-       P3- | |  | b. | S2-        Fe3+     S2-       P3- | |  | c. | O2-       Fe3+      K+ N3- | |  | d. | S2-        Fe2+     K+ N3- | |  | e. | O2-       Fe2+      S-2 P3- |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 4:28 AM | | *DATE MODIFIED:* | 3/8/2017 4:41 AM | |

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| Use the following pairs, i-iii, to answer the next **two (2)** questions:  ​                                      Pair     i) Al and Si           ii) Ar and Br        iii) F and I |

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| 181. Which element in each pair has the **more negative** electron affinity?  ​  Pair:i)            ii)             iii)   |  |  |  | | --- | --- | --- | |  | a. | Al             Ar             I | |  | b. | Si             Ar             F | |  | c. | Al            Br              I | |  | d. | Si             Br              F | |  | e. | Si             Br              I |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Electron Affinity and Atomic radii | | *DATE CREATED:* | 3/8/2017 4:42 AM | | *DATE MODIFIED:* | 3/8/2017 5:06 AM | |

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| 182. Which element in each pair has the **larger** atomic radii?  ​  Pair:i)          ii)            iii)   |  |  |  | | --- | --- | --- | |  | a. | Si            Ar           F | |  | b. | Al           Br            I | |  | c. | Al           Ar            I | |  | d. | Si            Br            F | |  | e. | Al           Ar            F |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Electron Affinity and Atomic radii | | *DATE CREATED:* | 3/8/2017 5:07 AM | | *DATE MODIFIED:* | 3/8/2017 5:11 AM | |

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| 183. **A paramagnetic substance has unpaired electrons and a substance with no unpaired electrons is a diamagnetic substance.** Using these definitions, which of the following statements, I-IV, is/are **true** about the element, Hg?  I.  Hg is paramagnetic.  II. f orbitals are filled in the electron configuration of Hg.  III. A Hg atom has 5 unpaired electrons.  IV. The electron configuration of Hg is [Xe] 6s24f145d10.   |  |  |  | | --- | --- | --- | |  | a. | II and IV only | |  | b. | IV only | |  | c. | I and II only | |  | d. | I and III only | |  | e. | II only |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 5:11 AM | | *DATE MODIFIED:* | 3/8/2017 5:13 AM | |

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| 184. The table below gives the number of the stated subatomic particles present in seven species, A, D, E, G, J, L and M. All species are in their ground state. Based on the information provided below, which of the following statement(s), I-V, is/are **false**?  ​  **Species**      A        D         E         G        J          L          M  ​  **# e-**            10         26        18        18        54        28        82  **# p+**           10        28        19        17        52        29        82  **# n0**           11         31        20        18        76        35       125  ​  I.  Species E is an ion of an alkaline earth metal.  II. Four of these species listed are ions of transition metals.  III. Species J is an anion of the f block element, terbium.  IV. The short-hand electron configuration of species G is [Ne]3s23p6.  V. Three of these species are ions or atoms of elements of the p block.   |  |  |  | | --- | --- | --- | |  | a. | IV only | |  | b. | I, II, III and V only | |  | c. | I and IV only | |  | d. | III and V only | |  | e. | I-V |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 5:15 AM | | *DATE MODIFIED:* | 3/8/2017 5:17 AM | |

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| 185. Which of the following electron configurations, I-IV, represents an excited state?  I.   [He]2s12p5  II.   [Kr] 5s24d105p1  III. [Ar] 4s23d104p5  IV. [Ne]3s23p24s1   |  |  |  | | --- | --- | --- | |  | a. | I only | |  | b. | II and III only | |  | c. | III only | |  | d. | I-IV | |  | e. | I and IV only |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 5:18 AM | | *DATE MODIFIED:* | 3/8/2017 5:23 AM | |

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| 186. Which of the following statements, I-V, is/are **true**?  I. The short-hand electron configuration of Cu+ is [Ar]3d10.  II. The following combination of quantum numbers is valid:   |  |  |  |  | | --- | --- | --- | --- | | n | l | ml | ms | | 1 | 0 | -1 | ​ |   III. The 3s orbital of a hydrogen atom in ground state is lower in energy than any of its 3p orbitals.  IV. Only two electrons in an atom can have the quantum numbers, n = 4 and l = 0.   |  |  |  | | --- | --- | --- | |  | a. | I only | |  | b. | II and III only | |  | c. | I-III only | |  | d. | I and IV only | |  | e. | II only |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 5:24 AM | | *DATE MODIFIED:* | 3/8/2017 5:41 AM | |

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| 187. Which of the following orbital energy-level diagrams, I- V, is/are correct for nitrogen if an atom of nitrogen is in an excited state?   |  |  |  | | --- | --- | --- | |  | a. | I-V (All of them) | |  | b. | V only | |  | c. | II-IV only | |  | d. | III and IV only | |  | e. | None of the above |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *DATE CREATED:* | 3/8/2017 5:43 AM | | *DATE MODIFIED:* | 3/8/2017 7:02 AM | |