Chemistry 1A Fall 2017

Name_____ Student ID _____

Exam 1

You will have 120 minutes to complete this exam. Please fill in the bubble that corresponds to the correct answer on the answer sheet. Only your answer sheet will be graded.

Each question has only 1 correct answer unless otherwise specified in the question. You are allowed to use the provided equation sheet and periodic table to help you answer the questions.

While all questions have been taken from the online database, specific details such as an element or number may have been changed and answers may have been switched around. Please read each question carefully.

Good luck!!

1. How many grams of water are formed when a 10 g sample of acetylene (C_2H_2) burns in excess oxygen (O_2)?

   A) 5 g B) 7 g C) 10 g D) 18 g E) 20 g

2. When the reaction for the decomposition of two moles of silver carbonate is balanced, what is the stoichiometric coefficient for carbon dioxide (CO_2)?

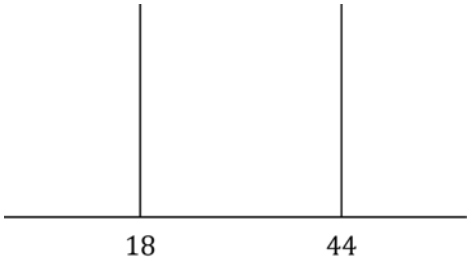
   $2\ Ag_2CO_3 \dashrightarrow \_\_\ Ag + \_\_\ CO_2 + \_\_\ O_2$

   A) 0 B) 1 C) 1.5 D) 2 E) 3

3. Which of the following statements is true for chemical reactions?

   A) The number of moles of products is the sum of the moles of reactants.
   B) Total mass is conserved between products and reactants.
   C) The number of moles is conserved between products and reactants.
   D) The number of molecules is constant.
   E) None of these.

4. Which is the formula of a compound whose combustion products give the following mass spectrum?



   A) C_2H_2O B) C_3HO_2 C) $C_6H_8O_6$ D) $C_6H_{12}O_4$ E) $C_7H_5O_2$

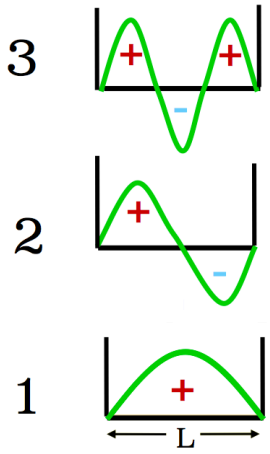
5. What is the frequency (in Hz) of an electromagnetic wave of wavelength 5000 nm?

   A) 5.00×10^{10} Hz B) 6.00×10^{13} Hz C) 7.00×10^{15} Hz
   D) 8.00×10^{17} Hz E) 9.00×10^{23} Hz

6. Which molecule or ion will have the lowest ionization energy?

   A) $H(2p^1)$ B) $He(1s^13p^1)$ C) $Li(1s^24p^1)$
   D) $Be(1s^22s^15p^1)$ E) $B(1s^22s^26p^1)$

7. For a particle in a box with the energies corresponding to the following wavefunctions:



Which absorption $n_i \rightarrow n_f$ requires the highest energy photon? (ChemQuiz 5.2).

A) 1 → 2 B) 2 → 3 C) 3 → 1

8. Which of the following objects has the longest de Broglie wavelength when all are traveling at the same velocity?

A) Bowling ball (2 kg) B) Golf ball (50 g) C) Ping pong ball (1 g)
D) Baseball (105 g) E) Basketball (1500 g)

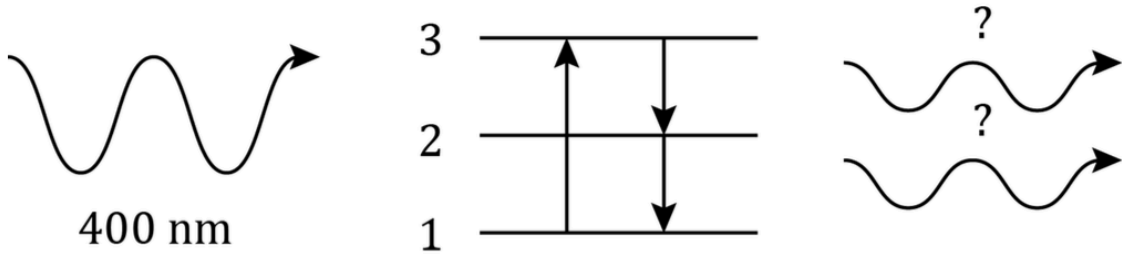
9. Hydrogen has two stable isotopes, ^{1}H and ^{2}H, and carbon has two stable isotopes, ^{12}C and ^{13}C. Which isotopic species of methane (CH_4) will give a peak at mass 18 in a mass spectrometer?

A) $^{12}C^{1}H_4$ B) $^{12}C^{1}H_2{}^{2}H_2$ C) $^{13}C^{1}H^{2}H_3$ D) $^{12}C^{1}H^{2}H_3$ E) $^{13}C^{2}H_4$

10. Light of 450 nm wavelength will eject electrons from a metal sample. Which also must be true?

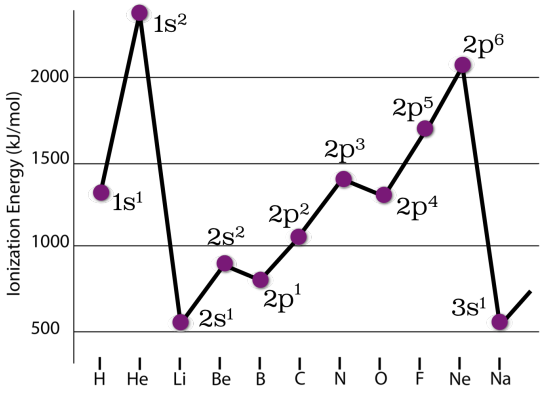
A) Light of 500 nm will also eject electrons
B) Light of 400 nm will also eject electrons
C) 450 nm light of greater intensity will eject electrons with greater velocity
D) 600 nm light will eject electrons provided the intensity is great enough.
E) None are true

11. A photon of blue light with a wavelength of 400 nm splits into two identical photons. Knowing that energy is conserved, what is the wavelength of each of these two photons?



A) 200 nm B) 283 nm C) 400 nm D) 566 nm E) 800 nm

12. Based on the trends in the figure below, which atom has the highest ionization energy?(ChemQuiz 9.2)



A) Cl B) Ar C) K

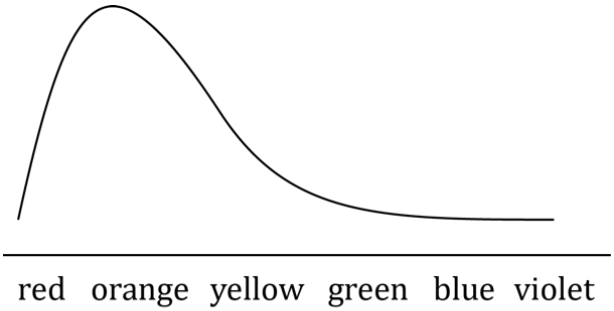
13. How much energy is required (in joules) to ionize the hydrogen atom?

A) 3.3×10^{-15} J B) 2.2×10^{-18} J C) 6.6×10^{-10} J
D) 2.1×10^{-17} J E) 4.3×10^{-20} J

14. Which transition in He^+ corresponds to the same energy difference as n = 2 to n = 1 in H?

A) 2 to 1 B) 3 to 1 C) 4 to 1 D) 4 to 2 E) 4 to 3

15. Which color does an orange solution appear to be when viewed through a filter with absorption profile shown here?



A) Clear B) Green C) Blue D) Black E) We can't tell

16. Which atom has the greatest number of neutrons?

A) ^{27}Al B) ^{28}Si C) ^{32}S D) ^{32}P E) ^{35}Cl

17. Which best describes the atomic structure of the $^{56}Fe^{2+}$ ion?

A) 56 electrons, 56 neutrons, 56 protons
B) 2 electrons, 56 neutrons, 56 protons
C) 24 electrons, 30 neutrons, 26 protons
D) 26 electrons, 30 neutrons, 26 protons
E) 26 electrons, 28 neutrons, 28 protons

18. Which of the following is a valid set of quantum numbers for an electron in a 3d orbital?

A) $m_\ell=0$, $\ell=2$, n=3 B) $m_\ell=3$, $\ell=3$, n=3 C) $m_\ell=1$, $\ell=3$, n=2
D) $m_\ell=-1$, $\ell=1$, n=3 E) $m_\ell=3$, $\ell=2$, n=3

19. Which neutral atom could have the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^4 4s^1$?

A) K B) Cl C) Na D) Rb E) S

20. What is the charge on a Boron ion with 7 electrons?

A) -2 B) -1 C) 0 D) 1 E) 2

21. Which orbital listed below has the greatest number of radial nodes?

A) 1s B) 2p C) 3s D) 4d E) 5f

22. For which species does the energy level n = 1 have an energy of $-9R_\infty$?

A) H B) He^+ C) Li^{2+} D) Be^{3+} E) B^{4+}

23. Which ion has the ground state electronic configuration of $[Ar]3d^5$?

A) V^{3+} B) Mn^{2+} C) Cu^+ D)Co^{2+} E) Tc^{2+}

24. Which compound has the highest percentage of chlorine by mass?

A) HCl B) KCl C) $MgCl_2$ D) $BaCl_2$ E) $AlCl_3$

25. Relative to an electron's energy level in an atom, which condition represents zero energy?

A) The electron and nucleus infinitely separated.
B) The ground state.
C) The nucleus.
D) There is no zero point in the electronic energy level scheme.
E) None of these.

26. Which neutral atom in its ground state is paramagnetic?

A) He B) Ar C) Ca D) Mg E) C

27. Which is the proper ordering of the following elements from lowest ionization energy to highest?

A) Ar, S, Si, Mg, Na
B) Mg, S, Si, Na, Ar
C) S, Ar, Si, Na, Mg
D) Mg, Na, Ar, S, Si
E) Na, Mg, Si, S, Ar

28. Which species has the highest ionization energy?

A) Br^- B) Kr C) Sr^{2+} D) Rb^+ E) Se^{2-}

29. Which of the following has the largest atomic radius?

A) Li B) C C) As D) Br E) K

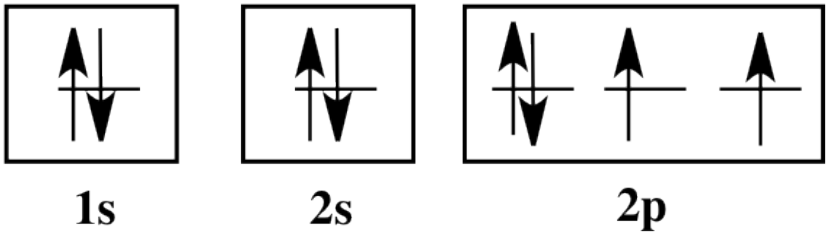
30. Cadmium hydroxide contains 76.77% cadmium by mass. What is the empirical formula of cadmium hydroxide? (Atomic masses: Cd: 112.41 g/mol, H: 1.01 g/mol, O: 16.00 g/mol)

A) CdOH B) $Cd(OH)_2$ C) $Cd(OH)_3$ D) $Cd(OH)_4$ E) $Cd(OH)_5$

31. How much energy is released (in Rydbergs) when a He^+ ion relaxes from its 2p state to its 1s state?

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

32. The electron configuration for oxygen is shown below. What are possible quantum numbers for the last electron added?



A) n = 2, ℓ = 0, m_ℓ = 0, m_s = 1/2

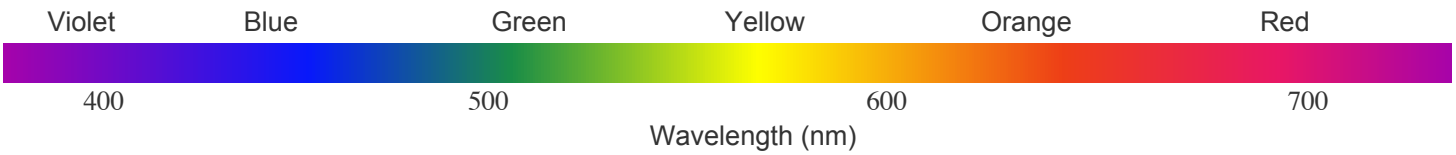
B) n = 3, ℓ = 1, m_ℓ = 0, m_s = -1/2

C) n = 2, ℓ = 0, m_ℓ = 2, m_s = 1

D) n = 2, ℓ = 1, m_ℓ = -1, m_s = -1/2

E) n = 1, ℓ = 0, m_ℓ = 0, m_s = 1/2

Potentially Useful Information



Light: $\lambda\nu = c$, $E_{photon} = h\nu$, c = 2.99792 x 10^{8} m s^{-1}

Photoelectric Effect: $KE_{electron} = h\nu - \Phi = h\nu - h\nu_0$

Matter: $p = mv$, $E_{kin} = \frac{1}{2}\,mv^2 = \frac{p^2}{2m}$

Wave/Matter: $\lambda_{deBroglie} = \frac{h}{p}$

Particle 1D box: $E_n = \frac{h^2 n^2}{8mL^2}$; n = 1, 2, 3...

H atom, 1-electron ion: $E_n = -\left(\frac{Z^2}{n^2}\right)R_\infty$; n = 1,2,3…

Orbital Nodes: Total = n – 1, Angular = ℓ, Radial = n – 1 – ℓ

N_A = 6.02214 x 10^{23} mol^{-1}

h = 6.62608 x 10^{-34} J s

$\mathcal{R}$ = 3.28984 x 10^{15} Hz

$R_\infty = h\mathcal{R}$ = 2.17987 x 10^{-18} J ≡ 1312 kJ/mol

m_e = 9.10938 x 10^{-31} kg

J = $\frac{kg\ m}{s^2}$

	H	Na	K	Rb	Cl	Br	I
Ionization Energy [IE] (kJ/mol)	1312	496	419	403	1251	1140	1008
Electron Affinity [EA] (kJ/mol)	73	53	48	47	349	325	295

You may verify that the IE of atomic H corresponds to UV light with a photon wavelength of 91 nm.

Name _____ Student ID _____

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Question 2
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Question 3
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Question 4
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Question 5
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Question 6
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