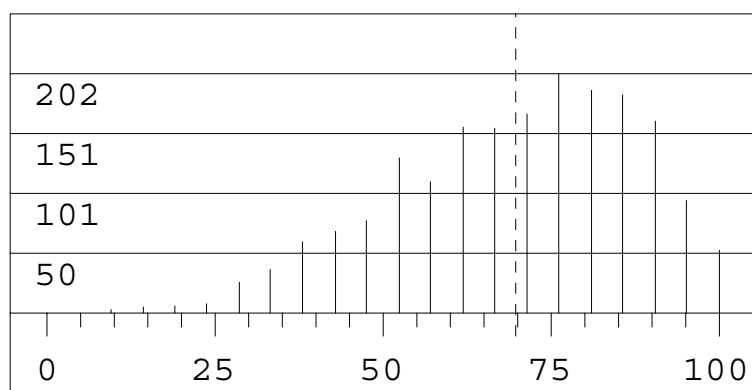


Please use these answers constructively and learn from them. If you are not sure why an answer is the correct answer, it is recommended that you go through your workbook and find the relevant concepts that are involved. If you still cannot figure it out, please visit the Resource Room for assistance.

Stats: mean = 69.7%, median = 71.4%, min = 9.5%, max = 104.8%. The distribution (histogram) is shown in the space below Question 1. Note that out of fairness to all students, Chem 1100a does not "curve" or "bell" marks. Such a practice would result in some students (those at the lower end of the histogram) getting a larger increase than others, and some students (those at the upper end) possibly getting a decrease.

1. What mass of NaN_3 contains 10.0 moles of nitrogen atoms?

- A) 217 g 1 mol NaN_3 has 3 mol N
B) 195 g so need 3.33 mol NaN_3
C) 434 g
D) 140 g 3.33 mol \times 65.02 g/mol
E) 650 g = 217 g



2. Sucrose, the compound found in table sugar, consists of carbon, hydrogen, and oxygen. If the mole percent of carbon in sucrose is 26.7%, what could be the empirical formula of sucrose?

- A) $\text{C}_{0.27}\text{HO}$ 26.7% of the total
B) $\text{C}_{27}\text{H}_{100}\text{O}_{100}$ number of moles is carbon
C) CH_4O_4
D) $\text{C}_9\text{H}_{36}\text{O}_{36}$
E) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ 12 of 45 is 26.7%

3. The percent abundance of deuterium (^2H) in naturally occurring hydrogen is 1.4×10^{-2} atom %. How many grams of deuterium are present in one mole of $\text{C}_6\text{H}_{12}\text{O}_6$?

A) 3.4×10^{-3}

B) 2.8×10^{-4}

C) 1.7×10^{-3}

D) 1.4×10^{-3}

E) 1.7×10^{-1}

- 1 mol of $\text{C}_6\text{H}_{12}\text{O}_6$ has 12 mol H

- 0.014% of the 12 mol of H is ^2H

$\therefore 0.00168 \text{ mol } ^2\text{H}$

- ^2H has a mass number of 2, so 0.00168 mol ^2H has a mass of approx.

0.0034 g

4. A solution of phosphoric acid, H_3PO_4 (97.99 g mol^{-1}), is 26.0% H_3PO_4 by mass and has a density of 1.153 kg L^{-1} . How many mL of 0.100 M NaOH are required to completely neutralize 10.0 mL of the phosphoric acid solution?

A) 1508

B) 306

C) 102

D) 918

E) 13575

- one mL of solution weighs 1.153g, so we have 11.53g of solution

- 26.0% of the 11.53g is H_3PO_4 , so we have 3.00g H_3PO_4

\therefore moles of $\text{H}_3\text{PO}_4 = 0.0306$

- H_3PO_4 is triprotic, so we'll need 0.0918 mol of NaOH

- the conc of NaOH is 0.1 M, so we'll need 918 mL

5. What is the maximum mass of NH_3 that could be produced from 5.00 g of N_2 and 0.500 g of H_2 ?

A) 1.41 g

B) 2.82 g

C) 8.45 g

D) 6.34 g

E) 6.08 g

← 0.2480 mol

↑ 0.1784 mol



- we need 3 H_2 for every N_2 ,
so H_2 is the limiting reagent

- every 3 H_2 gives 2 NH_3 , so we'll
get two-thirds the amount of NH_3

∴ 0.1653 mol NH_3

∴ 2.82 g

6. Consider this reaction: $2\text{A} + \text{B} \rightarrow \text{C}$

0.75 mol of A were reacted with 0.50 mol of B to obtain 0.25 mol of C. What was the percent yield of the reaction?

A) 50

B) 20

C) 33

D) 67

E) 17

- for every B, we need 2 A

∴ A is the limiting reagent

- 0.75 mol A should give 0.375 mol C,
but we only made 0.25 mol C

∴ 67%

7. When 1.68 g of a compound containing only C, N, and S are burned in excess oxygen, 1.76 g of CO_2 are produced. In another experiment, 0.561 g of the same compound are burned in excess oxygen, and the sulfur present is converted into 1.56 g of BaSO_4 . What is the empirical formula of the compound?

A) CNS_2

B) CNS

C) $\text{C}_2\text{N}_2\text{S}$ D) CN_2S E) C_2NS

- 1.68 g of sample gave 0.04 mol CO_2

∴ 1.68 g of sample contains

0.04 mol C, so 0.480 g C

- 0.561 g of sample gave 0.00668 mol BaSO_4

∴ 0.561 g of sample contains

0.00668 mol S, so 0.214 g S

- this tells us that 38.2% of the sample is S by mass

- so, 0.642 g of the 1.68 g sample must be S (i.e. 0.0200 mol S)

- the balance of $1.68\text{g} - 0.642\text{g} - 0.480\text{g} = 0.558\text{g}$ is N (i.e. 0.0400 mol N)

$\text{C}_{0.04}\text{N}_{0.04}\text{S}_{0.02}$

8. A solution of HCl has a pH of 2.50. How many grams of HCl are present in 1 L of the solution?

A) 91.1

B) 0.00325

C) 0.115

D) 2.50

E) 14.5

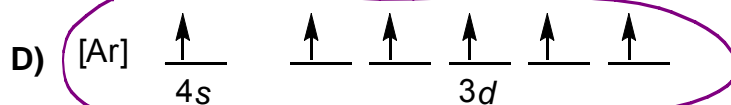
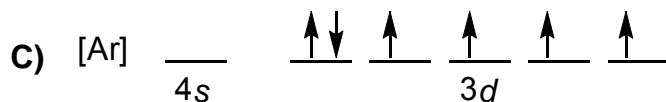
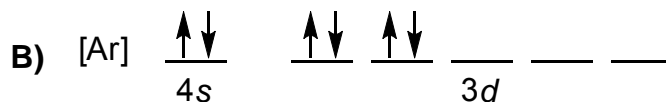
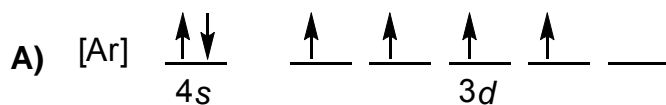
$$[\text{H}^+] = 10^{-2.50} = 0.00316 \text{ mol/L}$$

∴ 0.00316 mol of HCl in 1 L

∴ 0.115 g HCl in 1 L

9. Which one of the following types of electromagnetic radiation has the shortest wavelength?
- A) Radio
 B) Infrared
 C) Visible
 D) Microwave
 E) **Ultraviolet**
10. The Bohr model of the hydrogen atom explains only which one of A – E?
- A) The magnetic properties of electrons.
 B) The relative intensities of the lines in the emission spectrum of hydrogen.
 C) The wave behavior of electrons.
 D) The fine structure in the emission spectrum of hydrogen.
 E) **The positions of the lines in the emission spectrum of hydrogen.**
11. How many of the following statements regarding the 2s orbital are correct?
- It has ~~two~~ ^{one} spherical (radial) nodes.
 - It has quantum numbers $n = 2, l = 0, m_l = 0$. ✓
 - It has one nodal plane. ~~X~~ ^{spherical (radial) node}
 - It holds a maximum of two electrons. ✓
 - The entire orbital is in the same phase. ~~X~~ ^{2 phases}
- A) **2**
 B) 4
 C) 3
 D) 1
 E) 5
12. How many nodes are present in the wavefunction Ψ_{54-2} ?
- A) 5
 B) **4**
 C) 3
 D) 2
 E) 7
- $n = 5$
 $\therefore 4$ nodes

17. Which one of the following is the correct orbital diagram for a ground-state Cr atom?



E) None of the above

18. Which one of A – E is isoelectronic with Zn^{2+} ? All species are in the ground state.



- A) Ni $[\text{Ar}] 4s^2 3d^8$
 B) Cd^{2+} $[\text{Kr}] 4d^{10}$
 C) Cu^+ $[\text{Ar}] 3d^{10}$ ✓
 D) Ga^+ $[\text{Ar}] 4s^2 3d^{10}$
 E) None of the above

(C) is the correct answer based on the definition of isoelectronic that is found in the workbook. Because some students had learned elsewhere that isoelectronic can also mean "same number of electrons," which is also valid definition, (A) was also accepted and has been reflected in the marking.

19. Choose the answer that best explains, in general, why atomic size increases when going down a group, and why atomic size decreases when going across a period from left to right.

	Going down	Going across, left to right
A)	Electron affinity becomes more favourable.	Ionization energy decreases
B)	Electronegativity decreases	Ionization energy increases
C)	Ionization energy increases	Electron affinity becomes less favourable
D)	Z^* decreases	p orbitals are occupied
E)	Orbitals with higher principal quantum numbers are occupied	Z^* increases

20. Based on periodic trends, how many of the following statements are correct?

- Mg^{2+} has a larger radius than Be^{2+} . ✓
- Br has a ~~lower~~ ^{higher} electronegativity than Te. ✗
- Rb has a ~~more~~ ^{less} favourable electron affinity than Sr. ✗
- In terms of size, $\text{H}^- > \text{He} > \text{He}^+ > \text{H}^+$. (see in-class exercise)

- A) 2
 B) 4
 C) 3
 D) 1
 E) None

Based strictly on periodic trends, this would not be correct. Yet, H^+ is the smallest because it doesn't have any electrons. Answers 1 + 2 were accepted and have been reflected in the marking.

21. Which statement best explains why the first ionization energy of $\text{O}(\text{g})$ is lower than that of $\text{N}(\text{g})$?

- A) O has a higher Z^* than N.
 B) O has a higher electronegativity than N.
 C) The electrons in O experience more repulsion than those in N.
 D) All electrons in O have the same spin, but those in N do not.
 E) O has more protons than does N.

22. BONUS QUESTION

Suppose that because you'll be attending a university-sanctioned event, you will not be able to write your tutorial quiz. What should you do?

- A) Contact your instructor to reschedule your tutorial.
 B) Contact your tutorial TA to make alternate arrangements to write the quiz.
 C) Contact your instructor to make arrangements to complete an online version of the quiz.
 D) Go to Student Accounts, pay the re-write fee, and then make arrangements with your instructor to write the quiz.
 E) Submit documentation to your Dean's Office.

Final check... make sure that you have:

- Accurately indicated your answers and student number on the Scantron
- Correctly and completely filled in the Scantron bubbles (see the example on the Scantron) using an HB pencil

End of test. Solutions and marks will be posted after the tests have been marked and statistical analyses have been performed.