

Exam 1 Key: This is form A/J. All other forms of the exam are scrambled versions of this form.

Each question is worth 4 points. Choose the BEST answer for each question.

1. Which of the following is equivalent to 0.002100 ? *Note: 0.2 is 2×10^{-1}
0.02 is 2×10^{-2}
0.002 is 2×10^{-3}*
- a. 2.1×10^3
 - b. 2.10×10^4
 - c. 2.10×10^{-3} *only 3 sig figs*
 - d. 2.100×10^{-3} *4 sig figs*
 - e. 2.100×10^{-4}
2. The elements tin, titanium, tantalum and thallium are represented respectively by the symbols: *Sn Ti Ta Tl*
- a. Ti, Tm, Ta, Th
 - b. Sb, Ti, Tl, Tm
 - c. Sn, Ti, Tl, Th
 - d. Sn, Ti, Ta, Tl
 - e. W, Tc, Tl, Hg
3. How many nonmetal atoms are there in the formula: NaH_2PO_4 ? *metal*
- a. 1
 - b. 2
 - c. 4
 - d. 6
 - e. 7 *2 H atoms
1 P atom
4 oxy atoms
7 non metal atoms*
4. Which is a transition metal?
- a. iron *Fe*
 - b. iodine
 - c. indium
 - d. selenium
 - e. antimony
5. Which of the following elements is misspelled?
- a. scandium
 - b. vanadium
 - c. tellerium *tellurium*
 - d. iridium
 - e. lanthanum
6. Which pair (group and valence shell electron configuration) contains an error?
- a. noble gas, ns^2np^6
 - b. alkali metal, ns^1
 - c. group 5A, np^5 *(group 5A)
ET N $1s^2 2s^2 2p^3$
 $ns^2 np^3$*
 - d. halogen, ns^2np^5
 - e. alkaline earth metal, ns^2

7. The symbols Ar, Ni and Si are:
- argon, nitrogen and silver
 - gold, nickel and silver
 - arsenic, niobium and silicon
 - d.** argon, nickel and silicon
 - arsenic, nitrogen and silver

nitrogen is N
 silver is Ag
 arsenic is As
 niobium is Nb
 gold is Au

8. Which of the following describes a chemical change?
- new materials are formed ✓
 - the change is reversible
 - the change is not reversible ✓
 - a and b
 - e.** a and c

9. How many protons are in an isotope of strontium that has 50 neutrons?

- 50
- 87
- 36
- d.** 38
- 12

(all isotopes of strontium have 38p
 The number of protons in the nucleus
 "defines the element")

10. What is the approximate mass in amu of 33 atoms of gold-203?

- 5200 amu
- b.** 6700 amu
- 1.1×10^{-19} amu
- 1.1×10^{-20} amu
- 1.0×10^{-23} amu

$$(33 \text{ atoms}) \left(\frac{203 \text{ amu}}{203 \text{ Au atom}} \right) = 6700 \text{ amu}$$

^{203}Au $79p \Rightarrow \sim 1 \text{ amu each}$
 $124n \Rightarrow \sim 1 \text{ amu each}$
 203 amu

11. Identify the physical change (or changes) in the following list.

- diluting bleach with water ✓
- explosion of gasoline in an automobile engine
- making rock candy by evaporating water from a sugar solution ✓
- a and b
- e.** a and c

12. Which of the following has exactly 4 significant figures?

- a.** 5.050×10^7
- 9.7001 **5**
- 0.0020 **2**
- 0.15510 **5**
- 3510 **3**

13. A compound is a liquid at 250°F. Which of the following could be the correct melting point and boiling point for this material?
- a. 0°C and 100°C *gas*
- b. 390°C and 840°C *solid*
- c.** 100°C and 212°C *liquid*
- d. -20°C and 120°C *gas*
- e. 130°C and 180°C *solid*
- convert to °C*
- given: $F = (1.8 \times C) + 32$
- algebra $\left\{ \begin{aligned} F - 32 &= 1.8 \times C \\ \frac{F - 32}{1.8} &= C \end{aligned} \right.$
- $^{\circ}\text{C} = \frac{F - 32}{1.8}$
- $^{\circ}\text{C} = \frac{250 - 32}{1.8} = 121^{\circ}\text{C}$

14. Sodium and lithium have similar chemical properties because
- a. sodium ion and lithium ion are isoelectronic.
- b.** they have the same number of valence electrons.
- c. they are both alkali earth metals *alkali metals*
- d. a and b *yes both ns'*
- e. b and c
- Na and Li group 1A \Rightarrow both are alkali metals*

15. A piece of lead floats when it is dropped into a pool of mercury. This means that
- a.** the density of lead is less than the density of mercury.
- b. the density of lead is less than one.
- c. the atomic weight of lead is less than the atomic weight of mercury.
- d. the density of lead is less than the specific gravity of lead.
- e. the specific gravity of lead is greater than the specific gravity of mercury.

16. Elements that have one, two or three valence electrons are likely
- a.** metals. *ex) oxygen 6 val e*
- b. nonmetals. *ex) Na 1s²2s²2p⁶3s¹ 1 val e*
- c. nearly inert. *noble gases (8 val e)*
- d. liquids at room temperature. *Ca 1s²2s²2p⁶3s²3p⁴ 2 val e*
- e. gases at room temperature. *Al 1s²2s²2p⁶3s²3p¹ 3 val electrons*

17. What is the subatomic particle that has a positive charge and a mass of approximately 1 amu?
- a. electron *neg charge - small mass*
- b.** proton
- c. neutron *neutral - 1 amu*
- d. protium
- e. deuterium
- not "subatomic" particles*
- *these are names for particular isotopes of H.*

18. Which of the following would be described as a heterogeneous mixture?
- a. air, a mixture of O_2 , N_2 , CO_2 and other gases
- b. propane gas, C_3H_8
- c. 95% ethyl alcohol ($\text{C}_2\text{H}_6\text{O}$ dissolved in water)
- d. elemental sulfur, S_8
- e.** none of the above
- all are homogeneous*
- \hookrightarrow "same throughout"*

19. The density of air is 1.185×10^5 cg/kL. Express this density in mg/L.
- (centi means 10^{-2}
milli means 10^{-3}
kilo means 10^3)
- a. 1.185×10^{-5} mg/L
 b. 1.185×10^{-3} mg/L
 c. 1.185×10^{-2} mg/L
 d. 1.185 mg/L
 e. 1185 mg/L
- Handwritten solution:*
 $(1.185 \times 10^5 \frac{cg}{kL}) \left(\frac{1k}{10^3g} \right) \left(\frac{10^3mg}{g} \right) \left(\frac{1kL}{10^3L} \right) = 1185 \frac{mg}{L}$
 or $(\frac{10^{-2}g}{1cg}) \left(\frac{1mg}{10^{-3}g} \right)$

20. How much heat (in kcal) is released when 125 g of water cools from 90.0°C to 9.5°C ? (Note: the specific heat value for water is $1.0 \text{ cal/g}^\circ\text{C}$.)
- $\Delta T = 80.5^\circ\text{C}$
- a. 0.644 kcal
 b. 1.55 kcal
 c. 12.5 kcal
 d. 2.44 kcal
 e. 10.1 kcal
- Handwritten solution:*
 $q = m c \Delta T$
 $q = (125g) \left(\frac{1.0 \text{ cal}}{g^\circ\text{C}} \right) (80.5^\circ\text{C}) = 10,062.5 \text{ cal}$
 which is approx. 10.1 kcal
 Note: 1000 cal/kilocal

21. Alkali metals
- a. react violently with water. ✓
 b. form 1:1 compounds with halogens. ✓
 c. have one valence electron. ✓
 d. all of the above
 e. none of the above

22. A certain isotope has 17 protons, 18 neutrons, and 18 electrons. The correct symbol for this is:
- a. ^{35}Ar
 b. $^{35}\text{Cl}^-$
 c. $^{17}\text{Cl}^-$
 d. $^{36}\text{K}^{2-}$
 e. $^{53}\text{I}^-$
- Handwritten notes:*
 defines the element as chlorine.
 $17p18e$ $^{35}\text{Cl}^-$ mass # = 35 $17p18n$
 $17+18-$
 -1 charge

23. How many micrograms are in a kilogram?
- a. 10^9
 b. 10^{-9}
 c. 10^{-6}
 d. 10^6
 e. 10^3
- Handwritten solution:*
 kilo- means 10^3 micro- means 10^{-6}
 therefore $10^9 \frac{\mu\text{g}}{\text{g}}$
 $(1kg) \left(\frac{1000g}{kg} \right) \left(\frac{10^6 \mu\text{g}}{g} \right) = 10^9 \mu\text{g}$
 $1kg \text{ is } 10^9 \mu\text{g}$

24. How many significant figures are in the result when you add the following together?
 $44.500 \text{ g} + 400. \text{ g} + 5.5 \times 10^{-2} \text{ g}$

a. 1
 b. 2
 c. 3
 d. 4
 e. 5

Handwritten solution:

$$\begin{array}{r} 44.500 \\ 400. \\ \hline 444.555 \end{array}$$

 0.055
 3 sig figs 445
 Note: 400. is uncertain in the ones place.
 * The answer will also be uncertain in the ones place.

25. Which has more neutrons than electrons?

- a. $^{32}_{16}\text{S}^{2-}$ 16n 18e
- b. $^{38}_{19}\text{K}$ 19n 19e
- c. $^{31}_{15}\text{P}^{3-}$ 16n 18e
- d.** $^{24}_{12}\text{Mg}^{2+}$ 12n 10e
- e. ^9_5B 4n 5e

26. Antimony is a _____ that has _____ valence electrons.

- a. metal, 3
- b. nonmetal, 3
- c. metalloid, 4
- d. nonmetal, 5
- e.** metalloid, 5

antimony is Sb
group 5A \Rightarrow 5 valence electrons.

27. Which is the correct electron configuration for an uncharged selenium atom in the ground state?

- a. $[\text{Ar}]3s^23d^{10}3p^4$
- b. $[\text{Ar}]4s^24d^{10}4p^4$
- c.** $[\text{Ar}]4s^23d^{10}4p^4$ ✓
- d. $1s^22s^22p^63s^23p^64s^23d^{10}4p^6$
- e. $1s^22s^22p^63s^23p^64s^24d^{10}4p^6$

neutral Se
34p and 34e

28. Which represents the electron configuration of a neutral sodium atom in an excited state?

- a. $[\text{He}]2s^22p^63s^13p^1$ 12e
- b. $1s^22s^22p^6$ 10e
- c. $1s^22s^22p^33s^1$ 10e
- d.** $[\text{Ne}]3p^1$
- e. $[\text{Ne}]3s^2$ 12e

Na 11e not the ground state
g.s. would be $1s^22s^22p^63s^1$
Note: choices a and c are excited states but have the wrong # of electrons.

29. A liquid sample has a density of 1.3 g/mL. What is the volume occupied by 10. g of this liquid?

- a.** 7.7 mL
- b. 10. mL
- c. 13 mL
- d. 0.077 mL
- e. 1.3×10^{-2} mL

$$D = \frac{m}{V} \text{ algebra } \rightarrow V = \frac{m}{D}$$

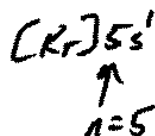
$$V = \frac{10. \text{g}}{1.3 \text{g/mL}} = 7.6923 \text{ mL}$$

only 2 sig figs
7.7 mL

30. The valence shell for a neutral atom of rubidium is n = _____.

- a. 2
- b. 3
- c. 4
- d.** 5
- e. 6

Rb
5th row, s-block
n = 5



31. Which could be represented by the following electron configuration? *7 electrons*
 $1s \uparrow\downarrow \quad 2s \uparrow\downarrow \quad 2p \uparrow \uparrow \uparrow \quad 3s _$ *This is a ground state*
- a. a carbon atom in an excited state *C would be 6e*
b. a nitrogen atom in the ground state *neutral N atom 7p 7e*
 c. a phosphorus atom in the ground state *P would be 15e*
 d. an oxygen ion in an excited state *Oxy would be 8e*
 e. a fluorine atom that has gained two electrons *if F gained 2e it would have 11e*

32. Put the following types of electromagnetic radiation in order of increasing energy.
 I: orange light II: UV radiation III: red light IV: microwaves
- a. IV < I < II < III
b. IV < III < I < II *low E → higher E*
 c. I < IV < III < II
 d. III < IV < I < II
 e. II < I < III < IV
- micro IR ROYGBIV UV*
IV III I II

33. Which of the following sets of isotopic abundance data does NOT make sense based on the atomic weights listed in the periodic table for these elements?
atomic wt. PT
- a. vanadium-50, 0.25% and vanadium-51, 99.75% *50.942*
 b. bromine-79, 50.7% and bromine-81, 49.3% *79.904*
c. lithium-6, 72.3% and lithium-7, 27.7% *6.941*
 d. neon-20, 90.5% and neon-22, 9.5% *20.180*
 e. boron-10, 19.8% and boron-11, 80.2% *10.810*
- * See your class notes and p 46-47 in your text.*
⁶Li 72% } would lead to an atomic weight less than 6.5
⁷Li 28%

34. Which have the following electron configuration? $1s^2 2s^2 2p^6 3s^2 3p^6$
 a. S and Cl
 b. K^+ and P^{3-} *Yes*
 c. Ar and Ca^{2+} *Yes*
 d. a and b
e. b and c
- 18e [Ar]*

K^+	P^{3-}	Ar	Ca^{2+}
19p	15p	18p	20p
18e	18e	18e	18e

all have 18e

35. A polonium atom that has gained 2 electrons has the same number of electrons as:
 a. a neutral atom of lead *82e*
 b. a neutral atom of radium *88e*
c. an atom of radium that has lost 2 electrons *Ra²⁺*
 d. an atom of barium that has lost 2 electrons *54e*
 e. an atom of astatine that has lost 1 electron *84e*
- Po when neutral: 84p 84e*
if it gains 2e 84p 86e
↓
isoelectronic w/ Rn radon

36. Convert 6.0 pints to nanoliters. (Note: 1 pint = 0.473 L)
- a. 2.8×10^{-9} nL
b. 2.8×10^9 nL *(6 pints) (0.473 L / pint) (10⁹ nL / L) = 2.8 x 10⁹ nL*
 c. 7.1×10^8 nL
 d. 1.3×10^8 nL
 e. 1.3×10^{-8} nL

37.

Which of the following is equivalent to the volume of a cube that is 100 cm on each side?

Note: $1\text{cm}^3 = 1\text{mL}$
(on front of exam)

Note: The volume of a cube is length \times width \times height.

$$(100\text{cm})^3 = 1 \times 10^6 \text{cm}^3 = 1 \times 10^6 \text{mL}$$

- a. 1 kiloliter
b. 1 megaliter
c. 10^2 centiliters
d. 10^6 microliters
e. 10^9 milliliters

$$(1 \times 10^6 \text{mL}) \left(\frac{10^{-3} \text{L}}{1 \text{mL}} \right) \left(\frac{1 \text{KL}}{10^3 \text{L}} \right) = 1 \text{KL}$$

OR $\left(\frac{1 \text{L}}{10^3 \text{mL}} \right)$

38.

Consider $^{54}_{27}\text{Co}^{2+}$. The atomic number, mass number, number of protons, number of neutrons and number of electrons are (in order):

- a. 27, 54, 27, 27, 29
b. 27, 54, 27, 27, 25
c. 54, 59, 27, 27, 25
d. 54, 59, 29, 27, 27
e. none of the above

* Co is atomic # 27, so 27p

* mass # is 54 which is p + n

* Co^{2+} (2e less than neutral atom) (if neutral 27p 27e therefore 27p 25e)

39.

How many atoms are there in a 10.0 g sample of aluminum?

- a. 2.23×10^{23} atoms
b. 6.15×10^{-25} atoms
c. 1.62×10^{26} atoms
d. 4.48×10^{-22} atoms
e. 2.23×10^{21} atoms

$$(10.0 \text{g Al}) \left(\frac{1 \text{amu}}{1.6606 \times 10^{-24} \text{g}} \right) \left(\frac{1 \text{Al atom}}{26.981 \text{amu}} \right) = 2.23 \times 10^{23} \text{atoms}$$

↑
mass conversion
amu \leftrightarrow g

↑
atomic wt.
from P.T.

40.

A single orbital (for example: a *d* orbital in the 3rd shell or a 2*p* orbital) has a maximum capacity of

- a. 2 protons.
b. 2 neutrons.
c. 2 electrons.
d. 6 electrons.
e. 10 electrons.

any single orbital can hold
2 electrons at most!