

Exam 1

MULTIPLE CHOICE (3 pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

1. How many neutrons are present in an atom of ^{60}Co ?

- (a) 31 (b) 32 (c) 33 (d) 34 (e) 35

1. C

$$60 - 27 = 33$$

2. What is the frequency of a wave with a wavelength of 256 micrometers?

- (a) $1.17 \times 10^{12} \text{ Hz}$ (b) $1.17 \times 10^6 \text{ Hz}$ (c) $7.68 \times 10^{10} \text{ Hz}$ (d) $7.68 \times 10^4 \text{ Hz}$

2. A

$$256 \mu\text{m} \left(\frac{1 \text{ m}}{1 \times 10^6 \mu\text{m}} \right) = 2.56 \times 10^{-4} \text{ m} \rightarrow \frac{3.00 \times 10^8 \text{ m/s}}{2.56 \times 10^{-4} \text{ m}} = 1.17 \times 10^{12} \text{ Hz}$$

3. How many electrons are present in a neutral atom of Tin?

- (a) 69 (b) 119 (c) 14 (d) 50

3. D

$$\text{Sn} = 50$$

4. The volume of a 25.6g cylinder was measured four times and the following measurements were obtained: 2.56mL, 2.54mL, 2.51mL, and 2.53mL. If the density of the cylinder is 22.38g/mL, the measurements are:

- (a) accurate & precise (b) accurate but not precise
(c) precise but not accurate (d) neither accurate nor precise

4. C

$$\frac{25.6 \text{ g}}{2.51 \text{ mL}} = 10.2 \text{ g/mL} \neq 22.38 \text{ g/mL}$$

5. How many nanometers are present in $5.66 \times 10^{-8} \text{ km}$?

- (a) $5.66 \times 10^{-20} \text{ nm}$ (b) $5.66 \times 10^4 \text{ nm}$ (c) 5.66×10^{-14} (d) $5.66 \times 10^{-2} \text{ nm}$

5. B

$$5.66 \times 10^{-8} \text{ km} \left(\frac{1000 \text{ m}}{1 \text{ km}} \right) \left(\frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} \right) = 5.66 \times 10^4 \text{ nm}$$

6. Which response includes a correct set of 4 quantum numbers for the last electron added to an element of potassium?

- (a) $n=1 \ell=0 m_\ell=0 m_s=+1/2$ (b) $n=4 \ell=1 m_\ell=-2 m_s=-1/2$
(c) $n=1 \ell=1 m_\ell=1 m_s=+1/2$ (d) $n=4 \ell=0 m_\ell=0 m_s=-1/2$

6. D

$$K = \text{Row 4} = n=4$$

7. Which letter represents the orbital with an ℓ quantum number of 2?

- (a) d (b) f (c) s (d) p

7. A

8. How many m^2 are present in 128000 mm^2 ?

- (a) 128 m^2 (b) $1.28 \times 10^{-4} \text{ m}^2$ (c) $1.28 \times 10^8 \text{ m}^2$ (d) 0.128 m^2

8. D

$$128000 \text{ mm}^2 \left(\frac{1 \text{ m}}{1000 \text{ mm}} \right) \left(\frac{1 \text{ m}}{1000 \text{ mm}} \right) = 0.128 \text{ m}^2$$

9. Which of the following represents a chemical change?

- (a) burning wood (b) melting salt (c) dissolving salt in water (d) breaking glass

9. A

10. How many grams are present in 0.00364 moles of silver?

- (a) $3.37 \times 10^{-5} \text{ g}$ (b) 0.393g (c) $2.19 \times 10^{21} \text{ g}$

10. B

- (d) $2.41 \times 10^{-36} \text{ g}$

$$0.00364 \text{ mol} \left(\frac{107.868 \text{ g}}{\text{mol}} \right) = 0.393 \text{ g}$$

11. Which of the following is an intrinsic property?

- (a) length (b) mass (c) intensity of color

11. D

- (d) molar mass

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! SHOW ALL WORK. Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

1. a.) How many atoms are present in 137.4g of chromium? ^{4 sig figs} Answer: 1.591×10^{24} atoms

$$137.4 \text{ g Cr} \left(\frac{1 \text{ mol}}{51.996 \text{ g}} \right) = 2.64251 \text{ mol} \left(\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}} \right) = 1.59132 \times 10^{24} \text{ atoms}$$

_{5 sf} ^{4 sf} _{atoms}

- b.) How many moles are present in 223.8g of gallium? ^{4 sig figs} Answer: 3.210 mol

$$223.8 \text{ g Ga} \left(\frac{1 \text{ mol}}{69.723 \text{ g}} \right) = 3.20984 \text{ mol}$$

_{5 sf}

2. What is the density, in g/mL, of a sphere made of platinum that contains 5.61×10^{20} atoms of platinum and has a radius of 0.00625m? (volume of a sphere = $\frac{4}{3}\pi r^3$) ^{3 sf}

Vol: $0.00625 \text{ m} \left(\frac{100 \text{ cm}}{1 \text{ m}} \right) = (0.625 \text{ cm})^3 = 0.24414 \text{ cm}^3$ Answer: 0.178 g/mL

$$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi (0.625 \text{ cm})^3 = 1.022654 \text{ cm}^3$$

mass: $5.61 \times 10^{20} \text{ atoms} \left(\frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} \right) = 9.31584 \times 10^{-4} \text{ mol} \left(\frac{195.078 \text{ g}}{1 \text{ mol}} \right) = 0.18173 \text{ g}$

density = $\frac{\text{mass}}{\text{volume}} = \frac{0.18173 \text{ g}}{1.022654 \text{ cm}^3} = 0.1777 \text{ g/cm}^3 \left(\frac{1 \text{ cm}^3}{1 \text{ mL}} \right) = 0.1777 \text{ g/mL}$

3. a.) What is the wavelength, in nm, of light if a mole of photons of that light has an energy of $1.269 \times 10^5 \text{ J}$?

^{4 sf} $1.269 \times 10^5 \text{ J} \left(\frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ photons}} \right) = 2.10727 \times 10^{-19} \text{ J/photon}$ Answer: 943 nm

equation is for a photon

$$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s}) (3.00 \times 10^8 \text{ m/s})}{\lambda} = 2.10727 \times 10^{-19} \text{ J}$$

$$\lambda = \frac{1.9878 \times 10^{-25} \text{ J}\cdot\text{m}}{2.10727 \times 10^{-19} \text{ J}} = 9.433 \times 10^{-7} \text{ m} \left(\frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} \right) = 943.3 \text{ nm}$$

- b.) What is the frequency of this light in Hz?

Answer: $3.180 \times 10^{14} \text{ Hz}$

$$E = h\nu$$

$$\frac{2.10727 \times 10^{-19} \text{ J}}{6.626 \times 10^{-34} \text{ J}\cdot\text{s}} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s}) \nu}{6.626 \times 10^{-34} \text{ J}\cdot\text{s}}$$

$$\nu = 3.1803 \times 10^{14} \text{ Hz}$$

$$(0.5^{-1})$$

4. Element Gh has four isotopes with the following masses and abundances:

Isotope 1: Mass: 265.984amu; abundance: 15.9634%

Isotope 2: Mass: 269.884amu; abundance: 33.6595%

Isotope 3: Mass: 251.658amu; abundance: 18.9956%

Isotope 4: Mass: 256.552amu; abundance: 31.3815%

Calculate the average atomic mass of this element.

Answer: 261.6155 amu

$$(265.984 \text{ amu})(0.159634) = 42.46008986 \text{ amu}$$

$$(269.884 \text{ amu})(0.336595) = 90.84160498 \text{ amu}$$

$$(251.658 \text{ amu})(0.189956) = 47.80394705 \text{ amu}$$

$$(256.552 \text{ amu})(0.313815) = 80.50986588 \text{ amu}$$

$$261.61551078 \text{ amu}$$

5. Identify each of the following as a heterogeneous mixture, solution, or pure substance:

a.) Pewter

(metal made from tin, antimony, and copper melted together)

solution

b.) Carbon dioxide (CO₂)

pure subst.

c.) Iodine

pure subst.

d.) Fruit salad

heterogeneous mix.

e.) Tea (with any tea leaves filtered out)

solution

6. a.) What is the energy change when an electron moves from $n=3$ to $n=5$?

$$\begin{aligned} E &= -2.18 \times 10^{-18} \text{ J} \left(\frac{1}{5^2} - \frac{1}{3^2} \right) \\ &= -2.18 \times 10^{-18} \text{ J} \left(\frac{1}{25} - \frac{1}{9} \right) \\ &= -2.18 \times 10^{-18} \text{ J} (-0.071111) \\ &= 1.55022 \times 10^{-19} \text{ J} \end{aligned}$$

Answer: $1.55 \times 10^{-19} \text{ J}$

b.) Is energy released or absorbed in this transition?

Answer: absorbed

Value is positive
so energy is absorbed