1. How many cubic nanometers are present in 0.012 cubic micrometers?

\[0.012 \, \text{\mu m}^3 \times \left(\frac{10^6 \, \text{m}}{1 \, \text{\mu m}}\right)^3 \times \left(\frac{1 \, \text{nm}}{10^9 \, \text{m}}\right)^3 = 1.2 \times 10^7 \, \text{nm}^3\]

2. A coin is made of 40.0% Ag (d = 10.5 g/cm³) and 60.0% Pt (d = 21.5 g/cm³).

a) What is the density of the coin?

\[0.400 \times 10.5 + 0.600 \times 21.5 = 17.1 \, \text{g/cm}^3\]

b) If this coin is 1.50 mm in thickness and weighs 60.0 g, what is its diameter? (assume the coin is a perfect cylinder) (version 2 = 1.20 mm)

\[V = m/d = 60/17.1 = 3.51 \, \text{cm}^3\]

or \[V = 60/14.9 = 4.03 \, \text{cm}^3\]

solving for \(r = \frac{Diameter}{2} = 5.46 \, \text{cm}\)

3. An element has three isotopes. The first has 12 protons and 12 neutrons and has an abundance of 78.6%. The second isotope has 13 neutrons and has an abundance of 10.1%. The third isotope has 14 neutrons with an abundance of 11.3%. Note – the mass numbers are good to 3 sig figs.

a) Write the symbols of the isotopes showing their atomic numbers and masses

\(^{12}\text{Mg}\)\(^{24}\) \(^{12}\text{Mg}\)\(^{25}\) \(^{12}\text{Mg}\)\(^{26}\)

b) Calculate the atomic mass of the element (showing setup).

\[24.0 \times 0.786 + 25.0 \times 0.101 + 26.0 \times 0.113 = 24.3\]

4. Recall the formula for heat transfer: \(Q = \text{m c} \Delta \mathcal{C}\) for water = 4.184 J/g/K \(Q_w = -Q_m\)

Calculate the final temperature of a system (water and metal) in a calorimeter, after a piece of silver weighing 80 grams (\(c = 0.232 \text{ J/gK}\)) initially at a temperature of 200.0°C is immersed in 100.0 g water initially at a temperature of 20.0°C. Ignore any minor heat loss to the air or calorimeter.

\[m_{\text{H}_2\text{O}} \cdot c_{\text{H}_2\text{O}} \cdot \Delta \mathcal{C}_{\text{H}_2\text{O}} = \text{m}_m \cdot c_m \cdot \Delta \mathcal{T}_m\]

\[100 \times 4.184 \times (T_f - 20.0) = -80 \times 0.232 \times (T_f - 200.0)\]

\[418.4T_f - 8368 = -18.56T_f + 3712\]

\[437 T_f = 12080\]

\[T_f = 27.6 \, ^\circ\text{C}\]

second version – using incorrect value for Cu \(c = 0.0835\)

\[100 \times 4.184 \times (T_f - 20.0) = -80 \times 0.232 \times (T_f - 200.0)\]

\[418.4T_f - 8368 = -18.56T_f + 3712\]

\[437 T_f = 12080\]

\[T_f = 21.3 \, ^\circ\text{C}\]

third version – using correct value for \(c = 0.385\)

\[100 \times 4.184 \times (T_f - 20.0) = -80 \times 0.385 \times (T_f - 200.0)\]

\[418.4T_f - 8368 = -30.8T_f + 3712\]

\[449.2 T_f = 12080\]

\[T_f = 27.6 \, ^\circ\text{C}\]

5. An 80.0 g piece of Ag/Au alloy \(d = 14.9 \, \text{g/cm}^3\) is immersed in water so \(V = \frac{80}{14.9} = 5.37 \, \text{ml}\) and has a density of 14.9 g/cm³.

a) Predict how many grams it will appear to weigh once immersed in water. (\(d_{\text{H}_2\text{O}} = 1.00 \, \text{g/mL}\)).

\[80.0 - 5.37 = 74.6 \, \text{g}\]

b) If ethanol \((d = 0.790 \, \text{g/mL})\) is used as the liquid for immersion, how many grams will the metal piece appear to weigh?

\[\text{displaced 5.37 mL x 0.790 g/mL} = 4.24 \, \text{g weight lost}\]

\[75.8 \, \text{g}\]
** c) bonus . What is the % composition of the alloy ? (% Ag, % Au )

Let \( x = d_{Ag} = 10.5 \text{ g/cm}^3 \) or \( x = d_{Cu} = 8.92 \)

\[ 10.5x + 19.3y = 14.9 \]

Let \( y = d_{Au} = 19.3 \text{ g/cm}^3 \)

\[ 10.5x + 19.3(1-x) = 14.9 \]

6. Name these elements: refer to a periodic table,

a) Ti  b) Sn  c) Kr  d) Co  e) Hg  f) K  a) Mn  b) Si  c) Sn  d) Ni  e) Hg  f) Pb

7. What are two allotropes of oxygen – \( O , O_2 , O_3 \)  What are two allotropes of carbon ? \( C_{60} \), (fullerene)

Graphite , diamond

8. Name these items from your locker.(3 pts) (complete names)

a ) __wash bottle____ b) __Erlenmeyer flask____ c) __evaporating dish____

9. Which of these graphs describe an inversely proportional relationship between \( x \) and \( y \) ? (circle letter below)

2 pts

\[
\begin{align*}
\text{a} & : y = -kx \\
\text{b} & : xy=k \\
\text{c} & : y = kx \\
\text{d} & : y = x^k \\
\text{e} &
\end{align*}
\]

10. Define these and explain or give an example. 10 pts

a) \( \beta^+ \) particle  = positron  like the electron but with + charge, emitted from an unstable nucleus

b) exothermic process  emission of energy from a chemical reaction or a change of state such as liq – solid  

Endothermic absorption

c) isobars  isotopes of different elements with the same mass #

d) alpha (\( \alpha^2 \)) particle  \( He^{2+} \) ion emitted during nuclear decay of heavy elements.

e) molecule  2 or more atoms bonded together, I.e, \( H_2 \)  \( CO_2 \)

11. Predict which ions will be formed by the following elements based on gain or loss of electrons. (Write the positive or negative charge above and to the right of the symbol. Example \( Fe^{3+} \)  5 pts

a) \( Li^+ \)  b) \( Ca^{++} \)  c) \( P^{3-} \)  d) \( Br^- \)  e) \( Al^{3+} \)
12. Which of these are chemical properties, and which are physical properties (Write P or C) 5 pts

a) flammability _C_ b) density _P_ c) melting point _P_ d) solubility _P_ e) corrosion _C_

11. Predict which ions will be formed by the following elements based on gain or loss of electrons. (Write the positive or negative charge above and to the right of the symbol. Example Fe$^{3+}$) 5 pts

a) Mg$^{2+}$ b) K$^+$ c) As$^{-3}$ d) I e) Sc$^{3+}$

gain or lose electrons to = noble gas configuration

13. Write the symbol of the isotope, including charge if any, and mass number or the number of particles in the following table 5 pts

<table>
<thead>
<tr>
<th>Symbol</th>
<th># protons</th>
<th># neutrons</th>
<th># electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{68}$Zn$^{2+}$</td>
<td>30</td>
<td>38</td>
<td>28</td>
</tr>
<tr>
<td>$^{234}$U</td>
<td>92</td>
<td>142</td>
<td>92</td>
</tr>
<tr>
<td>$^{3}$He$^{2+}$</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Other versions: $^{92}$Zr$^{2+}$ $^{66}$Zn$^{2+}$ $^{3}$H$^{-}$ $^{2}$H$^{-}$

12. Describe some chemical achievements of two of these great scientists. Take your pick. 10 pts

A. Lavoisier, discoverer of oxygen, law of conservation of mass, metric system

J Berzelius, atomic symbols, atomic masses, precision work, discovered some elements

D Mendeleev arranged the symbols of the elements according to increasing atomic mass and repetition of chemical properties in groups.

E. Rutherford, gold foil experiment proved the existence of a small dense nucleus in the atom containing most of the mass and all the positive charge

J. Thomson, charge/mass ratio on the electron. Plum pudding model of the atom

R. Millikan, measured the charge per electron in his oil drop experiment.

J Priestley discovered oxygen, founded the ACS

C. Scheele – discovered oxygen, fluorine and many compounds.