Station 1:

Amy needs to determine the percent water in a hydrated salt ($Na_2CO_3 \cdot xH_2O$). She heats the sample in a crucible over a Bunsen burner for five minutes and records the following measurements.

Mass of crucible (g)	24.05 g
Mass of crucible and sample before heating (g)	26.55 g
Mass of crucible and sample after heating (g)	25.68 g

1. What safety precautions should Amy use when carrying out her experiment? Goggles, Aprons, Hair Back
2. Why did the sample lose mass as it was heated? H_2O evaporated
3. Is the process carried out by Amy ~~endothermic~~ or an exothermic? How do you know? Heat absorbed
4. What is the mass of water lost? 0.87g
5. How many moles of water are lost? 4.8×10^{-2} mol
6. What is the mass of the anhydrous salt used by Amy? 1.63g
7. How many moles of anhydrous salt are used by Amy? 1.5×10^{-2}
8. What is the formula for the hydrated salt? $\frac{4.8 \times 10^{-2}}{1.5 \times 10^{-2}} = 3.2$ $Na_2CO_3 \cdot 3H_2O$
9. Make one suggestion to Amy that would result in a better procedure for this lab activity. Heat Again + Reweigh

#4. $26.55g - 25.68g = 0.87g\ H_2O$

#5. $0.87g \times \frac{1\ mol}{18.0g} = 0.048\ mol\ H_2O$

#6. $25.68g - 24.05g = 1.63g\ Na_2CO_3$

#7. $1.63g \times \frac{1\ mol}{106.0g} = 0.015\ moles\ Na_2CO_3$

#8. To find "x" in $Na_2CO_3 \cdot xH_2O$ find out the ratio of moles of H_2O : moles Na_2

$$\frac{0.048\ mol\ H_2O}{0.015\ moles\ Na_2CO_3} = 3.2 \approx 3 \qquad \therefore Formula = Na_2CO_3 \cdot 3H_2O$$

Station 2:

John needs to determine the type of bonding present (covalent, ionic, or metallic) in three unknown substances (X, Y, and Z). He makes the following observations about the appearance of the substances:

Substance	Observations
X	Small white crystals
Y	Lustrous gray solid
Z	Small white crystals

1. Can you predict the type of bonding in any/all of the substances based only on the appearance? Explain why or why not. Y = metallic
2. John decides to measure the melting points of each of the substances. He collects the following data: X = 450°C, Y= 400°C, Z = 110°C. Predict the type of bonding in each substance based on these results. X = ionic Y = metallic Z = covalent
3. John also measures the conductivity of each of the solids. He finds that substance X and Z do not conduct electricity while substance Y is a good conductor. Does this support your answer to #2? Explain why or why not. Yes. Solid ionic + cov do not conduct.
4. Suggest one more test that John could do to distinguish the types of bonding present in each sample. State the expected results for each substance. Dissolve, Hardness, Cond of Soln
5. Give an example of a covalently bonded substance, metallically bonded substance, and ionically bonded substance. $C_6H_{12}O_6$ Na NaCl

Station 3:

A sample of pure Thallium is run through a mass spectrometer. (A mass spectrometer is an instrument used to measure masses of each substance in a mixture of substances.) The following results are obtained:

Exact Mass	Percent abundance
202.9723 amu	29.50 %
204.9745 amu	70.50 %

1. Based on the results above what are the mass numbers of the two isotopes of thallium? 203, 205
2. Calculate the average atomic mass (weighted mass average) of Thallium. $(202.9723\text{ amu})(0.2950) + (204.9745\text{ amu})(0.7050) = 204.4$ amu
3. How many protons, neutrons, and electrons are in an atom of Tl-205? 81, 124, 81
4. How many protons and electrons are in an ion of Tl^{3+}? 81, 78
5. Write the electron configuration for a thallium atom. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^1$
6. How many valence electrons does a thallium atom contain?

Station 4:

The periodic table is probably the most useful piece of equipment to a chemist. The position of an element on the periodic table tells us a huge amount of information about that element. It also allows chemists to compare properties of different elements. The following questions are all related to the periodic table.

1. If M represents an alkaline earth element and X represents a halogen in M_aX_b, what are the values for *a* and *b*? MX_2
2. Which element has a larger atomic radius, O or S? Explain your answer based on atomic structure. S. more Energy levels + greater shielding in S.
3. Which element has a larger ionization energy, Na or Mg? Explain your answer based on atomic structure. Mg More protons (greater nuclear pull)
4. Which has a larger radius, the phosphorus atom or the phosphide ion? P^{3-} (more electrons, same # of protons)
5. How many valence electrons do most transition metals contain? 2
6. Which group on the periodic table is unlikely to bond? Why? 18 - have 8 valence electrons
7. How many orbitals are in a p-sublevel? 3
8. How many total electrons can fit into the third principle energy level? 18 e -
9. Write the chemical formula for aluminum nitrite. $Al(NO_2)_3$
10. Write the name for $CrCl_3$. Chromium (III) chloride

Station 5:

Many substances, when placed in flame, will emit visible light. The color of this light can often be used to identify the substance. This process is called atomic emission spectroscopy.

#2. $c = \lambda\nu$
$3.00 \times 10^8 \text{ m/s} = (6.5 \times 10^{-7} \text{ m})\nu$
$\nu = 4.6 \times 10^{14} \text{ Hz}$

1. Based on atomic structure, explain why substances will release visible light when heated. Electrons move from higher to lower energy levels

2. A substance releases light with a wavelength of 6.5×10^{-7} m. Calculate the frequency of this light. $4.6 \times 10^{14} \text{ s}^{-1}$

#3 $E = h\nu$
$E = (6.63 \times 10^{-34} \text{ J·s})(4.6 \times 10^{14} \text{ Hz})$
$E = 3.0 \times 10^{-19} \text{ J}$

3. How much energy is associated with the light released in #2? 3.0×10^{-19} J or 3.1×10^{-19} J

Some solids, when placed in a flame, will either melt or combust.

4. Is melting a chemical or physical change? Explain. No change in ID of sub.
5. Balance the following equation for the combustion of propane.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

6. The melting point of a substance was read on the thermometer shown to the right. Write down the melting point to the correct number of significant figures (°C).

208.4 °C