Master Materials and Equipment List

Italicized entries indicate items not available from PASCO. The quantity indicated is per student or group. NOTE: These activities also require protective gear for each student (for example, safety goggles, gloves, apron, or lab coat).

Instructors can conduct some lab activities with sensors other than those listed here. For assistance with substituting compatible sensors for a lab experiment, contact PASCO Instructor Support (800-772-8700 inside the United States or http://www.pasco.com/support).

Lab	Title	Materials and Equipment	Qty
	Chemical Composition and Stoichiometry		
1	**Determining the Empirical Formula of a Compound** Use a crucible and Bunsen burner to react a chemical with air in order to determine the stoichiometric composition of an ionic compound.	*Crucible with lid* Ring stand *Bunsen burner* Balance *Crucible tongs* *Wash bottle with deionized water* *Clay triangle* *Paper clip* *Magnesium powder*	1 1 1 1 per class 1 1 1 1 0.5 g
2	**Determine the Percentage of Water in a Hydrate** Use a crucible and Bunsen burner to determine the water content of a hydrated salt.	*Crucible with lid* Ring stand *Bunsen burner* Balance *Crucible tongs* *Wash bottle with deionized water* *Clay triangle* *Copper sulfate, $CuSO_4$, hydrated*	1 1 1 1 1 1 per class 1 4.5 g
3	**Mole Relationships in a Chemical Reaction** Use a conductivity sensor to determine the stoichiometric coefficients of the reactants of a chemical reaction.	Data Collection System PASPORT Conductivity Sensor *Test tubes, 15-mL* *Beaker, 100-mL* Graduated pipet, 10-mL *Pipet bulb* *Test tube rack* *Unknown solution (use potassium chromate)* *0.01 M Silver nitrate ($AgNO_3$)* *Wash bottle with deionized water* *Parafilm®* *Marking pen*	1 1 9 1 2 1 1 50 mL 50 mL 1 1 1

Lab	Title	Materials and Equipment	Qty
4	**Gravimetric Determination of a Precipitate** Use a stainless steel temperature sensor with gravimetric analysis to determine the amount of sulfate in a sample of an unknown alkali sulfate.	Data Collection System	1
		PASPORT Stainless Steel Temperature Sensor	1
		Ring stand with ring	1
		Clamp, utility	1
		Clamp, buret	1
		Crucible with lid	1
		Tongs	1
		Beaker, glass, 400-mL	1
		Beaker, glass, 250-mL	1
		Beaker, 25-mL	3
		Beaker or flask, 400-mL,	1
		Graduated cylinder, 100-mL	1
		Graduated cylinder, 10-mL	1
		Buret, 50 mL	1
		Funnel	1
		Dropper	1
		Hot plate	1
		Bunsen burner	1
		Clay triangle	1
		0.5 M Barium chloride ($BaCl_2$)	30 mL
		0.1 M Silver nitrate ($AgNO_3$)	5 mL
		6 M Hydrochloric acid (HCl)	5 mL
		Unknown alkali sulfate (use K_2SO_4 and Na_2SO_4*)*	0.35 g
		Filter paper, Whatman® Ashless, #42	1
		Rubber policeman and stirring rod	1
		Watch glass, 100-mm	1
		Distilled water	100 mL
		Wash bottle with distilled water	1
5	**Identifying an Unknown Metal** Use an absolute pressure sensor and stainless steel temperature sensor to identify an unknown metal by applying the Ideal Gas Law.	Data Collection System	1
		PASPORT Absolute Pressure Sensor	1
		PASPORT Stainless Steel Temperature Sensor	1
		PASPORT Sensor Extension Cable	1
		Quick-release connector**	1
		Tubing connector**	1
		Tubing, 1- to 2-cm**	1
		Graduated cylinder, 10-mL or 25-mL	1
		Graduated cylinder, 250-mL	1
		Erlenmeyer flask, 250-mL	1
		Beaker, 1500-mL	1
		Balance	1 per class
		Rubber stopper with one hole	1
		3 M Hydrogen chloride (HCl)	100 mL
		Unknown metal, 0.2 g (use magnesium ribbon)	3 pieces
		Electrical tape	1 roll

Lab	Title	Materials and Equipment	Qty
6	**Synthesis of a Coordination Compound** Use a series of reactions to synthesize a coordination compound, potassium aluminum sulfate dodecahydrate (alum), and calculate the theoretical and percent yields.	Balance Hot plate *Fume hood* *Beaker, 400-mL* *Beaker, 250-mL* *Beaker, 100-mL* *Graduated cylinder, 50-mL* *Büchner funnel* *Büchner filter flask* *Stirring rod, glass* *Watch glass* *Scissors* *Beaker tongs* *Filter paper* *Wire gauze* *3 M Sulfuric acid (H_2SO_4)* *3 M Potassium hydroxide (KOH)* *50% Ethanol* *100% Ethanol* *Acetone (C_3H_6O)* *Aluminum foil* *Distilled water for rinsing equipment* *Ice*	1 per class 1 1 1 2 1 1 1 1 1 1 1 1 3 1 35 mL 25 mL 50 mL 50 mL 50 mL 1.1 g 1 400 mL
7	**Analysis of a Coordination Compound** Use a stainless steel temperature sensor to help confirm the identity of a sample of alum synthesized in Lab 15a by conducting both qualitative and quantitative analyses.	Data Collection System PASPORT Stainless Steel Temperature Sensor Ring stand with ring *Clay triangle* *Clamp, buret* Clamp, utility *Crucible with lid* *Tongs* *Test tubes, 10 mL* *Beaker, 250-mL* *Capillary tube* *Stirring rod* *Watch glass, 100-mm* Balance *Centrifuge* *Wire with a loop on the end, 4 in.* Hot plate *Bunsen burner* *Striker* *0.2 M Barium chloride ($BaCl_2$)* *6 M Sodium hydroxide (NaOH)* *6 M Hydrochloric acid (HCl)* *Borax* *Alum from Synthesis of a Coordination Compound experiment* *Rubber band* *Water* *Distilled water*	1 1 1 1 1 1 1 2 1 1 1 2 1 per class 1 per class 1 1 1 1 1 mL 5 mL 5 mL 0.5 g 3 g 1 200 mL 10 mL

Lab	Title	Materials and Equipment	Qty
	Thermochemistry and Thermodynamics		
8	**Enthalpy of a Chemical Reaction** Use a stainless steel temperature sensor to derive the enthalpy change of a reaction.	Data Collection System PASPORT Stainless Steel Temperature Sensor *Polystyrene cup, 8 oz.* Clamp, utility *Beaker, 250-mL* *Graduated cylinder, 50-mL or 100-mL* Ring stand *2.00 M Sodium hydroxide (NaOH)* *2.00 M Hydrochloric acid (HCl)* *2.00 M Ammonium chloride (NH_4Cl)* *2.00 M Ammonia (NH_3)*	1 1 1 1 1 1 1 50 mL 50 mL 50 mL 50 mL
	Atomic and Nuclear Structure		
9	**Absorption Spectra** Use a spectrometer to learn about the composition of the electromagnetic radiation in the visible range, to develop an understanding of how the interaction of objects and solutions with light result in the perception of color, and to dispel misconceptions of objects "having color."	Data Collection System PASPORT Sensor Extension Cable Amadeus Spectrometer System Glass cuvette with cap** *Test tubes, large* *Test tube rack* *Graduated cylinder, 10-mL* *0.1 M Iron(III) chloride ($FeCl_3$)* *0.1 M Copper(II) chloride ($CuCl_2$)* *0.1 M Cobalt chloride ($CoCl_2$)* *0.1 M Nickel(II) chloride ($NiCl_2$)* *0.1 M Sodium chloride (NaCl)* *Color chart* *Wash bottle with distilled water* *Marking pen*	1 1 1 1 6 1 1 10 mL 10 mL 10 mL 10 mL 10 mL 1 1 1
10	**Determining the Half-Life of an Isotope** Use an alpha beta gamma radiation sensor to investigate the radioactive decay and half-life of an isotope.	Data Collection System PASPORT Alpha Beta Gamma Radiation Sensor Isotope Generator Kit (Barium-137m) Barium-137m solution Aluminum plate	1 1 1 per class 1 1

Lab	Title	Materials and Equipment	Qty
		Gas Laws	
11	**Determine the Molar Mass of a Volatile Liquid** Use a stainless steel temperature sensor to determine the molar mass of an unknown volatile liquid at the boiling temperature of water and atmospheric pressure.	Data Collection System PASPORT Stainless Steel Temperature Sensor PASPORT Absolute Pressure Sensor Quick-release connector** Tubing connector** Tubing, 1- to 2-cm** *Beaker, 400-mL* *Erlenmeyer flask, 125-mL* *Graduated cylinder, 100-mL* *Hot plate with magnetic stirrer and stir bar* Balance Ring stand *Clamp* *Unknown volatile liquid (use acetone)* *Aluminum foil, about 4-cm by 4-cm* *Paper towel, sheets* *Dropper* *Water*	1 1 1 1 1 1 2 1 1 1 1 per class 1 2 8 mL 1 2 or 3 1 600 mL
12	**Molar Volume of a Gas** Use an absolute pressure sensor and stainless steel temperature sensor to determine the molar volume of a gas by relating pressure, volume, and temperature.	Data Collection System PASPORT Absolute Pressure Sensor PASPORT Stainless Steel Temperature Sensor PASPORT Sensor Extension Cable Quick-release connector** Tubing connector** Tubing, 1- to 2-cm** *Beaker, 600-mL* *Erlenmeyer flask, 250-mL* *Graduated cylinder, 10-mL or 25-mL* *Graduated cylinder, 100-mL* Balance *Rubber stopper with one hole* *3 M Hydrochloric acid (HCl)* *Magnesium ribbon* *Water* *Electrical tape (optional)*	1 1 1 1 1 1 1 1 1 1 1 1 per class 1 20 mL about 0.20 g 300 mL 1 roll

Lab	Title	Materials and Equipment	Qty
13	**Exploring Gas Laws** Use an absolute pressure sensor and stainless steel temperature sensor to explore the relationship between pressure and volume, and pressure and temperature, for a gas.	Data Collection System PASPORT Absolute Pressure Sensor PASPORT Sensor Extension Cable PASPORT Stainless Steel Temperature Sensor Quick-release connector** Tubing connector** Tubing, 1- to 2-cm** Ring stand Clamp, utility *Beaker, 1500-mL* *Erlenmeyer flask, 250-mL* *Syringe, 60-mL* Hot plate with magnetic stirrer and stir bar *Rubber stopper, 2-hole* *Glycerin* *Electrical tape* *Water*	1 1 1 1 1 1 1 1 1 1 1 1 1 1 several drops 1 roll 1200 mL
	Intermolecular Forces and States of Matter		
14	**Molecular Interaction in Ethanol and Acetone** Use an absolute pressure sensor and stainless steel temperature sensor to determine and relate the heat of vaporization of substances to the interactions between molecules.	Data Collection System PASPORT Stainless Steel Temperature Sensor PASPORT Absolute Pressure Sensor PASPORT Sensor Extension Cable Quick-release connector** Tubing connector** Tubing, 1- to 2-cm** *Beaker, 1500-mL* *Beaker, 50-mL* *Erlenmeyer flask, 250-mL* *Graduated cylinder, 50-mL* Hot plate with magnetic stirrer and stirring bar Clamp, utility Ring stand *100% Ethanol (C_2H_5OH)* *Acetone ($(CH_3)_2CO$)* *Rubber stopper, 2-hole* *Glycerin* *Water*	1 1 1 1 1 1 1 1 1 1 1 1 1 1 50 mL 50 mL 1 2 drops 1200 mL

Lab	Title	Materials and Equipment	Qty
		Solutions and Solubility	
15	**Molecular Weight by Freezing Point Depression** Use a stainless steel temperature sensor to determine the molecular weight of a compound by measuring the freezing point depression of a solution.	Data Collection System PASPORT Stainless Steel Temperature Sensor *Erlenmeyer flask, 250-mL* *Beaker, 400-mL* *Test tube, 20-mL* *Copper wire coil* Ring stand Hot plate Stirring bar *Clamp, utility* *Lauric acid, $CH_3(CH_2)_{10}COOH$* *Unknown solute (use benzoic acid)* *Water*	1 1 1 1 1 1 1 1 1 2 8 g 0.5 g 300 mL
16	**Colorimetric Analysis** Use a colorimeter to learn how the factors of concentration and path length affect the absorbance of a colored solution.	Data Collection System PASPORT Colorimeter PASPORT Sensor Extension Cable** Glass cuvette with cap** *Beakers, 100-mL* *Test tubes, large* *Test tube rack* *Graduated cylinder, 50-mL* Pipet with pump or bulb 10-mL *Pipet bulb* *Glass stirring rod* *0.40 M copper(II) sulfate ($CuSO_4$)* *Distilled water* *Marking pen* *Wash bottle with distilled water*	1 1 1 1 2 6 1 1 1 1 1 30 mL 30 mL 1 1
17	**Separation by Liquid Chromatography** Use liquid chromatography to separate the ingredients of a mixture.	*C18 Sep-Pak® cartridge* *Syringe, 1-mL* *Syringe, 10-mL, or dropper bottle or wash bottle* *Graduated cylinder, 10-mL* *18% Isopropanol* *Unsweetened Kool-Aid® drink* *Distilled water*	1 1 1 1 100 mL 10 mL 10 mL

Lab	Title	Materials and Equipment	Qty
18	**Conductometric Titration** Use a conductivity sensor and drop counter to determine the concentration of a solution with titration.	Data Collection System PASPORT Conductivity Sensor PASPORT High Accuracy Drop Counter Micro stir bar** Magnetic stirrer *Buret, 50-mL* *Beaker, 100-mL* *Beaker, 50-mL* Buret or volumetric pipet, 50-mL Ring stand Clamp, right-angle *Clamp, buret* *0.0200 M H_2SO_4 solution* *Barium hydroxide ($Ba(OH)_2$), unknown concentration* *Deionized water* *Wash bottle with deionized water* *Cotton swab or tissue*	1 1 1 1 1 1 2 1 1 1 1 1 50 mL 50 mL 50 mL 1 1
19	**Separation and Analysis of Cations** Use chemical reactions and chemical properties to identify the cations present in a mixture by systematically reacting the unknown with various reagents.	*Test tube, 10-mL* *Test tube rack* Pipet, graduated, 10-mL *Pipet bulb* Pipet, plastic, 1-mL *Centrifuge* *Beaker, 250-mL* *Evaporating dish* *Stirring rod* Hot plate *Litmus paper* *pH paper* *6 M Sodium hydroxide (NaOH)* *6 M Ammonia (NH_3)* *0.1 M Potassium chromate (K_2CrO_4)* *1% Aluminon dye* *6 M Hydrochloric acid (HCl)* *Dimethylglyoxime (DMG) reagent* *0.2 M Potassium ferrocyanide ($K_4[Fe(CN)_6]$)* *3 M Sulfuric acid (H_2SO_4)* *3 % Hydrogen peroxide (H_2O_2)* *Unknown cation solution (use $AlCl_3$, $NiCl_3$, $Pb(NO_3)_2$, $AgNO_3$, $MnSO_4$, $(NH_4)_2Fe(SO_4)_2$)* *Deionized water* *Marking pen*	10 1 1 1 7 1 1 1 1 1 10 1 roll 20 mL 20 mL 20 mL 2 mL 20 mL 5 drops 2 mL 3 mL 2 mL 20 mL 5 mL 1

Lab	Title	Materials and Equipment	Qty
20	**Analysis of Anions** Use chemical reactions and chemical properties to analyze solutions of known anions, using the results to analyze a solution of unknown anions.	*Test tube, 10-mL* *Test tube rack* *Pipets, 1 mL, disposable* *Stirring rods* *Litmus paper* *0.2 M Sodium sulfate (Na_2SO_4)* *0.2 M Monopotassium phosphate (KH_2PO_4)* *0.2 M Sodium nitrate ($NaNO_3$)* *0.2 M Sodium chloride (NaCl)* *Unknown anion solution (use Na_2SO_4, KH_2PO_4, $NaNO_3$, NaCl)* *0.2 M Barium nitrate ($Ba(NO_3)_2$)* *Saturated iron(II) sulfate ($FeSO_4$)* *0.1 M Silver nitrate ($AgNO_3$)* *6 M Nitric acid (HNO_3)* *5 M Ammonia (NH_3)* *3 M Sulfuric acid (H_2SO_4)* *Concentrated H_2SO_4* *Distilled water* *Centrifuge* *Marking pen*	13 1 13 5 15 10 mL 5 mL 5 mL 5 mL 20 mL 5 mL 2 mL 5 mL 5 mL 5 mL 5 mL 2 mL 10 mL 1 1
	Acid–Base Chemistry		
21	**Standardizing a Solution of Sodium Hydroxide** Use a pH sensor and drop counter to determine the concentration of a sodium hydroxide solution by titrating it with a standard solution of known concentration.	Data Collection System PASPORT pH Sensor PASPORT High Accuracy Drop Counter Micro stir bar** Magnetic stirrer Ring stand *Beaker, 250-mL* *Beaker, 100-mL* *Beaker, 10-mL* *Volumetric flask, 250-mL* *Buret, 50-mL* *Clamp, buret* Clamp, right-angle *Funnel* *Potassium hydrogen phthalate (KHP)* *Sodium hydroxide (NaOH)* *Buffers, pH 4 and pH 10* *Water, deionized* *Wash bottle with deionized water* *Parafilm® or aluminum foil* *Cotton swab or tissue*	1 1 1 1 1 1 1 1 2 1 1 1 1 1 0.6 g 1.0 g 10 mL 500 mL 1 1 1

Lab	Title	Materials and Equipment	Qty
22	**Acid–Base Titration** Use a pH sensor and drop counter to determine the molar concentration of a strong acid solution by titrating measured volumes with a strong base of known concentration.	Data Collection System PASPORT pH Sensor PASPORT High Accuracy Drop Counter Micro stir bar** Magnetic stirrer *Buret, 50-mL* Graduated pipet, 25-mL *Pipet bulb* *Beaker, 100-mL* *Beaker, 25-mL* Clamp, right-angle *Clamp, buret* Ring stand *Parafilm® or aluminum foil* *Funnel* *Hydrochloric acid, unknown concentration* *Sodium hydroxide (NaOH), standardized by students in Standardizing a Solution of Sodium Hydroxide experiment* *Buffers, pH 4 and pH 10* *Deionized water* *Wash bottle with deionized water* *Cotton swab or tissue*	1 1 1 1 1 1 1 1 2 2 1 1 1 1 1 70 mL 100 mL 10 mL 100 mL 1 1 1
23	**Using Different Indicators for pH Determination** Use a drop counter and pH sensor to determine the CO_2 content of a beverage by performing titrations with multiple acid-base indicators.	Data Collection System PASPORT High Accuracy Drop Counter PASPORT pH Sensor Micro stir bar** Clamp, right-angle *Clamp, buret* *Buret, 50-mL* *Beaker, 25-mL* *Beaker, 250-mL* *Erlenmeyer flask, 250-mL* *Graduated cylinder, 100-mL* *Phenolphthalein* *Methyl orange* Magnetic stirrer and stir bar Ring stand *Commercial soda drink* *Kimwipes®* *4.00 M HCl solution* *1 M NaOH solution* *Wash bottle with deionized water* *Funnel* *Balloon (fits on Erlenmeyer flask; holds 100 mL)* Buffers, pH 4 and pH 10 *Cotton swab or tissue*	1 1 1 1 1 1 1 2 2 1 1 5 drops 5 drops 1 1 1 can 1 100 mL 100 mL 1 1 1 10 mL 1

Lab	Title	Materials and Equipment	Qty
24	**Properties of Buffer Solutions** Use a pH sensor to demonstrate the properties of buffer solutions and buffer capacity.	Data Collection System PASPORT pH Sensor *Beaker, 400-mL* *Buret, 50-mL* Pipet, 5-mL *Pipet bulb* *Beaker, 100-mL* *Beaker, 25-mL* *Graduated cylinder, 250-mL* Magnetic stirrer and stirring bar Ring stand *Clamp, buret* Clamp, utility *Funnel* *2.000 M Sodium hydroxide (NaOH)* *0.1 M Acetic acid (HOAc)* *0.3 M Acetic acid (HOAc)* *0.5 M Acetic acid (HOAc)* *6.00 M Hydrochloric acid (HCl)* *Buffers, pH 4 and pH 10* *Wash bottle with deionized water*	1 1 1 1 1 1 1 2 1 1 1 1 1 1 250 mL 250 mL 250 mL 250 mL 5 mL 10 mL 1
25	**Determining K_a by Half-Titration of a Weak Acid** Use a pH sensor and drop counter to determine the equilibrium constant for the ionization of a weak acid to ascertain the identity of the acid.	Data Collection System PASPORT pH Sensor PASPORT High Accuracy Drop Counter Ring stand Clamp, right-angle Clamp, buret *Beaker, 100-mL* *Buret, 50-mL* *Graduated cylinder, 100-mL* *Funnel* Magnetic stirrer and stir bar *0.20 M Sodium hydroxide (NaOH)* *Unknown weak acid solution (use acetic acid)* *Buffer solutions, pH 4 and pH 10*	1 1 1 1 1 1 2 1 1 1 1 75 mL 50 mL 10 mL

Lab	Title	Materials and Equipment	Qty
26	**Determination of the K_a Values of Two Isomeric Multi-Protic Acids** Use a pH sensor and drop counter to determine the acidity constants of two isomeric multi-protic acids and relate the acidity constants to their structural differences.	Data Collection System PASPORT pH Sensor PASPORT High Accuracy Drop Counter Micro stir bar** Ring stand Clamp, right-angle *Clamp, buret* *Beaker, 250-mL* *Beaker, 25-mL* *Buret , 50-mL* *Graduated cylinder, 100-mL* Magnetic stirrer *Unidentified fumaric acid solution* *Unidentified maleic acid solution* *0.500 M Sodium hydroxide (NaOH)* *Funnel* *Buffers, pH 4 and pH 10* *Wash bottle with deionized water* *Cotton swab or tissue*	1 1 1 1 1 1 1 2 2 1 1 1 50 mL 50 mL 150 mL 1 10 mL 1 1
	Kinetics and Equilibrium		
27	**Determine the Equilibrium Constant for a Chemical Reaction** Use a colorimeter to determine the equilibrium constant for a chemical reaction.	Data Collection System PASPORT Colorimeter and cuvette PASPORT Sensor Extension Cable** *Beaker, 50-mL* *Test tube, 15-mL* *Test tube rack* Graduated pipet, 10-mL *Pipet bulb* *0.01 M Iron (Fe^{3+})* *0.00300 M Potassium thiocyanate (KSCN)* *Kimwipes®* *Deionized water* *Marker*	1 1 1 2 5 1 2 1 20 mL 20 mL 1 40 mL 1
28	**Determination of the Rate of the Decomposition of Hydrogen Peroxide** Use an absolute pressure sensor and stainless steel temperature sensor to determine the rate constant of a chemical reaction.	Data Collection System PASPORT Absolute Pressure Sensor PASPORT Stainless Steel Temperature Sensor PASPORT Sensor Extension Cable Quick-release connector** Tubing connector** Tubing, 1- to 2-cm** *Beaker, 100-mL* *Erlenmeyer flask, 250-mL* Graduated pipet, 25-mL *Pipet bulb* *Stopper, two holes, for the Erlenmeyer flask* *Beaker, 50-mL* *Glycerin* *0.1000 M Potassium iodide (KI)* *3% Hydrogen peroxide (H_2O_2)* *Deionized water* *Electrical tape, 60 in. (optional)*	1 1 1 1 1 1 1 3 1 3 3 1 1 several drops 60 mL 40 mL 100 mL 1

Lab	Title	Materials and Equipment	Qty
29	**Determination of a Solubility Product** Use a pH sensor and drop counter to determine the solubility product of an ionic compound through titration and calculations.	Data Collection System PASPORT pH Sensor PASPORT High Accuracy Drop Counter Micro stir bar** Ring stand *Clamp, buret* Clamp, right-angle *Beaker, 100-mL* *Beaker, 150-mL* *Beaker, 25-mL* Pipet, graduated or volumetric, 50-mL *Pipet bulb* *Buret, 50-mL* *Büchner filter flask* *Büchner funnel* Pipet, transfer *Filter paper* Magnetic stirrer *0.1000 M Hydrochloric acid (HCl)* *Calcium hydroxide ($Ca(OH)_2$), saturated* *Buffers, pH 4 and pH 10* *Wash bottle with distilled water* *Parafilm® or aluminum foil* *Cotton swab or tissue*	1 1 1 1 1 1 1 1 2 2 1 1 1 1 1 1 1 1 200 mL 200 mL 10 mL 1 1 1
30	**Order of Reaction** Use a colorimeter to determine the rate constant and the order of reaction.	Data Collection System PASPORT Colorimeter PASPORT Sensor Extension Cable** Glass cuvette with cap** *Beaker, 50-mL* *Syringe, 5-mL* *Watch glass, 4 in* *0.1 M Sodium hydroxide (NaOH)* *1.2×10^{-5} M Crystal violet* *Water, distilled* *Marking pen* *Kimwipes®*	1 1 1 1 3 3 1 20 mL 20 mL 30 mL 1 1

Lab	Title	Materials and Equipment	Qty
		Electrochemistry	
31	**Oxidation–Reduction Titration** Use an oxidation reduction potential electrode and drop counter to determine the concentration of a commercial, nominally 3% hydrogen peroxide solution, measuring the change in potential during an oxidation-reduction reaction.	Data Collection System PASPORT Chemistry Sensor PASPORT Oxidation Reduction Potential Electrode PASPORT High Accuracy Drop counter Magnetic stirrer and stir bar *Buret, 50-mL* *Beaker, 150-mL* Volumetric pipet, 10-mL *Pipet bulb* *Graduated cylinder, 50-mL* Clamp, right-angle *Clamp, buret* Ring stand *Hydrogen peroxide, ~ 3%, 1:20 dilution* *1.000 × 10^{-2} M Potassium permanganate ($KMnO_4$)* *4 M Sulfuric acid (H_2SO_4)* *Water, deionized*	1 1 1 1 1 1 2 1 1 1 1 1 1 1 40 mL 100 mL 70 mL 250 mL
32	**Determination of Electrochemical Series** Use a voltage sensor to determine the half-reactions that relate to the anode and cathode of a galvanic cell and to calculate the electromotive force for a battery.	Data Collection System PASPORT Voltage Sensor *Beaker, 50-mL* *Glass plate (5 × 5 in)* *Disposable droppers, 1 mL* *Iron strip, 1-cm × 1-cm* *Lead strip, 1-cm × 1-cm* *Copper strip, 1-cm × 1-cm* *Silver wire, 1-cm* *Zinc strip, 1-cm × 1-cm* *Circular filter paper, 11-cm diameter* *1.0 M Zinc sulfate ($ZnSO_4$)* *1.0 M Iron sulfate ($FeSO_4$)* *1.0 M Copper sulfate ($CuSO_4$)* *1.0 M Silver nitrate ($AgNO_3$)* *1.0 M Lead nitrate ($Pb(NO_3)_2$)* *1.0 M Sodium nitrate ($NaNO_3$)* *Steel wool* *Scissors*	1 1 6 1 6 1 1 1 1 1 1 10 mL 10 mL 10 mL 10 mL 10 mL 20 mL 1 1

Lab	Title	Materials and Equipment	Qty
33	**Electroplating** Use a voltage-current sensor to construct an electrochemical cell that deposits copper onto another metal surface and to apply Faraday's law to relate the total electric charge to the mass of metal deposited.	Data Collection System PASPORT Voltage–Current sensor DC power supply *Banana plug cords, red* *Banana plug cord, black* *Alligator clip, red* *Alligator clip, black* Ring stand Clamps *Beaker, 100-mL* Magnetic stir plate Balance *Metal object (key or spoon)* *Copper strip or heavy gauge copper wire (3 in)* *1.0 M Copper sulfate ($CuSO_4$)* *Steel wool* *Electrical tape* *Paper towel* Magnetic stirring bar	1 1 1 2 1 1 1 1 2 1 1 1 1 1 50 mL 1 1 1 sheet 1
34	**The Breathalyzer™ Test for Alcohol** Use a colorimeter to determine the concentration of an ethanol solution using the Breathalyzer™ test: chemical oxidation of ethanol by acidic dichromate.	Data Collection System PASPORT Colorimeter PASPORT Sensor Extension Cable** Glass cuvette with cap** *Erlenmeyer flask, 125-mL* *Volumetric flask, 100-mL* Graduated pipet, 10-mL Graduated pipet, 5-mL *Pipet, plastic, 1-mL* *Graduated cylinder, 100-mL* *Beaker, 25-mL* *Beaker, 100-mL* *Beaker, 400-mL* *Beaker, 250-mL* *Beaker, 1-L* Ring stand Clamps, utility Hot plate *15% Sulfuric acid (H_2SO_4)* *Silver nitrate ($AgNO_3$), 15%* *5.10×10^{-2} M Potassium dichromate ($K_2Cr_2O_7$)* *Ethanol solution, unknown concentration* *Marking pen* *Wash bottle with distilled water*	1 1 1 1 7 1 1 1 1 1 2 1 2 1 1 1 2 1 800 mL 10 mL 30 mL 5 mL 1 1

Lab	Title	Materials and Equipment	Qty
		Organic Chemistry	
35	**Organic Synthesis I—Preparation** Use a stainless steel temperature sensor to synthesize an organic compound (aspirin).	Data Collection System	1
		PASPORT Stainless Steel Temperature Sensor	1
		Ring stand	1
		Clamp	2
		Erlenmeyer flask, 125-mL	1
		Graduated cylinder, 10-mL	1
		Beaker, 100-mL	1
		Beaker, 400-mL	1
		Hot plate	1
		Büchner filter flask	1
		Büchner funnel	1
		Filter paper	1
		Salicylic acid ($C_7H_6O_3$)	2 g
		Acetic anhydride ($C_4H_6O_3$)	4 mL
		Concentrated phosphoric acid (H_3PO_4)	1 mL
		Wash bottle with distilled water	1
		Eye dropper	1
		Rubber policeman	1
		Ice cold distilled water	50 mL
		Ice for ice bath	300 mL
		Forceps	1

Lab	Title	Materials and Equipment	Qty
36	**Organic Synthesis II—Analysis** Use a stainless steel temperature sensor, pH sensor, and drop counter to perform qualitative and quantitative analytical methods, including melting point determination and titration, to analyze the purity of the aspirin synthesized in Lab 22a.	Data Collection System	1
		PASPORT Stainless Steel Temperature Sensor	1
		PASPORT pH Sensor	1
		PASPORT High Accuracy Drop Counter	1
		Micro stir bar**	1
		Ring stand	1
		Clamp, utility	1
		Clamp, right-angle	1
		Clamp, buret	1
		Beaker, 150-mL	2
		Beaker, 100-mL	1
		Beaker, 25-mL	2
		Test tubes, 15-mL	3
		Melting point capillary tube	1
		Buret, 50-mL	1
		Graduated cylinder, 100-mL	1
		Magnetic stirrer and stir bar	1
		Hot plate with magnetic stirrer and stir bar	1
		Mortar and pestle	1
		Product from Organic Synthesis I experiment	1
		Aspirin tablet	1
		Ethanol	15 mL
		0.1 M Sodium hydroxide (NaOH)	75 mL
		1% Iron chloride ($FeCl_3$)	2 mL
		Mineral oil	150 mL
		Buffers, pH 4 and pH 10	10 mL
		Water, distilled	100 mL
		Rubber band, small	1
		Wash bottle with deionized water	1

*Either the PASPORT Fast Response Temperature Sensor or the PASPORT Stainless Steel Temperature Sensor can be used for this experiment.

** These items are included with the specific apparatus or sensor used in the experiment.

Calibration materials

If you want to calibrate various sensors, you will need the following:

pH Sensor

Item	Quantity	Where Used
Buffer solution, pH 4 Buffer solution, pH 10 Beaker, small Wash bottle with deionized or distilled water	25 mL 25 mL 3 1	21, 22, 23, 24, 25, 26, 29, 36

Colorimeter

Item	Quantity	Where Used
Cuvette (included with colorimeter) Distilled water	1 7 mL	16, 27, 30, 34