

CaYPT 2022 Problem Selection Supplementary Information

Compiled by the CaYPT Committee, Published on Oct 19, 2021

I. Scores by Problem Selection Committee

Problem	Avg. Score	SD of Score	Decision
Ring on the Rod	4.4	0.7	Selected
Balls on an Elastic Band	4.3	1.2	Selected
Tennis Ball Tower	4.1	1.1	Selected
Droplet Explosion	4.0	1.4	Selected
Rayleigh Disk	3.9	0.8	Selected
Equipotential Lines	3.8	1.1	Selected
Boycott Effect	3.7	0.9	Selected
Unsinkable Disk	3.7	0.7	Selected
Strange Motion	3.6	1.3	Selected
Bimetallic Oscillator	3.2	1.0	Selected
Water Spiral	2.8	0.6	Not Selected
Ball on Membrane	2.5	0.8	Not Selected
Candle Powered Turbine	2.4	1.3	Not Selected
Saving Honey	2.3	1.1	Not Selected
Three-Sided Dice	2.1	0.8	Not Selected
Invisibility	2.0	1.5	Not Selected
Invent Yourself	1.9	1.5	Not Selected

II. Safety Information for Students and Team Leaders

In this section we present the potential safety concerns for each selected problem and provide advice for minimizing the risk of injury or property damage when performing the experiments in a school setting. Students should always discuss safety with their team leader/supervising teacher before performing any experiments.

Problem	Potential Safety Concerns, and Risk Minimizing Advice
Ring on the Rod	<p>Safety Concerns</p> <ul style="list-style-type: none"> Possible concerns about cutting metal rods. The problem statement explicitly mentioned steel rods. Cutting steel rods using power tools may produce sparks. Some students may decide to use threaded rods (as demonstrated by some reference videos). Depending on the thread form and how it is manufactured, the edges of the thread may be sharp. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> Avoid cutting metal rods if possible. It is possible to purchase metal rods of varying length in home improvement stores. Wear appropriate PPEs like gloves and safety goggles when handling threaded rods
Balls on an Elastic Band	<p>Safety Concerns</p> <ul style="list-style-type: none"> The elastic band and metal balls can move fast when released. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> Wear appropriate PPEs like gloves and safety goggles when performing the experiment
Tennis Ball Tower	<p>Safety Concerns</p> <ul style="list-style-type: none"> One might accidentally step on tennis balls, causing injury. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> Ensure that the tennis balls are confined to a region when the tower collapses.
Droplet Explosion	<p>Safety Concerns</p> <ul style="list-style-type: none"> Depending on students' choices of water mixture, organic solvents may be used. Different organic solvent may produce harmful vapour, be flammable, or react with certain materials of the container. The hydrophobic surface of choice is flammable Students may choose to use a syringe with a needle to dispense the droplet. Potential risks with sharps. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> Before choosing to work with a particular chemical, one should always consult the material safety data sheet. Check the chemical compatibility between solvent and the container Wear appropriate PPEs like chemical resistant gloves, sealing safety goggles, and lab coats Ensure that the work space is well ventilated. Work in a fume hood if necessary. Follow proper procedures for waste disposal. Do not pour waste down the drain unless it is safe. Avoid using needles if possible. A replacement can be non-sharp nozzles for syringes. If a needle is needed, place the protective cap over the needle whenever possible and take proper precautions when disposing the needle.
Rayleigh Disk	<p>Safety Concerns</p> <ul style="list-style-type: none"> Thin threads may cause cuts. Exposure to loud sounds may cause hearing loss High-frequency sound may cause discomfort Students may decide to wire their own speaker system. Amplifiers may produce high voltage and current. Diaphragm style speakers often have strong permanent magnets. Magnets can move toward other magnetic materials and cause injury. Diaphragm style speakers can have a high inductance. When switching off current, there could be large back emf(voltage) generated and sparks can be produced. After a long period of operation, the diaphragm style speaker may get hot. Piezoelectric buzzers/transducers may build up charge after mechanical stress. <p>Risk Minimizing Advice</p>

	<ul style="list-style-type: none"> ● Wear appropriate PPEs like gloves, and hearing protection ● Limit the power output of the speaker system if possible ● Secure the speaker and clear the workspace of anything magnetic. (e.g. other magnets, steel tools etc.) ● Switch on and off the speaker system slowly and ensure all exposed wires are properly insulated. Do not have anything flammable near the speaker. ● Check the coils of the speaker for damage before use. Monitor the temperature of the speaker coils and do not operate the speaker above its rated power. ● Occasionally discharge piezoelectric buzzer/transducer.
Equipotential Lines	<p>Safety Concerns</p> <ul style="list-style-type: none"> ● There could be current flow into the water, starting electrolysis. Hydrogen and oxygen gas can be produced. In high enough concentrations, Hydrogen and oxygen gas mixture is highly flammable. ● Depending on the purity of water, ions in the water may also become gas. (e.g. if table salt is added, Cl gas may be produced) ● High enough voltage is a risk for electric shocks. This risk is greater when one's skin is wet. ● Risk of short circuit when electrodes are misplaced. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> ● Avoid high voltage. Keep the voltage below 1.23V (the voltage needed for electrolysis of water). Note that common batteries(including rechargeable types) can exceed this voltage. ● Monitor the current flow at all times. ● If bubbles are produced at the electrode, stop the experiment and check the voltage. ● Wear appropriate PPEs like insulating gloves ● Used distilled water if possible. It can be found at most grocery stores. ● Do not add electrolyte to the water if possible. ● Ensure that the meter is indeed a voltmeter. If a multimeter is used, ensure that the leads are not connected to the low resistance ammeter line.
Boycott Effect	<p>Safety Concerns</p> <ul style="list-style-type: none"> ● There could be hazards associated with the choice of liquid. ● Small particles may be hazardous. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> ● Choose liquids that are non-hazardous. ● Wear appropriate PPEs like gloves, goggles and masks
Unsinkable Disk	<p>Safety Concerns</p> <ul style="list-style-type: none"> ● Metal disk may have sharp edges ● Water jet may cause flooding or other property damage <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> ● Ensure the metal disk is free of sharp edges ● Wear appropriate PPEs like gloves ● Secure the water jet. Check all connections to prevent leaks. Turn on and off water slowly to minimize water hammer effects.
Strange Motion	<p>Safety Concerns</p> <ul style="list-style-type: none"> ● Strong magnets can move together quickly by attractive forces. <p>Risk Minimizing Advice</p> <ul style="list-style-type: none"> ● Wear appropriate PPEs like gloves ● Use protective spacers to separate magnets
Bimetallic Oscillator	<p>Safety Concerns</p> <ul style="list-style-type: none"> ● Risk of electric shock by high voltage

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| | <ul style="list-style-type: none">● High current can cause high temperatures <p>Risk Minimizing Advice</p> <ul style="list-style-type: none">● Avoid using high voltage● Wear appropriate PPEs like gloves and goggles● Monitor the temperature of the experiment and avoid flammable materials |
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