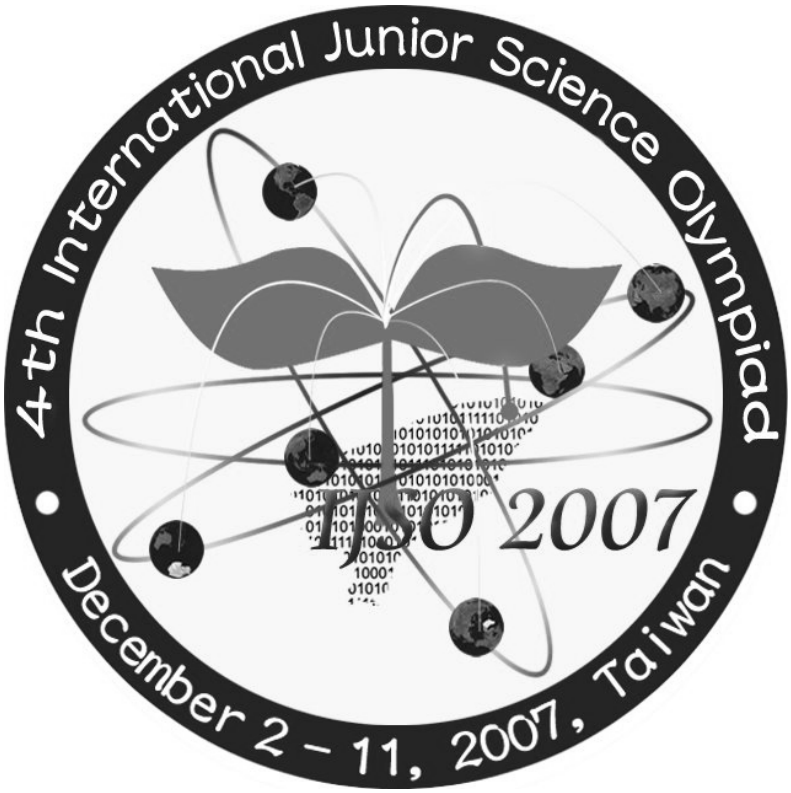
4th International Junior Science Olympiad



Practical Examination

December 08, 2007

Important Remarks

1. While you are in the laboratory, you should wear safety spectacles at all times.
2. Eating of any kind of food is strictly prohibited in the laboratory. If necessary you may ask Lab Assistant and take a snack break nearby the laboratory.
3. The safety showers are located inside the bathroom on both side of the stage.
4. Participants are expected to work safely, to behave socially and to keep equipment and work environment clean. When carrying out discussions with your teammates, keep your voice low.
5. Do not leave the examination laboratory until you have permission to do so. Ask Lab Assistant if you need to use the bathroom.
6. **Work may only begin when the start signal is given.**
7. You have **4.5 hours** (including extra 30 min reading time) to complete the experimental task, and record your results on the answer sheets. There will be a pre-warning 30 minutes before the end of your time. You must stop your work immediately after the stop command is given. A delay in doing this by 5 minutes will lead to zero points for the task.
8. Be sure that your team has a complete set of the experimental examination (3 copies) and the answer sheets (4 copies). **Only one copy (light yellow paper) of the answer sheets should be submitted for marking.**
9. **Use only the pen and calculator provided.**
10. Team code and student codes must be written on every page of the final answer sheets. **Each team member must sign on the front page of the final answer sheets.**
11. All results must be written in the designated boxes on the answer sheets. Data written elsewhere will not be graded.
12. After completing the task, put all the equipments back to its original place and discard all solutions in the beaker labeled “Waste”.
13. **After the stop command is given, put ONLY the final answer sheets (one copy) on top of the envelope on the desk. Wait for the Lab Assistant to check and collect it. You can take the other papers with you.**

A. Introduction

Energy is essential in our everyday life. Electricity is one of the forms of energy that is easily obtained in modern society. To produce and convert electricity efficiently is one of the most important issues in the 21st century. In this task, you will construct a chemical battery, find out how electrolytes affect the current, and assess how well (or poorly) natural products conduct electricity. Electricity can be utilized to promote light, heat, and chemical reactions. You will connect commercial batteries to a system to initiate electrolysis and initiate a chemical process. Heat is an unwanted byproduct upon the conversion of electricity to light. You will determine the temperature of an incandescent lamp.

B. Objectives (They are not necessarily to be solved in sequence.)

I. To study the characteristics of a fruit battery and to determine the factors that influence the efficiency of the fruit battery.

II. To observe the starch particles in potato and to determine how chemical reagents affect them.

III. To assess the relationship between the concentration of an electrolyte and the conductivity of an electrolysis cell. To determine the concentration of an electrolyte solution from the concentration-conductivity relationship and by acid-base titration.

IV. To investigate the thermal and energy transfer properties of the tungsten filament in an incandescent lamp.

C. Apparatus and Materials

Part I: Fruit Battery

Materials	Quantity	Materials	Quantity
Lime	6	Petri-dish	3
Multimeter (in common basket)	1	Ruler (in common basket)	1
Connecting wire	6	Scissor	1
Metal plate	1 set (A, B, C, D)	Binder clips	6
LED device	1	Knife (For Part I & II)	1
Wash bottle 500 mL (in common basket)	1	Paper towel (in common basket)	1
Latex glove (wear all time for Part I, and III)	1 (more are available)	Towel (in common basket)	1

Part II: Starch Granules

Materials	Quantity	Materials	Quantity
Potato	1	Cover slip, Slide	1 set
Microscope	1 set	Iodine solution（1%）	1
Knife (in Part I basket)	1	Reagents (labeled with A, B & C)	3

Part III: Conductivity of electrolyte solution

Chemicals	Quantity	Chemicals	Quantity
0.5 $mol \cdot L^{-1}$ $NaOH_{(aq)}$	100 mL	0.25 $mol \cdot L^{-1}$ $HCl_{(aq)}$	100 mL
A solution of $NaOH_{(aq)}$ of unknown concentration	100 mL	Indicator	1 mL

Apparatus	Quantity	Apparatus	Quantity
Multimeter (in common basket)	1	Burette holder and rack	1
Connecting wire	4	Burette 50 mL	1
Battery set (3V, for this Part only)	1	Funnel	1
Pt electrode	2	Erlenmeyer flask 125 mL	3
Plastic test box	2	Test tube	2
Beaker 600 mL	1	Graduated cylinder 50 mL	1
400 mL	1	10 mL	1
100 mL	4	Dropper	10
Forceps	1	Label	1
Latex glove (in common basket)	1	Towel (in common basket)	1
"Waste" beaker 1000 mL (in common basket)	1	Wash bottle 500 mL (in common basket)	1

*More distilled water are available. Ask Lab Assistant.

*You should wear gloves at all time. In case of skin contact with acid or base, wash with distilled water immediately.

*All glass wares provided are clean, and there is no need to wash before experiments. However, if necessary, you may clean them with a wash bottle and transfer the waste to a beaker labeled "Waste".

*Keep the battery box on the "off" position when not in use as shown below.

off

on

Part IV: Energy Transfer Associated with an Incandescent Lamp:

Apparatus	Quantity	Photo #
Battery set (6V, for this Part only)	1	Photo IV-1
Light Bulb	1	Photo IV-2
Resistors	9	Photo IV-3
Connecting wire	6	Photo IV-4
Thermometer (fixed on the partition. Read only, don't touch)	1	Photo IV-5
Multimeter (in common basket)	2	

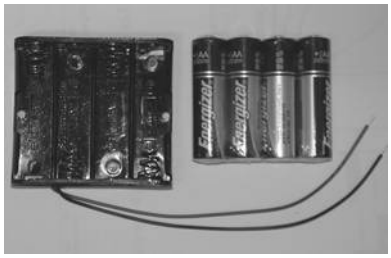


Photo IV-1. Battery set: The voltage is 6 V. There are two leads, positive and negative, colored red and black, respectively. The battery set will be represented by the circuit symbol  .

Photo IV-2. Incandescent light bulb set. This light bulb set has two leads for connection. The light bulb set will be represented by the circuit symbol  .

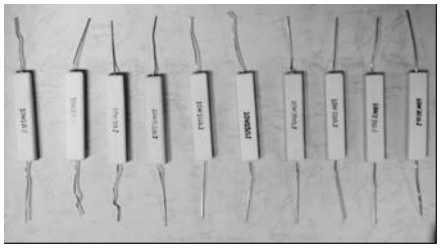
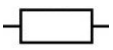
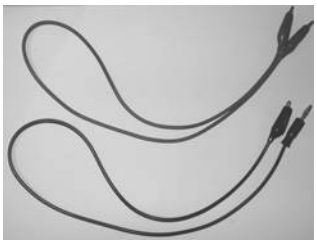


Photo IV-3. Resistors. Each is labeled with power rating (10W), Resistance (~ Ω), and Type (J). The resistor will be represented by the circuit symbol  .



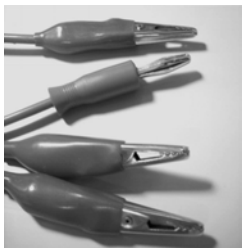
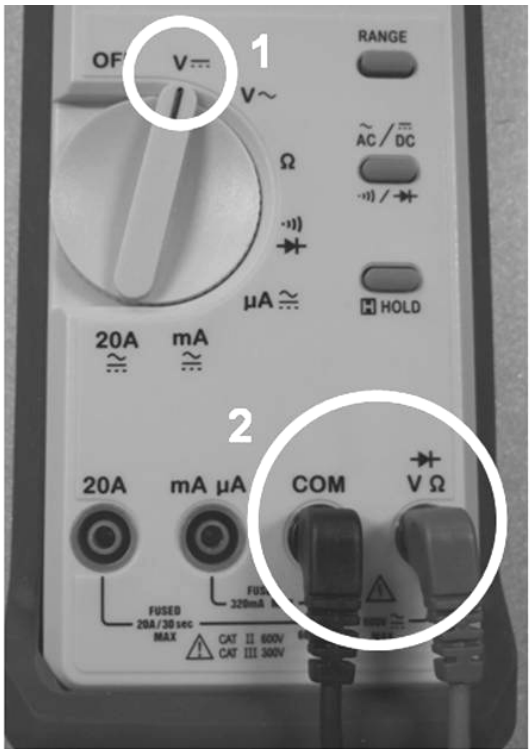


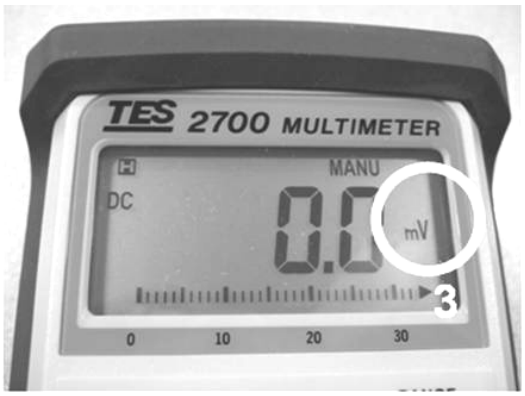
Photo IV-4. Connecting wires. Two types of wires are provided: alligator- alligator and alligator-banana.

Photo IV-5. Thermometer: The thermometer shows Celsius reading. If Fahrenheit reading is shown, ask Lab Assistance. Read the temperature only, do not touch.

Wire connection and dial setting for using Multimeter

Measure Voltage:

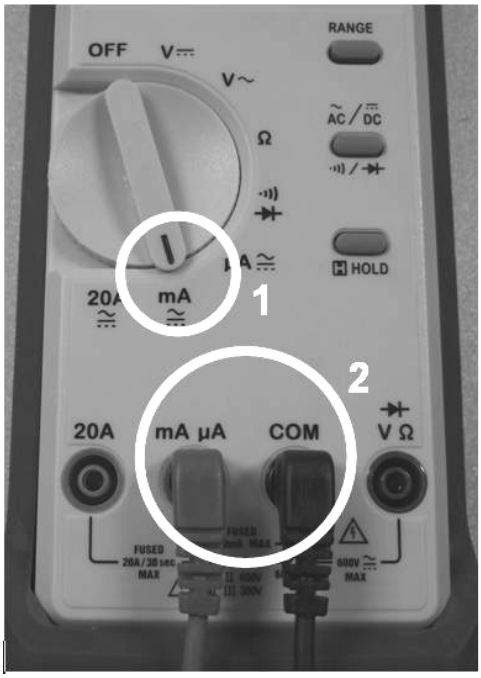




1. Voltage (Direct current)
2. COM (Black);

   V (Red)
3. Voltage unit (V or mV)

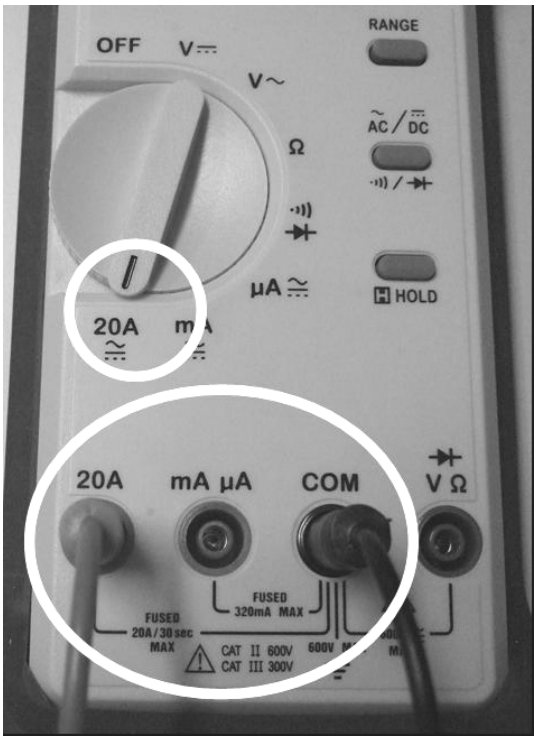
Measure current: There are three ranges setting for measuring current. In Part I and III you will use mA and μA ranges. The wire connection is the same for both mA and μA range measurements, but the dial should turn to the appropriate place.



1. Current
2. COM (Black)

   mA or μA (Red)
3. Current unit (mA)
4. Direct current

In Part IV, you have to use 20 A setting for measuring current. **Incorrect dial setting and wiring of multimeter will cause damages and no points will be given.**



Measure Resistance: Ohm-meter can only be used in the open circuit condition.