

## PhysMate Lab 4: ECG and Exercise

### Start the Software

1. Click on LabScribeLite
2. Click Settings → ECG-Exercise

### ECG Cable and Pulse Transducer Setup

1. Plug the red, black and green leads (C-ISO-SL5) into the PhysMate color coded ports.
2. Plug the PTP-100 Pulse sensor into the Sensor port.



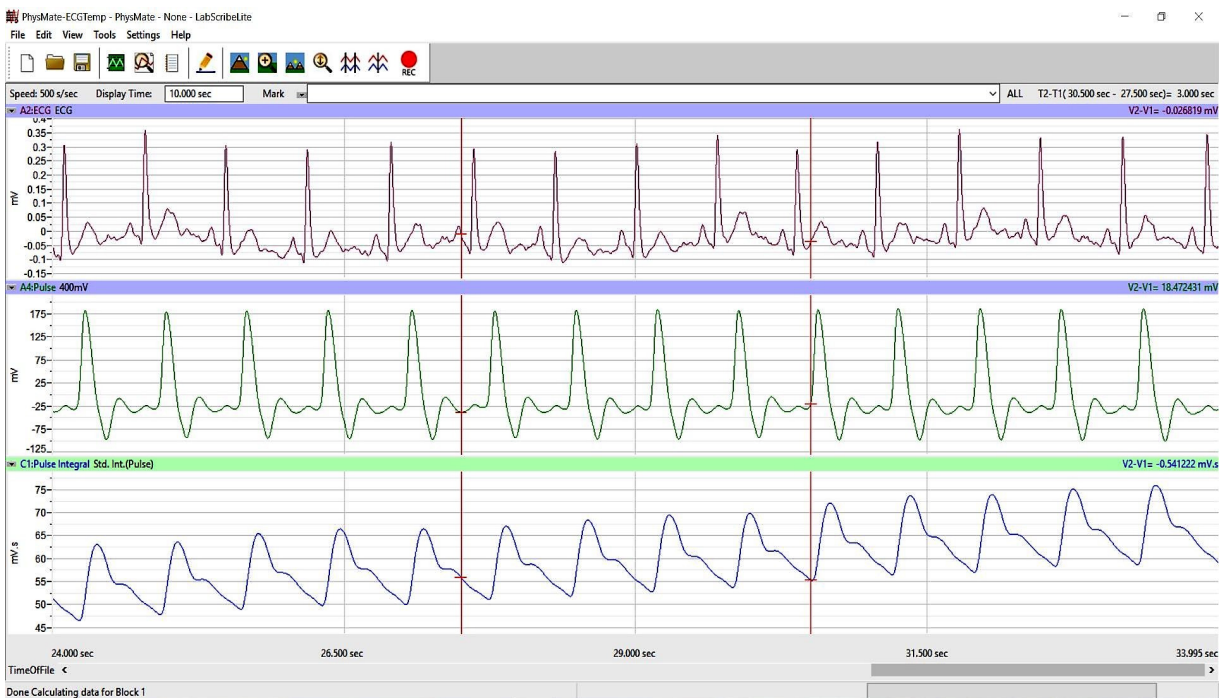
3. Snap the lead wires onto the electrodes:
  - the red lead is connected to the left wrist or under the left clavicle,
  - the black lead is connected to the right wrist or under the right clavicle,
  - the green (ground) lead is connected to the right leg or on the abdomen.
  - Place these electrodes on the subject after you have snapped on the leads.
5. Place the Pulse sensor on the fleshy part of the left thumb or middle finger. Adjust the velcro so the subject can just lightly feel the pulse in their finger.
6. Make sure the subject sits still with their hands in their lap.

## Exercise 1: The ECG and the Pulse in a Resting Subject

Aim: To measure ECG and the pulse in a resting individual.

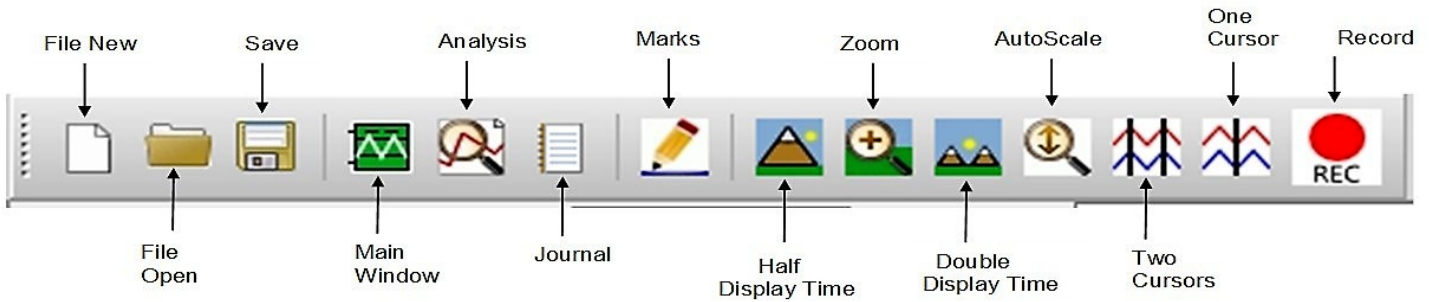
### Procedure

1. Click on the Record button, located on the upper right side of the LabScribe Main window
2. Click on the AutoScale button on the tool bar
  - If a larger ECG signal is required, the electrodes should be moved from the wrists to the skin below each clavicle.
  - If the pulse signal is small or noisy, adjust the tension on the strap.
3. Mark the recording by typing “Resting ECG” in the Mark box and click the Mark button.
4. Record for 5 minutes then click Stop.
5. Select Save As in the File menu and save your data to your Desktop or another folder.

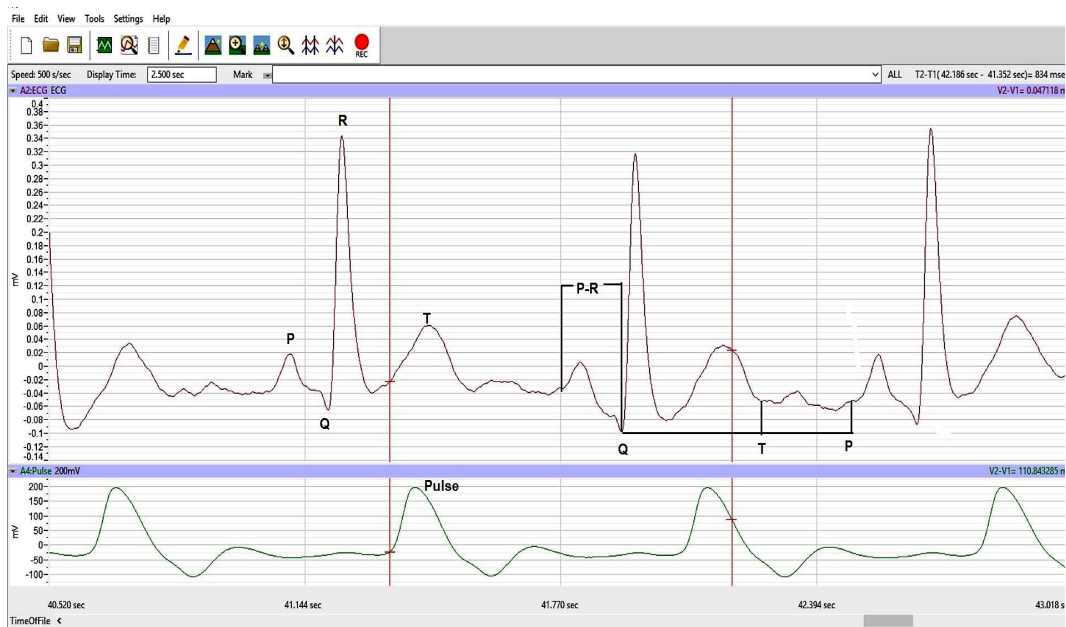


### Data Analysis

1. Go to the beginning of the recording by clicking on the down arrow next to the Mark Button and click Resting-ECG.
2. Make sure to have at least 10 ECG cycles on screen. Double or half the display time by clicking the mountain icons or changing the display time.



3. You will be moving the vertical cursors into position by clicking and dragging on them to get them into the right locations.
  - Place the cursors to measure the amplitudes (V2-V1) and time intervals (T2-T1) of the ECG/Pulse cycles.
4. Use the mouse to click on and drag the cursors to specific points on the ECG/Pulse recording to measure the following (measure at least 5 ECG cycles):
  - The beat period, which is the time interval between two adjacent R waves. Place one cursor on the peak of an R wave and the second cursor on the peak of the adjacent R wave. The value for T2-T1 on the ECG channel is the beat period.
  - The R-Pulse interval, which is the time interval between the peak of the R wave and the peak of the pulse wave that follows the R wave. Place one cursor on the peak of an R wave and the second cursor on the peak of the pulse wave to its right. The value for T2-T1 is this interval.
5. Calculate the following values and record your results into the Journal or on a separate data table:
  - The average beat period, in seconds/beat.
  - The heart rate, which is expressed in beats per minute and calculated from the average beat period by using the following equation:
  - Heart Rate (beats/minute) =  $\frac{60 \text{ seconds/minute}}{\# \text{ seconds/beat}}$
  - The average R-Pulse interval.



## Questions

1. What electrical and mechanical events take place during the R wave?
2. What events take place in the cardiovascular system during the R and pulse waves?
3. The signal recorded on the Pulse channel is rate of change of the blood pressure entering the subject's finger tip. When this signal is integrated, the wave displayed on Pulse Integral channel is similar to an arterial pressure curve.
  - Is there a short plateau or dip during each cycle displayed on the Pulse Integral channel? This plateau or dip is called the dichrotic notch.
4. What event recorded on the Pulse channel corresponds to the dichrotic notch? What causes a dichrotic notch?

## Exercise 2: The Effect of Cold on ECG and Pulse

Aim: To measure the effects of cold on the pulse and heart rate.

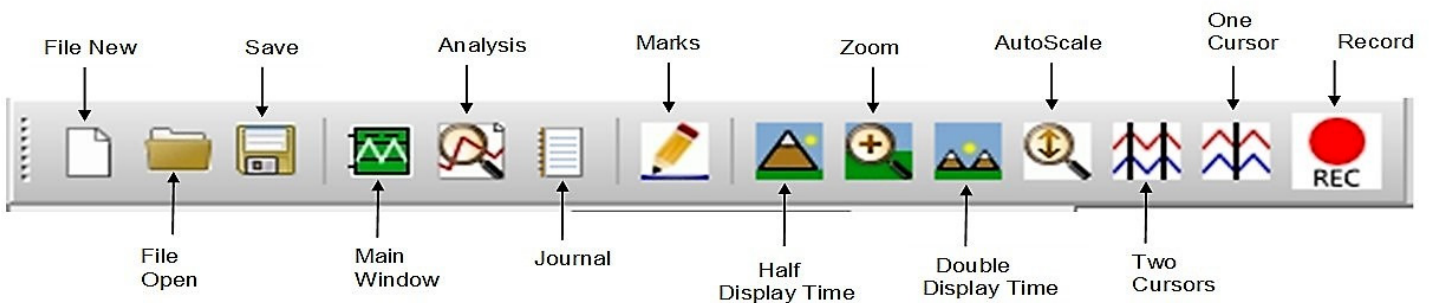
### Procedure

1. Click on the Record button. The signal should begin scrolling across the screen.
2. Click on the AutoScale button.
3. Place a bag containing a mixture of ice and cold water on the subject's left forearm. Type "Cold" in the Mark box and press the mark button. Record for at least two minutes while the cold pack is on the subject's forearm.
4. Type "Remove" in the Mark box and remove the ice bag and press the mark button.

5. Record for at least two minutes; then, click Stop.
6. Click Save to save your data.

### **Data Analysis**

1. Analyze the data using the same techniques used in Exercise 1.
2. Repeat Steps 3, 4 and 5 for the data at 1 and 2 minutes into the cooling period, and at 1 and 2 minutes into the rewarming period
3. Calculate the following values and type your results into the Journal or on a separate data table:
  - The average pulse wave amplitude while the forearm was at room temperature, cooled for 1 and 2 minutes, or rewarmed for 1 and 2 minutes.
  - The heart rate while the forearm was at room temperature, cooled for 1 and 2 minutes, or rewarmed for 1 and 2 minutes.
  - The average R-Pulse interval while the forearm was at room temperature, cooled for 1 and 2 minutes, or rewarmed for 1 and 2 minutes.



### **Questions**

1. What effect does cooling have on the amplitude of the pulse wave?
2. Does cooling of the forearm affect the heart rate, or the time interval between the R wave and the peak of the pulse wave?
3. Through what mechanism does cooling affect the peripheral circulation?
4. What other factors may affect peripheral circulation?

### **Exercise 3: The Effect of Heat on the Pulse**

Aim: To measure the effects of heat on the pulse and heart rate.

#### ***Procedure***

1. Move the pulse sensor to the middle finger or thumb of the subject's right hand.
2. Follow the directions used in Exercise 2 to do an experiment on the right forearm of the subject with a bag of very warm water. Mark the recording to indicate when the bag of warm water was applied and removed from the forearm.

#### ***Questions***

1. What effect does warming have on the amplitude of the pulse wave?
2. Does warming of the forearm affect the heart rate, or the time interval between the R wave and the peak of the pulse wave?
3. Through what mechanism does warming affect the peripheral circulation?