Stair-Climbing Work and Power Lab

Background Information:
Work equals force times the distance through which the force acts. Force is expressed in Newtons (N) and distance is expressed in meters (m). Work is expressed in newton-meters, or the simplification, joules (J).
The rate which work is done is called power. Power equals work divided by time. If work is in joules (J) and time is in seconds (s), power is expressed in joules/second, or the simplification watt (W).

Objective:
1) To find out how much power you use when climbing the stairs.
2) To practice calculating work and power.

Materials:
Metric ruler    stairs    stopwatch

Procedure:
1) Guess your mass in pounds. Weight should be expressed in newtons. Convert pounds to newtons by multiplying pounds by 4.45.
2) Measure the height of one stair (in meters).
3) Count the number of steps you will be climbing—and multiply this by the height of a step to find the total height, in meters.
4) Choose 1 group member to climb the stairs as quickly and as safely as possible while another group member times you. Record the time as accurately as possible. CAUTION: Be very careful.
5) Repeat steps #4 twice, completing two more runs. CAUTION: Be careful, if you are feeling overly exerted, do not continue.

Observations:
1) Were the three climbing times roughly the same, or did they vary considerably?
2) Did you feel as if you exerted the same effort on each climb? Explain.
Analysis:
Calculate your work and you power for each of the three climbs:

<table>
<thead>
<tr>
<th></th>
<th>Work (J)</th>
<th>Power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climb 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climb 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climb 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Was the amount of work you did for each trial the same? Why?

2) Was the amount of power you expended the same for each trial? Why or why not?

3) If you had climbed more slowly, how would the work have been affected? How would the power output have been affected? Explain you answer.

Conclusions:
1) How does your power output in climbing the stairs compare to the power output of a 100-watt light bulb? If your power could have been harnessed and the energy converted to electricity, how many 100-watt bulbs could you have kept burning during your climb?

2) How do you calculate the amount of work done? The amount of power exerted?

3) What is the difference between work and power?

4) Two people climbed to the roof of a building. The old person walked up a gentle ramp. The young person climbed up a steep spiral staircase. Which person did more work? Explain.