

Measuring Time

Time is a unit that is based on the concept of processes that repeat themselves over and over again. The most basic form of time is the division of the solar year into smaller parts called days, days into hours, hours into minutes, and minutes into seconds. The second was at one time defined as a fractional part (1/86,400) of an average solar day as found in the year 1940. This interval of time (about the interval between heart beats for a resting human being) is the standard even today but we have developed a new way to define this time interval more precisely and conveniently. We now define the second as the time that it takes for 9,192,631,770 cycles of an oscillating atom of the element cesium -133.

For all the work we will ever do in real life, the secondary standards (clocks) can be used to measure time. These clocks must be calibrated against the cesium time standard to assure their accuracy. Most of us just assume that any clock that we purchase is calibrated or we set it with a local TV or radio station as often as necessary to keep it close to the correct time. We may also rely in the time set on our other electronic devices as laptops, phones, or tablets.

Using timer (e.g. the timer on your phone), determine the frequency of your heart beat in beats per minute. You can locate your pulse either at your wrist (the radial pulse) or at the side of your neck (the carotid pulse). Record the frequency and period for your pulse in the table. Note that the period can now be calculated by dividing the frequency of beats into unity (one).

$$\text{Period} = 1 / \text{frequency} \quad \text{or} \quad T = \frac{1}{f}$$

Reading	Pulse rate (beats/min)	Frequency f (beats/s)	Period T=1/f (s)
Trial 1			
Trial 2			
Trial 3			
Trial 4			

You can now determine the average of your measurement by adding all measured values and divide by the number of measurements (Trials).

Calculate the average frequency of your heart beat _____

The percent error in a measurement is given by the following equation:

$$\%error = \frac{\square_{experimental} - \square_{theoretical}}{\square_{theoretical}} \times 100$$

where the theoretical value in this case is your average value.

Calculate the % error in the measurement of your heart frequency:

% error _____