

Homework Assignment 9: Solutions

1. The key to deciphering the transformations that were performed to create the new function p from the given function h is to start from the inside and work your way out.

$$p(x) = -h(x + 1) + 2.$$

First transformation: Horizontal shift one unit to the left.

Second transformation: Reflection across the x -axis.

Third transformation: Vertical shift upwards by two units.

2. A graph of $y = p(x)$ is shown in Figure 1 (below).

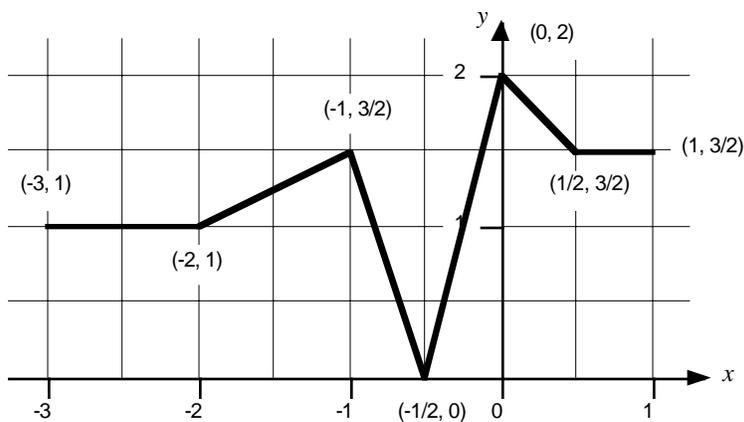


Figure 1.

3. To determine the length of time that each heart beat takes, you can:

- count the number of squares covered by one heart beat, and,
- multiply the number of squares by 0.04 (as each little square represents 0.04 seconds).

The length of one complete heart beat is shown in Figure 2 (below). The little black marks on Figure 2 show where the edges of the squares are. Counting these from Figure 2, one heart beat covers 20 squares, so one heart beat takes $20 \cdot 0.04 = 0.8$ seconds.

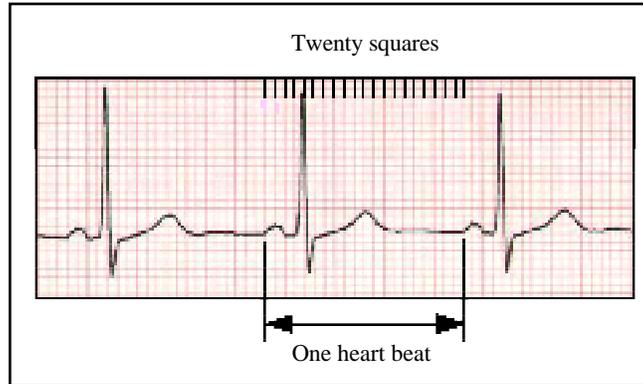


Figure 2: Analysis of the ECG readout.

In one minute, this person's heart will beat a total of $\frac{60}{0.8} = 75$ times.

4. The ECG readout shown in Figure 2 can be interpreted as the graph of a function $y = B(t)$. The main modification that is required is that the function be changed to show 189 heart beats in one minute, rather than just 75. This means that instead of having a duration of 0.8 seconds, each heart beat must now have a duration of:

$$\frac{60}{189} = 0.3175 \text{ seconds.}$$

The modification of the function B that will achieve this is a horizontal stretch. The appropriate stretch factor is:

$$\frac{189}{75} = \frac{0.8}{0.3175} = 2.52.$$

So, when the person's heart is beating at 189 beats per minute the ECG would be represented by the graph of:

$$y = B(2.52*t).$$

5. From Figure 2, the difference between the peak of the "R" wave and the bottom of the "S" wave is 20 squares. Vertically, each square represents 0.1 mV, so the difference between the top of the "R" wave and the bottom of the "S" wave in Figure 2 is $20*0.1 = 2$ mV.

An individual who had a difference between the top of the "R" wave and the bottom of the "S" wave of 30 mV would have an ECG that was 15 times taller than the one shown in Figure 2. The appropriate modification of $y = B(t)$ to represent this situation would be a vertical stretch with a stretch factor of 15. In other words, such an ECG would be represented by the graph of:

$$y = 15*B(t).$$