Objective
The object of this experiment is to
determine the amount of horsepower
I can personally generate in climbing
a set of steps.

Apparatus
The experiment was performed on the
upper bleacher steps located in the
southwest corner of the Norton
fieldhouse. The steps were fairly
steep and of an average height, and
cement construction. There was a 90°
turn before the top steps. The
scale in the southeast corner of the
courtside level was used to calculate
our personal heights.
A standard ruler was used to calculate
the timing device used was a Timer,
Ironman Triathlon stopwatch.

Theory
Gravitational Potential Energy (GPE)
is also known as the energy of elevation.
Any object in a gravitational field
possesses energy by virtue of its
position relative to the ground.
Energy itself is the capacity to do work.
The work done by any force is the product of the force and the distance moved in the direction of the force.

\[ \text{GPE} = \text{weight} \times \text{height} \]

In our example, the GPE, or work, is calculated by multiplying my personal weight by the height of the flight of steps I have climbed.

The increase in potential energy in the gravitational field is thus the amount of work done in lifting myself to the top of the steps.

The rate at which work is done is called Power. Power is the work done divided by the time needed to do the work. Whether I climb the steps in 3 sec or 30 sec, the work done will always remain the same because my weight and the height of the steps I climb remains constant. However, the amount of power used changes when the time needed to complete the task differs. Less power is required when the work is done in more time, and less power is required when the work is done in less time.

\[ \text{Power} = \frac{\text{work}}{\text{time}} \]
In the English system, we say that a horse can do the work of about 550 ft/lbs, so we call 550 ft/lbs/s one horsepower. In order to determine my horsepower, I then divide the power I generated by climbing the steps by 550 ft/lbs.

\[ H_p = \frac{\text{Power (in ft/lbs)}}{550 \text{ ft/lbs/s}} \]

Manipulation:
Mark and I met at the Fieldhouse at 9:45 p.m. on Sunday Jan 7th. We first measured our weight, and then measured the height of the steps which we had pre-determined to be a flight of exactly 20 steps.
I then stood at the top of the steps to time Mark, who began at the very bottom. Mark was given a warning of on your mark, get set, before I said go and started the watch. I stopped the watch as his foot hit the last step. Mark made five attempts either hitting all steps, or skipping some.

We then switched positions and Mark timed me in the same manner. I made five attempts hitting every, or every other step.
Data

Steps 7.5 inches tall
\[ \times 20 \text{ steps} \]
\[ \frac{150 \text{ inches}}{150 \text{ inches}} \]

Height: \( \frac{1.50 \text{ in}}{1 \text{ in}} \times \frac{1 \text{ ft}}{12 \text{ in}} = 1.25 \text{ ft} \) Precision to nearest tenth

My weight 137 lbs Precision to nearest lb

<table>
<thead>
<tr>
<th>Trial</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.78 sec</td>
</tr>
<tr>
<td>2</td>
<td>3.30 sec</td>
</tr>
<tr>
<td>3</td>
<td>3.92 sec</td>
</tr>
<tr>
<td>4</td>
<td>rounded to 3.2 sec</td>
</tr>
<tr>
<td>5</td>
<td>3.16 sec</td>
</tr>
</tbody>
</table>

Trial 4: 3.16 sec to account for an average 1.3 sec human delay in timing

Calculations

\[ \text{GPE} = \text{weight} \times \text{height} \]

\[ \text{GPE} = (137/1\text{ lb}) \times (12.5/1\text{ ft}) = 1712.5 \text{ ft-lbs} \]

\[ = 1710 \text{ ft-lbs} \]

Power = \( \frac{\text{Work}}{\text{time}} \)

\[ \text{Power} = \frac{1710 \text{ ft-lbs}}{3.2 \text{ sec}} = 534.375 \text{ ft-lbs/sec} \]

\[ \text{Horsepower} = \left( \frac{534.375 \text{ ft-lbs/sec}}{1 \text{ hp}} \right) \left( \frac{1 \text{ hp}}{550 \text{ ft-lbs/sec}} \right) = 0.9636 \text{ hp} \]

\[ = 0.96 \text{ horsepower} \]
Results
I have now calculated that my horsepower on my fourth trial was 96.6 hp.

Sources of Error:
- Human, hand held timing is never precise. It varies around 1.3 seconds. I rounded 3.16 sec to 3.2 to try to account for it.
- The scale in the fieldhouse could have been sticking a bit and thus inaccurate. Isn't state precision of scale?!
- Our ruler could have been slightly slanted when calculating the height of the steps, or there could have been a slight variation in the height of the steps.