THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

Design Competition Results
Includes photos shot during the competition and Team Report Submitted by the Team.

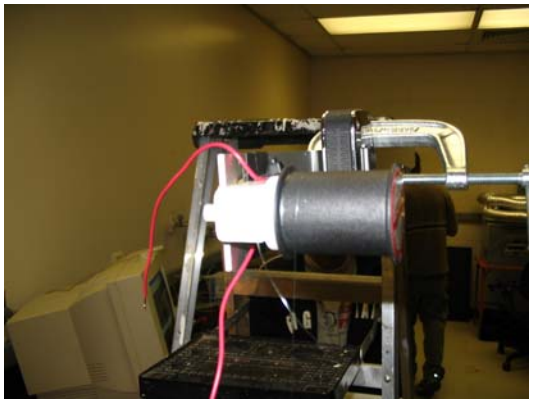
Team 1

Wheel radius = 16 mm
Mass lifted = 464.6 g
Height achieved = 5 ft.
Time used = 4:06 (m:sec)

Design used series connection of solar cells to have highest voltage:



Design used thread spool for reeling in the string with fishing line:



The team selected fishing weights and scrounged metal for their task:



The team discussed their results:

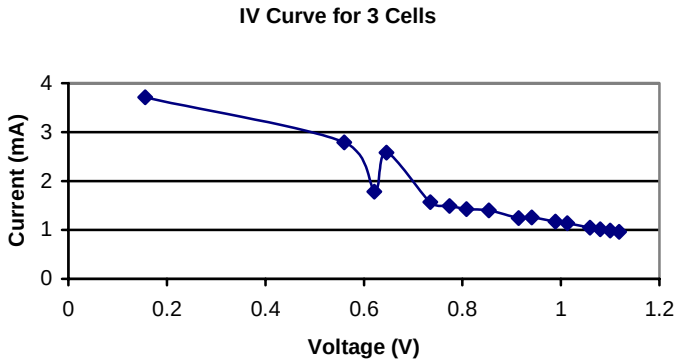


Solar Cell Competition

JD Sorge and Steve Miller
December 9, 2004

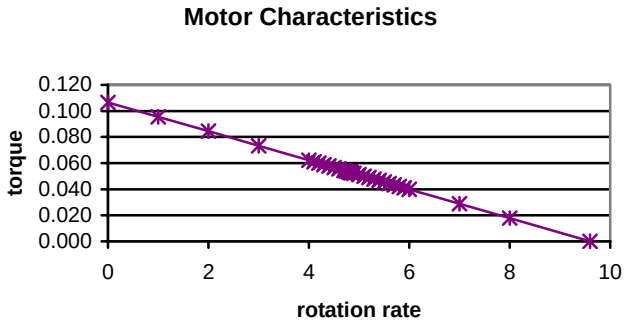
Purpose: Raise the greatest mass possible to a height of 5ft in 5min using three single crystal silicon solar cells and given hobby motor, only adjusting gears and setup.

Solar Cell Characteristics



To characterize our three single crystal silicon solar cells in series, three lamps close to the surface of the cells were used while the current and voltage were measured using two multimeters and a series resistance box. The resistances ranged from zero to 1.13Ω, with the voltage decreasing with resistance while the current increased. The curve should be continuous; however, switching the multimeter from reading in mAmps to Amps caused an unlikely jump in the current, which is only a factor of measurement conditions. The three cells were characterized in series only because the voltage is the limiting factor when connecting to the motor, and a series placement maximizes the voltage.

Motor Characteristics



Following a trial and error experiment, the motor was characterized in a simple manner using the three solar cells as the energy source. Two points were measured in the lab; the first was done by lifting a given mass a given height and the second by counting rotations at the no load speed. The following equations gave rotation rate and torque, respectively.

$$r = (\text{height/circumference}) / \text{time}$$

$$\tau = \text{force} \times \text{radius} = \text{mass} \times \text{gravitational constant} \times \text{radius}$$

Using these two points, a line was produced with an equation used to derive other points to determine the maximum amount of mass able to be lifted in five minutes. At three rotations per minute, and a circumference of approximately 4in, the mass to be lifted in five minutes is 462g.

Since the cells were used to characterize the motor, rather than a battery, no matching of power between the two was explicitly needed. Maximizing the rotation rate ensures that the entire five minutes is utilized which leads to the optimized mass x height for our motor and cell.