Name:

AP Physics C
M. Lam

The Stationary Derrick

Block:

Objective
To design and build the apparatus to hold the greatest load as far from the edge of a table as possible.

Construction Rules

Derrick — A structure that both rests on a table and extends beyond its edge hold the load.
- The derrick must be constructed by the contestants themselves.
- The maximum mass of the derrick is 10 kg.
- The part of the derrick located directly above the table must be able to fit within a box positioned as in Figure 1. This box extends 30 cm above the table's horizontal surface and 40 cm back from the table's edge. It is 30 cm wide. The part of the derrick extending beyond the table's edge can be any height and width.

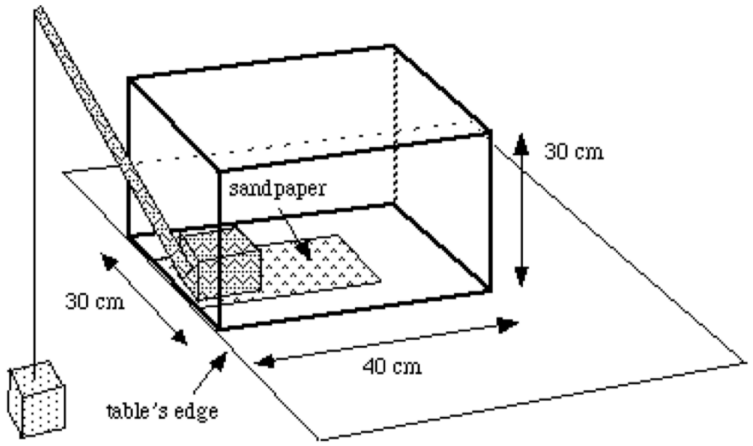

Figure 1: Diagram of the table illustrating the bounding box and a simple derrick.

- No part of the derrick may extend below the plane defined by the table's horizontal surface. Note that this rule applies not only to the part of the derrick above the table but also to the part extending beyond the table's edge.
- The base of the derrick may not have dimensions larger than 20 cm × 20 cm square. The base is the portion of the derrick in contact with the table's surface.
- No part of the derrick may be attached either temporarily or permanently to the table. Moreover, the table's horizontal surface must provide the sole source of support for the derrick; for example, the it cannot be supported by the floor, ceiling or vertical edges of the table's top.

Load —A detachable mass that is supported by the derrick some distance from the table.

- Each team must supply their own load. It may consist of standard laboratory weights and may be of any shape, dimension or material so long as it complies with all other rules. The load must be readily detachable from the derrick for the purpose of scoring.
- The minimum mass of the load is 1 kg. The maximum mass of the load is 10 kg.
- Both the derrick and the load must have a weight related to their mass by the usual formula, $W = mg$, where W is their weight, m is their mass and g is the gravitational acceleration.This relation must hold at all times during the event. In addition, the weight cannot change during the event. Note that this rule restricts the composition and design of the derrick and load. For example, it rules out use of buoyant materials such as helium filled balloons.
- The load must be supported by a single strand of string, wire or fishing line connected to the derrick at a single point. The uppermost point of the load must be at least 10 cm below the plane defined by the table's horizontal surface. The lowermost point of the load should be no more than 50 cm below this plane to ensure that it does not touch the floor. Its width must be such that it does not extend under the edge of the table.

Load Testing

1. The derrick and load must be registered on the competition date. All derricks and loads will be inspected to ensure that all contestants have met the construction rules.
2. The contestants will be provided with a table for the trial. Its surface will be covered with one 9” × 11” sheet of 80 grit garnet paper backed sandpaper secured with masking tape. The sandpaper will extend to the edge of the table.
3. Only one trial will be permitted. Four minutes will be designated for the setup of the derrick. At the expiration of the four minutes or at the completion of the derrick's preparation, contestants will notify the judges they are ready to begin.
4. The trial period will begin when the judges indicate that they are ready and the contestants have released both the derrick and the load.
5. The derrick must remain stationary, within the bounds (Figure 1), without collapsing, for the trial period of one minute. During the period no external intervention is allowed to adjust, steady, or support the derrick. A collapse of the derrick or intervention before the trial period has elapsed will result in a disqualification.

Scoring

Given that the load is at least 1 kg, a score will be given by the formula

$$\frac{m_l d}{m_d}$$

where m_l is the mass of the load (in kg), d is the horizontal distance from the table edge to the thin medium attaching the load to the derrick (in cm) and m_d is the mass of the derrick (in kg).

Derricks will receive a grade based on either the score or placing among all contestants, whichever is higher.

Score (rounded down)	Grade
50	100
48	99
46	98
44	97
42	96
40	95
38	94
36	93
34	92
32	91
30	90
28	89
26	88
24	87
22	86
20	85
18	84
16	83
14	82
12	81
10	80
<10	70
Derrick supports a load of 200 g	50
Disallowed Derricks or Loads*	<50

Place	Grade
1st	100
2nd	98
3rd	96
4th	94
5th	92

*Derricks or loads that do not meet design requirements are scaled between 0 and 50. A derrick scores 50 earns a 50; a derrick that scores 10 earns a 40; a derrick that scores less than 10 earns a 35; a derrick that supports only 200 g earns a 25.