



Monday, March 10, 2003

To: Diane Shankle

From: Tony Fraser-Smith

Subject: Ph.D. Quads Question, 2003

Impact-Triggered Flashing-Light Device

This question was prompted by a company recruiting open house at Stanford. One of the more technically-oriented companies handed out a clear plastic ball with the company's logo on its outside and a spherical plastic insert at its center that would flash for about 30 s (at about 10-20 flashes/s) after the ball was bounced on the ground. One of these balls was taken apart and the plastic insert removed. The insert was then split in half and the electronic "innards" removed. The figure below shows the two halves of the plastic insert and the electronic part. A pen shows the scale. The students had the ball and its operation described, after which they were shown the parts of the plastic insert exactly as they appear in the figure and asked how the electronic part worked. They were allowed to fiddle around with the parts shown as much as they liked, but not allowed to dismember the electronic part (since it was required for other exams).



The answer to this question usually took place in two stages: (1) the various components of the electronic part were identified, and then (2) a hypothesis for how the electronics worked was formulated. For this latter part the students were asked to write down a circuit and to base their hypothesis entirely on what they could identify in the electronic component.

Points for (1) were awarded for identifying two LEDs, one on each side of the green circuit board (left and right in the figure), a small cylindrical spring with a fixed metal rod sticking up along its axis (between the two LED's in the figure), and two small silver oxide button batteries connected in series (underneath the circuit board in the figure). There was sometimes discussion of the black dot that can be seen on the front right of the circuit board, and sometimes it was asserted – probably correctly – that there had to be a "chip" hidden underneath it, but once again the students were instructed to come up with a hypothesis for how that electronics worked based on the components they could see. A point was specifically awarded for recognition that there had to be