

some source of power for the device to work, since, rather incredibly, not all students could identify the batteries.

Points for (2) were awarded for sensible circuits and hypotheses, which left room for some interesting discussions. The following outline several of these discussions:

1. Quite commonly, there was discussion of the circuit arrangement of the two LEDs: were they connected in parallel or series? Here it was helpful to know that an LED requires about 0.8 V to light up, and the silver oxide batteries that appear to power the electronic unit are connected in series and provide about 3 V. These facts led to the conclusion that the LEDs were most probably connected in series rather than in parallel.

2. Two LEDs connected in parallel with a battery power supply could not have a simpler circuit. However, what triggers the flashing light? Obviously some kind of triggering mechanism (or accelerometer) is required and equally obviously this must be the spring component. Most students who identified this component as the trigger argued that it would be displaced as the ball bounced on the ground and that it would touch the vertical metal rod along its axis, thus providing the electrical contact to initiate flashing of the LEDs. But what maintains the flashing? At this point some students argued plausibly that the spring would keep on vibrating and touching the metal rod, thus keeping the flashing going until the vibration of the spring became damped.

3. Some students argued that the spring was actually an inductor and the flashing of the LEDs corresponded to the electrical oscillation frequency of the spring's (or coil's) inductance in parallel with the stray capacitance of the circuit. This led to further consideration of the appropriate angular resonance frequency of an LC circuit: $(LC)^{-0.5}$. Here reasonable assumptions for the values of L and C led to frequencies in the MHz or even GHz range. At this stage most students would dismiss this particular explanation for the flashing.

In general, identification of the various components comprising the electronic component of the flashing ball and reasonable hypotheses for the way it worked (along with intelligent comments on why there were two LEDs and two batteries, instead of one of each) would lead to a perfect score.
