up the primary. Obviously the much greater number of turns in the secondary will lead to higher voltages. During this inspection part of the test the students either noticed or had their attention drawn to the fact that one of the ends of the secondary coil was connected to the aluminum ball on the top and the other end, at the bottom, was connected to the green-colored socket on the right in the picture.; there was no direct electrical connection to any other part of the circuitry. At this time the students either noticed or had their attention drawn to the fact that the two ends of the primary disappeared into the circuitry containing the spark gap that was adjusted by means of the black knurled knob. Some students noticed that the wire comprising the secondary was much thinner than the wire for the primary, suggesting that the primary carried higher current.

Points for (ii) were awarded for sensible explanations for how the coil works based on Faraday's law. These explanations most succinctly made use of Faraday's law in the form:

$$EMF = -\,\partial N/\partial t$$

where EMF indicates the induced emf, N is the magnetic flux threading the circuit, and t is the time. The transformer action discussed above is one part of this explanation, and it involves N. Another part, however, involves the $\partial/\partial t$ term in the above equation. The noise produced by the Tesla coil in the AM radio indicates that high frequencies are involved, and high frequencies imply high $\partial/\partial t$, which in turn implies large emfs according to the Faraday equation. How are these high frequencies produced? This is where the students were expected to home in on the very noisy spark gap. The sparks were obviously very short lived and thus, eureka (for a Stanford EE student): the Fourier transform of an impulse is a function covering a wide range of frequencies in the frequency domain and the range of frequencies becomes larger as duration of the impulse gets smaller, thus the short-lived sparks give a big $\partial/\partial t$ which helps produce the high voltages in the Tesla coil.

To put this question into perspective, the earliest demonstrations of radio waves (e.g., by their discoverer Heinrich Hertz) made use of spark gaps to generate the waves, and the earliest commercial transmitters were all mostly based on spark gap technology.

Finally, a small fluorescent bulb was brought near the Tesla Coil while it was in operation, whereupon it began to glow. Thus the second, minor, question: (2) why does the bulb glow when it is not even connected to the Coil? A hint was given that the bulb contained gas at low pressure along with some mercury vapor. Here it was sufficient to point out that the strong em fields being produced by the Tesla Coil could ionize the gases in the bulb, generating em radiation in the UV and visible ranges. The UV radiation would make the phosphor coating on the inside of the bulb begin to glow.