

Physics for future Presidents

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Homework 13, draft answers due in recitation on Thursday, November 7th
full answers due in lecture on Friday, November 8th

Five questions

This homework presents you with five short questions involving the concepts of light, waves, polarization, *etc.* You're expected to answer each question with one or two short sentences. Make sure you give a good physical (or possibly also physiological) *argument* in your answer, not just an *opinion*!

1. If a mixture of red and green light hits the human eye, it will create the visual impression of “yellow”. The same happens if light of the spectral color yellow (*i. e.*, *not* a mixture of red and green) hits the eye. Why can't the eye tell these obviously different situations apart?
2. A science fiction scenario: the Earth is visited by (benevolent) aliens. They also happen to have eyes which are light sensitive in a range that coincides with the range where human eyes can see (so roughly between 380 nm and 750 nm). However, unlike we humans, the aliens have 16 different color receptor spread out over the visible spectrum, not just 3. One evening alien Xuthus watches the Superbowl with his Earth-friend Steve on Steve's brand new plasma TV. He asks Steve: “Look, I know you spent an awful lot of money on that TV, but the colors are all horribly wrong. They have nothing to do with what things *really* look like! How can you stand watching this? Why don't you humans build TVs which make things appear in the colors they actually have?” Steve, however, is confused. The colors look perfectly fine to him. What is going on?
3. The speed of light in glass is given by $c_{\text{glass}} = c_{\text{vacuum}}/n$, where n is the “*index of refraction*” (which typically has values somewhere around 1.5). In graded-index optical fibers n is not the same everywhere in the fiber. It is bigger near the central axis by maybe 2% compared to the edges of the fiber. Explain, why this can keep light, which is sent through the fiber, inside the fiber.
4. If you buy new ink cartridges for your ink-jet printer, they come in the colors “cyan”, “magenta”, and “yellow”. Do you think that's weird? Haven't we just learned that all colors are made of “red”, “green” and “blue”, because that's what the color receptors in the human eye can see? Why are these complementary colors used?
5. A friend of yours is working on a scientific experiment. Using big card-boards with many parallel slits cut into them he tries to polarize sound waves. Unfortunately, so far all his attempts have failed, and he's quite frustrated. Can you give him some useful advice as to what he should do?