

## Homework Problem 7 – Due March 16

### Chapter 25

#### 62

A magician places an aluminum ring on a table with a hidden electromagnet underneath. When the magician says “abracadabra” (and pushes a hidden switch that starts current flowing through the coil under the table), the ring jumps into the air. Explain this “trick” in detail – what are the applicable laws? (at least 3 sentences for full credit).

### Chapter 26

#### 44

Which have the longest wave lengths: light waves, X-rays, or radio waves?

#### Q1

Sort the following electromagnetic wave by wave velocity, from slowest to fastest (if two of them are equal, any order is fine):

Radio wave in outer space, red laser beam in water, blue laser beam in water, yellow sunlight in Earth’s atmosphere, x-rays in vacuum.

### Chapter 27

#### 40

What color does red cloth appear to be when illuminated with sun light? When illuminated by a red neon sign? When illuminated by cyan light?

#### Q2

A red laser produces ONLY light of a **single** wavelength,  $\lambda = 700$  nm. A filter passes a whole range of wave lengths – with a maximum in the range 680 – 720 nm. When illuminated with a source of white light, it appears to have EXACTLY the same color as the

laser. Is this possible, and if so, how? (Use your knowledge of color perception to explain this.)

## **Chapter 28**

### **Q3**

It is difficult to read a book if you hold it up to the mirror. The conventional wisdom is that that is because left and right are interchanged. I claim that's incorrect – it is actually front and back that are interchanged. Explain why and how that makes the “mirror image” harder to read.

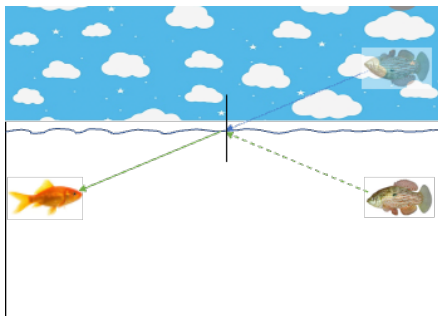
### **Q4**

#### **Part 1:**

You are racing towards a bus stop to catch the bus. Between you and the bus stop, there is a wide, paved, and empty parking lot, followed by a muddy strip of lawn. The most direct path between your present position and the bus stop would cross both the parking lot and the lawn diagonally. Should you run along a straight line? Explain!

#### **Part 2 - XC:**

Explain how this example applies to light traveling from, say, the atmosphere through a layer of water to the bottom of a swimming pool.



### **Q5**

A fish that is submerged 2 m below the surface of a pond is looking at a spot on the boundary between its pond and the atmosphere (i.e., at the pond's surface from below), about 10 m away horizontally from where the fish is located. Surprisingly, the fish doesn't see the sky at all, but rather a perfect reflection from another fish in the pond, 20 m away from its location and also 2 m below the surface. Explain why (and why it doesn't see the sky)!

(Hint: consider the angles made by the light rays in the picture with the vertical).

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