Outline

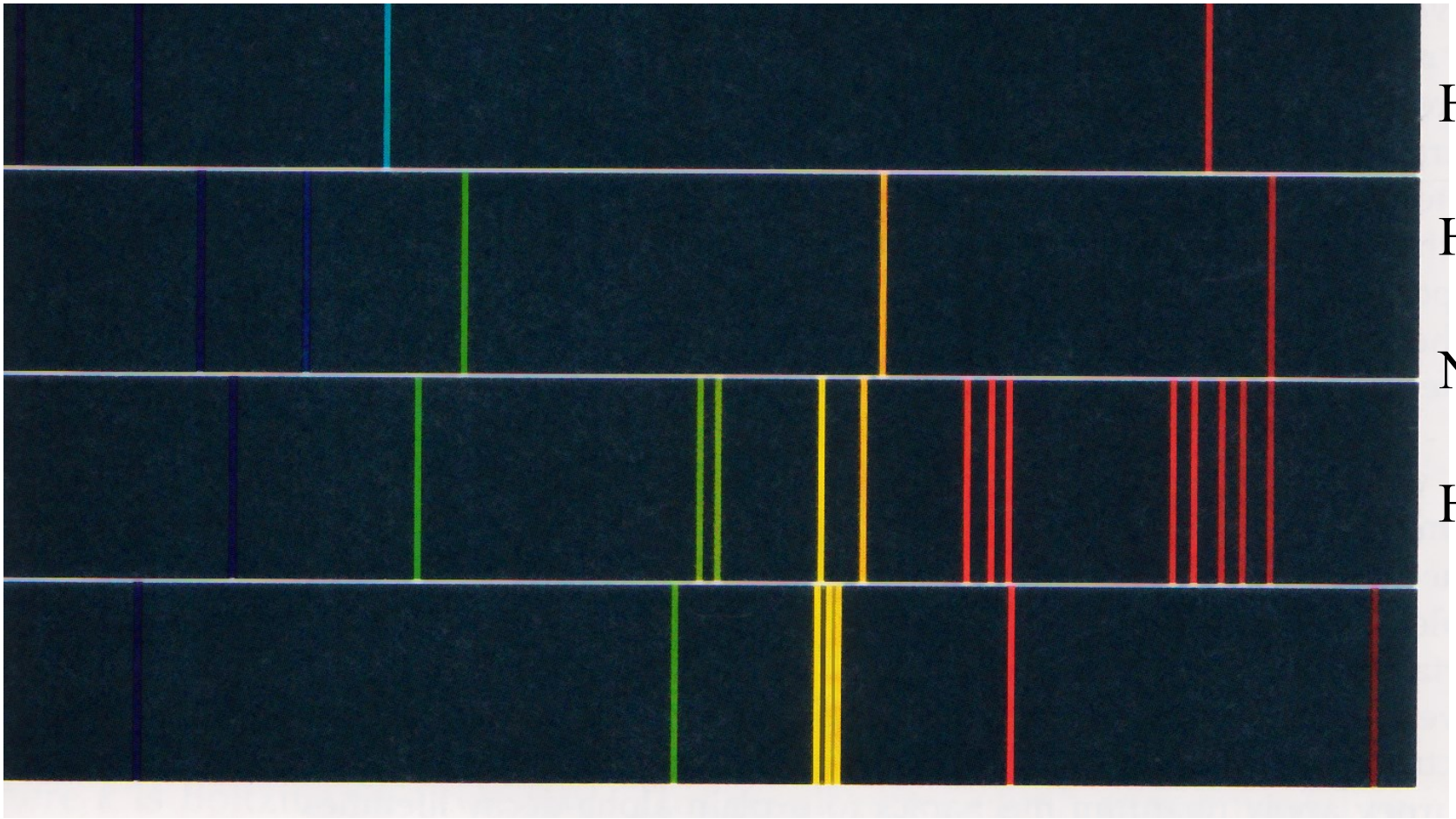
Models of Light

1. Photons
2. Rays

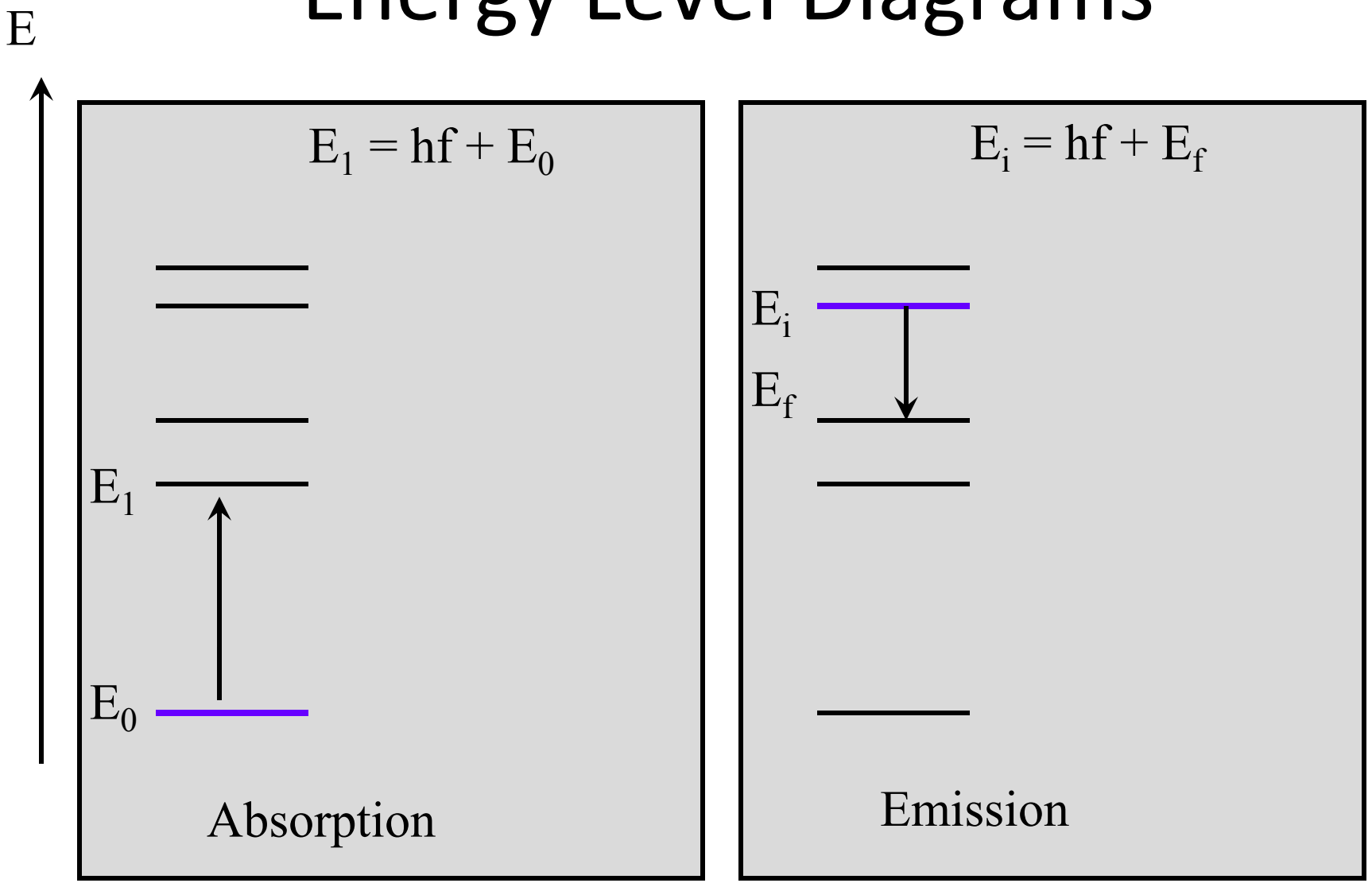
Foothold Ideas: Light interacting with Matter

- Atoms and molecules naturally exist in states having specified energies. EM radiation can be absorbed or emitted by these atoms and molecules.
- When light interacts with matter, both energy and momentum are conserved.
- The energy of radiation either emitted or absorbed therefore corresponds to the difference of the energies of states.

Line Spectra

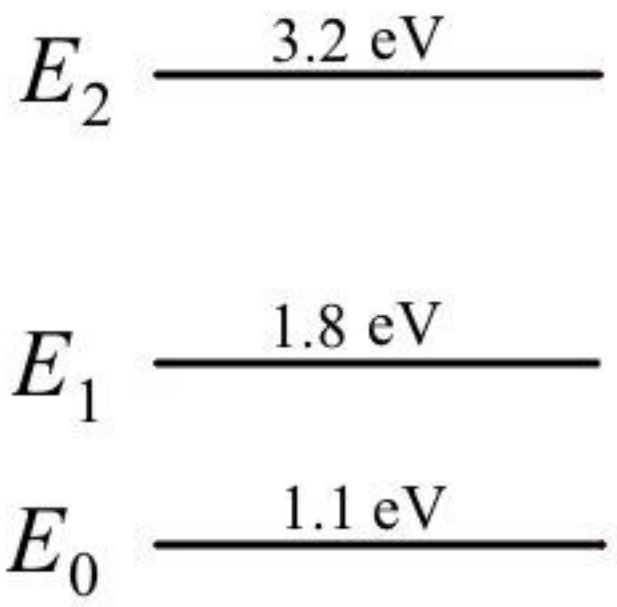


Energy Level Diagrams



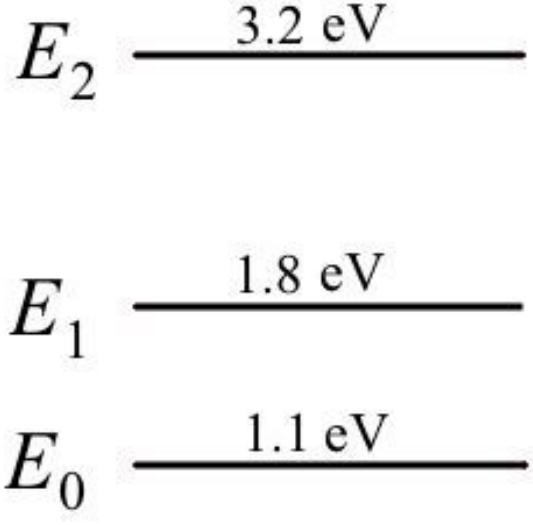
A molecule has the energy levels shown in the diagram at the right. We begin with a large number of these molecules in their ground states. We want to raise a lot of these molecules to the state labeled E_2 by shining light on it. What energy photon should we use?

1. 0.7 eV
2. 1.1 eV
3. 1.4 eV
4. 1.8 eV
5. 2.1 eV
6. 3.2 eV
7. Something else



A molecule has the energy levels shown in the diagram at the right. We have a large number of these molecules in the state E_2. The state decays by emitting photons. What might we expect about the wavelength of the emitted photons?

1. They will be the same as the wavelength of the photons that were used to pump the molecules up to state E_2.
2. Some might be the same wavelength, but some might be shorter.
3. Some might be the same wavelength, but some might be longer.
4. You only expect to see shorter wavelengths
5. You only expect to see longer wavelengths.
6. You will see longer, shorter, and the same wavelengths.



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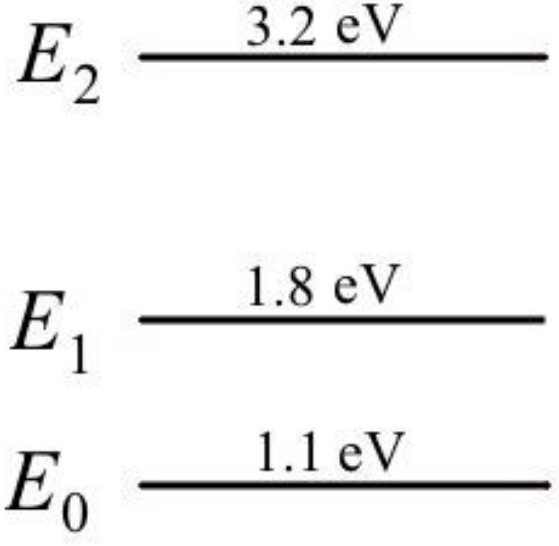
1. B D F
2. B D
3. C
4. C E
5. A C E
6. Some other set



In the transitions you found in the last slide, which corresponds to the longest wavelength? (and what is it)

1. 0.7 eV
2. 1.4 eV
3. 2.1 eV

$$E = hf$$

$$f\lambda = c$$

$$hc = 1234 \text{ eV-nm}$$

$$c = 3 \square 10^{8} \text{ m/s}$$

Foothold Ideas 1:
Light as Rays - The Physics

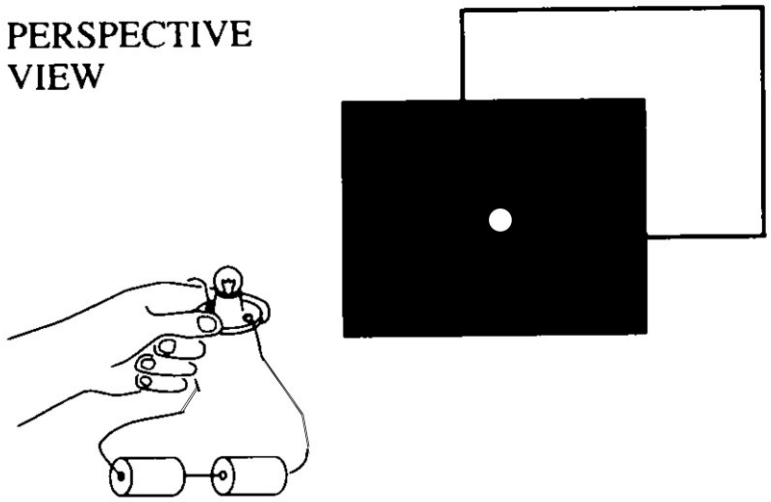
- Through empty space (or ~air) light travels in straight lines.
- Each point on an object scatters light, spraying it off in all directions.
- A polished surface reflects rays back again according to the rule: *The angle of incidence equals the angle of reflection*.

Foothold Ideas 2:
Light as Rays - the perception

- We only see something when light coming from it enters our eyes.
- Our eyes identify a point as being on an object when rays traced back converge at that point.

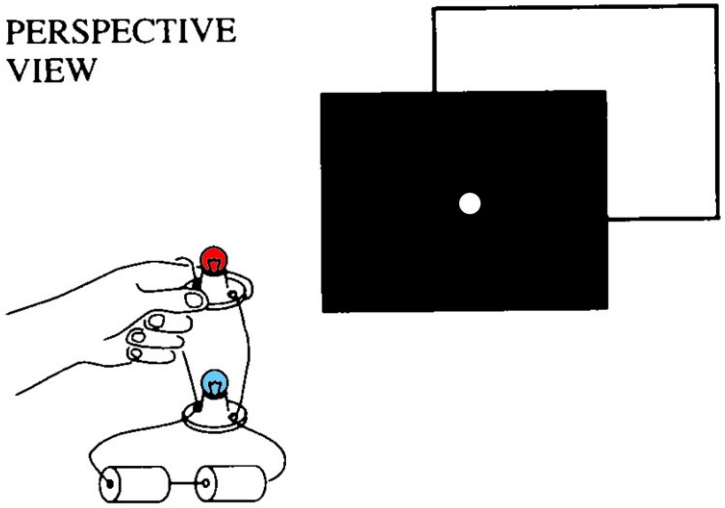
Suppose you have a small brightly lit bulb, a mask (a cardboard screen with a small circular hole cut in it), and a screen. You see a small circle of light on the screen. What would happen to the spot if you moved the bulb straight upward a bit?

1. The spot would stay where it was.
2. The spot would move up a bit.
3. The spot would move down a bit.
4. The spot would move left a bit.
5. The spot would move right a bit.
6. Something else



Suppose you have two lit bulbs, the top one red and the bottom one blue, a mask (a cardboard screen with a small circular hole cut in it), and a screen, as shown. What would you see on the screen if you held the bulbs one over the other as shown?

1. One purple circle.
2. Two circles, one above the other with the top one red, the lower one blue.
3. Two circles, one above the other with the top one blue the lower one red.
4. Something else.



You are sitting in a chair looking at two objects that are suspended from the ceiling. It appears to you that object A is above object B. When you stand up, object A appears to be below object B. Which of the two objects is farther away from you?

1. Object A
2. Object B
3. They are both the same distance.
4. You can't tell. It could be either one