Sunlight

Question:

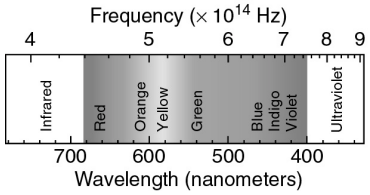
When you look up at the sky during the day, is the light from distant stars reaching your eyes?

Observations About Sunlight

- Appears whiter than most light
- Casts shadows
- Makes the sky appear blue
- Becomes redder at sunrise and sunset
- Reflects from many surfaces, not all metallic
- Bends and separates into colors in materials

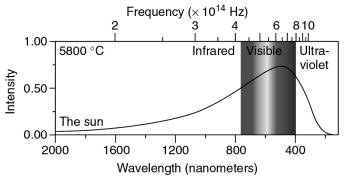
Light

- Medium-wavelength electromagnetic waves
- The range of wavelengths we can see



Spectrum of Sunlight

- Thermal agitation make charges accelerate
- Highly agitated charges emit light
- The sun is a black-body at 5800° C



Rayleigh Scattering

- Passing sunlight polarizes particles in air
- Fluctuating polarization → light emission
- Air particles scatter light (absorb & reemit)
- Air particles too small to be good antennas
- Long-wavelengths (reds) scatter poorly
- Shorter-wavelengths (violets) scatter better
- Scattered light is bluish in appearance

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Refraction

- Polarization of matter delays light's passage
- Light slows as it passes through matter
- As sunlight slows, it bends – refraction
  - On slowing, bend is toward normal line
- As sunlight speeds up, it also refracts
  - On speeding up, bend is away from normal line
- Index of refraction
  - factor by which light's speed is reduced

Reflection

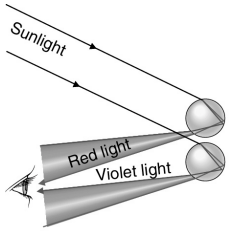
- Light polarizes different materials differently
- In different materials, light has different
  - speeds of travel
  - relationships between electric & magnetic fields
- These changes lead to reflections
  - As sunlight slows, some of it reflects
  - As sunlight speeds up, some of it reflects

Dispersion

- Light's speed in a material depends on color
- Violet light usually moves slower than red
- Refraction (bending) depends speed change
- Violet light usually bends more than red

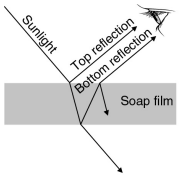
Rainbows

- Refraction, reflection, and dispersion



Interference

- Light from different paths can interfere
  - Constructive – fields are in same direction
  - Destructive – fields are in opposite directions
- The two reflections from a film interfere
- Different colors may interfere differently



Reflection of Polarized Light

- Angled reflection varies for polarized light
- Fluctuating electric field parallel to surface
  - large fluctuating surface polarization
  - big reflection
- Electric field perpendicular to surface
  - small fluctuating surface polarization
  - small reflection

Polarized Sunlight

- Most glare is horizontally polarized light
- Polarizing sunglasses
  - block horizontally polarized light
  - block glare from horizontal surfaces
- Much of the blue sky is polarized light, too