Review Clickers

Chapter 5: Light and Matter: Reading Messages from the Cosmos

When light approaches matter, it can

a) be *absorbed* by the atoms in the matter.
b) be *transmitted* through the matter.
c) bounce off the matter, and be *reflected*.
d) any of the above

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What is light?

a) a wave, like sound only much faster
b) a particle (each one is a *photon*)
c) the absence of dark.
d) energy we *model* with some of the properties of waves and some properties of particles
e) the sensation you feel when hit by energy, visible or invisible

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e) the sensation you feel when hit by energy, visible or invisible

How can light behave as both a wave and a particle?

a) It doesn't really.
b) It really is *both* a wave and a particle.
c) Light and small particles (e.g., electrons and atoms) behave in ways we never see in everyday objects, so we can't describe them in everyday terms.
d) This is what *quantum mechanics* describes.
e) C and D

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Light as a ‘wave – particle duality’

Louis de Broglie (1892 – 1987)

What is the electromagnetic spectrum?

a) The distribution of light of all different wavelengths
b) The distribution of light of all different energies
c) The distribution of photons of all different energies
d) all of the above

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b) The distribution of light of all different energies
c) The distribution of photons of all different energies
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Compared to red light, blue light has

a) shorter wavelengths.
b) longer wavelengths.
c) higher energy photons.
d) A and C
e) none of the above

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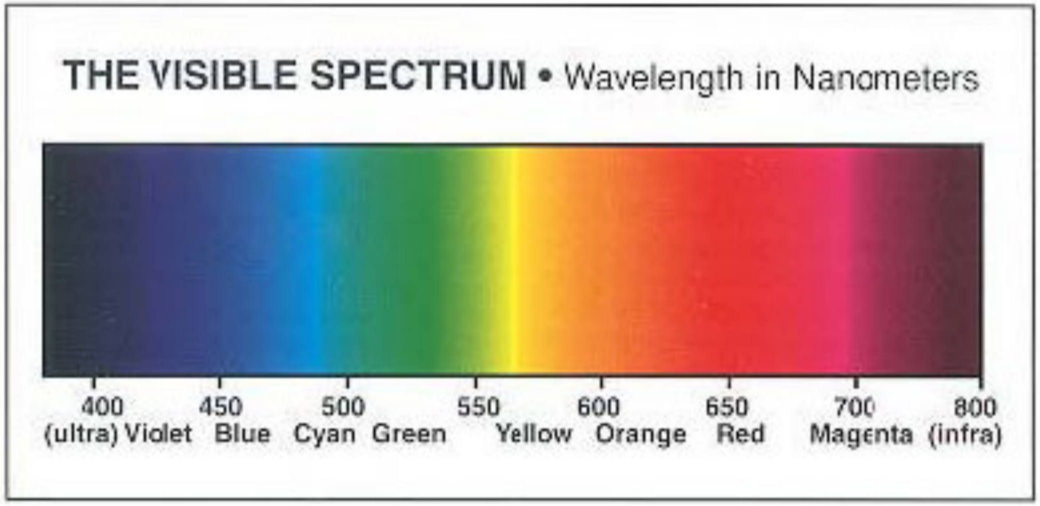

Which of the following lists the different kinds of light in order from shortest to longest wavelength?

a) visible light, ultraviolet, infrared, radio, microwaves, X rays, gamma rays
b) gamma rays, X rays, ultraviolet, visible, infrared, radio
c) x rays, ultraviolet, visible, infrared, radio, gamma rays
d) ultraviolet, visible light, infrared, gamma rays, X rays

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b) **gamma rays, X rays, ultraviolet, visible, infrared, radio**

c) x rays, ultraviolet, visible, infrared, radio, gamma rays

d) ultraviolet, visible light, infrared, gamma rays, X rays

We can't see infrared, but we can perceive it as

a) heat.
b) sound.
c) static.

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Which travels fastest?

a) X rays
b) ultraviolet light
c) visible light
d) radio waves
e) They all travel at the same speed.

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$$c = \lambda f$$

$$c \simeq 300{,}000 \text{ km/s}$$

Which carries the most energy?

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b) X rays
c) ultraviolet light
d) visible light
e) radio waves

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$E = h f$

h: Planck's constant

f: frequency

Which is likely to originate from the hottest (most energetic) object?

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b) X rays
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What happens to thermal radiation (a continuous spectrum) if you make the source hotter?

a) It produces more energy at all wavelengths.
b) The *peak* of the spectrum shifts redward.
c) The *peak* of the spectrum shifts blueward.
d) A and B
e) A and C

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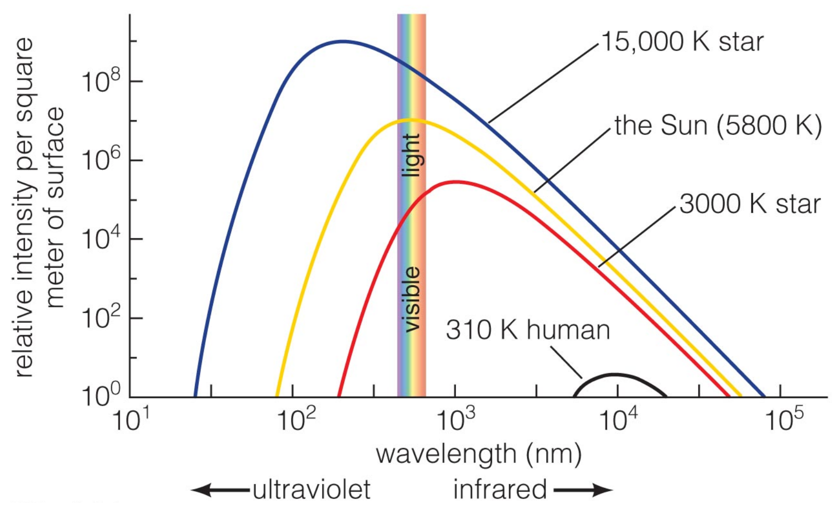

What happens to thermal radiation (a continuous spectrum) if you make the source twice as hot?

a) twice as much energy is emitted
b) 4 times as much energy is emitted
c) 8 times as much energy is emitted
d) 16 times as much energy is emitted

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$$E_1 = \sigma T^4$$

$$E_2 = \sigma (2T)^4$$

$$\frac{E_2}{E_1} = \frac{\sigma}{\sigma} \frac{(2T)^4}{T^4} = 2^4 = 16$$

What is found in the nucleus of atoms?

a) protons with a + charge
b) neutrons with no charge
c) electrons with a – charge
d) all of the above
e) A and B

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What does the 12 in ^{12}C (pronounced "carbon twelve") mean?

a) This is the twelfth element in the periodic table.
b) The atom has 12 protons in its nucleus.
c) The sum of the number of protons and neutrons in its nucleus is 12 (atomic mass number).
d) The atom has 12 electrons.
e) none of the above

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How is the isotope ^{14}C different from ^{12}C?

a) It has more protons.
b) It has more neutrons.
c) It has more electrons.
d) all of the above
e) none of the above

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In what ways is an electron orbiting the nucleus of an atom like a planet orbiting the Sun?

a) Both are held in orbit by a force.
b) The smallest orbits are the most tightly held.
c) If you give an electron or a planet more energy, it will move to a bigger orbit.
d) If you give an electron or a planet enough energy, it can break free.
e) all of the above

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In what ways is an electron orbiting the nucleus of an atom <u>different</u> from a planet orbiting the Sun?

a) The central force is the electromagnetic force, not gravity.
b) Not all orbits are allowed (they are *quantized*).
c) An electron can *jump* or make a *transition* from one orbital to another.
d) All of the above

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When an electron in an atom jumps from a high-energy orbital to a lower-energy one, what happens?

a) a photon of light is emitted
b) a photon of light is absorbed
c) the atom's temperature changes
d) the atom changes color
e) none of the above

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What can cause an electron to jump from a low-energy orbital to a higher-energy one?

a) a photon of light is emitted
b) a photon of light is absorbed
c) the atom's temperature changes
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What's the difference in what you see when visible light of different energies enters your eye?

a) You see a range of brightnesses.
b) You see different colors.
c) Your eye feels different temperatures.
d) More energetic light makes you blink.
e) none of the above

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What kind of spectrum does hot gas produce?

a) emission line
b) absorption line
c) continuous
d) infrared
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Suppose you observed the spectrum of sunlight reflected from Mars. Compared to the spectrum of the Sun observed directly, it would have

a) more emission lines.
b) more absorption lines.
c) more energy in the red part of the spectrum.
d) A and C
e) B and C

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Since each element has a different number of protons and electrons and a different pattern of orbitals,

a) gasses made of different elements have different patterns of emission and absorption lines.
b) each element's spectrum is unique.
c) we can tell what a gas is made of from by looking at its spectrum.
d) all of the above
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In a continuous spectrum, what controls how much energy comes out in different colors (more red or more blue light)?

a) what the object is made of
b) how hot the object is
c) A and B
d) none of the above

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What determines a star's color?

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b) how hot the star is
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The hottest star is one that appears

a) orange.
b) red.
c) yellow.
d) white or bluish-white.
e) They are all the same temperature; they just look different colors.

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What controls the color of a shirt, a planet, or anything that shines by *reflecting* light?

a) its temperature
b) how well it reflects light of different colors
c) the color of the light hitting it
d) B and C
e) A, B, and C

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By looking at the light of a hot, solid object, you can tell

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b) what it is made of.
c) both A and B
d) none of the above

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If a source of light is moving away from you, its spectrum will be

a) shifted to shorter wavelengths (blueshifted).
b) shifted to longer wavelengths (redshifted).
c) unaffected.

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Does the Doppler shift affect sound?

a) yes
b) no

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b) no

Can the Doppler shift be measured with invisible light?

a) yes
b) no

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a) yes

b) no

We should not expect to see a visible emission line spectrum from a very cold cloud of hydrogen gas because

a) hydrogen gas does not have any visible emission lines.
b) the gas is too cold for collisions to bump electrons up from the ground state (lowest energy level).
c) hydrogen gas is transparent to optical light.
d) emission lines are only found in hot objects.

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If the Sun's surface became much hotter (while the Sun's size remained the same), it would emit more ultraviolet light but less visible light than it currently emits.

a) Yes, because the visible light would be absorbed by the Sun's warmer surface.
b) Yes, because the Sun's warmer surface would emit more ultraviolet light and less visible light.
c) No, the Sun's warmer surface would emit less light at all wavelengths.
d) No, the Sun's warmer surface would emit more light at all wavelengths.
e) No, because if the Sun's size remained the same, the amount of light emitted would remain the same at all wavelengths.

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d) **No, the Sun's warmer surface would emit more light at all wavelengths.**
e) No, because if the Sun's size remained the same, the amount of light emitted would remain the same at all wavelengths.

If a distant galaxy has a substantial redshift (as viewed from our galaxy), then anyone living in that galaxy would see a substantial redshift in a spectrum of the Milky Way Galaxy.

a) Yes, and the redshifts would be the same.
b) Yes, but we would measure a higher redshift than they would.
c) Yes, but we would measure a lower redshift than they would.
d) No, they would not measure a redshift toward us.
e) No, they would measure a blueshift.

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