HW04 - Electromagnetic Radiation

1 1 point

What is the frequency of light with a wavelength of 4.0×10^{-7} m?

- ○ 7.5×10^{14} s^{-1}
- ○ 1.3×10^{-15} s^{-1}
- ○ 3.0×10^{-14} s^{-1}
- ○ 3.0×10^{14} s^{-1}

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2 1 point

What is the correct order of increasing frequency?

- ○ radio waves, infrared radiation, visible light, ultraviolet radiation
- ○ ultraviolet radiation, visible light, infrared radiation, radio waves
- ○ radio waves, visible light, ultraviolet radiation, infrared radiation
- ○ radio waves, infrared radiation, ultraviolet radiation, visible light
- ○ infrared radiation, radio waves, visible light, ultraviolet radiation

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3 1 point

Light with a frequency of 7.30×10^{14} Hz lies in the violet region of the visible spectrum. What is the wavelength of this frequency of light?

- ○ 411 nm
- ○ 4.11×10^{-16} nm
- ○ 4.11×10^{21} nm
- ○ 4.11×10^{-7} nm

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4 1 point

When an electron beam strikes a block of copper, x-rays of frequency 1.97×10^{19} Hz are emitted. What is the wavelength of these x-rays?

- ○ 15.2 nm
- ○ 1.52×10^{-11} nm
- ○ 15.2 pm
- ○ 1.52×10^{-2} pm

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5 1 point

Wavelength is...

- ○ the distance between successive peaks in a wave.
- ○ the number of waves passing a fixed point in one second.
- ○ the distance between a peak of one wave and the trough of the next.
- ○ one-half of the height of a wave.

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6 1 point

Frequency is...

- ○ the distance between successive peaks in a wave.
- ○ the number of waves passing a fixed point in one second.
- ○ one half the height of the wave.
- ○ the distance between a peak in one wave to the trough in the next wave.

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7 1 point

It takes light with a wavelength of 212 nm to break the N-H bond in ammonia. What energy is required per photon to break this bond? What is the N-H bond strength in terms of kJ per mole?

- ○ 6.61×10^{-22} kJ/photon; 398 kJ/mol
- ○ 9.38×10^{-22} kJ/photon; 565 kJ/mol
- ○ 9.38×10^{-22} kJ/photon; 565,000 kJ/mol
- ○ 6.61×10^{-22} kJ/photon; 0.398 kJ/mol

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8 1 point

In 1 sec, a 60 W bulb emits 11 J of energy in the form of infrared radiation (heat) of a corresponding wavelength of 1850 nm. How many photons of infrared radiation does the lamp generate in 1 sec?

- ○ 6.63×10^{23} photons
- ○ 1.10×10^{-19} photons
- ○ 1.02×10^{20} photons
- ○ 1.04×10^{29} photons

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9 1 point

A photon has a frequency of 223 MHz. What is the energy of this photon?

- ○ 8.91×10^{-22} J
- ○ 8.91×10^{-28} J
- ○ 1.48×10^{-25} J
- ○ 1.48×10^{-31} J

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10 1 point

Carbon emits photons at 745 nm when exposed to blackbody radiation. How much energy would be obtained if 44g of carbon were irradiated? Assume each carbon atom emits one photon.

- ○ 9.1×10^{5} J
- ○ 2.7×10^{-19} J
- ○ 5.9×10^{5} J
- ○ 7.1×10^{6} J

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11 1 point

A 200 nm photon has ______ times the energy of a 700 nm photon.

- ○ 3.5
- ○ 4.2
- ○ 0.37
- ○ 0.29

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12 1 point

If a photon's wavelength is 663 µm, what is its energy?

- ○ 3.00×10^{-22} J
- ○ 4.40×10^{-43} J
- ○ 4.40×10^{-46} J
- ○ 3.00×10^{-25} J

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13 1 point

Sodium vapor lamps, used for public lighting, emit yellow light of a wavelength of 570 nm. How much energy is emitted by an excited sodium atom when it generates a photon?

- ○ 2.8×10^{-19} J
- ○ 2.8×10^{-20} J
- ○ 3.5×10^{-19} J
- ○ 3.5×10^{-28} J

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14 1 point

Consider the sodium vapor lamps described in question 13. How much energy is emitted by 45.8 mg of sodium atoms emitting light at this wavelength? Assume each sodium atom emits one photon.

- ○ 420 J
- ○ 4.2×10^{5} J
- ○ 2.0×10^{-3} J
- ○ 2.0×10^{21} J

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15 1 point

A particular metal has a work function of 1.05 eV. A light is shined onto this metal with a corresponding wavelength of 324 nm. What is the maximum velocity of the photoelectrons produced? (Hint: 1eV = 1.6022×10^{-19} J, mass of an electron = 9.11×10^{-31} kg)

- ○ No photoelectrons are produced.
- ○ 1.35×10^{12} m/s
- ○ 9.89×10^{5} m/s
- ○ 1.16×10^{6} m/s

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16 1 point

A particular metal has a work function of 3.05 eV. A light is shined onto this metal with a corresponding wavelength of 524 nm. What is the maximum velocity of the photoelectrons produced? (Hint: 1eV = 1.6022×10^{-19} J, mass of an electron = 9.11×10^{-31} kg)

- ○ 8.32×10^{11} m/s
- ○ 9.12×10^{5} m/s
- ○ 8.72×10^{8} m/s
- ○ No photoelectrons are produced.

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17 1 point

Max Planck's theory averted the so called "UV Catastrophe" of classical mechanics. Which of the following best describes *how* Planck's theory avoided the "UV Catastrophe"?

- ○ Radiation emitted by blackbody radiators will reach UV energy levels only at extremely high temperatures.
- ○ Radiation given off by blackbody radiators can only be emitted in quantized amounts.
- ○ Radiation given off by blackbody radiators can be emitted in all types of radiation, not just UV radiation.
- ○ Eventually, blackbody radiators can cool to a temperature of absolute zero, resulting in its inability to release any more UV radiation.

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18 1 point

The de Broglie equation was important for a number of reasons, not least of which was that it demonstrated that _______.

- ○ only macroscopic objects have wavelengths.
- ○ all objects have a wavelength. However, in the case of macroscopic objects, these wavelengths are so small that they can be ignored.
- ○ all objects have a wavelength. However, in the case of quantum objects, these wavelengths are so small that they can be ignored.
- ○ only quantum objects have wavelengths.

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19 1 point

An atom of which element, moving at 240 m/s, would possess a de Broglie wavelength of 1.40×10^{-11} m?

- ○ At
- ○ Cs
- ○ Sn
- ○ Mn