

Period 3 Exercise Answers

E.1 An electron absorbs a photon that has 5.0×10^{-21} joules of energy and the electron moves to a higher energy level. The electron later drops to a lower energy level and emits a photon that has 3.3×10^{-22} joules of energy. How much more energy must be emitted to satisfy conservation of energy?

- a) 1.7×10^{-22} joules
- b) 4.7×10^{-22} joules
- c) 1.7×10^{-21} joules
- d) 4.7×10^{-21} joules
- e) 4.7×10^{-20} joules

The total energy emitted by the electron must equal the total energy absorbed. Subtract to find the difference between the energy absorbed and the energy emitted. **When adding or subtracting numbers in scientific notation, each term must have the same power of ten.**

$$\begin{array}{r} 5.0 \times 10^{-21} \text{ J} \\ - 3.3 \times 10^{-22} \text{ J} \\ \hline \end{array} = \begin{array}{r} 5.0 \times 10^{-21} \text{ J} \\ - 0.33 \times 10^{-21} \text{ J} \\ \hline 4.7 \times 10^{-21} \text{ J} \end{array}$$

Or

$$\begin{array}{r} 5.0 \times 10^{-21} \text{ J} \\ - 3.3 \times 10^{-22} \text{ J} \\ \hline \end{array} = \begin{array}{r} 50.0 \times 10^{-22} \text{ J} \\ - 3.3 \times 10^{-22} \text{ J} \\ \hline 46.7 \times 10^{-22} \text{ J} = 4.7 \times 10^{-21} \text{ J} \end{array}$$

E.1 = d

E.2 The part of the electromagnetic spectrum that causes tanning is

- a) the infrared.
- b) the ultraviolet.
- c) the yellow end of the visible spectrum.
- d) radio waves.
- e) All of the above cause tanning.

E.2 = b

E.3 A signal with an average energy of 4,000 joules has a signal-to-noise ratio of 200. The average energy of the noise is then reduced so that it is 4 times smaller. What is the new signal-to-noise ratio?

- a) 20
- b) 50
- c) 200
- d) 800
- e) 1,000

Using **ratio reasoning**: If we decrease the noise by $\frac{1}{4}$, then the SNR is 4 times larger. The SNR is now $4 \times 200 = 800$.

Using the **equation**:

$$\text{SNR} = \frac{\text{average energy in the signal}}{\text{average energy in the noise}}$$

$$\text{noise} = \frac{\text{signal}}{\text{SNR}} = \frac{4,000 \text{ J}}{200} = 20 \text{ J}$$

making the noise 4 times smaller = $\frac{1}{4} (20 \text{ J}) = 5 \text{ J}$

$$\text{SNR} = \frac{4,000 \text{ J}}{5 \text{ J}} = 800$$

E.3 = d

E.4 In broadcasting, the term “carrier wave” refers to the sine wave being sent out from a radio station at its operating frequency. Which of the following techniques could be used to encode a signal on a carrier wave?

- a) modulation of the amplitude of the carrier wave
- b) modulation of the frequency of the carrier wave
- c) modulation of the speed of the carrier wave
- d) Either a) and b) could be used to encode a signal.
- e) All of the above techniques could be used to encode a signal.

Carrier waves are waves of electromagnetic radiation that travel at the same speed (3×10^8 m/s or 186,000 miles/s).

E.4 = d

E.5 A radio station broadcasts at a frequency of 105.7 megahertz (MHz). What is the wavelength of the station's carrier wave?

- a) 0.35 meters
- b) 2.8 meters
- c) 5.6 meters
- d) 28 meters
- e) 105.7 meters

$$L = \frac{s}{f} = \frac{3 \times 10^8 \text{ m/s}}{105.7 \times 10^6 \text{ 1/s}} = \frac{3 \times 10^8 \text{ m/s}}{1.057 \times 10^8 \text{ 1/s}} = 2.8 \text{ m}$$

E.5 = b

E.6 You are attending a concert and have a seat at the back of the auditorium, 50 meters from the stage. Your friend is listening to the same concert on her radio at home, 10 kilometers from the concert hall. If there is no delay in the broadcast of the concert, who do you think hears the sound first?

Find the time for the radio waves to travel 10 km.

Convert km into meters:

$$10 \text{ km} \times \frac{1,000 \text{ m}}{1 \text{ km}} = 10,000 \text{ m} = 1 \times 10^4 \text{ m}$$

Speed of radio waves = $3 \times 10^8 \text{ m/s}$.

$$S = \frac{D}{t} \text{ or } t = \frac{D}{S} = \frac{1 \times 10^4 \text{ m}}{3 \times 10^8 \text{ m/s}} = 0.33 \times 10^{-4} \text{ s}$$

Find the time for the sound waves to travel 50 meters in the auditorium.

Speed of sound waves is 340 m/s.

$$t = \frac{D}{S} = \frac{50 \text{ meters}}{340 \text{ meters/s}} = 0.15 \text{ s}$$

If there is no delay in the broadcast of the concert, **your friend at home** hears the sound first.

Period 3 Exercise Answers

E.1 = d

E.2 = b

E.3 = d

E.4 = d

E.5 = b

E.6 = your friend at home