

Amplitude Energy Lab

Use amplitude ratios to model wave energy.

GRADES 6-8 • MS-PS4-1

MS-PS4-1 "Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave..."

NAME _____

DATE _____

AMPLITUDE SQUARED

In a simple wave model, energy is proportional to amplitude squared. Use $E_2 = E_1 \times (A_2/A_1)^2$, where A is amplitude and E is energy.

WORKED EXAMPLE

A repeating wave has an amplitude of 3 cm and carries 18 model energy units. What energy will it carry at an amplitude of 6 cm?

1. Amplitude factor = $6 / 3 = 2$.
2. Energy factor = $2^2 = 4$.
3. New energy = $18 \times 4 = 72$ model energy units.

Answer: 72 model energy units

PRACTICE 6 problems

- 1** A repeating wave has an amplitude of 2 mm and energy of 5 model units. What is its energy at an amplitude of 4 mm?

ANSWER _____

- 2** A wave's amplitude changes from 8 cm to 4 cm. Its first energy is 32 model units. Find its new energy.

ANSWER _____

- 3** A wave has an amplitude of 5 cm and energy of 45 model units. Its energy later becomes 180 model units. What is its new amplitude?

ANSWER _____

- 4** A wave has energy of 7 model units. Its amplitude becomes 5 times its original amplitude. What is the new energy?

ANSWER _____

- 5** A water wave has an amplitude of 12 cm and energy of 64 model units. Its amplitude changes to 9 cm. Find its new energy.

ANSWER _____

- 6** A wave has energy of 96 model units. Its amplitude is cut in half. Find its new energy.

ANSWER _____

APPLY IT Show your work

- 1** A student in a music club models a repeating drumhead vibration. At an amplitude of 4 mm, the vibration carries 12 model energy units. During a louder section, the amplitude is 10 mm. How many model energy units does it carry?

WORK SPACE

ANSWER _____

- 2** A water park's repeating wave pool waves have an amplitude of 14 cm and carry 98 model energy units. A new setting must make the waves carry 9 times as much energy. What amplitude is needed?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Wave A has an amplitude of 15 cm and energy of 45 model units. Wave B carries 80 model energy units. What is Wave B's amplitude? Explain using an energy ratio and an amplitude ratio.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	A repeating wave has an amplitude of 2 mm and energy of 5 model units. What is its energy at an amplitude of 4 mm?	20 model energy units
2	A wave's amplitude changes from 8 cm to 4 cm. Its first energy is 32 model units. Find its new energy.	8 model energy units
3	A wave has an amplitude of 5 cm and energy of 45 model units. Its energy later becomes 180 model units. What is its new amplitude?	10 cm
4	A wave has energy of 7 model units. Its amplitude becomes 5 times its original amplitude. What is the new energy?	175 model energy units
5	A water wave has an amplitude of 12 cm and energy of 64 model units. Its amplitude changes to 9 cm. Find its new energy.	36 model energy units
6	A wave has energy of 96 model units. Its amplitude is cut in half. Find its new energy.	24 model energy units

PART 2 • APPLY IT

- 75 model energy units** The amplitude factor is $10/4 = 5/2$. Square the factor, then multiply: $12 \times (5/2)^2 = 12 \times 25/4 = 75$.
- 42 cm** An energy factor of 9 means the amplitude factor is 3 because $3^2 = 9$. Multiply the original amplitude: $14 \times 3 = 42$ cm.

CHALLENGE

20 cm. The energy ratio is $80/45 = 16/9$, so the amplitude ratio is $4/3$. Wave B's amplitude is $15 \times 4/3 = 20$ cm.

Accept equivalent ratio work, including simplifying ratios before squaring. Students should square the amplitude factor, not multiply energy by the amplitude factor alone.