

## Clicker Question

Which way does the air move on average after an airplane flies through it horizontally at a constant westward velocity?

- A. Horizontally eastward.
- B. Eastward and downward.
- C. **Downward.**
- D. The air does not move on average.

## Clicker Question

Why can't a commercial jetliner keep increasing its angle of attack to rise faster?

- A. It will start flying in loop-the-loops.
- B. **Turbulence will develop behind the wings.**
- C. Its engines won't point forward enough.
- D. Passengers will fall to the back of the plane.

## Introductory Question (revisited)

As you ride in a jet airplane, the clouds are passing you at 600 mph. The air that has just entered part way into the intake duct of one of the huge jet engines is traveling

- A. much faster than 600 mph.
- B. **much slower than 600 mph.**
- C. about 600 mph.

## Introductory Question

Which is more effective at heating a room:

- A. **a black woodstove**
- B. a shiny gold-plated woodstove
- C. both woodstoves are equally effective

## Clicker Question

Burning something always release thermal energy. Why doesn't burning something ever absorb thermal energy?

- A. Absorption wouldn't conserve energy.
- B. Absorption would violate the laws of motion.
- C. **Absorption is statistically unlikely.**

## Clicker Question

In which direction is conduction most effective?

- A. **Through the thin wall of a metal sheet**
- B. Along the thin wall of a metal sheet
- C. Both directions are equally effective

### Clicker Question

If you heat the top of a fluid, will natural convection carry heat to the bottom of that fluid?

- A. Yes
- B. No

### Clicker Question

If you wrap aluminum foil around food, can you still warm it easily with infrared light?

- A. Yes
- B. No

### Introductory Question (Revisited)

Which is more effective at heating a room:

- A. a black woodstove
- B. a shiny gold-plated woodstove
- C. both woodstoves are equally effective

### Introductory Question

A glass of ice water contains both ice and water. After a few minutes of settling, how do the temperatures of the ice and the water compare?

- A. The ice is colder than the water
- B. The water is colder than the ice
- C. They're at the same temperature

### Reading Question 7.2a

At atmospheric pressure, ice can exist in thermal equilibrium

- A. only at or below 0 °C (32 °F)
- B. only below 0 °C (32 °F)
- C. only at 0 °C (32 °F)

### Reading Question 7.2b

At 100% relative humidity,

- A. water evaporates, but very slowly.
- B. steam and liquid water can coexist.
- C. steam condenses, but very slowly.
- D. steam is an unstable phase of water.

### Introductory Question (revisited)

A glass of ice water contains both ice and water. After a few minutes of settling, how do the temperatures of the ice and the water compare?

- A. The ice is colder than the water
- B. The water is colder than the ice
- C. They're at the same temperature

### Clicker Question

What fraction of the molecules in this room's air are water molecules?

- A. 0%.
- B. about 0.2%.
- C. about 2%.
- D. about 20%.
- E. about 50%.

### Clicker Question

Can liquid water be heated above its boiling temperature?

- A. Yes
- B. No

### Introductory Question

To keep as cool as possible while fighting a forest fire, what "color" clothes should you wear?

- A. White
- B. Shiny black
- C. Flat black
- D. Silvery metallic

### Clicker Question

Suppose you have two wool sweaters. Both sweaters are 1 cm thick but one weighs 50% more than the other. Which sweater provides you with the best insulation?

- A. The heavier sweater is a better insulator.
- B. The lighter sweater is a better insulator.

### Clicker Question

You're sitting in a 150 °F sauna and are feeling pretty hot. If you turn on the fan, you will feel

- A. the same as before.
- B. hotter than before.
- C. cooler than before.

### Clicker Question

If you open the door of a freezer and stand in front of it, you'll feel cold even though no cold air is reaching you. That's primarily because

- A. you are radiating more heat at it than it at you.
- B. it is radiating cold at you.
- C. you are radiating less heat than normal.
- D. you are radiating more heat than normal.

### Introductory Question

If you operate a window air conditioner on a table in the middle of a room, the average temperature in the room will

- A. decrease
- B. increase
- C. stay the same

### Clicker Question

Why does heat naturally flow from hot to cold?

- A. Newton's laws require that direction.
- B. Conservation of energy requires that direction.
- C. Only that direction is statistically likely.

### Clicker Question

You add 1 joule of thermal energy to a cold object and to a hot object. Which one experiences the greater rise in entropy (disorder)?

- A. The hot object
- B. The cold object
- C. Neither, they experience equal rises in entropy

### Clicker Question

Which way does an air conditioner move heat?

- A. From a hot region to a cold region
- B. From a cold region to a hot region

### Introductory Question (Revisited)

If you operate a window air conditioner on a table in the middle of a room, the average temperature in the room will

- A. decrease
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## Introductory Question

A car burns gasoline to obtain energy but allows some heat to escape into the air. Could a mechanically perfect car avoid releasing heat altogether?

- A. Yes
- B. No

## Clicker Question

To convert thermal energy into work, some order must be consumed. Dipping duck is consuming the order in

- A. the room's oxygen and nitrogen molecules.
- B. the room's dry air and the duck's liquid water.
- C. the room's thermal energy.
- D. the room's thermal equilibrium.

## Clicker Question

To convert thermal energy into work, some order must be consumed. The steam engine is consuming the order in

- A. the steam.
- B. the room air.
- C. the liquid water and gaseous steam.
- D. the hot steam and cold room air.

## Introductory Question (revisited)

A car burns gasoline to obtain energy but allows some heat to escape into the air. Could a mechanically perfect car avoid releasing heat altogether?

- A. Yes
- B. No

## Clicker Question

The cylinder contains a piece of paper. When I shove the plunger into the cylinder and compress the air suddenly, the paper will

- A. become wet.
- B. burst into flames.
- C. become dry.
- D. dissolve.

## Introductory Question

You're bouncing gently up and down at the end of a springboard, never leaving the board's surface. If you bounce a little farther up and down, the time it takes for each bounce will

- A. increase
- B. decrease
- C. remain the same

### Clicker Question

If you double the mass of a pendulum, its period of oscillation—the time it takes to complete one full cycle of its motion—will

- A. increase by a factor of 4.
- B. increase by a factor of 2.
- C. **remain the same.**
- D. decrease by a factor of 2.

### Clicker Question

If you double the length of a pendulum, its period of oscillation will

- A. increase by a factor of 2.
- B. **increase by a factor of the square root of 2.**
- C. remain the same.
- D. decrease by a factor of 2.

### Clicker Question

Which of the following is definitely not a harmonic oscillator?

- A. **A bouncing ball.**
- B. The floor of your living room.
- C. A hanging scale at a grocery store.
- D. A car's radio antenna.

### Introductory Question

A tapped wineglass emits a characteristic tone that decays gradually. To break a glass with sound, choose a glass with a decay time that's

- A. **long and expose it to its characteristic tone.**
- B. short and expose it to its characteristic tone.
- C. long and expose it to a sudden sound.
- D. short and expose it to a sudden sound.

### Clicker Question

To get a pendulum swinging vigorously by giving it a series of small pushes, you should push it away from you each time it is

- A. as close to you as possible.
- B. as far from you as possible.
- C. moving toward you.
- D. **moving away from you.**

### Introductory Question (revisited)

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## Clicker Question

An open-open pipe has two open ends. If you close one end, making it an open-closed pipe, the pitch of its fundamental vibration will

- A. increase by a factor of 2.
- B. increase by a factor of the square-root of 2.
- C. remain the same.
- D. decrease by a factor of 2.