

## Introductory Question

How would raising the height of a sport utility vehicle affect its turning stability?

- A. Make it less likely to tip over
- B. **Make it more likely to tip over**
- C. Have no overall effect on its stability

## Reading Question 4.1a

A upright tricycle is in a stable equilibrium because tipping it

- A. decreases its potential energy.
- B. **increases its potential energy.**
- C. decreases its total energy.
- D. increases its total energy.

## Reading Question 4.1b

One can ride a bicycle without hands because it

- A. automatically leans in the direction that it is steering.
- B. **automatically steers under your center of gravity.**
- C. has static stability.
- D. has no static stability.

## Clicker Question

If a tricycle is on a sloping floor, will this rule about it being in a stable equilibrium as long as its center of gravity is above its base of support still work?

- A. **Yes**
- B. No

## Clicker Question

You can balance a broom on your hand if you're careful. To do this trick well, you must look at

- A. your hand.
- B. the top of the broom.
- C. **the broom's center of gravity.**
- D. the middle of the broom.

## Introductory Question

If there were no launch pad beneath the space shuttle at lift-off, the upward thrust of its engines would be

- A. **approximately unchanged.**
- B. approximately half as much.
- C. approximately zero.

## Clicker Question

**Spaceship-1** launches into orbit around the earth while **Spaceship-2** launches vertically and travels purely up and down. At their peak altitudes, the speed of **Spaceship-1** is approximately

- A. 2 times the speed of **Spaceship-2**.
- B. 4 times the speed of **Spaceship-2**.
- C. 8 times the speed of **Spaceship-2**.
- D.  $\infty$  (infinity) times the speed of **Spaceship-2**.

## Introductory Question

A helium balloon has mass, yet it doesn't fall to the floor. Is there a real force pushing up on the helium balloon?

- A. **Yes**
- B. No

## Reading Question 5.1a

What keeps the air molecules in our atmosphere from piling up on the ground?

- A. The atmosphere's density
- B. The atmosphere's momentum
- C. The atmosphere's weight
- D. **The atmosphere's thermal energy**

## Reading Question 5.1b

Why is atmospheric pressure lower in the mountains than it is at sea-level?

- A. Mountain air has more oxygen in it.
- B. Mountain air is more dense.
- C. **Mountain air has less air above it to support.**
- D. Mountain air is colder.

## Clicker Question

If you could take all the air out from inside an opened plastic bottle, its sides would

- A. remain where they are.
- B. bow inward slightly.
- C. bow outward slightly.
- D. **crush inward extensively.**

## Clicker Question

A hydrogen gas particle weighs half as much as a helium gas particle. If you replace the helium in a balloon with hydrogen, it will be able to lift

- A. **slightly more weight than it did with helium.**
- B. twice as much weight as it did with helium.
- C. the same weight as it did with helium.
- D. less weight than it did with helium.

## Introductory Question

Water enters your home plumbing at ground level. Where will you get the strongest spray from a shower?

- A. In the ground floor shower
- B. **In the basement shower**
- C. In the second floor shower

## Reading Question 5.2a

The total energy of a portion of water in steady state flow is constant

- A. **along a streamline.**
- B. everywhere in the flow.
- C. at the same height in the flow.
- D. at the same speed in the flow.

## Reading Question 5.2b

Water seeks its level (flows until it is the same height everywhere) because that arrangement

- A. maximizes the water's total energy.
- B. maximizes the water's total potential energy.
- C. minimizes the water's total energy.
- D. **minimizes the water's total potential energy.**

## Clicker Question

When you drink water through a straw, the water

- A. is attracted upward by your mouth.
- B. **is pushed upward by a pressure imbalance.**
- C. is suddenly weightless and rises spontaneously.

## Clicker Question

As a drinking straw is made taller and taller, drinking water through it

- A. remains equally easy.
- B. becomes harder, but never impossible.
- C. **becomes harder and eventually impossible.**

## Clicker Question

A new skyscraper supplies water to all of its floors through a single vertical pipe. When someone opens the faucet on the ground floor,

- A. **water rushes out at hundreds of miles per hour.**
- B. water does not come out at all.
- C. water only dribbles out.
- D. water flows out at a normal rate.

## Introductory Question

Water pours weakly from an open hose but sprays hard when you cover most of the end with your thumb. When is more water coming out of the hose?

- A. When the hose end is uncovered
- B. When your thumb covers most of the end

## Reading Question 6.1a

When water flows smoothly in a straight hose, that water's viscosity causes the water to

- A. speed up.
- B. move with constant momentum.
- C. move at constant velocity.
- D. waste some of its energy as thermal energy.

## Reading Question 6.1b

When water flows smoothly through a bent hose, the water pressure at the bend's inside is

- A. more than at the bend's outside.
- B. the same as at the bend's outside.
- C. less than at the bend's outside.
- D. either more or less than at the bend's outside.

## Clicker Question

Water flows through two tubes, one twice the diameter of the other. Both tubes have the same pressure differences between start and finish. The bigger tube will deliver water

- A. twice as quickly.
- B. four times as quickly.
- C. eight times as quickly.
- D. sixteen times as quickly.

## Clicker Question

Water pours gently from an open hose because it

- A. received little energy from the water company.
- B. wasted energy only as it left the hose's end.
- C. wasted energy only as it entered the hose.
- D. wasted energy throughout its trip.

## Clicker Question

If you send compressed, high-pressure air through a nozzle, the pressure inside the end of the nozzle can be

- A. as small as atmospheric pressure.
- B. as small as less than atmospheric pressure.
- C. as much as twice atmospheric pressure.
- D. as much as four times atmospheric pressure.

### Clicker Question

Air flows first through a nozzle and then through a reversed-nozzle (a “diffuser”). The air pressure after the diffuser is

- A. higher than after the nozzle.
- B. lower than after the nozzle.
- C. the same as after the nozzle.

### Clicker Question

You smack the top of a full glass bottle of root beer very hard with a rubber mallet and

- A. the top of the glass bottle shatters.
- B. the rubber mallet explodes.
- C. the bottom of the glass bottle falls off.
- D. the sides of the glass bottle burst outward.

### Introductory Question

A smooth, gentle river flows past a cylindrical post. At the sides of the post, is the water level higher, lower, or equal to its level in the open river?

- A. Higher
- B. Lower
- C. Equal

### Reading Question 6.2a

A pitcher throws a baseball toward home plate. Which type(s) of aerodynamic forces push the ball toward the pitcher?

- A. Lift forces.
- B. Drag forces.
- C. Both lift and drag forces.
- D. Gravitational forces.

### Reading Question 6.2b

You kick a soccer ball toward the goal. The airflow directly behind that ball

- A. has a pressure much greater than atmospheric.
- B. has a pressure much less than atmospheric.
- C. is turbulent.
- D. is laminar.

### Clicker Question

If air resistance slows a ball down, what happens to the ball’s momentum?

- A. It is given to the entire earth.
- B. It is given to the air near the ball.
- C. It becomes potential momentum.
- D. It becomes thermal momentum.

## Clicker Question

When a car drives down a street full of fallen leaves, the leaves swirl around behind the car. What kind of flow is present behind the car?

- A. Turbulent flow
- B. Laminar flow

## Clicker Question

A curveball accelerates to the side in flight. Where does the curveball get this sideways momentum?

- A. From the entire earth.
- B. From the pitcher's hand.
- C. From the pitcher's entire body.
- D. From the air near the ball.