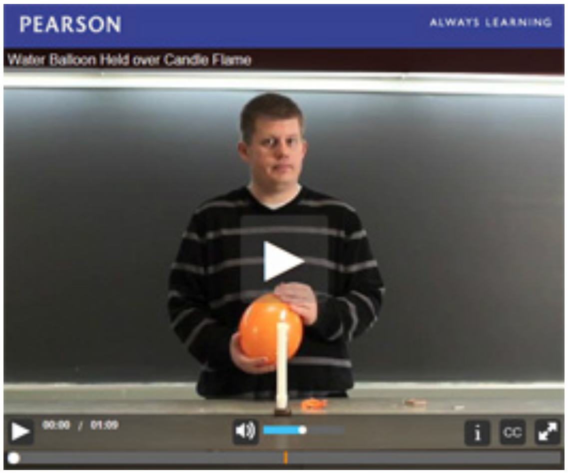
HW due 5/18 (extended to 5/25 for drop/add)

Due: 7:00am on Wednesday, May 25, 2016

To understand how points are awarded, read the Grading Policy for this assignment.

Video Tutor: Water Balloon Held over Candle Flame

First, launch the video below. You will be asked to use your knowledge of physics to predict the outcome of an experiment. Then, close the video window and answer the question at right. You can watch the video again at any point.



Part A

Which of the following changes would make the water balloon *more* likely to pop? (Ignore effects of convection within the fluid.)

Select all that apply.

Hint 1. How to approach the problem.

Recall that in the video, the water balloon did not pop because most of the candle's thermal energy went into heating the water. Let's think about the process in more detail.

The high heat capacity of water means that the water in the balloon warmed only slowly. (Recall that the higher a substance's heat capacity, the less the substance's temperature will rise in response to a given input of heat.) Contact with this relatively cool water kept the balloon's thin rubber skin from getting hot enough to melt.

Rubber conducts heat more slowly than water. If you make the rubber skin of a water balloon thicker, will the skin be more likely or less likely to melt? Think about the conduction of heat across the skin between the hot side facing the candle and the cooler side in contact with water.

ANSWER:

- [x] Use a liquid that has a *lower* heat capacity than water.
- [ ] Use a thinner balloon.
- [ ] Use a liquid that has a *higher* heat capacity than water.
- [x] Use a thicker balloon.

Correct

Using a liquid with a lower heat capacity than water means that the candle flame will raise the liquid's temperature more quickly than for water. A thicker balloon will conduct heat through to the liquid more slowly, so that the outer part of the balloon wall will heat up more quickly to its melting point.

Video Tutor: Candle Chimneys

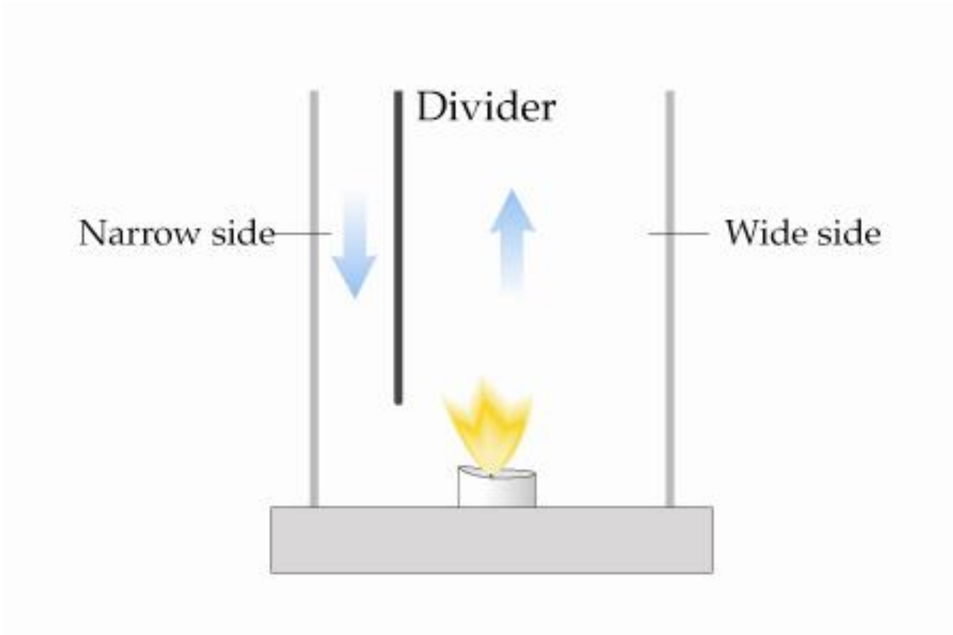
First, launch the video below. You will be asked to use your knowledge of physics to predict the outcome of an experiment. Then, close the video window and answer the question at right. You can watch the video again at any point.

Part A

Consider the video tutorial you just watched. Suppose we repeat the experiment, but this time place the divider closer to one side of the tube than to the other. How will the speed of the air on the wide and narrow sides of the divider compare? (Assume that burning has a negligible effect on the mass of the air circulating through the tube.)

Hint 1. How to approach the problem

The amount of air entering the tube per unit time must equal the amount leaving it.



ANSWER:

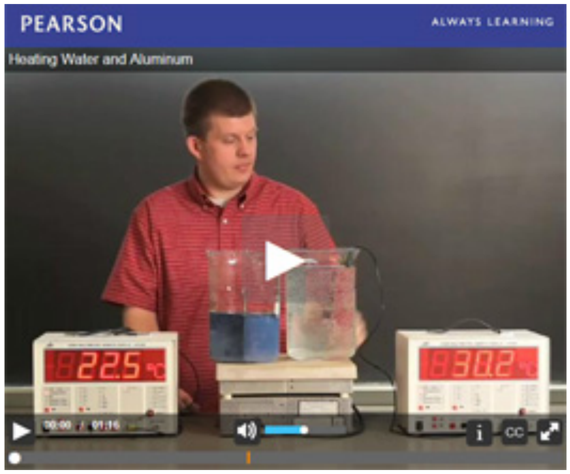
- (selected) The air will move faster on the narrow side.
- The air will move at the same speed on both sides.
- The air will move slower on the narrow side.

Correct

Since the same amount of air enters the tube per unit time as leaves it, the air must move faster on the narrow side.

Video Tutor: Heating Water and Aluminum

First, launch the video below. You will be asked to use your knowledge of physics to predict the outcome of an experiment. Then, close the video window and answer the question on the right. You can watch the video again at any point.



Part A

Suppose that we replace the aluminum with a mystery metal and repeat the experiment in the video. As in the video, the mass of the metal is the same as that of the water. Room temperature is about 20$^\circ\mathrm{C}$ before the start of the experiment. The water heats up to 40$^\circ\mathrm{C}$, and the mystery metal heats up to 80$^\circ\mathrm{C}$. Compared to that of water, the heat capacity of our mystery metal is

Hint 1. How to approach the problem

Recall that the heat Q delivered to a substance can be written $\mathrm{Q} = mc\,\Delta T$, where m is the mass of the substance and c is its heat capacity.

ANSWER:

- three times greater.
- the same.
- half as great.
- one-third as great.
- two times greater.

Correct

Given the same input of energy, the temperature of the metal increased three times as much as the temperature of the water. Therefore, the metal has one-third the heat capacity of water. (Recall that the heat Q delivered to a substance can be written $\mathrm{Q} = mc\,\Delta T$, where m is the mass of the substance and c is its heat capacity.)

Exercise 17.22

A brass rod is 185 cm long and 1.60 cm in diameter.

Part A

What force must be applied to each end of the rod to prevent it from contracting when it is cooled from 120 $^\circ\mathrm{C}$ to 10 $^\circ\mathrm{C}$?

Express your answer using two significant figures.

ANSWER:

4.0×10^4 N

Correct

Exercise 20.1

A diesel engine performs an amount of mechanical work equal to 2900 J and discards an amount of heat equal to 4600 J each cycle.

Part A

How much heat must be supplied to the engine in each cycle?

ANSWER:

7500 J

Correct

Part B

What is the thermal efficiency of the engine?

ANSWER:

e = 0.387

Correct

Score Summary:

Your score on this assignment is 100%.
You received 25 out of a possible total of 25 points.