## ConcepTest 17.1 Degrees

Which is the largest unit: one Celsius degree, one Kelvin degree, or one Fahrenheit degree?

- 1) one Celsius degree
- 2) one Kelvin degree
- 3) one Fahrenheit degree
- 4) both one Celsius degree and one Kelvin degree
- 5) both one Fahrenheit degree and one Celsius degree

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5) both one Fahrenheit degree and one Celsius degree

The Celsius degree and the Kelvin degree are the same size. The scales only differ by an offset, not by the size of the degree unit. For Fahrenheit, there are 180 degrees between boiling and freezing (212°F–32°F). For Celsius, there are 100 degrees between the same points, so the Celsius (and Kelvin) degrees must be larger.

# ConcepTest 17.3Thermometers

You may notice that if a mercury-in-glass thermometer is inserted into a hot liquid, the mercury column first drops, and then later starts to rise (as you expect). How do you explain this drop?

- 1) the mercury contracts before the glass contracts
- 2) the glass contracts before the mercury contracts
- 3) the mercury contracts before the glass expands
- 4) the glass expands before the mercury expands
- 5) the mercury expands before the glass contracts

# ConcepTest 17.3Thermometers

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The hot liquid touches the glass first, so initially the glass expands slightly. This increases the volume inside the glass, and so the mercury level drops slightly. Once the mercury heats up, it begins to expand and then the characteristic rise in the mercury column follows, indicating the increase in temperature that you expected to measure.

**Follow-up:** Is it possible to have the mercury first rise and later drop?

# ConcepTest 17.5a Ste

A steel tape measure is marked such that it gives accurate length measurements at room temperature. If the tape measure is used outside on a very hot day, how will its length measurements be affected?

# **Steel Expansion I**

- 1) measured lengths will be too small
- 2) measured lengths will still be accurate
- 3) measured lengths will be too big

#### ConcepTest 17.5a **Steel Expansion I**

A steel tape measure is marked such that it gives accurate length measurements at room temperature. If the tape measure is used outside on a very hot day, how will its length measurements be affected?

- measured lengths will be too small
- measured lengths will still be accurate 2)
- 3) measured lengths will be too big

The tape measure will expand, so its markings will spread out farther than the correct amount. When it is laid down next to an object of fixed length, you will read too few markings for that given length, so the measured length will be too small.

### ConcepTest 17.9a

Two identical cylinders at the same temperature contain the same gas. If A contains three times as much gas as B, which cylinder has the higher pressure?

#### Ideal Gas Law I

1) cylinder A

- 2) cylinder B
- 3) both the same
- 4) it depends on temp. T

Ideal gas law: PY = nRT

Solve for pressure: P = nRT / V

For constant *V* and *T*, the one with more gas (the larger value of *n*) has the higher pressure *P*.

# ConcepTest 17.9b

Two identical cylinders at the same pressure contain the same gas. If A contains three times as much gas as B, which cylinder has the higher temperature?

- Ideal Gas Law II
  - 1) cylinder A
  - 2) cylinder B
  - 3) both the same
  - 4) it depends on the pressure P

# ConcepTest 17.10 Soda Bottle

A plastic soda bottle is empty and sits out in the sun, heating the air inside. Now you put the cap on tightly and put the bottle in the fridge. What happens to the bottle as it cools?

- 1) it expands and may burst
- 2) it does not change
- 3) it contracts and the sides collapse inward
- 4) it is too dark in the fridge to tell

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2) it does not change

3) it contracts and the sides collapse inward

4) it is too dark in the fridge to tell

The air inside the bottle is warm, due to heating by the sun. When the bottle is in the fridge, the air cools. As the temperature drops, the pressure in the bottle also drops. Eventually, the pressure inside is sufficiently lower than the pressure outside (atmosphere) to begin to collapse the bottle.

# ConcepTest 17.11

What happens to the volume of a balloon if you put it in the freezer?

# **Balloon in Freezer**

- 1) it increases
- 2) it does not change
- 3) it decreases

What happens to the volume of a balloon if you put it in the freezer?

ConcepTest 17.11 Balloon in Freezer

1) it increases

2) it does not change

3) it decreases

According to the Ideal Gas Law, when the temperature is reduced at constant pressure, the volume is reduced as well. The volume of the balloon therefore decreases.

$$PV = nRT$$

Follow-up: What happens to the volume when the balloon rises in the air?