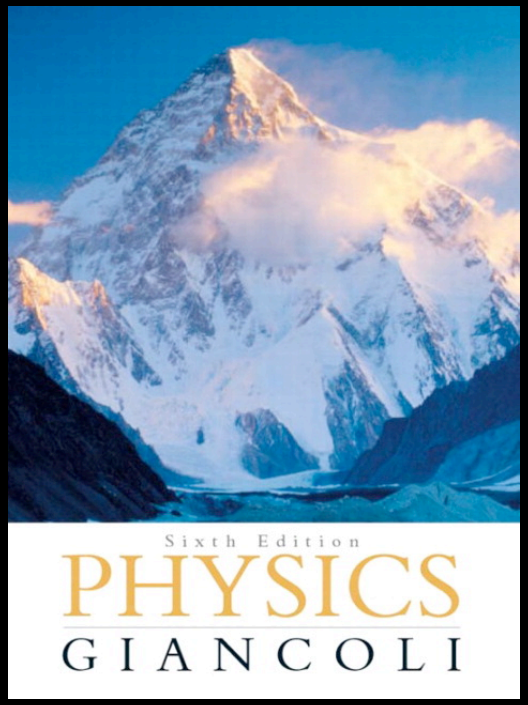


ConcepTest PowerPoints

Chapter 13

Physics: Principles with Applications, 6th edition

Giancoli

© 2005 Pearson Prentice Hall

This work is protected by United States copyright laws and is provided solely for the use of instructors in teaching their courses and assessing student learning. Dissemination or sale of any part of this work (including on the World Wide Web) will destroy the integrity of the work and is not permitted. The work and materials from it should never be made available to students except by instructors using the accompanying text in their classes. All recipients of this work are expected to abide by these restrictions and to honor the intended pedagogical purposes and the needs of other instructors who rely on these materials.

ConcepTest 13.1 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

ConcepTest 13.1 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

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 13.2 Freezing Cold

It turns out that – 40°C is the same temperature as – 40°F. Is there a temperature at which the Kelvin and Celsius scales agree?

1) yes, at 0 °C
2) yes, at -273 °C
3) yes, at 0 K
4) no

ConcepTest 13.2 Freezing Cold

It turns out that – 40°C is the same temperature as – 40°F. Is there a temperature at which the Kelvin and Celsius scales agree?

1) yes, at 0 °C
2) yes, at -273 °C
3) yes, at 0 K
4) no

The Celsius and Kelvin scales differ only by an offset, which is 273 degrees. Therefore, a temperature on one scale can never match the same numerical value on the other scale. The reason that such agreement is possible for Celsius and Fahrenheit is the fact that the actual degree units have different sizes (recall the previous question).

ConcepTest 13.3 Thermometers

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 13.3 Thermometers

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

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 13.4 Glasses

Two drinking glasses are stuck, one inside the other. How would you get them unstuck?

1) run hot water over them both
2) put hot water in the inner one
3) run hot water over the outer one
4) run cold water over them both
5) break the glasses

ConcepTest 13.4 Glasses

Two drinking glasses are stuck, one inside the other. How would you get them unstuck?

1) run hot water over them both
2) put hot water in the inner one
3) run hot water over the outer one
4) run cold water over them both
5) break the glasses

Running hot water only over the outer glass will allow the outer one to expand, while the inner glass remains relatively unchanged. This should loosen the outer glass and free it.

ConcepTest 13.5a 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?

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

ConcepTest 13.5a 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?

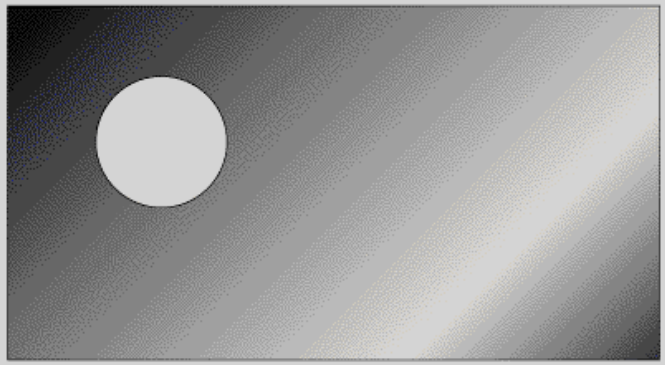
1) measured lengths will be too small
2) measured lengths will still be accurate
3) measured lengths will be too big

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 13.5b Steel Expansion II

Metals such as brass expand when heated. The thin brass plate in the movie has a circular hole in its center. When the plate is heated, what will happen to the hole?

1) gets larger
2) gets smaller
3) stays the same
4) vanishes

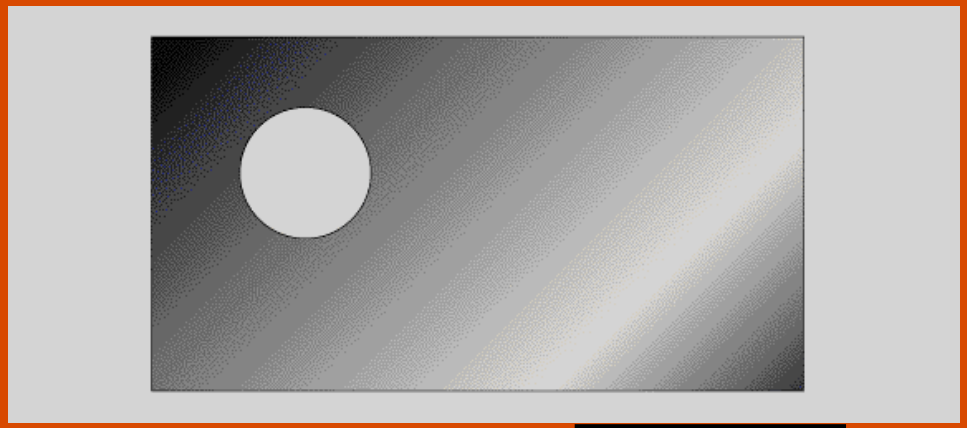


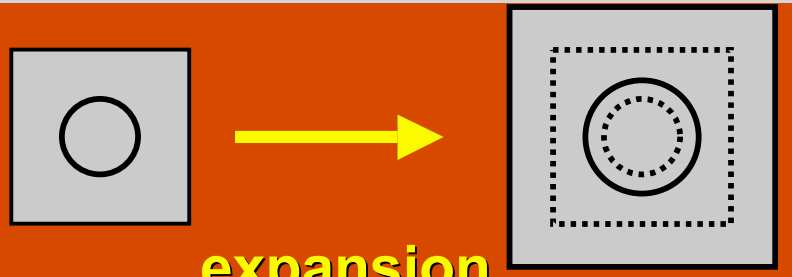
ConcepTest 13.5b Steel Expansion II

Metals such as brass expand when heated. The thin brass plate in the movie has a circular hole in its center. When the plate is heated, what will happen to the hole?

1) gets larger
2) gets smaller
3) stays the same
4) vanishes

Imagine drawing a circle on the plate. This circle will expand outward along with the rest of the plate. Now replace the circle with the hole, and you can see that the hole will expand outward as well. Note that the material does ***NOT*** "expand inward" to fill the hole!!

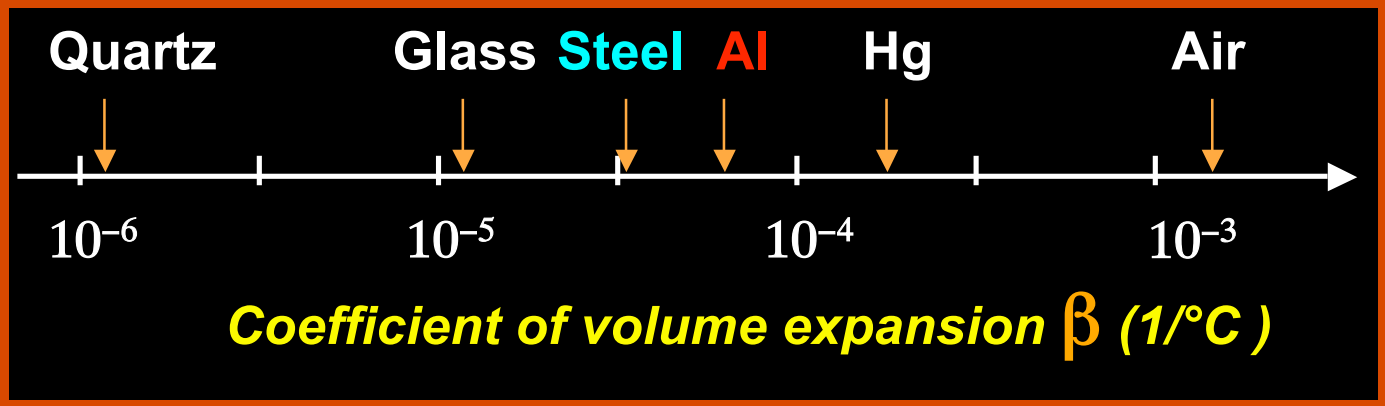


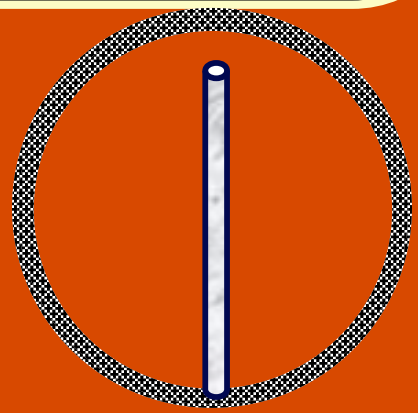


ConcepTest 13.6a Steel Ring I

A steel ring stands on edge with a rod of some material inside. As this system is heated, for which of the following rod materials will the rod eventually touch the top of the ring?

1) aluminum
2) steel
3) glass
4) aluminum and steel
5) all three

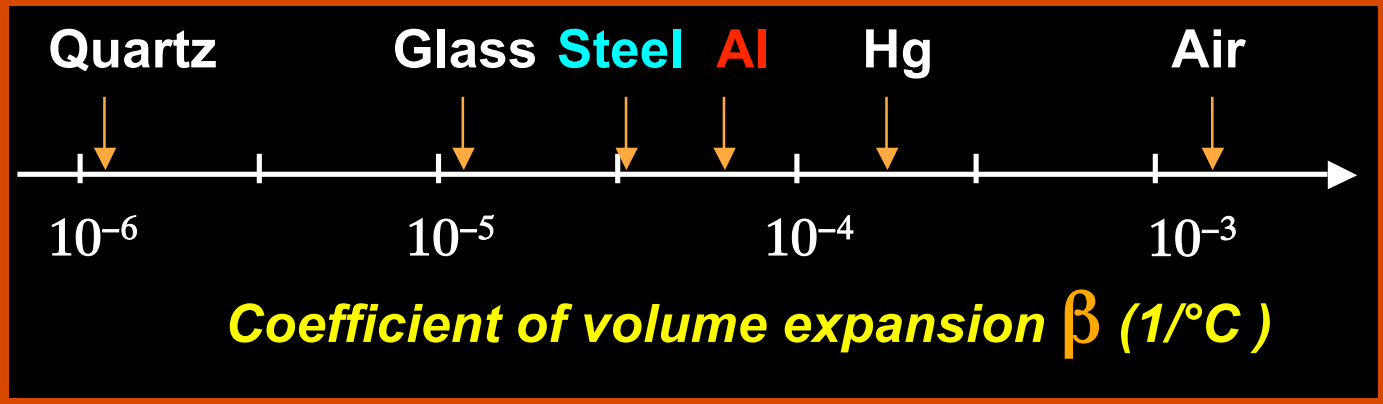


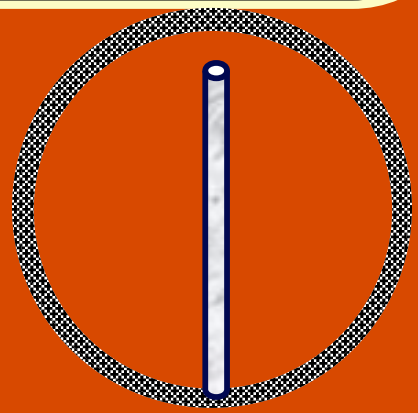


ConcepTest 13.6a Steel Ring I

A steel ring stands on edge with a rod of some material inside. As this system is heated, for which of the following rod materials will the rod eventually touch the top of the ring?

1) aluminum
2) steel
3) glass
4) aluminum and steel
5) all three



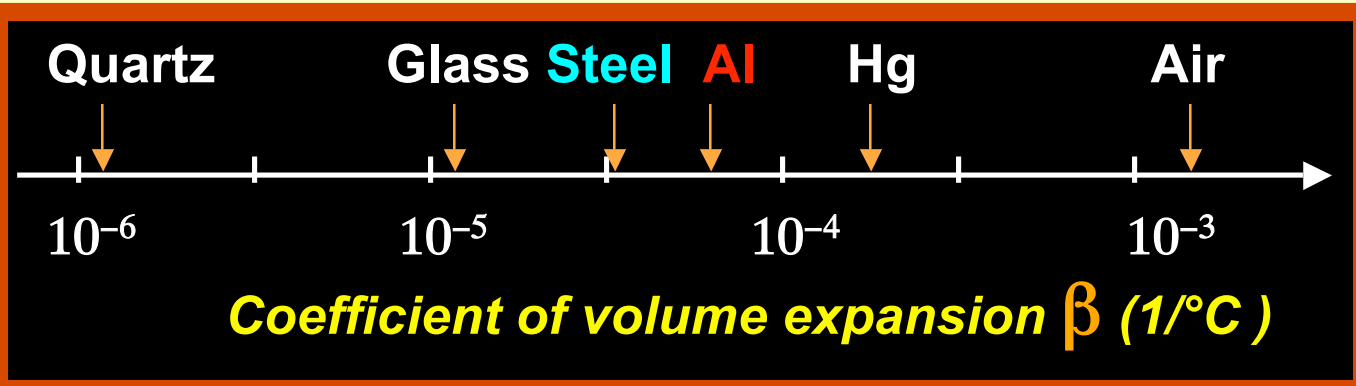


Aluminum is the only material that has a larger β value than the steel ring, so that means that the aluminum rod will expand more than steel ring. Thus, only in that case does the rod have a chance of reaching the top of the steel ring.

ConcepTest 13.6b Steel Ring II

You want to take apart a couple of **aluminum** parts held together by **steel** screws, but the screws are stuck. What should you do?

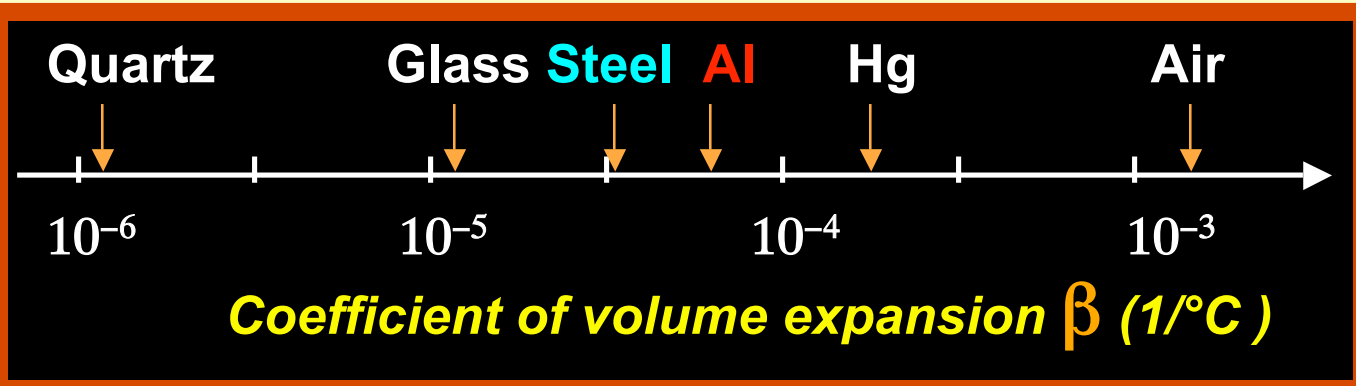
1) heat the thing up
2) cool the thing down
3) blow the thing up



ConcepTest 13.6b Steel Ring II

You want to take apart a couple of aluminum parts held together by steel screws, but the screws are stuck. What should you do?

1) heat the thing up
2) cool the thing down
3) blow the thing up



Since aluminum has a larger β value, that means aluminum expands more than steel. Thus, by heating the part, the aluminum holes will expand faster than the steel screws and the screws will come loose.

ConcepTest 13.7 Grandfather Clock

A grandfather clock uses a brass pendulum to keep perfect time at room temperature. If the air conditioning breaks down on a very hot summer day, how will the grandfather clock be affected?

1) clock will run slower than usual
2) clock will still keep perfect time
3) clock will run faster than usual

ConcepTest 13.7 Grandfather Clock

A grandfather clock uses a brass pendulum to keep perfect time at room temperature. If the air conditioning breaks down on a very hot summer day, how will the grandfather clock be affected?

1) clock will run slower than usual
2) clock will still keep perfect time
3) clock will run faster than usual

The pendulum will expand, so its length will increase. The period of a pendulum depends on the length as shown below, so the period will also increase. Thus, the clock will run slow.

$$T = 2\pi\sqrt{(L/g)}$$

Follow-up: Roughly by how much will it run slower?

ConcepTest 13.8a Nitrogen and Oxygen I

Which has more molecules – a mole of nitrogen (N_2) gas or a mole of oxygen (O_2) gas?

1) oxygen
2) nitrogen
3) both the same

ConcepTest 13.8a Nitrogen and Oxygen I

Which has more molecules – a mole of nitrogen (N_2) gas or a mole of oxygen (O_2) gas?

1) oxygen
2) nitrogen
3) both the same

A mole is defined as a quantity of gas molecules equal to Avogadro's number (6.02×10^{23}). This value is independent of the type of gas.

ConcepTest 13.8b Nitrogen and Oxygen II

Which weighs more – a mole of nitrogen (N_2) gas or a mole of oxygen (O_2) gas?

1) oxygen
2) nitrogen
3) both the same

ConcepTest 13.8b Nitrogen and Oxygen II

Which weighs more – a mole of nitrogen (N_2) gas or a mole of oxygen (O_2) gas?

1) oxygen
2) nitrogen
3) both the same

The oxygen molecules have a molecular mass of 32, while the nitrogen molecules have a molecular mass of 28.

Follow-up: Which one will take up more space?

ConcepTest 13.9a Ideal Gas Law I

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?

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

ConcepTest 13.9a Ideal Gas Law I

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?

1) cylinder A
2) cylinder B
3) both the same
4) it depends on temp. *T*

Ideal gas law: $PV = nRT$

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 13.9b Ideal Gas Law II

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?

1) cylinder A
2) cylinder B
3) both the same
4) it depends on the pressure P

ConcepTest 13.9b Ideal Gas Law II

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?

1) cylinder A
2) cylinder B
3) both the same
4) it depends on the pressure P

Ideal gas law: $PV = nRT$

Solve for temperature: $T = PV / nR$

For constant V and P, the one with less gas (the smaller value of n) has the higher temperature T.

ConcepTest 13.9c Ideal Gas Law III

Two identical cylinders at the same temperature contain the same gas. If B has twice the volume and half the number of moles as A, how does the pressure in B compare with the pressure in A?

1) $P_B = 1/2\ P_A$
2) $P_B = 2\ P_A$
3) $P_B = 1/4\ P_A$
4) $P_B = 4\ P_A$
4) $P_B = P_A$

ConcepTest 13.9c Ideal Gas Law III

Two identical cylinders at the same temperature contain the same gas. If B has twice the volume and half the number of moles as A, how does the pressure in B compare with the pressure in A?

1) $P_B = 1/2\ P_A$
2) $P_B = 2\ P_A$
3) $P_B = 1/4\ P_A$
4) $P_B = 4\ P_A$
4) $P_B = P_A$

Ideal gas law: $PV = nRT$

Since B has a factor of two more volume, it has a factor of two less pressure. But B also has half the amount of gas, so that is another factor of two reduction in pressure. Thus, B must have only 1/4 the pressure of A.

ConcepTest 13.10 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

ConcepTest 13.10 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

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 13.11 Balloon in Freezer

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

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

ConcepTest 13.11 Balloon in Freezer

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