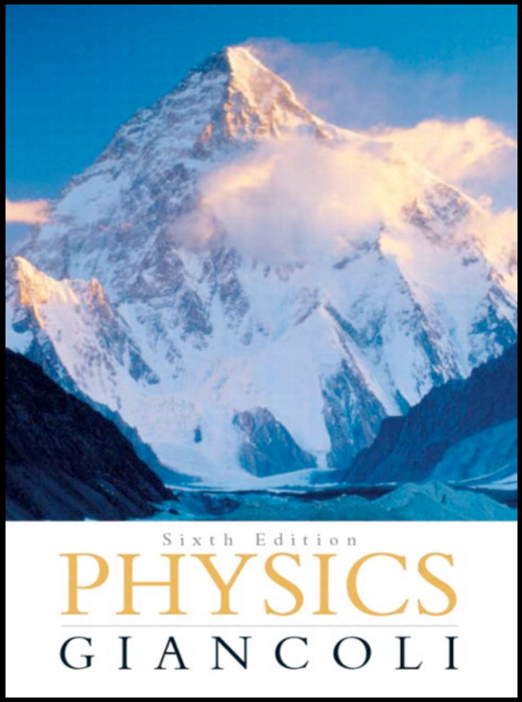

ConcepTest PowerPoints

Chapter 14

Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 14.1a Thermal Contact I

Two objects are made of the same material, but have different masses and temperatures. If the objects are brought into thermal contact, which one will have the greater temperature change?

1) the one with the higher initial temperature
2) the one with the lower initial temperature
3) the one with the greater mass
4) the one with the smaller mass
5) the one with the higher specific heat

ConcepTest 14.1a Thermal Contact I

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2) the one with the lower initial temperature
3) the one with the greater mass
4) the one with the smaller mass
5) the one with the higher specific heat

Since the objects are made of the same material, the only difference between them is their mass. Clearly, the object with less mass will be much easier to change temperature since there is not much material there (compared to the more massive object).

ConcepTest 14.1b Thermal Contact II

Two different objects receive the same amount of heat. Which of the following choices is <u>NOT</u> a reason why the objects may have different temperature changes?

1) they have different initial temperatures
2) they have different masses
3) they have different specific heats

ConcepTest 14.1b Thermal Contact II

Two different objects receive the same amount of heat. Which of the following choices is NOT a reason why the objects may have different temperature changes?

1) they have different initial temperatures
2) they have different masses
3) they have different specific heats

Since $Q = m\,c\,\Delta T$ and the objects received the same amount of heat, the only other factors are the masses and the specific heats. While the initial temperature is certainly relevant for finding the final temperature, it does not have any effect on the temperature change ΔT.

ConcepTest 14.2 Two Liquids

Two equal-mass liquids, initially at the same temperature, are heated for the same time over the same stove. You measure the temperatures and find that one liquid has a higher temperature than the other. Which liquid has a higher specific heat?

1) the cooler one
2) the hotter one
3) both the same

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2) the hotter one
3) both the same

Both liquids had the same increase in internal energy, because the same heat was added. But the cooler liquid had a lower temperature change.

Since $Q = mc\Delta T$, if Q and m are both the same and ΔT is smaller, then c (specific heat) must be bigger.

ConcepTest 14.3a Night on the Field

The specific heat of concrete is greater than that of soil. A baseball field (with real soil) and the surrounding parking lot are warmed up during a sunny day. Which would you expect to cool off faster in the evening when the sun goes down?

1) the concrete parking lot
2) the baseball field
3) both cool off equally fast

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1) the concrete parking lot
2) the baseball field
3) both cool off equally fast

The baseball field, with the lower specific heat, will change temperature more readily, so it will cool off faster. The high specific heat of concrete allows it to "retain heat" better and so it will not cool off so quickly – it has a higher "thermal inertia."

ConcepTest 14.3b Night on the Beach

Water has a higher specific heat than *sand*. Therefore, on the beach at night, breezes would blow:

1) from the ocean to the beach
2) from the beach to the ocean
3) either way, makes no difference

ConcepTest 14.3b Night on the Beach

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1) from the ocean to the beach
2) from the beach to the ocean
3) either way, makes no difference

- **Daytime**
  - sun heats both the beach and the water
    - beach heats up faster
    - warmer air above beach rises
    - cooler air from ocean moves in underneath
    - breeze blows ocean → land

$c_{sand} < c_{water}$

- **Nighttime**
  - sun has gone to sleep
    - beach cools down faster
    - warmer air is now above the ocean
    - cooler air from beach moves out to the ocean
    - breeze blows land → ocean

ConcepTest 14.4 Calorimetry

1 kg of water at 100 ^oC is poured into a bucket that contains 4 kg of water at 0 ^oC. Find the equilibrium temperature (neglect the influence of the bucket).

1) 0 ^oC
2) 20 ^oC
3) 50 ^oC
4) 80 ^oC
5) 100 ^oC

ConcepTest 14.4 Calorimetry

1 kg of water at 100 °C is poured into a bucket that contains 4 kg of water at 0 °C. Find the equilibrium temperature (neglect the influence of the bucket).

1) 0 °C
2) 20 °C
3) 50 °C
4) 80 °C
5) 100 °C

Since the **cold water mass is greater**, it will have a **smaller temperature change**!

The masses of cold/hot have a ratio of 4:1, so the temperature change must have a ratio of 1:4 (cold/hot).

$$Q_1 = Q_2$$

$$m_1 c \Delta T_1 = m_2 c \Delta T_2$$

$$\Delta T_1 / \Delta T_2 = m_2 / m_1$$

ConcepTest 14.5 More Calorimetry

A 1 kg block of silver (c = 234 J/kg ^{0}C) is heated to 100 ^{0}C, then dunked in a tub of 1 kg of water (c = 4186 J/kg ^{0}C) at 0 ^{0}C. What is the final equilibrium temperature?

1) 0°C
2) between 0°C and 50°C
3) 50°C
4) between 50°C and 100°C
5) 100°C

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1) 0°C
2) between 0°C and 50°C
3) 50°C
4) between 50°C and 100°C
5) 100°C

Since c_{water} >> c_{silver} it takes more heat to change the temperature of the water than it does to change the temperature of the silver. In other words, it is much "harder" to heat the water!! Thus, the final temperature has to be closer to the initial temperature of the water.

$$Q_1 = Q_2$$

$$mc_1\Delta T_1 = mc_2\Delta T_2$$

$$\Delta T_1 / \Delta T_2 = c_2 / c_1$$

ConcepTest 14.6 Adding Heat

If you add some heat to a substance, is it possible for the temperature of the substance to remain unchanged?

1) yes

2) no

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If you add some heat to a substance, is it possible for the temperature of the substance to remain unchanged?

1) yes
2) no

Yes, it is indeed possible for the temperature to stay the same. This is precisely what occurs during a phase change – the added heat goes into changing the state of the substance (from solid to liquid or from liquid to gas) and does <u>not</u> go into changing the temperature! Once the phase change has been accomplished, then the temperature of the substance will rise with more added heat.

Follow-up: Does that depend on the substance?

ConcepTest 14.7 Hot Potato

Will potatoes cook faster if the water is boiling faster?

1) yes
2) no

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Will potatoes cook faster if the water is boiling faster?

1) yes
2) no

The water boils at 100 °C and remains at that temperature until all of the water has been changed into steam. Only then will the steam increase in temperature. Since the water stays at the same temperature, regardless of how fast it is boiling, the potatoes will not cook any faster.

Follow-up: How can you cook the potatoes faster?

ConcepTest 14.8 Water and Ice

You put 1 kg of ice at 0°C together with 1 kg of water at 50°C. What is the final temperature?

- L_F = 80 cal/*g*
- c_{water} = 1 cal/*g* °C

1) 0°C
2) between 0°C and 50°C
3) 50°C
4) greater than 50°C

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1) 0°C
2) between 0°C and 50°C
3) 50°C
4) greater than 50°C

How much heat is needed to melt the ice?

$$Q = m L_f = (1000g) \times (80 \text{ cal}/g) = 80{,}000 \text{ cal}$$

How much heat can the water deliver by cooling from 50°C to 0°C?

$$Q = c_{water}\, m\, \Delta T = (1 \text{ cal}/g\ °C) \times (1000g) \times (50°C) = 50{,}000 \text{ cal}$$

Thus, there is not enough heat available to melt all the ice!!

Follow-up: How much more water at 50°C would you need?

ConcepTest 14.9 Ice and Steam

You put 1 kg of ice at 0°C together with 1 kg of steam at 100°C. What is the final temperature?

- L_F = 80 cal/*g*, L_v = 540 cal/*g*
- c_{water} = 1 cal/*g* °C

1) between 0°C and 50°C
2) 50°C
3) between 50°C and 100°C
4) 100°C
5) greater than 100°C

ConcepTest 14.9 Ice and Steam

You put 1 kg of ice at 0°C together with 1 kg of steam at 100°C. What is the final temperature?

- L_F = 80 cal/*g*, L_v = 540 cal/*g*
- c_{water} = 1 cal/*g* °C

1) between 0°C and 50°C
2) 50°C
3) between 50°C and 100°C
4) 100°C
5) greater than 100°C

How much heat is needed to melt the ice?

$Q = m L_f = (1000g) \times (80\ \text{cal}/g) = 80{,}000\ \text{cal}$

How much heat is needed to raise the water temperature to 100°C?

$Q = c_{water}\, m\, \Delta T = (1\ \text{cal}/g\ °\text{C}) \times (1000g) \times (100°\text{C}) = 100{,}000\ \text{cal}$

But if all of the steam turns into water, that would release **540,000 cal**. Thus, some steam is left over, and the whole mixture stays at 100°C.

Follow-up: How much more ice would you need?

ConcepTest 14.10 You're in Hot Water!

Which will cause more severe burns to your skin: 100 °C water or 100 °C steam?

1) water
2) steam
3) both the same
4) it depends...

ConcepTest 14.10 You're in Hot Water!

Which will cause more severe burns to your skin: 100 °C water or 100 °C steam?

1) water
2) steam
3) both the same
4) it depends...

While the water is indeed hot, it releases only 1 cal/g of heat as it cools. The steam, however, first has to undergo a phase change into water and that process releases 540 cal/g, which is a ***very large amount of heat***. That immense release of heat is what makes steam burns so dangerous.

ConcepTest 14.11 Spring Break

You step out of a swimming pool on a hot day, where the air temperature is 90° F. Where will you feel cooler, in Phoenix (dry) or in Philadelphia (humid)?

1) equally cool in both places
2) Philadelphia
3) Phoenix

ConcepTest 14.11 Spring Break

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1) equally cool in both places
2) Philadelphia
3) Phoenix

In Phoenix, where the air is dry, more of the water will evaporate from your skin. This is a phase change, where the water must absorb the heat of vaporization, which it takes from your skin. That is why you feel cool as the water evaporates.

ConcepTest 14.12 Heat Conduction

Given your experience of what feels colder when you walk on it, which of the surfaces would have the ***highest thermal conductivity?***

a) a rug

b) a steel surface

c) a concrete floor

d) has nothing to do with thermal conductivity

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d) has nothing to do with thermal conductivity

The heat flow rate is $k\,A\,(T_1 - T_2)/l$. All things being equal, bigger k leads to bigger heat loss.
From the book: Steel=40, Concrete=0.84, Human tissue=0.2, Wool=0.04, in units of J/(s.m.C^0).

ConcepTest 14.13 Radiation

If the Sun's surface temperature falls to half the current surface temperature, by what factor will the radiant energy reaching the Earth change?

a) increase by factor of 16
b) increase by factor of 4
c) it will remain the same
d) decrease by factor of 4
e) decrease by factor of 16

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b) increase by factor of 4
c) it will remain the same
d) decrease by factor of 4
e) decrease by factor of 16

Radiation energy is proportional to T^4. So if temperature is halved, radiation energy will decrease by a factor of 16.