Consider 4 grams of boiling water poured onto a cold surface. Suppose that 1 gram rapidly evaporates by absorbing 540 calories from the remaining 3 grams of water, ideally with no other heat transfer occurring. The remaining 3 grams will become

a) water at a temperature above 0°C.
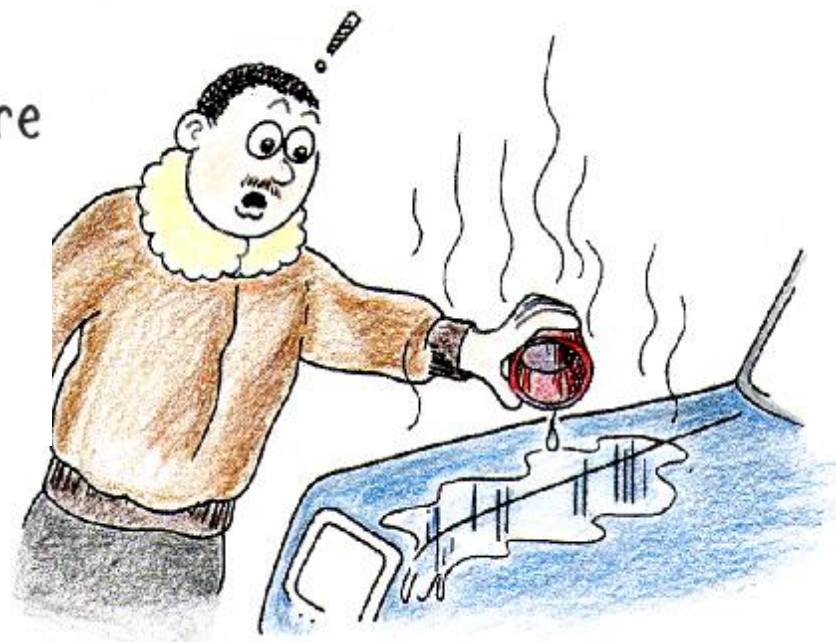
b) water at 0°C.

c) ice at 0°C.

Next-Time Question

Consider 4 grams of boiling water poured onto a cold surface. Suppose that 1 gram rapidly evaporates by absorbing 540 calories from the remaining 3 grams of water, ideally with no other heat transfer occurring. The remaining 3 grams will become
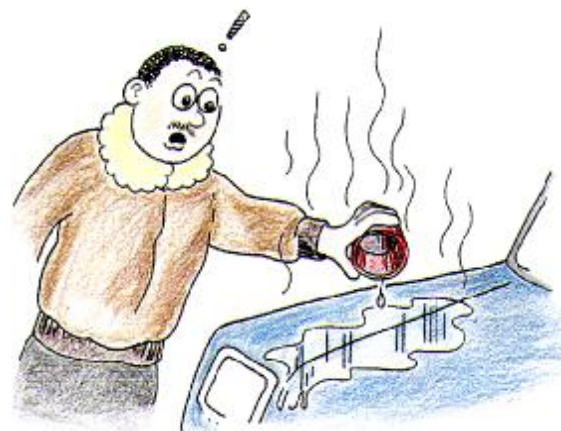
a) water at a temperature above 0°C.
b) water at 0°C.
c) ice at 0°C.

Answer: c

The remaining 3 g will be ice at 0°C! 540 cal taken from 3 g means each gram gives up 180 cal. 100 cal taken from a gram of boiling water reduces its temperature to 0°C, and removal of 80 more cal turns it to ice (assuming a constant 540 cal/g for water and ideal conditions).

Now you can see why hot water so quickly turns to ice in a freezing-cold environment — like washing your car with hot water on a cold day.

Would ice still form if we thought joules instead of calories?