Homework – Module 1 Name:

1) Warning signs such as the one to the right are common before bridges. And they are put there for good reason.

Why does the bridge get icy before the pavement on the ground when air temperatures drop below freezing? Use heat transfer concepts to explain your answer. Assume that wind is calm to simplify the discussion.

The bridge would become icy first because it would lose heat energy over its entire surface. The bridge would cool by radiative heat transfer to the air from its top, its sides and its underside. The net effect is that the bridge's temperature would closely mirror the air's temperature at night.

The road, on the other hand, would lose heat quickly too, but only at its upper surface. In addition, if the asphalt becomes colder than the ground underneath it, heat would flow from warmer ground through radiative heat transfer and conduction, which would slow the rate at which the asphalt cools.

2) One of my many humbling experiences as a fledgling forecaster (a.k.a. learning experiences) occurred for a forecast for Corvallis, Oregon during the winter of 1979-80. I forecast mostly clear, calm conditions overnight with a low near freezing (33˚F). It was indeed calm all night, and clear too… most of the night. Unfortunately for my forecast, low-clouds began to drift overhead after midnight, at which time the temperature warmed to above 45˚F and stayed there through the night. My forecast low ended up 10˚F too cold, a major bust!

Use heat transfer concepts to explain why the surface temperature warmed when the low clouds moved overhead.

The low clouds would absorb infrared radiation emitted from the earth's surface and re-radiate it back to the surface.

In other words, a portion of the infrared radiation lost by the earth to the atmosphere is absorbed by the low clouds and re-emitted to the surface where it is absorbed.