

## 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 calm winds to simplify the discussion.

There is a 600-character limit for all questions.



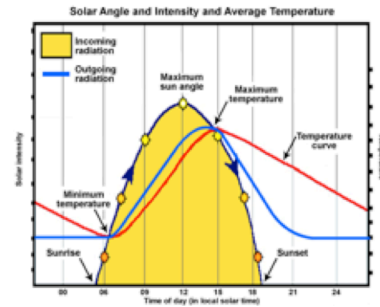
- 2) One of my most humbling experiences as a fledgling meteorologist (a.k.a. early learning experiences) occurred for Corvallis, Oregon during the winter of 1979-80. I forecast clear, calm conditions overnight with a low near freezing ( $33^{\circ}\text{F}$ ). It was indeed calm all night with cold air trapped in the Willamette Valley. And it was clear too...most of the night. Unfortunately for my forecast, low-clouds (stratocumulus) began to drift overhead after midnight, at which time the temperature warmed to  $45^{\circ}\text{F}$  and stayed there through the rest of the night. My forecast low ended up  $8^{\circ}\text{F}$  too cold, a major bust!

Use heat transfer concepts to explain why the surface temperature increased as the low clouds moved overhead.

(Hint: infer from Figs. 2.12 and 2.18 of textbook the impact of clouds on radiative heat transfer.)

- 3) The schematic to the right was shown in the overview slides to explain the diurnal cycle of temperature in terms of radiative balance. Unfortunately, the diagram has an error (that I intentionally omitted from the narrative) where two of the curves are not consistent with the physics of radiative heat transfer. Which two curves are in error? Use the laws of radiation to explain what the inconsistency is between the two curves.

(Hint: compare the diagram with Figure 3.02 of the text.)



Black curve-incoming solar radiation  
Blue curve-outgoing IR radiation  
Red curve-temperature

Use heat transfer concepts to answer the following two questions. Assume you are wearing the same clothing for every situation.

- 4) During a very cold, calm, winter night, why would you feel colder near sea level (e.g. 100 meters) than at a high elevation site like a ski resort (3000 meters) when the air temperatures are the same?
- 5) On a very cold, calm day, why do you feel warmer at noon on a clear sunny day than you would on an overcast day when the air temperature is the same?