

Show all work, including mental steps, in a clearly organized way that speaks for itself. Use proper mathematical notation, identifying expressions by their proper symbols (introducing them if necessary), and use EQUAL SIGNS and arrows when appropriate. Always SIMPLIFY expressions. BOX final short answers. LABEL parts of problem. Keep answers EXACT (but give decimal approximations for interpretation if appropriate). Indicate where technology is used and what type (Maple, GC).

1. The temperature-humidity index I (or humidex, for short) is the perceived air temperature when the actual temperature is T and the relative humidity is h , so we can write $I = f(T, h)$. The following table of values of I is an excerpt from a table compiled by the National Oceanic & Atmospheric Administration.

- (a) What is the value of $f(95, 20)$? What is its meaning?
- (b) For what value of h is $f(80, h) = 82$? Formulate this question in words.
- (c) For what value of T is $f(T, 40) = 86$? Formulate this question in words.
- (d) What are the meanings of the functions $I = f(85, h)$ and $I = f(100, h)$? Compare the behavior of these two functions of h , *i.e.*, as h increases, how does I behave for the second case compared to the first case? [Hint: compare the successive differences of the two functions.]

Apparent temperature as a function of temperature and humidity

Relative humidity (%)

$T \backslash h$	20	30	40	50	60	70
80	77	78	79	81	82	83
85	82	84	86	88	90	93
90	87	90	93	96	100	106
95	93	96	101	107	114	124
100	99	104	110	120	132	144

- (e) Evaluate the average rate of change for $f(100, h)$ for the intervals $h = 30 \dots 40$ and then $h = 40 \dots 50$ and then average these to get a decimal value for the "instantaneous" rate of change of $f(100, h)$ at $h = 40$:

$$\frac{d}{dh} f(100, h) \Big|_{h=40}$$

- f) Using this result, by how much would you expect the perceived temperature of 110 degrees F to increase if the humidity increases from 40% to 42% at an actual temperature of 100 degrees F?

► **solution**