

## Subject 12

**Please, do not write on the exam paper**

When the temperature drops below zero, it is usual for weather forecasters to give both the expected air temperature, and the wind chill temperature – **this is the temperature actually felt by someone, which depends on the wind speed and air temperature**. So, for example, the wind chill temperature for an actual temperature of  $0^{\circ}\text{C}$  and wind speed of 10 mph is given by  $-5.5^{\circ}\text{C}$ .

For  $v > 5$  mph, the wind chill temperature  $T$  is given by the formula :

$$T = 33 + (0.45 + 0.29\sqrt{v} - 0.02v)(t - 33)$$

where  $t$  in  $^{\circ}\text{C}$  is the air temperature and  $v$  in mph (mile per hour) is the wind speed.

This formula was devised by American scientists during the second World War, and is based on experimental evidence. There are different formulae to use depending on the country you are in.

### QUESTIONS :

1. Find the wind chill temperature when
  - (a)  $t = 2^{\circ}\text{C}$  and  $v = 20$  mph
  - (b)  $t = 0^{\circ}\text{C}$  and  $v = 40$  mph
  
2. We know that one mile is equivalent to 1.609 km.
  - (a) Convert 5mph into km/h .
  - (b) What do you think of this limit speed for the calculation in wind chill ?
  
3. Now, we want to study the influence of wind speed when the temperature is  $-5^{\circ}\text{C}$ .
  - (a) Write the function  $T$  with the given temperature. Expand the formula to have the simplest form in term of  $v$ .
  - (b) Compute the derivative of  $T$ .
  - (c) Draw the table of variation for  $T$  and sketch its graph.

### Beaufort Scale and effects of wind

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

*Adapted from CIMT plymouth (MEP project)*

### Nota :

Gale : tempête , grand vent ; twig : brindille ; vane : girouette;