a) This is a steady reference frame (air moving by at a constant speed of 10 m/s with a temperature of 260K). The temperature measured by the thermometer is higher than 260K since the flow stagnates on the surface of the thermometer (via a Q,S, adiabatic process with no external work) and the kinetic energy is converted to enthalpy.

\[ C_p T_r = C_p T + \frac{c^2}{2} \]

\[ T_r = 1003.5 \left( T_T \right) = 1003.5 (260) + \frac{10^2}{2} \]

\[ T_T = 260.05 \text{K} \]

b) Since the balloon is moving with the wind, there is no relative velocity difference between the air mass and the frame of reference of the balloon. Therefore, the temperature read by the thermometer is the same as the (static) temperature of the atmosphere.

\[ = 260 \text{K} \]

c) First you must put yourself in a steady reference frame (seated on the airplane next to the thermometer). You see the flow moving towards you at 300 m/s with a temperature of 260K. The temperature read by the thermometer is higher than 260K since the flow stagnates (via a Q,S, adiabatic process with no external work) and the kinetic energy is converted to enthalpy.

\[ C_p T_r = C_p T + \frac{c^2}{2} \]

\[ T_r = 1003.5 \left( T_T \right) = 1003.5 (260) + \frac{300^2}{2} \]

\[ T_T = 304.8 \text{K} \]
d) AGAIN, PUT YOURSELF IN A STEADY REFERENCE FRAME
(Seated on the fan blade next to the thermometer)
You see a flow moving towards you at \( c = \sqrt{360^2 + 250^2} = 390.5 \text{ m/s} \) and \( T = 260 \text{K} \)

\[
\frac{C_p T_f}{T} = C_p T + \frac{C_l}{2}
\]

\[
1003.5 (T_f - T) = \frac{390.5^2}{2}
\]

\[
T_f = 336 \text{K}
\]