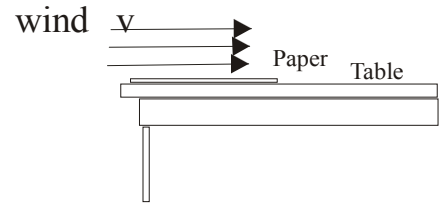


**Quiz 1 My Solutions**

A piece of paper rests on flat horizontal table. You gently blow air horizontally over the top of the paper - wind of velocity  $v$ . The paper rises off of the table. Explain.

(HINT: The air velocity under the paper is zero.)



State the appropriate physical principle(s). 30 points

Bernoulli's Principle

$$P_{\text{above}}/\rho_{\text{above}} + \frac{1}{2} v_{\text{above}}^2 + gh_{\text{above}} = P_{\text{under}}/\rho_{\text{under}} + \frac{1}{2} v_{\text{under}}^2 + gh_{\text{under}} \quad (1)$$

or

$$P/\rho + \frac{1}{2} v^2 + gh = \text{const} \quad (2)$$

Fill in the details 30 points

Substituting in Eq. (1) that  $\rho$  the same above and under,  $h$ 's are the same (thin paper) and  $v_{\text{under}} = 0$  gives

$$P_{\text{above}}/\rho + \frac{1}{2} v_{\text{above}}^2 + g*0 = P_{\text{under}}/\rho + \frac{1}{2}*0^2 + g*0 \quad (3)$$

which yields

$$P_{\text{above}}/\rho + \frac{1}{2} v_{\text{above}}^2 = P_{\text{under}}/\rho \quad (4)$$

So,

$$P_{\text{lift}} = P_{\text{under}} - P_{\text{above}} = \frac{1}{2} \rho v_{\text{above}}^2 > 0 \text{ (upward)} \quad (5)$$

Explain what is happening. 40 points

Using Eq(4) we see the pressure under the paper is higher than the pressure above, so it tends to raise the paper off of the table surface.

Or

Using Eq.(5), the net pressure is upward, it tends to raise the paper off of the table surface.

Spreadsheet Setup

	A	B	C	
1	$g =$	9.8	$\text{m/s}^2$	1. Enter the items in the cells as shown. DO NOT USE "" in cells B6 and C5. They are used here to keep the cell from executing the math. 2. COPY C5 and PASTE into C6. 3. COPY B6 and C6, PASTE B7 thru B20 or so.  You can alter cells B3 and B5 to cover any range of velocities.
2	density =	1.29	$\text{kg/m}^3$	
3	$\Delta V =$	10	$\text{m/s}$	
4		$v \text{ (m/s)}$	$P_{\text{lift}} \text{ (N/m}^2\text{)}$	
5		0	$"=0.5*b5"$	
6		$"=b5+\$b\$3"$		
7				