

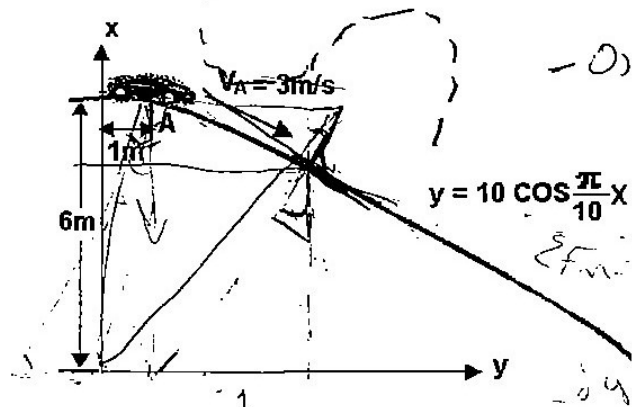
**Instructions:** You must explain your methodology carefully and in detail, including the specific assumptions you use. Steps should be clear.

**Problem #1 (10, 10 points)**

The car has a total weight of 950 kg.

- Find the resultant normal force acting on the car when it is at point A and freely going at 3m/s.
- Compute the increase in the car speed at this point. Neglect air resistance and do not pay attention for the size of the car.

$-0,4 \times 10 \times d + \frac{1}{2} \times \frac{10}{37,2} \times 100 = 0$

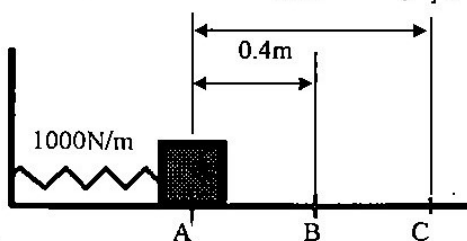


$-0,4 \times 10 \times 15 + \frac{10}{37,2} \times 100$   
 $= \frac{10}{37,2} \times 33,33$   
 $\frac{100}{37,2}$   
 $\frac{dx}{dy}$   
 $\frac{dy}{dx}$   
 $\frac{100}{37,2}$

**Problem #2 (15 points)**

A 5 Kg block rests on the horizontal surface. The spring is initially compressed 0.4 m from B to A. After the block is released from rest at A, determine its velocity when it passes point C.  $\mu_k = 0.25$ .

$-d \times 0,4 \times 90 + \frac{1}{2} \times \frac{10}{37,2} \times 100 = \frac{1}{2} \times \frac{10}{37,2} \times 100$



$-0,4 \times d \times 10$   
 $+ \frac{1}{2} \times \frac{10}{37,2} \times 100$

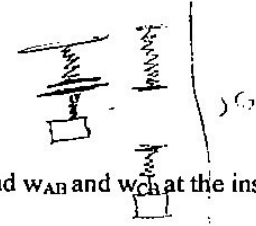
$T_1 + U_1 = T_2 + U_2$   
 $0 + 0,4 \times \frac{1}{2} \times 1000 = \frac{1}{2} m v_c^2 - \frac{1}{2} \times 1000 \times 0,4^2$   
 $= \frac{1}{2} m v_c^2 - \frac{1}{2} \times 1000 \times 0,16$

$180 \rightarrow \pi$   
 $84,26 \rightarrow$   
 $T_1 + U_1 = T_2 + U_2$   
 $0 + V = v_{of \text{ at } C}$

$P = 548,61883$   
 $5 \times 9,81 = N$   
 $- 5 \times 9,81 \times 0,15 \times 0,8 + \frac{1}{2} \times 1000 \times 0,4^2 - \frac{1}{2} \times 1000 \times 0,16$   
 $= \frac{1}{2} m v_c^2$

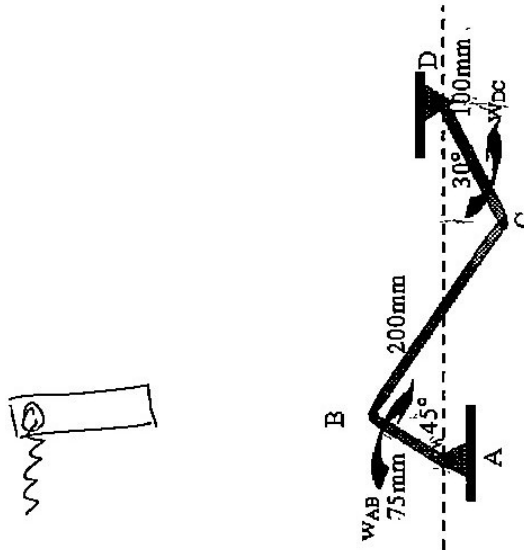
$$\begin{vmatrix} i & j & k \\ 0 & 0 & 40 \\ -0,053 & +0,0836 & 0 \\ -0,103 & -0,1715 & 0 \end{vmatrix} = + \vec{\omega} \cdot \hat{e}_0$$

26  
26  
26



**Problem#3(20points)**

For the three bar linkage shown  $\omega_{DC} = 4 \text{ rad/s}$ ; Find  $\omega_{AB}$  and  $\omega_{BC}$  at the instant shown.

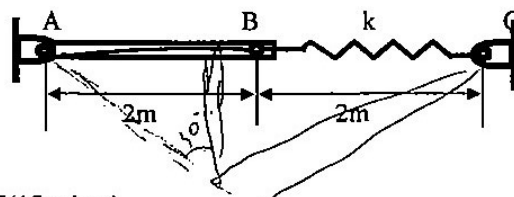


$\omega_{AB} = \omega_{BC} + \omega_{DC}$   
 $\omega_{AB} = \omega_{BC} + 4$

**Problem#4(15, 15points)**

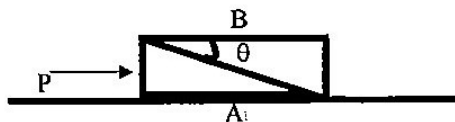
When the slender 20kg bar AB is horizontal; it is at rest and the spring is unstretched.

- Find the stiffness  $k$  of the spring so that the motion of the bar is momentarily stopped when it has rotated downward  $90^\circ$ .
- Find the angular velocity of the bar when  $\theta = 60^\circ$ .



**Problem#5(15points)**

Blocks A and B with mass  $m$ , find the largest horizontal force  $P$  which can be applied to A so that B will not move relative to A. All surfaces are smooth.



$$\begin{aligned} & \circ + 20 \times 9,81 \times 2 \\ & = (20 \times 2) \times \frac{1}{2} \omega^2 \\ & + \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2 \\ & v = \omega a \\ & \omega = \frac{v}{a} \end{aligned}$$