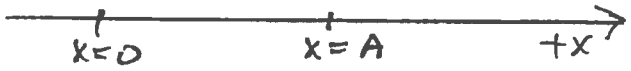
1. (25 Points)At $t = 0$ a motorcycle is at a point called the origin, at rest. It accelerates along a line defined to be the x-axis with acceleration $a = \alpha + \beta t$ where α and β are known constants. A car is moving in the positive x direction with a constant velocity, v_1. The car was at the known point $x = A$ at the time $t = 0$ sec. What does v_1 have to be in order for the car and the motorcycle to be at the same point when $t = 3$ sec?



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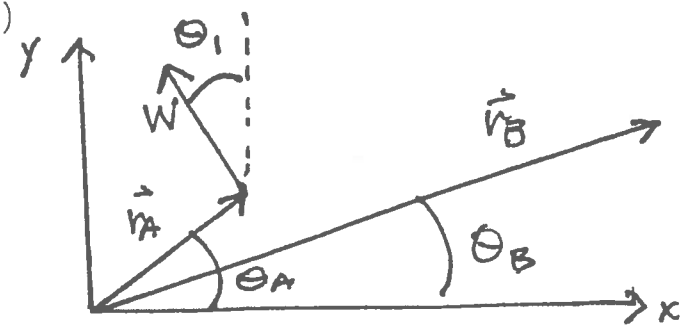
2. (25 Points) A block of mass m is moving in the x, y plane. At $t = 0$ it is placed at the point $\vec{r}_A$ and given the initial velocity of magnitude W and direction indicated by the angle θ_1. The block's acceleration is

$$\vec{a} = \alpha\vec{i} + \beta t\vec{j}$$

where α and β are unknown constants. The time required to reach the point r_B is given to be T. Find α and β. (The length of $\vec{r}_A$ is r_A, the length of $\vec{r}_B$ is r_B and the angles θ_A and θ_B are all known.)



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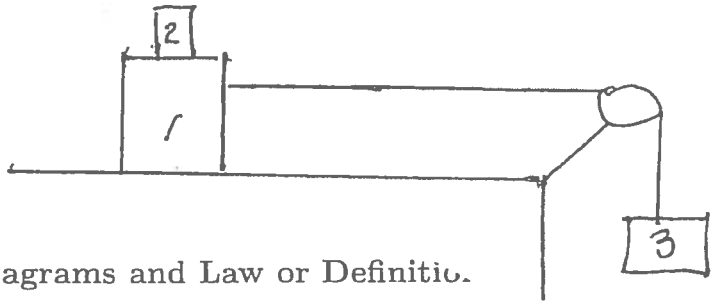
3. (25 Points) Two blocks, masses m_1 and m_2, on a horizontal, frictionless surface are being pulled by a massless, unstretchable rope that goes over a frictionless pulley and is connected to a block of mass m_3. Assumer two blocks move together. The coefficient of friction between block 1 and block 2 is μ. Find the force that block 2 exerts on block 1.



Free Body Diagrams and Law or Definitio.

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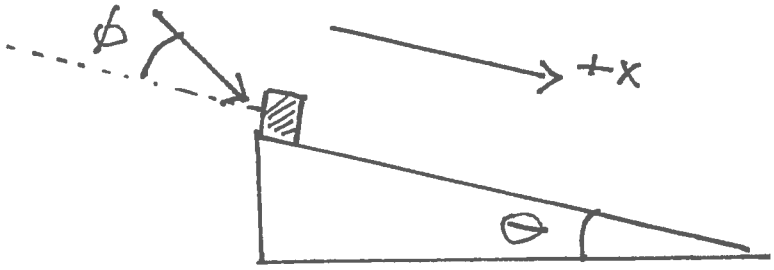
4. (25 points) An object of mass m slides down an inclined plane, angle θ. The coefficient of friction between the object and the plane is μ. At $t = 0$ a mysterious force acts on the object at the fixed, known angle ϕ as shown below. The position of the object is observed to be a function of time given by

$$x(t) = \alpha t^3 + \beta t^2$$

where α and β are known, positive constants. Find the magnitude of the unknown force.



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