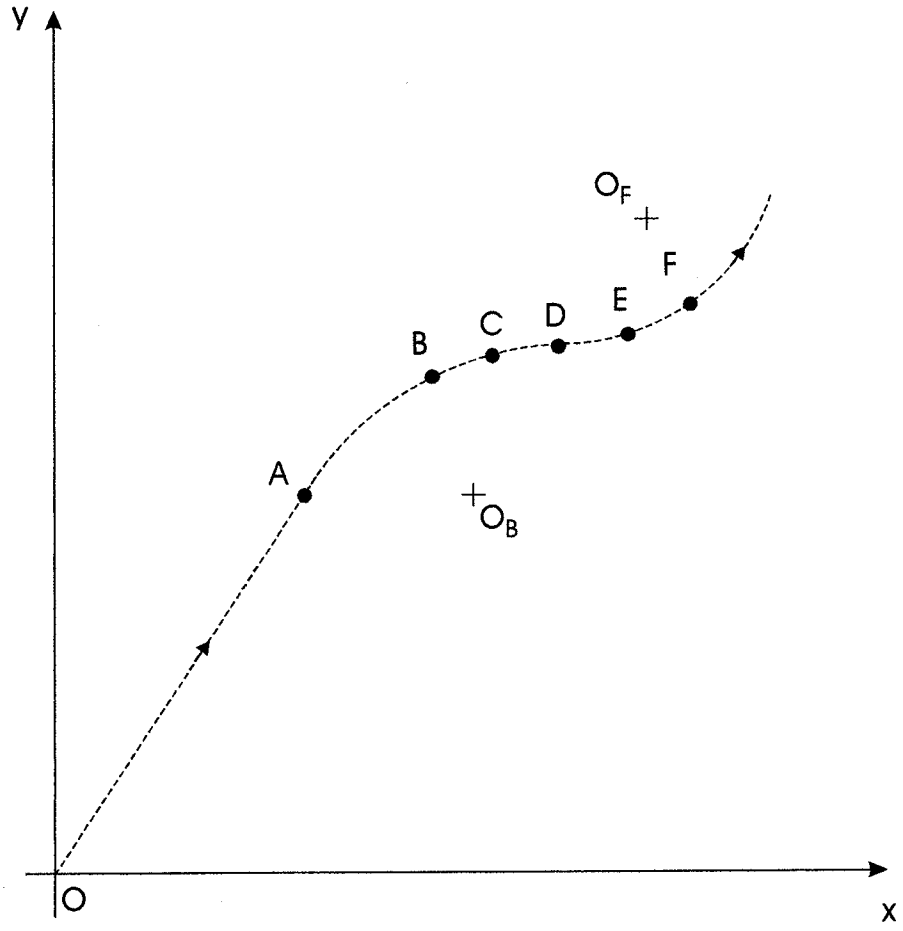
Name _____ Section (circle one): 0910 1010

ME 212
Quiz 1
Summer 2009

Solve the problems below on separate sheets of paper. In your solutions you need to show not only the answers but the steps or rationale you used to arrive at the answer. If you perform special actions on your calculator (like a SOLVE or a cross product), write out the steps you used and precisely what you entered into the calculator. Your answers need to be complete enough to make your work *checkable*. If the question has multiple parts, make sure that in your work, it is very clear which part of your work belongs to each sub-question. Box your final answers.

1.



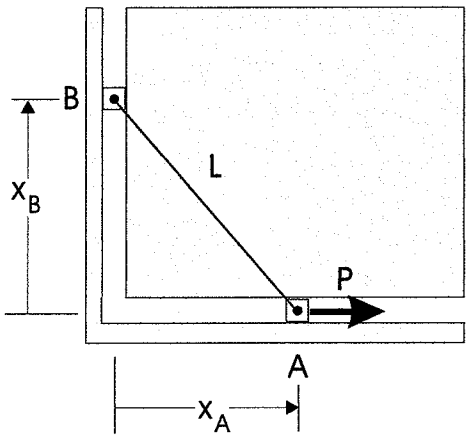
In the drawing at left, a particle moves from the origin O upward and to the right along the path. The section OA is straight. D is the inflection point between the two curves. The radius $\rho_B > \rho_F$.

Answer the following questions assuming that the speed of the particle along the path is a constant v:

a) Between O and A, what is a_r and a_θ? Why?
b) Between O and A, what are a_n and a_t? Why?
c) Between O and A, what are v_t and v_n? Why? What, in general, can be said about v_n?
d) Draw the vectors $\hat{e}_r$, $\hat{e}_\theta$, $\hat{e}_n$, $\hat{e}_t$ that occur at B. Make a separate drawing of this part of the curve that is large enough to show this clearly.

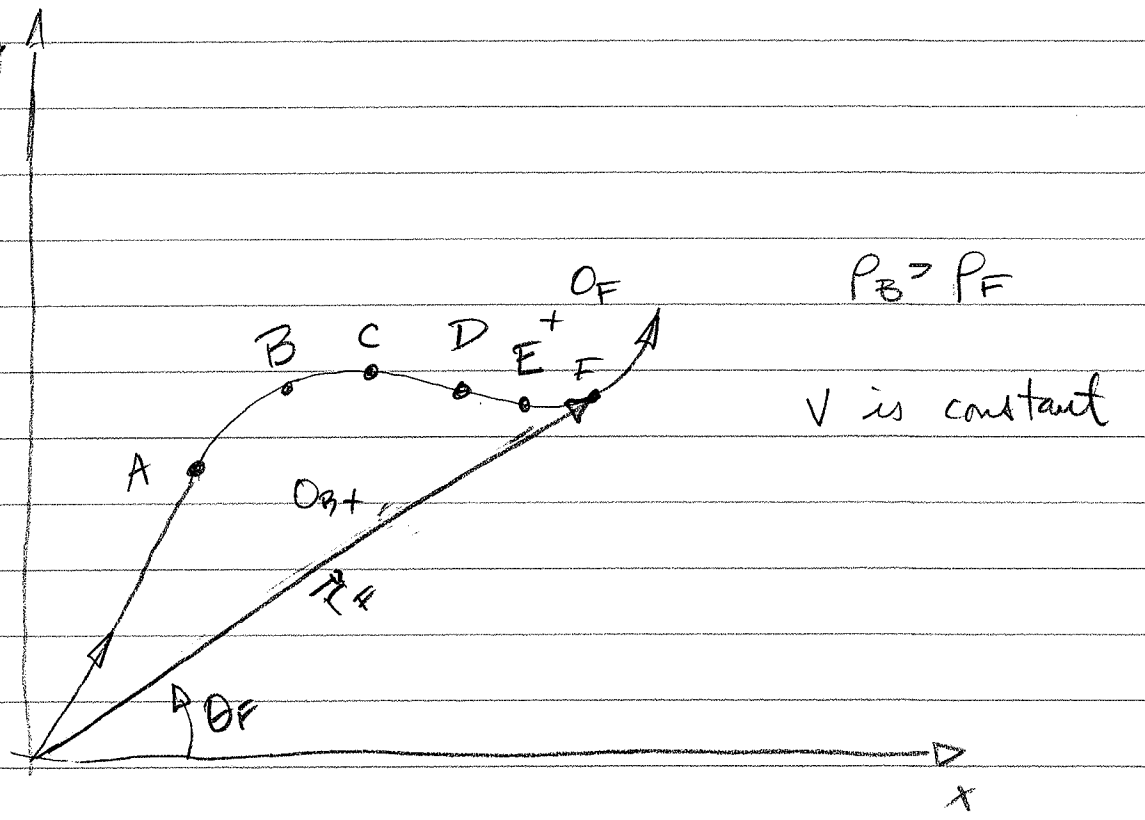
e) Do the same at F. Also draw $\vec{r}_F$ and θ_F on the drawing above.
f) At what point(s) is the magnitude of the total acceleration on the particle at its minimum? What is this minimum?
g) At what point(s) is the magnitude of the total acceleration at its maximum? Why?

2. In the drawing at right, the two slider blocks at A and B slide in the channels without friction. They have masses m_A and m_B. Their movement takes place in a standard gravitational field of strength g. They are joined by the link L. Block A is pulled to the right by applied force P.



   a. Draw the free body diagrams and mass acceleration diagrams of each block.
   b. Impose the appropriate dynamic equilibrium equation(s) on each block.
   c. Relate x_A, x_B, a_A, and a_B in a single equation in terms only of the quantities given above.
   d. Develop an expression of a_B in terms of a_A and the quantities above for the case when $x_A = x_B$.
   e. Develop an expression for x_B in terms of x_A for the case when $a_A = -a_B = a$.
   f. Develop an expression for the ratio of the velocities in terms of the displacements.

1237 10
1248
11 min



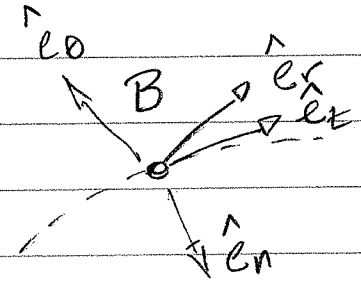
a) $a_r = 0$, $a_\theta = 0$ $\quad a_r = \frac{dv}{dt} = 0$ because V constant

$a_\theta = 0$ because path straight, so angle from origin doesn't change

b) $a_n = 0$ (direction doesn't change)
& $a_t = 0$ (v constant along path)

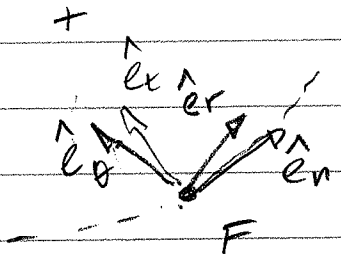
c) $V_t = V$, $V_n = 0$. V is velocity tangent to path. V_n is always $= 0$.

d)



+B

e)



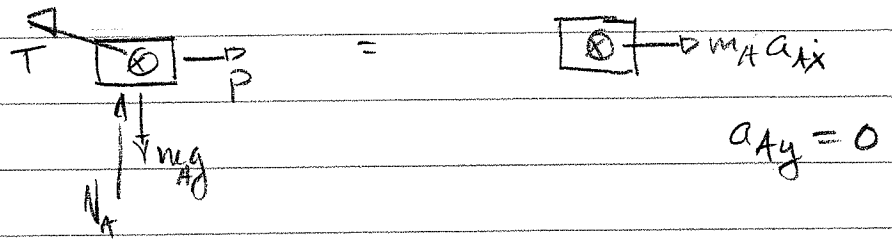
f) At A & D, $a = 0$

g) At F, $a_t = 0$ & a_n is greatest.

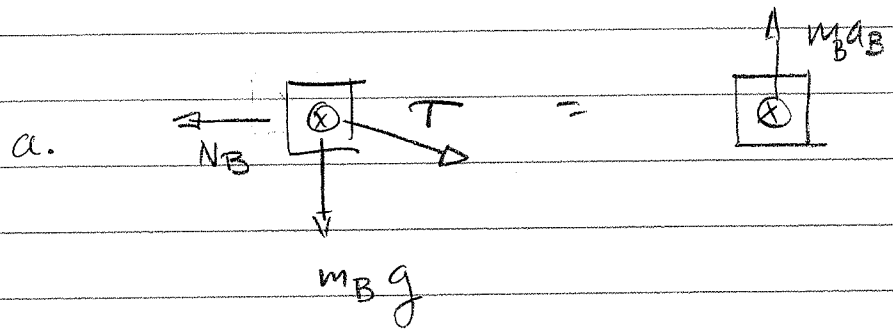
1434 2. a. FBD = MAD

1445

11



b. $\pm\Sigma F_x$: $P - T\frac{x_A}{L} = m_A a_{Ax}$



b. $+\uparrow\Sigma F_y$: $-m_B g - T\frac{x_B}{L} = m_B a_B$

c. $T = \boxed{\left(P - m_A a_A\right)\frac{L}{x_A} = -m_B(g + a_B)\frac{L}{x_B}}$ $(a_{Ax} = a_A)$

d. When $x_B = x_A$, they $= \frac{L}{\sqrt{2}}$

$P - m_A a_A = -m_B(g + a_B)$

$$\boxed{a_B = \frac{m_A a_A - P}{m_B} - g}$$

2 (cont.)

e. $$\frac{P - m_A a}{x_A} = \frac{-m_B (g - a)}{x_B}$$

$$\boxed{x_B = \frac{m_B (a - g)}{P - m_A a} x_A}$$

f. $$L^2 = x_B^2 + x_A^2$$

$$0 = 2 x_B \dot{x}_B + 2 x_A \dot{x}_A$$

$$\boxed{\frac{v_A}{v_B} = -\frac{x_B}{x_A}}$$