U = - F. F = - カタダ・ヒャズナタダ] = - mgy & (single protected) U= V, + Uz = - myy, - m, gyz) y, = 1, colp, , x, = 2, 1.46, Jz= 1, cosp, + 1 z cospz , x= 1, sing, + 12 sing. T = \ \frac{1}{2} m\_a Va2 = 1 m, (x,2+j,2) + 1 m, (x,2+j2)  $\dot{x_1} = \lambda_1(0)\beta_1\dot{\beta}_1 \rightarrow \dot{x_1}^2 = \lambda_1^2(0)^2\beta_1\dot{\beta}_1^2$ j, = -1, sinp, j, -> j, = 1,2 sin p, j,2 Tly, x3+2= 1,2/2 x= 1, (0, p, p, + 12 (0) p, p2 x2 = 1,2 (0) p, p,2 + 12 (0) p2 p2 +21, 12 (0) p, corps p, p2 y2 = -1, sinφ, φ, - 12 sinβ2 β2 y22 = 1,2 sin2β, \$,2 + 12 sin2β, \$,2 + 21, 12 sinβ, sinβ, \$,\$,2 -> x221y2= 1,26,2+ 1262 + 2112 (os(\$,-\$2)\$,\$2 Thus, I = = m, 1,2 p, 2 + = m2 (1,2 p, 2 + l2 p2 + 21,12 (05(p,-p)) p, q2) = + (m,+m2) 1,2/2 + + m2 12/2 + m2 1, 12 p, p2 (01 (p,-p2)) SO L=T-U with ( = = = (m,+m2)1, \$\dot\ 2 + \frac{1}{2}m\_2l\_2 \dot\ 2 + m\_2l\_1l\_2 \dot\ p\_1 \dot\ (or(\dot\ - \dot\ 2)) + (mitmz) gl, 101\$, + mzylz cospz

Sec 5, Poli2. X2 = X + 1 517 \$ Ji = 1 cosp mgy= = | - mylosp ( reference to yea) T= = (m, +2) + 1 m2 (x2 + y2)  $\dot{x}_{2} = \dot{x} + \lambda_{10}\phi\dot{p}$   $\rightarrow \dot{x}_{2}^{2} = \dot{x}^{2} + l^{2}_{10}l^{2}\phi\dot{p}^{2} + 2l_{10}l\dot{p}\dot{x}\dot{p}$   $\dot{y}_{1} = -l_{10}l\dot{p}\dot{q}$   $\rightarrow \dot{y}_{2}^{2} = l^{2}_{10}l\dot{p}\dot{p}^{2}$  $T = \pm m_1 x^2 + \pm m_2 (x^2 + p^2 p^2 + 2 \ln a p x p)$  $= \frac{1}{2} (m_1 + m_2) \dot{\chi}^2 + \frac{1}{2} m_2 (l^2 \dot{\rho}^2 + 2 l \cos \dot{\rho} \dot{\chi} \dot{\rho})$ Thu,

Sec 5, Prob3. (a) Y : my ular frag V=-mgy X = Xp + Lsing 50 = a 1038+ + 1 sinp y = yp + long - a singt + ligh U= -my [ -a sinxt + 1 (0) \$] T= = = (x2+y2) x = - a y singt + losp p - ax coixt - limp p -> x2 = 92 82 sin2 8t + 12 (052 \$ \$ 2 - 24 18 sin 8t los \$ \$ y = 4282 cos28+ 412 sin2 \$ \$ 2 + 2-18 cos8+ sing \$  $T = \pm m \left( q^2 \chi^2 + l^2 \dot{\phi}^2 + 2al \chi \left( sin \dot{\phi} \cos t - \sin t \cos \phi \right) \dot{\phi} \right)$ Sin ( - 8+) = 1 m a282 + + m 12 p2 + ma 18 p sin(p-8t) = 1 ma2 82 + + m12 p2 + mal x psin(p-xt) + mg[-4 snxt + l1018]

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Let's ignore functions of time, constants and total time devivatives:

3) mad 
$$y \neq sin(\beta-xt) = \frac{d}{dt} \left[ -mad x \left( o_1(\beta-xt) \right) \right] + mad x^2 sin(\beta-xt)$$

$$\begin{array}{lll}
\chi &= a \cos \theta t & (oscillates) \\
\chi &= \chi_p + \lambda \sin \theta &= a \cos \theta t + \lambda \sin \theta \\
\chi &= \lambda \cos \theta &= -m_g \lambda \cos \theta \\
U &= -m_g \gamma &= -m_g \lambda \cos \theta \\
U &= -m_g \gamma &= -m_g \lambda \cos \theta \\
T &= \pm m(x^2 + b^2) &= \pm m \left( \left[ -a x \sin \theta t + \lambda \cos \phi \right]^2 + \left[ -\lambda \sin \phi \right]^2 \right) \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 \phi \right]^2 - 2a \lambda x \sin x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 x \right] + \lambda^2 \sin^2 x t \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 x \right] + \lambda^2 \cos^2 x \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 x \right] + \lambda^2 \cos^2 x \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 x \right] + \lambda^2 \cos^2 x \cos \phi \\
&= \pm m \left[ a^2 x^2 \sin^2 x t + \lambda^2 \cos^2 x \right] + \lambda^2 \cos^2 x \cos^2 x \cos \phi \\
&= \pm m \left[ a^2 x^2 \cos^2 x \cos^2 x \right] + \lambda^2 \cos^2 x \cos^2$$

$$= \frac{1}{2} m \left[ a^2 \chi^2 \sin^2 \chi t + l^2 \phi^2 - 2al \chi \sin \chi t \cos \phi \right]$$

$$= \frac{1}{2} m \left[ a^2 \chi^2 \sin^2 \chi t + l^2 \phi^2 - mal \chi \sin \chi t \cos \phi \right]$$

$$+ mgl \cos \phi$$

As before ignore country Function of time, and total time derivatives. - maly single cosp = = = [-maly singt sinp] + mal & cost sin \$ Lessie Impijo + maldicostt sind + myking Jp = 9 cos xt (oscillatos) U=-mgy = -mgacosxt-mglosp

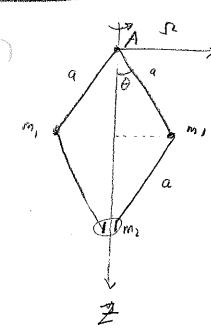
 $T = \pm m(x^2 + y^2) = \pm m(\lambda^2 \cos^2 \beta \dot{\beta}^2 + (-\alpha 8 \sin 8t - \lambda \sin \beta \dot{\beta})^2)$   $= \pm m[\lambda^2 \cos^2 \beta \dot{\beta}^2 + \alpha^2 8^2 \sin^2 8t + \lambda^2 \sin^2 \beta \dot{\beta}^2 + 2\alpha 18 \sin \beta \cos 8t \dot{\beta}]$   $= \pm m^2 8^2 \sin^2 8t + \pm m 1^2 \dot{\beta}^2 + mald \sin \beta \sin 8t \dot{\beta}$   $= \pm m^2 8^2 \sin^2 8t + \pm m 1^2 \dot{\beta}^2 + mald \sin \beta \sin 8t \dot{\beta}$ 

I grove courts, functions of time, total time decidates.

maly sing singly = It [-mal 8 cosp singt]

+ mal 8 cosp cosper

[ = ± m/2 p² + mal y² (os dt cosp + mgl cosp)



$$t_1 = 951h\theta$$
 cosst  
 $y_1 = 911h\theta$  sinst (right)  
 $z_1 = 911h\theta$  cosst

$$X_1 = -91190 \text{ Colore}$$

$$y'_1 = -91190 \text{ Sinre} \qquad (|eft|)$$

$$Z_1'_1 = 91190 \text{ Sinre} \qquad (|eft|)$$

$$X_2 = 0$$

$$Y_2 = 0$$

$$Z_2 = 2 \cdot \alpha \cdot (0) \cdot \theta$$



$$|U| = -m_1 g Z_1 - m_1 g Z_1' - m_2 g$$

$$= -2m_1 g \alpha \cos \theta - 2m_2 g \alpha \cos \theta$$

$$= -2(m_1 + m_2) g \alpha \cos \theta$$

$$T = \frac{1}{2} m_1 \left( x_1^2 + y_1^2 + z_1^2 \right) \cdot 2 + \frac{1}{2} m_2 z_1^2$$

$$= m_1 \left[ \left( a \cos \theta \cos \theta \cos \Omega + - a \Omega \sin \theta \sin \Omega \right)^2 + \left( a \cos \theta \cos \Omega + a \Omega \cos \theta \cos \Omega \right)^2 + a^2 \sin^2 \theta \cos^2 \theta \right]$$

$$+ \frac{1}{2} m_2 \left( 4 a^2 \sin^2 \theta \cos^2 \theta \right)$$

$$- m_1 \Omega^2 \left[ \theta^2 \left( c^2 c^2 \Lambda + c^2 s^2 \alpha + s^2 \right) + \Omega^2 \left( s^2 s^2 \Lambda + s^2 \cos \Omega \right) + C^2 \left( s^2 s^2 \Lambda + s^2 \cos \Omega \right) \right]$$

$$= m_1 a^2 \left[ \theta^2 + \sin^2 \theta \Omega^2 \right] + 2 m_2 a^2 \sin \theta \cos^2 \theta$$

$$= m_1 a^2 \left[ \theta^2 + \sin^2 \theta \Omega^2 \right] + 2 m_2 a^2 \sin \theta \cos^2 \theta$$

$$\Rightarrow \left(1 = T - U = m_1 a^2 \left(\theta^2 t \sin^2 \theta \Omega^2\right) + 2 m_2 \alpha^2 \sin^2 \theta \dot{\theta}^2 + 2 \left(m_1 t m_1\right) ga(\sigma) \theta\right)$$