7 a) $\frac{dv}{dt} = x - 1.$

$v^2 = 2\int a\,dx.$

$= 2\int (x-1)\,dx$

$= 2 \times \frac{(x-1)^2}{2} + c.$

$= (x-1)^2 + c.$

sub $v = 1,\ x = 0.$

$1 = (0-1)^2 + c$

$\therefore c = 0$

$\therefore v^2 = (x-1)^2.$

ii). $v = \pm\sqrt{(x-1)^2}$ $\qquad \therefore t = \ln(x-1),\ x > 1.$

$= \pm(x-1).$

take $v = (x-1)$

$\frac{dx}{dt} = x - 1$

$\frac{dt}{dx} = (x-1)^{-1}$

$t = \ln(x-1) + c.$

sub $t = 0,\ x = 0.$

$0 = \ln(-1) + c.$

$\overset{AP^2}{\cancel{\cos A}} = a^2+b^2-2bc\cos A.$

$\cos A = \dfrac{\cancel{c}^2+b^2-a^2}{2bc.}$

7b). $\tan\frac{\pi}{4} = \frac{h}{OA}.$

$1 = \frac{h}{OA}$

$\boxed{\therefore OA = h.}$

$\tan\alpha = \frac{h}{OP.}$

$\boxed{\therefore OP = h\cot\alpha.}$

$\therefore AP^2 = h^2 + (h\cot\alpha)^2 - \cancel{2\cos\frac{\pi}{3}}\ 2\times h\times h\cos\alpha\times\cos\frac{\pi}{3}.$

$= h^2 + h^2\cot^2\alpha - 2h^2\times\cos\alpha\times\frac{1}{2}.$

$\therefore AP^2 = h^2 + h^2\cot^2 h - h^2\cos\alpha.$

ii). $\sin\frac{\pi}{4} = \frac{h}{TA.}$

$\therefore TA = \frac{h}{1/\sqrt{2}}$

$\boxed{\therefore TA = \sqrt{2}h.}$

$\sin\alpha = \frac{h}{TP}$

$\therefore \boxed{TP = \frac{h}{\sin\alpha.}}$

$\cancel{AP^2 = (\sqrt{2}h)^2 + (}$

$\cos\theta = \dfrac{(\sqrt{2}h)^2 + \left(\frac{h}{\sin\alpha}\right)^2 - AP^2}{2\times\sqrt{2}h\times\frac{h}{\sin\alpha}.}$

$= \dfrac{2h^2 + \frac{h^2}{\sin^2\alpha} - \left[h^2 + h^2\cot^2 h - h^2\cos\alpha\right]}{2\sqrt{2}h^2/\sin\alpha.}$ ~~x sin~~ $\sin\alpha.$

$= h^2 + \frac{h^2}{\sin^2\alpha} - h^2\cot^2 h + h^2\cos\alpha \times \dfrac{\sin\alpha}{2\sqrt{2}h^2}$

$$= \cancel{k}^2 \left[1 + \frac{1}{\sin^2\alpha} - \cot^2 h + \cos\alpha \right] \times \frac{\sin\alpha}{2\sqrt{2}K^2}$$

$$= \frac{\sin\alpha}{2\sqrt{2}} + \frac{1}{2\sqrt{2}\sin\alpha} - \frac{\cos^2 h}{2\sqrt{2}\sin h} + \frac{\sin\alpha\cos\alpha}{2\sqrt{2}}.$$