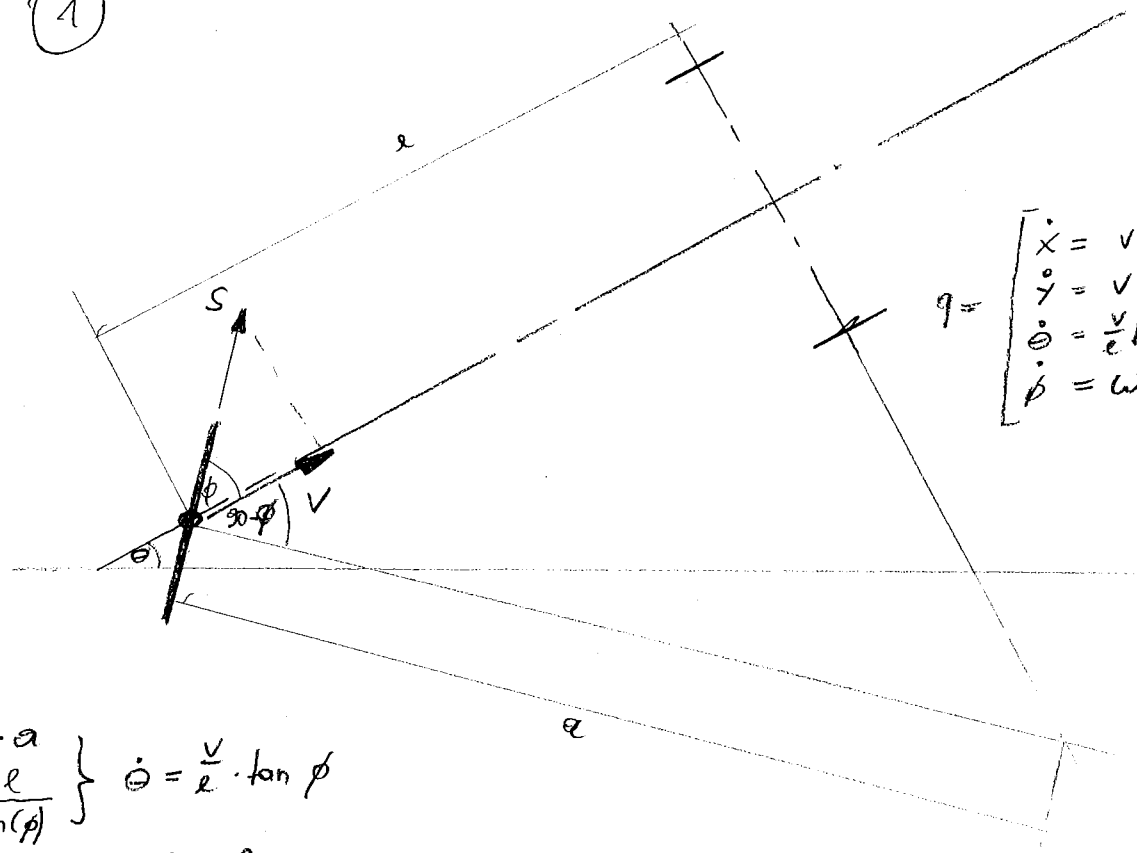
(1)



$$q = \begin{bmatrix} \dot{x} = V\cos\theta \\ \dot{y} = V\sin\theta \\ \dot{\theta} = \frac{V}{\ell}\tan\phi \\ \dot{\phi} = \omega \end{bmatrix}$$

$$\left.\begin{aligned} s &= \dot{\theta}\cdot a \\ a &= \frac{\ell}{\sin(\phi)} \end{aligned}\right\} \dot{\theta} = \frac{V}{\ell}\cdot\tan\phi$$

↳ $\cos(90-\phi) = \frac{\ell}{a}$

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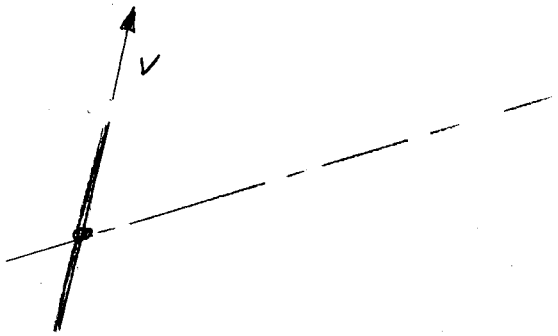
(2)



$$q = \begin{bmatrix} \dot{x} = V\cos\phi\cos\theta \\ \dot{y} = V\cos\phi\sin\theta \\ \dot{\theta} = \frac{V}{\ell}\sin\phi \\ \dot{\phi} = \omega \end{bmatrix}$$