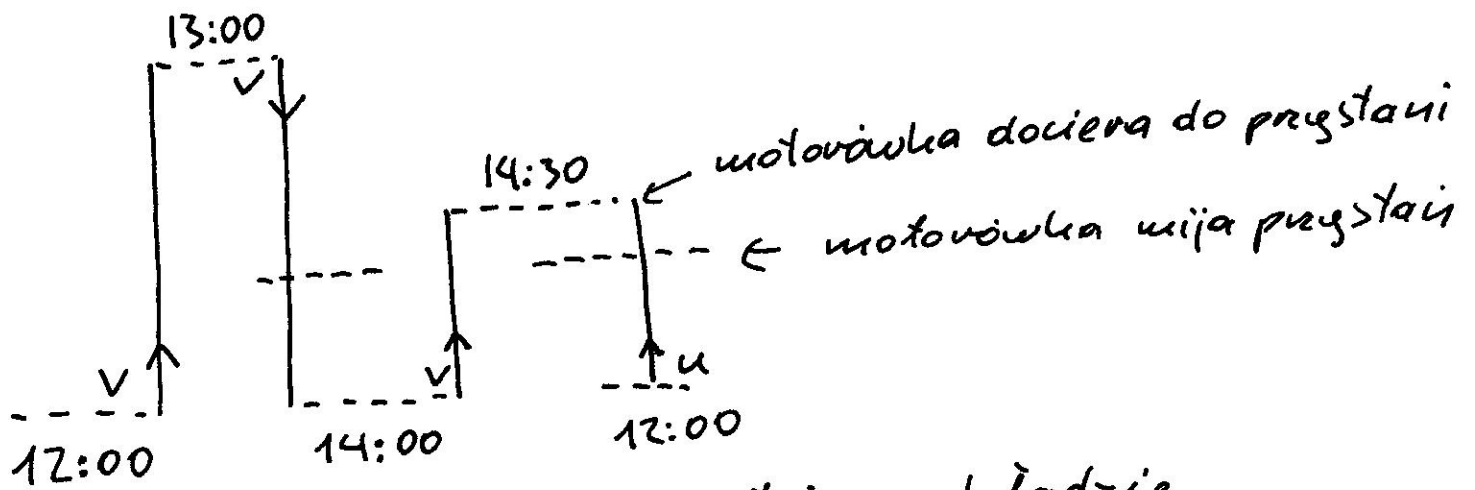


# Zadanie 1



motorówka  
w układzie związanym  
z wodą

motorówka dociera do przystani  
motorówka mija przystani  
przystani w układzie  
związanym z wodą.

$$\begin{cases} v \cdot \frac{1}{2} h = u \cdot 2 \frac{1}{2} h \rightarrow v = 5u \\ v \cdot 1h = v \cdot (x - 1h) + u \cdot x \end{cases}$$

$$5u \cdot 1h = 5u \cdot (x - 1h) + ux$$

$$10h = 6x$$

$$x = \frac{10}{6} h = 1h 40min$$

$$12:00 + 1:40 = 13:40$$

□

## Zadanie 2A



$$\begin{cases} x = v \cos \theta t \\ y = v \sin \theta t - \frac{1}{2} g t^2 \\ y = 0 \end{cases}$$

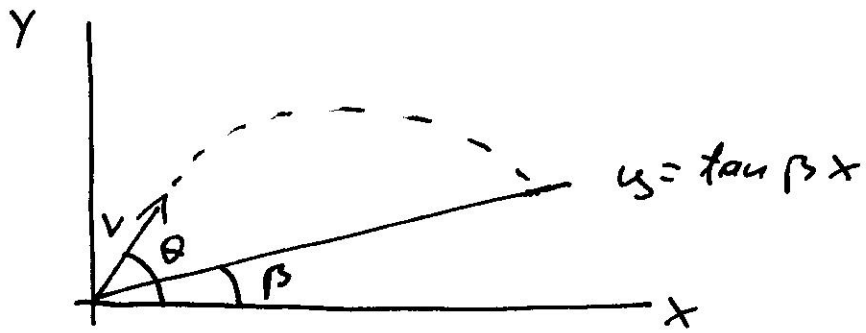
$$x = \frac{2v^2 \sin \theta \cos \theta}{g} = \frac{v^2 \sin 2\theta}{g}$$

$$2\theta = \frac{\pi}{2}$$

$$\theta = \frac{\pi}{4}$$

□

# Zadanie 2B



$$\left. \begin{aligned} x &= v \cos \theta t \\ y &= v \sin \theta t - \frac{1}{2} g t^2 \end{aligned} \right\} \quad y = \tan \theta x - \frac{g}{2v^2 \cos^2 \theta} x^2$$

$$\tan \beta x = \tan \theta x - \frac{g}{2v^2 \cos^2 \theta} x^2$$

$$x = \frac{2v^2}{g} (\tan \theta - \tan \beta) \cos^2 \theta, \quad \beta = \text{const.}$$

$$\sin(x+y) = \sin x \cos y + \sin y \cos x$$

$$\sin(x-y) = \sin x \cos y - \sin y \cos x$$

$$2 \sin x \cos y = \sin(x+y) + \sin(x-y)$$

$$\left( \frac{\sin \theta}{\cos \theta} - \frac{\sin \beta}{\cos \beta} \right) \cos^2 \theta = \frac{\sin \theta \cos \beta - \sin \beta \cos \theta}{\cos \beta} \cos \theta$$

$$= \frac{\sin(\theta - \beta) \cos \theta}{\cos \beta}$$

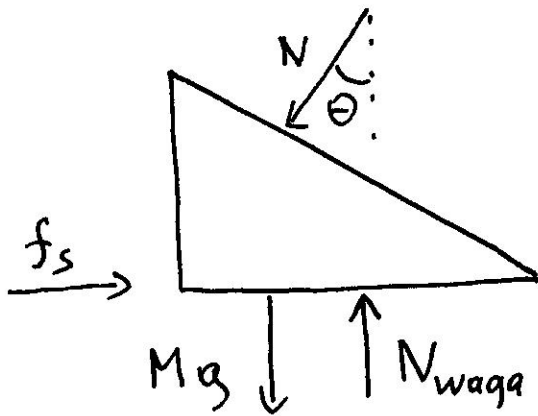
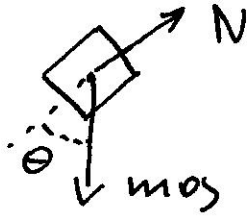
$$\sin(\theta - \beta) \cos \theta = \frac{1}{2} [\sin(2\theta - \beta) + \sin(-\beta)]$$

$$2\theta - \beta = \frac{\pi}{2}$$

$$\theta = \frac{\pi}{4} + \frac{\beta}{2}$$

□

### Zadanie 3



$$(a) \quad N = mg \cos \theta$$

$$f_s = N \sin \theta$$

$$f_s = mg \sin \theta \cos \theta$$

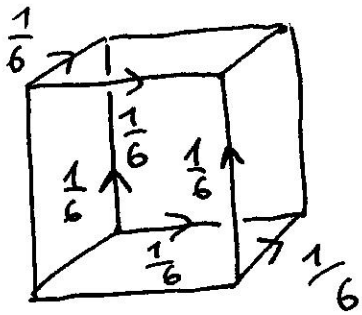
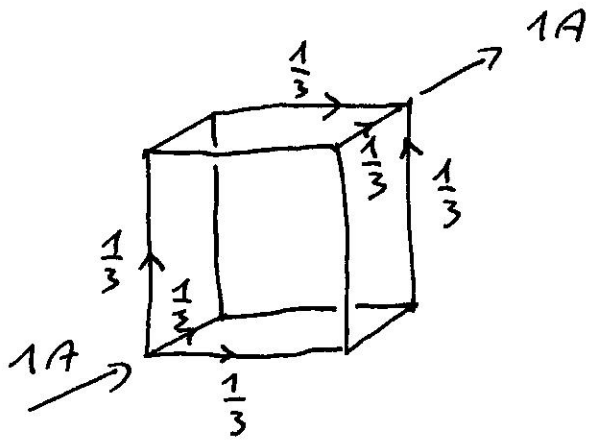
$$(b) \quad N_{waga} = Mg + N \cos \theta$$

$$N_{waga} = (M + m \cos^2 \theta) g$$



# Zadanie 4 (a)

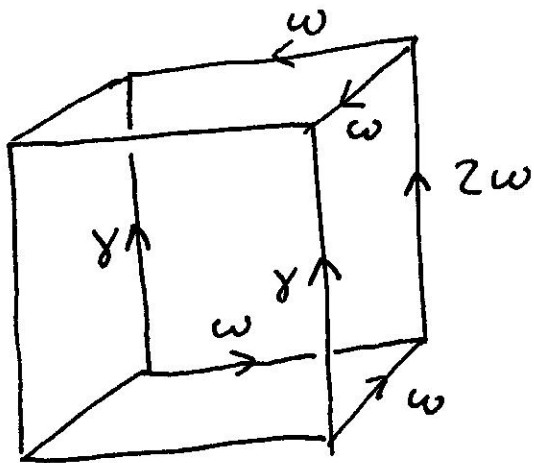
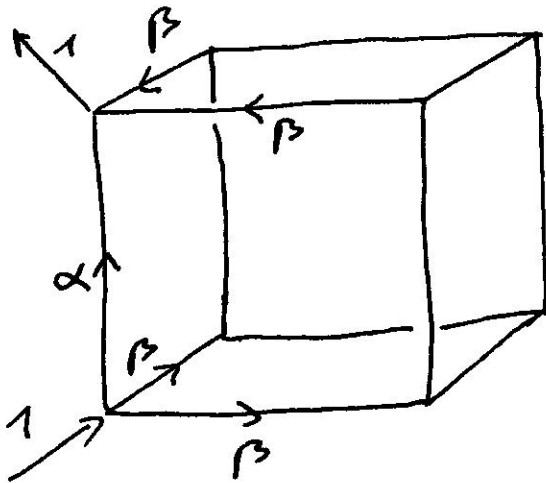
$$\bar{I} = 1A \quad R = 1\Omega$$



$$\left| \frac{\Delta V}{\bar{I}} \right| = \frac{1}{3} + \frac{1}{6} + \frac{1}{3} = \frac{5}{6} R$$

□

# Zadanie 4 (b)



$$(1) \quad 1 = \alpha + 2\beta$$

$$(4) \quad \beta = \gamma + \omega$$

$$(1, 2, 3, 4) \quad \alpha = 2\beta + \gamma$$

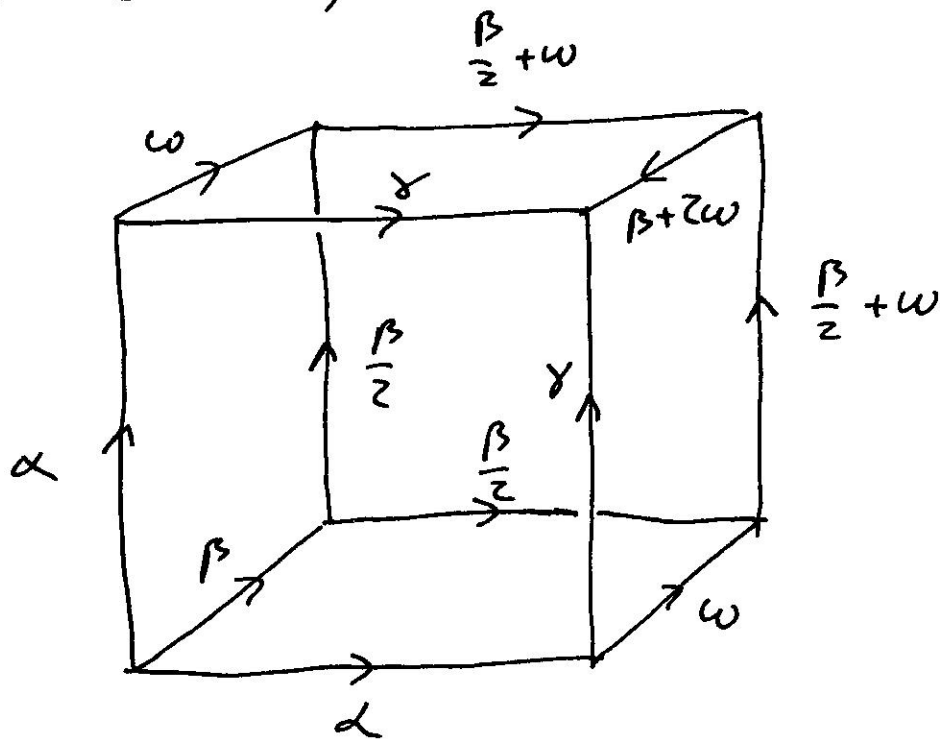
$$(3, 7, 8, 4) \quad \gamma = 4\omega$$

$$\alpha = \frac{7}{12}$$

$$\left| \frac{\Delta V}{I} \right| = \frac{7}{12} R$$

□

# Zadanie 4 cc)



$$(1) \quad 1 = 2\alpha + \beta$$

$$(3) \quad 1 = \beta + 2\gamma + 2w$$

$$(1584) \quad \frac{3}{2}\beta = \alpha + w$$

$$(2673) \quad \frac{3}{2}\beta + 4w = \gamma$$

$$\left. \begin{array}{l} (1) + (1584) \quad 1 = 4\beta - 2w \\ (3) + (2673) \quad 1 = 4\beta + 10w \end{array} \right\} \Rightarrow w = 0, \beta = \frac{1}{4}$$

$$\alpha = \frac{3}{2}\beta = \frac{3}{8}$$

$$(2) \quad \gamma = \alpha$$

$$\left| \frac{\Delta V}{I} \right| = \frac{3}{4} R \quad \square$$