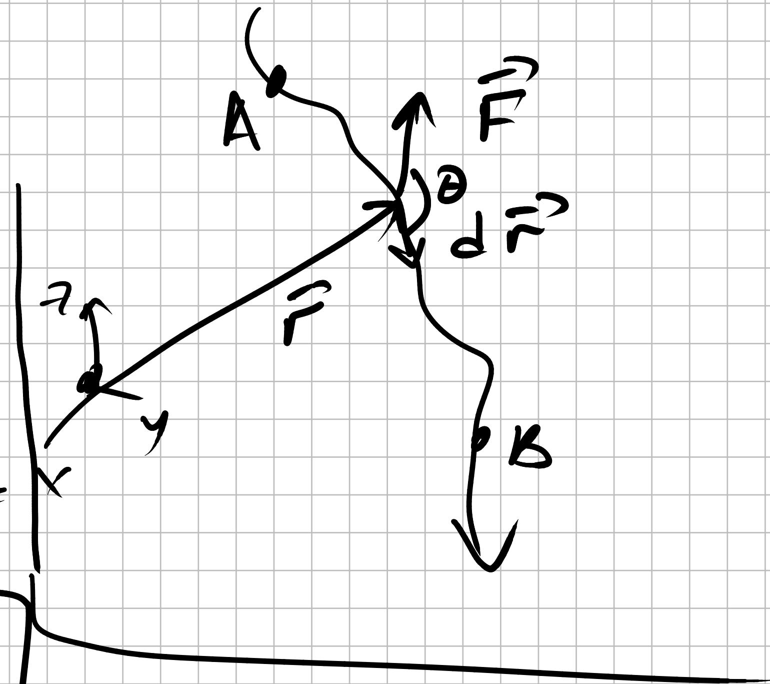
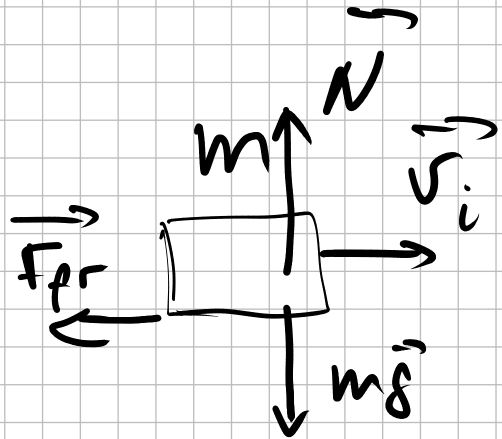
$$dW = \vec{F} \cdot d\vec{r}$$

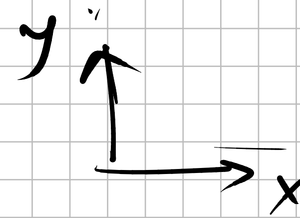
$$= F \cdot dr \cdot \cos\theta$$

$$= F_x \cdot dx + F_y \cdot dy + F_z dz$$



$$\boxed{W_{A \to B} = \int_A^B dW = \int_A^B \vec{F} d\vec{r}}$$





$$F_{fr} = \mu N = \mu m g$$

$$W_{fr} = \int \vec{F}_{fr}\, d\vec{r} = \int_i^f -\mu m g\, dx =$$

$$= -\mu m g \int_i^f dx = -\mu m g \cdot x \Big|_i^f = -\mu m g (\underbrace{x_f - x_i}_{L})$$

$$\overbrace{x_f - x_i} = \frac{v_f^2 - v_i^2}{2 a_x} = \frac{v_f^2 - v_i^2}{2\left(-\frac{\mu \cancel{m} g}{\cancel{m}}\right)}$$

$$W_{fr} = -\cancel{\mu} m\cancel{g}\left(\frac{v_f^2 - v_i^2}{-2\cancel{\mu}\cancel{g}}\right) = \frac{m v_f^2}{2} - \frac{m v_i^2}{2}$$

Kinetic energy

$$K = \frac{m v^2}{2}$$

$$W_{net} = \int_A^B \vec{F}_{net} \cdot d\vec{r} = \int_A^B m\vec{a} \cdot d\vec{r} =$$

$$= \int_A^B m \frac{d\vec{v}}{dt} \cdot d\vec{r} = \int_A^B m\, d\vec{v} \cdot \frac{d\vec{r}}{dt} = \int_A^B m\, d\vec{v} \cdot \vec{v}$$

$$= m\frac{\vec{v}^{\,2}}{2}\Bigg|_A^B = \frac{m\vec{v}_B^{\,2}}{2} - \frac{m\vec{v}_A^{\,2}}{2}$$

$$\boxed{W_{\substack{net \\ A\to B}} = \frac{m v_B^2}{2} - \frac{m v_A^2}{2}}$$

Kinetic energy

$$W_{\overrightarrow{unit}} \quad N\cdot m = kg\,\frac{m}{s^2}\,m = kg\,\frac{m^2}{s^2} = J$$

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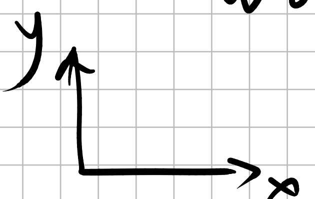
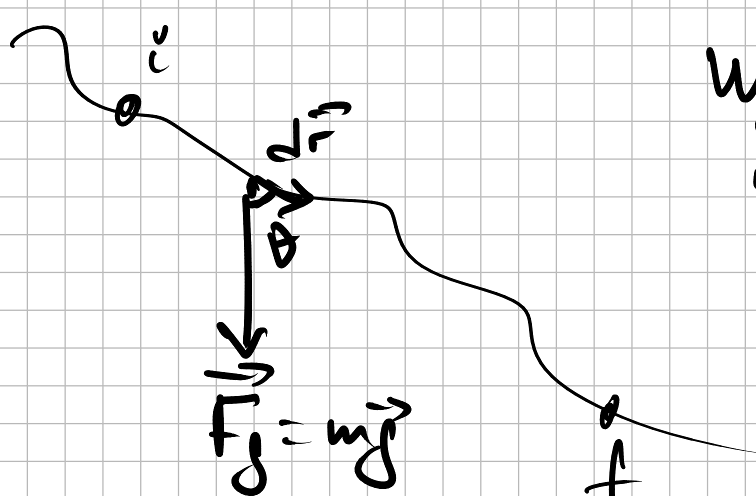
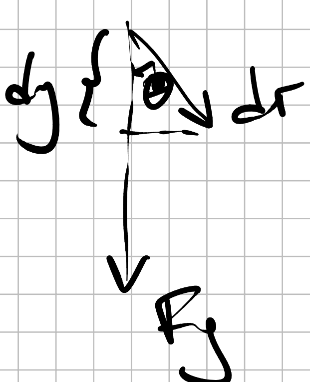
work done by gravity







$$W_{\substack{g \\ i\to f}} = \int_i^f \vec F_g \cdot d\vec r =$$

$$= \int F_g \cdot \underbrace{dr \cdot \cos(\theta(r))}_{dy}$$

$$= \int F_{g_y} \cdot dy = -\int_i^f mg\,dy$$

$$W_g = -mgy\Big|_i^f = -mg(y_f - y_i)$$

$$= -(\underset{\uparrow}{mg y_f} - mg y_i) = -(U_f - U_i)$$

Potential energy of gravitational field

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