UBRZANJE I RPPK

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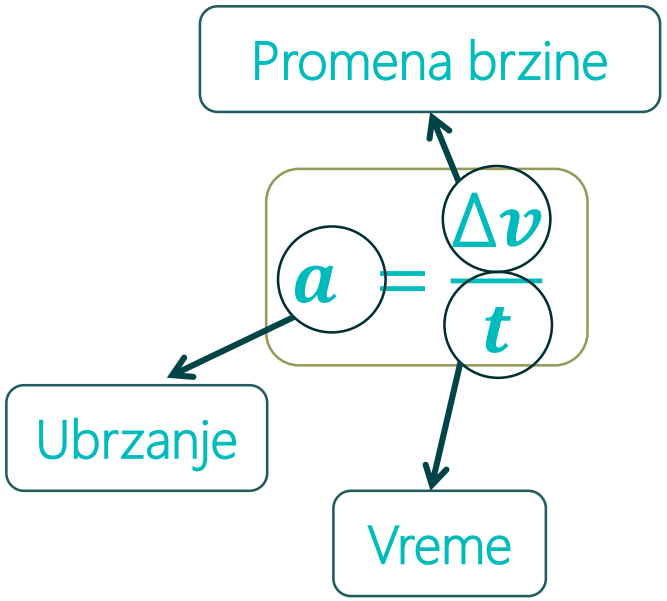
Ubrzanje



Ubrzanje je promena brzine u jedinici vremena.

Oznaka za ubrzanje je a, a merna jedinica je $\frac{m}{s^2}$

$$\Delta v = v - v_0$$

Srednja brzina kod RPPK

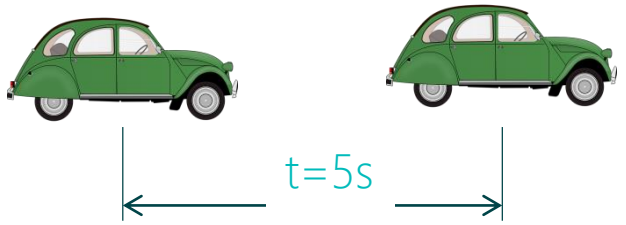
Kako smo u šestom razredu računali srednju brzinu kod RPK?

$$S_u = S_1 + S_2 + S_3 + \ldots$$

$$t_u = t_1 + t_2 + t_3 + \ldots$$

$$v_{sr} = \frac{S_u}{t_u}$$

Srednja brzina kod RPPK



$$v_0 = 10\ \frac{m}{s}$$

$$v = 30\ \frac{m}{s}$$

$$v_{sr} = \frac{v_0 + v}{2}$$

Brzina i put kod RPPK

v_0 - početna brzina $(\frac{m}{s})$

v - konačna brzina $(\frac{m}{s})$

t – vreme (s)

s- put (m)

a- ubrzanje $(\frac{m}{s^2})$

$$v = v_0 \pm a \cdot t$$

$$S = v_0 \cdot t \pm \frac{a \cdot t^2}{2}$$

$$v^2 = v_0^2 \pm 2 \cdot a \cdot S$$

\+ koristimo kod ubrzanog kretanja
\- koristimo kod usporenog kretanja

Ubrzano bez početne brzine $(v_0 = 0\,\frac{m}{s})$

$$v = a \cdot t$$

$$S = \frac{a \cdot t^2}{2}$$

$$v^2 = 2 \cdot a \cdot S$$

Ubrzano sa početnom brzinom $(v_0 > 0\,\frac{m}{s})$

$$v = v_0 + a \cdot t$$

$$S = v_0 \cdot t + \frac{a \cdot t^2}{2}$$

$$v^2 = v_0^2 + 2 \cdot a \cdot S$$

Usporeno

$$v = v_0 - a \cdot t$$

$$S = v_0 \cdot t - \frac{a \cdot t^2}{2}$$

$$v^2 = v_0^2 - 2 \cdot a \cdot S$$

Skijaš se spušta niz brdo ubrzanjem $0{,}5\,\frac{m}{s^2}$ i za $10s$ pređe $35m$. Kolike su brzine skijaša na početku i na kraju ovog puta?

$a = 0{,}5\,\frac{m}{s^2}$

$t = 10s$

$S = 35m$

$v_0 = ?$

$v = ?$

$$S = v_0 \cdot t + \frac{a \cdot t^2}{2}$$

$$v_0 \cdot t = S - \frac{a \cdot t^2}{2}$$

$$v_0 \cdot 10s = 35m - \frac{0{,}5\,\frac{m}{s^2} \cdot 100s^2}{2}$$

$$v_0 \cdot 10s = 35m - \frac{50m}{2}$$

$$v_0 \cdot 10s = 35m - 25m$$

$$v_0 \cdot 10s = 10m$$

$$v_0 = \frac{10m}{10s} = 1\,\frac{m}{s}$$

$$v = v_0 \pm a \cdot t$$

$$S = v_0 \cdot t \pm \frac{a \cdot t^2}{2}$$

$$v^2 = v_0^{\,2} \pm 2 \cdot a \cdot S$$

$$v = v_0 + a \cdot t$$

$$v = 1\,\frac{m}{s} + 0{,}5\,\frac{m}{s^2} \cdot 10s$$

$$v = 1\,\frac{m}{s} + 5\,\frac{m}{s}$$

$$v = 6\,\frac{m}{s}$$

Telo se kreće jednako ubrzano bez početna brzine ubrzanjem $4\frac{m}{s^2}$. Koliki put pređe za 5 s kretanja, a koliki u petoj sekundi kretanja?

$$v = v_0 \pm a \cdot t$$

$$S = v_0 \cdot t \pm \frac{a \cdot t^2}{2}$$

$$v^2 = v_0{}^2 \pm 2 \cdot a \cdot S$$

$v_0 = 0\frac{m}{s}$

$a = 4\frac{m}{s^2}$

$t = 5s$

$S_5 = ?$

$S_V = ?$

$$S = \frac{a \cdot t^2}{2}$$

$$S_5 = \frac{4\frac{m}{s^2} \cdot 25\ s^2}{2}$$

$$S_5 = \frac{100m}{2}$$

$$S_5 = 50m$$

$$S = \frac{a \cdot t^2}{2}$$

$$S_4 = \frac{4\frac{m}{s^2} \cdot 16\ s^2}{2}$$

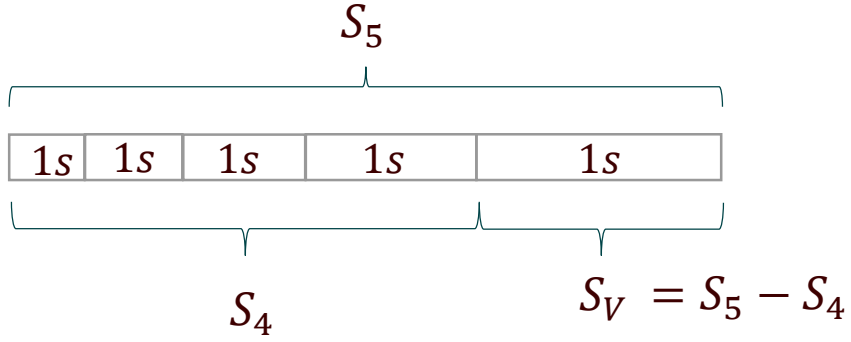
$$S_4 = \frac{64m}{2}$$

$$S_4 = 32m$$

$$S_V = S_5 - S_4$$

$$S_V = 50m - 32m$$

$$S_V = 18m$$



Telo prelazi prvu trećinu puta stalnom brzinom 6 m/s, a drugu trećinu puta ravnomerno usporeno tako da se brzina smanjila na 4 m/s, dok se na poslednjoj trećini puta telo kreće ravnomerno usporeno do zaustavljanja. Naći srednju brzinu tela na celom putu.

$$S_1 = \frac{S}{3}$$
$$v_1 = 6\frac{m}{s}$$
$$S_2 = \frac{S}{3}$$
$$v_1 = 6\frac{m}{s}$$
$$v_2 = 4\frac{m}{s}$$
$$S_3 = \frac{S}{3}$$
$$v_2 = 4\frac{m}{s}$$
$$v_3 = 0\frac{m}{s}$$
$$v_{sr} = ?$$

$$S_1 = \frac{S}{3}$$
$$v_{sr1} = 6\frac{m}{s}$$
$$S_2 = \frac{S}{3}$$
$$v_{sr2} = \frac{v_1 + v_2}{2}$$
$$v_{sr2} = \frac{6\frac{m}{s} + 4\frac{m}{s}}{2} = 5\frac{m}{s}$$
$$S_3 = \frac{S}{3}$$
$$v_{sr3} = \frac{v_2 + v_3}{2}$$
$$v_{sr3} = \frac{4\frac{m}{s} + 0\frac{m}{s}}{2} = 2\frac{m}{s}$$
$$v_{sr} = ?$$

$$S_1 = \frac{S}{3}$$
$$v_{sr1} = 6\frac{m}{s}$$
$$S_2 = \frac{S}{3}$$
$$v_{sr2} = 5\frac{m}{s}$$
$$S_3 = \frac{S}{3}$$
$$v_{sr3} = 2\frac{m}{s}$$
$$v_{sr} = ?$$

$$v_{sr} = \frac{S_u}{t_u} = \frac{S}{t_1 + t_2 + t_3} = \frac{S}{\frac{S_1}{v_{sr1}} + \frac{S_2}{v_{sr2}} + \frac{S_3}{v_{sr3}}}$$

$$v_{sr} = \frac{S}{\frac{S}{3 \cdot v_{sr1}} + \frac{S}{3 \cdot v_{sr2}} + \frac{S}{3 \cdot v_{sr3}}} = \frac{S}{S \cdot \left(\frac{1}{3 \cdot v_{sr1}} + \frac{1}{3 \cdot v_{sr2}} + \frac{1}{3 \cdot v_{sr3}}\right)}$$

$$v_{sr} = \frac{1}{\frac{1}{3 \cdot v_{sr1}} + \frac{1}{3 \cdot v_{sr2}} + \frac{1}{3 \cdot v_{sr3}}} = \frac{1}{\frac{1}{3 \cdot 6\frac{m}{s}} + \frac{1}{3 \cdot 5\frac{m}{s}} + \frac{1}{3 \cdot 2\frac{m}{s}}}$$

$$v_{sr} = \frac{1}{\frac{1}{18\frac{m}{s}} + \frac{1}{15\frac{m}{s}} + \frac{1}{6\frac{m}{s}}} = \frac{1}{\frac{5}{90\frac{m}{s}} + \frac{6}{90\frac{m}{s}} + \frac{15}{90\frac{m}{s}}} = \frac{1}{\frac{26}{90\frac{m}{s}}}$$

$$v_{sr} = \frac{90\frac{m}{s}}{26} = 3{,}46\frac{m}{s}$$

Auto se kreće ravnomerno brzinom 16 m/s. U trenutku kada prolazi pored motocikla, ovaj počinje da se kreće za njim, u istom pravcu i smeru sa stalnim ubrzanjem $2\frac{m}{s^2}$. Posle koliko vremena će motocikl stići auto? Koliki će put preći motociklista i kolika mu je brzina u trenutku sustizanja?

$v_A = 16\frac{m}{s}$

$v_{0M} = 0\frac{m}{s}$

$a_M = 2\frac{m}{s^2}$

$t_A = t_M = t = ?$

$S_M = ?$

$v_M = ?$

$S_M = S_A$

$S_M = \frac{a_M \cdot t^2}{2}$

$S_M = \frac{2\frac{m}{s^2} \cdot 256\ s^2}{2}$

$S_M = 256m$

$v_M = a \cdot t$

$v_M = 2\frac{m}{s^2} \cdot 16s$

$v_M = 32\frac{m}{s}$

$S_A = v_A \cdot t$

$S_A = 16\frac{m}{s} \cdot 16s$

$S_A = 256m$

$S_M = S_A$

$\frac{a_M \cdot t^2}{2} = v_A \cdot t$

$\frac{a_M \cdot t^2}{2} \cdot \frac{1}{t} = v_A \cdot t \cdot \frac{1}{t}$

$\frac{a_M \cdot t}{2} = v_A$

$t = \frac{2 \cdot v_A}{a_M}$

$t = \frac{2 \cdot 16\frac{m}{s}}{2\frac{m}{s^2}} = 16s$

Prvi vagon voza, koji kreće sa stanice stalnim ubrzanjem, prođe pored posmatrača za 4s. Za koliko vremena će proći pored njega ceo voz od 15 jednakih vagona i lokomotive iste dužine kao vagon? Za koliko vreme će pored posmatrača proći samo sedmi vagon?

$t_1 = 4s$

$n = 15 + 1 = 16$

$t_{16} = ?$

$t_{VII} = ?$

$l_1 = \frac{a \cdot t_1^2}{2}$ $\quad l = \frac{a \cdot t_{16}^2}{2}$

$l = n \cdot l_1$

$\frac{a \cdot t_{16}^2}{2} = n \cdot \frac{a \cdot t_1^2}{2}$

$t_{16}^2 = n \cdot t_1^2$

$t_{16}^2 = 16 \cdot 16s^2$

$t_{16}^2 = 256s^2$

$t_{16} = \sqrt{256s^2}$

$t_{16} = 16s$

$l_7 = \frac{a \cdot t_7^2}{2}$

$l_7 = 7 \cdot l_1$

$\frac{a \cdot t_7^2}{2} = 7 \cdot \frac{a \cdot t_1^2}{2}$

$t_7^2 = 7 \cdot t_1^2$

$t_7^2 = 7 \cdot 16s^2$

$t_7^2 = 112s^2$

$t_7 = \sqrt{112s^2}$

$t_7 = 10{,}6s$

$l_6 = \frac{a \cdot t_6^2}{2}$

$l_6 = 6 \cdot l_1$

$\frac{a \cdot t_6^2}{2} = 6 \cdot \frac{a \cdot t_1^2}{2}$

$t_6^2 = 6 \cdot t_1^2$

$t_6^2 = 6 \cdot 16s^2$

$t_6^2 = 96s^2$

$t_6 = \sqrt{96s^2}$

$t_6 = 9{,}8s$

$t_{VII} = t_7 - t_6$

$t_{VII} = 10{,}6s - 9{,}8s$

$t_{VII} = 0{,}8s$