VTMŠ - strukovnih studija- Trstenik januar 2018.

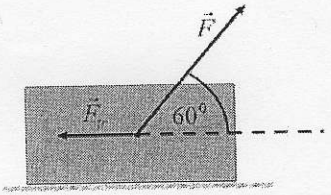
TEHNIČKA FIZIKA

- pisani ispit –

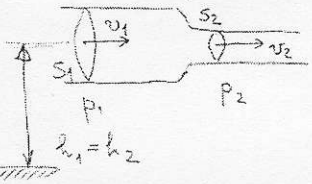
1. Transformisati:
   a) ugaonu brzinu od 5 rad/s izraziti preko broja obrtaja u minuti
   b) brzinu od 10 m/s izraziti u km/h
   c) pritisak od 20 bar izraziti u MPa
   d) zapreminu od 0,23 m^3 izraziti u litrima
   e) Navesti osnovne veličine i jedinice SI

2. Zamajac, poluprečnika $R = 0{,}8\,m$, obrće se stalnom ugaonom brzinom $\omega_0 = 7{,}5\,rad/s$. Po isključivanju pogonske mašine, zamajac se pod dejstvom inercijalne sile još obrće tokom vremena $t = 24\,s$. Koliko je: ugaono usporenje zamajca, tangencijalno ubrzanje tačke na periferiji zmajca i broj obrtaja zamajca do zaustavljanja. Nacrtati dijagram ugaone brzine i ugaonog ubrzanja.

3. Telo mase 2kg može da kliza po horizontalnoj podlozi, pri čemu na njega deluje sila trenja intenziteta 0,5N. U početnom trenutku na njega počne da deluje vučna sila intenziteta 5N, koja sa podlogom zaklapa ugao od 60^0, kako je na slici pokazano. Odrediti snagu vučne sile i sile trenja 2s nakon početka kretanja.



4. U širem delu horizontalno položene cevi naftovoda teče nafta brzinom $v_1 = 2\,m/s$. Odrediti brzinu protoka nafte u užem delu cevi, ako je razlika pritisaka između širokog i suženog dela $\Delta p = p_1 - p_2 = 50\,mmHg$, a gustina nafte $\rho_n = 900\,kg/m^3$. $(1\,mmHg = 133{,}33\,Pa)$



5. U cilindru prečnika d = 50 cm nalazi se V = 200 l vazduha temperature t = 18^0C i pritiska p = 20 N/cm^2. Klip je slobodno pomičan (opterećen tegom). Dovede li se vazduhu Q = 42 kJ toplote, za koliko će pomaknuti klip, koliki će biti izvršeni rad i kolika promena unutrašnje energije?

Napomena:
Ispit traje 2h. Literatura je dozvoljena

Predmetni nastavnik
Marina Karić

$\omega = 5\,rad/s \Rightarrow H\left[\frac{ob}{min}\right]$

a) $5\,\frac{rad \cdot \frac{1}{2\pi}\,\frac{ob}{rad}}{s \cdot \frac{1}{60}\,\frac{min}{s}} = \frac{5 \cdot 60}{2\pi} = \frac{5 \cdot 30}{\pi} = \frac{150}{3{,}14} = 47{,}77\,\frac{ob}{min}$

b) $v = 10\,m/s = 10\,\frac{m \cdot 10^{-3}\,\frac{km}{m}}{s \cdot \frac{1}{3600}\,\frac{h}{s}} = 36000 \cdot 10^{-3}\,\frac{km}{h} = 36\,\frac{km}{h}$

c) $p = 20\,bar = 20 \cdot 10^5\,Pa \cdot 10^{-6}\,\frac{MPa}{Pa} = 2\,MPa$

d) $V = 0{,}23\,m^3 = 0{,}23 \cdot 10^3\,l = 230\,l$

e)

основне вел.	основне единице
маса (m)	kg - килограм
време (t)	s - секунда
дужина (l)	m - метар
јачина струје	A - ампер
термод. темп. (T)	K - келвин
јачина светл.	cd - кандела
кол. материје	mol

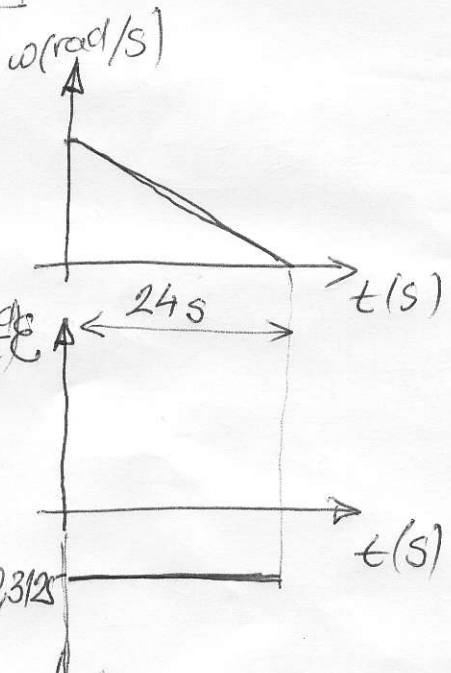
2. $R = 0{,}8\,m \quad \omega_0 = 7{,}5\,\frac{rad}{s}$

$t = 2$

$\varepsilon = \frac{d\omega}{dt} \Rightarrow \int_{\omega_0}^{\omega} d\omega = \int_0^{t_0} \varepsilon\,dt$

$\omega - \omega_0 = \varepsilon t \Rightarrow \varepsilon = -\frac{\omega_0}{t} = -\frac{7{,}5}{24}$ ($\frac{rad}{s^2}$)

$\boxed{\varepsilon = -0{,}3125\,\frac{rad}{s^2}}$



$\omega = \frac{d\varphi}{dt} \Rightarrow \int_{\varphi_0=0}^{\varphi} d\varphi = \int \omega\,dt \Rightarrow$

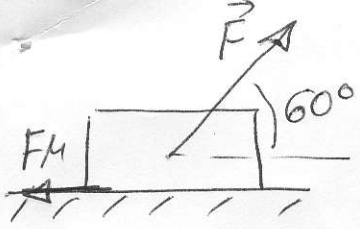
$\varphi = \int (\omega_0 - \varepsilon t)\,dt \Rightarrow \varphi = \omega_0 t - \varepsilon \frac{t^2}{2}$

$\varphi = 7{,}5 \cdot 24 - 0{,}3125 \cdot \frac{24^2}{2} = 180 - 90 = 90\,rad$

$\varphi = 2\pi H \Rightarrow H = \frac{\varphi}{2\pi} = \frac{90}{2\pi} = 14{,}33\,ob$ $\quad \boxed{H = 14{,}33\,ob}$

$a_T = R\varepsilon = 0{,}8 \cdot 0{,}3125 = 0{,}25\,\frac{m}{s^2}$ $\quad \boxed{a_T = 0{,}25\,\frac{m}{s^2}}$

3.



$m\vec{a} = \sum_{i=1}^{n} \vec{F}_i \Rightarrow m\vec{a} = \vec{F} + \vec{F}_\mu$

proiectând pe x: $ma = F\cdot\cos 60° - F_\mu$

$2a = 5\cdot\frac{1}{2} - 0{,}5 \Rightarrow 2a = 2 \Rightarrow \boxed{a = 1\,\frac{m}{s^2}}$

$a = \frac{dv}{dt} \Rightarrow dv = a\,dt \Rightarrow v - v_0 = at$ ($v_0 = 0$)

$v(t) = at \quad v_{(t=2s)} = 1\cdot 2 = 2\,\frac{m}{s}$

$P_F = \vec{F}\cdot\vec{v} = F\cdot v\cdot\cos 60°$

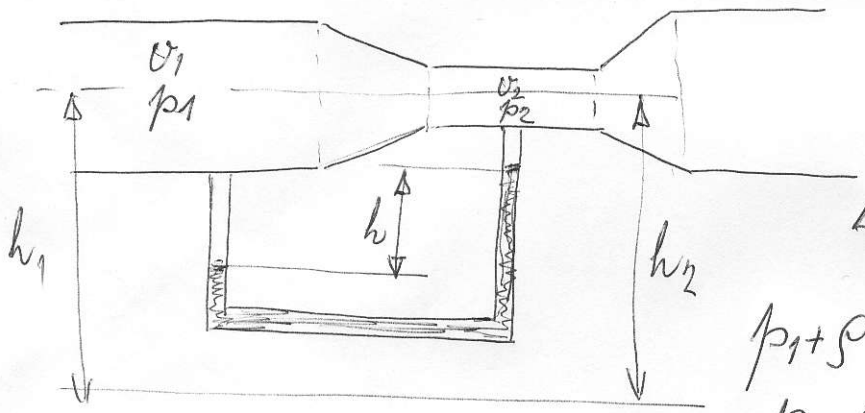
$P_F = 5\cdot 2\cdot\cos 60° = 5\,W$

$\boxed{P_F = 5\,W}$

$P_{FR} = \vec{F}_\mu\cdot\vec{v} = F_\mu\cdot v\cdot\cos 180° \Rightarrow -F_\mu\cdot v = -0{,}5\cdot 2 = -1\,kW$

$\boxed{P_{TR} = -1\,kW}$

4.



$h_1 = h_2$

$\Delta p = p_1 - p_2 = 50\,mmHg$

$\Delta p = 50\,mmHg\cdot 133{,}33\,\frac{Pa}{mmHg} = 6666{,}5\,Pa$

$p_1 + \rho\frac{v_1^2}{2} = p_2 + \rho\frac{v_2^2}{2}$

$p_1 - p_2 = \rho\frac{v_2^2 - v_1^2}{2} \Rightarrow$

$v_2^2 - v_1^2 = \frac{2(p_1-p_2)}{\rho} \Rightarrow v_2 = \sqrt{v_1^2 + \frac{2(p_1-p_2)}{\rho}}$

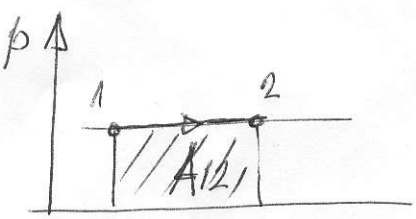
$v_2 = \sqrt{4 + \frac{2\cdot 6666{,}5}{900}} = \sqrt{18{,}814} \approx 4{,}34\,\frac{m}{s}$

5. $d = 50\,cm \Rightarrow 0{,}5\,m = d$

$V = 200\,l \Rightarrow V = 0{,}2\,m^3$

$t = 18°C \Rightarrow T_1 = 291{,}15\,K$

$p = 20\,\frac{N}{cm^2} = 20\,\frac{N}{cm^2\cdot 10^{-4}\,\frac{m^2}{cm^2}} = 2\cdot 10^5\,Pa$



$V_1 = \frac{d^2\pi}{4}\cdot h_1 \Rightarrow 0{,}2 = \frac{0{,}5^2\cdot\pi}{4}\cdot h_1$

$h_1 = \frac{0{,}2}{0{,}196} \approx 1\,m \qquad Q_{12} = m\,c_p(T_2 - T_1)$

$p_1V_1 = mRT_1 \Rightarrow m = \frac{p_1V_1}{RT_1} =$

$= \frac{2\cdot 10^5\cdot 0{,}2}{287\cdot 291{,}15} = 0{,}4787\,kg$

$c_p = \frac{(i+2)R}{2} = \frac{7\cdot R}{2} = 1004{,}5\,\frac{J}{kgK}$

$T_2 = T_1 + \frac{Q_{12}}{m\,c_p}$

$T_2 = 291{,}15 + 87{,}34 = 378{,}49\,K$

$\frac{h_2}{h_1} = \frac{V_2}{V_1} = \frac{T_2}{T_1} \Rightarrow h_2 = h_1\cdot\frac{T_2}{T_1}$

$h_2 = 1\cdot\frac{378{,}49}{291{,}15} = 1{,}3\,m$

$\Delta h = h_2 - h_1 = \boxed{0{,}3\,m}$

$L_{12} = p\cdot\Delta V = p\cdot\frac{d^2\pi}{4}\cdot\Delta h = 2\cdot 10^5\cdot 0{,}196\cdot 0{,}3 = 11{,}775\,kJ$

$\Delta U = m\,c_v\,\Delta T = 0{,}478\cdot 717\cdot 87{,}34 = 29{,}933\,kJ$