Esercizio 1

$a_C = 2kV_At \approx 0{,}65$ m/s^2

$a_T = \frac{V_A}{t} \approx 0{,}26$ m/s^2

$|\mathbf{a}| = \sqrt{a_C^2 + a_T^2} = \frac{V_A}{t}\sqrt{1 + (2kt^2)^2} \approx 0{,}7$ m/s^2

Esercizio 2

a) $\omega_{MEDIO} = \frac{2}{3}a = 4$ rad/s $\qquad \alpha_{MEDIO} = -\sqrt{3ba} = -6$ rad/s^2

b) $\alpha_{FINALE} = -2\sqrt{3ba} = -12$ rad/s^2

Esercizio 3

$\varphi = \frac{\omega_0}{a}(1 - e^{-at}) \qquad \omega = \omega_0\, e^{-at}$

Esercizio 4

$T = \sqrt[3]{\frac{4\sqrt{3}}{k}} \approx 7$s

Esercizio 5

$T = \sqrt{\frac{14\,R\,(\pi - 2\alpha)}{5g\,\sin(\alpha)}}$

Esercizio 6

$I = \frac{37}{72}mR^2 \approx 0{,}15$ Kg m^2

Esercizio 7

$I = \frac{1}{3}Ma^2 \qquad \frac{\Delta T}{1\,anno} \approx 8{,}2\ 10^{-6}$ s/y

Esercizio 8

$I = \frac{1}{4}mR^2$

Esercizio 9

$K = \frac{mv^2}{10R^2}\,(\,2r^2 + 7R^2\,)$

Esercizio 10

$\alpha = \frac{g(m_2 - m_1)}{R\left(\frac{m}{2} + m_1 + m_2\right)}$

$\frac{T_1}{T_2} = \frac{m_1\left(\frac{m}{2} + 2m_2\right)}{m_2\left(\frac{m}{2} + 2m_1\right)}$

Esercizio 11

$W = -\frac{\mu m_1 g^2 \tau^2 (m_2 - \mu m_1)}{\left(m + 2(m_1 + m_2)\right)}$

Esercizio 12

$F = (g+a)\,\frac{m_3\left(m_3 + 3(m_1 + m_2)\right) + 8m_1 m_2}{m_3 + 2(m_1 + m_2)}$

Esercizio 13

$L = \frac{2aF_2}{mw} = 1\text{m}$

Esercizio 14

a) $F_1 = \mu_S mg = 785$ N
b) $F_2 = mg/2 = 490{,}5$ N
c) $M = (mg/2 - F)L = 290{,}5$ Nm
d) $\alpha = \frac{3}{4}\,\frac{(2F - mg)}{mL} = 1{,}64$ rad/s^2

Esercizio 15

$\omega = \sqrt{\frac{2g}{L}}$

Esercizio 16

$V = \sqrt{3aL} = 1{,}27$ m/s

Esercizio 17

$\omega = \sqrt{\frac{6F\ sin(\varphi)}{mD}}$

Esercizio 18

a) $V_{MIN} = \sqrt{\frac{\rho_M s^2 g}{\rho_A h}}$
b) $\mu_{MAX} = s/h$

Esercizio 19

cos (θ) = 1/3

Esercizio 20

a) $\alpha_0 = 0$; $\alpha_0 = \pi/2$ (instabile)
b) $x_{CM}^2 + y_{CM}^2 = \left(\frac{L}{2}\right)^2$ circonferenza di raggio L/2 e centro nell'origine
c) $\dot{x}_{pavimento}\ (\alpha=0) = 0 \quad \dot{y}_{parete}\ (\alpha=0) = -\sqrt{3gL\ sin\ (\alpha_0)}$
d) $\dot{x}_{CM} = \frac{1}{2} sin(\propto)\sqrt{3gL\left(sin(\alpha_0) - sin(\propto)\right)}$
$\dot{y}_{CM} = -\frac{1}{2} cos(\propto)\sqrt{3gL\left(sin(\alpha_0) - sin(\propto)\right)}$
e) $\ddot{x}_{CM} = -\frac{3}{4}\,g\ cos(\propto)\left(2sin(\propto_0) - 5sin(\propto)\right)$
$\ddot{y}_{CM} = -\frac{3}{4}\,g\left(2sin(\propto)\left(sin(\alpha_0) - sin(\propto)\right) + cos^2(\propto)\right)$
f) $sin(\alpha) = 2/5\ sin(\alpha_0)$

Esercizio 21

$N_x = {}^3/_4\, mg\ sin(\theta)(3cos(\theta) - 2)$
$N_x = {}^1/_4\, mg\ (1 - 6cos(\theta) + 9cos^2(\theta))$
Si ha un valore minimo di $|\mathbf{N}|$ per $cos(\theta) = \frac{20}{33}$

Esercizio 22

$cos(\theta) = \frac{3}{2}\frac{g}{\omega^2 L}$

Esercizio 23

$$N = \frac{3Mmg\ cos(\theta)\left[-2m\left(sin(\theta_0) - sin(\theta)\right) + sin(\theta)\left(m + 3Msin^2(\theta)\right)\right]}{2\left(m + 3Msin^2(\theta)\right)^2}$$

Esercizio 24

$V_A = 2\ sin(\theta)\ \sqrt{\frac{3gl(sin(\theta_0)-sin(\theta))}{(1+3sin^2(\theta))}}$

Esercizio 25

$V = \sqrt{3gH}$

Esercizio 26

a) $\mu_{MIN} = \frac{tg(\propto)}{3}$

b) $K = \frac{1}{3}\ mg^2 sin^2(\alpha)t^2$

Esercizio 27

$a_M = \frac{7F}{2m+7M}$ $\quad$ $a_m = \frac{2F}{2m+7M}$

Esercizio 28

$a_M = \frac{F}{m+3M}$ $\quad$ $a_m = \frac{F(m+2M)}{m(m+3M)}$

Esercizio 29

a) $a_K = F\frac{3m_A+2m_B}{m_A(m_A+m_B)}$

b) $K = \frac{F^2(3m_A+2m_B)t^2}{2m_A(m_A+m_B)}$

Esercizio 30

A) $t_{SLIT} = \frac{\omega_0 R}{3\mu g}$

B) $W = -\frac{mR^2\omega_0^2}{6}$

Esercizio 31

$\omega_{MEDIA} = \omega_0/3$

Esercizio 32

$T = \frac{3\omega_0 R}{4\mu g}$

Esercizio 33

$N = \frac{\omega_0^2(\mu^2+1)R}{8\pi\mu(\mu+1)g}$

Esercizio 34

Per h = H/2 si ha $d_{MAX} = \sqrt{\frac{5}{7}}\,H$

Esercizio 35

$V_0 \leq \sqrt{\frac{gR(7\cos(\propto)-4)}{3}} \approx \sqrt{0{,}69\ gR}$

Esercizio 36

a) $tan(\theta) \leq \mu(n+1)$

b) $a = \frac{g(sin(\theta)-\mu cos(\theta)(n+1))}{(k+1)}$

Esercizio 37

$\alpha = \frac{2mgx}{MLR}$ $\quad x = \frac{L}{20}\left(e^{\sqrt{\frac{2mg}{ML}}\,t} + e^{-\sqrt{\frac{2mg}{ML}}\,t}\right)$ $\quad T = \sqrt{\frac{ML}{2mg}}\,ln\left(3\sqrt{11}+10\right)$

Esercizio 38

$F > \mu_S\, mg\,(1+2m/M)$

In caso di slittamento $a = F/m - \mu_D g$ $\quad \alpha = \frac{2\mu_D mg}{MR}$

In caso di NON slittamento $a = 2F/(M+2m)$ $\quad \alpha = a/R$

Esercizio 39

$\omega_D = \sqrt{\frac{10g(R+r)}{17r^2}}$

Esercizio 40

$\alpha = \frac{2g\ sin(\theta)}{3R}$ per $\theta < arc\ tan\left(\frac{\mu(m_2+m_1)}{\left(m_2+\frac{m_1}{3}\right)}\right)$

$\alpha = \frac{2g\ cos(\theta)}{3R}\ \frac{\mu(m_2+m_1)}{\left(m_2+\frac{m_1}{3}\right)}$ per $\theta > arc\ tan\left(\frac{\mu(m_2+m_1)}{\left(m_2+\frac{m_1}{3}\right)}\right)$

Esercizio 41

Zero

Esercizio 42

$tan\ (\alpha) = \frac{5sin(\beta)cos(\beta)}{9+5sin^2(\beta)} = \frac{5\sqrt{3}}{41}$

Esercizio 43

$F_A = \frac{2m_1m_3\left(1+sin(\theta)\right)g}{7(m_1+m_2)+2m_3}$ $\mu_S \geq \frac{2m_1\left(1+sin(\theta)\right)}{(7(m_1+m_2)+2m_3)cos(\theta)}$

$sin(\theta) > \frac{2m_1}{5m_1+7m_2+2m_3}$

Esercizio 45

$\omega_2 = -\frac{\omega_0 m_1 R_1}{R_2(m_1+m_2)}$

Esercizio 46

a) $\omega_1 = \omega_0 - \frac{4\mu_D M_2 g}{3RM_1}$ t $\omega_2 = \frac{4\mu_D g}{3R}$ t
b) $P_{DISS} = -\frac{dK}{dt} = -\frac{2\mu_D M_2 gR}{3}\left(-\omega_0 + \frac{4\mu_D g(M_1+M_2)t}{3RM_1}\right)$ fino a t=t*
c) $t^* = \frac{\omega_0}{\frac{4\mu_D g}{3R}\left(1+\frac{M_2}{M_1}\right)}$

Esercizio 47

T = mg/5 $\alpha_1 = -\alpha_2 = 2g/5R$ a = 4g/5

Esercizio 48

$$t = (M + 6m) \int_0^V \frac{v\,dv}{P-(M+4m)g\sin\alpha\, v} =$$

$$= \frac{(M+6m)}{((M+4m)g\sin\alpha)^2} \left[P\, ln\left(\frac{P}{P-(M+4m)g\sin\alpha\, V}\right) - (M + 4m)g\sin\alpha\, V \right]$$

Esercizio 49

Nessuno è perfetto

Esercizio 50

$$\ddot{y}_{cm} = -\frac{3g}{2}\left\{\left[\frac{\sqrt{3}}{2} - cos\left(\frac{\alpha}{2}\right)\right] cos\left(\frac{\alpha}{2}\right) + \frac{1}{2} sin^2\left(\frac{\alpha}{2}\right)\right\}$$

Esercizio 51

$$a = \frac{4(m+M)g\sin\alpha}{(4m+3M)}$$

Esercizio 52

Il risultato dipende dalle altre variabili scelte oltre x(t). Controllare sulla soluzione.

Esercizio 53

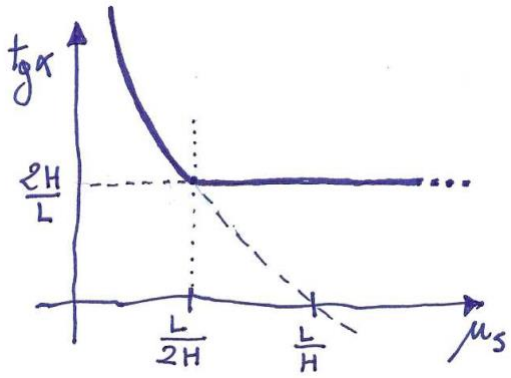
$$\text{gittata } G = R\left[\left(\frac{189}{289}\right)^{\frac{3}{2}} + \left(\frac{10}{17}\right)^{\frac{3}{2}} \sqrt{\frac{2H}{R} - \frac{2156}{(17)^3}}\right]$$

Esercizio 54

QUINDI ABBIAMO DETERMINATO L'ANGOLO CHE RENDE MASSIMA L'ACCELERAZIONE POSSIBILE

$$tg\alpha = \begin{cases} \left(2\left(\frac{1}{\mu_s} - \frac{H}{L}\right)\right) & \text{PER } \mu_s < \frac{L}{2H} \\ \frac{2H}{L} & \text{PER } \mu_s > \frac{L}{2H} \end{cases}$$

PER IL GRAFICO, $tg\alpha_1$ È UN'IPERBOLE MENTRE $tg\alpha_2$ È UNA COSTANTE



Esercizio 55

$$v = \sqrt{\frac{10g(R-r)M^2}{(7M^2+9mM+2m^2)}}$$

$$V = \sqrt{\frac{10g(R-r)m^2}{(7M^2+9mM+2m^2)}}$$

Esercizio 56

$$h_{MIN} = \frac{27}{10}(R-r)$$

Esercizio 57

$$t = \frac{3\omega_0 R}{4\mu_D g} = 0{,}2\ s$$

Esercizio 58

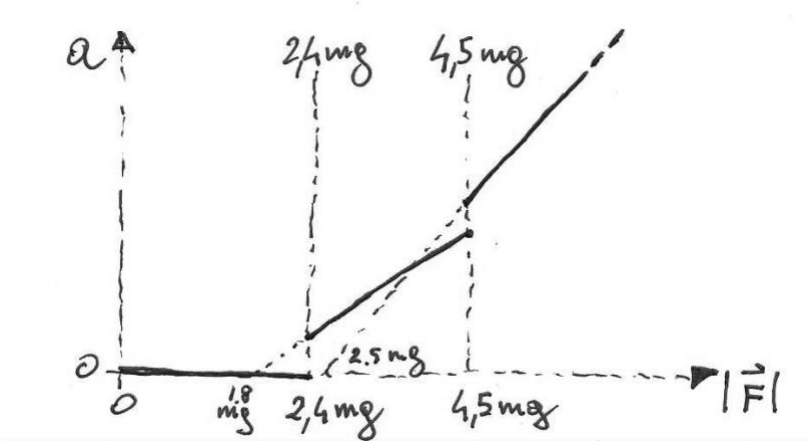
$$a_1 = \frac{7}{10}g$$

Esercizio 59

$per\ 0 \le F \le 2{,}4\ mg\ \rightarrow\ a = 0$

$per\ 2{,}4\ mg \le F \le 4{,}5\ mg\ \rightarrow\ a = \frac{2}{3m}(F - 1{,}8\ mg)$

$per\ F \ge 4{,}5\ mg\ \rightarrow\ a = \frac{1}{m}(F - 2{,}5\ mg)$



Esercizio 60

$$\mu_D = \frac{4V_0^2 M}{gL}\frac{(6M+m)}{(7M+2m)^2}$$

Esercizio 61

$a)\quad F_{MAX} = (M+m)g\ tg(\alpha)$

$b)\quad a = \dfrac{5\left(Fcos(\alpha) - (M+m)\ g\ sin(\alpha)\right)}{\left(2 + 5\ sin^2(\alpha)\right) m + 7M}$

Esercizio 62

$$I_0 = \frac{M}{6}\frac{(3\pi R^3 + 12R^2 d + 3\pi R d^2 + 4d^3)}{(\pi R + 2d)}$$

Esercizio 63

$a)\quad x_{CM} = \dfrac{7L}{12} \quad (x\ a\ partire\ da\ A, verso\ destra)$

$b)\quad I_{CM} = \dfrac{11}{144} mL^2$

$c)\quad \ddot{y}_B = +\dfrac{10}{11} g \quad (y\ orientato\ verso\ l'alto)$

Esercizio 64

$$V_{M_F} = \sqrt{\frac{6mgL}{7m + 5M}}$$