4. $E_c = \dfrac{m}{2}\left(r^2\dot{\theta}^2 + \dot{r}^2\right)$

$U = Kr^4$

$\ddot{r} = -\dfrac{4Kr^3 - m\dot{\theta}^2 r}{m} = \dot{\theta}^2 r - \dfrac{4Kr^3}{m}$

$\boxed{D}$

3. E

5. C

7. $m = 500\,g = 0,5\,kg$ $\qquad$ $F_r = 0,5 \times 1,8 = 0,9$

$a = 1,8$
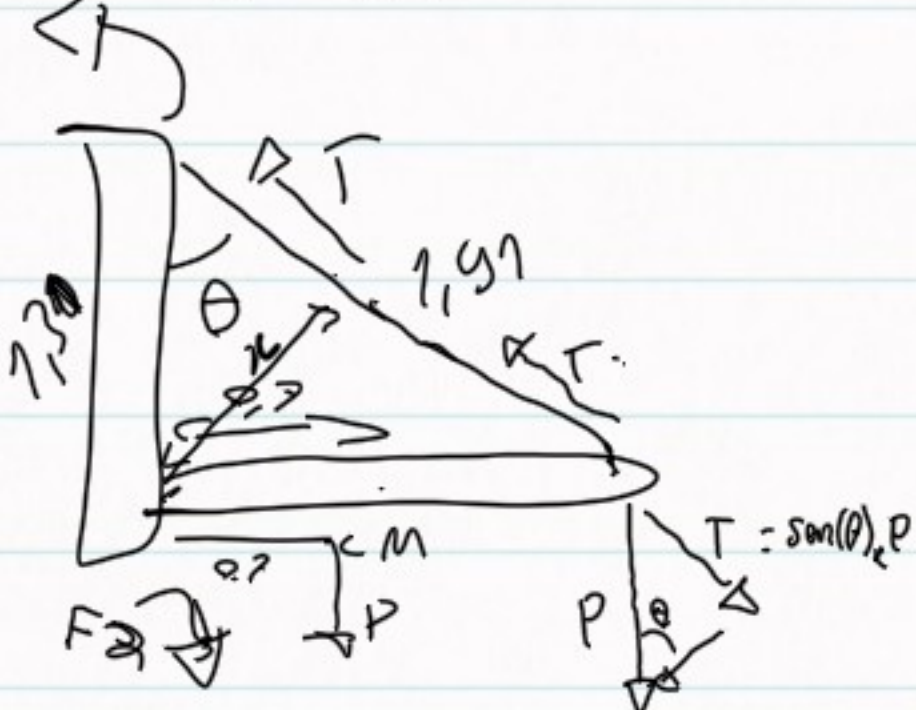
$\mu_c = 0,4$

$F_c = 0,4 \times 0,5 \times 9,8 = 1,96$

$\boxed{B}$

$F_{r_b} = -F_{at} + \left(F_{ab}\right) \implies F_{ab} = 0,9 + 1,96 = 2,86$

8. $m = 2,1\,kg$

$d = 1,4\,m$

$\theta = 47°$

$x = \dfrac{1,4 \times 1,3055}{1,914} = 0,954$

$\operatorname{sen}(47) = \dfrac{1,4}{H} \iff H = 1,914$

$F_1 = F_2 \implies 0,954 \times T = 0,7 \times 2,1 \times 9,8 \implies T = 15,1\,N$ $\qquad$ B

9. $\lambda_1 = -0,2 + 0,8\,i$

$\lambda_2 = -0,2 - 0,8\,i$

$\qquad$ foco estável $\qquad$ D

6. Quando o $\ddot{\theta}$ é constante e $\dot{r}$ não é constante então é foco
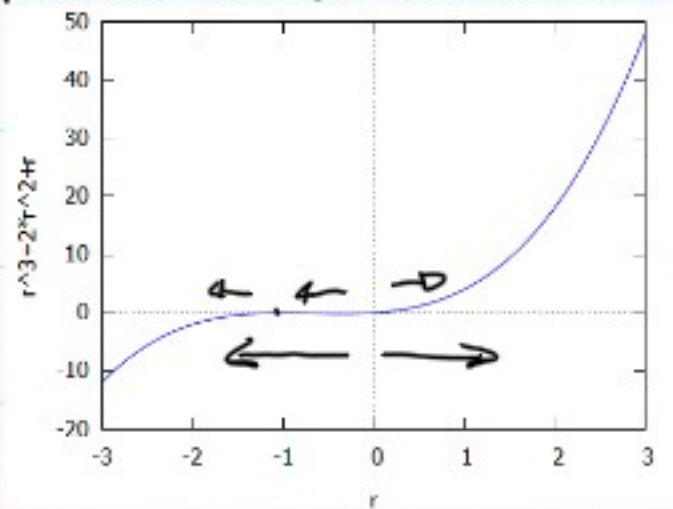
instavel logo foco repulsivo **B**

10.

$$\frac{E_{mA}}{E_{mB}} = \frac{E_{cA} + U_A}{E_{cB} + U_B} = \frac{\frac{1}{2}K r_A^2}{\frac{1}{2}K r_B^2} = \frac{4 r_B^2}{r_B} = 4 \qquad \text{D}$$

11.

v=0

35cm

$$I = \frac{2mr^2}{5} \qquad w = \frac{v}{R}$$
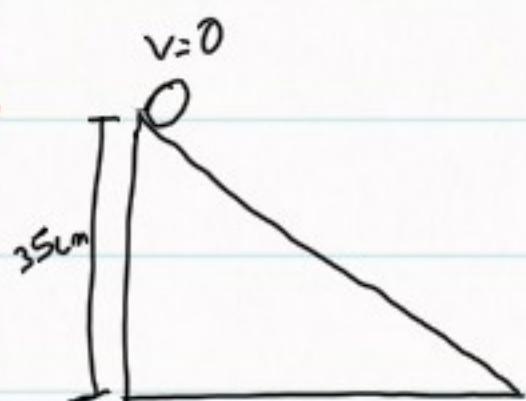
$$E_{m_i} = E_{m_f} \Rightarrow E_{c_i}^0 + U_i = E_{c_f} + U_f^0 \Leftrightarrow mgh = \frac{1}{2}m v_f^2 + \frac{1}{2}\cdot 2m\frac{r^2}{5}\frac{v_f^2}{r^2} \Leftrightarrow$$

$$\Leftrightarrow 9,8 \times 0,35 = \frac{1}{2}v_f^2 + \frac{1}{5}v_f^2 \Leftrightarrow v_f = 2,21 \, m/s \qquad \text{D}$$

12. $v(t) = t^3 \hat{\imath} + 0,2t^2$

$v(0) \Rightarrow y = -5$

$$0 = -5 + \int_0^t 0,2t^2 \Leftrightarrow t = 4,22$$

13. $\dot{y} = 2xy + 3y$ quando $y \to 0$ o limite dá 0 é contem x. **C**

14. $F_t = -s^2 + 14s - 48$

plotdf $([v, -s^2 + 14s - 48], [s, v])$

15. $E_{m_i} = E_{m_f} \Rightarrow E_{c_i} + U_i^0 = E_{c_f}^0 + U_f \Rightarrow \frac{1}{2}m v^2 = mgR \Rightarrow v = \sqrt{2gR} = 11,2 \times 10^3 \, m/s$

C

16. $w = be^{-n\theta} \qquad \alpha = w \dfrac{dw}{d\theta}$

$\alpha = ?$

$$\alpha = be^{-n\theta} \frac{d(be^{-n\theta})}{d\theta} \Leftrightarrow$$

$$\alpha = -b^2 n e^{-2n\theta} \qquad \text{D}$$

1. $m = 3 \times 10^4 \, kg$ $d = 4,1 \, Km$

     $h_A = 480 \, m$ $v_A = 300 \, Km/h = 83,3 \, m/s$

     $h_B = 0 \, m$ $v_B = 200 \, Km/h = 55,5 \, m/s$

a) $\overline{AB} = \sqrt{4100^2 + 480^2} = 4128 \, m$

     $a = a_t$

     $a_t = v \dfrac{dv}{ds} \iff a_t \displaystyle\int_0^{4128} ds = \int_{83,3}^{55,5} v \, dv \iff a_t = -0,4673 \, m/s^2$

b) $F_{ct} = ?$

     $P_t = m \, g \, sen\theta = 3 \times 10^4 \times 9,8 \times \dfrac{480}{4128} = 34186$

       $sen\theta = \dfrac{h}{\overline{AB}}$

     $P_n = m \, g \, cos\theta = 3 \times 10^4 \times 9,8 \times \dfrac{4100}{4128} = 292006$

       $cos\theta = \dfrac{d}{\overline{AB}}$

     $P_t - F_t = m \, a_t \iff 34186 - F_t = 3 \times 10^4 \times -0,4673 \iff F_t = 48\,205 \, N$

     $F_n - P_n = 0 \iff F_n = 292006 \, N$

     $F = \sqrt{F_t^2 + F_n^2} \iff F = 296958 \, N$

2. $m = 0,2 \, Kg$

     $U = 6 - 3,11x + 0,58$

a) $F = m \times a$ $v = \dot{x}$

     $a = \dot{v} = \ddot{x}$ $F_x = 0,2\ddot{x} = -\dfrac{dU}{dx} = 3,11 - 1,16x$

     $\ddot{x} = v$

     $\dot{v} = 15,55 - 5,8x$

     $\begin{bmatrix} 0 & 1 \\ -5,8 & 0 \end{bmatrix} \implies \begin{array}{l} \lambda_1 = 2,4 \\ \lambda_2 = -2,4 \end{array}$

     Isso mostra que o unico ponto de equilibrio é um centro e todos os possiveis movimentos do corpo são oscilações.

b) $\Omega = 2,4$ $T = \dfrac{2\pi}{\Omega} = 2,6s$