SOLUCIONES –TEMA 3. LEYES DE NEWTON Y DINÁMICA DE LA PARTÍCULA

3.1. b) $\vec{F} = (-2\vec{j} + 4{,}3\vec{i}) \cdot 10^{20} N$; c) 65º **3.2.** a) $\vec{a} = (-11{,}5\vec{i} + 2{,}5\vec{j})\, m/s^2$; b) $\vec{v} = (-18{,}4\vec{i} + 4\vec{j})\, m/s$; c) $\vec{r} = (-14{,}7\vec{i} + 3{,}2\vec{j})\, m$

3.3. $\vec{F} = -6{,}8(\vec{j} + 2\vec{k}) \cdot 10^{-22} N$, $\vec{p} = 1{,}7 \cdot (5\vec{i} + (2 - 40t)\vec{j} - 80t\vec{k}) \cdot 10^{-23} N \cdot s$ **3.4.** hecho en clase de teoría

3.5. θ = $tg^{-1}(a/g)$ a) a=3,96 m/s^2, b) T=0,423 N

3.6. b) a=F/($m_1 + m_2$)=1 m/s^2, c) $F_{12} = m_2 a = 40\,N = -F_{21}$

3.7. a) F=m(g+a), b) F=m(g-a), c) F=144,8 N

3.8. a=(m_1-m_2)g/(m_1+m_2), T=2g$m_1 m_2$/($m_1 + m_2$)=2gμ_{red} $\mu_{red} = \frac{m_1 m_2}{m_1 + m_2} = masa\ reducida\ del\ sistema\ m_1\ m_2$

3.9. hecho en clase de teoría. T=2π $(m/k)^{1/2}$

3.10. resultado en el enunciado del problema

3.11. f_r= Tcosθ≤ μ_e (mg-Tsinθ) a) μ =μ_e ; f_r =77 N, a=0, b) μ =μ_d, f_r = μ_c (mg-Tsinθ) =60 N, a= (Tcosθ–f_r)/m= 0,94 m/s^2

3.12. a) $D = (1 + \frac{m_c}{m_p})\frac{v_0^2}{2\mu_c g}$, b) $F_{pc} = m_c \frac{\mu_c m_p g}{m_p + m_c} = \mu_c g \mu_{red}$ (ver definición en 3.8)

3.13. $t_p = v_0/a$; $x(t_p) = v_0 t_p - a t_p^2/2 = v_0^2/2a$ =55 m

3.14. T_1=(N_t-1) $m_v a$= 66048 N, T_n=(N_t-n)$m_v a$=T_1·(25-n)/24

3.15. v_L=mg/k; v=v_L([1-exp(-gt/v_L)]; z=(v_L/g)[$v_L$ln (v_L/(v_L-v))-v]

3.16. a= 1,16 m/s^2 ; $m_{2\,max}$ = 3,386 kg, ; $m_{2\,min}$ = 0,614 kg

3.17. $m_1 = m_2/(2)^{1/2}$= 3,46 kg ; $T_1 = T_3 = m_1 g$= 33,9 N ; $T_2 = m_2 g$=58,8 N

3.18. caso sin rozamiento: b) a=F/(m_1+ m_2+ m_3)= 2 m/s^2 ; c) F_1 = m_1 a =4 N, F_2 = m_2 a= 6 N, F_3 = m_3 a= 8 N; d) F_{12} =F- m_1 a= 14 N, F_{23} =F_3= 8 N . Caso con rozamiento: a'=a-μg=1,02 m/s^2; F_1' = m_1 a' =2,04 N; F_2' = m_2 a'= 3,06 N; F_3' = m_3 a'= 4,08 N; d) F_{12}' = F_{12}, F_{23}'= F_{23}

3.19. completar a) $T = \frac{m_1(a + \mu g)}{\cos\theta + \mu \sin\theta} = \frac{m_1(\mu - 1)g}{\cos\theta + \mu\sin\theta + \frac{m_1}{m_2}}$ b) en el caso a=0, $T_{min} = \frac{m_1 \mu_e g}{\sqrt{1 + \mu_e^2}}$ y $\mu_e = tg\theta$ c) $m_{2\,min} = T_{min}/g$

3.20. a) $a = \frac{m_2 \sin\alpha_2 - m_1 \sin\alpha_1}{m_1 + m_2} g = 1{,}37\ m/s^2$; $T = m_1(a + g\sin\alpha_1) = 61{,}4N$; b) de a=0, m_1/m_2 = sinα_2/ sinα_1 =1,19

3.21. $a_2 = \frac{F - \mu(2m_1 + m_2)g}{m_2} = 0{,}58\ m/s^2$; $T_2 = \mu m_1 g = 9{,}8\ N$. si μ=0, $a_2 = F/m_2$

3.22. m_1: $-f_{r12} + T = m_1 a$, $F_{12} - F_{g1} = 0$ $f_{r12} = \mu F_{12}$, m_2: $F - T - f_{r21} - f_{rs2} = m_2 a$, $N - F_{12} - F_{g2} = 0$;

$f_{r2s} = \mu N = \mu(m_1 + m_2)g$, $a = \frac{F - 2\mu m_1 g}{m_1 + m_2} - \mu g$, $T = \frac{m_1}{m_1 + m_2}(F - 2\mu m_1 g)$

3.23. a) a_{max}= $f_{r\,max}/m_1$=2,9 m/s^2 ; F_{max} = ($m_1 + m_2$) a_{max} =17,7 N; b) a = F_{max}/2($m_1 + m_2$)=1,48 m/s^2; f_r = m_1a= 2,96 N; c) a_1 =μ_cg= 1,96m/s^2 ; a_2 = (2F_{max}-f_r)/m_2 = 7,9 m/s^2

3.24. $a = g(\sin\alpha - (\mu_1 + \mu_2)\cos\alpha/2) = 6{,}04\ m/s^2$, $T = m_1 g(\mu_1 - \mu_2)(\cos\alpha)/2 = 0.1g = 0.98N\ m/s^2$

3.25. $a_1 = a;\ a_2 = a - a';\ a_3 = a + a'$; $a = \frac{m_1 - m_2 - m_3}{m_1 + m_2 + m_3} g$, $a' = \frac{m_2 - m_3}{m_2 + m_3} g$

3.26. a) $F = m(\frac{v_a^2}{r} - g)$ b) $\sqrt{rg}$ c) $F = m(\frac{v_b^2}{r} + g)$ d) $T_{max} = 2\pi\sqrt{R/g} = 2\ s$

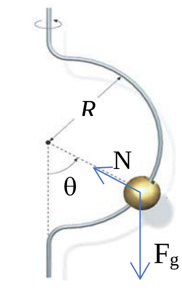
3.27. a) $v = \frac{2\pi r}{T} = 18{,}9\ m/s$, b) $a_c = \left(\frac{2\pi}{T}\right)^2 r = 7{,}8\ m/s^2$, c) $\mu_e = \left(\frac{2\pi}{T}\right)^2 \frac{r}{g} = 0{,}797$

3.28. $\theta = tg^{-1}\frac{v^2}{Rg} = 22{,}8^o$ **3.29.** $v_{\substack{max\\min}} = \left(gR\frac{\sin\alpha \pm \mu\cos\alpha}{\cos\alpha \mp \mu\sin\alpha}\right)^{1/2}$;$v_{max}$=43 ms^{-1} si μ>tgθ no hay v_{min} **3.30.** $v = \left(\frac{m_2}{m_1} gr\right)^{1/2}$; $T = \frac{2\pi}{\omega} = \frac{2\pi r}{v}$

3.31. cosα =g/ω^2L **3.32.** $T_1 = \left(\frac{2\pi}{T}\right)^2 [m_1 L_1 + m_2(L_1 + L_2)]$ $T_2 = \left(\frac{2\pi}{T}\right)^2 m_2(L_1 + L_2)$ **3.33.** $\omega_{min} = \left(\frac{g}{\mu_e R}\right)^{1/2} = 2{,}48\ rad/s$

3.34. Ver http://www.youtube.com/watch?v=vMr7i0-KgA4

3.35. $N_0 = m\omega_0^2 R = 1{,}4N$ $\theta_0 = \arccos(g/\omega_0^2 R) \approx 46^o$



3.36. a) $a_m = -\frac{(m + M)(tg\theta - \mu)g\cos\theta}{(m + M) - m(1 - \mu \cdot tg\theta)\cos^2\theta}$; $a_M = -\frac{(tg\theta - \mu)mg\cos^2\theta}{(m + M) - m(1 - \mu \cdot tg\theta)\cos^2\theta}$ b) a_m =2,43 m/s^2, a_M= - 0,87 m/s^2 ;

t_m =(2L/a_m)$^{1/2}$= 0,91 s; e) v_M = a_M t_m= -0,79 m/s,

v_m = a_m t_m = 2.20 m/s, V_m'= v_m cosθ+ v_M = 1.12 m/s

3.37. a) ec. din. dir. radial ($\vec{F} = q\vec{v} \times \vec{B} = qvB\,\overrightarrow{u_r}$): $qvB = ma_r = \frac{v^2}{R}$; b) $\omega = \frac{v}{R} = \frac{qB}{m}$=1,4·10^8 rad/s
c) ec. din. en dir y: $qE_y = ma_y$. $v_y = \frac{qE_y}{m}t$; $y(t) = \frac{qE_y}{2m}t^2$. Para t_1 =1000T; $E_y = \frac{2q\,y(t_1)}{4\pi^2\,m\,10^6}B^2 = 1{,}1\ V/m$