بسم الله الرحمن الرحيم

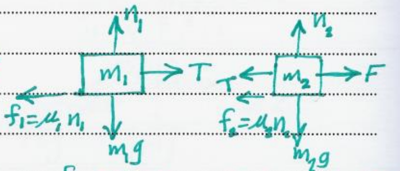
حل الاختبار الثاني لمقرر ١٠٣ فيز المنعقد في ١٤٣٢/٤/٨هـ

1 (Prob. # 5.46)

$m_1 = 2M$, $m_2 = M$, $\mu_1 = 0.2$, $\mu_2 = 0.3$

$F = 10\,N$, $M = 1\,kg$

$\Sigma F_x = ma$



for block #2 $\quad f_2 = \mu_2 n_2 = \mu_2 m_2 g$

$F - T - f_2 = m_2 a$

$F - T - \mu_2 Mg = Ma \quad ①$

for block #1 $\quad T - f_1 = m_1 a \quad f_1 = \mu_1 n_1 = \mu_1 m_1 g = \mu_1 (2M$

$T - \mu_1 (2Mg) = 2Ma \quad ②$

Adding ① + ② $\quad F - Mg(\mu_2 + 2\mu_1) = 3Ma$

$10 - (1)(9.8)(0.3 + 0.4) = 3(1)a$

$10 - (9.8)(0.7) = 3a$

$10 - 6.86 = 3a$

$3.14 = 3a$

$a = \frac{3.14}{3} = 1.05\ m/s^2$

substitute into equation ②

$T = 2(1)(1.05) + (0.2)(2)(1)(9.8) = 6.01 \simeq 6\,N$

If $F = 12\,N \quad T = 7.4\,N$

If $F = 14\,N \quad T = 8.7\,N$

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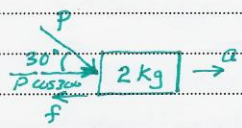
2 $\Sigma F_x = P\cos 30° - f = 2a$



If $P = 6\,N \quad f = 6\cos 30° - (2)(1.2)$

$= 2.8\,N$

If $P = 7\,N \quad f = 3.7\,N$

If $P = 8\,N \quad f = 4.5\,N$

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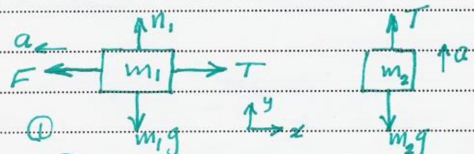
3 $m_1 = 2M$, $m_2 = M$

$M = 1.5\,kg$



for m_1 : $\Sigma F_x = T - F = -2Ma \quad ①$

for m_2 : $\Sigma F_y = T - Mg = Ma \quad ②$

subtracting ① − ② $\quad Mg - F = -3Ma$

$a = \frac{Mg - F}{-3M}$

If $F = 40\,N \quad a = \frac{(1.5)(9.8) - 40}{(-3)(1.5)} = 5.6\ m/s^2$

from equation ② $\quad T = Ma + Mg = M(a+g) = (1.5)(5.6 + 9.8)$

$= 23.1\,N$

If $F = 30\,N$, $T = 19.8\,N$, If $F = 20\,N$, $T = 16.5\,N$

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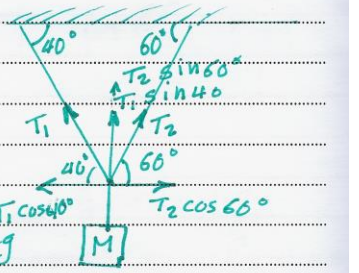
4. $T_1 \sin 40^\circ + T_2 \sin 60^\circ = Mg$ (1)

$T_1 \cos 40^\circ = T_2 \cos 60^\circ$ (2)



from (2): $T_2 = T_1 \dfrac{\cos 40^\circ}{\cos 60^\circ}$

Substitute into equation (1)

$T_1 \sin 40^\circ + T_1 \left(\dfrac{\cos 40^\circ}{\cos 60^\circ}\right) \sin 60^\circ = Mg$

$T_1 [\sin 40^\circ + (\cos 40^\circ)(\tan 60^\circ)] = Mg$

$T_1 [0.643 + 1.3268] = Mg$

$1.9698\, T_1 = M(9.8)$

$T_1 = \dfrac{M(9.8)}{1.9698} = \dfrac{(4)(9.8)}{1.9698} = 19.90 \approx 20\ N$

If $M = 6\ kg$ $T_1 = 30\ N$

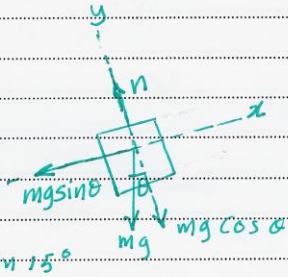
If $M = 8\ kg$ $T_1 = 40\ N$

5. $\Sigma F_x = -mg \sin\theta = ma$

$a = -g \sin\theta$

$\Sigma F_y = n - mg\cos\theta = 0$

$n = mg\cos\theta$



$\theta = 15^\circ$ $a = -(9.8)\sin 15^\circ$

$= -2.54\ m/s^2$

$= 2.54\ m/s^2$ down the incline surf

If $\theta = 20^\circ$ $a = 3.35\ m/s^2$

If $\theta = 25^\circ$ $a = 4.14\ m/s^2$

6. $f_s = m\dfrac{v^2}{r}$

$\mu_s mg = m\dfrac{v_{max}^2}{r}$, $\mu_s = \dfrac{v_{max}^2}{gr}$

$r = 33\ m$, $m = 1500\ kg$ $v = 13.1\ m/s$

$\mu_s = \dfrac{(13.1)^2}{(9.8)(33)} = 0.53$

If $r = 40\ m$ $\mu_s = 0.44$, If $r = 50\ m$, $\mu_s = 0.3$

7. $m = 2\ kg$ $W = K_f - K_i = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

If $v_i = 10\ m/s$, $v_f = 15\ m/s$ $W = \frac{1}{2}(2)[(15)^2 - (10)^2] =$

If $v_i = 15\ m/s$, $v_f = 20\ m/s$ $W = 175\ J$

If $v_i = 20\ m/s$, $v_f = 25\ m/s$ $W = 225\ J$

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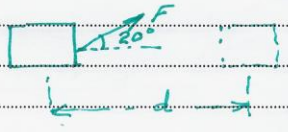
8. $W = (F\cos\theta)\, d$

$= 12 \cos 20^\circ (3.) = 33.8\,J$

If $d = 5\ m$ $\quad W = 56.4\,J$

If $d = 7\ m$ $\quad W = 78.9\,J$



9. $m = 10\ kg$, $k = 1.4 \times 10^3\ N/m$, $x = 8\ cm$

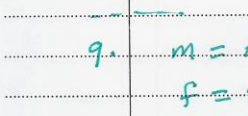
$f = 25\ N$ $\quad W_s = \frac{1}{2} k x_{max}^2 = \frac{1}{2}(1.4\times10^3)(8\times10^{-2})^2 = 4.48$

$\Delta K = -f_k d = -(25)(8\times10^{-2}) = -2\,J$

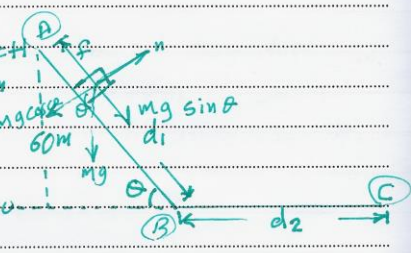
$K_f = 4.48 - 2 = 2.48\,J \approx 2.5\,J$

If $f = 10\ N$ $\quad K_f = 3.7\,J$

If $f = 40\ N$ $\quad K_f = 1.3\,J$



10. $\sin\theta = \frac{60}{d}$ $\quad \therefore d = \frac{60}{\sin 45} \approx 85\ m$



$\Delta E_{mech} = (K_f + U_f) - (K_i + U_i)$

$-f_k d = \frac{1}{2} m v_f^2 + 0 - (0 + mgH)$

$-f_k d = \frac{1}{2} m v_f^2 - mgH$

$f_k = \mu_k n = \mu_k mg\cos\theta$

$-\mu_k (mg\cos\theta)(d_1) = \frac{1}{2} m v_B^2 - mgH$

$v_0^2 = 2gH - 2\mu_k g d_1 \cos\theta$

$= 2(9.8)(60) - 2(0.6)(9.8)(85)\cos 45^\circ$

$= 469$

$\Delta E_{mech} = E_C - E_B = -\mu_k mg d_2$

$(K_C + U_C) - (K_B + U_B) = (0+0) - (\frac{1}{2} m v_B^2 + 0) = -\mu_k mg$

$d_2 = \frac{v_B^2}{2\mu_k g} = \frac{469}{(2)(0.6)(9.8)} = 40\ m$

If $H = 50\ m$ $\quad d_2 = 33.3\ m$

If $H = 40\ m$ $\quad d_2 = 26.6\ m$

11. $P = 25\ W$, $x = 7.5\ cm$, $\Delta t = 1\ sec$

$P = \frac{W}{\Delta t} = \frac{\frac{1}{2} k x^2}{\Delta t}$ $\quad \therefore \frac{1}{2} k x^2 = P\Delta t$, $\quad k = \frac{2P\Delta t}{x^2}$

$k = \frac{(2)(25)(1)}{(7.5\times10^{-2})^2} = 8.9 \times 10^3\ N/m$

If $P = 50\ W$, $\quad k = 1.9 \times 10^4\ N/m$,

If $P = 75\ W$, $\quad k = 2.7 \times 10^4\ N/m$

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12. The apparent weight of a fish in an elevator is greatest when the elevator accelerates upward.

13. A split curved highway has a number of curved lanes for traffic in one direction. The radius for the inside of the curve is half the radius for the outside. One car, car A, travels on the inside while another car of equal mass, car B, travels at equal speed on the outside of the curve. The force on B is half the force on A

14. A dart is loaded into a spring-loaded toy dart gun by pushing the spring a distance d. For the second loading, the spring is compressed a distance 2d. How much work is required to load the second dart compa to that required to load the first?

Ans. Four times as much

15. $F(x) = -\frac{dU(x)}{dx}$