Sample final answers – fall 2001

Here are my answers to the sample final. Please remember that I am only human and I do make mistakes. Please let me know if you think any of these answers are wrong.

Problems

1. $T = \frac{2m_2 + M(1-\mu)}{m_1 + m_2 + M} m_1 g$ where T is the force on the rope you want to find, M is the mass of the block on the table, m_1 is the mass of the block you are interested in, m_2 is the mass of the other block, μ is the coefficient of kinetic friction, and g is the gravitational acceleration.

$$T = \frac{2(20\text{kg}) + (30\text{kg})(1-0.08)}{(12\text{kg}) + (20\text{kg}) + (30\text{kg})}(12\text{kg})\left(9.8\frac{\text{m}}{\text{s}^2}\right) = 1.3\times10^2\ \text{N}$$

2. $T_1 = \frac{W_2 d_2 + W\frac{L}{2} + W_1(L - d_1)}{L}$ where T_1 is the tension in the rope nearest the 115 lb worker, W_1 is the weight of that worker, d_1 is the distance of that worker from the end of the platform, W is the weight of the platform, L is its length, W_2 is the weight of the other worker, and d_2 is the distance of that worker from the end of the platform.

$$T_1 = \frac{(160\text{lb})(4.0\text{ft}) + (130\text{lb})\frac{(12\text{ft})}{2} + (115\text{lb})(12\text{ft} - 2.5\text{ft})}{12\text{ft}} = 209\text{lb}$$

$$T_2 = \frac{W_1 d_1 + W\frac{L}{2} + W_2(L - d_2)}{L} = \frac{(115\text{lb})(2.5\text{ft}) + (130\text{lb})\frac{(12\text{ft})}{2} + (160\text{lb})(12\text{ft} - 4.0\text{ft})}{12\text{ft}} = 196\text{lb}$$

3. $v_f = \frac{m}{m+M} v_o$ where v_f is the final velocity of the center of mass of the worker & ring system, m is the mass of the worker, M is the mass of the ring, and v_o is the speed of the worker before grabbing the ring.

$\omega = \frac{mM}{m^2 + mM + M^2}\frac{v_o}{r}$ where ω is the final angular speed of the worker & ring system and r is the radius of the ring.

4. $v_j = \sqrt{2gL}$ where v_j is the speed that the jumping cat hits the ground, L is the length of the ladder, and g is the gravitational acceleration.

$$v_j = \sqrt{2\left(9.8\frac{m}{s^2}\right)(4.0m)} = 8.9\frac{m}{s}$$

$$v_h = \sqrt{2gL\frac{m+\frac{M}{2}}{m+\frac{M}{3}}} = v_f\sqrt{\frac{m+\frac{M}{2}}{m+\frac{M}{3}}}$$ where v_h is the speed that the cat that hangs on hits the ground, m is the mass of the cat, and M is the mass of the ladder.

$$v_h = 8.9\frac{m}{s}\sqrt{\frac{(5.0kg)+\frac{(15kg)}{2}}{(5.0kg)+\frac{(15kg)}{3}}} = 10\frac{m}{s}$$ The cat is better off jumping.

5. $f = \frac{1}{2\pi}\sqrt{\frac{k_1+k_2}{m+M}}$ where f is the frequency after the additional mass is added.

$$v_{max} = \frac{1}{m+M}\sqrt{M(k_1+k_2)}A$$

6. $D = \sqrt{\frac{20}{7}h(H-h)}$ where D is the distance the ball lands from the edge of the table, h is the height of the table above the floor, and H is the height of the center of the ball above the floor at the top of the ramp.

Multiple Choice Questions

1. e	11. e	21. b
2. a	12. d	22. c
3. b	13. d	23. e
4. c or d (they are the same)	14. b	24. a
5. e	15. b	25. e
6. c	16. d	26. b
7. a	17. a	27. b
8. c	18. b	28. a
9. a	19. e	29. a
10. a	20. b	30. c