Texbook: Engineering Mechanics – Dynamics by R. C. Hibbeler 13th Edition

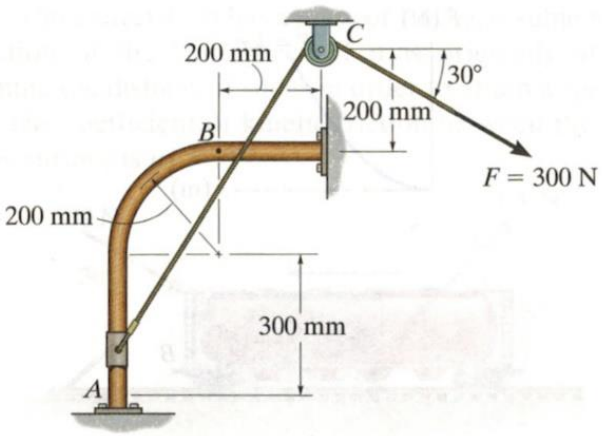
Cover Chapters: Chapter 14, Chapter 15, Chapter 17, Chapter 18, Chapter 19, Chapter 21

Problems:

Chapter 14:

1. 14-14

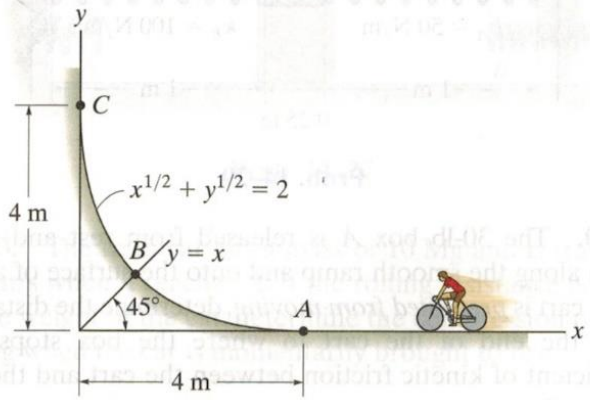
14–14. If the cord is subjected to a constant force of $F = 300$ N and the 15-kg smooth collar starts from rest at A, determine the velocity of the collar when it reaches point B. Neglect the size of the pulley.



Prob. 14–14

2. 14-32

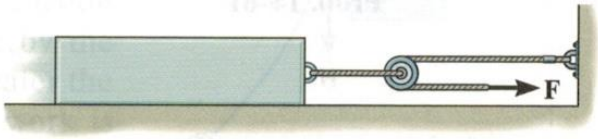
*14–32. The cyclist travels to point A, pedaling until he reaches a speed $v_A = 8$ m/s. He then coasts freely up the curved surface. Determine the normal force he exerts on the surface when he reaches point B. The total mass of the bike and man is 75 kg. Neglect friction, the mass of the wheels, and the size of the bicycle.



Prob. 14–32

3. 14-58

14–58. The block has a mass of 150 kg and rests on a surface for which the coefficients of static and kinetic friction are $\mu_s = 0.5$ and $\mu_k = 0.4$, respectively. If a force $F = (60t^2)$ N, where t is in seconds, is applied to the cable, determine the power developed by the force when $t = 5$ s. *Hint:* First determine the time needed for the force to cause motion.

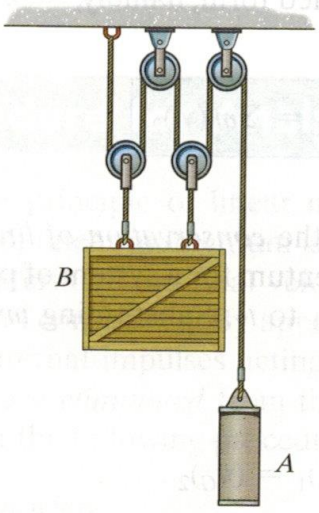


Prob. 14–58

Chapter 15

4. 15-30

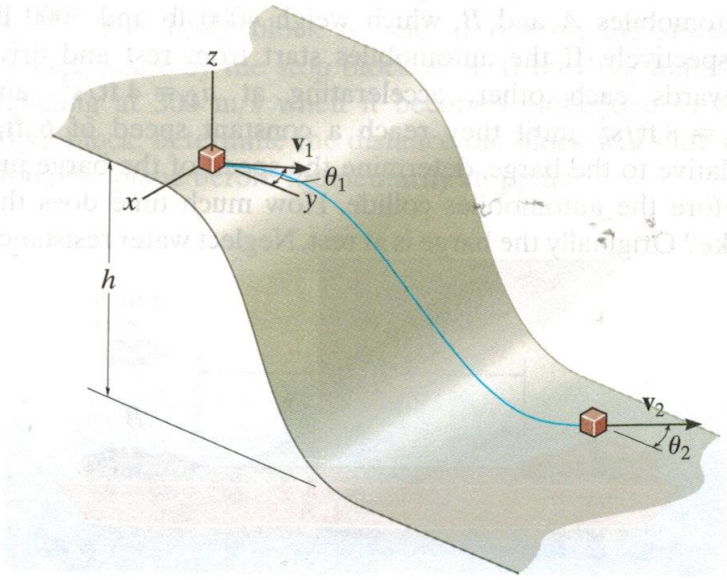
15–30. The crate B and cylinder A have a mass of 200 kg and 75 kg, respectively. If the system is released from rest, determine the speed of the crate and cylinder when $t = 3$ s. Neglect the mass of the pulleys.



Prob. 15–30

5. 15-45

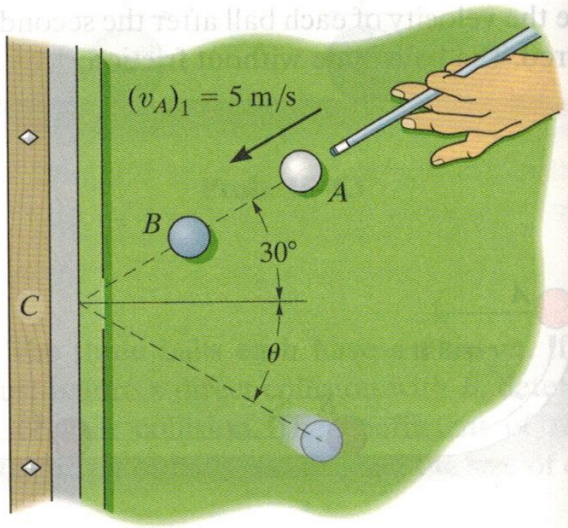
15–45. The block of mass m travels at v_1 in the direction θ_1 shown at the top of the smooth slope. Determine its speed v_2 and its direction θ_2 when it reaches the bottom.



Prob. 15–45

6. 15-77

15–77. The cue ball A is given an initial velocity $(v_A)_1 = 5$ m/s. If it makes a direct collision with ball B ($e = 0.8$), determine the velocity of B and the angle θ just after it rebounds from the cushion at C ($e' = 0.6$). Each ball has a mass of 0.4 kg. Neglect their size.

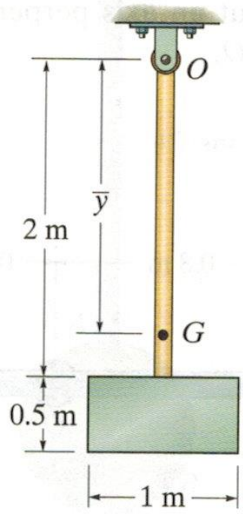


Prob. 15–77

Chapter 17

7. 17-21

17–21. The pendulum consists of the 3-kg slender rod and the 5-kg thin plate. Determine the location $\bar{y}$ of the center of mass G of the pendulum; then calculate the moment of inertia of the pendulum about an axis perpendicular to the page and passing through G.

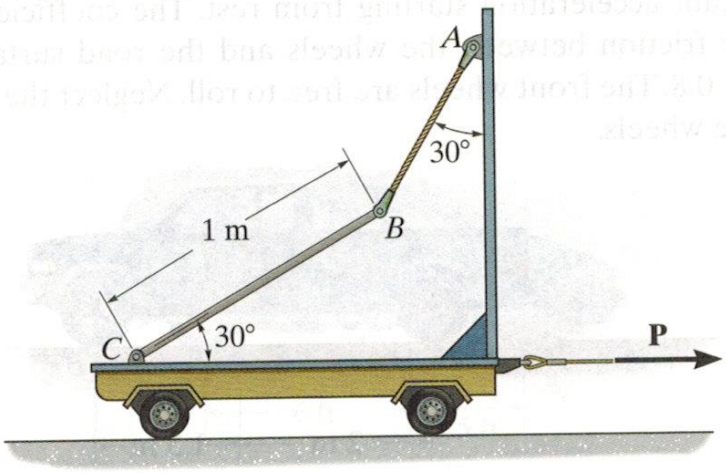


Prob. 17–21

8.& 9. 17-49&17-50

17–49. If the cart's mass is 30 kg and it is subjected to a horizontal force of $P = 90$ N, determine the tension in cord AB and the horizontal and vertical components of reaction on end C of the uniform 15-kg rod BC.

17–50. If the cart's mass is 30 kg, determine the horizontal force P that should be applied to the cart so that the cord AB just becomes slack. The uniform rod BC has a mass of 15 kg.

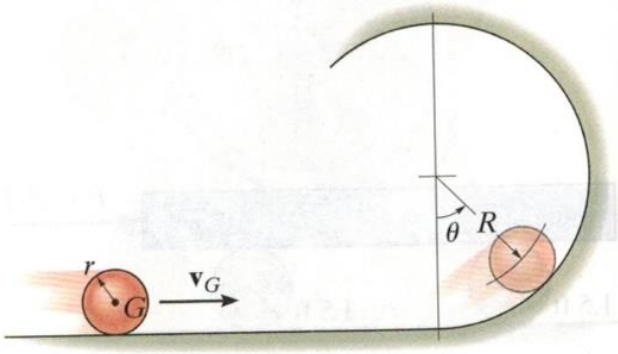


Probs. 17–49/50

Chapter 18

10. 18-35

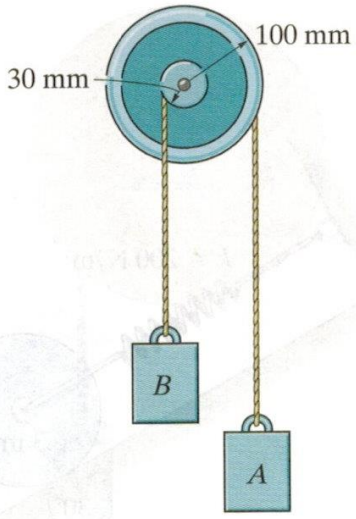
18–35. A ball of mass m and radius r is cast onto the horizontal surface such that it rolls without slipping. Determine the minimum speed v_G of its mass center G so that it rolls completely around the loop of radius $R + r$ without leaving the track.



Probs. 18–34/35

11. 18-50

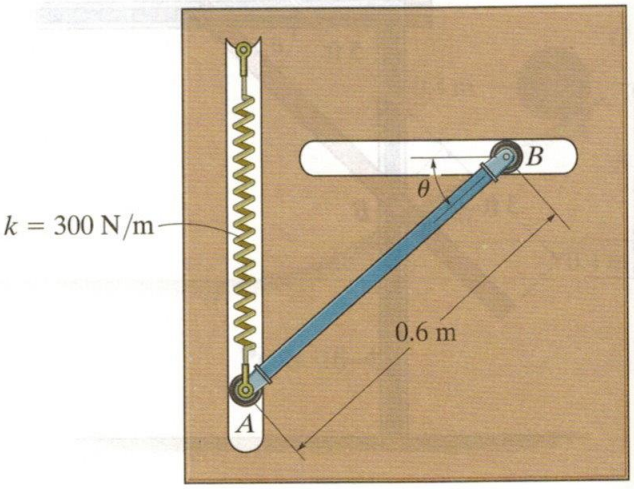
18–50. The compound disk pulley consists of a hub and attached outer rim. If it has a mass of 3 kg and a radius of gyration $k_G = 45$ mm, determine the speed of block A after A descends 0.2 m from rest. Blocks A and B each have a mass of 2 kg. Neglect the mass of the cords.



Prob. 18–50

12. 18-51

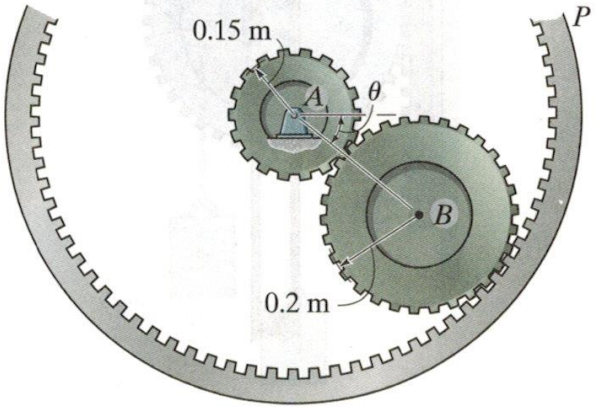
18–51. A spring having a stiffness of $k = 300\ \text{N/m}$ is attached to the end of the 15-kg rod, and it is unstretched when $\theta = 0°$. If the rod is released from rest when $\theta = 0°$, determine its angular velocity at the instant $\theta = 30°$. The motion is in the vertical plane.



Prob. 18–51

13. 18-60

***18–60.** If the 40-kg gear B is released from rest at $\theta = 0°$, determine the angular velocity of the 20-kg gear A at the instant $\theta = 90°$. The radii of gyration of gears A and B about their respective centers of mass are $k_A = 125$ mm and $k_B = 175$ mm. The outer gear ring P is fixed.

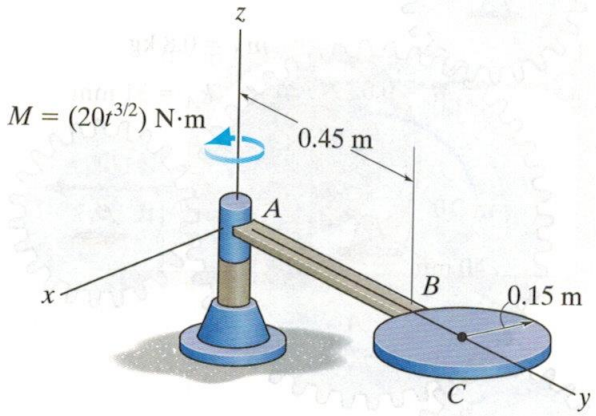


Prob. 18–60

Chapter 19

14. 19-15

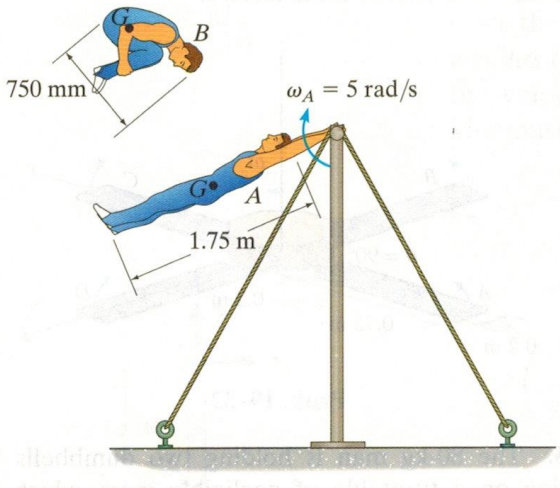
19–15. The assembly shown consists of a 10-kg rod AB and a 20-kg circular disk C. If it is subjected to a torque of $M = (20t^{3/2})$ N·m, where t is it in seconds, determine its angular velocity when $t = 3$ s. When $t = 0$ the assembly is rotating at $\boldsymbol{\omega}_1 = \{-6\mathbf{k}\}$ rad/s.



Prob. 19–15

15. 19-34

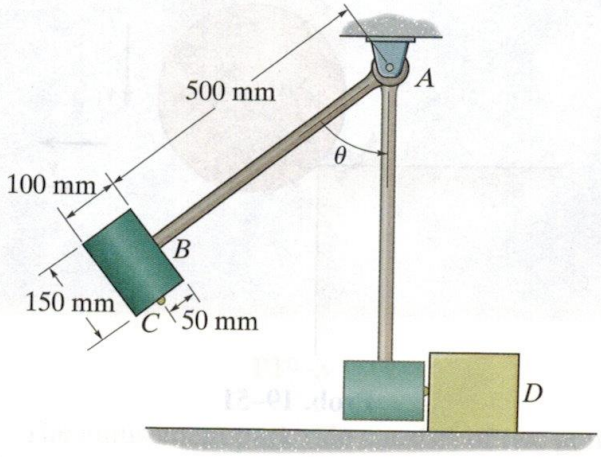
19–34. The 75-kg gymnast lets go of the horizontal bar in a fully stretched position A, rotating with an angular velocity of $\omega_A = 3$ rad/s. Estimate his angular velocity when he assumes a tucked position B. Assume the gymnast at positions A and B as a uniform slender rod and a uniform circular disk, respectively.



Prob. 19–34

16. 19-49

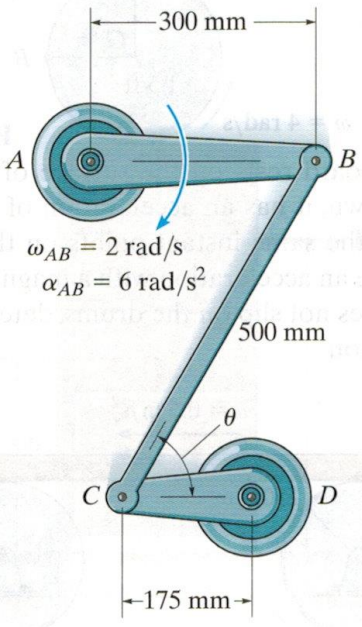
19–49. The hammer consists of a 10-kg solid cylinder C and 6-kg uniform slender rod AB. If the hammer is released from rest when $\theta = 90°$ and strikes the 30-kg block D when $\theta = 0°$, determine the velocity of block D and the angular velocity of the hammer immediately after the impact. The coefficient of restitution between the hammer and the block is $e = 0.6$.



Prob. 19–49

17. R2-24

***R2–24.** At the instant shown, link AB has an angular velocity $\omega_{AB} = 2$ rad/s and an angular acceleration $\alpha_{AB} = 6$ rad/s^2. Determine the acceleration of the pin at C and the angular acceleration of link CB at this instant, when $\theta = 60°$.

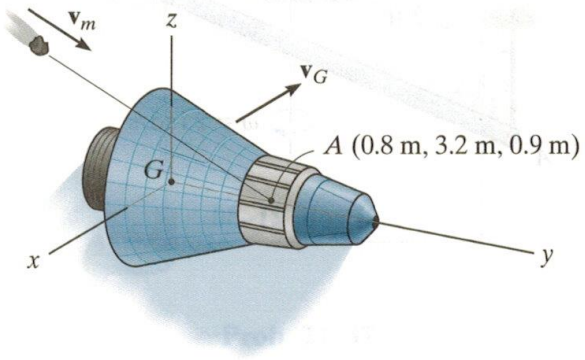


Prob. R2–24

Chapter 21

18. 21-28

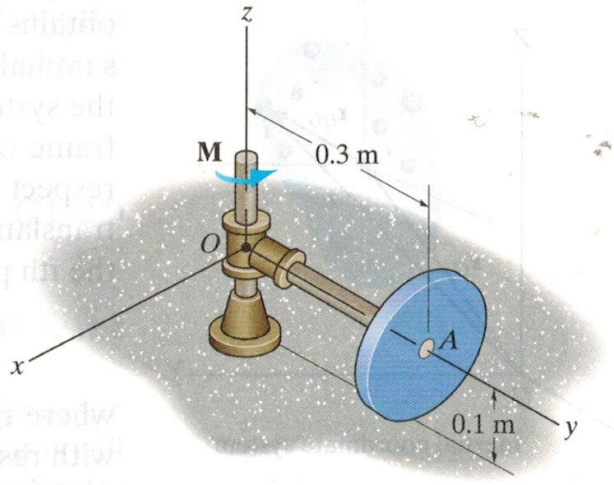
***21–28.** The space capsule has a mass of 5 Mg and the radii of gyration are $k_x = k_z = 1.30$ m and $k_y = 0.45$ m. If it travels with a velocity $\mathbf{v}_G = \{400\mathbf{j} + 200\mathbf{k}\}$ m/s, compute its angular velocity just after it is struck by a meteoroid having a mass of 0.80 kg and a velocity $\mathbf{v}_m = \{-300\mathbf{i} + 200\mathbf{j} - 150\mathbf{k}\}$ m/s. Assume that the meteoroid embeds itself into the capsule at point A and that the capsule initially has no angular velocity.



Prob. 21–28

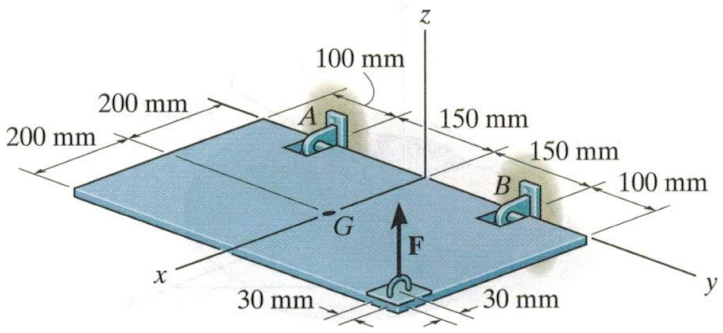
19. 21-39

21–39. If arm OA is subjected to a torque of $M = 5$ N · m, determine the spin angular velocity of the 10-kg disk after the arm has turned 2 rev, starting from rest. The disk rolls on the horizontal plane without slipping. Neglect the mass of the arm.



Probs. 21–38/39

21–51. The uniform hatch door, having a mass of 15 kg and a mass center at G, is supported in the horizontal plane by bearings at A and B. If a vertical force $F = 300$ N is applied to the door as shown, determine the components of reaction at the bearings and the angular acceleration of the door. The bearing at A will resist a component of force in the y direction, whereas the bearing at B will not. For the calculation, assume the door to be a thin plate and neglect the size of each bearing. The door is originally at rest.



Prob. 21–51