## CHAPTER 7

1. A grindstone spinning at the rate of $8.3 \mathrm{rev} / \mathrm{s}$ has what approximate angular speed?
a. $3.2 \mathrm{rad} / \mathrm{s}$
b. $26 \mathrm{rad} / \mathrm{s}$
c. $52 \mathrm{rad} / \mathrm{s}$
d. $81 \mathrm{rad} / \mathrm{s}$
2. A ventilation fan has blades 0.25 m in radius rotating at 20 rpm . What is the tangential speed of each blade tip?
a. $0.02 \mathrm{~m} / \mathrm{s}$
b. $0.52 \mathrm{~m} / \mathrm{s}$
c. $5.0 \mathrm{~m} / \mathrm{s}$
d. $20 \mathrm{~m} / \mathrm{s}$
3. A ventilation fan has blades 0.25 m long rotating at 20 rpm . What is the centripetal acceleration of a point on the outer tip of a blade?
a. $1.1 \mathrm{~m} / \mathrm{s}^{2}$
b. $0.87 \mathrm{~m} / \mathrm{s}^{2}$
c. $0.55 \mathrm{~m} / \mathrm{s}^{2}$
d. $0.23 \mathrm{~m} / \mathrm{s}^{2}$
4. A 0.30 -m-radius automobile tire rotates how many rad after starting from rest and accelerating at a constant $2.0 \mathrm{rad} / \mathrm{s}^{2}$ over a $5.0-\mathrm{s}$ interval?
a. 12.5 rad
b. 25 rad
c. 2.0 rad
d. 0.50 rad
5. A 0.30 -m-radius automobile tire accelerates from rest at a constant $2.0 \mathrm{rad} / \mathrm{s}^{2}$. What is the centripetal acceleration of a point on the outer edge of the tire after 5.0 s ?
a. $300 \mathrm{~m} / \mathrm{s}^{2}$
b. $33 \mathrm{~m} / \mathrm{s}^{2}$
c. $30 \mathrm{~m} / \mathrm{s}^{2}$
d. $3.0 \mathrm{~m} / \mathrm{s}^{2}$
6. A 0.30 -m-radius automobile tire accelerates from rest at a constant $2.0 \mathrm{rad} / \mathrm{s}^{2}$ over a $5.0-\mathrm{s}$ interval. What is the tangential component of acceleration for a point on the outer edge of the tire during the 5 -s interval?
a. $33 \mathrm{~m} / \mathrm{s}^{2}$
b. $6.7 \mathrm{~m} / \mathrm{s}^{2}$
c. $0.60 \mathrm{~m} / \mathrm{s}^{2}$
d. $0.30 \mathrm{~m} / \mathrm{s}^{2}$
7. A fan blade, initially at rest, rotates with a constant acceleration of $0.025 \mathrm{rad} / \mathrm{s}^{2}$. What is its angular speed at the instant it goes through an angular displacement of 4.2 rad ?
a. $0.025 \mathrm{rad} / \mathrm{s}$
b. $0.11 \mathrm{rad} / \mathrm{s}$
c. $0.46 \mathrm{rad} / \mathrm{s}$
d. $1.2 \mathrm{rad} / \mathrm{s}$
8. A fan blade, initially at rest, rotates with a constant acceleration of $0.025 \mathrm{rad} / \mathrm{s}^{2}$. What is the time interval required for it to reach a 4.2 -rad displacement after starting from rest?
a. 1.8 s
b. 2.0 s
c. 16 s
d. 18 s
9. A $0.40-\mathrm{kg}$ mass, attached to the end of a $0.75-\mathrm{m}$ string, is whirled around in a circular horizontal path. If the maximum tension that the string can withstand is 450 N , then what maximum speed can the mass have if the string is not to break?
a. $370 \mathrm{~m} / \mathrm{s}$
b. $22 \mathrm{~m} / \mathrm{s}$
c. $19 \mathrm{~m} / \mathrm{s}$
d. $29 \mathrm{~m} / \mathrm{s}$
10. Two satellites are monitored as they orbit the Earth; satellite X is eight times as far from the Earth's center as is satellite Y. From Kepler's third law one may conclude that the period or revolution of X is what factor times that of Y ?
a. $1 / 2$
b. 2.0
c. 4.0
d. 22.6
11. A point on the rim of a $0.30-\mathrm{m}-r a d i u s$ rotating wheel has a tangential speed of $4.0 \mathrm{~m} / \mathrm{s}$. What is the tangential speed of a point 0.20 m from the center of the same wheel?
a. $1.0 \mathrm{~m} / \mathrm{s}$
b. $1.3 \mathrm{~m} / \mathrm{s}$
c. $2.7 \mathrm{~m} / \mathrm{s}$
d. $8.0 \mathrm{~m} / \mathrm{s}$
12. A point on the rim of a 0.25 -m-radius fan blade has centripetal acceleration of $0.20 \mathrm{~m} / \mathrm{s}^{2}$. Find the centripetal acceleration of a point 0.05 m from the center of the same wheel.
a. $0.01 \mathrm{~m} / \mathrm{s}^{2}$
b. $0.02 \mathrm{~m} / \mathrm{s}^{2}$
c. $0.04 \mathrm{~m} / \mathrm{s}^{2}$
d. $0.08 \mathrm{~m} / \mathrm{s}^{2}$
13. A point on the rim of a 0.25 -m-radius rotating wheel has a centripetal acceleration of 4.0 $\mathrm{m} / \mathrm{s}^{2}$. What is the angular speed of the wheel?
a. $1.0 \mathrm{rad} / \mathrm{s}$
b. $2.0 \mathrm{rad} / \mathrm{s}$
c. $3.2 \mathrm{rad} / \mathrm{s}$
d. $4.0 \mathrm{rad} / \mathrm{s}$
14. A point on the rim of a 0.15 -m-radius rotating disk has a centripetal acceleration of $5.0 \mathrm{~m} / \mathrm{s}^{2}$. What is the angular speed of a point 0.075 m from the center of the disk?
a. $0.89 \mathrm{rad} / \mathrm{s}$
b. $1.6 \mathrm{rad} / \mathrm{s}$
c. $3.2 \mathrm{rad} / \mathrm{s}$
d. $5.8 \mathrm{rad} / \mathrm{s}$
15. Which of the following best describes the property of the period of orbital revolution for an Earth satellite?
a. greater when the orbital radius is smaller
b. greater when the orbital radius is larger
c. independent of the orbital radius
d. determined mainly by the satellite's mass
16. Of the nine known planets in our solar system, the innermost is Mercury. When compared to the other planets in the system, Mercury has the:
a. greatest centripetal acceleration.
b. greatest period of revolution.
c. smallest angular velocity.
d. smallest tangential velocity.
17. A 0.12 -m-radius grinding wheel takes 5.5 s to speed up from $2.0 \mathrm{rad} / \mathrm{s}$ to $11.0 \mathrm{rad} / \mathrm{s}$. What is the wheel's average angular acceleration?
a. $9.6 \mathrm{rad} / \mathrm{s}^{2}$
b. $4.8 \mathrm{rad} / \mathrm{s}^{2}$
c. $1.6 \mathrm{rad} / \mathrm{s}^{2}$
d. $0.33 \mathrm{rad} / \mathrm{s}^{2}$
18. A 0.15 -m-radius grinding wheel starts at rest and develops an angular speed of $12.0 \mathrm{rad} / \mathrm{s}$ in 4.0 s . What is the average tangential acceleration of a point on the wheel's edge?
a. $0.45 \mathrm{~m} / \mathrm{s}^{2}$
b. $6.8 \mathrm{~m} / \mathrm{s}^{2}$
c. $28 \mathrm{~m} / \mathrm{s}^{2}$
d. $14 \mathrm{~m} / \mathrm{s}^{2}$
19. A $0.150-\mathrm{m}$-radius grinding wheel, starting at rest, develops an angular speed of $12.0 \mathrm{rad} / \mathrm{s}$ in a time interval of 4.00 s . What is the centripetal acceleration of a point 0.100 m from the center when the wheel is moving at an angular speed of $12.0 \mathrm{rad} / \mathrm{s}$ ?
a. $0.450 \mathrm{~m} / \mathrm{s}^{2}$
b. $7.20 \mathrm{~m} / \mathrm{s}^{2}$
c. $14.4 \mathrm{~m} / \mathrm{s}^{2}$
d. $28.8 \mathrm{~m} / \mathrm{s}^{2}$
20. A Ferris wheel starts at rest and builds up to a final angular speed of $0.70 \mathrm{rad} / \mathrm{s}$ while rotating through an angular displacement of 4.9 rad . What is its average angular acceleration?
a. $0.10 \mathrm{rad} / \mathrm{s}^{2}$
b. $0.05 \mathrm{rad} / \mathrm{s}^{2}$
c. $1.8 \mathrm{rad} / \mathrm{s}^{2}$
d. $0.60 \mathrm{rad} / \mathrm{s}^{2}$
21. A Ferris wheel, rotating initially at an angular speed of $0.50 \mathrm{rad} / \mathrm{s}$, accelerates over a $7.0-\mathrm{s}$ interval at a rate of $0.040 \mathrm{rad} / \mathrm{s}^{2}$. What is its angular speed after this $7-\mathrm{s}$ interval?
a. $0.20 \mathrm{rad} / \mathrm{s}$
b. $0.30 \mathrm{rad} / \mathrm{s}$
c. $0.46 \mathrm{rad} / \mathrm{s}$
d. $0.78 \mathrm{rad} / \mathrm{s}$
22. A Ferris wheel, rotating initially at an angular speed of $0.500 \mathrm{rad} / \mathrm{s}$, accelerates over a $7.00-\mathrm{s}$ interval at a rate of $0.0400 \mathrm{rad} / \mathrm{s}^{2}$. What angular displacement does the Ferris wheel undergo in this 7-s interval?
a. 4.48 rad
b. 2.50 rad
c. 3.00 rad
d. 0.500 rad
23. The distance from the center of a Ferris wheel to a passenger seat is 12 m . What centripetal acceleration does a passenger experience when the wheel's angular speed is $0.50 \mathrm{rad} / \mathrm{s}$ ?
a. $16.9 \mathrm{~m} / \mathrm{s}^{2}$
b. $9.0 \mathrm{~m} / \mathrm{s}^{2}$
c. $3.0 \mathrm{~m} / \mathrm{s}^{2}$
d. $6.0 \mathrm{~m} / \mathrm{s}^{2}$
24. What centripetal force does an $80-\mathrm{kg}$ passenger experience when seated 12 m from the center of a Ferris wheel whose angular speed is $0.50 \mathrm{rad} / \mathrm{s}$ ?
a. 484 N
b. 720 N
c. 914 N
d. 240 N
25. A $0.400-\mathrm{kg}$ object is swung in a circular path and in a vertical plane on a $0.500-\mathrm{m}$-length string. If the angular speed at the bottom is $8.00 \mathrm{rad} / \mathrm{s}$, what is the tension in the string when the object is at the bottom of the circle?
a. 5.60 N
b. 10.5 N
c. 16.7 N
d. 19.6 N
26. A $0.30-\mathrm{kg}$ rock is swung in a circular path and in a vertical plane on a $0.25-\mathrm{m}$-length string. At the top of the path, the angular speed is $12.0 \mathrm{rad} / \mathrm{s}$. What is the tension in the string at that point?
a. 7.9 N
b. 16 N
c. 18 N
d. 83 N
27. A $1500-\mathrm{kg}$ car rounds an unbanked curve with a radius of 52 m at a speed of $12 \mathrm{~m} / \mathrm{s}$. What minimum coefficient of friction must exist between the road and tires to prevent the car from slipping? $\left(g=9.8 \mathrm{~m} / \mathrm{s}^{2}\right)$
a. 0.18
b. 0.30
c. 0.28
d. 0.37
28. At what angle (relative to the horizontal) should a curve 52 m in radius be banked if no friction is required to prevent the car from slipping when traveling at $12 \mathrm{~m} / \mathrm{s} ?\left(g=9.8 \mathrm{~m} / \mathrm{s}^{2}\right)$
a. $28^{\circ}$
b. $32^{\circ}$
c. $16^{\circ}$
d. $10^{\circ}$
29. At what speed will a car round a 52 -m-radius curve, banked at a $45^{\circ}$ angle, if no friction is required between the road and tires to prevent the car from slipping? $\left(g=9.8 \mathrm{~m} / \mathrm{s}^{2}\right)$
a. $27 \mathrm{~m} / \mathrm{s}$
b. $17 \mathrm{~m} / \mathrm{s}$
c. $23 \mathrm{~m} / \mathrm{s}$
d. $35 \mathrm{~m} / \mathrm{s}$
30. An object of mass 0.50 kg is transported to the surface of Planet $X$ where the object's weight is measured to be 20 N . The radius of the planet is $4.0 \times 10^{6} \mathrm{~m}$. What is the mass of Planet X ? ( $G=6.67 \times 10^{-11} \mathrm{~N} \cdot \mathrm{~m}^{2} / \mathrm{kg}^{2}$ )
a. $13 \times 10^{19} \mathrm{~kg}$
b. $17 \times 10^{22} \mathrm{~kg}$
c. $9.6 \times 10^{24} \mathrm{~kg}$
d. $21 \times 10^{25} \mathrm{~kg}$
31. An object of mass 0.50 kg is transported to the surface of Planet $X$ where the object's weight is measured to be 20 N . The radius of the planet is $4.0 \times 10^{6} \mathrm{~m}$. What free fall acceleration will the $0.50-\mathrm{kg}$ object experience when at the surface of Planet X?
a. $48 \mathrm{~m} / \mathrm{s}^{2}$
b. $20 \mathrm{~m} / \mathrm{s}^{2}$
c. $16 \mathrm{~m} / \mathrm{s}^{2}$
d. $40 \mathrm{~m} / \mathrm{s}^{2}$
32. An object of mass 0.50 kg is transported to the surface of Planet $X$ where the object's weight is measured to be 20 N . The radius of the planet is $4.0 \times 10^{6} \mathrm{~m}$. What free fall acceleration will the $0.50-\mathrm{kg}$ object experience when transported to a distance of $2.0 \times 10^{6} \mathrm{~m}$ from the surface of this planet?
a. $90 \mathrm{~m} / \mathrm{s}^{2}$
b. $20 \mathrm{~m} / \mathrm{s}^{2}$
c. $13 \mathrm{~m} / \mathrm{s}^{2}$
d. $18 \mathrm{~m} / \mathrm{s}^{2}$
33. Consider a point on a bicycle wheel as the wheel makes exactly four complete revolutions about a fixed axis. Compare the linear and angular displacement of the point.
a. Both are zero.
b. Only the angular displacement is zero.
c. Only the linear displacement is zero.
d. Neither is zero.
34. Consider a point on a bicycle wheel as the wheel turns about a fixed axis, neither speeding up nor slowing down. Compare the linear and angular velocities of the point.
a. Both are constant.
b. Only the angular velocity is constant.
c. Only the linear velocity is constant.
d. Neither is constant.
35. Consider a point on a bicycle wheel as the wheel turns about a fixed axis, neither speeding up nor slowing down. Compare the linear and angular accelerations of the point.
a. Both are zero.
b. Only the angular acceleration is zero.
c. Only the linear acceleration is zero.
d. Neither is zero.
36. Consider a point on a bicycle tire that is momentarily in contact with the ground as the bicycle rolls across the ground with constant speed. The direction for the acceleration for this point at that moment is:
a. upward.
b. down toward the ground.
c. forward.
d. at that moment the acceleration is zero.
37. Consider a child who is swinging. As she reaches the lowest point in her swing:
a. the tension in the rope is equal to her weight.
b. the tension in the rope is equal to her mass times her acceleration.
c. her acceleration is downward at $9.8 \mathrm{~m} / \mathrm{s}^{2}$.
d. none of the above.
38. An Earth satellite is orbiting at a distance from the Earth's surface equal to one Earth radius ( 4000 miles). At this location, the acceleration due to gravity is what factor times the value of $g$ at the Earth's surface?
a. There is no acceleration since the satellite is in orbit.
b. 2
c. 1/2
d. $1 / 4$
39. If a planet has 3 times the radius of the Earth, but has the same density as the Earth, what is the gravitational acceleration at the surface of the planet? $\left(g=9.8 \mathrm{~m} / \mathrm{s}^{2}\right)$
a. $29.4 \mathrm{~m} / \mathrm{s}^{2}$
b. $88.2 \mathrm{~m} / \mathrm{s}^{2}$
c. $265 \mathrm{~m} / \mathrm{s}^{2}$
d. $3.27 \mathrm{~m} / \mathrm{s}^{2}$
40. An object when orbiting the Earth at a height of three Earth radii from the center of the Earth has a weight of 1.00 N . What is the object's mass? ( $g$ at the surface of the Earth is $9.8 \mathrm{~m} / \mathrm{s}^{2}$.)
a. 0.102 kg
b. 0.306 kg
c. 0.92 kg
d. 1.0 kg
41. According to Kepler's second law, Halley's Comet circles the Sun in an elliptical path with the Sun at one focus of the ellipse. What is at the other focus of the ellipse?
a. nothing
b. the Earth
c. The comet itself passes through the other focus.
d. The tail of the comet stays at the other ellipse.
42. Somewhere between the Earth and the Moon is a point where the gravitational attraction of the Earth is canceled by the gravitational pull of the Moon. The mass of the Moon is $1 / 81$ that of the Earth. How far from the center of the Earth is this point?
a. $8 / 9$ the way to the Moon
b. $9 / 10$ the way to the Moon
c. $3 / 4$ the way to the Moon
d. $80 / 81$ the way to the Moon
43. A satellite is in a circular orbit about the Earth at a distance of one Earth radius above the surface. What is the speed of the satellite? (The radius of the Earth is $6.4 \times 10^{6} \mathrm{~m}$ and $G=$ $6.67 \times 10^{-11} \mathrm{~N} \cdot \mathrm{~m}^{2} / \mathrm{kg}^{2}$.)
a. $2800 \mathrm{~m} / \mathrm{s}$
b. $4200 \mathrm{~m} / \mathrm{s}$
c. $5600 \mathrm{~m} / \mathrm{s}$
d. $16800 \mathrm{~m} / \mathrm{s}$
44. An airplane in a wide sweeping "outside" loop can create zero gees inside the aircraft cabin. What must be the radius of curvature of the flight path for an aircraft moving at $150 \mathrm{~m} / \mathrm{s}$ to create a condition of "weightlessness" inside the aircraft?
a. 1150 m
b. 1800 m
c. 2300 m
d. 3600 m
45. If the mass of Mars is 0.107 times that of Earth and its radius is 0.530 that of Earth, estimate the gravitational acceleration $g$ at the surface of Mars.
a. $2.20 \mathrm{~m} / \mathrm{s}^{2}$
b. $3.73 \mathrm{~m} / \mathrm{s}^{2}$
c. $4.20 \mathrm{~m} / \mathrm{s}^{2}$
d. $5.5 \mathrm{~m} / \mathrm{s}^{2}$
46. The Earth is 93 million miles (mi) from the Sun and its period of revolution is 1 year $=3.15 \times$ $10^{7}$ s. What is the acceleration of the Earth in its orbit about the Sun?
a. $18.6 \mathrm{mi} / \mathrm{s}^{2}$
b. $9.3 \times 10^{-3} \mathrm{mi} / \mathrm{s}^{2}$
c. $13.6 \times 10^{-6} \mathrm{mi} / \mathrm{s}^{2}$
d. $3.7 \times 10^{-6} \mathrm{mi} / \mathrm{s}^{2}$
47. The escape speed from the surface of the Earth is $11.2 \mathrm{~km} / \mathrm{s}$. Estimate the escape speed for a spacecraft from the surface of the Moon. The Moon has a mass $1 / 81$ that of Earth and a radius 0.25 that of Earth.
a. $2.5 \mathrm{~km} / \mathrm{s}$
b. $4.0 \mathrm{~km} / \mathrm{s}$
c. $5.6 \mathrm{~km} / \mathrm{s}$
d. $8.7 \mathrm{~km} / \mathrm{s}$
48. For any object orbiting the Sun, Kepler's Law may be written $T^{2}=k r^{3}$. If $T$ is measured in years and $r$ in units of the Earth's distance from the Sun, then $k=1$. What, therefore, is the time (in years) for Mars to orbit the Sun if its mean radius from the Sun is 1.5 times the Earth's distance from the Sun?
a. 1.8 years
b. 2.8 years
c. 3.4 years
d. 4.2 years
49. An asteroid is in orbit at 4 times the earth's distance from the Sun. What is its period of revolution?
a. one fourth year
b. 4 years
c. 8 years
d. 16 years
50. Doubling the mean distance from the Sun results in changing the orbital period of revolution by what factor?
a. $2^{1 / 2}$
b. 2
c. $2^{3 / 2}$
d. $2^{2}$
51. At an altitude of 4 times the radius of the earth, the acceleration due to gravity is
a. $\mathrm{g} / 2$.
b. $g / 4$.
c. $\mathrm{g} / 16$.
d. not given.
52. A wheel is rotated about a horizontal axle at a constant angular speed. Next it is rotated in the opposite direction with the same angular speed. The acceleration at a point on the top of the wheel in the second case as compared to the acceleration in the first case
a. is in the same direction.
b. is in the opposite direction.
c. is upward.
d. is tangential to the wheel.
53. A spool of thread has an average radius of 1.00 cm . If the spool contains 62.8 m of thread, how many turns of thread are on the spool?
a. 100
b. 1000
c. 3140
d. 62800

## Chapter 7 - Answers

| \# | Ans | Difficulty | \# | Ans | Difficulty |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | C | 1 | 34. | D | 2 |
| 2. | B | 1 | 35. | D | 3 |
| 3. | A | 1 | 36. | C | 2 |
| 4. | B | 1 | 37. | B | 2 |
| 5. | C | 2 | 38. | C | 2 |
| 6. | C | 2 | 39. | C | 2 |
| 7. | C | 2 | 40. | B | 2 |
| 8. | D | 2 | 41. | B | 2 |
| 9. | D | 2 | 42. | A | 2 |
| 10. | D | 2 | 43. | D | 2 |
| 11. | C | 2 | 44. | D | 1 |
| 12. | C | 2 | 45. | A | 1 |
| 13. | D | 2 | 46. | C | 2 |
| 14. | D | 2 | 47. | A | 2 |
| 15. | D | 2 | 48. | C | 2 |
| 16. | A | 1 | 49. | A | 1 |
| 17. | A | 1 | 50. | B | 2 |
| 18. | B | 1 | 51. | C | 2 |
| 19. | A | 1 | 52. | A | 2 |
| 20. | C | 1 | 53. | C | 2 |
| 21. | A | 2 | 54. | A | 2 |
| 22. | C | 2 | 55. | B | 3 |
| 23. | B | 2 | 56. | B | 2 |
| 24. | D | 2 | 57. | D | 2 |
| 25. | A | 2 | 58. | A | 2 |
| 26. | C | 2 | 59. | A | 2 |
| 27. | D | 2 | 60. | B | 3 |
| 28. | C | 3 | 61. | B | 2 |
| 29. | A | 3 | 62. | C | 2 |
| 30. | C | 2 | 63. | C | 2 |
| 31. | C | 2 | 64. | D | 3 |
| 32. | C | 2 | 65. | A | 2 |
| 33. | C | 2 | 66. | B | 2 |

