7.1 Angular Measure

1. **MC** The radian unit is equivalent to a ratio of (a) degree/time, (b) length, (c) length/length, (d) length/time.

2. **MC** For the polar coordinates of a particle traveling in a circle, the variables are (a) both r and θ, (b) only r, (c) only θ, (d) none of these.

8. ● Convert the following angles from degrees to radians, to two significant figures: (a) 15°, (b) 45°, (c) 90°, and (d) 120°.

9. ● Convert the following angles from radians to degrees: (a) $\pi/6$ rad, (b) $5\pi/12$ rad, (c) $3\pi/4$ rad, and (d) π rad.

17. ●● At the end of her routine, an ice skater spins through 7.50 revolutions with her arms always fully outstretched at right angles to her body. If her arms are 60.0 cm long, through what linear arc length distance do the tips of her fingers move during her finish?

7.2 Angular Speed and Velocity

21. **MC** Viewed from above, a turntable rotates counterclockwise. The angular velocity vector is then (a) tangential to the turntable's rim, (b) out of the plane of the turntable, (c) counterclockwise, (d) none of the preceding.

22. **MC** The frequency unit of hertz is equivalent to (a) that of the period, (b) that of the cycle, (c) radian/s, (d) s^{-1}.

23. **MC** The particles in a uniformly rotating object all have the same (a) angular acceleration, (b) angular speed, (c) tangential velocity, (d) both (a) and (b).

28. ● A race car makes two and a half laps around a circular track in 3.0 min. What is the car's average angular speed?

29. ● If a particle is rotating with an angular speed of 3.5 rad/s, how long does the particle take to go through one revolution?

36. ●● A little boy jumps onto a small merry-go-round (radius of 2.00 m) in a park and rotates for 2.30 s through an arc length distance of 2.55 m before coming to rest. If he landed (and stayed) at a distance of 1.75 m from the central axis of rotation of the merry-go-round, what was his average angular speed and average tangential speed?

37. ●●● The driver of a car sets the cruise control and ties the steering wheel so that the car travels at a uniform speed of 15 m/s in a circle with a diameter of 120 m. (a) Through what angular distance does the car move in 4.00 min? (b) What linear distance does it travel in this time?

7.3 Uniform Circular Motion and Centripetal Acceleration

39. **MC** Uniform circular motion requires (a) centripetal acceleration, (b) angular speed, (c) tangential velocity, (d) all of the preceding.

40. **MC** In uniform circular motion, there is a (a) constant velocity, (b) constant angular velocity, (c) zero acceleration, (d) nonzero tangential acceleration.

41. **MC** If the centripetal force on a particle in uniform circular motion is increased, (a) the tangential speed will remain constant, (b) the tangential speed will decrease, (c) the radius of the circular path will increase, (d) the tangential speed will increase and/or the radius will decrease.

48. ● A rotating cylinder about 16 km long and 7.0 km in diameter is designed to be used as a space colony. With what angular speed must it rotate so that the residents on it will experience the same acceleration due to gravity on Earth?

49. ●● The Moon revolves around the Earth in 27.3 days in a nearly circular orbit with a radius of 3.8×10^5 km. Assuming that the Moon's orbital motion is a uniform circular motion, what is the Moon's acceleration as it "falls" toward the Earth?

55. ●● A light string of length of 56.0 cm connects two small square blocks, each with a mass of 1.50 kg. The system is placed on a slippery (frictionless) sheet of horizontal ice and spun so the two blocks rotate uniformly about their common center of mass, which itself does not move. They are supposed to rotate with a period of 0.750 s. If the string can exert a force of only 100 N before it breaks, determine whether this string will work.

56. **IE** ●● A jet pilot puts an aircraft with a constant speed into a vertical circular loop. (a) Which is greater, the normal force exerted on the seat by the pilot at the bottom of the loop or that at the top of the loop? Why? (b) If the speed of the aircraft is 700 km/h and the radius of the circle is 2.0 km, calculate the normal forces exerted on the seat by the pilot at the bottom and top of the loop. Express your answer in terms of the pilot's weight, *mg*.

7.4 Angular Acceleration

60. **MC** The angular acceleration in circular motion (a) is equal in magnitude to the tangential acceleration divided by the radius, (b) increases the angular velocity if both angular velocity and angular acceleration are in the same direction, (c) has units of s^{-2}, (d) all of the preceding.

61. **MC** In circular motion, the tangential acceleration (a) does not depend on the angular acceleration, (b) is constant, (c) has units of s^{-2}, (d) none of these.

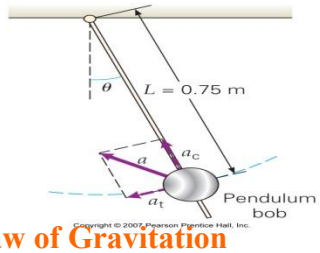
62. **MC** For uniform circular motion, (a) $\alpha = 0$, (b) $\omega = 0$, (c) $r = 0$, (d) none of the preceding.

66. ● During an acceleration, the angular speed of an engine increases from 600 rpm to 2500 rpm in 3.0 s. What is the average

angular acceleration of the engine?

67. ● A merry-go-round accelerating uniformly from rest achieves its operating speed of 2.5 rpm in five revolutions. What is the magnitude of its angular acceleration?

72. ●●● A pendulum swinging in a circular arc under the influence of gravity, as shown in ▼ Fig. 7.32, has both centripetal and tangential components of acceleration. (a) If the pendulum bob has a speed of $2.7\ \text{m/s}$ when the cord makes an angle of $\theta = 15°$ with the vertical, what are the magnitudes of the components at this time? (b) Where is the centripetal acceleration a maximum? What is the value of the tangential acceleration at that location?



7.5 Newton's Law of Gravitation

74. **MC** The gravitational force is (a) a linear function of distance, (b) an inverse function of distance, (c) an inverse function of distance squared, (d) sometimes repulsive.

75. **MC** The acceleration due to gravity of an object on the Earth's surface (a) is a universal constant, like *G*; (b) does not depend on the Earth's mass; (c) is directly proportional to the Earth's radius; (d) does not depend on the object's mass.

76. **MC** Compared with its value on the Earth's surface, the value of the acceleration due to gravity at an altitude of one Earth radius is (a) the same, (b) two times as great, (c) one half as great, (d) one fourth as great.

80. ● From the known mass and radius of the Moon (see the tables inside the back cover of the book), compute the value of the acceleration due to gravity, g_M, at the surface of the Moon.

81. ● Calculate the gravitational force between the Earth and the Moon.

83. ●● Four identical masses of 2.5 kg each are located at the corners of a square with 1.0-m sides. . What is the net force on anyone of the masses?

7.6 Kepler's Laws and Earth Satellites

91. **MC** A new planet is discovered and its period determined. The new planet's distance from the Sun could then be found by using Kepler's (a) first law, (b) second law, (c) third law.

92. **MC** As a planet moves in its elliptical orbit, (a) its speed is constant. (b) its distance from the Sun is constant, (c) it moves faster when it is closer to the Sun, (d) it moves slower when it is closer to the Sun.

93. **MC** If a satellite near the Earth's surface does not have a minimum tangential speed of $11\ \text{km/s}$, it could (a) go into an elliptical orbit, (b) go into a circular orbit, (c) crash into the Earth, (d) all of the preceding.
net force on any one of the masses?

98. ●● In the year 2056, Martian Colony I wants to put a Mars-synchronous communication satellite in orbit about Mars to facilitate communications with the new bases being planned on the Red Planet. At what distance above the Martian equator would this satellite be placed? (To a good approximation, the Martian day is the same length as that of the Earth's.)

102. ●●● A small space probe is put into circular orbit about a newly discovered moon of Saturn. The moon's radius is known to be 550 km. If the probe orbits at a height of 1500 km above the moon's surface and takes 2.00 Earth days to make one orbit, determine the moon's mass.