4. When NASA was communicating with astronauts on the Moon, the time from sending on the Earth to receiving on the moon was 1.33 s. Find the distance from Earth to the Moon. (The speed of radio waves is $3.00 \times 10^8$ m/s.)

a. 240,000 km  
c. 399,000 km  
b. 384,000 km  
d. 768,000 km

16. A railroad train travels forward along a straight track at 80.0 m/s for 1000 m and then travels at 40.0 m/s for the next 1000 m. What is the average velocity?

a. 60.0 m/s  
c. 63.7 m/s  
b. 37.5 m/s  
d. 53.3 m/s

26. A 50-g ball traveling at 25.0 m/s is bounced off a brick wall and rebounds at 20.0 m/s. A high-speed camera records this event. If the ball is in contact with the wall for 3.50 ms, what is the magnitude of the average acceleration of the ball during this time interval?

a. $714 \text{ m/s}^2$  
c. $6430 \text{ m/s}^2$  
b. $1430 \text{ m/s}^2$  
d. $12,900 \text{ m/s}^2$

47. On a position-time graph for a particle, suppose the plot starts at some positive position and as the time goes on the curve gets steeper and steeper while curving upwards. Which of the following must be true?

a. The speed of the particle is constant.  
c. The speed of the particle is decreasing.  
b. The acceleration of the particle is constant.  
d. The acceleration of the particle is positive.

58. An automobile of mass 2000 kg moving at 20 m/s is braked suddenly with a constant braking force of 10,000 N. How far does the car travel before stopping?

a. 40 m  
c. 120 m  
b. 80 m  
d. 160 m
Chapter 3

4. A cheetah can run at approximately 100 km/hr and a gazelle at 80.0 km/hr. If both animals are running at full speed, with the gazelle 60.0 m ahead, how long before the cheetah catches its prey?
   a. 6.30 s   
   b. 21.6 s   
   c. 5.40 s   
   d. 10.8 s

9. A European sports car dealer claims that his product will accelerate at a constant rate from rest to a speed of 100 km/hr in 9.00 s. What distance will the sports car travel during the 9.00 s acceleration period? (Hint: First convert speed to m/s.)
   a. 55.5 m   
   b. 125 m   
   c. 111 m   
   d. 250 m

20. A baseball batter hits an incoming 40 m/s fastball. The ball leaves the bat at 60 m/s after a ball-on-bat contact time of 0.030 s. What is the force exerted on the 0.15 kg baseball?
   a. 450 N   
   b. 250 N   
   c. 90 N   
   d. 500 N

30. Three identical 6.0-kg cubes are placed on a horizontal frictionless surface in contact with one another. The cubes are lined up from left to right and a force is applied to the left side of the left cube causing all three cubes to accelerate to the right at 3.0 m/s^2. What is the magnitude of the force exerted on the middle cube by the left cube in this case?
   a. 18 N   
   b. 27 N   
   c. 54 N   
   d. none of the above

64. A stone is thrown downward from a cliff. Take “up” to be the positive direction. Which of the following statements is true about the stone?
   a. The velocity is negative, the acceleration is negative, and the speed is negative.
   b. The velocity is positive, the acceleration is negative, and the speed is positive.
   c. The velocity is negative, the acceleration is negative, and the speed is positive.
   d. The velocity is positive, the acceleration is positive, and the speed is positive.

68. Find the tension in an elevator cable if the 1000-kg elevator is ascending with an acceleration of 1.2 m/s^2, upward.
   a. 11,000 N   
   b. 9800 N   
   c. 8600 N   
   d. 1200 N
Chapter 4

2. A box of mass \( m \) is placed on an incline with angle of inclination \( \theta \). The box does not slide. The magnitude of the frictional force in this case is:

a. \( \mu_s mg \sin \theta \)

b. \( mg \cos \theta \)

c. \( mg \sin \theta \)

d. not given.

9. A 25-kg traffic light hangs midway on a cable between two poles 40 meters apart. If the sag in the cable is 0.40 meters, what is the tension in each side of the cable?

a. 12,200 N

b. 9800 N

c. 4900 N

d. 6100 N

17. A projectile is fired over a horizontal surface at an angle of elevation of 70°. Neglecting air resistance, what are possible angles in flight between the acceleration vector and the velocity vector?

a. 170° and 40°

b. 120° and 70°

c. 90° and 15°

d. none of the above

41. The highest mountain on Mars is Olympus Mons, rising 22,000 meters above the Martian surface. If we were to throw an object horizontally off the mountain top, how long would it take to reach the surface? Note: Ignore atmospheric drag forces and use \( g_{\text{Mars}} = 3.72 \text{ m/s}^2 \).

a. 1.8 minutes

b. 2.4 minutes

c. 3.0 minutes

d. 0.79 minute

57. Two ropes are attached to a 40-kg object. The first rope applies a force of 50 N and the second, 40 N. If the two ropes are perpendicular to each other, what is the resultant magnitude of the acceleration of the object?

a. 1.2 m/s²

b. 1.6 m/s²

c. 25 m/s²

d. 47 m/s²

74. Dana uses a rope to pull a box that weighs 300 N across a level surface with constant velocity. The rope makes an angle of 30° above the horizontal and the tension in the rope is 50 N. What is the coefficient of friction?

a. 0.35

b. 0.29

c. 0.16

d. 0.20
Chapter 5

6. A ventilation fan has blades 0.50 m long rotating at 20 rpm. What is the centripetal acceleration of a point on the outer tip of a blade?
   a. 1.1 m/s²
   b. 2.2 m/s²
   c. 0.55 m/s²
   d. 3.3 m/s²

11. A 1500-kg car rounds an unbanked curve with a radius of 52 m at a speed of 14 m/s. What minimum coefficient of friction must exist between the road and tires to prevent the car from slipping? (g = 9.8 m/s²)
   a. 0.18
   b. 0.30
   c. 0.28
   d. 0.38

29. If a planet has 9 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? (g = 9.8 m/s²)
   a. 29.4 m/s²
   b. 88.2 m/s²
   c. 265 m/s²
   d. 39.2 m/s²

33. 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

40. At an altitude of 3 times the radius of the Earth, the acceleration due to gravity is
   a. g/3.
   b. g/9.
   c. g/27.
   d. not given.
Chapter 6

7. The area under the force-displacement curve represents:
   a. area.
   b. work.
   c. force.
   d. coefficient of static friction.

10. The net force acting on a 12.6-kg object is given by \( F_x = (8 - x) \) N, where \( F_x \) is in newtons and \( x \) is in meters. How much work is done on the object as it moves from \( x = 0 \) to \( x = 6 \) m?
   a. 64 J
   b. 30 J
   c. 28 J
   d. 24 J

13. A golf ball hits a wall and bounces back at 3/4 the original speed. What part of the original kinetic energy of the ball did it lose in the collision?
   a. 1/4
   b. 3/8
   c. 7/16
   d. 9/16

18. In 1908 there was a huge explosion referred to as the Tunguska event which occurred in Siberia. Apparently this was caused by a very large meteorite, a small asteroid, or a comet colliding with the Earth. If the energy released, estimated at \( 5 \times 10^{16} \) J, were from the kinetic energy of the object, what would have been its approximate mass if its speed had been \( 10^4 \) m/s?
   a. \( 10^5 \) kg
   b. \( 10^9 \) kg
   c. \( 10^{12} \) kg
   d. \( 10^{14} \) kg

25. Samantha pushes a 60-N crate up a ramp 20.0 m in length and inclined at 10° with the horizontal. What potential energy change does the crate experience?
   a. 1200 J
   b. 210 J
   c. 600 J
   d. 300 J

29. A simple pendulum, 2.00 m in length, is released from rest when the support string is at an angle of 35.0° from the vertical. What is the speed of the suspended mass at the bottom of the swing? \( g = 9.80 \) m/s² and ignore air resistance
   a. 0.941 m/s
   b. 1.88 m/s
   c. 2.66 m/s
   d. 1.33 m/s
4. Alex throws a 0.43-kg rubber ball down onto the floor. The ball’s speed just before impact is 6.5 m/s, and just after is 5.5 m/s. What is the magnitude of the change in the ball’s momentum?
   a. 0.09 kg·m/s  
   b. 1.0 kg·m/s  
   c. 4.3 kg·m/s  
   d. 5.2 kg·m/s

7. Object 1 has twice the mass of Object 2. Both objects have the same kinetic energy. Which of the following statements is true?
   a. Both objects can have the same magnitude of momentum.
   b. Object 1 has a momentum of greater magnitude than Object 2.
   c. The magnitude of the momentum of Object 2 is four times that of Object 1.
   d. All the statements are false.

14. The dimensional equivalent of the quantity impulse in terms of the fundamental quantities (mass, length, time) is which of the following?
   a. MLT
   b. ML²T⁻²
   c. ML⁻¹
   d. ML⁻²

18. A crane drops a 0.40-kg steel ball onto a steel plate. The ball’s speeds just before impact and after are 4.5 m/s and 4.2 m/s, respectively. If the ball is in contact with the plate for 0.030 s, what is the magnitude of the average force that the ball exerts on the plate during impact?
   a. 87 N  
   b. 116 N  
   c. 3.0 N  
   d. 3.5 N

29. A 75-kg swimmer dives horizontally off a 250-kg raft initially at rest. If the diver’s speed immediately after leaving the raft is 2 m/s, what is the corresponding raft speed?
   a. 0.2 m/s  
   b. 0.3 m/s  
   c. 0.6 m/s  
   d. 4.0 m/s

36. A 2500-kg truck moving at 10.00 m/s strikes a car waiting at a traffic light, hooking bumpers. The two continue to move together at 6.00 m/s. What was the mass of the struck car?
   a. 1730 kg  
   b. 1670 kg  
   c. 1200 kg  
   d. 1070 kg
65. A lump of clay is thrown at a wall. A rubber ball of identical mass is thrown with the same speed toward the same wall. Which statement is true?

a. The clay experiences a greater change in momentum than the ball.
b. The ball experiences a greater change in momentum than the clay.
c. The clay and the ball experience the same change in momentum.
d. It is not possible to know which object has the greater change in momentum.

80. Three masses are positioned along the x-axis. Their masses and positions are: $m_1 = m$ with $x_1 = 1 \text{ m}$, $m_2 = 2m$ with $x_2 = 2 \text{ m}$, and $m_3 = 3m$ with $x_3 = 3 \text{ m}$. What is the x-coordinate of center of mass of this system?

a. $(14/3) \text{ m}$
b. $(7/3) \text{ m}$
c. $2 \text{ m}$
d. Not enough information is given to answer this question.
Chapter 8

6. A spool of thread has an average radius of 1.00 cm. If the spool contains 126 m of thread, how many turns of thread are on the spool? “Average radius” allows us to not need to treat the layering of threads on lower layers.

a. 100  
   b. 1000  
   c. 2000  
   d. 62,800

9. 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.

21. A 3.0-m rod is pivoted about its left end. A force of 10 N is applied perpendicular to the rod at a distance of 1.2 m from the pivot causing a ccw torque, and a force of 5.2 N is applied at the end of the rod 3.0 m from the pivot. The 5.2-N force is at an angle of 30° to the rod and causes a cw torque. What is the net torque about the pivot? (Take ccw as positive.)

a. 18 N·m  
   b. −18 N·m  
   c. 4.2 N·m  
   d. −4.2 N·m

24. Two children seat themselves on a seesaw. The one on the left has a weight of 400 N while the one on the right weighs 300 N. The fulcrum is at the midpoint of the seesaw. If the child on the right is not at the end but is 1.50 m from the fulcrum and the seesaw is balanced, what is the torque provided by the weight of the child on the left? (Take ccw as positive.)

a. 600 N·m  
   b. 450 N·m  
   c. −600 N·m  
   d. −450 N·m

41. A 4.0-kg mass is placed at (3.0, 4.0) m, and a 7.0-kg mass is placed at (3.0, −4.0) m. What is the moment of inertia of this system of masses about the y axis?

a. 275 kg·m²  
   b. 90 kg·m²  
   c. 176 kg·m²  
   d. 99 kg·m²

63. A 0.40-m radius automobile tire accelerates from rest at a constant 2.0 rad/s² over a 5.0 s interval. What is the tangential component of acceleration for a point on the outer edge of the tire during the 5.0-s interval?

a. 33 m/s²  
   b. 0.80 m/s²  
   c. 0.60 m/s²  
   d. 0.30 m/s²

69. A disk has a moment of inertia of $3.0 \times 10^{-4}$ kg·m² and rotates with an angular speed of 3.5 rad/sec. What net torque must be applied to bring it to rest within 3.7 s?

a. $4.6 \times 10^{-4}$ N·m  
   b. $7.5 \times 10^{-4}$ N·m  
   c. $3.5 \times 10^{-4}$ N·m  
   d. $2.8 \times 10^{-4}$ N·m
2. A ventilation fan with a moment of inertia of 0.034 kg · m² has a net torque of 0.11 N·m applied to it. If it starts from rest, what kinetic energy will it have 10 s later?

a. 31 J  
   b. 18 J  
   c. 11 J  
   d. 6.6 J

6. A gyroscope has a moment of inertia of 0.14 kg · m² and an initial angular speed of 30 rad/s. Friction in the bearings causes its speed to reduce to zero in 30 s. What is the value of the average frictional torque?

a. $3.3 \times 10^{-2}$ N·m  
   b. $8.1 \times 10^{-2}$ N·m  
   c. $14 \times 10^{-2}$ N·m  
   d. $7.0 \times 10^{-2}$ N·m

14. A solid sphere, a solid cylinder, and a hoop each have the same mass and radius. If they are spinning at the same angular velocity, which one has the greatest rotational kinetic energy?

a. the sphere 
   b. the cylinder 
   c. the hoop 
   d. They all have the same rotational kinetic energy.

21. A solid sphere of mass 2.5 kg and radius 0.12 m starts from rest at the top of a ramp inclined 15° and rolls to the bottom. The upper end of the ramp is 1.2 m higher than the lower end. What is the linear speed of the sphere when it reaches the bottom of the ramp? (Note: $I = 0.4MR^2$ for a solid sphere, and $g = 9.8 \text{ m/s}^2$.)

a. 4.1 m/s  
   b. 4.7 m/s  
   c. 3.4 m/s  
   d. 2.4 m/s

34. An ice skater spins at 3.5 rev/s with his arms are extended. He draws his arms in and spins at 8.3 rev/s. By what factor does his moment of inertia change in the process?

a. 2.4  
   b. 0.58  
   c. 0.42  
   d. 0.12

38. A turntable has a moment of inertia of $3.0 \times 10^{-2}$ kg·m² and spins freely on a frictionless bearing at 25 rev/min. A 0.60-kg ball of putty is dropped vertically on the turntable and sticks at a point 0.10 m from the center. By what factor does the kinetic energy of the system change after the putty is dropped onto the turntable?

a. 0.91  
   b. 1.0  
   c. 0.83  
   d. 1.5

48. A 6.0 kg mass in the $xy$ plane is moving in the negative $x$ direction at 3.0 m/s along the line $y = 4.0$ m. As the mass passes the point $(x, y) = (10 \text{ m}, 4.0 \text{ m})$, what is its angular momentum with respect to the $z$ axis?

a. 30 SI units  
   b. 72 SI units  
   c. $-60$ SI units  
   d. $-180$ SI units
Chapter 10

2. The quantity “pressure” expressed in terms of the fundamental quantities (mass, length, time) is equivalent to:

a. $ML^{-1}T^{-1}$

b. $ML^{-1}T^{-2}$

c. $M^2L^{-1}T^{-3}$

d. A dimensionless quantity.

3. The pressure inside a commercial airliner is maintained at 1.00 atm ($10^5$ Pa). What is the net outward force exerted on a 1.0 m × 2.0 m cabin door if the outside pressure is 0.40 atm?

a. 120,000 N

b. 12,000 N

c. 1200 N

d. 120 N

9. A reading of a tire gauge tells you that the gauge pressure in a tire is 30 lb/in$^2$. What is the absolute pressure in the tire? Assume that atmospheric pressure is 14 lb/in$^2$.

a. 30 lb/in$^2$.

b. 16 lb/in$^2$.

c. 44 lb/in$^2$.

d. You can’t be sure since you may have nitrogen-filled tires.

20. How deep under the surface of a lake would the pressure be triple that at the surface? (1 atm = $1.01 \times 10^5$ Pa)

a. 1.00 m

b. 9.80 m

c. 10.3 m

d. 20.6 m
Chapter 10 continued

23. A 15,000-N car on a hydraulic lift rests on a cylinder with a piston of radius 0.20 m. If a connecting cylinder with a piston of 0.050-m radius is driven by compressed air, what force must be applied to this smaller piston in order to lift the car?

   a. 600 N  
   b. 940 N  
   c. 3000 N  
   d. 15,000 N

28. A block of wood has density 0.50 g/cm³ and mass 2250 g. It floats in a container of oil (the oil’s density is 0.75 g/cm³). What volume of oil does the wood displace?

   a. 3000 cm³  
   b. 2250 cm³  
   c. 1500 cm³  
   d. 1000 cm³

57. The Garfield Thomas water tunnel at Pennsylvania State University has a circular cross-section that constricts from a diameter of 3.6 m to the test section, which is 1.2 m in diameter. If the speed of flow is 2.0 m/s in the large-diameter pipe, determine the speed of flow in the test section.

   a. 9.0 m/s  
   b. 18 m/s  
   c. 27 m/s  
   d. 1.0 m/s
Chapter 11

6. If a simple harmonic motion is described by \( x = 4.0 \sin(6.0t) \), what is the period of oscillation and what is the maximum speed during the oscillation? Assume SI units.
   a. \( (\pi / 3) \text{s}, 24 \text{ m/s} \)
   b. \( (1 / 6) \text{s}, (2 / 3) \text{ m/s} \)
   c. \( (12 \pi) \text{s}, (3 / 2) \text{ m/s} \)
   d. \( (\pi / 12) \text{s}, 12 \text{ m/s} \)

11. A large spring requires a force of 100 N to compress it only 0.010 m. What is the spring constant of the spring?
   a. 1.0 N/m
   b. 100 N/m
   c. 10,000 N/m
   d. 100,000 N/m

12. A 0.20-kg object is attached to a spring with spring constant \( k = 10 \text{ N/m} \) and moves with simple harmonic motion over a horizontal, frictionless surface. At the instant that it is displaced from equilibrium by \(-0.060 \text{ m}\), what is its acceleration?
   a. 360 \text{ m/s}^2
   b. \(-30 \text{ m/s}^2\)
   c. 3.0 \text{ m/s}^2
   d. 0.18 \text{ m/s}^2

24. A mass on a spring vibrates in simple harmonic motion at a frequency of 4.0 Hz and amplitude of 8.0 cm. If the mass of the object is 0.25 kg, what is the spring constant?
   a. 40 N/m
   b. 87 N/m
   c. 126 N/m
   d. 158 N/m
38. When an object is moving in simple harmonic motion, which of the following is at a minimum when the displacement from equilibrium is zero?

a. the magnitude of the velocity  
   b. the magnitude of the acceleration
   c. the kinetic energy  
   d. the total mechanical energy

42. A mass of 0.40 kg, hanging from a spring with a spring constant of 160 N/m, is set into an up-and-down simple harmonic motion. What is the speed of the mass when moving through the equilibrium point? The starting displacement from equilibrium is 0.10 m.

a. zero  
   b. 1.4 m/s  
   c. 2.0 m/s  
   d. 3.4 m/s
3. Which of the following media cannot support longitudinal waves?

a. aluminum  

b. air  

c. string  

d. water

6. If the frequency of a traveling wave train is increased by a factor of four in a medium where the speed is constant, which of the following is the result?

a. amplitude is one fourth as big  

b. amplitude is quadrupled  

c. wavelength is quadrupled  

d. wavelength is one fourth as big

10. A musical tone, sounded on a piano, has a frequency of 820 Hz and a wavelength in air of 0.400 m. What is the wave speed?

a. 587 m/s  

b. 328 m/s  

c. 235 m/s  

d. 170 m/s

15. A wave is described by \( y = 10 \sin (4.0 \pi t - 6.0 \pi x) \). If the equation is in SI units with the units suppressed, what is its speed?

a. \( \frac{2}{3} \text{ m/s} \)  

b. \( \frac{3}{2} \text{ m/s} \)  

c. \( \frac{1}{6} \text{ m/s} \)  

d. \( \frac{1}{4} \text{ m/s} \)

20. In SI units, a wave is represented by \( y = 0.8 \sin(200 \pi t - 50x) \). What is the time required for a single wavelength to pass a fixed point by this wave?

a. 200 s  

b. \( \frac{2\pi}{50} \) s  

c. 0.010 s  

d. \( 80\pi \) s

26. A 2.0-m long piano string of mass 40 g is under a tension of 338 N. Find the speed with which a wave travels on this string.

a. 130 m/s  

b. 260 m/s  

c. 520 m/s  

d. 1040 m/s

39. Two water waves meet at the same point, one having a displacement above equilibrium of 60 cm and the other having a displacement above equilibrium of 40 cm. At this moment, what is the resulting displacement above equilibrium?

a. 140 cm  

b. 100 cm  

c. 70 cm  

d. Information about the amplitudes needs to be given to find an answer.
5. Consider a vibrating guitar string that makes a sound wave that moves through the air. As the string moves up and down, the air molecules that are a certain horizontal distance from the string will move:

a. up and down.
b. toward and away from the guitar string.
c. back and forth along the direction of the length of the string.
d. in circles around the guitar string.

8. The frequency separating audible waves and ultrasonic waves is considered to be 20 kHz. What wavelength in air at room temperature is associated with this frequency? (Assume the speed of sound to be 340 m/s.)

a. 0.59 cm  
c. 34 cm
b. 1.7 cm  
d. 55 cm

19. Doubling the power output from a speaker emitting a single frequency will result in what increase in loudness?

a. 0.33 dB  
c. 4.8 dB
b. 3.0 dB  
d. 9.0 dB

29. If the distance between a point sound source and a dB detector is increased by a factor of 10, what will be the reduction in intensity level?

a. 10 dB  
c. 20 dB
b. 16 dB  
d. 32 dB

41. Two loudspeakers are placed facing each other and driven by the same source at 680 Hz. A listener is positioned between the two speakers on the line separating them, thus creating a constructive interference at the listener’s ear. If one of the speakers is gradually pushed toward the listener, how far must it be moved to repeat the condition of constructive interference at the listener's ear? (The speed of sound = 340 m/s.)

a. 0.13 m  
c. 0.50 m
b. 0.25 m  
d. 1.00 m
12. If heat is flowing from a table to a block of ice moving across the table, which of the following must be true?
   a. The table is rough, and there is friction between the table and ice.
   b. The ice is cooler than the table.
   c. The ice is changing phase.
   d. All three are possible, but none is absolutely necessary.

16. Arrange the following units, Calorie, calorie, and Joule from smallest to largest.
   a. Joule, Calorie, calorie
   b. calorie, Calorie, Joule
   c. Joule, calorie, Calorie
   d. Answers a and c are both correct, it apparently is a trick question.

31. A waterfall is 70 m high. What is the increase in water temperature at the bottom of the falls if all the initial potential energy goes into heating the water? \((g = 9.8 \text{ m/s}^2, c_w = 4186 \text{ J/kg·°C})\)
   a. 0.16°C
   b. 0.34°C
   c. 0.69°C
   d. 1.04°C

51. How much heat energy is required to vaporize a 1.0-g ice cube at 0°C? The heat of fusion of ice is 80 cal/g. The heat of vaporization of water is 540 cal/g, and \(c_{water} = 1.00 \text{ cal/g·°C}\).
   a. 620 cal
   b. 720 cal
   c. 820 cal
   d. 1 kcal

63. What happens to a given mass of water as it is cooled from 4°C to zero?
   a. expands
   b. contracts
   c. vaporizes
   d. Neither expands, contracts, nor vaporizes.

114. What temperature increase is necessary to increase the power radiated from an object by a factor of 16?
   a. 8 K
   b. 2 K
   c. 100%
   d. about 68%
7. In the relationship $\Delta P \propto \Delta T$, what scale is used for temperature?
   a. Fahrenheit
   b. Celsius
   c. Kelvin
   d. Both Celsius and Kelvin may be used since the degree size is the same for both.

10. For a quantity of ideal gas, which of the following is constant?
   a. $PTV$
   b. $P/TV$
   c. $PT/V$
   d. $PV/T$

42. If the temperature of a volume of ideal gas increases for 100°C to 200°C, what happens to the average kinetic energy of the molecules?
   a. It halves.
   b. It doubles.
   c. It increases but less than double.
   d. It increases more than double.

44. If the temperature of a gas doubles, by what factor does the speed of a molecule with the average kinetic energy change?
   a. It increases by a factor of 2.
   b. It increases by a factor of $\sqrt{2}$.
   c. It increases by a factor of $2\sqrt{2}$.
   d. It increases by a factor of 4.