Physics Questions

Translational Motion

1. Which of the following numbers is given to four significant figures?

a. 0.00020
b. 0.0020
c. 2.000
d. 2000

2. An auto travels at the rate of 25 km/h for 4.0 minutes, then at 50 km/h for 8.0 minutes, and finally at 20 km/h for 2.0 minutes. Find (a) the total distance covered in km and (b) the average speed for the complete trip in m/s.

a. (a) 540 km, (b) 642 m/s
b. (a) 12.5 km, (b) 38.6 m/s
c. (a) 10.7 km, (b) 126 m/s
d. (a) 9.0 km, (b) 10.7 m/s

3. A body with initial velocity 8.0 m/s moves along a straight line with constant acceleration and travels 640 m in 40 s. For the 40 s interval, find (a) the average velocity, (b) the final velocity, and (c) the acceleration.

a. (a) 4.0 m/s, (b) 8.0 m/s, (c) 0.6 m/s^2
b. (a) 24 m/s, (b) 16 m/s, (c) 0.20 m/s^2
c. (a) 16 m/s, (b) 24 m/s, (c) 0.40 m/s^2
d. (a) 0.4 m/s, (b) 160 m/s, (c) 16 m/s^2

4. A bottle dropped from a balloon reaches the ground in 20 s. Determine the height of the balloon if (a) it was at rest in the air and (b) it was ascending with a speed of 50 m/s when the bottle was dropped.

a. (a) 98 km, (b) 2960 km
b. (a) 196 km, (b) 1960 km
c. (a) 0.49 km, (b) 1000 km
d. (a) 2.0 km, (b) 0.96 km

5. A bug starts at point *A*, crawls 8.0 cm east, then 5.0 cm south, 3.0 cm west, and 4.0 cm north to point *B*. (a) How far north and east is *B* from *A*? (b) Find the displacement from *A* to *B* both graphically and algebraically.

a. (a) 5.0 cm - EAST, 1.0 cm - SOUTH, (b) 5.10 cm - 11.3° SOUTH OF EAST
b. (a) 11.0 cm - EAST, 1.0 cm - SOUTH, (b) 11.1 cm - 5.2° SOUTH OF EAST
c. (a) 5.0 cm - EAST, 1.0 cm - NORTH, (b) 5.1 cm - 11.3° NORTH OF EAST
d. (a) 5.0 cm - EAST, 9.0 cm - SOUTH, (b) 10.1 cm - 60.9° SOUTH OF EAST

6. Compute algebraically the resultant of the following coplanar forces: 100 N at 30 degrees, 141.4 N at 45°, and 100 N at 240°. Check your result graphically.

a. 0.341 kN at 0°
b. 0.335 kN at 45°
c. 0.15 kN at 65°
d. 0.15 kN at 25°

7. A ball is thrown upward at an angle of 30 °; to the horizontal and lands on the top edge of a building that is 20 m away. The top edge is 5.0 m above the throwing point. How fast was the ball thrown?

a. 11 m/s
b. 20 m/s
c. 16 m/s
d. 5230 m/s

8. What displacement at 70 °; has an *x*-component of 450 m? What is its y-component?

a. (a) 1.3 km, (b) 1.2 km
b. (a) 0.48 km, (b) 0.16 km
c. (a) 0.15 km, (b) 0.45 km
d. (c) 0.42 km, (b) 0.42 km

9. A marble dropped from a bridge strikes the water in 5.0 s. Calculate (a) the speed with which it strikes and (b) the height of the bridge.

a. (a) 1.96 m/s, (b) 49 m
b. (a) 49 m/s, (b) 120 m
c. (a) 123 m/s, (b) 245 m
d. (a) 24.5 m/s, (b) 24.5 m

Force and Motion, Gravitation

1. A young South African girl has a mass of 40.0 kg. (a) What is her weight in newtons? (b) If she came to the United States, what would her weight be in pounds as measured on an American scale? Assume g = 9.81 N/kg.

a. (a) 453 N; (b) 88.2 lb
b. (a) 392 N; (b) 88.2 lb
c. (a) 486 N; (b) 80.5 lb
d. (a) 392 N; (b) 80.5 lb
e. (a) 453 N; (b) 101 lb

2. (a) What is the magnitude of the gravitational force that the Earth exerts on the Moon? (b) What is the magnitude of the gravitational force that the Moon exerts on the Earth?

a. (a) 3.12 × 1018 N; (b) twice the force of Earth
b. (a) 1.98 × 1020 N; (b) inversely proportional to the force of Earth
c. (a) 1.98 × 1020 N; (b) the same
d. (a) 1.98 × 1020 N; (b) twice the force of Earth
e. (a) 3.12 × 1018 N; (b) inversely proportional to the force of Earth

3. A sailboat is tied to a mooring with a line. The wind is from the southwest. Identify all the forces acting on the sailboat.

a. 1) the force of gravity; 2) the force of the tide; 3) the force of the wind; 4) the force of the line tied to the mooring
b. 1) the force of gravity; 2) the force of water opposing gravity and the force of water currents; 3) the force of the wind; 4) the force of the line tied to the mooring
c. 1) the force of the water currents; 2) the force of the wind; 3) the force of the line tied to the mooring
d. 1) the force of gravity; 2) the force of the water currents; 3) the weight of the boat

4. A box slides down an incline with uniform acceleration. It starts from rest and attains a speed of 2.7 m/s in 3.0 s. Find (a) the acceleration and (b) the distance moved in the first 6.0 s.

a. (a) 2.22 m/s^2, (b) 16 m
b. (a) 8.1 m/s^2, (b) 2.7 m
c. (a) 0.3 m/s^2, (b) 32.4 m
d. (a) 0.90 m/s^2, (b) 16 m

5. Calculate the velocity of a satellite that is in a circular orbit with a radius of 7.5×10^7 m measured from the center of the earth.

a. 2940 m/s
b. 2130 m/s
c. 1680 m/s
d. 7470 m/s

6. A jetliner traveling at 600 km/h is turning in a circle of radius 2.5 km. What is its centripetal acceleration?

a. 144,000 m/s^2
b. 144 m/s^2
c. 11 m/s^2
d. 4.8 m/s^2

7. A 3.0-kg block is at rest on a horizontal floor. If you push horizontally on the 3.0-kg block with a force of 12.0 N, it just starts to move. (a) What is the coefficient of static friction? (b) A 7.0-kg block is stacked on top of the 3.0-kg block. What is the magnitude F of the force, acting horizontally on the 3.0-kg block as before, that is required to make the two blocks start to move?

a. (a) 0.41 ; (b) 98 N
b. (a) 0.37; (b) 68 N
c. (a) 0.25; (b) 98 N
d. (a) 0.41 ; (b) 40 N
e. (a) 0.37; (b) 40 N

8. The coefficient of static friction between a block and a horizontal floor is 0.40, while the coefficient of kinetic friction is 0.15. The mass of the block is 5.0 kg. If a horizontal force is slowly increased until it is barely enough to make the block start moving, what is the net force on the block the instant that it starts to slide?

a. 12 N
b. 35 N
c. 49 N
d. 20 N

9. A rock is swung on the end of a rope in a horizontal circle at constant speed. The rope breaks. Immediately after the rope breaks, the ball will

a. fall straight down to the ground.
b. move inward toward the center of the circle.
c. move outward normal to the circle from the point the rope broke.
d. move outward tangent to the circle from the point the rope broke.

Equilibrium and Momentum

1. Typically, a tennis ball hit during a serve travels away at about 51 m/s. If the ball is at rest mid-air when struck, and it has a mass of 0.058 kg, what is the change in its momentum on leaving the racket?

a. 3000 kg·m/s
b. 880 kg·m/s
c. 3.0 kg·m/s
d. 29 kg·m/s

2. A 40,000-kg freight car is coasting at a speed of 5.0 m/s along a straight track when it strikes a 30,000-kg stationary freight car and couples to it. What will be their combined speed after impact?

a. 6.7 m/s
b. 2.9 m/s
c. 2.1 m/s
d. 5.0 m/s

3. Two balls of equal mass, moving with speeds of 3 m/s, collide head-on. Find the speed of each after impact if (a) they stick together, (b) the collision is perfectly elastic.

a. (a) 3 m/s, (b) 0 m/s
b. (a) 6 m/s, (b) 6 m/s
c. (a) 0 m/s, (b) each rebounds at 3 m/s
d. (a) 1.5 m/s, (b) 1.5 m/s

4. A force of 200 N acts tangentially on the rim of a wheel 25 cm in radius. (a) Find the torque. (b) Repeat if the force makes an angle of 40°; to a spoke of the wheel.

a. (a) 50 N·m (b) 32 N·m
b. (a) 500 N·m (b) 38 N·m
c. (a) 4.0 N·m (b) 50 N·m
d. (a) 314 N·m (b) 3200 N·m

5. A 500-g wheel that has a moment of inertia of 0.015 kg $\cdot$ m^2 is initially turning at 30 rev/s. It coasts to rest after 163 rev. How large is the torque that slowed it?

a. 0.04 N·m
b. 0.26 N·m
c. 0.09 N·m
d. 4.50 N·m

6. An ice skater is in a fast spin with her arms held tightly to her body. When she extends her arms, which of the following statements is *not* true?

a. She increases her moment of inertia.
b. She decreases her angular speed.
c. Her moment of inertia remains constant.
d. Her total angular momentum remains constant.

7. A 90-g ball moving at 100 cm/s collides head-on with a stationary 10-g ball. Determine the speed of each after impact if (a) they stick together, (b) the collision is perfectly elastic

a. (a) 90 cm/s, (b) 80 cm/s; 1.8 m/s
b. (a) 100 cm/s, (b) 80 cm/s; 20 cm/s
c. (a) 900 cm/s, (b) 90 cm/s; 90 cm/s
d. (a) 50 cm/s, (b) 1110 cm/s; 180 cm/s

8. A turntable rotates through 10 radians in 4 seconds. The turntable experiences uniform acceleration. If the turntable started from rest, what is its angular velocity at the end of the 4 seconds?

a. 2.5 rad/s
b. 5 rad/s
c. 40 rad/s
d. we cannot calculate the answer since the angular acceleration was not given.

9. The torque exerted on the moon by the gravitational pull of the earth is

a. normal to the direction of the moon's path.
b. parallel to the direction of the moon's path.
c. tangent to the imaginary line connecting the earth and the moon.
d. zero.

Work and Energy

1. Just before striking the ground, a 2.0-kg mass has 400 J of KE. If friction can be ignored, from what height was it dropped?

a. 200 m
b. 20.0 m
c. 40.8 m
d. 40.0 m

2. At sea level a nitrogen molecule in the air has an average translational KE of 6.2×10^{-21}J. Its mass is 4.7×10^{-26}kg. (a) If the molecule could shoot straight up without striking other air molecules, how high would it rise? (b) What is the molecule's initial speed?

a. (a) 14 km, (b) 0.51 km/s
b. (a) 1.35×10^{46}, b) 2.64×10^{5}
c. (a) 132 km, (b) 0.36 km/s
d. (a) 7.9×10^{-9}, (b) 0.26 km/s

3. Compute the power output of a machine that lifts a 500-kg crate through a height of 20.0 m in a time of 60.0 s.

a. 1.63 KW
b. 0.082 kW
c. 98 kW
d. 0.167 kW

4. Sam pushes a 10.0-kg sack of bread flour on a frictionless horizontal surface with a constant horizontal force of 2.0 N starting from rest. (a) What is the kinetic energy of the sack after Sam has pushed it a distance of 35 cm? (b) What is the speed of the sack after Sam has pushed it a distance of 35 cm?

a. (a) 0.70 J; (b) 0.37 m/s
b. (a) 7.0 J; (b) 0.37 m/s
c. (a) 0.70 J; (b) 0.21 m/s
d. (a) 7.0 J; (b) 3.5 m/s
e. (a) 3.5 J; (b) 3.5 m/s

5. A 1000-kg auto travels up a 3.0 percent grade at 20 m/s. Find the horsepower required, neglecting friction.

a. 5880 hp
b. 263 hp
c. 7.9 hp
d. 4.4 hp

6. A 4.0-kg object is lifted 1.5 m. (a) How much work is done against the Earth's gravity? (b) Repeat if the object is lowered instead of lifted. How large a force is required to accelerate a 1300-kg car from rest to a speed of 20 m/s in a distance of 80 m?

a. (a) 59 J, (b) -59 J
b. (a) 6 J, (b) -6 J
c. (a) -9 J, (b) 59 J
d. (a) 39 J, (b) -39 J

7. A proton (m = 1.67 x 10^{-27}kg) that has a speed of 5.0 x 10^{6} m/s passes through a metal film of thickness 0.010 mm and emerges with a speed of 2.0 x 10^{6}m/s. How large an average force opposed its motion through the film?

a. 1.8 x 10^{-9} N
b. 7.5 x 10^{-10} N
c. 3.3 x 10^{-10} N
d. 3.5 x 10^{-11} N

8. A 200-kg cart is pushed slowly up an incline. How much work does the pushing force do in moving the cart up to a platform 1.5 m above the starting point of friction is negligible?

a. 1.96 kJ
b. 2.94 kJ
c. 0.30 kJ
d. 44.1 kJ

9. A bead slides on a wire. How large must height h_1 be if the bead, starting at rest at A, is to have a speed of 200 cm/s at point B? Ignore friction.

a. 10.2 cm
b. 20.4 cm
c. 40.8 cm
d. 78.4 cm

Waves and Periodic Motion

1. A pendulum is timed as it swings back and forth. The clock is started when the bob is at the left end of its swing. When the bob returns to the left end for the 90th return, the clock reads 60.0s. (a) What is the period of vibration? (b) What is the frequency of vibration?

a. (a) 1.50 s, (b) 0.667 Hz
b. (a) 0.667 s, (b) 1.50 Hz
c. (a) 60 s, (b) 0.0167 Hz
d. (a) 0.0167 s, (b) 60 Hz

2. A 300-g mass at the end of an ideal spring vibrates up and down in such a way that it is 2.0 cm above the tabletop at its lowest point and 16 cm above at its highest point. Its period is 4.0 s. Determine (a) the amplitude of vibration, (b) the spring constant, (c) the speed and acceleration of the mass when it is 9 cm above the table top, (d) the speed and acceleration of the mass when it is 12 cm above the table-top.

a. (a) 8.0 cm (b) 0.24 N/m (c) 0.14 m/s; zero (d) 0.099 m/s, 2.47 m/s^2
b. (a) 9.0 cm (b) 2.96 N/m (c) -0.22 m/s; zero (d) 0.15 m/s, 1.2 m/s^2
c. (a) 7.0 cm (b) 0.74 N/m (c) 0.11 m/s; zero (d) 0.099 m/s, 0.074 m/s^2
d. (a) 14.0 cm (b) 740 N/m (c) 0.121 m/s; zero (d) 0.07 m/s, 0.074 m/s^2

3. A 300-g mass at the end of a spring executes SHM with a period of 2.4 s. Find the period of oscillation of a 133-g mass attached to the same spring.

a. 1.6 s
b. 0.033 s
c. 24.7 s
d. 0.41 s

4. A certain Hookean spring is stretched 20 cm when a given mass is hung from it. What is the frequency of vibration of the mass if pulled down a little and released?

a. 1.1 Hz
b. 44 Hz
c. 0.11 Hz
d. 7.80 Hz

5. A string 180 cm long resonates in three segments to transverse waves sent down it by a 270 Hz vibrator. What is the speed of the waves on the string?

a. 486 m/s
b. 225 m/s
c. 324 m/s
d. 32400 m/s

6. The higher the frequency of a wave

a. the smaller its speed.
b. the shorter its wavelength.
c. the greater its amplitude.
d. the longer its period.

7. Standing waves are produced by the superposition of two waves with

a. the same amplitude, frequency, and direction of propagation.
b. the same amplitude and frequency, and opposite propagation directions.
c. the same amplitude and direction of propagation, but different frequencies.
d. the same amplitude, different frequencies, and opposite directions of propagation.

8. Two successive transverse pulses, one caused by a brief displacement to the right and the other by a brief displacement to the left, are sent down a Slinky that is fastened at the far end. At the point where the first reflected pulse meets the second advancing pulse, the deflection (compared with that of a single pulse) is

a. quadrupled.
b. doubled.
c. canceled.
d. halved.

9. The intensity of an isotropic sound wave is

a. directly proportional to the distance from the source.
b. inversely proportional to the distance from the source.
c. directly proportional to the square of the distance from the source.
d. inversely proportional to the square of the distance from the source.
e. none of the above.

Sound

1. The average person can hear sound waves ranging in frequency from about 20 Hz to 20 kHz. Determine the wavelengths at these limits, taking the speed of sound to be 340 m/s.

a. 17 m, 1.7 cm
b. 0.059 m, 58.8 cm
c. 6800 m, 6.8×10^6
d. 17m, 0.0017 cm

2. Of these properties of a wave, the one that is independent of the others is its

a. amplitude
b. wavelength
c. speed
d. frequency

3. The speed of waves in a stretched string depends upon which one of the following?

a. The tension in the string
b. The amplitude of the waves
c. The wavelength of the waves
d. The gravitational field strength

4. A moving van and a small car are traveling in the same direction on a two-lane road. The van is moving at twice the speed of the car and overtakes the car. The driver of the car sounds his horn, frequency = 440 Hz, to signal the van that it is safe to return to the lane. Which is the correct statement?

a. The car driver and van driver both hear the horn frequency as 440 Hz.
b. The car driver hears 440 Hz, but the van driver hears a lower frequency.
c. The car driver hears 440 Hz, but the van driver hears a higher frequency.
d. Both drivers hear the same frequency and it is lower than 440 Hz.

5. A long, narrow pipe closed at one end does not resonate to a tuning fork having frequency of 300 Hz until the length of the air column reaches 28 cm. (a) What is the speed of sound in air at the existing room temperature? (b) What is the next length of column that will resonate to the fork?

a. (a) 0.68 km/s, (b) 56 cm
b. (a) 0.27 km/s, (b) 14 cm
c. (a) 0.34 km/s, (b) 84 cm
d. (a) 0.13 km/s, b) 7.3 cm

6. A locomotive moving at 30.0 m/s approaches and passes a person standing beside the track. Its whistle is emitting a note of frequency 2.00 kHz. What frequency will the person hear (a) as the train approaches and (b) as it recedes? The speed of sound is 340 m/s.

a. (a) 1.84 kHz (b) 2.19 kHz
b. (a) 2.19 kHz (b) 1.84 kHz
c. (a) 2.18 kHz (b) 2.18 kHz
d. (a) 1.82 kHz (b) 1.82 kHz

7. What is the speed of sound in air when the air temperature is 31° C

a. 0.313 km/s
b. 0.362 km/s
c. 0.35 km/s
d. 0.332 km/s

8. A sound has an intensity of 5.0×10^{-7} W/m^2. What is the intensity level?

a. 57 dB
b. 5.0×10^6 dB
c. 6.99 dB
d. 50 dB

9. The intensity of a sound wave is directly proportional to

a. the frequency.
b. the amplitude.
c. the square of the amplitude.
d. the square of the speed of sound.
e. none of the above.

Fluids and Solids

1. A metal cube, 2.00 cm on each side, has a density of 6600 kg/m^3. Find its apparent mass when it is totally submerged in water.

a. 0.439 g
b. 8.01 g
c. 12.2 g
d. 44.8 g

2. A certain town receives its water directly from a water tower. If the top of the water in the tower is 26.0 m above the water faucet in a house, what should be the water pressure at the faucet? (Neglect the effects of other water users.)

a. 0.255 kPa
b. 255 kPa
c. 2.65 kPa
d. 127 kPa

3. A solid piece of aluminum (ρ = 2.70 g/cm^3) has a mass of 8.35 g when measured in air. If it is hung from a thread and submerged in a vat of oil (ρ = 0.75 g/cm^3), what will be the tension in the thread?

a. 0.059 N
b. 0.082 N
c. 0.023 N
d. 0.105 N

4. A pipe of varying inner diameter carries water. At point 1 the diameter is 20 cm and the pressure is 130 kPa. At point 2, which is 4.0 m higher than point 1, the diameter is 30 cm. If the flow is 0.080 m^3/s, what is the pressure at the second point?

a. 93 kPa
b. 91 kPa
c. 135 kPa
d. 39 kPa

5. The speed of glycerin flowing in a 5.0 cm i.d. pipe is 0.54 m/s. Find the fluid's speed in a 3.0 cm i.d. pipe that connects with it, both pipes flowing full.

a. 1.5 m/s
b. 0.9 m/s
c. 0.19 m/s
d. 0.32 m/s

6. A large open tank of nonviscous liquid springs a leak 4.5 m below the top of the liquid. What is the theoretical velocity of outflow from the hole? If the area of the hole is $0.25 cm^2$, how much liquid would escape in exactly 1 minute?

a. (a) 9.4 m/s, (b) 0.0141 m^3
b. (a) 88.3 m/s, (b) 0.000235 m^3
c. (a) 3.0 m/s, (b) 2540 m^3
d. (a) 4.7 m/s, (b) 50.8 m^3

7. A container is filled with gas at a pressure of 4.0 × 105 Pa. The container is a cube, 0.10 m on a side, with one side facing south. What is the magnitude and direction of the force on the south side of the container due to the gas inside?

a. 2.0 kN southward
b. 4.0 kN northward
c. 2.0 kN northward
d. 4.0 kN southward

8. At a height of 10 km (33000 ft) above sea level, atmospheric pressure is about 210 mm of mercury. What is the resultant normal force on a 600 cm^2 window of an airplane flying at this height? Assume the pressure inside the plane is 760 mm of mercury. The density of mercury is 13 600 kg/m^3.

a. 6.1 kN
b. 4.4×10^3
c. 1.2×10^3
d. 4.4 kN

9. A glass tube is bent into the form of a U. A 50.0 cm height of olive oil in one arm is found to balance 46.0 cm of water in the other. What is the density of the olive oil?

a. 920 kg/m^3
b. 1080 kg/m^3
c. 230 kg/m^3
d. 0.920 kg/m^3

Electrostatics and Electromagnetism

1. If two equal charges, each of 1 C, were separated in air by a distance of 1 km, what would be the force between them?

a. 9.0 kN repulsion
b. 9.0×10^{9} repulsion
c. 1.0×10^{-6} repulsion
d. 9.0×10^{15} repulsion

2. One charge of (+5.0μC) is placed at exactly x = 0, and a second charge (+7.0μC) at x = 100 cm. Where can a third be placed so as to experience zero net force due to the other two?

a. at x = 5.5 cm
b. at x = 0.42 cm
c. at x = 0.35 cm
d. at x = 46 cm

3. A proton ($q = e$, $m_p = 1.67 \times 10^{-27}$kg) is accelerated from rest through a potential difference of 1.0 MV. What is the final speed?

a. 1.4×10^{7} m/s
b. 1.4×10^{4} m/s
c. 3.5×10^{16} m/s
d. 1.4×10^{-1} m/s

4. An electron has a speed of 6.0×10^{5} m/s as it passes point *A* on its way to point *B*. Its speed at *B* is 12×10^{5} m\s. What is the potential difference between *A* and *B*, and which is at the higher potential?

a. 0.17 V, *B*
b. 4.1 V, *B*
c. 3.1 V, *B*
d. 3.1×10^{-10} V, *B*

5. A straight wire 15 cm long, carrying a current of 6.0 A, is in a uniform field of 0.40 T. What is the force on the wire when it is (a) at right angles to the field and (b) at the 30° to the field?

a. (a) 36 N (b) 0.36 N
b. (a) 0.36 N (b) 0.18 N
c. (a) 2.25 N (b) 0.16 N
d. (a) 0 N (b) 0.72 N

6. Two long parallel wires are 4 cm apart and carry currents of 2 A and 6 A in the same direction. Compute the force between the wires per meter of wire length.

a. 6.0×10^{-7} N/m, attraction
b. 6.0×10^{-5} N/m, attraction
c. 2.5×10^{-6} N/m, attraction
d. 6.0×10^{-5} N/m, repulsion

7. A flat coil with radius 8.0 mm has 50 loops of wire. It is placed in a magnetic field B = 0.30 T in such a way that the maximum flux goes through it. Later, it is rotated in 0.020 s to a position such that no flux goes through it. Find the average emf induced between the terminals of the coil.

a. 0.15 V
b. 15 mV
c. 18.8 V
d. 3.0 mV

8. An electron is traveling horizontally east in Earth's magnetic field. What is the direction of the magnetic force on the particle?

a. Up
b. Down
c. West
d. Zero

9. An ideal solenoid 50 cm long has 4000 loops wound on it. Compute B in its interior when a current of 0.25 A exists in the winding.

a. 10.0 mT
b. 2.5 mT
c. 2.5×10^{-5} T
d. 0.63 mT

Electronic Circuit Elements

1. The potential difference between two large parallel metal plates is 120 V. The plate separation is 3.0 mm. Find the electric field between the plates.

a. 40 V/m toward the negative plate
b. 0.36 V/m toward the negative plate
c. 40 kV/m toward the positive plate
d. 40 kV/m toward negative plate

2. What resistance must be placed in parallel with 20Ω to make the combined resistance 15Ω?

a. 8.57 ohm
b. 60.0 ohm
c. 0.0167 ohm
d. 0.117 ohm

3. A heater is labeled 1600 W/120 V. How much current does the heater draw from a 120-V source?

a. 13.3 A
b. 0.075 A
c. 192 kA
d. 21 kA

4. We desire to measure the current through and the voltage across a resistor connected in a circuit. How should an ammeter and a voltmeter be connected to the resistor?

a. Both are connected in parallel with the resistor.
b. Both are connected in series with the resistor.
c. The ammeter is connected in series and the voltmeter is connected in parallel with the resistor.
d. The ammeter is connected in parallel and the voltmeter is connected in series with the resistor.

5. What is the current through an 8.0-Ω toaster when it is operating on 120 V?

a. 15 A
b. 960 A
c. 0.067 A
d. 1800 A

6. Three resistors, of 8.0 Ω, 12 Ω, and 24 Ω, are in parallel, and a current of 20 A is drawn by the combination. Determine (a) the potential difference across the combination and (b) the current through each resistance.

a. (a) 5.0 V (b) 160 A, 240 A, 480 A
b. (a) 4.0 V (b) 0.1 A, 0.15 A, 0.3 A
c. (a) 0.45 V (b) 640 A, 960 A, 1920 A
d. (a) 80 V (b) 10 A, 6.7 A, 3.3 A

7. A capacitor with air between its plates has capacitance of 3.0μF. What is its capacitance when wax of dielectric constant 2.8 is placed between the plates?

a. 0.93 μF
b. 1.1 μF
c. 25.2 μF
d. 8.4 μF

8. A coil has resistance of 20 Ω and inductance of 0.35 H. Compute its reactance and its impedance to an alternating current of 25 cycles/s.

a. 55Ω, b) 59 Ω
b. 2.2Ω, b) 75 Ω
c. 157Ω, b) 3425 Ω
d. 0.018Ω, b) 51 Ω

Light and Geometrical Optics

1. A double-slit experiment is done in the usual way with 480-nm light and narrow slits that are 0.050 cm apart. At what angle to the straight-through beam will one observe (a) the third-order bright spot and (b) the second minimum from the central maximum?

a. (a) 0.17° (b) 0.083°
b. (a) 0.0017° (b) 0.00083°
c. (a) 0.055° (b) 0.165°
d. (a) 2.88° (b) 0.170°

2. Red light of wavelength 644 nm, from a point source, passes through two parallel and narrow slits which are 1.00 mm apart. Determine the distance between the central bright fringe and the third dark interference fringe formed on a screen parallel to the plane of the slits and 1.00 m away.

a. 1.61 mm
b. 1.93 mm
c. 1.61 μm
d. 2.25 mm

3. A single slit of width 0.140 mm is illuminated by monochromatic light, and diffraction bands are observed on a screen 2.00 m away. If the second dark band is 16.0 mm from the central bright band, what is the wavelength of the light?

a. 560 nm
b. 56 nm
c. 55 mm
d. 1.12 μm

4. Which of the following effects could *not* be observed for sound waves in air?

a. interference
b. refraction
c. polarization
d. diffraction

5. Describe the image of an object positioned 20 cm from a concave spherical mirror of radius 60 cm.

a. virtual, erect, 60 cm in front of mirror, magnified 3 times
b. virtual, erect, 60 cm behind mirror, magnified 3 times
c. virtual, erect, 60 cm behind mirror, magnified -3 times
d. virtual, erect, 12 cm behind mirror, magnified 3 times

6. An object 7.0 cm high is placed 15 cm from a convex spherical mirror of radius 45 cm. Describe its image.

a. virtual, erect, 9.0 cm behind mirror, 4.2 cm high
b. virtual, erect, 45.0 cm behind mirror, 4.2 cm high
c. virtual, erect, 9.0 cm behind mirror, 0.6 cm high
d. virtual, inverted, 9.0 cm behind mirror, 4.2 cm high

7. The speed of light in a certain glass is 1.91×10^8 m/s. What is the refractive index of the glass?

a. 1.57
b. 0.64
c. 1.09
d. 4.9

8. What are the nature and focal length of the lens that will form a real image having one-third the dimensions of an object located 9.0 cm from the lens?

a. diverging, -4.50 cm
b. converging, +2.25 cm
c. converging, +13.5 cm
d. converging, +6.75 cm

9. The solar panels on the roof of a house measure 2.0 m by 6.0 m. Assume they convert 35% of the incident EM wave's energy to electrical energy. (a) What average power do the panels supply when the incident intensity is 1.0 kW/m^2 and the panels are perpendicular to the incident light? (b) What average power do the panels supply when the incident intensity is 0.40 kW/m^2 and the light is incident at an angle of 60.0° from the normal?

a. (a) 4.2 kW; (b) 840 W
b. (a) 4.4 kW; (b) 840 W
c. (a) 4.2 kW; (b) 810 W
d. (a) 4.7 kW; (b) 840 W
e. (a) 4.7 kW; (b) 810 W

Atomic and Nuclear Structure

1. What is the binding energy of an alpha particle (a ^{4}He nucleus)? The mass of an alpha particle is 4.001 51 u.

a. 27.86 MeV
b. 28.33 MeV
c. 27.95 MeV
d. 28.29 MeV

2. The half-life of carbon-14 is 5.7×10^{3} years. What fraction of a sample of ^{14}C will remain unchanged after a period of five half-lives?

a. 0.20
b. 0.10
c. 0.031
d. 0.50

3. By natural radioactivity ^{238}U emits an α-particle. The heavy residual nucleus is called UX_1. UX_1 in turn emits a beta particle. The resultant nucleus is called UX_2. Determine the atomic number and mass number for (a) UX_1 and (b) UX_2.

a. (a) 90, 234 (b) 91, 234
b. (a) 88, 236 (b) 92, 234
c. (a) 91, 237 (b) 91, 233
d. (a) 93, 238 (b) 88, 230

4. Two isotopes of an element have

a. the same number of nucleons in their nuclei.
b. the same number of protons as well as neutrons.
c. the same number of protons but a different number of neutrons.
d. a different number of protons but the same number of neutrons.

5. The wave-particle duality theory is the first to give an adequate explanation of which of the following facts about the hydrogen atom?

a. Why more than one possible orbit exists for the electron.
b. Why only certain energies are possible for the orbiting electron.
c. Why more than one momentum is possible for the orbiting electron.
d. None of these are correct.

6. By how much does the mass of a heavy nucleus change as it emits a 4.8-MeV gamma ray?

a. 5.2×10^{-3} u = 8.6×10^{-30} kg
b. 4.5×10^{3} u = 7.4×10^{-24} kg
c. 1.9×10^{2} u = 3.2×10^{-25} kg
d. 9.4 u = 8.6×10^{-26} kg

7. An electron confined to a one-dimensional box has a ground-state energy of 40.0 eV. (a) If the electron makes a transition from its first excited state to the ground state, what is the wavelength of the emitted photon? (b) If the box were somehow made twice as long, how would the photon's energy change for the same transition (first excited state to ground state)?

a. (a) 10.3 nm; (b) energy reduced to one-half its original value
b. (a) 14.5 nm; (b) energy reduced to one-fourth its original value
c. (a) 13.8 nm; (b) energy reduced to one-fourth its original value
d. (a) 10.3 nm; (b) energy reduced to one-fourth its original value
e. (a) 14.5 nm; (b) energy reduced to one-half its original value

8. The chemical properties of an atom (what element it is) are determined by

a. its atomic number.
b. its mass number.
c. its neutron number.
d. All of these are correct.

9. Cesium-124 has a half-life of 31 s. What fraction of a cesium-124 sample will remain after 0.10 h?

a. 0.086
b. 4.66×10^{-10}
c. 0.00032
d. 0.17

Physics Answers

Translational Motion

1. (c)
2. (d)
3. (c)
4. (d)
5. (a)
6. (d)
7. (b)
8. (a)
9. (b)

Force and Motion, Gravitation

1. (b)
2. (c)
3. (b)
4. (d)
5. (b)
6. (c)
7. (d)
8. (a)
9. (d)

Equilibrium and Momentum

1. (c)
2. (b)
3. (c)
4. (a)
5. (b)
6. (c)
7. (a)

8. (b)
9. (d)

Work and Energy

1. (b)
2. (a)
3. (a)
4. (a)
5. (c)
6. (a)
7. (a)
8. (b)
9. (b)

Waves and Periodic Motion

1. (b)
2. (c)
3. (a)
4. (a)
5. (c)
6. (b)
7. (b)
8. (b)
9. (d)

Sound

1. (a)
2. (a)
3. (a)
4. (b)
5. (c)
6. (b)
7. (c)

8. (a)
9. (c)

Fluids and Solids

1. (d)
2. (b)
3. (a)
4. (a)
5. (a)
6. (a)
7. (d)
8. (d)
9. (a)

Electrostatics and Electromagnetism

1. (a)
2. (d)
3. (a)
4. (c)
5. (c)
6. (b)
7. (a)
8. (a)
9. (b)

Electronic Circuit Elements

1. (d)
2. (b)
3. (a)
4. (c)
5. (a)
6. (d)

7. (d)
8. (a)

Light and Geometrical Optics

1. (a)
2. (a)
3. (a)
4. (c)
5. (b)
6. (a)
7. (a)
8. (b)
9. (a)

Atomic and Nuclear Structure

1. (d)
2. (c)
3. (a)
4. (c)
5. (b)
6. (a)
7. (d)
8. (a)
9. (c)