AP Physics 1 Practice Ladder

Use this key to check answers and read the explanations.

1. A velocity-time graph shows a straight segment from 2 meters per second at 0 seconds to 6 meters per second at 4 seconds. What is the displacement over the segment?

A. 16 meters
B. 8 meters
C. 12 meters
D. 24 meters

Correct answer: A. 16 meters
Displacement is the area under the velocity-time graph. The average velocity on the straight segment is 4 meters per second. Multiply by 4 seconds to get 16 meters.

2. A satellite is moved to twice its original distance from the center of the same planet. What is the new gravitational force on it compared with the original force?

A. Twice as large
B. One-half as large
C. One-quarter as large
D. Four times as large

Correct answer: C. One-quarter as large
The gravitational force depends on the inverse square of center-to-center distance. Doubling that distance makes the force one divided by four of its original value.

3. Two forces act on a board, perpendicular to their lever arms. A force of 3 newtons acts 0.40 meter from the pivot and tends to turn the board counterclockwise. A force of 5 newtons acts 0.20 meter from the pivot and tends to turn the board clockwise. What is the net torque from these forces?

A. 0.20 newton-meter clockwise
B. 0.20 newton-meter counterclockwise
C. 2.20 newton-meters counterclockwise
D. 1.00 newton-meter clockwise

Correct answer: B. 0.20 newton-meter counterclockwise
The torques have magnitudes of 1.20 and 1.00 newton-meters. They oppose each other, so the net torque is 0.20 newton-meter in the direction of the larger torque, counterclockwise.

4. Take east as positive. A 1-kilogram puck moves west at 1 meter per second, then receives an eastward net impulse of 2 newton-seconds. What is its final velocity?

A. 3 meters per second east
B. 1 meter per second west
C. 2 meters per second east
D. 1 meter per second east

Correct answer: D. 1 meter per second east
The puck begins with momentum of negative 1 kilogram-meter per second. The impulse adds 2 in the positive direction, leaving momentum of positive 1. Divide by the mass to find the final velocity.

5. Two connected, open reservoirs contain still water. Their widths differ, but point A and point B are at equal depths below the shared water surface. How do the gauge pressures at the two points compare?

A. Pressure is greater in the wider reservoir.
B. They are equal.
C. Pressure is greater in the narrower reservoir.
D. Both gauge pressures must be zero at any depth.

Correct answer: B. They are equal.
For still water of uniform density, gauge pressure is density times gravitational acceleration times depth. Both points have the same depth, so the widths do not change the pressure comparison.

6. A force in the direction of motion increases linearly from 0 to 12 newtons as an object moves from 0 to 3 meters. The force stays at 12 newtons from 3 to 5 meters. How much work does this force do?

A. 42 joules
B. 24 joules
C. 36 joules
D. 60 joules

Correct answer: A. 42 joules
Work is the area under the force-displacement graph. The triangle contributes one-half times 3 times 12, or 18 joules. The rectangle contributes 2 times 12, or 24 joules.

7. A 1.5-kilogram cart rolls east at 4 meters per second and sticks to a stationary 2.5-kilogram cart. Assume negligible external horizontal impulse. What is their shared velocity?

A. 4 meters per second east
B. 1.5 meters per second west
C. 2.5 meters per second east
D. 1.5 meters per second east

Correct answer: D. 1.5 meters per second east
The system starts with 6 kilogram-meters per second of eastward momentum. The carts move together afterward with a total mass of 4 kilograms. Dividing gives 1.5 meters per second east.

8. Two flywheels spin at the same nonzero angular speed. Their rotational inertias are 0.60 and 0.30 kilogram-meter squared, respectively. How does the first wheel’s rotational kinetic energy compare with the second’s?

A. It is half as large.
B. It is four times as large.
C. It is twice as large.
D. It is the same.

Correct answer: C. It is twice as large.
Rotational kinetic energy is one-half times rotational inertia times angular speed squared. With equal angular speeds, the energies have the same ratio as the rotational inertias.

9. A mass oscillates on an ideal spring. The mass is replaced with one four times as large while the spring constant stays the same. What happens to the period?

A. It doubles.
B. It quadruples.
C. It halves.
D. It becomes one-quarter as long.

Correct answer: A. It doubles.
For an ideal mass-spring oscillator, the period is proportional to the square root of mass when the spring constant is fixed. The square root of four is two.

10. An unattached block of uniform density 750 kilograms per cubic meter floats at rest in water of density 1,000 kilograms per cubic meter. What fraction of the block’s volume is submerged?

A. 4/3
B. 1/4
C. 1/2
D. 3/4

Correct answer: D. 3/4
The buoyant force balances the block’s weight. The fraction submerged is the block’s density divided by the water’s density, which is 750/1,000 or 3/4.

11. A ball is launched horizontally at 5 meters per second from a platform 3.2 meters above a level floor. Use 10 meters per second squared for gravity and ignore air resistance. How far from the platform’s base does the ball land?

A. 5 meters
B. 2.5 meters
C. 4 meters
D. 8 meters

Correct answer: C. 4 meters
The vertical drop equals one-half times gravity times the flight time squared. A 3.2-meter drop takes 0.8 second. The horizontal speed remains 5 meters per second, so the horizontal distance is 4 meters.

12. An 8-newton force acts 0.50 meter from a disk’s axle at an angle of 30 degrees to the radius pointing from the axle to the point of application. The disk’s rotational inertia is 0.40 kilogram-meter squared. With no other torque, what is the magnitude of its angular acceleration?

A. 2 radians per second squared
B. 5 radians per second squared
C. 10 radians per second squared
D. 20 radians per second squared

Correct answer: B. 5 radians per second squared
Only the perpendicular component of force creates torque. The torque is 0.50 times 8 times sine of 30 degrees, or 2 newton-meters. Divide by 0.40 to get 5 radians per second squared.

13. A spinning platform has rotational inertia 2.4 kilogram-meter squared and angular speed 2 radians per second. With negligible external torque, its rotational inertia drops to 0.8 kilogram-meter squared. What happens to its angular speed and rotational kinetic energy?

A. Speed becomes 2/3 radian per second and kinetic energy falls to one third.
B. Speed becomes 6 radians per second and kinetic energy stays the same.
C. Speed becomes 2 radians per second and kinetic energy triples.
D. Speed becomes 6 radians per second and kinetic energy triples.

Correct answer: D. Speed becomes 6 radians per second and kinetic energy triples.
Angular momentum stays at 2.4 times 2, or 4.8 kilogram-meter squared per second. Dividing by 0.8 gives a new speed of 6. In the kinetic-energy formula, inertia falls to one third but speed squared grows by a factor of nine, making the energy three times as large.

14. A 0.50-kilogram mass oscillates on a frictionless horizontal spring with spring constant 200 newtons per meter and amplitude 0.10 meter. What is its speed when it is 0.06 meter from equilibrium?

A. 1.6 meters per second
B. 0.8 meter per second
C. 2.0 meters per second
D. 2.56 meters per second

Correct answer: A. 1.6 meters per second

The total mechanical energy is one-half times 200 times the amplitude squared, or 1.00 joule. At the stated position, spring potential energy is 0.36 joule, leaving 0.64 joule of kinetic energy. Solving for speed gives 1.6 meters per second.

15. Steady, incompressible water flows through a horizontal pipe. The cross section narrows from 4 to 2 square centimeters, and the speed in the wider section is 2 meters per second. Use water density 1,000 kilograms per cubic meter and ignore energy losses. How does pressure change from the wider to the narrower section?

A. It falls by 2,000 pascals.
B. It rises by 6,000 pascals.
C. It falls by 6,000 pascals.
D. It stays the same.

Correct answer: C. It falls by 6,000 pascals.

Halving the area doubles the speed to 4 meters per second. At equal elevation, Bernoulli’s equation gives a pressure drop of one-half times 1,000 times the difference between 4 squared and 2 squared, or 6,000 pascals.