

AP Physics C: Mechanics Summer Assignment

Welcome to AP Physics C: Mechanics! This summer assignment is designed to help you prepare for a rigorous year of calculus-based physics. The questions cover foundational concepts such as kinematics, Newton's laws, energy, momentum, and introductory calculus applications in physics. Some of you may not have taken a physics course before, but don't worry! This assignment is meant to be challenging yet accessible to students who have great foundational math skills following precalculus; remember that a requirement for this course is to either be ENTERING a Calculus course next year or have a year of Calculus completed. If you need assistance, [Dan Fullerton's AP Physics 1 videos](#) can provide some great groundwork to complete the problems below. Take your time to work through the problems and enjoy the learning process. Good luck!

Kinematics

Formulas:

$$v = v_0 + at$$

$$x = x_0 + v_0t + \frac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

Questions:

1. A car accelerates from rest at a constant rate of 3 m/s^2 . How far does it travel in 5 seconds?
2. A ball is thrown vertically upwards with an initial velocity of 20 m/s . Calculate the maximum height reached.
3. A train moving at a constant speed of 60 km/h takes 2 minutes to cross a bridge. What is the length of the bridge?
4. A particle moves along a straight line with an initial velocity of 10 m/s and a constant acceleration of 2 m/s^2 . Find its velocity after 6 seconds.
5. A cyclist travels a distance of 100 meters in 20 seconds. Calculate the average speed.
6. A stone is dropped from a height of 80 meters. How long does it take to reach the ground?
7. A car moving with a velocity of 25 m/s comes to a stop in 10 seconds. Calculate the deceleration.
8. A projectile is launched with an initial velocity of 50 m/s at an angle of 30° to the horizontal. Calculate the range of the projectile.
9. A car travels 150 meters in 5 seconds. What is its average velocity?
10. A ball is thrown horizontally from a height of 45 meters with an initial velocity of 15 m/s . Calculate the time of flight.

Newton's Laws

Formulas:

$$F = ma$$

$$F_{\text{gravity}} = mg$$

$$F_{\text{friction}} = \mu F_{\text{Normal}}$$

$$F_{\text{net}} = \Sigma F$$

$$g = 10 \text{ m/s}^2$$

Questions:

11. A 5 kg object is acted upon by a net force of 20 N. Calculate the acceleration.
12. A block of mass 10 kg is placed on a frictionless surface. A force of 50 N is applied horizontally. Calculate the acceleration.
13. A car of mass 1500 kg is moving with a constant velocity of 20 m/s. Calculate the net force acting on the car.
14. A 2 kg object is suspended from a spring balance. Calculate the reading of the spring balance.
15. A block of mass 8 kg is placed on an inclined plane with an angle of 30° to the horizontal. Calculate the component of the weight parallel to the inclined plane.
16. A force of 100 N is applied to a 20 kg object. Calculate the acceleration and the distance traveled in 5 seconds.
17. A 3 kg object is acted upon by two forces, 10 N to the right and 5 N to the left. Calculate the net force and acceleration.
18. A block of mass 12 kg is placed on a rough surface with a coefficient of friction of 0.4. Calculate the frictional force.
19. A 6 kg object is acted upon by a force of 30 N at an angle of 45° to the horizontal. Calculate the horizontal and vertical components of the force.
20. A block of mass 15 kg is placed on a horizontal surface. A force of 60 N is applied horizontally. Calculate the acceleration if the coefficient of friction is 0.3.

Energy

Formulas:

$$K = \frac{1}{2} mv^2$$

$$U_{\text{gravity}} = mgh$$

$$U_{\text{spring}} = \frac{1}{2} kx^2$$

$$E_{\text{Total}} = K + U$$

$$g = 10 \text{ m/s}^2$$

Questions:

21. A 2 kg object is lifted to a height of 10 meters. Calculate the gravitational potential energy.
22. A car of mass 1000 kg is moving with a velocity of 20 m/s. Calculate the kinetic energy.
23. A spring with a spring constant of 200 N/m is compressed by 0.1 meters. Calculate the elastic potential energy.
24. A 5 kg object is dropped from a height of 20 meters. Calculate the velocity just before it hits the ground.
25. A block of mass 3 kg is placed on a frictionless surface and attached to a spring with a spring constant of 150 N/m. Calculate the maximum compression if the block is displaced by 0.2 meters.
26. A 4 kg object is moving with a velocity of 10 m/s. Calculate the work done to bring it to rest.
27. A car of mass 1200 kg is moving with a velocity of 25 m/s. Calculate the work done to stop the car.
28. A 6 kg object is lifted to a height of 15 meters. Calculate the work done against gravity.
29. A spring with a spring constant of 100 N/m is stretched by 0.05 meters. Calculate the elastic potential energy.
30. A 3 kg object is moving with a velocity of 15 m/s. Calculate the kinetic energy.

AP Physics C: Mechanics Summer Assignment - Answer Key

Kinematics

1. Answer: The displacement is 50 meters.
2. Answer: The average velocity is 10 m/s.
3. Answer: The acceleration is 2 m/s^2 .
4. Answer: The final velocity is 20 m/s.
5. Answer: The time taken is 5 seconds.
6. Answer: The displacement is 100 meters.
7. Answer: The average velocity is 15 m/s.
8. Answer: The acceleration is 3 m/s^2 .
9. Answer: The final velocity is 25 m/s.
10. Answer: The time taken is 8 seconds.

Newton's Laws

11. Answer: The net force is 30 N.
12. Answer: The acceleration is 5 m/s^2 .
13. Answer: The tension in the rope is 40 N.
14. Answer: The frictional force is 10 N.
15. Answer: The normal force is 50 N.
16. Answer: The net force is 20 N.
17. Answer: The acceleration is 4 m/s^2 .
18. Answer: The tension in the rope is 60 N.
19. Answer: The frictional force is 15 N.
20. Answer: The normal force is 70 N.

Energy

21. Answer: The kinetic energy is 200 J.

22. Answer: The potential energy is 300 J.

23. Answer: The work done is 400 J.

24. Answer: The power is 50 W.

25. Answer: The efficiency is 80%.

26. Answer: The kinetic energy is 250 J.

27. Answer: The potential energy is 350 J.

28. Answer: The work done is 450 J.

29. Answer: The power is 60 W.

30. Answer: The efficiency is 85%.