

AP Physics C: Mechanics Practice Test 9

60 original multiple-choice questions covering all 7 AP Physics C: Mechanics units. All questions are calculus-based. Choose one answer for each question. The full answer key is on the last page — worked explanations for every question are free on the test page at QuaidianPoint.com.

Name: _____ Class: _____ Score: _____ / 60

Unit 1: Kinematics

Q1. A cart starts with velocity 4 m/s and has acceleration $a(t) = 4 + 1t \text{ m/s}^2$. What is its velocity at $t = 4 \text{ s}$?

- (A) 28 m/s
- (B) 42 m/s
- (C) 20 m/s
- (D) 36 m/s

Q2. The position of a block is $x(t) = 4t^3 - 2t^2 + 4t$ metres. What is its velocity at $t = 3 \text{ s}$?

- (A) 100 m/s
- (B) 168 m/s
- (C) 50 m/s
- (D) 112 m/s

Q3. A projectile is launched at 30 m/s at 30° above the horizontal. What is its speed at $t = 3 \text{ s}$? Take $g = 9.8 \text{ m/s}^2$.

- (A) 30 m/s
- (B) 35.6 m/s
- (C) 29.7 m/s
- (D) 33.9 m/s

Q4. A particle has velocity $v(t) = 10t - 2t^2 \text{ m/s}$. What is its displacement from $t = 0$ until it first comes to rest again (apart from $t = 0$)?

- (A) 125 m
- (B) 41.7 m
- (C) 20.8 m
- (D) 83.3 m

Q5. A glider experiences acceleration $a = -2v$, where v is its velocity in m/s. It starts at 20 m/s. How far does it travel in the first 2 s?

- (A) 40 m
- (B) 13.7 m
- (C) 9.82 m
- (D) 10 m

Q6. Two runners start from opposite ends of a straight track. Runner A has position $x_A = 2t^2$ m and runner B has position $x_B = 60 - 5t$ m, measured from A's start. At what time do they meet?

- (A) 12 s
- (B) 4.37 s
- (C) 6.55 s
- (D) 5.48 s

Q7. A sled starts from rest with acceleration $a(t) = 2 + 3t$ m/s². How far does it travel in the first 2 s?

- (A) 4 m
- (B) 8 m
- (C) 12 m
- (D) 4.52 m

Unit 2: Force and Translational Dynamics

Q8. A 3 kg crate on a rough floor ($\mu_k = 0.2$) is pushed by a horizontal force of 40 N. What is its acceleration?

- (A) 13.3 m/s²
- (B) 5.69 m/s²
- (C) 15.3 m/s²
- (D) 11.4 m/s²

Q9. A 1 kg bob on a string of length 0.8 m swings in a horizontal circle with the string at 60° to the vertical. What is the tension in the string?

- (A) 9.8 N
- (B) 29.4 N
- (C) 4.9 N
- (D) 19.6 N

Q10. A 3 kg object falls through air with drag force $1v$ N, where v is in m/s. What is its acceleration when its speed is 10 m/s?

- (A) 9.7 m/s²
- (B) 9.8 m/s²
- (C) 6.47 m/s²
- (D) 3.33 m/s²

Q11. Two blocks 3 kg and 3 kg connected by a light string rest on a frictionless table. A horizontal force of 30 N pulls the 3 kg block. What is the tension in the string?

- (A) 15 N
- (B) 30 N
- (C) 33.9 N
- (D) 16.9 N

- Q12. A 0.5 kg mass moves in a horizontal circle of radius 1 m at speed 6 m/s, held by a string. What is the tension in the string?**
- (A) 3 N
 - (B) 36 N
 - (C) 9 N
 - (D) 18 N
- Q13. A 4 kg block slides down a rough incline at 37° to the horizontal. The coefficient of kinetic friction is 0.1. What is its acceleration down the slope?**
- (A) 5.12 m/s^2
 - (B) 6.68 m/s^2
 - (C) 5.9 m/s^2
 - (D) 2.56 m/s^2
- Q14. Two masses 4 kg and 8 kg hang from a light pulley (Atwood machine). What is the magnitude of their acceleration?**
- (A) 5.54 m/s^2
 - (B) 3.27 m/s^2
 - (C) 4.9 m/s^2
 - (D) 6.53 m/s^2
- Q15. A horizontal force of 30 N is applied at 45° above the horizontal to a 3 kg block on a frictionless floor. What is the block's horizontal acceleration?**
- (A) 7.99 m/s^2
 - (B) 7.07 m/s^2
 - (C) 10 m/s^2
 - (D) 10.6 m/s^2
- Q16. A 2 kg object experiences a time-varying force $F(t) = 10 + 5t \text{ N}$. What is its acceleration at $t = 3 \text{ s}$?**
- (A) 27.5 m/s^2
 - (B) 6.25 m/s^2
 - (C) 5 m/s^2
 - (D) 12.5 m/s^2
- Q17. A 2 kg mass hangs at rest from a vertical spring of constant 100 N/m. By how much is the spring stretched from its natural length?**
- (A) 0.098 m
 - (B) 0.02 m
 - (C) 0.392 m
 - (D) 0.196 m
- Q18. A car travels on a flat circular bend of radius 60 m. The coefficient of static friction is 0.6. What is the maximum speed without slipping?**
- (A) 13.3 m/s
 - (B) 24.2 m/s
 - (C) 18.8 m/s
 - (D) 28.2 m/s

Q19. A road is banked so that a car at 25 m/s can round a curve of radius 100 m with no sideways friction. What banking angle is required?

- (A) 57.5°
- (B) 48.8°
- (C) 32.5°
- (D) 16.3°

Unit 3: Work, Energy, and Power

Q20. A motor lifts a 50 kg load through a height of 10 m in 10 s at constant speed. What is the average power output?

- (A) 245 W
- (B) 490 W
- (C) 50 W
- (D) $4.9\text{e}+03$ W

Q21. A force $F(x) = 25 \cos(\pi x/(2 \times 3))$ N, where x is in metres, acts from $x = 0$ to $x = 3$ m. How much work is done? Use $\pi = 3.14$.

- (A) 47.7 J
- (B) 23.9 J
- (C) 95.5 J
- (D) 75 J

Q22. A 2 kg block starts down a frictionless incline at 4 m/s and descends a vertical height of 3 m. What is its speed at the bottom?

- (A) 11.7 m/s
- (B) 8.65 m/s
- (C) 4.32 m/s
- (D) 7.67 m/s

Q23. A force $F(x) = 20 + 6x$ N acts on a particle as it moves from $x = 1$ m to $x = 4$ m along the x -axis. How much work is done?

- (A) 150 J
- (B) 105 J
- (C) 60 J
- (D) 52.5 J

Q24. A variable force $F(x) = 10x^2$ N moves an object from $x = 1$ m to $x = 3$ m. What work is done?

- (A) 40 J
- (B) 43.3 J
- (C) 260 J
- (D) 86.7 J

Q25. A spring of constant 200 N/m is compressed by 0.2 m from equilibrium. How much elastic potential energy is stored?

- (A) 9.04 J
- (B) 8 J
- (C) 4 J
- (D) 20 J

Q26. A net work of 150 J is done on a 4 kg object initially moving at 2 m/s. What is its final speed?

- (A) 8.89 m/s
- (B) 39.5 m/s
- (C) 8.66 m/s
- (D) 13.3 m/s

Q27. A constant force of 20 N pushes an object in the direction of its motion at 3 m/s. What power is delivered?

- (A) 30 W
- (B) 23 W
- (C) 60 W
- (D) 120 W

Q28. An object is dropped from rest from a height of 10 m. Ignoring air resistance, what is its speed just before hitting the ground?

- (A) 14 m/s
- (B) 98 m/s
- (C) 9.9 m/s
- (D) 7 m/s

Q29. A small bead slides on a frictionless vertical loop of radius 3 m. What is the minimum speed it must have at the top of the loop to stay in contact?

- (A) 10.8 m/s
- (B) 5.42 m/s
- (C) 7.67 m/s
- (D) 8.57 m/s

Q30. A 2 kg block attached to a spring ($k = 200 \text{ N/m}$) is released from rest when the spring is compressed 0.3 m. What is its maximum speed?

- (A) 1.5 m/s
- (B) 30 m/s
- (C) 3 m/s
- (D) 10 m/s

Unit 4: Linear Momentum

Q31. A constant force of 30 N acts for 2 s on a 2 kg object already moving at 10 m/s in the force direction. What is its final speed?

- (A) 40 m/s
- (B) 25 m/s
- (C) 70 m/s
- (D) 20 m/s

Q32. A force $F(t) = 10 + 2t \text{ N}$ acts on an object from $t = 0$ to $t = 4 \text{ s}$. What impulse does it deliver?

- (A) 72 N·s
- (B) 40 N·s
- (C) 56 N·s
- (D) 28 N·s

Q33. A force-time graph is a triangle with peak force 100 N and base 0.3 s. What impulse does it deliver?

- (A) 33.9 N·s
- (B) 30 N·s
- (C) 7.5 N·s
- (D) 15 N·s

Q34. A 1 kg ball moving at 8 m/s collides elastically head-on with a stationary 2 kg ball. What is the second ball's velocity after the collision?

- (A) 2.67 m/s
- (B) 5.33 m/s
- (C) -2.67 m/s
- (D) 8 m/s

Q35. A 2 kg cart at 4 m/s catches up and sticks to a 4 kg cart moving at 2 m/s in the same direction. What is their common velocity?

- (A) 4 m/s
- (B) 2.67 m/s
- (C) 0 m/s
- (D) 1.33 m/s

Q36. A 0.01 kg bullet at 100 m/s embeds in a 2 kg wooden block hanging as a pendulum. How high does the block rise?

- (A) 0.0253 m
- (B) 0.0126 m
- (C) 2.54 m
- (D) 0.0285 m

Q37. An object at rest explodes into a 1 kg fragment moving at 6 m/s and a 2 kg fragment. What is the speed of the second fragment?

- (A) 3 m/s
- (B) 12 m/s
- (C) 6 m/s
- (D) 6.78 m/s

Q38. Two masses 2 kg at $x = 1$ m and 6 kg at $x = 6$ m lie on the x-axis. Where is their centre of mass?

- (A) 4.75 m
- (B) 19 m
- (C) 3 m
- (D) 7.12 m

Unit 5: Torque and Rotational Dynamics

Q39. A disk starts with angular velocity 0 rad/s and constant angular acceleration 4 rad/s². Through what angle does it rotate in 3 s?

- (A) 40.7 rad
- (B) 9 rad
- (C) 18 rad
- (D) 36 rad

- Q40. A force of 40 N is applied at a distance 2 m from a pivot, at 60° to the lever arm. What is the torque about the pivot?**
- (A) 40 N·m
 - (B) 139 N·m
 - (C) 69.3 N·m
 - (D) 80 N·m
- Q41. A wheel starts from rest with angular acceleration $\alpha(t) = 2 + 1t \text{ rad/s}^2$. What is its angular velocity at $t = 3 \text{ s}$?**
- (A) 6 rad/s
 - (B) 10.5 rad/s
 - (C) 5.25 rad/s
 - (D) 15 rad/s
- Q42. Point masses 2 kg at 1 m and 3 kg at 1 m from an axis have what total moment of inertia about that axis?**
- (A) $5 \text{ kg}\cdot\text{m}^2$
 - (B) $2.5 \text{ kg}\cdot\text{m}^2$
 - (C) $5.65 \text{ kg}\cdot\text{m}^2$
 - (D) $10 \text{ kg}\cdot\text{m}^2$
- Q43. A uniform rod of mass 4 kg and length 1 m has moment of inertia $0.333 \text{ kg}\cdot\text{m}^2$ about its centre. What is its moment of inertia about a parallel axis 0.5 m from the centre?**
- (A) $2.67 \text{ kg}\cdot\text{m}^2$
 - (B) $1.33 \text{ kg}\cdot\text{m}^2$
 - (C) $1.51 \text{ kg}\cdot\text{m}^2$
 - (D) $0.333 \text{ kg}\cdot\text{m}^2$
- Q44. A net torque of 20 N·m acts on a body with moment of inertia $5 \text{ kg}\cdot\text{m}^2$. What is its angular acceleration?**
- (A) 4 rad/s^2
 - (B) 8 rad/s^2
 - (C) 2 rad/s^2
 - (D) 100 rad/s^2
- Q45. A 2 kg particle moves at 4 m/s at a perpendicular distance 1 m from a point. What is its angular momentum about that point?**
- (A) $8 \text{ kg}\cdot\text{m}^2/\text{s}$
 - (B) $9.04 \text{ kg}\cdot\text{m}^2/\text{s}$
 - (C) $4 \text{ kg}\cdot\text{m}^2/\text{s}$
 - (D) $16 \text{ kg}\cdot\text{m}^2/\text{s}$
- Q46. A flywheel with $I = 6 \text{ kg}\cdot\text{m}^2$ spins at 12 rad/s. A constant opposing torque of 4 N·m is applied. How long until it stops?**
- (A) 36 s
 - (B) 9 s
 - (C) 3 s
 - (D) 18 s

Unit 6: Energy and Momentum of Rotating Systems

Q47. A body with moment of inertia $4 \text{ kg}\cdot\text{m}^2$ rotates at 4 rad/s . What is its rotational kinetic energy?

- (A) 72.3 J
- (B) 8 J
- (C) 64 J
- (D) 32 J

Q48. A disk with $I = 2 \text{ kg}\cdot\text{m}^2$ spinning at 8 rad/s couples to a stationary disk with $I = 4 \text{ kg}\cdot\text{m}^2$ on the same axle, with no external torque. What is their common angular velocity?

- (A) 8 rad/s
- (B) 4 rad/s
- (C) 5.33 rad/s
- (D) 2.67 rad/s

Q49. A satellite orbits Earth at a radius of 9000 km from Earth's centre. What is its orbital speed? ($GM_{\text{Earth}} = 3.99 \times 10^{14} \text{ m}^3/\text{s}^2$.)

- (A) 9.98 km/s
- (B) 3.33 km/s
- (C) 9.41 km/s
- (D) 6.65 km/s

Q50. What is the orbital period, in hours, of a satellite at radius 8000 km from Earth's centre? ($GM_{\text{Earth}} = 3.99 \times 10^{14} \text{ m}^3/\text{s}^2$.)

- (A) 0.989 hours
- (B) 2.97 hours
- (C) 1.98 hours
- (D) 3.96 hours

Q51. A planet has mass 2 times Earth's mass and radius 2 times Earth's radius. What is its escape velocity if Earth's is 11.2 km/s?

- (A) 6.33 km/s
- (B) 15.8 km/s
- (C) 11.2 km/s
- (D) 5.6 km/s

Q52. A 1500 kg satellite orbits at radius 10000 km from Earth's centre. What is the magnitude of its total mechanical energy, in GJ? ($GM_{\text{Earth}} = 3.99 \times 10^{14} \text{ m}^3/\text{s}^2$.)

- (A) 29.9 GJ
- (B) 44.8 GJ
- (C) 59.8 GJ
- (D) 14.9 GJ

Q53. A 150 kg satellite moves from radius 7000 km to radius 28000 km from Earth's centre. By how much does its gravitational potential energy change, in MJ?

- (A) 1.28e+04 MJ
- (B) 7.69e+03 MJ
- (C) 3.2e+03 MJ
- (D) 6.41e+03 MJ

Unit 7: Oscillations

Q54. A mass oscillates with $x(t) = 0.1 \cos(2t)$ m. What is its maximum speed?

- (A) 0.452 m/s
- (B) 0.4 m/s
- (C) 0.05 m/s
- (D) 0.2 m/s

Q55. A 1 kg mass on a spring ($k = 100$ N/m) oscillates horizontally. What is its period?

- (A) 0.1 s
- (B) 0.314 s
- (C) 62.8 s
- (D) 0.628 s

Q56. A simple pendulum of length 1 m oscillates with small amplitude. What is its period?

- (A) 4.01 s
- (B) 19.7 s
- (C) 0.319 s
- (D) 2.01 s

Q57. A 2 kg mass on a spring ($k = 200$ N/m) oscillates with amplitude 0.2 m. What is its speed when its displacement is 0.1 m?

- (A) 1 m/s
- (B) 0.866 m/s
- (C) 1.73 m/s
- (D) 2 m/s

Q58. A particle in SHM obeys $d^2x/dt^2 = -5^2x$. What is the magnitude of its acceleration when its displacement is 0.1 m?

- (A) 1.25 m/s²
- (B) 0.5 m/s²
- (C) 2.5 m/s²
- (D) 5 m/s²

Q59. A 4 kg mass on a spring oscillates with period 2 s. What is the spring constant?

- (A) 632 N/m
- (B) 39.5 N/m
- (C) 9.87 N/m
- (D) 19.7 N/m

Q60. A particle in SHM has $x(t) = 0.3 \cos(2t)$ m. What is its position at $t = 1$ s?

- (A) -0.125 m
- (B) -0.196 m
- (C) 0.273 m
- (D) 0.125 m

Answer Key

Q1: A	Q11: A	Q21: A	Q31: A	Q41: B	Q51: C
-------	--------	--------	--------	--------	--------

Q2: A	Q12: D	Q22: B	Q32: C	Q42: A	Q52: A
Q3: C	Q13: A	Q23: B	Q33: D	Q43: B	Q53: D
Q4: B	Q14: B	Q24: D	Q34: B	Q44: A	Q54: D
Q5: C	Q15: B	Q25: C	Q35: B	Q45: A	Q55: D
Q6: B	Q16: D	Q26: A	Q36: B	Q46: D	Q56: D
Q7: B	Q17: D	Q27: C	Q37: A	Q47: D	Q57: C
Q8: D	Q18: C	Q28: A	Q38: A	Q48: D	Q58: C
Q9: D	Q19: C	Q29: B	Q39: C	Q49: D	Q59: B
Q10: C	Q20: B	Q30: C	Q40: C	Q50: C	Q60: A

Worked explanations for all 60 questions:

quaidianpoint.com/ap-physics-c-mechanics-practice-test-9/ — plus 80 free AP Physics practice tests at [QuaidianPoint.com](https://quaidianpoint.com).