

AP Physics C: Mechanics Practice Test 16

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 particle moves along the x-axis with position $x(t) = 0.8 t^2 + 3.0 t$, where x is in metres and t is in seconds. What is its velocity at $t = 2.2$ s?

- (A) 3.52 m/s
- (B) 4.76 m/s
- (C) 6.52 m/s
- (D) 0.520 m/s

Q2. A particle has velocity $v(t) = 2.9 + 2.5 t + 0.6 t^2$, with v in m/s and t in seconds. What is its displacement from $t = 0$ to $t = 3.1$ s?

- (A) 50.89 m
- (B) 21.00 m
- (C) 14.95 m
- (D) 26.96 m

Q3. A cart starts with velocity 3.5 m/s and has acceleration $a(t) = 3.6 + 0.6 t$, with a in m/s^2 and t in seconds. What is its velocity at $t = 3.2$ s?

- (A) 18.09 m/s
- (B) 21.16 m/s
- (C) 15.02 m/s
- (D) 14.59 m/s

Q4. An object starts from rest at the origin with acceleration $a(t) = 1.5 t^2$, with a in m/s^2 and t in seconds. What is its position at $t = 3.0$ s?

- (A) 13.50 m
- (B) 30.38 m
- (C) 10.12 m
- (D) 5.06 m

Q5. A projectile is launched with horizontal velocity 7.4 m/s and vertical velocity 8.0 m/s. What is its speed at $t = 1.8$ s? Take $g = 9.8 \text{ m/s}^2$.

- (A) 12.15 m/s
- (B) 17.04 m/s
- (C) 10.90 m/s
- (D) 9.64 m/s

Q6. A particle has position $x(t) = 1.1 t^3 - 2.8 t^2$, with x in metres and t in seconds. At what positive time is its velocity zero?

- (A) 0.848 s
- (B) 1.70 s
- (C) 2.55 s
- (D) 5.09 s

Q7. A ball is thrown vertically upward with speed 12.2 m/s from ground level. What is its maximum height? Take $g = 9.8 \text{ m/s}^2$.

- (A) 15.19 m
- (B) 7.59 m
- (C) 1.24 m
- (D) 3.80 m

Unit 2: Force and Translational Dynamics

Q8. A block of mass 2.2 kg on a frictionless surface is acted on by a horizontal force $F(t) = 22 + 4 t$, with F in newtons and t in seconds. What is its acceleration at $t = 3.4 \text{ s}$?

- (A) 16.18 m/s^2
- (B) 8.09 m/s^2
- (C) 10.00 m/s^2
- (D) 35.60 m/s^2

Q9. A block slides down a rough plane inclined at 35 degrees to the horizontal. The coefficient of kinetic friction is 0.25. What is its acceleration down the plane? Take $g = 9.8 \text{ m/s}^2$.

- (A) 5.62 m/s^2
- (B) 7.63 m/s^2
- (C) 8.03 m/s^2
- (D) 3.61 m/s^2

Q10. A horizontal force of 83 N pushes a 11.0 kg crate across a floor with coefficient of kinetic friction 0.2. What is the acceleration of the crate? Take $g = 9.8 \text{ m/s}^2$.

- (A) 7.55 m/s^2
- (B) 9.51 m/s^2
- (C) 1.96 m/s^2
- (D) 5.59 m/s^2

Q11. A 1.3 kg mass is whirled in a horizontal circle of radius 1.0 m at speed 5.5 m/s by a string. What is the tension in the string?

- (A) 39.33 N
- (B) 44.81 N
- (C) 7.15 N
- (D) 12.74 N

Q12. A satellite of mass 852 kg orbits Earth (mass 6.0×10^{24} kg) at a distance of 9.6 million metres from Earth's centre. What is the gravitational force on the satellite? Use $G = 6.67 \times 10^{-11}$ N m²/kg².

- (A) 1850 N
- (B) 7400 N
- (C) 36998 N
- (D) 3700 N

Q13. A 1.7 kg block is held against a spring of spring constant 165 N/m compressed by 0.16 m on a frictionless surface. What is the magnitude of its acceleration the instant it is released?

- (A) 26.40 m/s²
- (B) 15.53 m/s²
- (C) 44.88 m/s²
- (D) 0.094 m/s²

Q14. A person of mass 67.5 kg stands on a scale in a lift accelerating upward at 1.7 m/s². What is the scale reading in newtons? Take $g = 9.8$ m/s².

- (A) 776.2 N
- (B) 661.5 N
- (C) 546.8 N
- (D) 114.8 N

Q15. Two masses 3 kg and 11 kg are connected by a light string over a frictionless pulley. What is the magnitude of their acceleration? Take $g = 9.8$ m/s².

- (A) 7.13 m/s²
- (B) 17.15 m/s²
- (C) 5.60 m/s²
- (D) 9.80 m/s²

Q16. A car travels around a banked curve of radius 5.8 m banked at 30 degrees with no reliance on friction. What speed is required?

- (A) 5.73 m/s
- (B) 7.54 m/s
- (C) 32.82 m/s
- (D) 9.92 m/s

Q17. A 7 kg block on a horizontal table (coefficient of kinetic friction 0.15) is connected by a string over a pulley to a hanging 4 kg block. What is the acceleration of the system? Take $g = 9.8$ m/s².

- (A) 3.56 m/s²
- (B) 2.63 m/s²
- (C) 4.50 m/s²
- (D) 1.47 m/s²

Q18. A skydiver of mass 62.8 kg experiences air resistance $F = bv$ with $b = 10.0$ kg/s. What is the terminal velocity? Take $g = 9.8$ m/s².

- (A) 6154 m/s
- (B) 0.016 m/s
- (C) 7.84 m/s
- (D) 61.54 m/s

Q19. A planet has mass 3.8×10^{23} kg and radius 4.2 million metres. What is the gravitational field strength at its surface? Use $G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$.

- (A) 2.87 m/s^2
- (B) 1.44 m/s^2
- (C) 0.718 m/s^2
- (D) 6034762 m/s^2

Unit 3: Work, Energy, and Power

Q20. A variable force $F(x) = 14 + 11x$, with F in newtons and x in metres, acts on an object as it moves from $x = 0$ to $x = 3.2$ m. How much work is done?

- (A) 44.80 J
- (B) 157.4 J
- (C) 101.1 J
- (D) 80.00 J

Q21. A force $F(x) = 1.5x^2$, with F in newtons and x in metres, pushes an object from $x = 0$ to $x = 2.6$ m. How much work is done?

- (A) 8.79 J
- (B) 26.36 J
- (C) 5.07 J
- (D) 13.18 J

Q22. A spring of constant 249 N/m is stretched from 0.12 m to 0.3 m. How much work is done by the spring force during this stretch? Give the signed work.

- (A) 9.41 J
- (B) 11.21 J
- (C) -9.41 J
- (D) -11.21 J

Q23. A 4.6 kg block moving at 9.8 m/s slides 3.0 m while a constant friction force of 20 N opposes it. What is its final speed?

- (A) 11.05 m/s
- (B) 8.36 m/s
- (C) -3.24 m/s
- (D) 9.80 m/s

Q24. A constant force of 45 N acts in the direction of motion on an object moving at 5.5 m/s. What is the instantaneous power delivered?

- (A) 247.5 W
- (B) 8.18 W
- (C) 50.50 W
- (D) 123.8 W

Q25. A motor delivers power $P(t) = 115 + 25t$, with P in watts and t in seconds. How much work does it do from $t = 0$ to $t = 2.4$ s?

- (A) 348.0 J
- (B) 276.0 J
- (C) 420.0 J
- (D) 336.0 J

Q26. A particle has potential energy $U(x) = 2.8 x^2 + 1.0 x^3$, with U in joules and x in metres. What is the force on the particle at $x = 1.0$ m?

- (A) 8.60 N
- (B) -8.60 N
- (C) -5.60 N
- (D) -3.00 N

Q27. A 2.4 kg block attached to a spring of constant 102 N/m is released from rest with the spring compressed by 0.33 m on a frictionless surface. What is its speed as it passes equilibrium?

- (A) 0.051 m/s
- (B) 14.03 m/s
- (C) 6.52 m/s
- (D) 2.15 m/s

Q28. A 13.5 kg crate is lifted vertically at constant speed through a height of 5.6 m. How much work is done by the lifting force? Take $g = 9.8 \text{ m/s}^2$.

- (A) 132.3 J
- (B) 740.9 J
- (C) 75.60 J
- (D) 370.4 J

Q29. A motor lifts a 50.6 kg load through 3.5 m in 8.6 s at constant speed. What is its average power output? Take $g = 9.8 \text{ m/s}^2$.

- (A) 1736 W
- (B) 14926 W
- (C) 201.8 W
- (D) 57.66 W

Q30. A force $F(x) = 11 + 6 x + 1.5 x^2$, with F in newtons and x in metres, acts from $x = 0$ to $x = 2.1$ m. How much work is done?

- (A) 36.33 J
- (B) 27.73 J
- (C) 40.96 J
- (D) 23.10 J

Unit 4: Linear Momentum

Q31. A time-varying force $F(t) = 26 + 7 t$, with F in newtons and t in seconds, acts from $t = 0$ to $t = 3.5$ s. What is the impulse delivered?

- (A) 91.00 N s
- (B) 176.8 N s
- (C) 133.9 N s
- (D) 115.5 N s

Q32. A force-time graph shows a triangular pulse rising to 87 N and returning to zero over 0.2 s. What is the impulse delivered?

- (A) 17.40 N s
- (B) 4.35 N s
- (C) 8.70 N s
- (D) 5.80 N s

Q33. A 2.7 kg object moving at 2.8 m/s receives an impulse of 23 N s in the direction of motion. What is its final velocity?

- (A) 25.80 m/s
- (B) 64.90 m/s
- (C) 11.32 m/s
- (D) 8.52 m/s

Q34. A 2 kg cart moving at 7.2 m/s collides with and sticks to a stationary 6 kg cart. What is their common velocity after the collision?

- (A) 7.20 m/s
- (B) 2.40 m/s
- (C) 1.80 m/s
- (D) 28.80 m/s

Q35. An object of mass 8 kg at rest explodes into two fragments of masses 4 kg and 4 kg. The 4 kg fragment moves at 5.6 m/s. What is the velocity of the 4 kg fragment?

- (A) 5.60 m/s
- (B) -5.96 m/s
- (C) 6.70 m/s
- (D) -5.60 m/s

Q36. Two carts of masses 2 kg and 2 kg collide and stick together. Their x-velocities before the collision are 5.7 m/s and 0.0 m/s. What is the x-velocity of the combined carts after the collision?

- (A) 5.70 m/s
- (B) 6.81 m/s
- (C) 3.59 m/s
- (D) 2.85 m/s

Q37. Masses 4 kg at $x = 0.5$ m and 5 kg at $x = 3.4$ m lie on the x-axis. What is the x-coordinate of their centre of mass?

- (A) 9.50 m
- (B) 2.11 m
- (C) 1.95 m
- (D) 4.25 m

Q38. A 0.4 kg ball hits a wall at 5.7 m/s and rebounds at 4.6 m/s in the opposite direction. What is the magnitude of the impulse delivered by the wall?

- (A) -0.440 N s
- (B) 1.84 N s
- (C) 4.12 N s
- (D) 2.28 N s

Unit 5: Torque and Rotational Dynamics

- Q39. A force of 20 N is applied at a distance 0.8 m from a pivot, at an angle of 45 degrees to the lever arm. What is the magnitude of the torque about the pivot?**
- (A) 11.31 N m
 - (B) 16.00 N m
 - (C) 13.15 N m
 - (D) 22.63 N m
- Q40. What is the moment of inertia of a uniform rod of mass 5.9 kg and length 1.9 m about an axis through one end perpendicular to the rod?**
- (A) 1.77 kg m^2
 - (B) 7.10 kg m^2
 - (C) 21.30 kg m^2
 - (D) 10.65 kg m^2
- Q41. What is the moment of inertia of a thin hoop of mass 4.6 kg and radius 0.7 m about its central axis?**
- (A) 2.92 kg m^2
 - (B) 1.13 kg m^2
 - (C) 2.25 kg m^2
 - (D) 4.51 kg m^2
- Q42. A net torque of 22 N m acts on an object with moment of inertia 3.0 kg m^2 . What is its angular acceleration?**
- (A) 7.33 rad/s^2
 - (B) 66.00 rad/s^2
 - (C) 25.00 rad/s^2
 - (D) 0.136 rad/s^2
- Q43. A wheel has angular acceleration $\alpha(t) = 2.5 + 0.6 t$, with α in rad/s^2 and t in seconds, and initial angular velocity 3.6 rad/s . What is its angular velocity at $t = 2.1 \text{ s}$?**
- (A) 11.50 rad/s
 - (B) 8.85 rad/s
 - (C) 10.17 rad/s
 - (D) 6.57 rad/s
- Q44. An object has moment of inertia 3.0 kg m^2 about its centre of mass. What is its moment of inertia about a parallel axis 0.8 m away if its mass is 4.0 kg?**
- (A) 5.56 kg m^2
 - (B) 6.20 kg m^2
 - (C) 3.00 kg m^2
 - (D) 2.56 kg m^2
- Q45. A horizontal beam is pivoted at its left end. A weight of 143 N hangs 1.1 m from the pivot, and an upward force is applied at the right end 3.1 m from the pivot. What upward force balances the beam?**
- (A) 403.0 N
 - (B) 143.0 N
 - (C) 157.3 N
 - (D) 50.74 N

Q46. A disc with moment of inertia 5.1 kg m^2 undergoes angular acceleration 3.0 rad/s^2 . What net torque acts on it?

- (A) 1.70 N m
- (B) 8.10 N m
- (C) 30.60 N m
- (D) 15.30 N m

Unit 6: Energy and Momentum of Rotating Systems

Q47. A rotating object has moment of inertia 2.6 kg m^2 and angular velocity 5.1 rad/s . What is its rotational kinetic energy?

- (A) 67.63 J
- (B) 6.63 J
- (C) 13.26 J
- (D) 33.81 J

Q48. A spinning skater with moment of inertia 4.6 kg m^2 rotates at 3.2 rad/s , then pulls in her arms so her moment of inertia becomes 1.4 kg m^2 . What is her new angular velocity? Neglect external torques.

- (A) 10.51 rad/s
- (B) 0.974 rad/s
- (C) 3.20 rad/s
- (D) 14.72 rad/s

Q49. A solid cylinder of mass 3.7 kg rolls without slipping at speed 6.7 m/s . What is its total kinetic energy? For a solid cylinder $I = 0.5MR^2$.

- (A) 124.6 J
- (B) 83.05 J
- (C) 166.1 J
- (D) 18.59 J

Q50. What is the orbital speed of a satellite in a circular orbit 11.4 million metres from Earth's centre? Earth mass = $6.0 \times 10^{24} \text{ kg}$, $G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$.

- (A) 8887 m/s
- (B) 35105263 m/s
- (C) 2962 m/s
- (D) 5925 m/s

Q51. What is the orbital period of a satellite in a circular orbit 8.9 million metres from Earth's centre? Earth mass = $6.0 \times 10^{24} \text{ kg}$, $G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$.

- (A) 4170 s
- (B) 8339 s
- (C) 16678 s
- (D) 0.001 s

Q52. What is the escape velocity from a distance of 11.1 million metres from Earth's centre? Earth mass = $6.0 \times 10^{24} \text{ kg}$, $G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$.

- (A) 6005 m/s
- (B) 8492 m/s
- (C) 4246 m/s
- (D) 12009 m/s

Q53. A 1.0 kg particle moves at 6.7 m/s on a line whose perpendicular distance from a fixed point is 0.7 m. What is its angular momentum about that point?

- (A) 6.70 kg m²/s
- (B) 4.69 kg m²/s
- (C) 0.700 kg m²/s
- (D) 5.67 kg m²/s

Unit 7: Oscillations

Q54. A 0.8 kg mass on a spring of constant 78 N/m oscillates on a frictionless surface. What is its period?

- (A) 62.04 s
- (B) 0.101 s
- (C) 0.636 s
- (D) 0.064 s

Q55. A simple pendulum of length 0.7 m undergoes small oscillations. What is its period? Take $g = 9.8 \text{ m/s}^2$.

- (A) 23.51 s
- (B) 1.68 s
- (C) 0.267 s
- (D) 0.449 s

Q56. A mass of 0.6 kg on a spring of constant 30 N/m oscillates with amplitude 0.1 m. What is its maximum speed?

- (A) 0.354 m/s
- (B) 1.41 m/s
- (C) 0.014 m/s
- (D) 0.707 m/s

Q57. An oscillator with amplitude 0.26 m and angular frequency 3.77 rad/s is at displacement 0.13 m from equilibrium. What is its speed there?

- (A) 0.980 m/s
- (B) 0.490 m/s
- (C) 1.10 m/s
- (D) 0.849 m/s

Q58. A mass of 1.1 kg on a spring of constant 73 N/m oscillates with amplitude 0.17 m. What is its maximum acceleration?

- (A) 11.28 m/s²
- (B) 1.38 m/s²
- (C) 66.36 m/s²
- (D) 0.692 m/s²

Q59. A physical pendulum has moment of inertia 1.4 kg m² about its pivot, mass 1.6 kg, and its centre of mass is 0.3 m from the pivot. What is its period for small oscillations? Take $g = 9.8 \text{ m/s}^2$.

- (A) 11.52 s
- (B) 0.546 s
- (C) 1.87 s
- (D) 3.43 s

Q60. A mass of 1.3 kg on a spring of constant 62 N/m oscillates as $x = A \sin(\omega t)$, starting from equilibrium. How long does it first take to reach $x = A/2$?

- (A) 0.227 s
- (B) 0.076 s
- (C) 0.152 s
- (D) 0.455 s

Answer Key

Q1: C	Q11: A	Q21: A	Q31: C	Q41: C	Q51: B
Q2: D	Q12: D	Q22: C	Q32: C	Q42: A	Q52: B
Q3: A	Q13: B	Q23: B	Q33: C	Q43: C	Q53: B
Q4: C	Q14: A	Q24: A	Q34: C	Q44: A	Q54: C
Q5: A	Q15: C	Q25: A	Q35: D	Q45: D	Q55: B
Q6: B	Q16: A	Q26: B	Q36: D	Q46: D	Q56: D
Q7: B	Q17: B	Q27: D	Q37: B	Q47: D	Q57: D
Q8: A	Q18: D	Q28: B	Q38: C	Q48: A	Q58: A
Q9: D	Q19: B	Q29: C	Q39: A	Q49: A	Q59: D
Q10: D	Q20: C	Q30: C	Q40: B	Q50: D	Q60: B

Worked explanations for all 60 questions:

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