

AP Physics C: Mechanics Practice Test 17

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 $x(t) = 2.5 t^2 + 2.1 t$, where x is in metres and t is in seconds. What is its velocity at $t = 5.0$ s?

- (A) 27.10 m/s
- (B) 25.00 m/s
- (C) 14.60 m/s
- (D) 22.90 m/s

Q2. A particle has velocity $v(t) = 3.1 + 1.3 t + 0.8 t^2$, with v in m/s and t in seconds. What is its displacement from $t = 0$ to $t = 3.7$ s?

- (A) 33.88 m
- (B) 69.79 m
- (C) 20.37 m
- (D) 24.98 m

Q3. A cart starts with velocity 2.0 m/s and has acceleration $a(t) = 1.8 + 1.3 t$, with a in m/s^2 and t in seconds. What is its velocity at $t = 2.0$ s?

- (A) 8.20 m/s
- (B) 10.80 m/s
- (C) 5.60 m/s
- (D) 6.20 m/s

Q4. An object starts from rest at the origin with acceleration $a(t) = 1.3 t^2$, with a in m/s^2 and t in seconds. What is its position at $t = 2.0$ s?

- (A) 3.47 m
- (B) 1.73 m
- (C) 5.20 m
- (D) 0.867 m

Q5. A projectile is launched with horizontal velocity 14.8 m/s and vertical velocity 10.4 m/s. What is its speed at $t = 2.5$ s? Take $g = 9.8 \text{ m/s}^2$.

- (A) 20.44 m/s
- (B) 28.90 m/s
- (C) 18.09 m/s
- (D) 14.10 m/s

Q6. A particle has position $x(t) = 0.6 t^3 - 3.9 t^2$, with x in metres and t in seconds. At what positive time is its velocity zero?

- (A) 2.17 s
- (B) 4.33 s
- (C) 6.50 s
- (D) 13.00 s

Q7. A ball is thrown vertically upward with speed 19.6 m/s from ground level. What is its maximum height? Take $g = 9.8 \text{ m/s}^2$.

- (A) 39.20 m
- (B) 19.60 m
- (C) 2.00 m
- (D) 9.80 m

Unit 2: Force and Translational Dynamics

Q8. A block of mass 3.7 kg on a frictionless surface is acted on by a horizontal force $F(t) = 20 + 4 t$, with F in newtons and t in seconds. What is its acceleration at $t = 2.2 \text{ s}$?

- (A) 3.89 m/s^2
- (B) 5.41 m/s^2
- (C) 7.78 m/s^2
- (D) 28.80 m/s^2

Q9. A block slides down a rough plane inclined at 25 degrees to the horizontal. The coefficient of kinetic friction is 0.2. What is its acceleration down the plane? Take $g = 9.8 \text{ m/s}^2$.

- (A) 2.37 m/s^2
- (B) 4.14 m/s^2
- (C) 5.92 m/s^2
- (D) 8.88 m/s^2

Q10. A horizontal force of 65 N pushes a 7.7 kg crate across a floor with coefficient of kinetic friction 0.19. What is the acceleration of the crate? Take $g = 9.8 \text{ m/s}^2$.

- (A) 6.58 m/s^2
- (B) 8.44 m/s^2
- (C) 10.30 m/s^2
- (D) 1.86 m/s^2

Q11. A 1.3 kg mass is whirled in a horizontal circle of radius 1.5 m at speed 5.6 m/s by a string. What is the tension in the string?

- (A) 40.77 N
- (B) 4.85 N
- (C) 12.74 N
- (D) 27.18 N

Q12. A satellite of mass 891 kg orbits Earth (mass 6.0×10^{24} kg) at a distance of 10.0 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) 1783 N
- (B) 3566 N
- (C) 7132 N
- (D) 35658 N

Q13. A 2.9 kg block is held against a spring of spring constant 172 N/m compressed by 0.14 m on a frictionless surface. What is the magnitude of its acceleration the instant it is released?

- (A) 24.08 m/s²
- (B) 69.83 m/s²
- (C) 0.048 m/s²
- (D) 8.30 m/s²

Q14. A person of mass 88.0 kg stands on a scale in a lift accelerating upward at 1.2 m/s². What is the scale reading in newtons? Take $g = 9.8$ m/s².

- (A) 862.4 N
- (B) 756.8 N
- (C) 968.0 N
- (D) 105.6 N

Q15. Two masses 4 kg and 9 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) 5.44 m/s²
- (B) 25.48 m/s²
- (C) 9.80 m/s²
- (D) 3.77 m/s²

Q16. A car travels around a banked curve of radius 7.8 m banked at 45 degrees with no reliance on friction. What speed is required?

- (A) 10.25 m/s
- (B) 76.44 m/s
- (C) 8.74 m/s
- (D) 11.95 m/s

Q17. A 4 kg block on a horizontal table (coefficient of kinetic friction 0.21) is connected by a string over a pulley to a hanging 5 kg block. What is the acceleration of the system? Take $g = 9.8$ m/s².

- (A) 5.44 m/s²
- (B) 6.36 m/s²
- (C) 2.06 m/s²
- (D) 4.53 m/s²

Q18. A skydiver of mass 64.4 kg experiences air resistance $F = bv$ with $b = 11.2$ kg/s. What is the terminal velocity? Take $g = 9.8$ m/s².

- (A) 7069 m/s
- (B) 56.35 m/s
- (C) 0.018 m/s
- (D) 7.51 m/s

Q19. A planet has mass 6.4×10^{23} kg and radius 6.4 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) 2.08 m/s^2
- (B) 0.521 m/s^2
- (C) 6670000 m/s^2
- (D) 1.04 m/s^2

Unit 3: Work, Energy, and Power

Q20. A variable force $F(x) = 23 + 5x$, with F in newtons and x in metres, acts on an object as it moves from $x = 0$ to $x = 4.0$ m. How much work is done?

- (A) 92.00 J
- (B) 172.0 J
- (C) 112.0 J
- (D) 132.0 J

Q21. A force $F(x) = 1.9x^2$, with F in newtons and x in metres, pushes an object from $x = 0$ to $x = 2.3$ m. How much work is done?

- (A) 23.12 J
- (B) 7.71 J
- (C) 5.03 J
- (D) 11.56 J

Q22. A spring of constant 237 N/m is stretched from 0.07 m to 0.34 m. How much work is done by the spring force during this stretch? Give the signed work.

- (A) 13.12 J
- (B) -13.12 J
- (C) 13.70 J
- (D) -13.70 J

Q23. A 3.0 kg block moving at 7.6 m/s slides 2.1 m while a constant friction force of 10 N opposes it. What is its final speed?

- (A) 8.47 m/s
- (B) 6.62 m/s
- (C) 0.600 m/s
- (D) 7.60 m/s

Q24. A constant force of 32 N acts in the direction of motion on an object moving at 3.2 m/s. What is the instantaneous power delivered?

- (A) 102.4 W
- (B) 10.00 W
- (C) 35.20 W
- (D) 51.20 W

Q25. A motor delivers power $P(t) = 95 + 23t$, with P in watts and t in seconds. How much work does it do from $t = 0$ to $t = 3.8$ s?

- (A) 527.1 J
- (B) 361.0 J
- (C) 693.1 J
- (D) 448.4 J

Q26. A particle has potential energy $U(x) = 4.4 x^2 + 0.7 x^3$, with U in joules and x in metres. What is the force on the particle at $x = 1.5$ m?

- (A) -17.93 N
- (B) 17.93 N
- (C) -13.20 N
- (D) -4.72 N

Q27. A 1.6 kg block attached to a spring of constant 169 N/m is released from rest with the spring compressed by 0.16 m on a frictionless surface. What is its speed as it passes equilibrium?

- (A) 0.016 m/s
- (B) 16.90 m/s
- (C) 1.64 m/s
- (D) 10.28 m/s

Q28. A 7.9 kg crate is lifted vertically at constant speed through a height of 2.5 m. How much work is done by the lifting force? Take $g = 9.8 \text{ m/s}^2$.

- (A) 193.6 J
- (B) 77.42 J
- (C) 19.75 J
- (D) 96.78 J

Q29. A motor lifts a 37.3 kg load through 5.8 m in 4.6 s at constant speed. What is its average power output? Take $g = 9.8 \text{ m/s}^2$.

- (A) 2120 W
- (B) 9753 W
- (C) 79.47 W
- (D) 460.9 W

Q30. A force $F(x) = 18 + 4 x + 0.8 x^2$, with F in newtons and x in metres, acts from $x = 0$ to $x = 3.2$ m. How much work is done?

- (A) 78.08 J
- (B) 66.34 J
- (C) 86.82 J
- (D) 57.60 J

Unit 4: Linear Momentum

Q31. A time-varying force $F(t) = 22 + 8 t$, with F in newtons and t in seconds, acts from $t = 0$ to $t = 2.6$ s. What is the impulse delivered?

- (A) 57.20 N s
- (B) 111.3 N s
- (C) 78.00 N s
- (D) 84.24 N s

Q32. A force-time graph shows a triangular pulse rising to 76 N and returning to zero over 0.4 s. What is the impulse delivered?

- (A) 30.40 N s
- (B) 7.60 N s
- (C) 15.20 N s
- (D) 10.13 N s

Q33. A 3.2 kg object moving at 2.1 m/s receives an impulse of 27 N s in the direction of motion. What is its final velocity?

- (A) 29.10 m/s
- (B) 88.50 m/s
- (C) 8.44 m/s
- (D) 10.54 m/s

Q34. A 3 kg cart moving at 7.5 m/s collides with and sticks to a stationary 3 kg cart. What is their common velocity after the collision?

- (A) 3.75 m/s
- (B) 7.50 m/s
- (C) 8.84 m/s
- (D) 15.00 m/s

Q35. An object of mass 12 kg at rest explodes into two fragments of masses 4 kg and 8 kg. The 4 kg fragment moves at 3.7 m/s. What is the velocity of the 8 kg fragment?

- (A) 1.85 m/s
- (B) -1.85 m/s
- (C) -3.70 m/s
- (D) 7.40 m/s

Q36. Two carts of masses 4 kg and 4 kg collide and stick together. Their x-velocities before the collision are 5.0 m/s and -1.7 m/s. What is the x-velocity of the combined carts after the collision?

- (A) 3.30 m/s
- (B) 4.10 m/s
- (C) 1.65 m/s
- (D) 3.35 m/s

Q37. Masses 5 kg at $x = 0.9$ m and 4 kg at $x = 4.9$ m lie on the x-axis. What is the x-coordinate of their centre of mass?

- (A) 12.05 m
- (B) 2.90 m
- (C) 2.68 m
- (D) 3.92 m

Q38. A 0.7 kg ball hits a wall at 4.3 m/s and rebounds at 3.6 m/s in the opposite direction. What is the magnitude of the impulse delivered by the wall?

- (A) -0.490 N s
- (B) 5.53 N s
- (C) 2.52 N s
- (D) 3.01 N s

Unit 5: Torque and Rotational Dynamics

Q39. A force of 47 N is applied at a distance 0.9 m from a pivot, at an angle of 30 degrees to the lever arm. What is the magnitude of the torque about the pivot?

- (A) 21.15 N m
- (B) 42.30 N m
- (C) 36.63 N m
- (D) 84.60 N m

Q40. What is the moment of inertia of a uniform rod of mass 3.8 kg and length 2.2 m about an axis through one end perpendicular to the rod?

- (A) 1.53 kg m^2
- (B) 6.13 kg m^2
- (C) 18.39 kg m^2
- (D) 9.20 kg m^2

Q41. What is the moment of inertia of a thin hoop of mass 4.1 kg and radius 0.6 m about its central axis?

- (A) 1.48 kg m^2
- (B) 2.04 kg m^2
- (C) 0.738 kg m^2
- (D) 2.95 kg m^2

Q42. A net torque of 23 N m acts on an object with moment of inertia 3.0 kg m^2 . What is its angular acceleration?

- (A) 69.00 rad/s^2
- (B) 7.67 rad/s^2
- (C) 26.00 rad/s^2
- (D) 0.130 rad/s^2

Q43. A wheel has angular acceleration $\alpha(t) = 1.3 + 0.9 t$, with α in rad/s^2 and t in seconds, and initial angular velocity 1.2 rad/s . What is its angular velocity at $t = 3.8 \text{ s}$?

- (A) 19.14 rad/s
- (B) 6.14 rad/s
- (C) 12.64 rad/s
- (D) 11.44 rad/s

Q44. An object has moment of inertia 1.5 kg m^2 about its centre of mass. What is its moment of inertia about a parallel axis 0.5 m away if its mass is 2.5 kg?

- (A) 2.75 kg m^2
- (B) 1.50 kg m^2
- (C) 0.625 kg m^2
- (D) 2.12 kg m^2

Q45. A horizontal beam is pivoted at its left end. A weight of 94 N hangs 1.3 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) 224.2 N
- (B) 94.00 N
- (C) 122.2 N
- (D) 39.42 N

Q46. A disc with moment of inertia 2.4 kg m^2 undergoes angular acceleration 2.3 rad/s^2 . What net torque acts on it?

- (A) 1.04 N m
- (B) 4.70 N m
- (C) 5.52 N m
- (D) 11.04 N m

Unit 6: Energy and Momentum of Rotating Systems

Q47. A rotating object has moment of inertia 4.3 kg m^2 and angular velocity 4.2 rad/s . What is its rotational kinetic energy?

- (A) 37.93 J
- (B) 75.85 J
- (C) 9.03 J
- (D) 18.06 J

Q48. A spinning skater with moment of inertia 2.3 kg m^2 rotates at 4.9 rad/s , then pulls in her arms so her moment of inertia becomes 1.5 kg m^2 . What is her new angular velocity? Neglect external torques.

- (A) 3.20 rad/s
- (B) 7.51 rad/s
- (C) 4.90 rad/s
- (D) 11.27 rad/s

Q49. A solid cylinder of mass 2.4 kg rolls without slipping at speed 4.8 m/s . What is its total kinetic energy? For a solid cylinder $I = 0.5MR^2$.

- (A) 27.65 J
- (B) 55.30 J
- (C) 41.47 J
- (D) 8.64 J

Q50. What is the orbital speed of a satellite in a circular orbit 11.6 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) 8811 m/s
- (B) 5874 m/s
- (C) 34500000 m/s
- (D) 2937 m/s

Q51. What is the orbital period of a satellite in a circular orbit 14.1 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) 8315 s
- (B) 16629 s
- (C) 33258 s
- (D) 0.001 s

Q52. What is the escape velocity from a distance of 7.3 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) 7404 m/s
- (B) 5236 m/s
- (C) 14808 m/s
- (D) 10471 m/s

Q53. A 3.1 kg particle moves at 8.8 m/s on a line whose perpendicular distance from a fixed point is 1.2 m. What is its angular momentum about that point?

- (A) 27.28 kg m²/s
- (B) 3.72 kg m²/s
- (C) 32.74 kg m²/s
- (D) 10.56 kg m²/s

Unit 7: Oscillations

Q54. A 0.9 kg mass on a spring of constant 64 N/m oscillates on a frictionless surface. What is its period?

- (A) 52.98 s
- (B) 0.119 s
- (C) 0.745 s
- (D) 0.088 s

Q55. A simple pendulum of length 1.0 m undergoes small oscillations. What is its period? Take $g = 9.8 \text{ m/s}^2$.

- (A) 19.67 s
- (B) 0.319 s
- (C) 2.01 s
- (D) 0.641 s

Q56. A mass of 1.8 kg on a spring of constant 58 N/m oscillates with amplitude 0.19 m. What is its maximum speed?

- (A) 0.539 m/s
- (B) 2.16 m/s
- (C) 1.08 m/s
- (D) 0.033 m/s

Q57. An oscillator with amplitude 0.3 m and angular frequency 4.30 rad/s is at displacement 0.15 m from equilibrium. What is its speed there?

- (A) 1.29 m/s
- (B) 0.645 m/s
- (C) 1.44 m/s
- (D) 1.12 m/s

Q58. A mass of 0.9 kg on a spring of constant 23 N/m oscillates with amplitude 0.12 m. What is its maximum acceleration?

- (A) 0.607 m/s²
- (B) 25.56 m/s²
- (C) 0.303 m/s²
- (D) 3.07 m/s²

Q59. A physical pendulum has moment of inertia 1.4 kg m² about its pivot, mass 1.1 kg, and its centre of mass is 0.5 m from the pivot. What is its period for small oscillations? Take $g = 9.8 \text{ m/s}^2$.

- (A) 3.20 s
- (B) 12.33 s
- (C) 0.510 s
- (D) 1.63 s

Q60. A mass of 0.5 kg on a spring of constant 32 N/m oscillates as $x = A \sin(\omega t)$, starting from equilibrium. How long does it first take to reach $x = A/2$?

- (A) 0.196 s
- (B) 0.131 s
- (C) 0.393 s
- (D) 0.065 s

Answer Key

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

Worked explanations for all 60 questions:

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