

AP Physics C: Mechanics Practice Test 20

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 $x(t) = 2.7 t^2 + 3.4 t$, where x is in metres and t is in seconds. What is its velocity at $t = 5.0$ s?

- (A) 30.40 m/s
- (B) 27.00 m/s
- (C) 16.90 m/s
- (D) 23.60 m/s

Q2. A particle has velocity $v(t) = 5.1 + 1.3 t + 0.4 t^2$, with v in m/s and t in seconds. What is its displacement from $t = 0$ to $t = 2.9$ s?

- (A) 23.51 m
- (B) 35.48 m
- (C) 20.26 m
- (D) 18.04 m

Q3. A cart starts with velocity 1.1 m/s and has acceleration $a(t) = 2.2 + 1.0 t$, with a in m/s^2 and t in seconds. What is its velocity at $t = 3.7$ s?

- (A) 22.93 m/s
- (B) 9.24 m/s
- (C) 16.09 m/s
- (D) 14.99 m/s

Q4. An object starts from rest at the origin with acceleration $a(t) = 0.7 t^2$, with a in m/s^2 and t in seconds. What is its position at $t = 4.0$ s?

- (A) 17.24 m
- (B) 44.80 m
- (C) 7.47 m
- (D) 14.93 m

Q5. A projectile is launched with horizontal velocity 12.0 m/s and vertical velocity 14.5 m/s. What is its speed at $t = 2.2$ s? Take $g = 9.8 \text{ m/s}^2$.

- (A) 19.06 m/s
- (B) 13.92 m/s
- (C) 18.82 m/s
- (D) 7.06 m/s

Q6. A particle has position $x(t) = 0.5 t^3 - 2.9 t^2$, with x in metres and t in seconds. At what positive time is its velocity zero?

- (A) 3.87 s
- (B) 1.93 s
- (C) 5.80 s
- (D) 11.60 s

Q7. A ball is thrown vertically upward with speed 18.2 m/s from ground level. What is its maximum height? Take $g = 9.8 \text{ m/s}^2$.

- (A) 16.90 m
- (B) 33.80 m
- (C) 1.86 m
- (D) 8.45 m

Unit 2: Force and Translational Dynamics

Q8. A block of mass 4.9 kg on a frictionless surface is acted on by a horizontal force $F(t) = 29 + 3 t$, with F in newtons and t in seconds. What is its acceleration at $t = 3.5 \text{ s}$?

- (A) 4.03 m/s^2
- (B) 5.92 m/s^2
- (C) 39.50 m/s^2
- (D) 8.06 m/s^2

Q9. A block slides down a rough plane inclined at 30 degrees to the horizontal. The coefficient of kinetic friction is 0.18. What is its acceleration down the plane? Take $g = 9.8 \text{ m/s}^2$.

- (A) 4.90 m/s^2
- (B) 6.43 m/s^2
- (C) 3.37 m/s^2
- (D) 8.49 m/s^2

Q10. A horizontal force of 61 N pushes a 11.9 kg crate across a floor with coefficient of kinetic friction 0.34. What is the acceleration of the crate? Take $g = 9.8 \text{ m/s}^2$.

- (A) 5.13 m/s^2
- (B) 1.79 m/s^2
- (C) 8.46 m/s^2
- (D) 3.33 m/s^2

Q11. A 1.7 kg mass is whirled in a horizontal circle of radius 0.6 m at speed 5.1 m/s by a string. What is the tension in the string?

- (A) 44.22 N
- (B) 73.70 N
- (C) 14.45 N
- (D) 16.66 N

Q12. A satellite of mass 504 kg orbits Earth (mass 6.0×10^{24} kg) at a distance of 9.5 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) 1117 N
- (B) 4470 N
- (C) 22349 N
- (D) 2235 N

Q13. A 1.7 kg block is held against a spring of spring constant 191 N/m compressed by 0.3 m on a frictionless surface. What is the magnitude of its acceleration the instant it is released?

- (A) 33.71 m/s²
- (B) 57.30 m/s²
- (C) 97.41 m/s²
- (D) 0.176 m/s²

Q14. A person of mass 59.0 kg stands on a scale in a lift accelerating upward at 1.4 m/s². What is the scale reading in newtons? Take $g = 9.8$ m/s².

- (A) 578.2 N
- (B) 660.8 N
- (C) 495.6 N
- (D) 82.60 N

Q15. Two masses 4 kg and 8 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) 4.90 m/s²
- (B) 29.40 m/s²
- (C) 3.27 m/s²
- (D) 9.80 m/s²

Q16. A car travels around a banked curve of radius 8.6 m banked at 30 degrees with no reliance on friction. What speed is required?

- (A) 9.18 m/s
- (B) 48.66 m/s
- (C) 12.08 m/s
- (D) 6.98 m/s

Q17. A 4 kg block on a horizontal table (coefficient of kinetic friction 0.23) is connected by a string over a pulley to a hanging 2 kg block. What is the acceleration of the system? Take $g = 9.8$ m/s².

- (A) 3.27 m/s²
- (B) 4.77 m/s²
- (C) 1.76 m/s²
- (D) 2.25 m/s²

Q18. A skydiver of mass 62.7 kg experiences air resistance $F = bv$ with $b = 10.5$ kg/s. What is the terminal velocity? Take $g = 9.8$ m/s².

- (A) 6452 m/s
- (B) 0.017 m/s
- (C) 58.52 m/s
- (D) 7.65 m/s

Q19. A planet has mass 7.3×10^{23} kg and radius 6.5 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) 1.15 m/s^2
- (B) 2.30 m/s^2
- (C) 0.576 m/s^2
- (D) 7490923 m/s^2

Unit 3: Work, Energy, and Power

Q20. A variable force $F(x) = 12 + 5x$, with F in newtons and x in metres, acts on an object as it moves from $x = 0$ to $x = 3.9$ m. How much work is done?

- (A) 46.80 J
- (B) 84.82 J
- (C) 122.8 J
- (D) 66.30 J

Q21. A force $F(x) = 1.2x^2$, with F in newtons and x in metres, pushes an object from $x = 0$ to $x = 3.2$ m. How much work is done?

- (A) 39.32 J
- (B) 6.14 J
- (C) 19.66 J
- (D) 13.11 J

Q22. A spring of constant 237 N/m is stretched from 0.09 m to 0.26 m. How much work is done by the spring force during this stretch? Give the signed work.

- (A) 7.05 J
- (B) -7.05 J
- (C) 8.01 J
- (D) -8.01 J

Q23. A 3.7 kg block moving at 8.2 m/s slides 2.5 m while a constant friction force of 20 N opposes it. What is its final speed?

- (A) 9.71 m/s
- (B) 6.34 m/s
- (C) -5.31 m/s
- (D) 8.20 m/s

Q24. A constant force of 38 N acts in the direction of motion on an object moving at 5.6 m/s. What is the instantaneous power delivered?

- (A) 6.79 W
- (B) 43.60 W
- (C) 106.4 W
- (D) 212.8 W

Q25. A motor delivers power $P(t) = 52 + 24t$, with P in watts and t in seconds. How much work does it do from $t = 0$ to $t = 3.2$ s?

- (A) 166.4 J
- (B) 412.2 J
- (C) 289.3 J
- (D) 243.2 J

Q26. A particle has potential energy $U(x) = 4.1 x^2 + 0.6 x^3$, with U in joules and x in metres. What is the force on the particle at $x = 1.4$ m?

- (A) 15.01 N
- (B) -11.48 N
- (C) -3.53 N
- (D) -15.01 N

Q27. A 2.2 kg block attached to a spring of constant 154 N/m is released from rest with the spring compressed by 0.29 m on a frictionless surface. What is its speed as it passes equilibrium?

- (A) 0.035 m/s
- (B) 2.43 m/s
- (C) 20.30 m/s
- (D) 8.37 m/s

Q28. A 15.0 kg crate is lifted vertically at constant speed through a height of 2.7 m. How much work is done by the lifting force? Take $g = 9.8 \text{ m/s}^2$.

- (A) 147.0 J
- (B) 396.9 J
- (C) 40.50 J
- (D) 198.5 J

Q29. A motor lifts a 35.0 kg load through 4.4 m in 7.0 s at constant speed. What is its average power output? Take $g = 9.8 \text{ m/s}^2$.

- (A) 1509 W
- (B) 215.6 W
- (C) 10564 W
- (D) 49.00 W

Q30. A force $F(x) = 20 + 2x + 1.4x^2$, with F in newtons and x in metres, acts from $x = 0$ to $x = 2.3$ m. How much work is done?

- (A) 51.29 J
- (B) 51.68 J
- (C) 46.00 J
- (D) 56.97 J

Unit 4: Linear Momentum

Q31. A time-varying force $F(t) = 28 + 3t$, with F in newtons and t in seconds, acts from $t = 0$ to $t = 2.7$ s. What is the impulse delivered?

- (A) 75.60 N s
- (B) 97.47 N s
- (C) 83.70 N s
- (D) 86.54 N s

Q32. A force-time graph shows a triangular pulse rising to 97 N and returning to zero over 0.3 s. What is the impulse delivered?

- (A) 14.55 N s
- (B) 29.10 N s
- (C) 7.27 N s
- (D) 9.70 N s

Q33. A 2.0 kg object moving at 4.4 m/s receives an impulse of 27 N s in the direction of motion. What is its final velocity?

- (A) 31.40 m/s
- (B) 58.40 m/s
- (C) 13.50 m/s
- (D) 17.90 m/s

Q34. A 3 kg cart moving at 8.6 m/s collides with and sticks to a stationary 3 kg cart. What is their common velocity after the collision?

- (A) 4.30 m/s
- (B) 8.60 m/s
- (C) 10.09 m/s
- (D) 17.20 m/s

Q35. An object of mass 8 kg at rest explodes into two fragments of masses 3 kg and 5 kg. The 3 kg fragment moves at 5.6 m/s. What is the velocity of the 5 kg fragment?

- (A) 3.36 m/s
- (B) -3.36 m/s
- (C) -5.60 m/s
- (D) 9.33 m/s

Q36. Two carts of masses 4 kg and 4 kg collide and stick together. Their x-velocities before the collision are 4.7 m/s and -0.9 m/s. What is the x-velocity of the combined carts after the collision?

- (A) 3.80 m/s
- (B) 1.90 m/s
- (C) 4.66 m/s
- (D) 2.80 m/s

Q37. Masses 2 kg at $x = 0.5$ m and 2 kg at $x = 3.2$ m lie on the x-axis. What is the x-coordinate of their centre of mass?

- (A) 3.70 m
- (B) 2.46 m
- (C) 1.85 m
- (D) 3.20 m

Q38. A 0.5 kg ball hits a wall at 4.6 m/s and rebounds at 3.8 m/s in the opposite direction. What is the magnitude of the impulse delivered by the wall?

- (A) -0.400 N s
- (B) 1.90 N s
- (C) 2.30 N s
- (D) 4.20 N s

Unit 5: Torque and Rotational Dynamics

- Q39. A force of 45 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) 40.50 N m
 - (B) 35.07 N m
 - (C) 81.00 N m
 - (D) 20.25 N m
- Q40. What is the moment of inertia of a uniform rod of mass 3.8 kg and length 1.2 m about an axis through one end perpendicular to the rod?**
- (A) 1.82 kg m^2
 - (B) 0.456 kg m^2
 - (C) 5.47 kg m^2
 - (D) 2.74 kg m^2
- Q41. What is the moment of inertia of a thin hoop of mass 3.2 kg and radius 0.8 m about its central axis?**
- (A) 2.05 kg m^2
 - (B) 2.68 kg m^2
 - (C) 1.02 kg m^2
 - (D) 4.10 kg m^2
- Q42. A net torque of 25 N m acts on an object with moment of inertia 5.7 kg m^2 . What is its angular acceleration?**
- (A) 142.5 rad/s^2
 - (B) 30.70 rad/s^2
 - (C) 4.39 rad/s^2
 - (D) 0.228 rad/s^2
- Q43. A wheel has angular acceleration $\alpha(t) = 2.5 + 0.8 t$, with α in rad/s^2 and t in seconds, and initial angular velocity 3.0 rad/s . What is its angular velocity at $t = 2.8 \text{ s}$?**
- (A) 16.27 rad/s
 - (B) 10.00 rad/s
 - (C) 13.14 rad/s
 - (D) 10.14 rad/s
- Q44. An object has moment of inertia 2.6 kg m^2 about its centre of mass. What is its moment of inertia about a parallel axis 0.6 m away if its mass is 3.6 kg?**
- (A) 4.76 kg m^2
 - (B) 3.90 kg m^2
 - (C) 2.60 kg m^2
 - (D) 1.30 kg m^2
- Q45. A horizontal beam is pivoted at its left end. A weight of 182 N hangs 1.1 m from the pivot, and an upward force is applied at the right end 3.0 m from the pivot. What upward force balances the beam?**
- (A) 496.4 N
 - (B) 182.0 N
 - (C) 200.2 N
 - (D) 66.73 N

Q46. A disc with moment of inertia 3.2 kg m^2 undergoes angular acceleration 2.8 rad/s^2 . What net torque acts on it?

- (A) 8.96 N m
- (B) 1.14 N m
- (C) 6.00 N m
- (D) 17.92 N m

Unit 6: Energy and Momentum of Rotating Systems

Q47. A rotating object has moment of inertia 3.1 kg m^2 and angular velocity 3.9 rad/s . What is its rotational kinetic energy?

- (A) 47.15 J
- (B) 6.04 J
- (C) 12.09 J
- (D) 23.58 J

Q48. A spinning skater with moment of inertia 2.1 kg m^2 rotates at 2.1 rad/s , then pulls in her arms so her moment of inertia becomes 1.1 kg m^2 . What is her new angular velocity? Neglect external torques.

- (A) 4.01 rad/s
- (B) 1.10 rad/s
- (C) 2.10 rad/s
- (D) 4.41 rad/s

Q49. A solid cylinder of mass 3.2 kg rolls without slipping at speed 5.3 m/s . What is its total kinetic energy? For a solid cylinder $I = 0.5MR^2$.

- (A) 67.42 J
- (B) 44.94 J
- (C) 89.89 J
- (D) 12.72 J

Q50. What is the orbital speed of a satellite in a circular orbit 11.8 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) 8736 m/s
- (B) 33915254 m/s
- (C) 2912 m/s
- (D) 5824 m/s

Q51. What is the orbital period of a satellite in a circular orbit 10.7 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) 5497 s
- (B) 21986 s
- (C) 10993 s
- (D) 0.001 s

Q52. What is the escape velocity from a distance of 9.3 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) 6560 m/s
- (B) 9277 m/s
- (C) 4639 m/s
- (D) 13120 m/s

Q53. A 1.1 kg particle moves at 7.5 m/s on a line whose perpendicular distance from a fixed point is 0.6 m. What is its angular momentum about that point?

- (A) 8.25 kg m²/s
- (B) 0.660 kg m²/s
- (C) 4.95 kg m²/s
- (D) 4.50 kg m²/s

Unit 7: Oscillations

Q54. A 0.6 kg mass on a spring of constant 25 N/m oscillates on a frictionless surface. What is its period?

- (A) 40.56 s
- (B) 0.155 s
- (C) 0.973 s
- (D) 0.151 s

Q55. A simple pendulum of length 1.7 m undergoes small oscillations. What is its period? Take $g = 9.8 \text{ m/s}^2$.

- (A) 2.62 s
- (B) 15.09 s
- (C) 0.416 s
- (D) 1.09 s

Q56. A mass of 1.9 kg on a spring of constant 31 N/m oscillates with amplitude 0.14 m. What is its maximum speed?

- (A) 0.565 m/s
- (B) 0.283 m/s
- (C) 1.13 m/s
- (D) 0.035 m/s

Q57. An oscillator with amplitude 0.32 m and angular frequency 5.70 rad/s is at displacement 0.16 m from equilibrium. What is its speed there?

- (A) 1.82 m/s
- (B) 0.912 m/s
- (C) 1.58 m/s
- (D) 2.04 m/s

Q58. A mass of 1.0 kg on a spring of constant 34 N/m oscillates with amplitude 0.29 m. What is its maximum acceleration?

- (A) 1.69 m/s²
- (B) 9.86 m/s²
- (C) 34.00 m/s²
- (D) 0.845 m/s²

Q59. A physical pendulum has moment of inertia 1.2 kg m² about its pivot, mass 3.1 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) 17.32 s
- (B) 0.363 s
- (C) 2.28 s
- (D) 0.827 s

Q60. A mass of 1.6 kg on a spring of constant 54 N/m oscillates as $x = A \sin(\omega t)$, starting from equilibrium. How long does it first take to reach $x = A/2$?

- (A) 0.270 s
- (B) 0.180 s
- (C) 0.090 s
- (D) 0.541 s

Answer Key

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

Worked explanations for all 60 questions:

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