

AP Physics C: Mechanics Practice Test 10

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 has velocity $v(t) = 8t - 1t^2$ m/s. What is its displacement from $t = 0$ until it first comes to rest again (apart from $t = 0$)?

- (A) 256 m
- (B) 85.3 m
- (C) 42.7 m
- (D) 171 m

Q2. A glider experiences acceleration $a = -0.5v$, where v is its velocity in m/s. It starts at 12 m/s. How far does it travel in the first 2 s?

- (A) 24 m
- (B) 15.2 m
- (C) 27.1 m
- (D) 21.2 m

Q3. Two runners start from opposite ends of a straight track. Runner A has position $x_A = 1t^2$ m and runner B has position $x_B = 40 - 10t$ m, measured from A's start. At what time do they meet?

- (A) 4.59 s
- (B) 4 s
- (C) 6.32 s
- (D) 3.06 s

Q4. A sled starts from rest with acceleration $a(t) = 4 + 2t$ m/s². How far does it travel in the first 3 s?

- (A) 45 m
- (B) 13.5 m
- (C) 18 m
- (D) 27 m

Q5. A particle moves along the x-axis with velocity $v(t) = 1 + 6t + 2t^2$ m/s, where t is in seconds. What is its displacement between $t = 1$ s and $t = 5$ s?

- (A) 79.3 m
- (B) 159 m
- (C) 238 m
- (D) 163 m

Q6. A cart starts with velocity 4 m/s and has acceleration $a(t) = 2 + 2t \text{ m/s}^2$. What is its velocity at $t = 3 \text{ s}$?

- (A) 28 m/s
- (B) 19 m/s
- (C) 28.5 m/s
- (D) 10 m/s

Q7. The position of a block is $x(t) = 3t^3 - 1t^2 + 5t$ metres. What is its velocity at $t = 3 \text{ s}$?

- (A) 132 m/s
- (B) 40 m/s
- (C) 80 m/s
- (D) 86 m/s

Unit 2: Force and Translational Dynamics

Q8. Two blocks 3 kg and 2 kg connected by a light string rest on a frictionless table. A horizontal force of 20 N pulls the 3 kg block. What is the tension in the string?

- (A) 12 N
- (B) 20 N
- (C) 16 N
- (D) 8 N

Q9. A 0.5 kg mass moves in a horizontal circle of radius 1 m at speed 8 m/s, held by a string. What is the tension in the string?

- (A) 4 N
- (B) 64 N
- (C) 16 N
- (D) 32 N

Q10. A 3 kg block slides down a rough incline at 45° to the horizontal. The coefficient of kinetic friction is 0.1. What is its acceleration down the slope?

- (A) 3.12 m/s^2
- (B) 6.93 m/s^2
- (C) 6.24 m/s^2
- (D) 7.62 m/s^2

Q11. Two masses 4 kg and 6 kg hang from a light pulley (Atwood machine). What is the magnitude of their acceleration?

- (A) 3.92 m/s^2
- (B) 3.27 m/s^2
- (C) 1.96 m/s^2
- (D) 3.69 m/s^2

Q12. A horizontal force of 40 N is applied at 30° above the horizontal to a 2 kg block on a frictionless floor. What is the block's horizontal acceleration?

- (A) 10 m/s^2
- (B) 26 m/s^2
- (C) 17.3 m/s^2
- (D) 20 m/s^2

Q13. A 2 kg object experiences a time-varying force $F(t) = 20 + 5t$ N. What is its acceleration at $t = 2$ s?

- (A) 7.5 m/s^2
- (B) 20 m/s^2
- (C) 15 m/s^2
- (D) 10 m/s^2

Q14. A 3 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) 0.294 m
- (B) 0.588 m
- (C) 0.03 m
- (D) 0.147 m

Q15. A car travels on a flat circular bend of radius 20 m. The coefficient of static friction is 0.3. What is the maximum speed without slipping?

- (A) 11.5 m/s
- (B) 5.42 m/s
- (C) 14 m/s
- (D) 7.67 m/s

Q16. A road is banked so that a car at 20 m/s can round a curve of radius 50 m with no sideways friction. What banking angle is required?

- (A) 58.8°
- (B) 50.8°
- (C) 19.6°
- (D) 39.2°

Q17. A planet has mass 2 times Earth's mass and radius 2 times Earth's radius. What is the gravitational field strength at its surface? (Earth's $g = 9.8 \text{ m/s}^2$.)

- (A) 4.9 m/s^2
- (B) 5.54 m/s^2
- (C) 39.2 m/s^2
- (D) 19.6 m/s^2

Q18. A 50 kg person stands on a scale in a lift accelerating upwards at 3 m/s^2 . What is the scale reading (normal force)?

- (A) 640 N
- (B) 768 N
- (C) 490 N
- (D) 340 N

Q19. A 4 kg crate on a rough floor ($\mu_k = 0.2$) is pushed by a horizontal force of 30 N. What is its acceleration?

- (A) 5.54 m/s^2
- (B) 7.5 m/s^2
- (C) 2.77 m/s^2
- (D) 9.46 m/s^2

Unit 3: Work, Energy, and Power

- Q20. A force $F(x) = 10 + 6x$ N acts on a particle as it moves from $x = 2$ m to $x = 5$ m along the x-axis. How much work is done?**
- (A) 156 J
 - (B) 93 J
 - (C) 46.5 J
 - (D) 30 J
- Q21. A variable force $F(x) = 10x^2$ N moves an object from $x = 2$ m to $x = 3$ m. What work is done?**
- (A) 190 J
 - (B) 63.3 J
 - (C) 25 J
 - (D) 31.7 J
- Q22. A spring of constant 200 N/m is compressed by 0.4 m from equilibrium. How much elastic potential energy is stored?**
- (A) 16 J
 - (B) 40 J
 - (C) 36.2 J
 - (D) 32 J
- Q23. A net work of 150 J is done on a 3 kg object initially moving at 2 m/s. What is its final speed?**
- (A) 10 m/s
 - (B) 15.3 m/s
 - (C) 52 m/s
 - (D) 10.2 m/s
- Q24. A constant force of 30 N pushes an object in the direction of its motion at 3 m/s. What power is delivered?**
- (A) 180 W
 - (B) 90 W
 - (C) 33 W
 - (D) 45 W
- Q25. An object is dropped from rest from a height of 20 m. Ignoring air resistance, what is its speed just before hitting the ground?**
- (A) 14 m/s
 - (B) 196 m/s
 - (C) 19.8 m/s
 - (D) 9.9 m/s
- Q26. A small bead slides on a frictionless vertical loop of radius 1 m. What is the minimum speed it must have at the top of the loop to stay in contact?**
- (A) 4.43 m/s
 - (B) 4.95 m/s
 - (C) 6.26 m/s
 - (D) 3.13 m/s

Q27. A 3 kg block attached to a spring ($k = 100 \text{ N/m}$) is released from rest when the spring is compressed 0.3 m. What is its maximum speed?

- (A) 10 m/s
- (B) 0.866 m/s
- (C) 5.77 m/s
- (D) 1.73 m/s

Q28. A 4 kg block slides 10 m across a rough horizontal surface with coefficient of kinetic friction 0.1. What is the magnitude of the work done by friction?

- (A) 19.6 J
- (B) 4 J
- (C) 392 J
- (D) 39.2 J

Q29. A motor lifts a 50 kg load through a height of 10 m in 5 s at constant speed. What is the average power output?

- (A) 490 W
- (B) 980 W
- (C) $4.9\text{e}+03 \text{ W}$
- (D) 100 W

Q30. A force $F(x) = 25 \cos(\pi x/(2 \times 2)) \text{ N}$, where x is in metres, acts from $x = 0$ to $x = 2 \text{ m}$. How much work is done? Use $\pi = 3.14$.

- (A) 15.9 J
- (B) 31.8 J
- (C) 63.7 J
- (D) 50 J

Unit 4: Linear Momentum

Q31. A 2 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) 9.04 m/s
- (B) 4 m/s
- (C) 8 m/s
- (D) 0 m/s

Q32. A 3 kg cart at 6 m/s catches up and sticks to a 2 kg cart moving at 3 m/s in the same direction. What is their common velocity?

- (A) 7.2 m/s
- (B) 2.4 m/s
- (C) 4.8 m/s
- (D) 3.6 m/s

Q33. A 0.02 kg bullet at 200 m/s embeds in a 2 kg wooden block hanging as a pendulum. How high does the block rise?

- (A) 0.2 m
- (B) 0.4 m
- (C) 0.452 m
- (D) 20.2 m

Q34. An object at rest explodes into a 2 kg fragment moving at 4 m/s and a 2 kg fragment. What is the speed of the second fragment?

- (A) 4 m/s
- (B) 5.11 m/s
- (C) 8 m/s
- (D) 4.52 m/s

Q35. Two masses 3 kg at $x = 0$ m and 4 kg at $x = 6$ m lie on the x-axis. Where is their centre of mass?

- (A) 3.43 m
- (B) 3 m
- (C) 5.14 m
- (D) 12 m

Q36. A 1 kg ball hits a wall at 10 m/s and rebounds at 10 m/s in the opposite direction. What is the magnitude of the impulse from the wall?

- (A) 20 N·s
- (B) 10 N·s
- (C) 5 N·s
- (D) 11.3 N·s

Q37. A force $F(t) = 20 \sin(\pi t/4)$ N acts from $t = 0$ to $t = 4$ s. What impulse does it deliver? Use $\pi = 3.14$.

- (A) 28.8 N·s
- (B) 25.5 N·s
- (C) 80 N·s
- (D) 50.9 N·s

Q38. A constant force of 20 N acts for 3 s on a 2 kg object already moving at 5 m/s in the force direction. What is its final speed?

- (A) 17.5 m/s
- (B) 35 m/s
- (C) 65 m/s
- (D) 20 m/s

Unit 5: Torque and Rotational Dynamics

Q39. Point masses 2 kg at 1 m and 2 kg at 1 m from an axis have what total moment of inertia about that axis?

- (A) $4.52 \text{ kg}\cdot\text{m}^2$
- (B) $2 \text{ kg}\cdot\text{m}^2$
- (C) $4 \text{ kg}\cdot\text{m}^2$
- (D) $8 \text{ kg}\cdot\text{m}^2$

Q40. A uniform rod of mass 4 kg and length 2 m has moment of inertia $1.33 \text{ kg}\cdot\text{m}^2$ about its centre. What is its moment of inertia about a parallel axis 0.5 m from the centre?

- (A) $1.33 \text{ kg}\cdot\text{m}^2$
- (B) $4.67 \text{ kg}\cdot\text{m}^2$
- (C) $2.33 \text{ kg}\cdot\text{m}^2$
- (D) $5.33 \text{ kg}\cdot\text{m}^2$

Q41. A net torque of $10 \text{ N}\cdot\text{m}$ acts on a body with moment of inertia $2 \text{ kg}\cdot\text{m}^2$. What is its angular acceleration?

- (A) 10 rad/s^2
- (B) 2.5 rad/s^2
- (C) 20 rad/s^2
- (D) 5 rad/s^2

Q42. A 2 kg particle moves at 3 m/s at a perpendicular distance 0.5 m from a point. What is its angular momentum about that point?

- (A) $1.5 \text{ kg}\cdot\text{m}^2/\text{s}$
- (B) $3 \text{ kg}\cdot\text{m}^2/\text{s}$
- (C) $6.78 \text{ kg}\cdot\text{m}^2/\text{s}$
- (D) $6 \text{ kg}\cdot\text{m}^2/\text{s}$

Q43. A flywheel with $I = 4 \text{ kg}\cdot\text{m}^2$ spins at 10 rad/s . A constant opposing torque of $4 \text{ N}\cdot\text{m}$ is applied. How long until it stops?

- (A) 5 s
- (B) 2.5 s
- (C) 20 s
- (D) 10 s

Q44. A uniform rod of mass 2 kg and length 1 m is pivoted at one end and held at 60° to the vertical. What torque does gravity exert about the pivot?

- (A) $4.24 \text{ N}\cdot\text{m}$
- (B) $9.8 \text{ N}\cdot\text{m}$
- (C) $17 \text{ N}\cdot\text{m}$
- (D) $8.49 \text{ N}\cdot\text{m}$

Q45. A tangential force of 20 N is applied at the rim of a wheel of radius 0.5 m and moment of inertia $2 \text{ kg}\cdot\text{m}^2$. What is the wheel's angular acceleration?

- (A) 10 rad/s^2
- (B) 5 rad/s^2
- (C) 11.3 rad/s^2
- (D) 2.5 rad/s^2

Q46. A disk starts with angular velocity 0 rad/s and constant angular acceleration 4 rad/s^2 . Through what angle does it rotate in 5 s ?

- (A) 100 rad
- (B) 50 rad
- (C) 113 rad
- (D) 25 rad

Unit 6: Energy and Momentum of Rotating Systems

Q47. What is the orbital period, in hours, of a satellite at radius 20000 km from Earth's centre? ($GM_{\text{Earth}} = 3.99 \times 10^{14} \text{ m}^3/\text{s}^2$.)

- (A) 11.7 hours
- (B) 3.91 hours
- (C) 7.82 hours
- (D) 15.6 hours

Q48. A planet has mass 8 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) 5.6 km/s
- (B) 31.7 km/s
- (C) 22.4 km/s
- (D) 11.2 km/s

Q49. A 500 kg satellite orbits at radius 9000 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) 11.1 GJ
- (B) 16.6 GJ
- (C) 22.1 GJ
- (D) 5.54 GJ

Q50. A 300 kg satellite moves from radius 7000 km to radius 14000 km from Earth's centre. By how much does its gravitational potential energy change, in MJ?

- (A) 1.71e+04 MJ
- (B) 1.02e+04 MJ
- (C) 4.27e+03 MJ
- (D) 8.54e+03 MJ

Q51. A 4 kg mass falls 10 m while unwinding a string from a pulley ($I = 2 \text{ kg}\cdot\text{m}^2$, radius 0.5 m). What is its speed at the end, ignoring friction?

- (A) 14 m/s
- (B) 4.04 m/s
- (C) 8.08 m/s
- (D) 12.1 m/s

Q52. Planet A orbits a star with period 3 years. Planet B orbits the same star at 8 times A's orbital radius. What is B's period?

- (A) 33.9 years
- (B) 192 years
- (C) 67.9 years
- (D) 24 years

Q53. A body with moment of inertia $4 \text{ kg}\cdot\text{m}^2$ rotates at 10 rad/s. What is its rotational kinetic energy?

- (A) 452 J
- (B) 20 J
- (C) 200 J
- (D) 400 J

Unit 7: Oscillations

Q54. A 2 kg mass on a spring ($k = 100 \text{ N/m}$) oscillates with amplitude 0.2 m. What is its speed when its displacement is 0.1 m?

- (A) 1.41 m/s
- (B) 1.22 m/s
- (C) 0.612 m/s
- (D) 0.707 m/s

Q55. A particle in SHM obeys $d^2x/dt^2 = -2^2x$. What is the magnitude of its acceleration when its displacement is 0.1 m?

- (A) 0.4 m/s^2
- (B) 0.8 m/s^2
- (C) 0.226 m/s^2
- (D) 0.2 m/s^2

Q56. A 1 kg mass on a spring oscillates with period 1 s. What is the spring constant?

- (A) 19.7 N/m
- (B) 39.5 N/m
- (C) 44.6 N/m
- (D) 9.87 N/m

Q57. A particle in SHM has $x(t) = 0.2 \cos(2t)$ m. What is its position at $t = 2$ s?

- (A) -0.131 m
- (B) -0.151 m
- (C) -0.0291 m
- (D) 0.131 m

Q58. A pendulum of length 1 m has period 2.01 s. If its length is multiplied by 4, what is its new period?

- (A) 4.01 s
- (B) 2.01 s
- (C) 2.27 s
- (D) 8.03 s

Q59. Two springs of constants 200 N/m and 200 N/m act in parallel on a 2 kg mass. What is the period of oscillation?

- (A) 0.444 s
- (B) 0.889 s
- (C) 1 s
- (D) 0.628 s

Q60. A mass oscillates with $x(t) = 0.2 \cos(2t)$ m. What is its maximum speed?

- (A) 0.4 m/s
- (B) 0.8 m/s
- (C) 0.1 m/s
- (D) 0.904 m/s

Answer Key

Q1: B	Q11: C	Q21: B	Q31: C	Q41: D	Q51: C
Q2: B	Q12: C	Q22: A	Q32: C	Q42: B	Q52: C
Q3: D	Q13: C	Q23: D	Q33: A	Q43: D	Q53: C
Q4: D	Q14: A	Q24: B	Q34: A	Q44: D	Q54: B
Q5: B	Q15: D	Q25: C	Q35: A	Q45: B	Q55: A
Q6: B	Q16: D	Q26: D	Q36: A	Q46: B	Q56: B

Q7: C	Q17: A	Q27: D	Q37: D	Q47: C	Q57: A
Q8: D	Q18: A	Q28: D	Q38: B	Q48: C	Q58: A
Q9: D	Q19: A	Q29: B	Q39: C	Q49: A	Q59: A
Q10: C	Q20: B	Q30: B	Q40: C	Q50: D	Q60: A

Worked explanations for all 60 questions:

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