

AP Physics C: Mechanics Practice Test 8

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. Two runners start from opposite ends of a straight track. Runner A has position $x_A = 1t^2$ m and runner B has position $x_B = 60 - 5t$ m, measured from A's start. At what time do they meet?

- (A) 7.75 s
- (B) 8.46 s
- (C) 5.64 s
- (D) 12 s

Q2. A sled starts from rest with acceleration $a(t) = 4 + 2t$ m/s². How far does it travel in the first 4 s?

- (A) 53.3 m
- (B) 26.7 m
- (C) 85.3 m
- (D) 32 m

Q3. A particle moves along the x-axis with velocity $v(t) = 1 + 2t + 2t^2$ m/s, where t is in seconds. What is its displacement between $t = 1$ s and $t = 5$ s?

- (A) 111 m
- (B) 166 m
- (C) 113 m
- (D) 55.3 m

Q4. A cart starts with velocity 2 m/s and has acceleration $a(t) = 5 + 1t$ m/s². What is its velocity at $t = 3$ s?

- (A) 32.2 m/s
- (B) 21.5 m/s
- (C) 17 m/s
- (D) 26 m/s

Q5. The position of a block is $x(t) = 4t^3 - 2t^2 + 5t$ metres. What is its velocity at $t = 2$ s?

- (A) 22.5 m/s
- (B) 53 m/s
- (C) 45 m/s
- (D) 89 m/s

Q6. A projectile is launched at 30 m/s at 45° above the horizontal. What is its speed at $t = 3$ s? Take $g = 9.8 \text{ m/s}^2$.

- (A) 27.3 m/s
- (B) 30 m/s
- (C) 33.9 m/s
- (D) 22.7 m/s

Q7. A particle has velocity $v(t) = 8t - 2t^2$ m/s. What is its displacement from $t = 0$ until it first comes to rest again (apart from $t = 0$)?

- (A) 21.3 m
- (B) 10.7 m
- (C) 42.7 m
- (D) 64 m

Unit 2: Force and Translational Dynamics

Q8. A road is banked so that a car at 10 m/s can round a curve of radius 50 m with no sideways friction. What banking angle is required?

- (A) 17.3°
- (B) 78.5°
- (C) 11.5°
- (D) 5.77°

Q9. A planet has mass 4 times Earth's mass and radius 3 times Earth's radius. What is the gravitational field strength at its surface? (Earth's $g = 9.8 \text{ m/s}^2$.)

- (A) 3.27 m/s^2
- (B) 118 m/s^2
- (C) 4.36 m/s^2
- (D) 39.2 m/s^2

Q10. A 50 kg person stands on a scale in a lift accelerating upwards at 2 m/s^2 . What is the scale reading (normal force)?

- (A) 708 N
- (B) 590 N
- (C) 490 N
- (D) 390 N

Q11. A 3 kg crate on a rough floor ($\mu_k = 0.3$) is pushed by a horizontal force of 30 N. What is its acceleration?

- (A) 10 m/s^2
- (B) 7.06 m/s^2
- (C) 3.53 m/s^2
- (D) 12.9 m/s^2

Q12. A 2 kg bob on a string of length 0.5 m swings in a horizontal circle with the string at 45° to the vertical. What is the tension in the string?

- (A) 19.6 N
- (B) 27.7 N
- (C) 41.6 N
- (D) 13.9 N

- Q13. A 2 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) 4.8 m/s^2
 - (B) 9.8 m/s^2
 - (C) 5 m/s^2
 - (D) 7.2 m/s^2
- Q14. Two blocks 4 kg and 3 kg connected by a light string rest on a frictionless table. A horizontal force of 20 N pulls the 4 kg block. What is the tension in the string?**
- (A) 8.57 N
 - (B) 17.1 N
 - (C) 20 N
 - (D) 11.4 N
- Q15. A 1 kg mass moves in a horizontal circle of radius 0.5 m at speed 8 m/s, held by a string. What is the tension in the string?**
- (A) 256 N
 - (B) 16 N
 - (C) 64 N
 - (D) 128 N
- Q16. A 2 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) 5.9 m/s^2
 - (B) 2.56 m/s^2
 - (C) 6.68 m/s^2
 - (D) 5.12 m/s^2
- Q17. Two masses 3 kg and 8 kg hang from a light pulley (Atwood machine). What is the magnitude of their acceleration?**
- (A) 6.12 m/s^2
 - (B) 6.92 m/s^2
 - (C) 8.91 m/s^2
 - (D) 4.45 m/s^2
- Q18. A horizontal force of 40 N is applied at 30° above the horizontal to a 3 kg block on a frictionless floor. What is the block's horizontal acceleration?**
- (A) 17.3 m/s^2
 - (B) 6.67 m/s^2
 - (C) 11.5 m/s^2
 - (D) 13.3 m/s^2
- Q19. A 4 kg object experiences a time-varying force $F(t) = 10 + 2t$ N. What is its acceleration at $t = 2$ s?**
- (A) 4.5 m/s^2
 - (B) 3.5 m/s^2
 - (C) 2.5 m/s^2
 - (D) 1.75 m/s^2

Unit 3: Work, Energy, and Power

- Q20. A small bead slides on a frictionless vertical loop of radius 1.5 m. What is the minimum speed it must have at the top of the loop to stay in contact?**
- (A) 6.06 m/s
 - (B) 5.42 m/s
 - (C) 3.83 m/s
 - (D) 7.67 m/s
- Q21. A 2 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) 7.07 m/s
 - (B) 15 m/s
 - (C) 1.06 m/s
 - (D) 2.12 m/s
- Q22. A 4 kg block slides 10 m across a rough horizontal surface with coefficient of kinetic friction 0.2. What is the magnitude of the work done by friction?**
- (A) 78.4 J
 - (B) 8 J
 - (C) 39.2 J
 - (D) 392 J
- Q23. A motor lifts a 50 kg load through a height of 20 m in 10 s at constant speed. What is the average power output?**
- (A) $9.8\text{e}+03 \text{ W}$
 - (B) 100 W
 - (C) 980 W
 - (D) 490 W
- Q24. A force $F(x) = 10 \cos(\pi x/(2 \times 2)) \text{ N}$, where x is in metres, acts from $x = 0$ to $x = 2 \text{ m}$. How much work is done? Use $\pi = 3.14$.**
- (A) 6.37 J
 - (B) 20 J
 - (C) 25.5 J
 - (D) 12.7 J
- Q25. A 3 kg block starts down a frictionless incline at 4 m/s and descends a vertical height of 5 m. What is its speed at the bottom?**
- (A) 10.7 m/s
 - (B) 5.34 m/s
 - (C) 9.9 m/s
 - (D) 13.9 m/s
- Q26. A force $F(x) = 20 + 6x \text{ N}$ acts on a particle as it moves from $x = 2 \text{ m}$ to $x = 5 \text{ m}$ along the x -axis. How much work is done?**
- (A) 123 J
 - (B) 61.5 J
 - (C) 186 J
 - (D) 60 J

Q27. A variable force $F(x) = 6x^2$ N moves an object from $x = 1$ m to $x = 3$ m. What work is done?

- (A) 24 J
- (B) 26 J
- (C) 156 J
- (D) 52 J

Q28. A spring of constant 100 N/m is compressed by 0.3 m from equilibrium. How much elastic potential energy is stored?

- (A) 4.5 J
- (B) 10.2 J
- (C) 9 J
- (D) 15 J

Q29. A net work of 50 J is done on a 3 kg object initially moving at 2 m/s. What is its final speed?

- (A) 9.17 m/s
- (B) 5.77 m/s
- (C) 6.11 m/s
- (D) 18.7 m/s

Q30. A constant force of 20 N pushes an object in the direction of its motion at 2 m/s. What power is delivered?

- (A) 80 W
- (B) 22 W
- (C) 20 W
- (D) 40 W

Unit 4: Linear Momentum

Q31. Two masses 2 kg at $x = 0$ m and 6 kg at $x = 6$ m lie on the x-axis. Where is their centre of mass?

- (A) 6.75 m
- (B) 18 m
- (C) 4.5 m
- (D) 3 m

Q32. A 1 kg ball hits a wall at 20 m/s and rebounds at 10 m/s in the opposite direction. What is the magnitude of the impulse from the wall?

- (A) -10 N·s
- (B) 15 N·s
- (C) 20 N·s
- (D) 30 N·s

Q33. A force $F(t) = 20 \sin(\pi t/2)$ N acts from $t = 0$ to $t = 2$ s. What impulse does it deliver? Use $\pi = 3.14$.

- (A) 40 N·s
- (B) 12.7 N·s
- (C) 25.5 N·s
- (D) 14.4 N·s

Q34. A constant force of 20 N acts for 3 s on a 2 kg object already moving at 10 m/s in the force direction. What is its final speed?

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

Q35. A force $F(t) = 10 + 5t$ N acts on an object from $t = 0$ to $t = 4$ s. What impulse does it deliver?

- (A) 45.2 N·s
- (B) 80 N·s
- (C) 120 N·s
- (D) 40 N·s

Q36. A force-time graph is a triangle with peak force 150 N and base 0.2 s. What impulse does it deliver?

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

Q37. A 2 kg ball moving at 6 m/s collides elastically head-on with a stationary 2 kg ball. What is the second ball's velocity after the collision?

- (A) 6 m/s
- (B) 0 m/s
- (C) 6.78 m/s
- (D) 3 m/s

Q38. A 3 kg cart at 6 m/s catches up and sticks to a 2 kg cart moving at 2 m/s in the same direction. What is their common velocity?

- (A) 6.6 m/s
- (B) 3.6 m/s
- (C) 2.8 m/s
- (D) 4.4 m/s

Unit 5: Torque and Rotational Dynamics

Q39. A flywheel with $I = 6 \text{ kg}\cdot\text{m}^2$ spins at 10 rad/s. A constant opposing torque of 2 N·m is applied. How long until it stops?

- (A) 15 s
- (B) 30 s
- (C) 5 s
- (D) 60 s

Q40. A uniform rod of mass 4 kg and length 1 m is pivoted at one end and held at 30° to the vertical. What torque does gravity exert about the pivot?

- (A) 22.1 N·m
- (B) 19.6 N·m
- (C) 4.9 N·m
- (D) 9.8 N·m

Q41. A tangential force of 20 N is applied at the rim of a wheel of radius 0.4 m and moment of inertia $4 \text{ kg}\cdot\text{m}^2$. What is the wheel's angular acceleration?

- (A) 8 rad/s^2
- (B) 2 rad/s^2
- (C) 1 rad/s^2
- (D) 5 rad/s^2

Q42. A disk starts with angular velocity 2 rad/s and constant angular acceleration 2 rad/s^2 . Through what angle does it rotate in 5 s?

- (A) 60 rad
- (B) 35 rad
- (C) 50 rad
- (D) 17.5 rad

Q43. A force of 30 N is applied at a distance 2 m from a pivot, at 30° to the lever arm. What is the torque about the pivot?

- (A) $30 \text{ N}\cdot\text{m}$
- (B) $60 \text{ N}\cdot\text{m}$
- (C) $52 \text{ N}\cdot\text{m}$
- (D) $67.8 \text{ N}\cdot\text{m}$

Q44. A wheel starts from rest with angular acceleration $\alpha(t) = 3 + 2t \text{ rad/s}^2$. What is its angular velocity at $t = 2 \text{ s}$?

- (A) 6 rad/s
- (B) 5 rad/s
- (C) 10 rad/s
- (D) 14 rad/s

Q45. Point masses 1 kg at 2 m and 2 kg at 1 m from an axis have what total moment of inertia about that axis?

- (A) $3 \text{ kg}\cdot\text{m}^2$
- (B) $6 \text{ kg}\cdot\text{m}^2$
- (C) $4 \text{ kg}\cdot\text{m}^2$
- (D) $9 \text{ kg}\cdot\text{m}^2$

Q46. A uniform rod of mass 2 kg and length 2 m has moment of inertia $0.667 \text{ kg}\cdot\text{m}^2$ about its centre. What is its moment of inertia about a parallel axis 0.5 m from the centre?

- (A) $2.33 \text{ kg}\cdot\text{m}^2$
- (B) $2.67 \text{ kg}\cdot\text{m}^2$
- (C) $0.667 \text{ kg}\cdot\text{m}^2$
- (D) $1.17 \text{ kg}\cdot\text{m}^2$

Unit 6: Energy and Momentum of Rotating Systems

Q47. A 150 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) $2.14\text{e}+03 \text{ MJ}$
- (B) $8.54\text{e}+03 \text{ MJ}$
- (C) $4.27\text{e}+03 \text{ MJ}$
- (D) $5.12\text{e}+03 \text{ MJ}$

Q48. A 4 kg mass falls 5 m while unwinding a string from a pulley ($I = 1 \text{ kg}\cdot\text{m}^2$, radius 0.2 m). What is its speed at the end, ignoring friction?

- (A) 1.84 m/s
- (B) 5.51 m/s
- (C) 3.68 m/s
- (D) 9.9 m/s

Q49. Planet A orbits a star with period 1 years. Planet B orbits the same star at 4 times A's orbital radius. What is B's period?

- (A) 8 years
- (B) 4 years
- (C) 16 years
- (D) 4.52 years

Q50. A body with moment of inertia $3 \text{ kg}\cdot\text{m}^2$ rotates at 8 rad/s. What is its rotational kinetic energy?

- (A) 192 J
- (B) 12 J
- (C) 96 J
- (D) 217 J

Q51. A disk with $I = 4 \text{ kg}\cdot\text{m}^2$ spinning at 6 rad/s couples to a stationary disk with $I = 2 \text{ kg}\cdot\text{m}^2$ on the same axle, with no external torque. What is their common angular velocity?

- (A) 4 rad/s
- (B) 8 rad/s
- (C) 6 rad/s
- (D) 12 rad/s

Q52. A satellite orbits Earth at a radius of 10000 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) 9.47 km/s
- (B) 3.16 km/s
- (C) 6.31 km/s
- (D) 8.93 km/s

Q53. What is the orbital period, in hours, of a satellite at radius 7000 km from Earth's centre? ($GM_{\text{Earth}} = 3.99 \times 10^{14} \text{ m}^3/\text{s}^2$.)

- (A) 1.62 hours
- (B) 0.81 hours
- (C) 3.24 hours
- (D) 2.43 hours

Unit 7: Oscillations

Q54. A particle in SHM has $x(t) = 0.2 \cos(2t)$ m. What is its position at $t = 1$ s?

- (A) -0.131 m
- (B) 0.0832 m
- (C) 0.182 m
- (D) -0.0832 m

- Q55. A pendulum of length 2 m has period 2.84 s. If its length is multiplied by 2, what is its new period?**
- (A) 5.68 s
(B) 2.01 s
(C) 2.84 s
(D) 4.01 s
- Q56. Two springs of constants 100 N/m and 200 N/m act in parallel on a 1 kg mass. What is the period of oscillation?**
- (A) 0.628 s
(B) 0.363 s
(C) 0.726 s
(D) 0.77 s
- Q57. A mass oscillates with $x(t) = 0.1 \cos(10t)$ m. What is its maximum speed?**
- (A) 2 m/s
(B) 1 m/s
(C) 0.01 m/s
(D) 10 m/s
- Q58. A 1 kg mass on a spring ($k = 400$ N/m) oscillates horizontally. What is its period?**
- (A) 0.05 s
(B) 0.314 s
(C) 126 s
(D) 0.157 s
- Q59. A simple pendulum of length 2 m oscillates with small amplitude. What is its period?**
- (A) 5.68 s
(B) 0.452 s
(C) 13.9 s
(D) 2.84 s
- Q60. 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 0.05 m?**
- (A) 1.94 m/s
(B) 0.968 m/s
(C) 2 m/s
(D) 0.5 m/s

Answer Key

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

Q6: D	Q16: D	Q26: A	Q36: B	Q46: D	Q56: B
Q7: A	Q17: D	Q27: D	Q37: A	Q47: C	Q57: B
Q8: C	Q18: C	Q28: A	Q38: D	Q48: C	Q58: B
Q9: C	Q19: B	Q29: C	Q39: B	Q49: A	Q59: D
Q10: B	Q20: C	Q30: D	Q40: D	Q50: C	Q60: A

Worked explanations for all 60 questions:

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