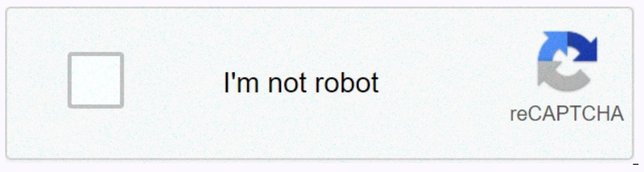

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Ap physics 1 college board workbook answers

Enroll in this CourseCourse DescriptionDescriptionThe course provides students with an introductory experience in the concepts and methods of physical analysis, focused on classical mechanics and simple electrical circuits. Building the ability to reason qualitatively and quantitatively is a primary focus, with inquiry and investigation, modeling and diagramming, symbolic algebra, unit analysis, communication and argumentation, laboratory techniques, data analysis, and integration and application of concepts as emphasized skills.Students have the primary responsibility for building understanding, with the instructor as a resource and guide. Students will spend instructional time engaging with the textbook, online lecture videos, simulations, online discussions, hands-on labs (constituting 25% of instructional time), problem-solving screencasts, online homework problems, and tests/exams. This course has synchronous virtual class meetings and students may also schedule one-on-one virtual meetings directly with the instructor to answer questions or concerns. The instructor will schedule meeting dates/times at the start of the course after polling student availability. Meetings will be recorded for students who are unable to attend due to scheduling conflicts.Major course themes include:KinematicsDynamicsCircular Motion and GravitationEnergyMomentumSimple Harmonic MotionTorque and Rotational MotionElectric Charge and Electric ForceDC CircuitsMechanical Waves and SoundThis course includes a laboratory component designed to meet College Board standards and has been reviewed and approved by the College Board. Hands-on labs require a materials kit that also must be purchased separately by the student.AP Physics 1 is the equivalent to a first-semester college course in algebra-based physics. This demanding course requires a substantial time commitment during the entire session and should not be combined with other CTY courses.A free, online placement test is available to determine if the student has the math skills needed to enroll in this course.Virtual classrooms, and student activities in the classroom, may be recorded and added to the course as an ongoing asset for all class students to review. Videos from YouTube or other web providers may be present in this course. Video recommendations or links provided at end of videos are generated by the video host provider and are not CTY recommendations.Materials NeededStudents must purchase access to FlinnPrep, and lab kit for this course:FlinnPrep websiteAP Physics 1 Lab KitAccess to the eTextbook (College Physics by Serway, 11th edition) and corresponding WebAssign is included in the registration.Detailed Course InformationCourse DetailsUnit 1: KinematicsMotionMotion DiagramsUsing Graphs to Describe MotionThe Kinematic EquationsVector Description of MotionMotion in Two DimensionsTwo-Dimensional KinematicsProjectile MotionUnit 2: DynamicsOverview of ForcesTypes of ForcesNewton's First Law of MotionNetwon's Second Law of MotionNetwon's Third Law of MotionFree Body DiagramsFriction as a ForceProblem Solving StrategyAnalyzing ForcesUnit 3: Circular Motion and GravitationAngular Position,Velocity and AccelerationRotational Motion with Constant Angular AccelerationRelationship Between Linear and Angular QuantitiesUniform Circular MotionCentripetal AccelerationUniversal GravitationCalculating Free-Fall AccelerationGravitational ForceOrbital MotionUnit 4: EnergyOverview of Work and EnergyWorkKinetic Energy and WorkPotential EnergyConservative and Non-Conservative ForcesConservative Forces and Potential EnergyEnergy GraphsConservation of Mechanical EnergyPowerUnit 5: MomentumMomentum and ImpulseMomentum of a System of Particles: MomentumCollisions and MomentumInelastic CollisionsElastic CollisionsCollisions in Two DimensionsProblem-Solving Techniques with MomentumUnit 6: Torque And Rotational MotionRotational MotionTorqueCenter of MassRotation Of Point Masses About A Fixed AxisRotational Kinetic EnergyAngular MomentumWork,Power and EnergyRolling MotionUnit 7: Simple Harmonic MotionOverviewOverview of Simple Harmonic MotionValues Related to Simple Harmonic MotionRestoring ForcesEnergy in Simple Harmonic MotionCircular Motion and Simple Harmonic MotionMass-Spring SystemSimple PendulumDamped Harmonic OscillatorUnit 8: Mechanical Waves and SoundWave Motion and PropagationWave Interference and Standing WavesWaves on Strings: Speed of a WaveEnergy Transmitted by a WaveSound WavesThe Doppler EffectResonanceBeatsUnit 9: ElectrostaticsProperties of Electric ChargeCharging ObjectsConductors and InsulatorsCoulomb's LawMultiple Charge ConfigurationsElectric FieldsUnit 10: DC CircuitsElectric CurrentResistanceOhm's LawElectric PowerResistors in SeriesResistor in ParallelKirchhoff's LawsBack to topTechnical RequirementsThis course requires a properly maintained computer with high-speed internet access and an up-to-date web browser (such as Chrome or Firefox). The student must be able to communicate with the instructor via email. Visit the Technical Requirements and Support page for more details.Zoom online virtual classroomThis course uses an online virtual classroom which can be used for instructor-student communication if the student has any questions about the course or curriculum. The classroom works on standard computers with the Zoom desktop client and also tablets or handhelds that support the Zoom Mobile app. Students will need a computer with the Zoom desktop client installed to watch any recorded meetings. The Zoom desktop client and Zoom Mobile App are both available for free download.This course uses Respondus LockDown Browser proctoring software for designated assessments. LockDown Browser is a client application that is installed to a local computer. Visit the Respondus website for system requirements.While Chromebook can be used to progress through the course, all exams must be completed on a PC or Mac. Page 1 AP Physics 1 – Practice Workbook – Book 1 Mechanics, Waves and Sound, Electrostatics and DC Circuits …. The following(© is applicable to this entire document – copies for student distribution for exam preparation explicitly allowed. 1) Copyright © 1973-2009 College Entrance Examination Board. All rights reserved. College Board, Advanced Placement Program, AP, AP Central, AP Vertical Teams, APCD, Pacesetter, Pre-AP, SAT, Student Search Service, and the acorn logo are registered trademarks of the College Entrance Examination Board. PSAT/NMSQT is a registered trademark of the College Entrance Examination Board and National Merit Scholarship Corporation. Educational Testing Service and ETS are registered trademarks of Educational Testing Service. Other products and services may be trademarks of their respective owners. 2) © 1994-2009 AAPT Has a copyright or other licensing restriction. Table of Contents Chapter 1 Kinematics Kinematics Multiple Choice .....6 Kinematics Free Response.....21 Answers to Kinematics Questions .....28 Chapter 2 Dynamics Dynamics Multiple Choice Section A – Linear Dynamics.....39 Section B – Circular Motion.....50 Dynamics Free Response Section A – Linear Dynamics.....56 Section B – Circular Motion.....73 Answers to Dynamics Questions .....80 Chapter 3 Torque Torque Multiple Choice.....99 Torque Free Response.....104 Answers to Torque Questions.....108 Chapter 4 Work, Power and Energy Work, Power and Energy Multiple Choice.....115 Work, Power and Energy Free Response .....121 Answers to Work, Power and Energy Questions.....150 Chapter 5 Momentum and Impulse Momentum and Impulse Multiple Choice .....176 Momentum and Impulse Free Response.....183 Answers to Momentum and Impulse Questions.....203 Chapter 6 Rotational Motion Rotational Motion Multiple Choice .....220 Rotational Motion Free Response.....227 Answers to Rotational Motion Questions.....251 Chapter 7 Gravitation Gravitation Multiple Choice .....268 Gravitation Free Response.....274 Answers to Gravitation Questions .....280 Chapter 8 Oscillations Oscillations Multiple Choice .....288 Oscillations Free Response.....293 Answers to Oscillations Questions .....303 1 Chapter 9 Waves and Sound Waves and Sound Multiple Choice.....316 Waves and Sound Free Response .....321 Answers to Waves and Sound Questions.....324 Chapter 10 Electrostatics Electrostatics Multiple Choice.....332 Electrostatics Free Response.....338 Answers to Electrostatics Questions.....361 Chapter 11 Circuits Circuits Multiple Choice.....378 Circuits Free Response .....393 Answers to Circuits Questions.....412 Appendix 1 AP Lab Questions .....429 2 IMPORTANT: This book is a compilation of all the problems published by College Board in AP Physics B and AP Physics C that were appropriate for the AP B level as well as problems from AAPT's Physics Bowl and U.S. Physics Team Qualifying Exams organized by topic. DISCLAIMER The Multiple Choice Questions in this workbook have been compiled and modified from previous AP Physics B and C examinations and Physics Bowl exams. They are not meant to be representative of the new AP Physics courses. The Free-Response Questions have not been edited and might not represent the topics covered nor the style of questions in the new exams. PLEASE RESPECT YOUR FELLOW TEACHERS AND ABIDE BY COPYRIGHT LAW BY NOT POSTING THIS WORKBOOK AND/OR SECTIONS OF THIS WORKBOOK ONLINE The answers as presented are not the only method to solving many of these problems and physics teachers may present slightly different methods and/or different symbols and variables in each topic, but the underlying physics concepts are the same and we ask you read the solutions with an open mind and use these differences to expand your problem solving skills. Finally, we are fallible and if you find any typographical errors, formatting errors or anything that strikes you as unclear or unreadable, please let us know so we can make the necessary announcements and corrections. 3 Chapter 1 Kinematics 4 5 AP Physics Multiple Choice Practice – Kinematics Questions 1 – 3 relate to two objects that start at x = 0 at t = 0 and move in one dimension independently of one another. Graphs, of the velocity of each object versus time are shown below Object A Object B 1. Which object is farthest from the origin at t = 2 seconds. (A) A (B) B (C) they are in the same location at t = 2 seconds (D) They are the same distance from the origin, but in opposite directions 2. Which object moves with constant non-zero acceleration? (A) A (B) B (C) both A and B (D) neither A nor B 3. Which object is in its initial position at t = 2 seconds? (A) A (B) B (C) both A and B (D) neither A nor B 4. The graph above shows the velocity versus time for an object moving in a straight line. At what time after t = 0 does the object again pass through its initial position? (A) 1 s (B) Between 1 and 2 s (C) 2 s (D) Between 2 and 3 s 5. A body moving in the positive x direction passes the origin at time t = 0. Between t = 0 and t = 1 second, the body has a constant speed of 24 meters per second. At t = 1 second, the body is given a constant acceleration of 6 meters per second squared in the negative x direction. The position x of the body at t = 11 seconds is (A) + 99m (B) + 36m (C) – 36 m (E) – 99 m 6. A diver initially moving horizontally with speed v dives off the edge of a vertical cliff and lands in the water a distance d from the base of the cliff. How far from the base of the cliff would the diver have landed if the diver initially had been moving horizontally with speed 2v? (A) d (B) d 2 (C) 2d (D) 4d 1.0 2.0 1.0 2.0 6 7. A projectile is fired with initial velocity vo at an angle ⚠0 with the horizontal and follows the trajectory shown above. Which of the following pairs of graphs best represents the vertical components of the velocity and acceleration, v and a, respectively, of the projectile as functions of time t? Questions 8-9 A ball is thrown and follows the parabolic path shown above. Air friction is negligible. Point Q is the highest point on the path. Points P and R are the same height above the ground. 8. How do the speeds of the ball at the three points compare? (A) vP < vQ < vR (B) vR < vQ < vP (C) vQ < vR < vP (D) vQ< vP = vR 9. Which of the following diagrams best shows the direction of the acceleration of the ball at point P? (A) (B) (C) (D) 10. The graph above represents position x versus time t for an object being acted on by a constant force. The average speed during the interval between 1 s and 2 s is most nearly (A) 2 m/s (B) 4 m/s (C) 5 m/s (D) 6 m/s 7 Questions 11 – 12 At time t = 0, car X traveling with speed v0 passes car Y which is just starting to move. Both cars then travel on two parallel lanes of the same straight road. The graphs of speed v versus time t for both cars are shown above. 11. Which of the following is true at time t = 20 seconds? (A) Car Y is behind car X. (B) Car Y is passing car X. (C) Car Y is in front of car X. (D) Car X is accelerating faster than car Y. 12. From time t = 0 to time t = 40 seconds, the areas under both curves are equal. Therefore, which of the following is true at time t = 40 seconds? (A) Car Y is behind car X. (B) Car Y is passing car X. (C) Car Y is in front of car X. (d) Car X is accelerating faster than car Y. 13. Which of the following pairs of graphs shows the distance traveled versus time and the speed versus time for an object uniformly accelerated from rest? t Distance Speed t o o (A) t Distance Speed t o o (B) t Distance Speed t o o (C) t Distance Speed t o o (E) 14. Vectors V1 and V2 shown above have equal magnitudes. The vectors represent the velocities of an object at times t1, and t2, respectively. The average acceleration of the object between time t1 and t2 was (A) directed north (B) directed west (C) directed north of east (D) directed north of west (D) 8 15. The velocity of a projectile at launch has a horizontal component vh and a vertical component vv. Air resistance is negligible. When the projectile is at the highest point of its trajectory, which of the following shows the vertical and horizontal components of its velocity and the vertical component of its acceleration? Vertical Horizontal Vertical Velocity Velocity Acceleration (A) vv vh 0 (B) 0 vh 0 (C) 0 0 g (D) 0 vh g 16. The graph above shows the velocity v as a function of time t for an object moving in a straight line. Which of the following graphs shows the corresponding displacement x as a function of time t for the same time interval? 17. A target T lies flat on the ground 3 m from the side of a building that is 10 m tall, as shown above. A student rolls a ball off the horizontal roof of the building in the direction of the target. Air resistance is negligible. The horizontal speed with which the ball must leave the roof if it is to strike the target is most nearly (A) 3/10 m/s (B) 2 m/s (C) 2 3 m/s (D) 3 m/s 18. The graph above shows velocity v versus time t for an object in linear motion. Which of the following is a possible graph of position x versus time t for this object? (A) (B) (C) (D) 9 19. A student is testing the kinematic equations for uniformly accelerated motion by measuring the time it takes for light-weight plastic balls to fall to the floor from a height of 3 m in the lab. The student predicts the time to fall using g as 9.80 m/s2 but finds the measured time to be 35% greater. Which of the following is the most likely cause of the large percent error? (A) The acceleration due to gravity is 70% greater than 9.80 m/s2 at this location. (B) The acceleration due to gravity is 70% less than 9.80 m/s2 at this location. (C) Air resistance increases the downward acceleration. (D) The acceleration of the plastic balls is not uniform. 20. An object is thrown with velocity v from the edge of a cliff above level ground. Neglect air resistance. In order for the object to travel a maximum horizontal distance from the cliff before hitting the ground, the throw should be at an angle θ with respect to the horizontal of (A) greater than 60° above the horizontal (B) greater than 45° but less than 60° above the horizontal (C) greater than zero but less than 45° above the horizontal (D) greater than zero but less than 45° below the horizontal 21. Starting from rest at time t = 0, a car moves in a straight line with an acceleration given by the accompanying graph. What is the speed of the car at t = 3 s? (A) 1.0 m/s (B) 2.0 m/s (C) 6.0 m/s (D) 10.5 m/s 22. A child left her home and started walking at a constant velocity. After a time she stopped for a while and then continued on with a velocity greater than she originally had. All of a sudden she turned around and walked very quickly back home. Which of the following graphs best represents the distance versus time graph for her walk? (A) (B) (C) (D) 23. A whiffle ball is tossed straight up, reaches a highest point, and falls back down. Air resistance is not negligible. Which of the following statements are true? I. The ball's speed is zero at the highest point. II. The ball's acceleration is zero at the highest point. III. The ball takes a longer time to travel up to the highest point than to fall back down. (A) I only (B) II only (C) I & II only (D) I & III only 10 24. Above is a graph of the distance vs. time for car moving along a road. According the graph, at which of the following times would the automobile have been accelerating positively? (A) 0, 20, 38, & 60 min. (B) 5, 12, 29, & 35 min. (C) 5, 29, & 57 min. (D) 12, 35, & 41 min. 25. A large beach ball is dropped from the ceiling of a school gymnasium to the floor about 10 meters below. Which of the following graphs would best represent its velocity as a function of time? (do not neglect air resistance) (A) (B) (C) (D Questions 26-27 A car starts from rest and accelerates as shown in the graph below. 26. At what time would the car be moving with the greatest velocity? (B) 2 seconds (C) 4 seconds (D) 6 seconds (E) 8 seconds 27. At what time would the car be farthest from its original starting position? (A) 2 seconds (B) 4 seconds (C) 6 seconds (D) 8 seconds 28. Which of the following sets of graphs might be the corresponding graphs of Position, Velocity, and Acceleration vs. Time for a moving particle? (A) (B) (C) (D) 11 29. An object is thrown with a fixed initial speed v0 at various angles α relative to the horizon. At some constant height h above the launch point the speed v of the object is measured as a function of the initial angle α. Which of the following best describes the dependence of v on α? (Assume that the height h is achieved, and assume that there is no air resistance.) (A) v will increase monotonically with α. (B) v will increase to some critical value vmax and then decrease. (C) v will remain constant, independent of α. (D) v will decrease to some critical value vmin and then increase. 30. The position vs. time graph for an object moving in a straight line is shown below. What is the instantaneous velocity at t = 2 s? (A) – 2 m/s (B) ½ m/s (C) 0 m/s (D) 2 m/s 31. Shown below is the velocity vs. time graph for a toy car moving along a straight line. What is the maximum displacement from start for the toy car? (A) 5 m (B) 6.5 m (C) 7 m (D) 7.5 m 32. An object is released from rest and falls a distance h during the first second of time. How far will it fall during the next second of time? (A) h (B) 2h (C) 3h (D) 4h 33. Two identical bowling balls A and B are each dropped from rest from the top of a tall tower as shown in the diagram below. Ball A is dropped 1.0 s before ball B is dropped but both balls fall for some time before ball A strikes the ground. Air resistance can be considered negligible during the fall. After ball B is dropped but before ball A strikes the ground, which of the following is true? 12 (A) The distance between the two balls decreases. (B) The velocity of ball A increases with respect to ball (B) (C) The velocity of ball A decreases with respect to ball (B) (D) The distance between the two balls increases. 34. The diagram below shows four cannons firing shells with different masses at different angles of elevation. The horizontal component of the shell's velocity is the same in all four cases. In which case will the shell have the greatest range if air resistance is neglected? (A) cannon A (B) cannon B only (C) cannon C only (D) cannon D 35. Starting from rest, object 1 falls freely for 4.0 seconds, and object 2 falls freely for 8.0 seconds. Compared to object 1, object 2 falls: (A) half as far (B) twice as far (C) three times as far (D) four times as far 36. A car starts from rest and uniformly accelerates to a final speed of 20.0 m/s in a time of 15.0 s. How far does the car travel during this time? (A) 150 m (B) 300 m (C) 450 m (D) 600 m 37. An arrow is aimed horizontally, directly at the center of a target 20 m away. The arrow hits 0.050 m below the center of the target. Neglecting air resistance, what was the initial speed of the arrow? (A) 20 m/s (B) 40 m/s (C) 100 m/s (D) 200 m/s 38. A rocket near the surface of the earth is accelerating vertically upward at 10 m/s2. The rocket releases an instrument package. Immediately after release the acceleration of the instrument package is: (A) 20 m/s2 up (B) 10 m/s2 up (C) 0 (D) 10 m/s2 down 39. A ball which is dropped from the top of a building strikes the ground with a speed of 30 m/s. Assume air resistance can be ignored. The height of the building is approximately: (A) 15 m (B) 30 m (C) 45 m (D) 75 m 40. In the absence of air resistance, if an object were to fall freely near the surface of the Moon, (A) its acceleration would gradually decrease until the object moves with a terminal velocity. (B) the acceleration is constant. (C) it will fall with a constant speed. (D) the acceleration is zero 13