CollegeBoard AP

AP PHYSICS C: MECHANICS

AP Pacing Guide for Flipped Classrooms: Jan.–April 2021

Overview

Due to the challenges associated with hybrid and remote learning in 2020-21, a significant amount of the content and skills colleges are requiring for credit will likely need to be assigned to students as homework or independent learning. This guide allows students who are currently behind to complete all course topics from the course and exam description by May. This guide assumes students will complete approximately 30 minutes of AP Daily videos (~10 minutes each) and topic questions each day in lieu of, or addition to, assignments the teacher would ordinarily give.

How to Implement

Here is guidance for implementing this pacing guide:

- Teachers should **assign the AP Daily videos and topic questions** listed below as student assignments each week.
- Using the reports generated by the topic questions, teachers should focus their limited, direct class time on the Learning Objectives where students need more help.
- If students are ahead of the pace indicated below, teachers will be able to incorporate additional days or weeks to spend more time on challenging topics, practicing course skills, or reviewing for the exam.

Week 1: Jan. 4–8

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
1.1	Kinematics: Motion in One Dimension	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3	CHA-1.A: a. Determine the appropriate expressions for velocity and position as a function of time for an object accelerating uniformly in one dimension with given initial conditions. b. Calculate unknown variables of motion such as acceleration, velocity, or positions for an object undergoing uniformly accelerated motion in one dimension. *(continued on next page)*	Topic Questions

*Prioritize the most challenging Learning Objectives for your students for direct, synchronous instruction.

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
1.1	Kinematics: Motion in One Dimension	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3	c. Calculate values such as average velocity or minimum or maximum velocity for an object in uniform acceleration. CHA-1.B: Determine functions of position, velocity, and acceleration that are consistent with each other, for the motion of an object with a nonuniform acceleration. CHA-1.C: Describe the motion of an object in terms of the consistency that exists between position and time, velocity and time, and acceleration and time.	Topic Questions

Week 2: Jan. 11–15

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
1.2	Kinematics: Motion in Two Dimensions	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3	CHA-2.A: a. Calculate the components of a velocity, position, or acceleration vector in two dimensions. b. Calculate a net displacement of an object moving in two dimensions. c. Calculate a net change in velocity of an object moving in two dimensions. d. Calculate an average acceleration vector for an object moving in two dimensions. e. Calculate a velocity vector for an object moving relative to another object (or frame of reference) that moves with a uniform velocity. f. Describe the velocity vector for one object relative to a second object with respect to its frame of reference. CHA-2.B: Derive an expression for the vector position, velocity, or acceleration of a particle, at some point in its trajectory, using a vector expression or using two simultaneous equations. *(continued on next page)*	Topic Questions Personal Progress Check

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
1.2	Kinematics: Motion in Two Dimensions	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3	CHA-2.C: Calculate kinematic quantities of an object in projectile motion, such as displacement, velocity, speed, acceleration, and time, given initial conditions of various launch angles, including a horizontal launch at some point in its trajectory. CHA-2.D: Describe the motion of an object in two-dimensional motion in terms of the consistency that exists between position and time, velocity and time, and acceleration and time.	Topic Questions Personal Progress Check

Weeks 3 and 4: Jan. 18–29

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
2.1	Newton's Laws of Motion: First and Second Law	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4 AP Daily Video 5	INT-1.A: Describe an object (either in a state of equilibrium or acceleration) in different types of physical situations such as inclines, falling through air resistance, Atwood machines, or circular tracks. INT-1.B: a. Explain Newton's first law in qualitative terms and apply the law to many different physical situations. b. Calculate a force of unknown magnitude acting on an object in equilibrium. INT-1.C: a. Calculate the acceleration of an object moving in one dimension when a single constant force (or a net constant force) acts on the object during a known interval of time. b. Calculate the average force acting on an object moving in a plane with a velocity vector that is changing over a specified time interval. c. Describe the trajectory of a moving object that experiences a constant force in a direction perpendicular to its initial velocity vector. d. Derive an expression for the net force on an object in translational motion. *(continued on next page)*	Topic Questions

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
2.1	Newton's Laws of Motion: First and Second Law	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4 AP Daily Video 5	e. Derive a complete Newton's second law statement (in the appropriate direction) for an object in various physical dynamic situations (e.g., mass on incline, mass in elevator, strings/ pulleys, or Atwood machines). INT-1.D: Calculate a value for an unknown force acting on an object accelerating in a dynamic situation (e.g., inclines, Atwood machines, falling with air resistance, pulley systems, mass in elevator, etc.). INT-1.E: a. Describe the relationship between frictional force and the normal force for static friction and for kinetic friction. b. Explain when to use the static frictional relationship versus the kinetic frictional relationship in different physical situations (e.g., object sliding on surface or object not slipping on incline). INT-1.F: Describe the direction of frictional forces (static or kinetic) acting on an object under various physical situations. INT-1.G: a. Derive expressions that relate mass, forces, or angles of inclines for various slipping conditions with friction. b. Calculate the value for the static frictional force for an object in various dynamic situations (e.g., an object at rest on truck bed, an object at rest on incline, or an object pinned to a horizontal surface). INT-1.H: a. Derive an expression for the motion of an object freely falling with a resistive drag force (or moving horizontally subject to a resistive horizontal force). b. Describe the acceleration, velocity, or position in relation to time for an object subject to a resistive force (with different initial conditions, i.e., falling from rest or projected vertically). INT-1.I: Calculate the terminal velocity of an object moving vertically under the influence of a resistive force of a given relationship. *(continued on next page)*	Topic Questions

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
2.1	Newton's Laws of Motion: First and Second Law	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4 AP Daily Video 5	INT-1.J: a. Derive a differential equation for an object in motion subject to a specified resistive force. b. Derive an expression for a time-dependent velocity function for an object moving under the influence of a given resistive force (with given initial conditions). c. Derive expressions for the acceleration or position of an object moving under the influence of a given resistive force.	Topic Questions

Week 5: Feb. 1–5

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
2.2	Circular Motion	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-2.A: a. Calculate the velocity of an object moving in a horizontal circle with a constant speed, when subject to a known centripetal force. b. Calculate relationships among the radius of a circle, the speed of an object (or period of revolution), and the magnitude of centripetal acceleration for an object moving in uniform circular motion. INT-2.B: a. Explain how a net force in the centripetal direction can be a single force, more than one force, or even components of forces that are acting on an object moving in circular motion. b. Describe forces that are exerted on objects undergoing horizontal circular motion, vertical circular motion, or horizontal circular motion on a banked curve. c. Describe forces that are acting on different objects traveling in different circular paths. *(continued on next page)*	Topic Questions

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
2.2	Circular Motion	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-2.C: a. Describe the direction of the velocity and acceleration vector for an object moving in two dimensions, circular motion, or uniform circular motion. b. Calculate the resultant acceleration for an object that changes its speed as it moves in a circular path. INT-2.D: Derive expressions relating centripetal force to the minimum speed or maximum speed of an object moving in a vertical circular path. INT-2.E: Derive expressions relating the centripetal force to the maximum speed of an object or minimum speed of an object moving in a circular path on a banked surface with friction.	Topic Questions

Week 6: Feb. 8–12

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
2.3	Newton's Laws of Motion: Third Law	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-3.A: a. Describe the forces of interaction between two objects (Newton's third law). b. Describe pairs of forces that occur in a physical system due to Newton's third law. c. Describe the forces that occur between two (or more) objects accelerating together (e.g., in contact or connected by light strings, springs, or cords). INT-3.B: Derive expressions that relate the acceleration of multiple connected masses moving in a system (e.g., Atwood machines) connected by light strings with tensions (and pulleys).	Topic Questions

Week 7: Feb. 15–19

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
3.1	Work-Energy Theorem	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-4.A: a. Calculate work done by a given force (constant or as a given function *F(x)*) on an object that undergoes a specified displacement. b. Describe the work done on an object as the result of the scalar product between force and displacement. c. Explain how the work done on an object by an applied force acting on an object can be negative or zero. INT-4.B: Calculate a value for work done on an object from a force versus position graph. INT-4.C: a. Calculate the change in kinetic energy due to the work done on an object or system by a single force or multiple forces. b. Calculate the net work done on an object that undergoes a specified change in speed or change in kinetic energy. c. Calculate changes in an object's kinetic energy or changes in speed that result from the application of specified forces.	Topic Questions

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
3.2	Forces and Potential Energy	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	CON-1.A: a. Compare conservative and dissipative forces. b. Describe the role of a conservative force or a dissipative force in a dynamic system. CON-1.B: a. Explain how the general relationship between potential energy functions and conservative forces are used to determine relationships between the two physical quantities. b. Derive an expression that represents the relationship between a conservative force acting in a system on an object to the potential energy of the system using the methods of calculus. CON-1.C: Describe the force within a system and the potential energy of a system. CON-1.D: a. Derive the expression for the potential energy function of an ideal spring. b. Derive an expression for the potential energy function of a nonideal spring that has a nonlinear relationship with position. CON-1.E: Calculate the potential energy of a system consisting of an object in a uniform gravitational field. CON-1.F: Derive an expression for the gravitational potential energy of a system consisting of a satellite or large mass (e.g., an asteroid) and the Earth at a great distance from the Earth.	Topic Questions

Week 8: Feb. 22–26

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
3.3	Conservation of Energy	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	CON-2.A: a. Describe physical situations in which mechanical energy of an object in a system is converted to other forms of energy in the system. b. Describe physical situations in which the total mechanical energy of an object in a system changes or remains constant. CON-2.B: Describe kinetic energy, potential energy, and total energy in relation to time (or position) for a "conservative" mechanical system. CON-2.C: a. Calculate unknown quantities (e.g., speed or positions of an object) that are in a conservative system of connected objects, such as the masses in an Atwood machine, masses connected with pulley/string combinations, or the masses in a modified Atwood machine. b. Calculate unknown quantities, such as speed or positions of an object that is under the influence of an ideal spring. c. Calculate unknown quantities, such as speed or positions of an object that is moving under the influence of some other nonconstant one-dimensional force. CON-2.D: Derive expressions such as positions, heights, angles, and speeds for an object in vertical circular motion or pendulum motion in an arc.	Topic Questions
3.4	Power	AP Daily Video 1 AP Daily Video 2	CON-3.A: a. Derive an expression for the rate at which a force does work on an object. b. Calculate the amount of power required for an object to maintain a constant acceleration. c. Calculate the amount of power required for an object to be raised vertically at a constant rate.	Topic Questions Personal Progress Check

Week 9: Mar. 1–5

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
4.1	Center of Mass	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3	CHA-3.A: a. Calculate the center of mass of a system of point masses or a system of regular symmetrical objects. b. Calculate the center of mass of a thin rod of nonuniform density using integration. CHA-3.B: Describe the motion of the center of the mass of a system for various situations. CHA-3.C: Explain the difference between the terms “center of gravity” and “center of mass,” and identify physical situations when these terms have identical positions and when they have different positions.	Topic Questions
4.2	Impulse and Momentum	AP Daily Video 1 AP Daily Video 2	INT-5.A: a. Calculate the total momentum of an object or system of objects. b. Calculate relationships between mass, velocity, and linear momentum of a moving object. INT-5.B: Calculate the quantities of force, time of collision, mass, and change in velocity from an expression relating impulse to change in linear momentum for a collision of two objects. INT-5.C: Describe relationships between a system of objects’ individual momenta and the velocity of the center of mass of the system of objects. INT-5.D: Calculate the momentum change in a collision using a force versus time graph for a collision. INT-5.E: Calculate the change in momentum of an object given a nonlinear function, $F(t)$, for a net force acting on the object.	Topic Questions

Week 10: Mar. 8–12

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
4.3	Conservation of Linear Momentum, Collisions	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	CON-4.A: a. Calculate the velocity of one part of a system after an explosion or collision of the system. b. Calculate energy changes in a system that undergoes a collision or an explosion. CON-4.B: Calculate the changes of momentum and kinetic energy as a result of a collision between two objects. CON-4.C: Describe the quantities that are conserved in a collision. CON-4.D: Calculate the speed of the center of mass of a system. CON-4.E: a. Calculate the changes in speeds, changes in velocities, changes in kinetic energy, or changes in momenta of objects in all types of collisions (elastic or inelastic) in one dimension, given the initial conditions of the objects. b. Derive expressions for the conservation of momentum for a particular collision in one dimension. CON-4.F: a. Calculate the changes in speeds, changes in velocities, changes in kinetic energy, or changes in momenta of objects involved in a two- dimensional collision (including an elastic collision), given the initial conditions of the objects. b. Derive expressions for the conservation of momentum for a particular two-dimensional collision of two objects.	Topic Questions Personal Progress Check

Week 11: Mar. 15–19

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
5.1	Torque and Rotational Statics	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-6.A: a. Calculate the magnitude and direction of the torque associated with a given force acting on a rigid body system. b. Calculate the torque acting on a rigid body due to the gravitational force. INT-6.B: a. Describe the two conditions of equilibrium for an extended rigid body. b. Calculate unknown magnitudes and directions of forces acting on an extended rigid body that is in a state of translational and rotational equilibrium. INT-6.C: a. Explain the differences in the moments of inertia between different objects such as rings, discs, spheres, or other regular shapes by applying the general definition of moment of inertia (rotational inertia) of a rigid body. b. Calculate by what factor an object's rotational inertia will change when a dimension of the object is changed by some factor. c. Calculate the moment of inertia of point masses that are located in a plane about an axis perpendicular to the plane. INT-6.D: a. Derive the moment of inertia, using calculus, of a thin rod of uniform density about an arbitrary axis perpendicular to the rod. b. Derive the moment of inertia, using calculus, of a thin rod of nonuniform density about an arbitrary axis perpendicular to the rod. c. Derive the moments of inertia for a thin cylindrical shell or disc about its axis or an object that can be considered to be made up of coaxial shells (e.g., annular ring). INT-6.E: Derive the moments of inertia of an extended rigid body for different rotational axes (parallel to an axis that goes through the object's center of mass) if the moment of inertia is known about an axis through the object's center of mass.	Topic Questions

Week 12: Mar. 22–26

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
5.2	Rotational Kinematics	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3	CHA-4.A: a. Explain how the angular kinematic relationships for uniform angular acceleration are directly analogous to the relationships for uniformly linearly accelerated motion. b. Calculate unknown quantities such as angular positions, displacement, angular speeds, or angular acceleration of a rigid body in uniformly accelerated motion, given initial conditions. c. Calculate unknown quantities such as angular positions, displacement, angular velocity, or rotational kinetic energy of a rigid body rotating with a specified nonuniform angular acceleration. CHA-4.B: a. Explain the use of the relationships that connect linear translational motion to rotational motion in appropriate physical situations. b. Calculate the translational kinematic quantities from an object's rotational kinematic quantities for objects that are rolling without slipping. c. Calculate the (tangential) linear acceleration of a point on a rotating object given the object's angular acceleration.	Topic Questions

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
5.3	Rotational Dynamics and Energy	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-7.A: a. Describe the complete analogy between fixed axis rotation and linear translation for an object subject to a net torque. b. Calculate unknown quantities such as net torque, angular acceleration, or moment of inertia for a rigid body undergoing rotational acceleration. c. Calculate the angular acceleration of an extended rigid body, of known moment of inertia, about a fixed axis or about its center of mass when it is experiencing a specified net torque due to one or several applied forces. INT-7.B: a. Describe the net torque experienced by a rigid extended body in situations such as, but not limited to, rolling down inclines, pulled along horizontal surfaces by external forces, a pulley system (with rotational inertia), simple pendulums, physical pendulums, and rotating bars. b. Derive an expression for all torques acting on a rigid body in various physical situations using Newton's second law of rotation. INT-7.C: Derive expressions for physical systems such as Atwood machines, pulleys with rotational inertia, or strings connecting discs or strings connecting multiple pulleys that relate linear or translational motion characteristics to the angular motion characteristics of rigid bodies in the system that are— a. rolling (or rotating on a fixed axis) without slipping. b. rotating and sliding simultaneously. INT-7.D: a. Calculate the rotational kinetic energy of a rotating rigid body. b. Calculate the total kinetic energy of a rolling body or a body that has both translation and rotational motion. c. Calculate the amount of work done on a rotating rigid body by a specified force applied to the rigid body over a specified angular displacement. *(continued on next page)*	Topic Questions

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
5.3	Rotational Dynamics and Energy	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	INT-7.E: Derive expressions using energy conservation principles for physical systems such as rolling bodies on inclines, Atwood machines, pendulums, physical pendulums, and systems with massive pulleys that relate linear or angular motion characteristics to initial conditions (such as height or position) or properties of rolling body (such as moment of inertia or mass).	Topic Questions

Week 13: Mar. 29–Apr. 2

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
5.4	Angular Momentum and Its Conservation	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	CON-5.A: a. Calculate the angular impulse acting on a rotating rigid body given specified angular properties or forces acting over time intervals. b. Calculate the angular momentum vector of a rotating rigid body in cases in which the vector is parallel to the angular velocity vector. CON-5.B: Calculate the angular momentum vector of a linearly translating particle about a defined stationary point of reference. CON-5.C: a. Describe the conditions under which a rotating system's angular momentum is conserved. b. Explain how a one- or two-particle system (rotating object or satellite orbits) may have a change in angular velocity when other properties of the system change (such as radius or inertia). CON-5.D: a. Calculate changes in angular velocity of a rotating rigid body when the moment of inertia of the body changes during the motion (such as a satellite in orbit). *(continued on next page)*	Topic Questions Personal Progress Check

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
5.4	Angular Momentum and Its Conservation	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4	b. Calculate the increase or decrease in angular momentum of a rigid body when a point mass particle has a collision with the rigid body. c. Calculate the changes of angular momentum of each disc in a rotating system of two rotating discs that collide with each other inelastically about a common rotational axis.	Topic Questions Personal Progress Check

Week 14: Apr. 5–9

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
6.1	Simple Harmonic Motion, Springs, and Pendulums	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4 AP Daily Video 5 AP Daily Video 6 AP Daily Video 7	INT-8.A: a. Describe the general behavior of a spring-mass system in SHM in qualitative terms. b. Describe the relationship between the phase angle and amplitude in an SHM system. INT-8.B: a. Describe the displacement in relation to time for a mass-spring system in SHM. b. Identify the period, frequency, and amplitude of the SHM in a mass-spring system from the features of a plot. INT-8.C: Describe each of the three kinematic characteristics of a spring-mass system in SHM in relation to time (displacement, velocity, and acceleration). For a spring-mass system in SHM— a. describe the general features of the motion and b. identify the places on a graph where these values are zero or have maximum positive values or maximum negative values. *(continued on next page)*	Topic Questions Personal Progress Check

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
6.1	Simple Harmonic Motion, Springs, and Pendulums	AP Daily Video 1 AP Daily Video 2 AP Daily Video 3 AP Daily Video 4 AP Daily Video 5 AP Daily Video 6 AP Daily Video 7	INT-8.D: Derive a differential equation to describe Newton's second law for a spring-mass system in SHM or for the simple pendulum. INT-8.E: Calculate the position, velocity, or acceleration of a spring-mass system in SHM at any point in time or at any known position from the initial conditions and known spring constant and mass. INT-8.F: Derive the expression for the period of oscillation for various physical systems oscillating in SHM. INT-8.G: Calculate the mechanical energy of an oscillating system. Show that this energy is conserved in an ideal SHM spring-mass system. INT-8.H: Describe the effects of changing the amplitude of a spring-mass system. INT-8.I: Describe the kinetic energy as a function of time (or position), potential energy as a function of time (or position), and total mechanical energy as a function of time (or position) for a spring-mass system in SHM, identifying important features of the oscillating system and where these features occur. INT-8.J: Explain how the model of SHM can be used to determine characteristics of motion for other physical systems that can exhibit this behavior. INT-8.K: Describe a linear relationship between the period of a system oscillating in SHM and physical constants of the system.	Topic Questions Personal Progress Check

Week 15: Apr. 12–16

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
7.1	Gravitational Forces	AP Daily Video TBD	FLD-1.A: Calculate the magnitude of the gravitational force between two large spherically symmetrical masses. FLD-1.B: Calculate the value for *g* or gravitational acceleration on the surface of the Earth (or some other large planetary object) and at other points outside of the Earth. FLD-1.C: Describe the motion in a qualitative way of an object under the influence of a variable gravitational force, such as in the case where an object falls toward the Earth's surface when dropped from distances much larger than the Earth's radius.	Topic Questions
7.2	Orbits of Planets and Satellites	AP Daily Video TBD	CON-6.A: Calculate quantitative properties (such as period, speed, radius of orbit) of a satellite in circular orbit around a planetary object. CON-6.B: Derive Kepler's third law for the case of circular orbits. CON-6.C: Describe a linear relationship to verify Kepler's third law. CON-6.D: Calculate the gravitational potential energy and the kinetic energy of a satellite/Earth system in which the satellite is in circular orbit around the earth. CON-6.E: Derive the relationship of total mechanical energy of a satellite/earth system as a function of radial position. *(continued on next page)*	Topic Questions Personal Progress Check

Topic		Recommended Asynchronous Student Assignments	Options for Synchronous Instructional Focus*	Check for Understanding
7.2	Orbits of Planets and Satellites	AP Daily Video TBD	CON-6.F: a. Derive an expression for the escape speed of a satellite using energy principles. b. Describe the motion of a satellite launched straight up (or propelled toward the planet) from the planet's surface, using energy principles. CON-6.G: Calculate positions, speeds, or energies of a satellite launched straight up from the planet's surface, or a satellite that is projected straight toward the planet's surface, using energy principles. CON-6.H: Describe elliptical satellite orbits using Kepler's three laws of planetary motion. CON-6.I: a. Calculate the orbital distances and velocities of a satellite in elliptical orbit using the conservation of angular momentum. b. Calculate the speeds of a satellite in elliptical orbit at the two extremes of the elliptical orbit (perihelion and aphelion).	Topic Questions Personal Progress Check