AP Physics C: Mechanics
Instructor: Mr. Butler

Independent Study Assignment Itinerary
Note Milestone Due Dates!

Gravitation w/Kepler's Laws
MyAP: Unit 7
Text: Chapter 13

Days 1-2 >

Milestone Due Date: Sunday 3-5

Text

Read Sections 1 and 2.

Objectives: 1. Describe gravity in terms of a field and understand its universal nature.

2. Understand which quantities are involved in Newton's Law of Gravitation and describe how a change in each factor affects the strength of the gravitational force between two objects. Recognize gravity between objects as a 3rd law force pair. Be able to apply Equation 13-1 to solve gravitation problems.
3. Understand what the universal gravitational constant is and describe the features of Cavendish's experiment to determine the value for *G*.
4. Apply vector algebra to determine the magnitude and direction of the resultant gravitational force acting on an object due to two or more other objects.
5. Define *weight* in terms of gravity, understand how to determine the acceleration due to gravity, *g* for any distance and/or mass (Equations 13.3 and 13.4) and understand the inverse-square functionality of the gravitational force with respect to distance from a body (Graph in Figure 13.8).

Exercises/Problems: 13.1, 13.5, 13.8, 13.11, 13.15, 13.47.

MyAP

1. 7.1: Daily Video 1
2. 7.1: Daily Video 2
3. Quiz: Gravitation (Days 1-2)

Days 3-4 >

Milestone Due Date: Sunday 3-19

Text

Read Section 3.

Objectives: 1. Understand the work done by the gravitational force in the integral calculus derivation for the general expression for gravitational potential energy, (Equations 13.6, 13.8 and 13.9).

2. Understand the functional relationship between GPE and distance (Graph 13.11) and why GPE decreases and becomes more negative when r increases.
3. Incorporate GPE into energy conservation and apply these combined principles to calculate the escape speed for a body.
4. Understand the relationship between gravitational force on a body and its associated gravitational potential energy (Equation 13.9) and the work this force does on the body when it moves in the gravitational field (Equation 13.8).

Exercises/Problems: 13.16, 13.18, 13.79.

MyAP

1. 7.1: Daily Video 3
2. Quiz: Gravitation (Days 3-4)

Days 5-6 >

Milestone Due Date: Sunday 4-2

Text

Read Section 4.

Objectives: 1. Describe the motion of natural as well as artificial satellites in terms of Newton's projectile model (Figure 13.14) and free-fall motion.
2. Distinguish between open and closed orbits in terms of their specific trajectory speeds and the circular or elliptical orbit path produced by each.
3. From Newton's 2nd law centripetal force and gravitation equations, derive an expression for the minimum orbital speed of a satellite (Equation 13.10). Refer to Figure 13.15 that describes the vector quantities involved in a circular orbit at constant speed.
4. Understand the derivation of the expression for a satellite's orbital period, (Equation 13.12) and be able to apply this to solve problems.
5. Understand the principle for total mechanical energy of a circular orbit, (Equation 13.13); noting that increasing orbital radius makes E less negative!

Exercises/Problems: 13.19, 13.21, 13.22.

MyAP

1. 7.2: Daily Video 1
2. 7.2: Daily Video 2
3. Quiz: Gravitation (Days 5-6)

Days 7-8 >

Milestone Due Date: Sunday 4-23

Text

Read Section 5.

Objectives: 1. Be able to state and explain each of Kepler's three laws of planetary motion.
2. Describe the geometry of ellipses in terms of the foci, major axis, semi-major axis and eccentricity (Figure 13.18) and understand the relationship between the 'flatness' of an ellipse and its eccentricity value.
3. Be able to define and identify the *aphelion* and *perihelion* points in an orbit.
4. Understand the relation that Newton found between the $1/r^2$ attractive gravitational force and the resulting possible closed and open orbit trajectories; circular, elliptical, parabolic and hyperbolic.
5. Understand how angular momentum conservation of a planet about the sun gives rise to Kepler's 2nd law in the variable nature of the rate of change of angular displacement at different orbital points and the constancy of a planet's orbital sector velocity (Equations 13.14 thru 13.16 and Figure 13.19).
6. Understand Kepler's 3rd law and apply Equation 13.17 to calculate the circular or elliptical orbital period of a planetary body (planet, natural satellite, comet or asteroid) as well as an artificial satellite.
7. Explain *Newtonian synthesis* and describe how Kepler's laws support and validate Newton's laws of motion and gravity.

Exercises/Problems: 13.25, 13.26, 13.46, 13.73.

MyAP

1. 7.2: Daily Video 3
2. Quiz: Gravitation (Days 7-8)

Days 9-10 >

Milestone Due Date: Sunday 5-7

Text

Read Section 7.

Objectives: 1. Distinguish between *apparent* and *true* weight and identify the direction of net force acting on a body at the earth's surface.

2. Using vector analysis, identify the direction of the centripetal acceleration of an object at the earth's surface, describe how the earth's rotation produces differences in the *apparent* and *true* gravitational accelerations and identify the direction of an object's *apparent* and *true* weights at a given latitude (Figure 13.25).
3. Use the *true* weight and centripetal force to calculate an object's *apparent* weight at the equator (Equation 13.27) or at a given latitude (Equation 13.28).
4. Examine Table 13.1 to observe and compare how *g* values vary with latitude.

Exercises/Problems: 13.34, 13.35, 13.61.

MyAP

No Assignment