AP Physics 1 Unit Plan Spring 2020

Unit Five: Momentum, Impulse, & Collisions

AP Standards to be covered:

**3.D.1.1:** The student is able to justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force. **[SP 4.1]**

**3.D.2.1:** The student is able to justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction. **[SP 2.1]**

**3.D.2.2:** The student is able to predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. **[SP 6.4]**

**3.D.2.3:** The student is able to analyze data to characterize the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. **[SP 5.1]**

**3.D.2.4:**  The student is able to design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time. **[SP 4.2]**

**4.B.1.1:** The student is able to calculate the change in linear momentum of a two-object system with constant mass in linear motion from a representation of the system (data, graphs, etc.). **[SP 1.4, 2.2]**

**4.B.1.2:** The student is able to analyze data to find the change in linear momentum for a constant-mass system using the product of the mass and the change in velocity of the center of mass. **[SP 5.1]**

**4.B.2.1:** The student is able to apply mathematical routines to calculate the change in momentum of a system by analyzing the average force exerted over a certain time on the system. **[SP 2.2]**

**4.B.2.2:** The student is able to perform analysis on data presented a force-time graph and predict the change in momentum of a system. **[SP 5.1]**

**5.A.2.1:** The student is able to define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations. **[SP 6.4, 7.2]**

**5.D.1.1:** The student is able to make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions. **[SP 6.4, 7.2]**

**5.D.1.2:** The student is able to apply the principles of conservation of momentum and restoration of kinetic energy to reconcile a situation that appears to be isolated and elastic, but in which data indicate that linear momentum and kinetic energy are not the same after the interaction, by refining a scientific question to identify interactions that have not been considered. Students will be expected to solve qualitatively and/or quantitatively for one-dimensional situations and only qualitatively in two-dimensional situations. **[SP 2.2, 3.2, 5.1, 5.3]**

**5.D.1.3:** The student is able to apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy. **[SP 2.1, 2.2]**

**5.D.1.4:** The student is able to design an experimental test of an application of the principle of conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome. **[SP 4.2, 5.1, 5.3, 6.4]**

**5.D.1.5:** The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values. **[SP 2.1, 2.2]**

**5.D.2.1:** The student is able to qualitatively predict, in terms of linear momentum and kinetic energy, how the outcome of a collision between two objects changes depending on whether the collision is elastic or inelastic. **[SP 6.4, 7.2]**

**5.D.2.2:** The student is able to plan data collection strategies to test the law of conservation of momentum in a two-object collision that is elastic or inelastic and analyze the resulting data graphically. **[SP 4.1, 4.2, 5.1]**

**5.D.2.3:** The student is able to apply the conservation of linear momentum to a closed system of objects involved in an inelastic collision to predict the change in kinetic energy. **[SP 6.4, 7.2]**

**5.D.2.4:** The student is able to analyze data that verify conservation of momentum in collisions with and without an external friction force. **[SP 4.1, 4.2, 4.4, 5.1, 5.3]**

**5.D.2.5:** The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum as the appropriate solution method for an inelastic collision, realize that there is a common final velocity for the colliding objects in the totally inelastic case, solve for missing variables, and calculate their values. **[SP 2.1, 2.2]**

Topics to be covered:

Momentum

Impulse

Conservation of Momentum

Elastic Collisions

Inelastic Collisions

Agenda:

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| --- | --- | --- | --- | --- |
| Day | Date | EQ | Agenda | Std’s |
| 1 | 3/16  MON |  | * Notes: Momentum & impulse * Problem set: MOMENTUM & IMPULSE PRACTICE PROBLEMS DAY 1 | **3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3** |
| 2 | 3/17  TUE | How do momentum and impulse relate? | * Problem set: IMPULSE PRACTICE PROBLEMS DAY 2 | **3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3** |
| 3 | 3/18  WED | How do momentum and impulse relate? | * nTIPPERS: Momentum & Impulse DAY 3 * Notes: Conservation of Momentum | **3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3** |
| 4 | 3/119  THU | How is momentum and energy conservation seen experimentally? | * LAB (online Phet): Simple 1D collisions and momentum conservation (no lab write up). | **5.A.2.1, 5.D.1.1, 5.D.1.3, 5.D.1.5, 5.D.2.1, 5.D.2.3, 5.D.2.4, 5.D.2.5** |
| 5 | 3/20  FRI | How is momentum conserved? | * Problem Set: Collisions DAY 5 | **3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3, 3.D.2.4, 4.B.2.2** |
| 6 | 3/23  MON | How is momentum conserved? | * nTIPPERS: Collisions DAY 6 | **5.A.2.1, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.2, 5.D.2.3, 5.D.2.5** |
| 7 | 3/24  TUE | What are the major ideas about momentum? | * Conceptual Questions: Momentum DAY 7 * Study\_ * finish any homework/practice problems/nTIPPERS | **ALL OF THE ABOVE** |
| 8 | 3/25  WED | How well do you understand momentum? | * Originally a scheduled as a test day | **ALL OF THE ABOVE** |