

## Fast-Paced High School Physics CTY Course Syllabus

- 🌐 **Note 1 to the Student:** There will be two exams (Friday, Day 6 and Friday, Day 12). In addition, you will have the option of *either* choosing a project<sup>1</sup> you will work on evenings or afternoon session, or *working* on extra problems which you can hand in Thursday, Day 17.
- 🌐 **Note 2:** The course plan below gives an outline of what is planned, in terms of topics and time spent on them. Please keep in mind that deviations and adjustments may be necessary.

| Day                      | Time             | Skill and knowledge goals, concepts, readings   | Activities   |
|--------------------------|------------------|---|--|
| <b>Sunday<br/>Day 1</b>  | <b>Evening</b>   |   | Pre-test   |
| <b>Monday<br/>Day 2</b>  | <b>Morning</b>   | <ul style="list-style-type: none"> <li>🌐 Course Intro</li> <li>🌐 Dimensional Analysis</li> <li>🌐 Elementary Kinematics</li> </ul>   | <ul style="list-style-type: none"> <li>🌐 Read &amp; sign honor code and complete background information sheet</li> <li>🌐 Demonstrations in free-fall, vector arithmetic, (2D, 3D) projectile motion</li> </ul> <p>(Selected topics in Chapters 1, 2, 3 Giancoli)</p> |
|                          | <b>Afternoon</b> | Demonstration Lab   | Determine average speed or acceleration of objects in flight (released balloons, objects in free-fall, objects sliding down inclined planes). Determine kinematic parameters of a launched air rocket.   |
|                          | <b>Evening</b>   | Exercises/Assessment  | Selected problems in Chapters 1 & 2.   |
| <b>Tuesday<br/>Day 3</b> | <b>Morning</b>   | <ul style="list-style-type: none"> <li>🌐 Quantitative 1D kinematics ('Big Five' equations of motion)</li> <li>🌐 Quantitative 2D kin (parabolic motion equations)</li> </ul> | <ul style="list-style-type: none"> <li>🌐 Demos (individual and group) in 1D, 2D kinematics</li> <li>🌐 Activities involving parametric equations of motion (parabolic) determining range for flat and inclined surfaces</li> </ul>                                    |
|                          | <b>Afternoon</b> | Simple kinematics (II)<br>Demonstration Lab   | Parabolic motion (cont.) (Water-rocket lab). Determine kinematic parameters of water rocket's trajectory, based on measured height, time of flight.  |
|                          | <b>Evening</b>   | Exercises/Assessment  | Selected problems (Ch. 2, 3)   |

<sup>1</sup> I will provide a handout giving details. You can work individually or in groups of no more than two. You will present results Friday, Day 18. You must decide on a topic no later than Wednesday, Day 10.

| Day                        | Time             | Skill and knowledge goals, concepts, readings   | Activities  |
|----------------------------|------------------|---|---|
| <b>Wednesday<br/>Day 4</b> | <b>Morning</b>   | <ul style="list-style-type: none"> <li>● Dynamics (I) Newton's Three Laws</li> <li>● Free-body diagrams</li> <li>● Friction (FBDs)</li> </ul> | <ul style="list-style-type: none"> <li>● Demos (individual and group) in obtaining NL1, 2 from NL3</li> <li>● Group activities in sketching FBDs</li> </ul>                 |
|                            | <b>Afternoon</b> | Simple kinematics Lab (II) and dynamics lab   | Mass car lab (determine unknown masses on quasi-frictionless car, connected to track and pulley)  |
|                            | <b>Evening</b>   | Exercises/Assessments   | Selected problems (Giancoli) Ch3, Ch4.  |
| <b>Thursday<br/>Day 5</b>  | <b>Morning</b>   | <ul style="list-style-type: none"> <li>● Dynamics (II)</li> <li>● Circular Motion</li> <li>● Gravitation</li> </ul>                           | <ul style="list-style-type: none"> <li>● Demos in circular motion and circular forces</li> <li>● Group exercises (Ferris wheels, Coriolis force, etc.)</li> </ul>           |
|                            | <b>Afternoon</b> | Circular motion & gravitation topics – continued  | Instruction, exercises  |
|                            | <b>Evening</b>   | Exercises/Assessment  | Selected exercises & pre-test session   |
| <b>Friday<br/>Day 6</b>    | <b>Morning</b>   | <b>EXAM 1</b>   |   |
|                            | <b>Afternoon</b> | Introduction of energy<br>Catch up on Problems  |   |
| <b>Sunday<br/>Day 7</b>    | <b>Evening</b>   | Problems in energy conservation, work-energy theorem  |   |
| <b>Monday<br/>Day 8</b>    | <b>Morning</b>   | <ul style="list-style-type: none"> <li>● Mechanical energy (potential, kinetic)</li> <li>● Impulse, conservation of momentum</li> </ul>       | <ul style="list-style-type: none"> <li>● Demo: Determine power and energy spent running up a flight of stairs</li> <li>● Design examples of inelastic collisions</li> </ul> |
|                            | <b>Afternoon</b> | Determine energy/momentum for elastic and inelastic collisions  |   |
|                            | <b>Evening</b>   | Exercises/Assessment  | <ul style="list-style-type: none"> <li>● Selected exercises (Ch. 8)</li> <li>● Energy of subatomic collisions (intro to special relativity)</li> </ul>                      |
| <b>Tuesday<br/>Day 9</b>   | <b>Morning</b>   | <ul style="list-style-type: none"> <li>● Center of mass</li> <li>● Non-mechanical energy</li> </ul>   | <ul style="list-style-type: none"> <li>● Demo: Find your CM</li> <li>● Demo (heat engines, pumps)</li> </ul>  |
|                            | <b>Afternoon</b> | Ballistic Pendulum Lab  | Thermodynamic analysis of gas engine  |

| Day                 | Time      | Skill and knowledge goals, concepts, readings  | Activities  |
|---------------------|-----------|--|---|
|                     | Evening   | Exercises/Assessment   | <ul style="list-style-type: none"> <li>● Selected problems (Ch. 9, 15)</li> <li>● Group activity: Determine CMs for large complex objects using non-Calculus means</li> </ul> |
| Wednesday<br>Day 10 | Morning   | Fluid mechanics  | <ul style="list-style-type: none"> <li>● Demo: Archimedes Principle</li> <li>● Hydrostatic equation</li> <li>● Conservation of flow</li> <li>● Bernoulli equation</li> </ul>  |
|                     | Afternoon | Turntable Lab  | Determining masses and moments of inertia of spinning objects.  |
|                     | Evening   | Exercises/Assessment   | Selected exercises (Ch. 10)/ Student projects   |
| Thursday<br>Day 11  | Morning   | <ul style="list-style-type: none"> <li>● Pendulum</li> <li>● General oscillations</li> <li>● Wave motions (transverse &amp; longitudinal)</li> </ul> | <ul style="list-style-type: none"> <li>● Pendulum demo (period independence in mass)</li> <li>● Groups activity: sound waves</li> <li>● Light: wave or particle?</li> </ul>   |
|                     | Afternoon | Demonstration labs   | <ul style="list-style-type: none"> <li>● Solar balloon</li> <li>● Incompressible fluids, disk brake, density paradox set</li> </ul>   |
|                     | Evening   | Exercises/Assessment   | Selected problems (12,222 – Giancoli)<br>Students projects/pre-Exam II exercises  |
| Friday<br>Day 12    | Morning   | <b>EXAM II</b>   |   |
|                     | Afternoon | Catch-up session, and film: "Steven Hawkings's Universe."  |   |
| Sunday<br>Day 13    | Evening   | Exercises/Assessment   | Problems (continued)/Student projects   |
| Monday<br>Day 14    | Morning   | <ul style="list-style-type: none"> <li>● Electrostatics</li> <li>● Currents (DC)</li> </ul>  | Demos/fluid mechanics, analog/elementary circuit logic  |
|                     | Afternoon | DC Circuits  | Calculations for RC circuits, Kichoff's Laws, Loop Rules, Junction Rules  |
|                     | Evening   | Exercises/Assessment   | Selected problems (16-19)/student projects  |

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|-----------------------------|------------------|---|--|
| <b>Tuesday<br/>Day 15</b>   | <b>Morning</b>   | <ul style="list-style-type: none"> <li>● Circuits (con)</li> <li>● Magnetostatics</li> <li>● Electrodynamics</li> </ul> | Demos/ group activities/ Earth's magnetic field  |
|                             | <b>Afternoon</b> | DC circuit lab  | Determine currents across resistors set up in series and parallel, and compare qualitatively by wiring light bulbs (acting as resistors) |
|                             | <b>Evening</b>   | Exercises/Assessment  | Selected problems (19-21)/student projects   |
| <b>Wednesday<br/>Day 16</b> | <b>Morning</b>   | <ul style="list-style-type: none"> <li>● Optics (geometric)</li> <li>● Optics (wave)</li> </ul>                         | Ray-tracing exercises  |
|                             | <b>Afternoon</b> | Ray-tracing exercises (comparing measurements with calculations using mirror equations)                                 | Thin lens equation, total internal reflection  |
|                             | <b>Evening</b>   |   |  |
| <b>Thursday<br/>Day 17</b>  | <b>Morning</b>   | Issues in contemporary physics (quantum theory, general relativity, etc.)   | <ul style="list-style-type: none"> <li>● Group discussions</li> <li>● De on polarize light – why classical physics</li> </ul>            |
|                             | <b>Afternoon</b> | <b>POST-TEST</b>  |  |
|                             | <b>Evening</b>   | Study hall  | Finalizing problem sets<br>Finalizing projects   |
| <b>Friday<br/>Day 18</b>    | <b>Morning</b>   | Final presentations (projects)  |  |
|                             | <b>Afternoon</b> | Meetings with parents   |  |
|                             | <b>Evening</b>   |   |  |