**PHYSICS 2021 - 22 May 31, 2022**

**Today’s Agenda (Day 167)**

1. HOUSEKEEPING ITEMS

🡪

1. HOMEWORK CHECK:

 🡪 Project – Computer Research + Partner Choice

1. CLASS ACTIVITY

🡪PROJECT: a) Work on constructing your catapult

 b) Submit draft of catapult blueprint

🡪 CONT’D: Ch 19 PPT Review

1. **Section 19.2 - Diffraction**

HOMEWORK:

* READ: Chapter 19 – Interference and Diffraction
* STUDY: Final Exam [Ch 13 – 26]
* STUDY: Chapter 19Test

<http://glencoe.mheducation.com/sites/0078807220/student_view0/self-check_quizzes.html>

Ch 19 – Interference and Diffraction

|  |  |  |  |
| --- | --- | --- | --- |
| Incoherent light | Coherent light | Interference fringes | Monochromatic light |
| Thin-film interference | Diffraction pattern | Diffraction grating | Rayleigh criterion |

REMINDERS:

* TEST: Chapter 19 **🡪 June 2**

**Project Dates:**

**~~May 30:~~** ~~Computer research, partner selection – you cannot pick a partner after this date.~~

**May 31:** Rough draft of blueprints will be handed in. This will be a neat sketch of the design with a list of materials that will be used. The dimensions do NOT need to be exact but should be fairly representative.

**June 2:** In-class testing/adjustment/work day

**June 3:** Catapults/trebuchets and final blueprint are due! !!CATAPULT WARS!!

**June 6:** Reflection is due.

**PHYSICS 2021 - 22 PROJECT**

CATAPULT PROJECT

**Objective:** Your task is to design and construct a tabletop catapult/trebuchet (from scratch) that will fling a ball over a wall and hit a target on the other side. Use your knowledge of projectile motion to help guide your structure.

**Important Dimensions, Restrictions, and Requirements:** Please keep the following guidelines in mind when designing your catapult.

* Your catapult **base** can be no larger than 45.0 cm x 45.0 cm at any time; The **arm** of the catapult can reach a maximum height of 55.0 cm measured from the floor to its highest point when the arm is in the upright position.
* The castle wall will be \_\_\_1\_\_\_\_\_ m high in the center. The ball must clear the wall and land within the “castle courtyard” on the other side. If it hits the first wall and bounces into the courtyard, it will not receive a score based on where it hits (even if it lands on the bull’s-eye). If it hits the wall, that shot will be disqualified.
* There will be a second wall/cabinet 1.5 m behind the first. Your ball may not hit the back wall/cabinet and bounce back into the “courtyard”. If it does, that shot is disqualified.
* The minimum distance your catapult may launch is 0.5 m from the base (at the center) of the wall. This is measured to the front of the base of your catapult. This distance represents the castle moat. Your catapult may not enter the moat.
* Your catapult must launch within the classroom without hitting the ceiling. We will NOT be going outside for this project. If it does, your shot will be disqualified.
* Your catapult may be powered by a counterweight (like a trebuchet), elastic cords or springs, or twisted rope. **Nothing** **else** can be used to propel the ball over the wall. No sling shots or onager allowed.
* Materials used for your catapult will not come from the classroom. Anything that is part of your catapult must remain in the room with the catapult throughout the launching days. (i.e. textbooks should NOT be used as part of your catapult…)
* The center of the target (bull’s-eye) will be located 1.20 m behind the wall and will be lined up with the center of the wall.
* You MUST have a mechanical release and a way to lock your catapult arm in place prior to launching. You will then load your catapult, unlock the release mechanism, and launch! Failure to have a proper, working release mechanism will result in a loss of 5 points from your final grade.

**Grading and Testing Procedures:**

* You will receive **5** attempts to launch your attack on the target. Each shot will be scored. An average of the 3 best scoring hits will be taken to determine your final score. The average scores in each class will be used to determine the final grading scale—the best score from all classes will receive 100% for this portion of the project grade. All other groups will receive a grade based on their score relative to the highest scoring group.
* Nobody from the group launching may stand in the “courtyard” during the launch. You know where the target is, and you should know how your catapult behaves/launches. You will not be allowed to line up your catapult prior to launch.
* You will be told approximately where your ball lands, so you may make adjustments, if necessary.
* Note: Arguing with or complaining/whining to the judge(s) **will** result in a loss of points.
* The bull’s-eye of the target will be worth the most points. The score will decrease as the distance from the center of the target increases.

**Catapult Rubric (Failure to turn this in with report will lose 5 points from final grade)**

***Grading Breakdown:***

|  |  |  |  |
| --- | --- | --- | --- |
| Performance | Ball launches over the wall | 5 points |  |
| Result | Location of the ball on the target | 15 points |  |
| Final Draft Blueprint | The final draft of your blueprint must include a materials list and budget (how much did you spend on the project and on what). It should be done neatly with pen and ruler, or on the computer. The blueprints should be clear and easy to read, and they should include any appropriate dimensions. You will be required to hand in blueprints with 3 separate views of your final design—top view, side view, and front view. If this is on lined notebook paper, you will receive a zero for this section! | 15 points |  |
| Reflection: | Discuss your results explaining why it was accurate or not. (Explain why your device worked as expected or did not.) Be sure to include any problems encountered and any unexpected surprises that may have occurred during the running of the experiment. What could you do to make your project better if you did not hit the target on the first three tries.  | 15 points |  |

**Important Dates:**

**May 30:** Computer research, partner selection – you cannot pick a partner after this date.

**May 31:** Rough draft of blueprints will be handed in. This will be a neat sketch of the design with a list of materials that will be used. The dimensions do NOT need to be exact but should be fairly representative.

**June 2:** In-class testing/adjustment/work day

**June 3:** Catapults/trebuchets and final blueprint are due! !!CATAPULT WARS!!

**June 6:** Reflection is due.

**Theme**: An awareness theme to your catapult **may** be rewarded up to 5 bonus points. If you are decorating your catapult on the day of launch in the classroom, no points will be rewarded. It is to the teacher’s discretion if points will be rewarded or not. Arguing with the teacher will result in no points.

Catapult Research

Directions: Your responses need to be in complete sentence(s) or listed if requested.

1. What is a catapult?
2. Describe what the first catapult looked like?
3. What was the main purpose of catapults during Medieval times?
4. What are some Modern uses of catapults?
5. Draw and label a Mangonel Style Catapult
6. Draw and label a Ballista Style Catapult (you cannot build this one)
7. Draw and label a Trebuchet Style Catapult
8. How does this relate to projectile motion?
9. List only 5 requirements for this project.
10. Who is your partner?

**PHYSICS 2021 - 22 Review Questions**

 **CH 19 PRACTICE PROBLEMS**

SECTION 19.1 - Interference

1. Violet light falls on two slits separated by 1.90×10−5 m. A first-order bright band appears 13.2 mm from the central bright band on a screen 0.600 m from the slits. What is the λ?
2. Yellow orange light from a sodium lamp of wavelength 596 nm is aimed at two slits that are separated by 1.90 x 105 m. What is the distance from the central band to the first-order yellow band if the screen is 0.600 m from the slits?
3. In a double-slit experiment, physics students use a laser with λ = 632.8 nm. A student places the screen 1.00 m from the slits and find the first-order bright band 65.5 mm from the central line. What is the slit separation?
4. Yellow-orange light with a wavelength of 596 nm passes through two slits that are separated by 2.25×105 m and makes an interference pattern on a screen. If the distance from the central line to the first-order yellow band is 2.00×10−2 m, how far is the screen from the slits?
5. A glass lens has a non-reflective coating placed on it. If a film of magnesium fluoride is placed on the glass, how thick should the layer be to keep yellow-green light (λ = 555 nm) from being reflected? See the sketch in Figure 9.



1. You can observe thin-film interference by dipping a bubble wand into some bubble solution and holding the wand in the air. What is the thickness of the thinnest soap film at which you would see a black stripe if the light illuminating the film has a wavelength of 521 nm? Use n = 1.33 for the bubble solution.
2. What is the thinnest soap film (n = 1.33) for which light of wavelength 521 nm will constructively interfere with itself?
3. Two very narrow slits are cut close to each other in a large piece of cardboard. They are illuminated by monochromatic red light. A sheet of white paper is placed far from the slits, and a pattern of bright and dark bands is seen on the paper. Describe how a wave behaves when it encounters a slit, and explain why some regions are bright while others are dark. Sketch the pattern described.
4. Sketch what happens to the pattern in the previous problem when the red light is replaced by blue light.
5. Lucien is blowing bubbles and holds the bubble wand with a soap film (n = 1.33) in it vertically.

a) What is the second thinnest width of the soap film at which he could see a bright stripe if the light illuminating the film has a wavelength of 575 nm? B) What other widths produce a bright stripe at 575 nm?

SECTION 19.2

1. Monochromatic green light of wavelength 546 nm falls on a single slit with a width of 0.095 mm. The slit is located 75 cm from a screen. How wide will the central bright band be?
2. Yellow light with a wavelength of 589 nm passes through a slit of width 0.110 mm and makes a pattern on a screen.  If the width of the central bright band is 2.60×10−2 m, how far is it from the slits to the screen?
3. Light from a He-Ne laser (λ = 632.8 nm) falls on a slit of unknown width. A pattern is formed on a screen 1.15 m away, on which

the central bright band is 15.0 mm wide. How wide is the slit?

1. Yellow light falls on a single slit 0.0295 mm wide. On a screen that is 60.0 cm away, the central bright

band is 24.0 mm wide. What is the wavelength of the light?

1. White light shines through a grating onto a screen. Describe the pattern that is produced.
2. If blue light of wavelength 434 nm shines on a diffraction grating and the spacing of the resulting lines

on a screen that is 1.05 m away is 0.55 m, what is the spacing between the slits in the grating?

1. A diffraction grating with slits separated by 8.60×10−7 m is illuminated by violet light with a wavelength of 421 nm. If the screen is 80.0 cm from the grating, what is the separation of the lines in the diffraction pattern?
2. White light falls on a single slit that is 0.050 mm wide. A screen is placed 1.00 m away. A student first puts a blue-violet filter (λ = 441 nm) over the slit, then a red filter (λ = 622 nm). The student measures the width of the central bright band.

a) Which filter produced the wider band?

b) Calculate the width of the central bright band for both filters.

1. A diffraction grating with slits separated by 8.60×10−7 m is illuminated by violet light with a wavelength of 421 nm. If the screen is 80.0 cm from the grating, what is the separation of the lines in the diffraction pattern?
2. Light of wavelength 632 nm passes through a diffraction grating and creates a pattern on a screen that

is 0.55 m away. If the first bright band is 5.6 cm from the central bright band, how many slits per centimeter does the grating have?