**PHYSICS 2021 - 22 November 29, 2021**

**Today’s Agenda (Day 63)**

1. HOUSEKEEPING ITEMS

🡪

1. HOMEWORK CHECK:

🡪 Lab Report: Rocket Project

 🡪 Self-Reflection: Rocket Project

1. CLASS ACTIVITY

🡪 CONT’D: Chapter 10 PPT Review

1. Section 10.2 – Machines

🡪 REVIEW: Chapter 10 Practice Problems

HOMEWORK:

* READ: Chapter 11 – Energy and Its Conservation
* COMPLETE: Chapter 12 Vocabulary
* COMPLETE: Lab Report for Water Bottle Rocket Project AND Self-Reflection Questions
* STUDY: Chapter 10 Vocabulary AND Test

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

Chapter 11: Energy and Its Conservation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rotational kinetic energy | Gravitational potential energy | Elastic potential energy | Law of conservation of energy | Inelastic collision |
| Potential energy | Reference level | Thermal energy | Mechanical energy | Elastic collision |

Chapter 12: Thermal Energy

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Conduction | Thermal equilibrium | Heat | Convection | Radiation | Specific heat |
| Heat of fusion | Heat of vaporization | First law of thermodynamics | Heat engine | Entropy | Second law of thermodynamics |

REMINDERS:

* **TEST: Chapter 10 & Vocabulary 🡪 Nov. 30**
* Self-Reflection: Water Bottle Rocket – Nov. 30
* Lab Report: Water Bottle Rocket – Dec. 1
* Chapter 12 Vocabulary – Dec. 2
* **TEST: Ch 11 & Vocab🡪 Dec. 7**
* **TEST: Ch 12 & Vocab 🡪 Dec. 9**
* **Midterm Exam:** Chapters 1 - 13

**PHYSICS 2021 - 22** CHAPTER REVIEW

**PRACTICE PROBLEMS 10.1**

1. Together, two students exert a force of 825 N in pushing a car a distance of 35 m.
2. How much work do the students do on the car?
3. If their force is doubled, how much work must they do on the car to push it the same distance?

|  |
| --- |
|  |

1. A rock climber wears a 7.5 kg backpack while scaling a cliff. After 30.0 min, the climber is 8.2 m above the starting point.
2. How much work does the climber do on the backpack?
3. If the climber weighs 645 N, how much work does she do lifting herself and the backpack?
4. Two people lift a heavy box a distance of 15 m. they use ropes, each of which makes an angle of 15◦ with the vertical. Each person exerts a force of 225 N. How much do the ropes do?
5. An airplane passenger carries a 215 N suitcase up the stairs, a displacement of 4.20 m vertically and 4.60 m horizontally.
6. How much work does the passenger do on the suitcase?
7. The same passenger carries the same suitcase back down the same set of stairs. How much work does the passenger do on the suitcase to carry it down the stairs?
8. A rope is used to pull a metal box a distance of 15.0 m across the floor. The rope is held at an angle of 46.0 ◦ with the floor, and a force of 628 N is applied to the rope. How much work does the rope do on the box?
9. A 575 N box is lifted straight up a distance of 20.0 m by a cable attached to a motor. The box moves with a constant velocity and the job is done in 10.0 s. What power is developed by the motor in W and kW?
10. You push a wheelbarrow a distance of 60.0 m at a constant speed for 25.0 s by exerting a 145 N force horizontally.
11. What power do you develop?
12. If you move the wheelbarrow twice as fast, how much power is developed?
13. An electric motor develops 65 kW of power as it lifts a loaded elevator 17.5 m in 35 s. How much force does the motor exert?

**PRACTICE PROBLEMS 10.2**

1. A sledgehammer is used to drive a wedge into a log to split it. When the wedge is driven 0.20 m into the log, the log is separated a distance of 5.0 cm. A force of 1.7 x 104 N is needed to split the log, and the sledgehammer exerts a force of 1.1 x 104 N.
2. What is the IMA of the wedge?
3. What is the MA of the wedge?
4. Calculate the efficiency of the wedge as a machine.
5. A worker uses a pulley to raise a 24.0 kg carton 16.5 m, as shown in Figure 15 on p. 280 of the textbook. A force of 129 N is exerted, and the rope is pulled 33.0 m
6. What is the MA of the pulley?
7. What is the efficiency of the pulley?



1. A winch has a crank with a 45 cm radius. A rope is wrapped around a drum with a 7.5 cm radius. One revolution of the crank turns the drum one revolution.
2. What is the ideal mechanical advantage of this machine?
3. If, due to friction, the machine is only 75 percent efficient, how much force would have to be exerted on the handle of the crank to exert 750 N of force on the rope?
4. You exert a force of 225 N on a lever to raise a 1.25 x 103 N rock a distance of 13 cm. If the efficiency of the lever is 88.7%, how far did you move your end of the lever?
5. Classify each tool as a lever, a wheel and axle, an inclined plane, or a wedge. Describe how it changes the force to make the task easier.
6. Screwdriver c) chisel
7. Pliers d) nail puller
8. A worker is testing a multiple pulley system to estimate the heaviest object that he could lift. The largest downward force he can exert is equal to his weight, 875 N. When the worker moves the rope 1.5 m, the object moves 0.25 m. What is the heaviest object he could lift?
9. Takeshi raises a 1200-N piano a distance of 5.00 m using a set of pulleys. He pulls in 20.0 m of rope.
10. How much effort force would Takeshi apply if this were an ideal machine?
11. What force is used to balance the friction force if the actual effort is 340 N?
12. What is the output work?
13. What is the input work?
14. What is the mechanical advantage?
15. A motor with an efficiency of 88% runs a crane with an efficiency of 42 percent. The power supplied to the motor is 5.5 kW. At what constant speed does the crane lift a 410-kg crate?

**PHYSICS 2021 - 22** CHAPTER REVIEW

**PRACTICE PROBLEMS 11.1**

1. A 52.0 kg skater moves at 2.5 m/s and glides to a stop over a distance of 24.0 m. Find the skater’s initial kinetic energy. How much of her kinetic energy is transformed into other forms of energy by friction as she stops? How much work must she do to speed up to 2.5 m/s again?
2. An 875.0 kg sub-compact car speeds up from 22.0 m/s to 44.0 m/s. What are the initial and final kinetic energies of the car? How much work is done on the car to increase its speed?
3. A comet with a mass of 7.85 x 1011 kg strikes Earth at a speed of 25.0 km/s. Find the kinetic energy of the comet in joules, and compare the work that is done by Earth in stopping the comet to the 4.2 x 1015 J of energy that was released by the largest nuclear weapon ever exploded.
4. A 2 kg wheel rolls down the road with a linear speed of 15 m/s. Find its translational and rotational kinetic energies. (Hint: I = mr2)
5. If you slowly lower a 20.0 kg bag of sand 1.20 m from the trunk of the car to the driveway, how much work do you do?
6. A worker picks up a 10.1 kg box from the floor and sets it on a 1.1 m high table. He slides the box 5.0 m along the table and then lowers it back to the floor. What were the changes in the box-earth system’s energy, and how did the system’s total energy change? (Ignore friction.)
7. You get a spring-loaded jumping toy ready, compressing the spring. The toy then flies straight up. Draw bar graphs that describe the forms of energy present in the following instances. Assume the system includes the spring toy and earth.
8. The toy is pushed down thereby compressing the spring.
9. The spring expands and the toy jumps
10. The toy reaches the top of its flight.
11. A 90.0 kg rock climber climbs 45.0 m upward, then descends 85.0 m. The initial height is the reference level. Find the potential energy of the climber-earth system at the top and at the bottom. Draw bar graphs for both situations.

**PRACTICE PROBLEMS 11.2**

1. A bike rider approaches a hill at a speed of 8.5 m/s. The combined mass of the bike and the rider is 85.0 kg. Choose a suitable system. Find the initial kinetic energy of the system. The rider coasts up the hill. Assuming friction is negligible, at what height will the hike come to rest?
2. A skier starts from rest at the top of 45.0 m high hill, skis down a 30⁰ incline into a valley, and continues up a 40.0 m high hill. The heights of the both hills are measured from the valley floor. Assume that friction is negligible and ignore the effect of the ski poles.
3. How fast is the skier moving at the bottom of the valley?
4. What is the skier’s speed at the top of the second hill?
5. Do the angles of the hill affect your answers?
6. In a belly-flop diving contest, the winner is the diver who makes the biggest splash upon hitting the water. The size of the splash depends not only on the diver’s style, but also on the amount of kinetic energy the diver has. Consider a contest in which each diver jumps from a 3.00m platform.

One diver has a mass of 136 kg and simply steps off the platform. Another diver has a mass of 100 kg and leaps upward from the platform. How high would the second diver have to leap to make a competitive splash?

1. The spring in a pinball machine exerts an average force of 2N on a 0.08 kg pinball over 5 cm. As a result, the ball has both translational and rotational kinetic energy. If the ball is a uniform sphere (I = 5/2 mv2), what is its linear speed after leaving the spring? (Ignore the table’s tilt.)
2. An 8.00 g bullet is fired horizontally into a 9.00 kg block of wood on an air table and is embedded in it. After the collision, the block and bullet slide along the frictionless surface together with a speed of 10.0 cm/s. What is the initial speed of the bullet?
3. A 91.0 kg hockey player is skating on ice at 5.50 m/s. Another hockey player of equal mass, moving at 8.1 m/s in the same direction, hits him from behind. They slide together.
4. What are the total mechanical energy and momentum of the system before the collision?
5. What is the velocity of the two hockey players after the collision?
6. How much was the system’s kinetic energy decreased in the collision?
7. A child jumps on a trampoline. Draw bar diagrams to show the forms of energy present in the following situations.
8. The child is at the highest point.
9. The child is at the lowest point.
10. As shown in Figure 14, a child slides down a playground slide. At the bottom of the slide, she is moving at 3.0 m/s. How much energy was transformed by friction as she slid down the slide?



**PHYSICS 2021-22 Lab Activity**

**Physics Water Bottle Rocket Competition**



**http://aplusphysics.com/projects/water\_rockets.html**

**Event Description:** Teams of two or three people will build a water bottle rocket that will stay and can be vertically-launched AND horizontally-launched into the air for a maximum amount of time

**Specifications:**

1. Rockets are to be constructed from a 2-liter soda bottle.
2. The soda bottle must remain intact.
3. Additional materials such as fins, nose cones, parachutes, etc. are permitted, within reason.
4. The bottle will have water and 40 psi of compressed air put into it. When the pressure is released, the rocket should fly.
5. Launcher should be able to accommodate both a vertical and horizontal launch of the water bottle rocket. Launcher cannot be hand-held during pressure-infusion.

**Resources**:

* [All About Water Rockets](http://exploration.grc.nasa.gov/education/rocket/BottleRocket/about.htm)
* [Hayhurst's Quick and Easy Bottle Rockets](http://www.lnhs.org/hayhurst/rockets/)
* [Water Bottle Rockets](http://home.comcast.net/~timhesterberg/WaterRockets.html)
* [Water-Powered Bottle Rocket](http://www.tclauset.org/21_BtlRockets/BTL.html)
* [Rockets Away Software Demo](http://extension.osu.edu/rockets/cgi-bin/design_zone.cgi)
* [Principle of the Rocket](http://www-istp.gsfc.nasa.gov/stargaze/Srocket.htm)
* [Sim Water Rocket](http://www.et.byu.edu/~wheeler/benchtop/sim.php)
* [Bottle Rocket Construction](http://sections.asme.org/sandiego/Meetings/waterrocketconstruction.pdf)
* [Bottle Rocket Launcher Construction](http://users.soe.ucsc.edu/~karplus/abe/soda-bottle-rocket.pdf) (provided by instructors for project)
* [Cadre Water Rocket](http://alain.juge.pagesperso-orange.fr/English/EnFrame.htm)

**Procedure**:

1. Get into groups of 3.

2. Research how to design and construct a water bottle rocket, pressure-driven from reliable resource.

3. Agree on a design, where and when to construct apparatus.

4. Gather materials.

5. Begin assembly. Be mindful of all safety precautions and use all necessary safety gear (ie. eye goggles, etc).

6. Using your safety gear, test functioning of constructed apparatus (rocket launcher with “rocket”); be sure that you have the “trigger” that can release from a **safe** distance away! Ensure that your device can undergo multiple launches without breakdown of its foundation. **PREPARE THREE ROCKETS!!**

7. Bring apparatus to school at scheduled date, as per teacher’s notification. BRING BOTH ROCKETS & LAUNCHER ON DAY OF COMPETITION!

**\*Capture the step-by-step process via still photos or video!**

**\*Completed product must be a representative product of your age-level, knowledge and skills set!**

**POST-ACTIVITY**

**Team Reflection:** As a team, submit your answers to the following questions:

1. Analyze your rocket's motion:
	1. How long was your rocket in the air?
	2. Estimate your rocket's maximum height. Show and explain all calculations.
	3. What was your rocket's maximum velocity? Show and explain all calculations.
2. Did you have to do anything/employ different concepts to ensure that your rocket could be launched bi-directionally?
3. What role did friction play in the performance of your rocket? Did it aid or hinder? Explain.
4. Beginning with the stored mechanical energy in the pressurized rocket, explain the multiple transformations the energy goes through. See Unit II of Physics Textbook.
5. How did undertaking this project improve your understanding of work and energy?
6. How did you feel about this project when it was first assigned?
7. How do you feel about this project now that it has concluded?
8. What would you have done differently as you and your team worked through this project?

**Scoring:** Scoring will be based 50% on rocket performance, 50% on your team's reflection.

## **SELF-REFLECTION ON LEARNING**

Spend a few minutes to analyze your performance on group and individual tasks.

|  |  |
| --- | --- |
| **Name:** |  |
| **Project Name:** |  |
| **Describe the project in a sentence or two:** |  |
| **What is the most important thing you learned during this project:** |  |
| **What do you wish you had spent more time on:** |  |
| **What big idea(s) did this project help you understand?** |  |
| **What do you wish you had done differently:** |  |
| **What part of the project did you do your best work on:** |  |
| **What was the most enjoyable part of this project:** |  |
| **What was the least enjoyable part of this project:** |  |
| **How could your teacher(s) change this project to make it better next time:** |  |