**PHYSICS 2021 - 22 September 15, 2021**

**Today’s Agenda (Day 21)**

1. HOUSEKEEPING ITEMS

🡪 Request for: toy cars

1. HOMEWORK CHECK:

🡪 Lab Report – Coffee Filter

1. CLASS ACTIVITY

🡪 CONT’D: Chapter 3 PPT Review

1. **Section 3.1 – Acceleration**
2. **Section 3.2 – Motion with Constant Acceleration**
3. Section 3.3 – Free Fall

HOMEWORK:

* READ: Chapter 3 – Accelerated Motion
* COMPLETE: Chapter 3 Vocabulary (shortened template)
* STUDY: Chapter 3 Test

CH 3 – ACCELERATED MOTION

|  |  |  |
| --- | --- | --- |
| Acceleration | Average acceleration | Free fall |
| Velocity-time graph | Instantaneous acceleration | Free fall acceleration |

CH 4 – FORCES IN ONE DIMENSION

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Forces | Newton’s 1st Law | Inertia | Weight | Tension | Drag force  |
| System | Newton’s 2nd Law | Equilibrium | Weightlessness | Interaction pair | Normal force |
| Free-body diagram | Newton’s 3rd Law | Gravitational field | Terminal Velocity | Apparent weight | Net force |

REMINDERS:

* Ch 3 Vocabulary – Sept. 16
* **TEST: Chapter 3 🡪 Tuesday, September 21**
* **QUIZ: Ch 3 & 4 Vocabulary** **🡪 Thursday, September 23**

**PHYSICS 2021 - 22 SUMMARY REVIEW**

**PRACTICE PROBLEMS 3.1**

Instructions: Read the word problems below. Please show work for deriving the solution to each problem.

1. A race car’s forward velocity increases from 4.0 m/s to 36 m/s over a 4.0 s time interval. What is its average acceleration?
2. The race car in the previous problem slows from 36 m/s to 15 m/s over 3.0 s. What is its average acceleration?
3. A bus is moving west 25 m/s when the driver steps on the brakes and brings the bus to a stop in 3.0 s.
4. What is the average acceleration of the bus while braking?
5. If the bus took twice as long to stop, how would the acceleration compare with what you found in part **a**?
6. A car is coasting backward downhill at a speed of 3.0 m/s when the driver gets the engine started. After 2.5 s, the car is moving uphill at 4.5 m/s. If the uphill is chosen as the positive direction, what is the car’s average acceleration?
7. Rohith has been jogging east toward the bus stop at 3.5 m/s when he looks at his watch and sees that he has plenty of time before the bus arrives. Over the next 10.0 s, he slows his pace to a leisurely 0.75 m/s. What was his average acceleration during this 10.0 s?

CHALLENGE QUESTIONS:

1. If the rate of continental drift were to abruptly slow from 1.0 cm/y to 0.5 cm/y over the time interval of a year, what would be the average acceleration?
2. Plot a v-t graph representing the following motion: An elevator starts at rest from the ground floor of a three-story shopping mall. It accelerates upwards for 2.0 s at a rate of 0.5 m/s2, continues up at a constant velocity of 1.0 m/s for 12.0 s, and then slows down with a constant downward acceleration of 0.25 m/s2 for 4.0 s as it reaches the third floor.

**PRACTICE PROBLEMS 3.2**

1. A golf ball rolls up a hill toward a miniature-golf hole. Assume the direction toward the hole is positive.

a.If the golf ball starts with a speed of 2.0 m/s and slows at a constant rate of 0.50 m/s2, what is its velocity after 2.0 s?

b. What is the golf ball’s velocity if the constant acceleration continues for 6.0 s?

c. Describe the motion of the golf ball in words and with a motion diagram.

1. A bus traveling at 30.0 km/h east has a constant increase in speed of 3.5 m/s2. What velocity does it reach 6.8 s later?
2. If a car accelerates from rest at a constant rate of 5.5 m/s2 north, how long will it take for the car to reach a velocity of 28 m/s north?
3. A car slows from 22 m/s to 3.0 m/s at a constant rate of 2.1 m/s2. How many seconds are required before the car is traveling at a forward velocity of 3.0 m/s?
4. A race car travels on a straight racetrack with a forward velocity of 44 m/s and slows at a constant

rate to a velocity of 22 m/s over 11 s. How far does it move during this time?

1. The motion of two people, Carlos and Diana, moving south along a straight path is described by the graph in **Figure 14.** What is the total displacement of each person during the 4.0-s interval shown on the graph?



**PRACTICE PROBLEMS 3.3**

1. A construction worker accidentally drops a brick from a high scaffold.

a. What is the velocity of the brick after 4.0 s?

b. How far does the brick fall during this time?

1. A student drops a ball from a window 3.5 m above the sidewalk. How fast is it

moving when it hits the sidewalk?

1. A tennis ball is thrown straight up with an initial speed of 22.5 m/s. It is caught at the same distance above the ground.

a. How high does the ball rise?

 b. How long does the ball remain in the air? Hint: The time it takes the ball to rise equals the time it takes to fall.

1. Final Velocity Your sister drops your house keys down to you from the second floor window, as shown in Figure 25. What is the velocity of the keys when you catch them?



1. Free-Fall Ride Suppose a free-fall ride at an amusement park starts at rest and is in free fall. What is the velocity of the ride after 2.3 s? How far do people on the ride fall during the 2.3-s time period?

**PHYSICS 2021 - 22 MINI-LAB**

**AUTUMN LEAVES & PARACHUTES**

**(The Coffee Filter Lab)**

**PURPOSE:**   a) To analyze the motion of falling leaves.

 b) To explore terminal velocity

**PROCEDURE:**

1. Drop one coffee filter from a height of 2 m and time how long it takes for the filter to reach the ground.

 2. Drop it two more times and find the average time.

3. Repeat this procedure for 2 nested coffee filters, 3 nested filters and 4 nested filters etc. See the table below.

**DATA:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NUMBER OF FILTERS** | **TIME 1** | **TIME 2** | **TIME 3** | **AVERAGE TIME** | **AVERAGE VELOCITY** |
| 1 NESTED |   |   |   |   |   |
| 2 NESTED |   |   |   |   |   |
|   |   |   |   |   |   |
| 4 NESTED |   |   |   |   |   |
| 5 NESTED |   |   |   |   |   |
|   |   |   |   |   |   |
| 7 NESTED |   |   |   |   |   |
| 8 NESTED |   |   |   |   |   |
|   |   |   |   |   |   |
| 10 NESTED |   |   |   |   |   |

**LEAF ANALYSIS:**

1. Create a graph which compares the objects changing mass, measured in number of coffee filters, and the objects resulting average velocity.
2. Next, straighten the graph and create a mathematical model for the behavior of a falling leaf.

**EXTENSION: [**Parachute & Terminal Velocity]

A) Design a procedure that uses a **stopwatch** and a **meter stick** to determine how long it takes an object to reach terminal velocity. Consider how you will know that the object is falling at a steady speed and how you could measure the speed accurately.

B) Use your procedure to find the terminal velocity of a single **coffee filter** and then a combination of filters.

Parachute Analysis

What is the terminal velocity for each case? Does it depend on the mass?

**LEAF QUESTIONS:**

1. Describe the motion of each set of filters just after they have started to fall.  Are they moving with a constant velocity or is their velocity changing?

2. Compare the velocities of each set of filters.  Which is faster?

3. Using the graph:

 a. What is the relationship between an object's mass and its velocity as it falls?

 b. Predict the average velocity of the 3, 6 and 9 nested filters.

c. Experimentally determine the average velocity of the 3, 6 and 9 filters and determine the percent error.

4. What forces are acting on the filters after they are falling?

5. What is the relative strength of these forces? Are either of these stronger?

6. What is the total amount of force acting on the filter as it falls?

**CONCLUSION**:

Write a paragraph as an answer to the question: **Do falling leaves accelerate or do they move with a constant velocity?**