

Audio Text: Physics Lesson: Uniform Circular Motion and Centrifugal Force
Presented by: Khalid Mrashda
Dhahran National Schools - Kingdom of Saudi Arabia

Scene 8: Teacher's Guide Time 20:36-26:45

Location: A classroom

(Speech is directed to the camera.)

Dear, female/male physics teacher.

Peace, mercy and blessings of God and thank you very much for using this video. I would like to add some key notes that you may need to benefit more from this lesson.

First: Lesson Objectives

1. Correct the misconception in the students' understanding of centrifugal force and to clarify the reason for this sense of centrifugal force through Newton's three laws of motion, particularly the law of inertia, and to show that the only acting force during a uniform circular motion is a the centripetal force only, i.e., towards the center (Neglect the force of gravity).
2. Conduct experiments and activities that enable the students to explore and investigate by themselves the fact that centrifugal force does not exist and confirm it is just a centripetal force.
3. Calculate the centripetal force for an object in a uniform circular motion.

Second: Connecting to prior knowledge in such subjects

Before starting this lesson, students should be familiar with the following:

1. Force analysis of any static or moving object or drawing the Free Body Diagram.
2. Newton's three laws of motion.
3. Knowledge of the following terms:
Inertia, uniform circular motion, acceleration, tangent of a circle, the

circumference and the formula to calculate it ($2\pi r$), weight and the law to calculate it ($w = mg$).

4. Knowledge of the following symbols for the scientific terms and its measurement units in English language: Force (F) unit (Newton, N), mass (m) unit (kilogram Kg), velocity (v) unit (m / s), radius (r) unit (meter m), time (t) (seconds) the number of cycles (n).
5. Using the value of the acceleration of gravity as (9.8 m/s^2) without approximation.

Third: Classroom discussions while viewing the film (i.e., when stopping between the video clips)

The following points must be taken into consideration:

After the first scene: Please, ask the students to discuss the phenomenon that we experience when we feel as if we are being expelled from the center. Generate ideas until someone says it is “the centrifugal force”.

After the second scene: I hope that the students analyze the force for the ball and draw each of the two cases: the ball hanging with a string and the ball placed on the scoop, and focus on the direction of the forces on the ball to the top.

After the third scene: Please, do experiment # 1. Its report is attached. Note that the small nail must not cause the mass to be pulled up. As seen in the figure. The purpose for using it here (or a toothpick and a light ball) is to prevent the mass from break free in any direction and hit something or someone, i.e. as a safety precaution. The presence of this nail is for the purpose of safety only. So please make sure to tie it with the string firmly. The activity should be done several times by the students by changing the length of the string until the tangential movement of the ball appears away from the original circular path, and make sure to maintain a uniform circular motion with a constant velocity (in magnitude) as much as possible. After completion of the activity, students draw the direction of motion of the object (additional question) found in the report of the experiment.

After the fourth scene: I hope that the students repeat the activity of non-spilled water from a bucket moving in a perpendicular circular motion by the students themselves.

Apparatus and materials needed by the students: paper cup of water (instead of the bucket), string, water.

After the activity, I hope, my dear teacher, to start a discussion to explain non-spilled water using the ideas mentioned in the second scene regarding the tension force in the string and the perpendicular force (normal force) from the base of scoop on the ball.

After the fifth scene: Please, do experiment # 2 according to the procedure contained in the report, fill in the table, study the results, and discuss them with your students. Pay attention to the use of the international units of measurements during calculations.

6. After the fifth scene: Please, start a discussion to answer the following questions: "Can you summarize one point from what you have learned in this lesson to your friend?" "Can you explain one experiment to prove that centrifugal force does not exist?"

Fourth: Activities and Additional Questions for High Achievers.

You will notice dear teacher an additional question or activity at the end of each of the previous two experiments. This additional question or activity can be used as an additional challenge for gifted or outstanding students who preceded their colleagues in finishing the experiment and drawing conclusions.

Here is another challenging question:

Q: What if the motion was not uniform? You can discuss that with your students. What if the motion was not uniform i.e. the velocity is not constant (in magnitude)? What if there was a change in velocity? Whether an increase or decrease? How will the object start moving after it is set free from the string? Would that contradict with the proof of the non-existence of centrifugal force? Encourage the students to look for the answers.

Finally, I hope that this work has been useful for your students and the lesson is interesting and full of energy.

In case of inquiry about anything, please do not hesitate to contact me at the e-mail address at the end of the video. TenthBrother@hotmail.com

I thank you for your cooperation. Peace, mercy and blessings of God