Lesson Plan

Lesson: <u>Apply Newton's 2nd law to solve questions by using Cartesian Coordinate</u>

Timeframe: <u>75 minutes</u>

Materials needed:
Instructor: PPT slides; Videos; lecture notes
Students: Blank sheet, Pencil, ruler

Objectives:

> ***Basic:***
> *1. Students can define three Newton's laws;*
>
> *2. Students can remember the equation of Newton's 2nd law;*
>
> *3. Students can interpret the equation of Newton's 2nd law;*
>
> ***Advanced:***
> *1. Students can use three Newton's laws to interpret related physical phenomenon*
>
> *2. Students can use Newton's 2nd law to solve problems by using Cartesian Coordinate*
>
> *3. Students can tell when to use Newton's 2nd law and Cartesian Coordinate to solve problems*

Background:
The students in this lesson should already know, from previous sessions, that what is Cartesian coordinate system and how to find acceleration by using Cartesian Coordinate.
The pre-class activity will help the students build the concept related to Newton's laws and Newton's 2nd law specifically, the in-class activity will help students build the ability to solve questions by using Newton's 2nd law, and the post-class activity will help students strengthen the ability to solve questions by using Newton's 2nd law.

Introduction to Lesson: (3 minutes-5 minutes)
1. Brief summarize the results of pre-class online quiz. For example, what is percentage of students who get full score, what are the common mistakes appeared in the pre-class quiz (if any).
2. Announce the learning objectives for today's class
3. Show students' an interesting question that can only solved by using newton's 2nd law and tell them they will be able to solve this question after today's class.
3. Brief introduce the agenda of the in-class activity.

Procedure [Time needed, include additional steps if needed]:

Pre-Class Individual Space Activities and Resources:

Steps	Purpose	Estimated Time	Learning Objective

Step 1: Read the online materials. <u>Main contents of the online materials:</u> 1) The concept of three Newton's laws; 2) Example of three Newton's laws; 3) The equations related to Newton's 2nd law and the interpretation of each parameter.	1) Help the students build the basic concept of what are Newton's laws; 2) Help the students remember and understand the equations of Newton's 2nd law.	20 minutes	The students are able to: 1) Define Newton's 3 laws; 2) Remember the equation of Newton's 2nd law;
Step 2: Finish online quiz <u>Main format of the online quiz:</u> 1) True/false questions 2) Multiple choice questions	Check whether students achieve above purpose	5 minutes	

In-Class Group Space Activities and Resources:

Steps	Purpose	Estimated Time	Learning Objective
Step 1: Asking and answering The instructor will show 4 different videos to the students, and the students need to interpret the phenomenon appeared in the video by using the knowledge they have learned in the pre-class activity; <u>Techniques will be adopted:</u> 1). Cold call 2). i-clicker	*Instructor:* check whether students can tell the differences of three Newton's laws; *Students:* apply Newton's law to interpret physical phenomenon	10 minutes	**The students can strengthen the abilities to:** 1) Interpret physical phenomenon by using Newton's laws 2) Differentiate Newton's 3 laws
Step 2: Lecturing time – Interpret how to apply the Newton's 2nd law and Cartesian Coordinate to solve the problem The instructor will use PPT slides to talk about: 1) in which situation, we need to think about using both Newton's 2nd law and Cartesian Coordinate to solve the problem; and 2) basic procedures to solve the problems by using Newton's 2nd law and Cartesian Coordinate system	**Help students build basic concept about:** 1) what type of questions can be solved by using Newton's 2nd law and Cartesian Coordinate; 2) the basic procedure they need to follow to solve a problem by using Newton's 2nd law and Cartesian Coordinate	10 minutes	**The students build the basic concept on:** 1) what type of questions can be solved by using Newton's 2nd law and Cartesian Coordinate; 2) what is the basic procedure they need to follow to solve a problem by using Newton's 2nd law and Cartesian coordinate
Step 3: Demonstration time – The instructor will solve one example by using Cartesian Coordinate and Newton's 2nd Law. 1) The instructor will show the example; 2) Ask the students whether they can apply Newton's 2nd Law and Cartesian Coordinate and why; 3) Write done solving procedures step by step on the white board. 4) During the demonstration procedure, the instructor will raise some questions and ask students to answer.	Through example demonstration, help students to understand: 1) What type of questions can be solved by using Newton's 2nd law and Cartesian Coordinate; 2) How to apply the procedure they have learn in the previous 10 minutes to solve a problem	15 minutes	**The students will have the ability to:** 1) Decide whether a type of questions can be solved by using Newton's 2nd law and Cartesian Coordinate; 2) Solve a problem by using Newton's 2nd law and Cartesian coordinate

Step 4: Individual work – Solve one example The students will be given an another example, and they need to solve it on a piece of paper individually	Through independent work, the student can practice on using Newton's 2nd law to solve the problems	15 minutes	**The students will have the ability to:** 1) Solve a problem by using Newton's 2nd law and Cartesian coordinate independently; 2) Tell when can use Newton's 2nd law and Cartesian coordinate to solve the problem and why
Step 5: Group work – Pair and Share 5 students will be in a group. 1) They will compare their procedures to solve the problem; 2) Find the differences of their answers with other group members; 3) Find the reasons of differences: Due to the mistake or due to different methods; 4) One volunteer of several groups will be called to share their findings to the whole class	Through share and pair, the students can figure out what mistakes they themselves or other students have made and the reasons of the mistakes. I hope in the future these students can avoid these mistakes.	10 minutes	
Step 6: Wrap up Step 4-5. 1) the instructor will show her solution to the students 2) the instructor will conclude some common mistakes made by the students and tell the students how to avoid them in the future	Through comparing with the instructor's solution, the students can figure out whether they have made some mistakes and the reasons of the mistakes (if any)	5 minutes	

Closure/Evaluation: 5 minutes
1) The instructor will summarize the key content of this class and announce the homework;
2) The students need to finish one-minute paper and write done what concept/method they still do not understand.

Post-Class Individual Space Activities:
The students need to solve another 2-3 assigned examples and submit them online, and one of the questions is the question raised to the students at the beginning of the class.

Connections to Future Lesson Plan(s):
1) The instructor will read students' one-minute paper, and see whether there are some common questions, and will solve them in the next lessor.
2) The instructor will check the students' homework, and see whether there are some common mistakes, and will interpret then in the future lessons.