PBL: Rotation And Oscillation
活動單元: 轉動與振盪
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Names	IDs(3 digit)	Gr

0. Introduction 簡介

在這個單元，你要使用三個有關轉動與振盪的模擬實驗，在你開始作答問題前，玩玩看每個模擬實驗，熟悉每個模擬實驗的操作，並利用這些模擬來回答問題。

In this activity unit, you will perform virtual experiments with three different public domain physics simulations dealing with Rotation and Oscillation. Before you start answering the questions, play with each simulation. Get familiar with each of the different effects and buttons of the animations. Where there are tabs, utilize them.

1. Revolution

1.1 下載模擬器 Download, Run and Play with the PhET Simulation: "Ladybug Revolution".

1.2 [*open Intro Tab*] Play with the ladybugs. Find the instantaneous linear velocity of the bugs. Draw the free body diagram and the velocity vectors. Whats common things do they have and what differences do they show? Why? 找出瓢蟲的順時速度，畫力圖分析。他們有哪些常見的東西，他們顯示有哪些不同?為什麼?

1.3 [*Intro Ta*b] What conditions does an object have to have to satisfy for it to be a static object. Which motions are absent? 物體需要滿足那些條件才能定義是靜態，哪種運動不存在?

1.4 [*Intro Tab*] What is the identical parameters do both the ladybugs show irrespective of location on the plate. Why is this description so important? What's the advantage in using this? 說明不論位置是否在圓盤上瓢蟲（兩者）做的運動類型相同。為什麼這說明如此重要？請問他有那些優點可以使用？

1.5 [*Rotation Tab*] Put the lady bugs in motion. What is the constant velocity we see in the motion of the bugs? Show this in mathematical form. (hint: use radians or degrees) 使瓢蟲開始運動，在我們所觀察運動中的瓢蟲什麼速度是定值，利用數學式說明(提示:用半徑或角度)

1.6 [*Rotation Tab*] How can we treat the plate as a particle? Is there a way to simplify or find the place that have no net force applied? Draw the plate and show the center of mass. 我們怎麼視圓盤為一個質點，有沒有一種方法可以簡化或找出沒用受到力的位置?請劃出圓盤並標出質心位置。

2. Torque

2.1 下載模擬器 Download, Run and Play with the PhET Simulation:"Torque"

2.2 [intro Tab] Rotate the plate at two different distances from the center with an equal amount of initial force. What's the difference? What created the difference? What factors are directly proportional to the speed of rotation? Show the relationship in mathematical form. 旋轉圓盤從中心兩個不同距離的地方，用兩個相等的力，他們造成那些不同的現象?那些因素與旋轉速度成正比? 請寫出數學式的關係?

2.3 [*Torque Tab*] Perform the above experiment and observe on the graph the values for Torque. Draw the free body diagram and graph (force , torque) for few instances in the rotation. What is the best way to maximize the torque we get? 進行上述實驗，觀察圖表上的力矩值是多少？畫出的旋轉情況下的力圖分析以及力與力矩的關係圖。要得到力矩最大值，最簡單的方法是麼?

2.4 [Torque Tab] Rotate the plate in both directions. Imagine the plate is a Phillips screw driver. Here we use the vector cross product (i.e right hand rule) Write the correct mathematical relationship that describes the torque on an object and what will happen to the bolt tightened or become undone ?. 將圓盤往兩個方向轉動。請想像一下，該圓盤是十字螺絲起子。這裡我們用外積(右手定則)寫下正確的數學關係式。

2.5 [Angular momentum tab] From the 2D motion when we come to angular momentum. What factors come into play once we set the plate in motion? What causes the angular momentum to change? 描述對象上的轉矩與符合從 2D 運動我們旋轉運動的動量。是什麼因素使圓盤運動？是什麼原因造成的角動量的變化？

2.6 [Angular momentum tab] What is the mathematical relationship that helps us to predict the angular momentum and angular velocity (hint: vectors).什麼是學關係式可以幫助我們預測角動量與角速度(提示:速度)

3. Pendulum

3.1 下載模擬器 Download, Run and Play with the PhET Simulation: "Pendulum"

3.2 Start the pendulum moving. Put the gravity to g=0. How can we describe this motion? What similarities does it have with the previous simulations? 開始擺盪運動，將重里調整為 0。苗速此運動與之前模擬的運動有何相似之處?

3.3 Set the gravity to that of earth Earth. Track and draw a graph of pendulum x-axis movement (vertical) vs time (horizontal axis). What does this plot show? Any similarities with mathematical formulas for periodic motion? 將重力同整為地球的重力。畫出鐘擺運動的曲線圖 x 軸（縱向），與時間（橫軸），此圖說明的週期運動數學式是甚麼?

3.4 Put gravity to that of the earth or Jupiter. Change the mass of the pendulum while its in motion. What changed? Guess what is behind this effect? 將重力調整為木星的重力場。改變鐘擺運動的質量，他的運動有改變嗎?請猜測背後的效應是什麼?

3.5 Put gravity to Earth. Change the length of the pendulum once and measure the period it takes. What kind of movement allows it to be called periodic? 將重力同整為地球的重力，改變鐘擺運動的長度，測量他一次週期所花的時間?怎樣的運動可以被稱為有週期性?

3.6 What are some practical applications for pendulum? What will happen if we put some friction to the pendulum motion? Draw the x axis movement Vs time graph. 如果將中擺放在有磨擦力縱用的環境下會發生什麼事?畫出位置(X)與時間(Y)的關係圖。

3.7 Which linear motion parameters can we see in the pendulum motion? Any familiar relationship to a skateboard riding on a frictionless plane or with friction? 我們可以在鐘擺運動看到那些線性運動的參數?

3.8 What is the frequency and period of the pendulum. What is their relationship? If it was a circular motion what would be the angular frequency? Can we track on a uniform circular motion (hint: g = 0) the x displacement of the pendulum? Whats the mathematical representation for this? 請說明何為頻率、週期?清說明他們之間的關係?假使這是一個圓周運動頻率是否為角頻率?我們可以用等速圓周運動（提示：G =0）紀錄鐘擺 x 位置？請說明這種情況的數學表達式為何？

4. 您的意見 Student Comments

4.1 Did you enjoy the activity? 你喜歡這個活動馬？ Choose one"
         □ LOVED 喜爱 □ 75% □ 馬馬虎虎 □ 25% □ HATED 憎恨

Why? 為什麼？

4.2 提出 1 或 2 個問題 可以 添加到本題目簿 如果你的問題被使用，加 1 分！（最多加 5 分） Suggest one or two additional questions that could be asked concerning any of the simulations you played with. (If we add your question, you will get 1% bonus marks for the course!)

Activity	Suggested Question	Answer to suggested question

4.3 有沒有別的意見？ Any other suggestions to improve this activity?