Simple Harmonic Motion

SimpleHarmonicMotion.tns

Name ______________________

Class ______________________

Problem 1 – Motion of a Swing

1. On page 1.2, study the motion of point *P* as it travels along the segment. Describe the motion of *P* over time.

2. What general function could be given to describe the position *x* of *P* at any time *t* seconds?

3. Watch the diagram on page 1.5. Imagine yourself on a swing moving back and forth. Focus upon your speed. When are you moving the fastest? When do you stop?

4. Now focus upon the force acting upon you. Once you start swinging, gravity pulls you downward. When is the acceleration the greatest? Least?

5. Motion is defined to be simple harmonic if the acceleration is directly proportional to displacement from the origin. Explain what this statement means.

6. Use the **displacement** equation $x = A \cdot \sin(n \cdot t)$ to derive a formula for **velocity**.

7. From this equation, derive a formula for **acceleration** in terms of **time**.

8. Now substitute the formula for **displacement** into this **acceleration** formula.

9. In your own words, explain how this formula relates to our motion on a swing.

10. Referring to the graphs of motion you have seen, carefully describe the critical points of this motion in terms of displacement, velocity and acceleration.

Problem 2 – Extension

Ex 1: Find other examples of simple harmonic motion and try to analyze these in the same way as we have for the child on a swing.

Ex 2: Carefully study the following, then explain and justify each statement:

- $a = \dfrac{d^2(x)}{dt^2} = \dfrac{dv}{dt}$
- $a = v \cdot \dfrac{dv}{dx}$

Ex 3: Show that $\int v \cdot \dfrac{dv}{dx} dx = \dfrac{1}{2}v^2$ Use these results to derive the Simple Harmonic Motion formulas.

Ex 4: When might it be appropriate to express the time/displacement form using cosine instead of sine?