Topic 4.1

Oscillations
Subject guide

**Understandings:**
- Simple harmonic oscillations
- Time period, frequency, amplitude, displacement and phase difference
- Conditions for simple harmonic motion

**Applications and skills:**
- Qualitatively describing the energy changes taking place during one cycle of an oscillation
- Sketching and interpreting graphs of simple harmonic motion examples

**Guidance:**
- Graphs describing simple harmonic motion should include displacement–time, velocity–time, acceleration–time and acceleration–displacement
- Students are expected to understand the significance of the negative sign in the relationship: \( a \propto -x \)

**Data booklet reference:**
- \( T = \frac{1}{f} \)
Notes

• Let’s have a look at your notes

• Think about:
  • What is well done in that note?
  • What would you add?
  • Anything you would like to change?
Worksheets

• You have been handed out a worksheet package. You can find the answers to all questions on the website
• Bring the package to each class. We will use it when solving problems
4.1 Oscillations

Oscillations 1
This is a graphical representation of a pendulum that is hanging from the edge of a tall office building.
1. What is the period of this wave?
2. How many complete cycles are shown?
3. What is the amplitude?
4. What is the displacement at 5 seconds and at 11 seconds?
5. List all of the times in which the graph cuts through equilibrium.
6. What is the frequency of the pendulum?
Displacement time graph

• I’ll show you a movement on the pendulum.
• You are to

1) Draw a sketch of the displacement – time graph (you do not need to label your axes)

2) Show the movement on your spring mass system that has a similar graph.
Phase difference demonstrations

- Go surendranath.org

- Choose freq low.

In your teams

Discuss the following questions

1. What is difference in degrees between a crest and a trough of the wave?
2. What is the difference in radians between two crests?
3. What is the difference in degrees between a crest and the next equilibrium point?
Displacement time graph

• Same thing but now with two pendulums

• Draw the displacement time graphs for both oscillators on the same set of axis

• One full oscillation could be expressed as 360° or 2pi rad. What is the difference in the phase of the two oscillators?
6. A microwave is emitted as shown in the graph below. Additional microwaves are emitted a short time later with the same amplitude and wavelength except that they have a phase difference of (a) \(45^\circ\) and; (b) \(\pi\) radians. Sketch these additional waves on the same axis.
7. Two identical soundwaves are produced from two identical speakers. What is the phase difference between the two waves in (a) degrees; and (b) radians?
10. Calculate the phase difference between the two displacement-time graphs shown in the figure. Give your answers in
   a) seconds
   b) radians
   c) degrees
4.1
1: ALL
29: 6 & 7
27: ALL
28: 4
55: 1, 2
57: 5
58: ALL
59: 10
Motion sensor & mass spring

Guidance:

- Graphs describing simple harmonic motion should include displacement–time, velocity–time, acceleration–time and acceleration–displacement

1. Connect the motion sensor to the interface
2. Choose probes and sensors → motion detector → motion detector
3. Let the masses (with the cardboard) oscillate up and down. Collect data so you have three different graphs describing the same motion.

   Be careful with the stand that it doesn’t tip over.

Look at the point when the displacement is maximum
1. What can you say about the velocity?
2. What can you say about the acceleration?
Explain the results above

What is the phase difference between:

a) Displacement & velocity
b) Displacement & acceleration
c) Velocity & acceleration?

Look at the point where the velocity is maximum
3. What can you say about the displacement?
4. What can you say about the acceleration?
Explain the results above

Look at the point where acceleration is maximum
5. What can you say about the displacement?
6. What can you say about the velocity?
Explain the results above