Name: Vidhi Shah **Reg. No: 21BCE1297** **Date: 14/03/22** **Batch: L3-L4**

Experiment 4: Phase and Group velocity of EM waves

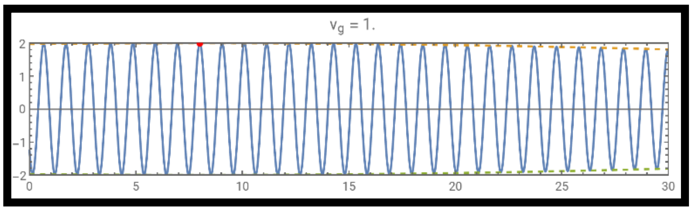
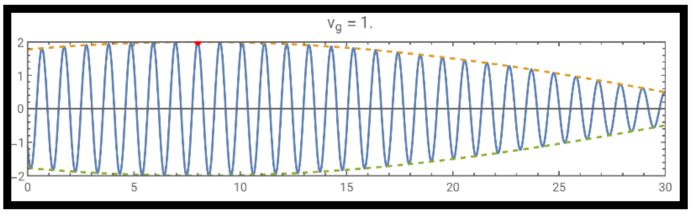
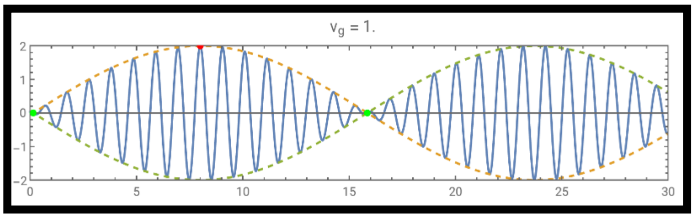
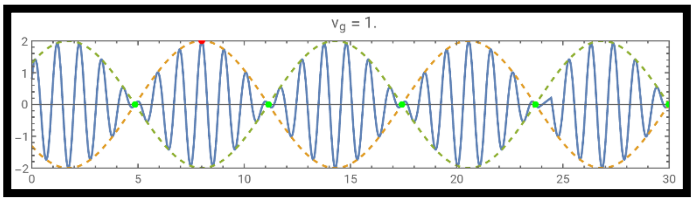
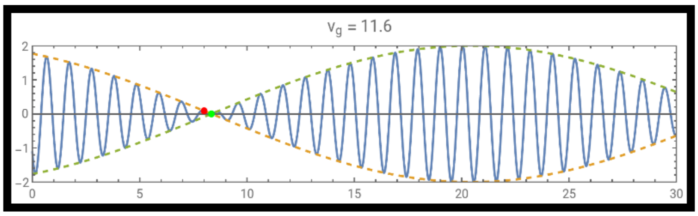
Tools required:

http://demonstrations.wolfram.com/GroupAndPhaseVelocity/

Objective:

To understand the nature of EM waves travelling in a medium with the help of Phase and Group velocities.

Observation table:

S. No	Δω	Δk	Wave pattern of the resultant waves	V_g
1	0.02	0.02		1
2	0.06	0.06		1
3	0.2	0.2		1
4	0.5	0.5		1
5	1.51	0.13		11.6

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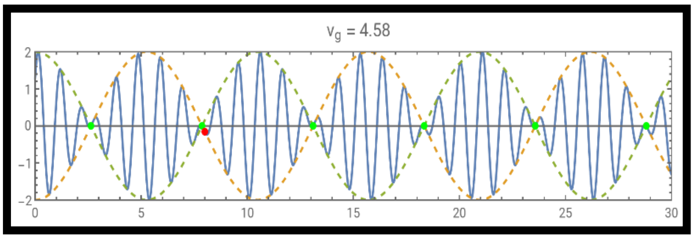
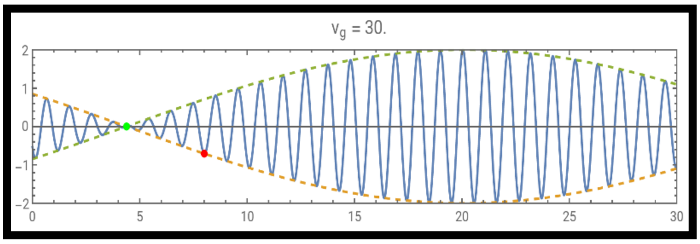
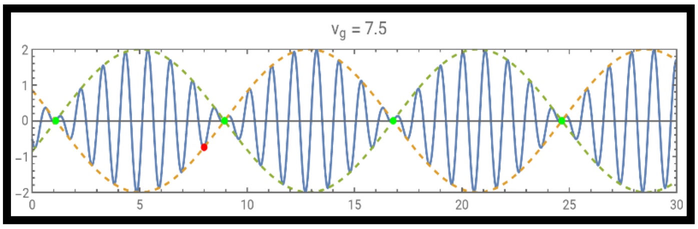
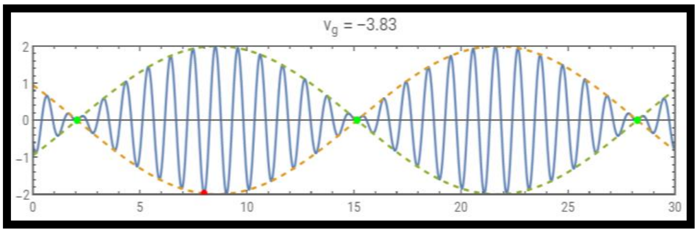
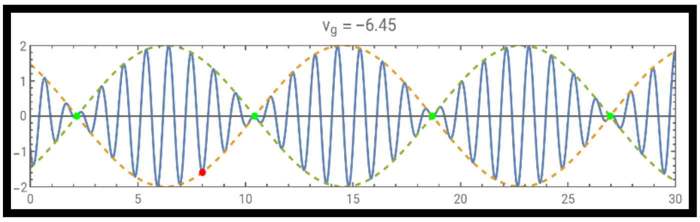
S. No	Δω	Δk	Wave pattern of the resultant waves	V_g
6	2.75	0.6		4.58
7	3	0.1		30
8	3	0.4		7.5
9	-0.92	0.24		-3.83
10	-2.45	0.38		-6.45

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Inferences:

1. **Are the wave patterns for various values of Δω and Δk same? If not, why?**
   No, the wave patterns for various values of Δω and Δk are not same even if V_g is same. The resultant wave formed by the superposition of two waves is dependent on the values of Δω and Δk. The resultant wave of the two waves is:

$$\boxed{2\cos\left(\frac{\Delta k}{2}z - \frac{\Delta \omega}{2}t\right)\cos\left(\bar{k}\cdot z - \bar{\omega}\cdot t\right)}$$

2. **Comment on the Phase velocity (Vp) of the waves for increased values of Δω and Δk.**
   Phase Velocity (V_p) remains the same for a wave in a given medium. It does not get affected by the increased values of Δω and Δk.

3. **When do we see V_p and V_g being the same?**
   If the phase velocity does not depend on the wavelength of the propagating wave, then
   $V_g = V_p$. This happens in non-dispersive media.

4. **Draw a typical dispersion relation curve (ω-k curve) for $V_p = V_g$ and $V_p \neq V_g$ cases.**
   $V_p = V_g$ – No dispersion
   $V_p \neq V_g$ – Anomalous Dispersion and Normal Dispersion