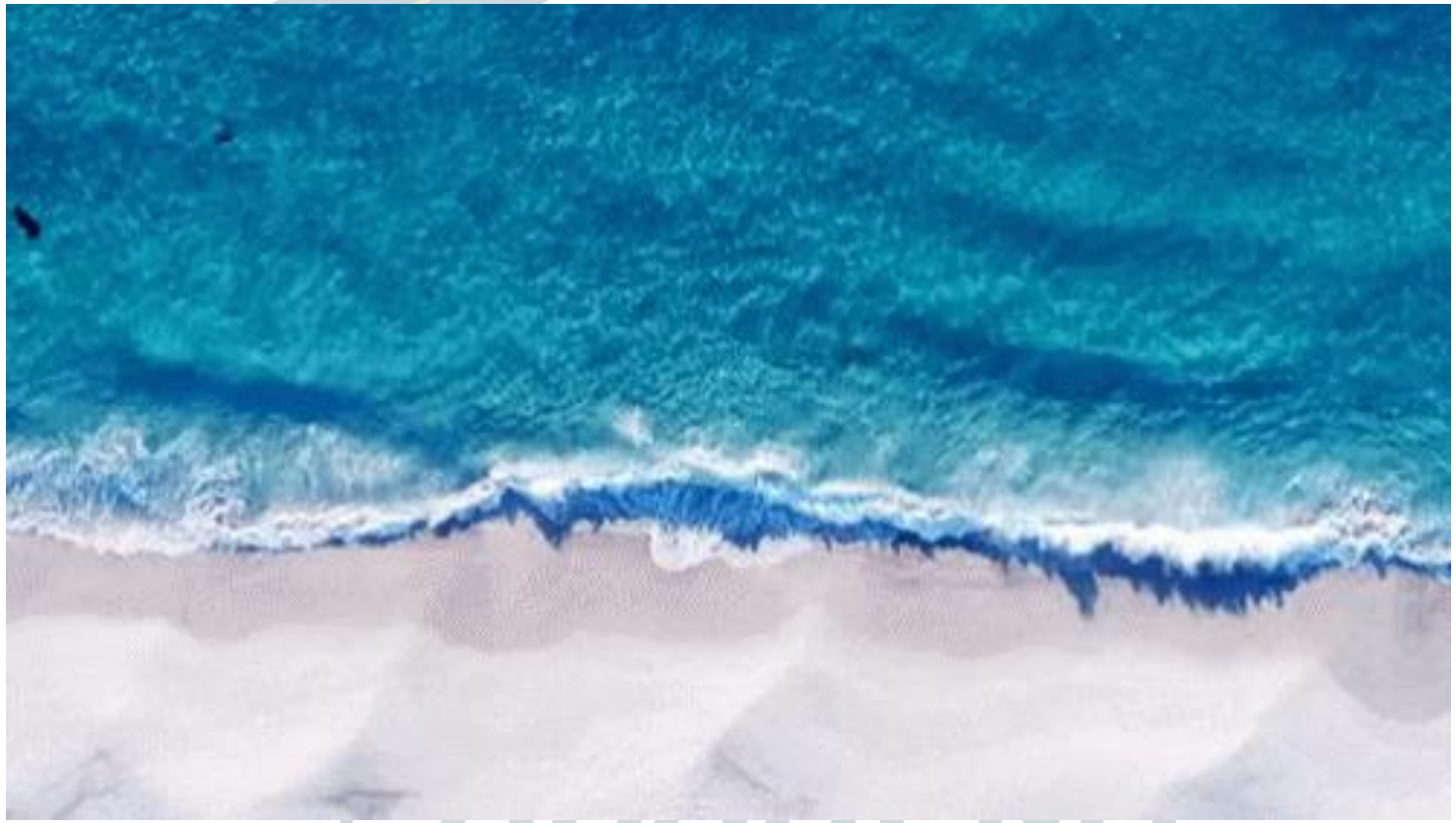
Physics - Grade 11 S

Unit One: Waves



Chapter 1: Waves

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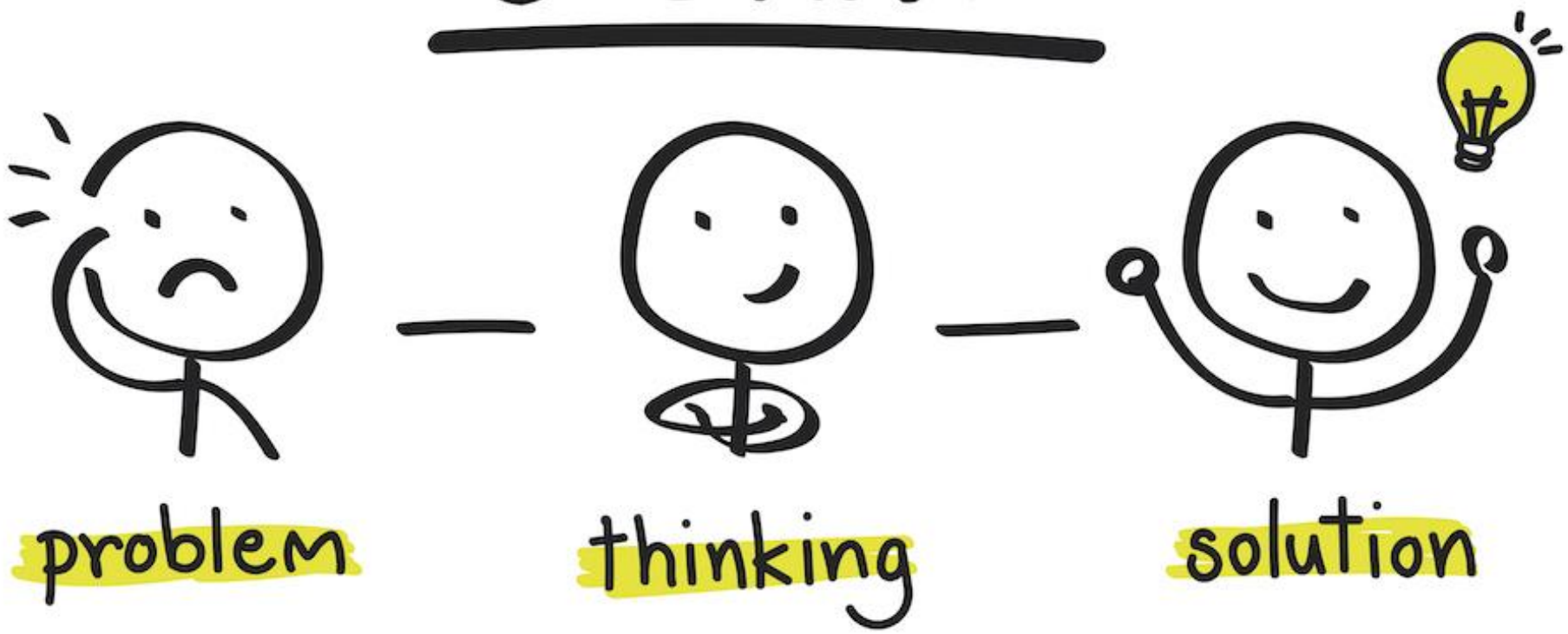
PROBLEM SOLVING



Exercise 1: Waves

Figure 1 represent, at the instant $t_0 = 0$, a snapshot for a progressive transverse wave propagating along a stretched rope.

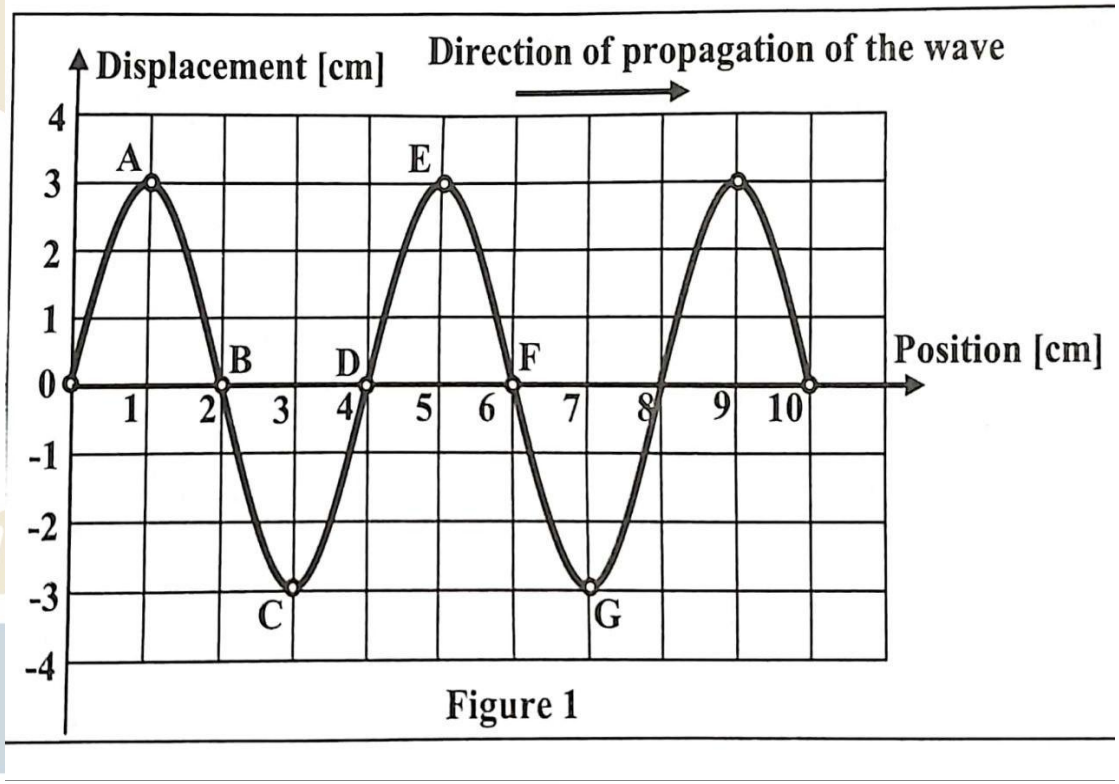


Figure 1

Part A: Answer by true or false. Correct the false statement(s).

a) The minimum distance between two points vibrating out of phase is quarter the wavelength.

False: The minimum distance between two points vibrating out of phase is half the wavelength.

Exercise 1: Waves

b)The points B and C vibrate in phase.

False: The points B and C vibrate in out of phase

c) The expression of the distance separating two points vibrating in phase is $d = (2k + 1)\frac{\lambda}{2}$, where $k \in R$.

False: The expression of the distance separating two points vibrating out of phase is $d = (2k + 1)\frac{\lambda}{2}$, where $k \in R$.

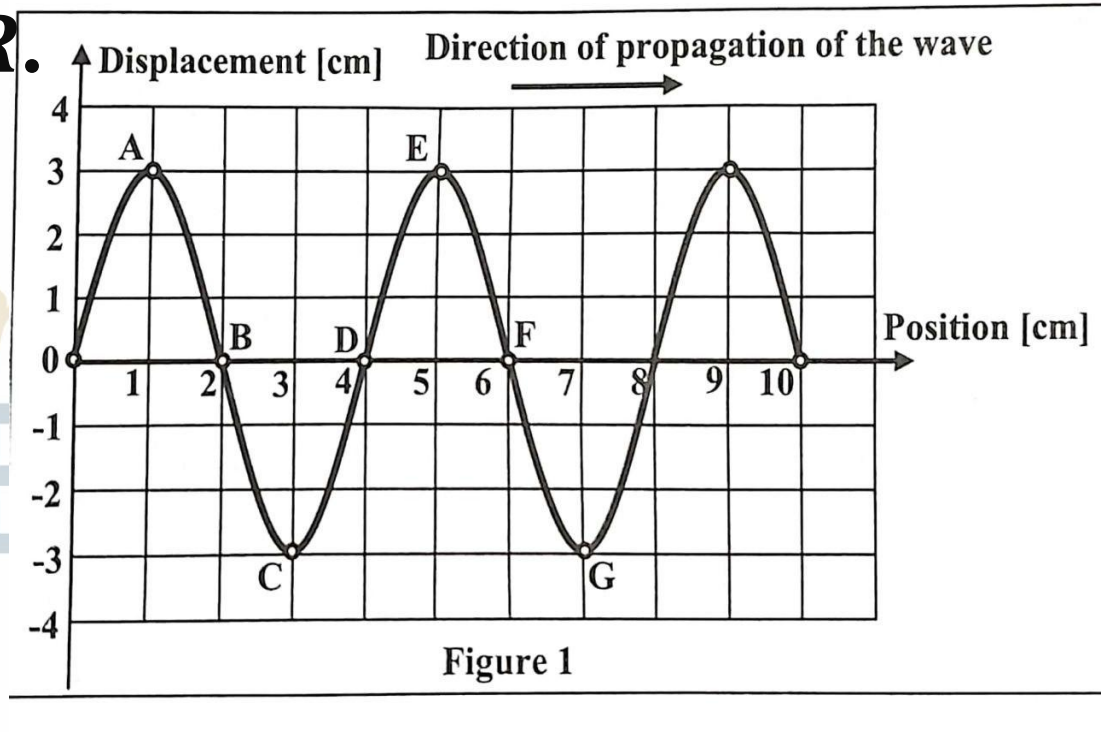


Figure 1

Exercise 1: Waves

Part B: Characteristics of the wave.

1. The wave is transverse. Explain.
2. Give the values of the amplitude and the wavelength of the wave.
3. Determine the speed of the wave knowing that the point A performs 20 oscillations in 2s.

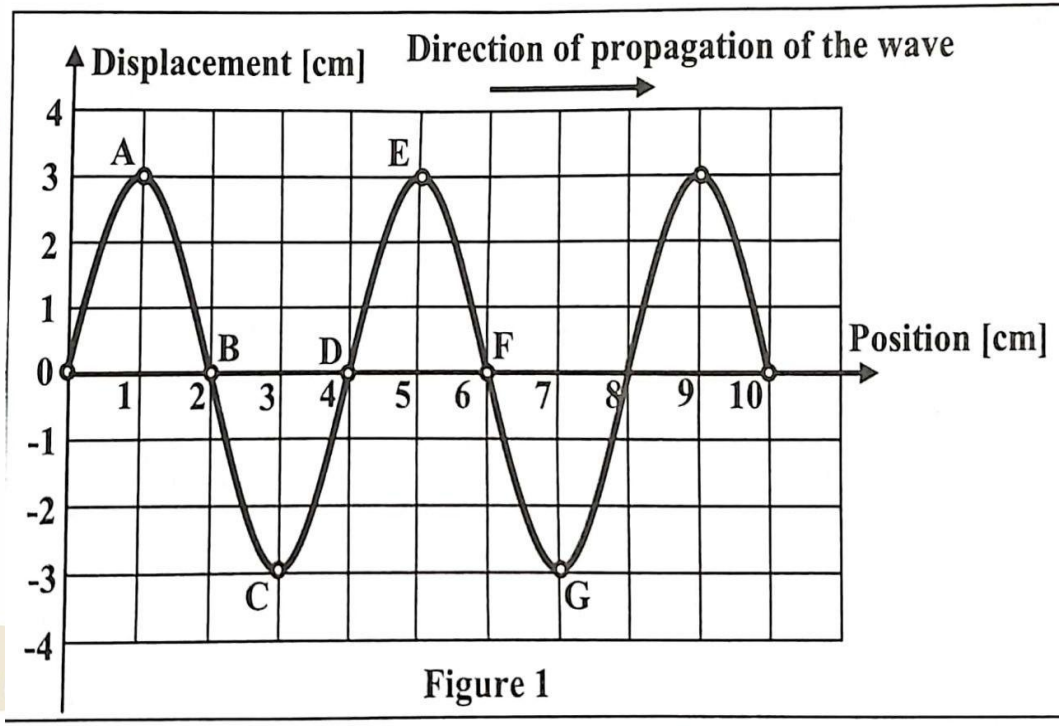


Figure 1

4. At what instant does A pass by the equilibrium position for the second time?

Exercise 1: Waves

1.The wave is transverse. Explain.

This wave is transverse, since direction of propagation of the wave is perpendicular to the direction of vibration of particles.

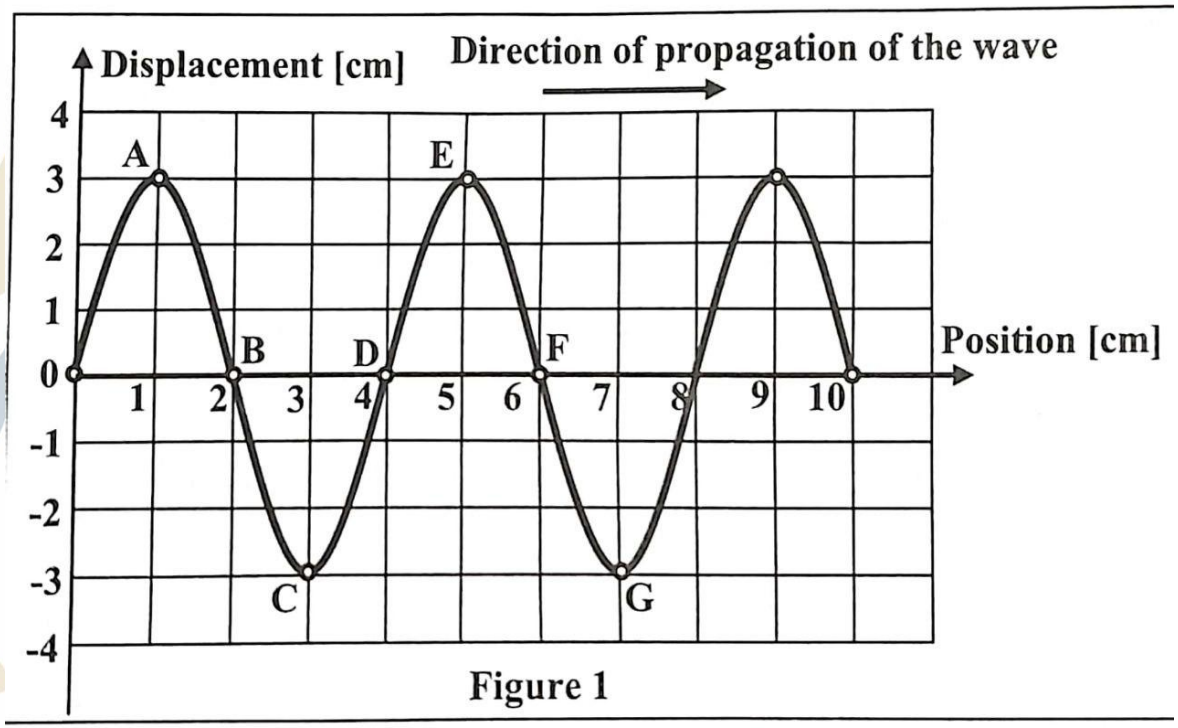


Figure 1

2.Give the values of the amplitude and the wavelength of the wave.

$a = 3cm$ And $\lambda = 4cm$

Exercise 1: Waves

3. Determine the speed of the wave knowing that the point A performs 20 oscillations in 2s.

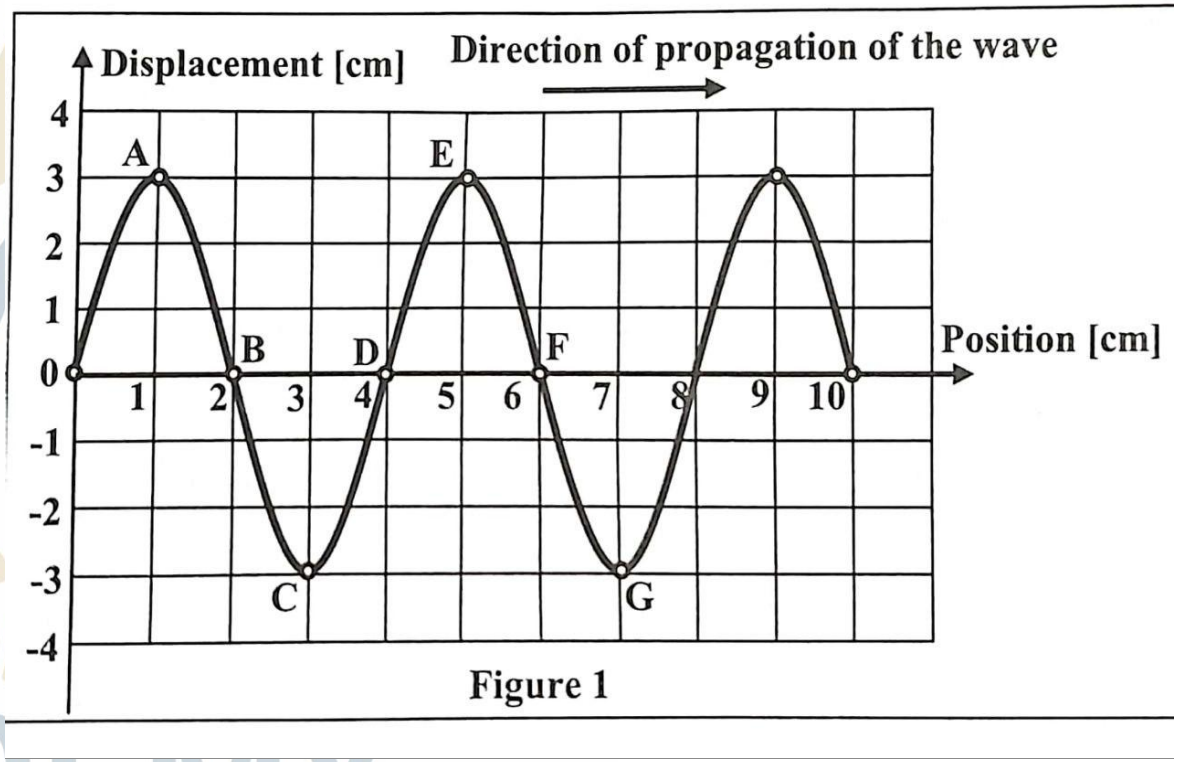


Figure 1

$$f = \frac{n}{t} = \frac{20}{2} \Rightarrow f = 10Hz$$

$$v = \lambda \times f \Rightarrow v = 0.04 \times 10 \Rightarrow v = 0.4m/s$$

Exercise 1: Waves

4.At what instant does A pass by the equilibrium position for the second time?

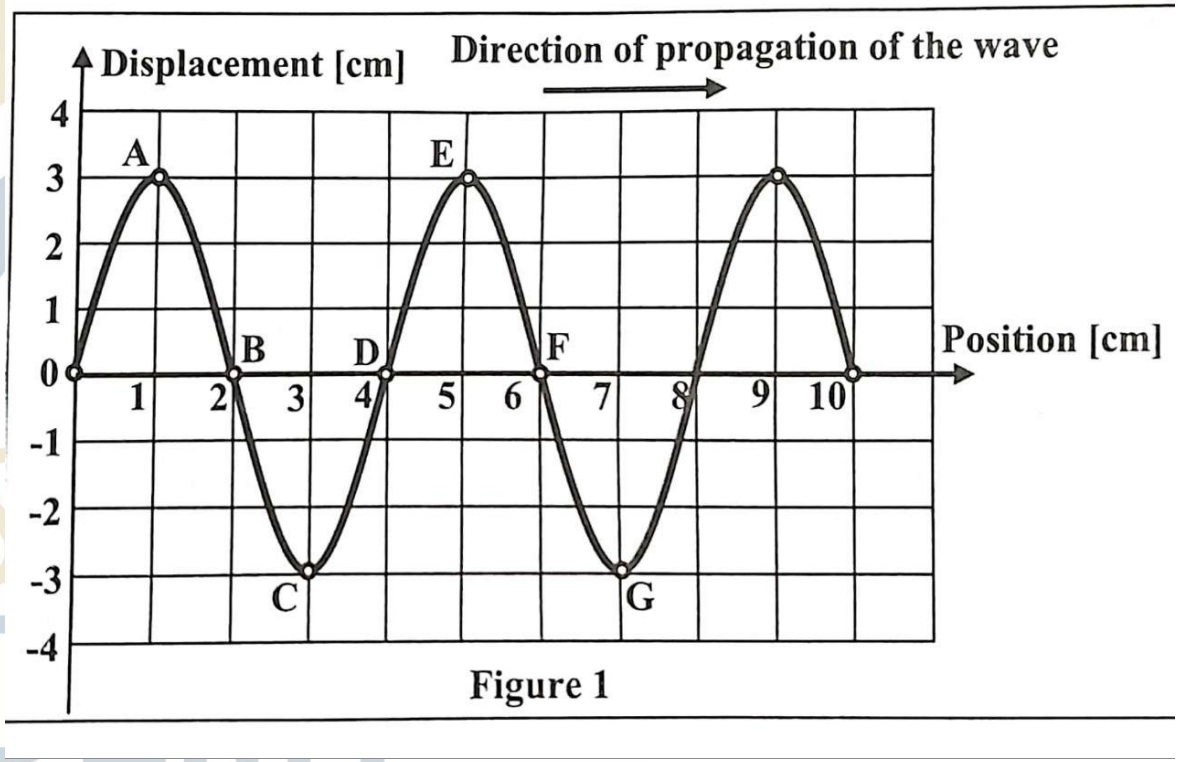
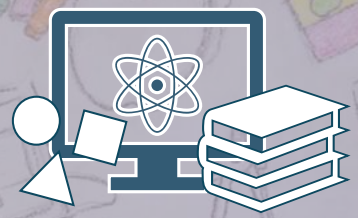


Figure 1

The point A passes through equilibrium position at

$$t = \frac{3T}{4} = \frac{3 \times 0.1}{4} = 0.075s$$

The End



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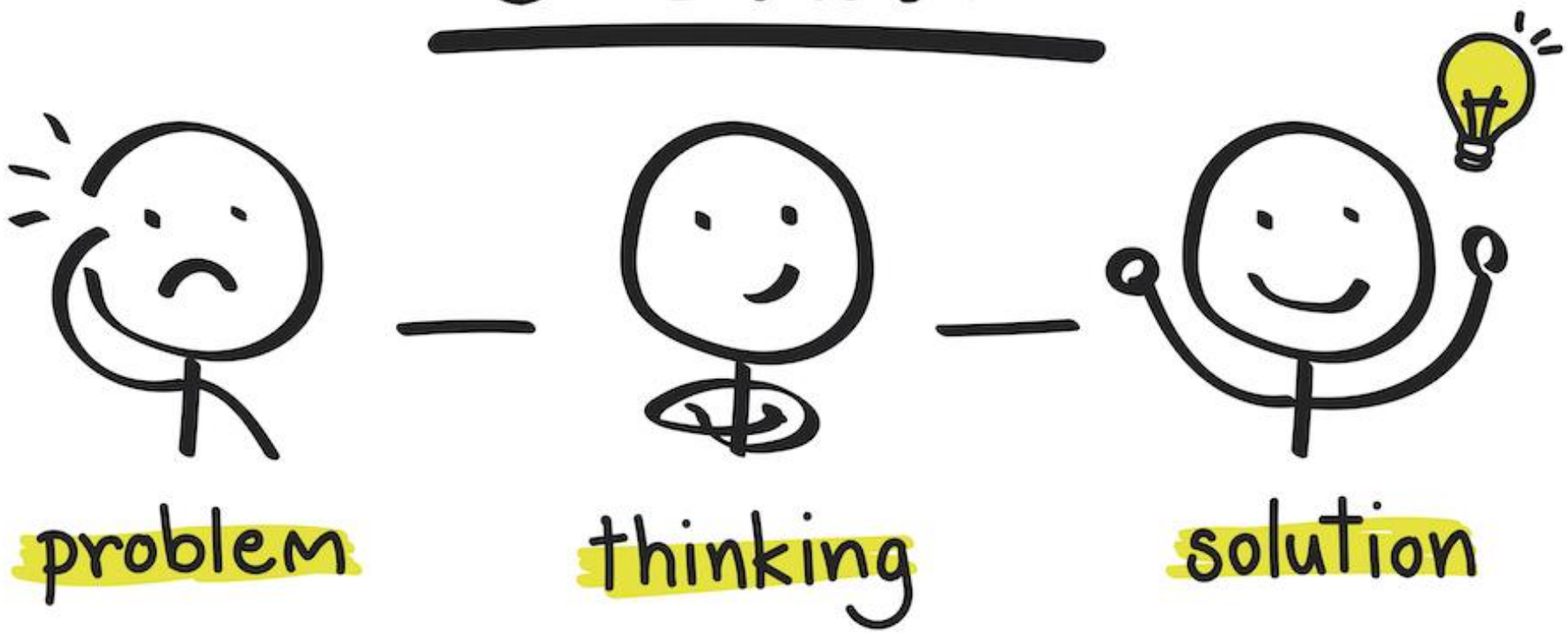

Exercise 2: Waves

A black disc, with a white sector painted on it, rotates with a frequency f. A stroboscope illuminates this disk by f_s in a dark room. f_s is given for different values from 40 to 400Hz.

The disk would seem motionless for $f_S = 50Hz$, $f_S = 75Hz$, $f_S = 150Hz$ and for $f_S = 300Hz$, the disk appears for the first time motionless with two symmetric sectors.

1. Calculate f in two different ways.
2. Interpret the phenomenon obtained for each value of f_S
3. Specify the appearance of the black disk when the frequency of the stroboscope is adjusted at 152Hz.
4. Specify, the appearance of the black disk when the frequency of the stroboscope is at 47.5Hz

Exercise 2: Waves

$f_S = 50Hz$, $f_S = 75Hz$ and for $f_S = 300Hz$

1)Calculate f in two different ways

$$f = kf'$$

For 1 sector apparent

$$f'_{max} = 150Hz$$

Then $k_{min} = 1$

$$f = 1 \times 150$$

$$f = 150Hz$$

$$kf' = kf$$

For 2 sector apparent

$$300 = 2 \times f$$

$$f = \frac{300}{2}$$

$$f = 150Hz$$

Exercise 2: Waves

$f_S = 50Hz, f_S = 75Hz, f_S = 150Hz$ and for $f_S = 300Hz$

2)Interpret the phenomenon obtained for each value of f_S

$f' = 50Hz$ And $f = 150Hz$

$f = kf'$ ➡ $150 = k.50$

➡ $k = 3$

We obtain three motionless sector

Between two consecutive flashes the sector rotates three completes cycles.

$f' = 75Hz$ And $f = 150Hz$

$f = kf'$ ➡ $150 = k.75$

➡ $k = 2$

We obtain one motionless sector

Between two consecutive flashes the sector rotates two completes cycles.

Exercise 2: Waves

$f_S = 50Hz, f_S = 75Hz, f_S = 150Hz$ and for $f_S = 300Hz$

2)Interpret the phenomenon obtained for each value of f_S

$f' = 150Hz$ And $f = 150Hz$

$f = kf' \Rightarrow 150 = k150$

$\Rightarrow k = 1$

We obtain one motionless sector since

Between two consecutive flashes the sector rotates one completes cycles.

$f' = 300Hz$ And $f = 150Hz$

We obtain one motionless sector since $f = kf'$ with k=2

Between two consecutive flashes the sector rotates two completes cycles.

Exercise 2: Waves

$f_S = 50Hz, f_S = 75Hz, f_S = 150Hz$ and for $f_S = 300Hz$

3)Specify the appearance of the black disk when the frequency of the stroboscope is adjusted at 152Hz

The frequency of the stroboscope is slightly larger than the frequency of the disk. Thus for each flash, the sector is observed in a position which is slightly behind the previous position

$$f_{app} = |152 - 152| = 2Hz$$

Exercise 2: Waves

$f_S = 50Hz, f_S = 75Hz, f_S = 150Hz$ and for $f_S = 300Hz$

4)Specify, the appearance of the black disk when the frequency of the stroboscope is at 47.5Hz

$f = 150Hz$ And $k.f' = 3 \times 47.5 = 142.5Hz$

$150Hz > 142.5Hz$

Then apparent slow motion with one sector

$$f_{app} = |150 - 142.5| = 7.5Hz$$

Between two consecutive flash, the sector will make a little more than three cycles.

The End