

ASSUME:

We discover a new particle and we name it 'Afteru'.

We find that the natural motion of the Afteru particle

can be expressed by the following relation,

in which u represents position, measured in cm, and t represents time, measured in sec:

$$\frac{\partial^2 u}{\partial t^2} = -nu$$

$$n = \frac{\pi^2}{64} \frac{\text{rad}^2}{\text{sec}^2}$$

$$\text{when } t = 0,$$

$$u \equiv u_0 = 300 \text{ cm}$$

1) Find, derive or write down a solution to the above dif. eq. for u :

That is, write down a relation by which we can obtain numerical values for u as a function of t .

2) Use the solution you obtained above:

In cm, determine the value of u for the following:

- a) $t = 0 \text{ sec}$
- b) $t = 1 \text{ sec}$
- c) $t = 2 \text{ sec}$
- d) $t = 4 \text{ sec}$
- e) $t = 8 \text{ sec}$
- f) $t = 16 \text{ sec}$
- g) $t = 32 \text{ sec}$

3) In seconds, determine T : the period of time for one full cycle of u values.

4) Assume that φ is constant, measured in radians.

Is $u = u_0 \cos(\omega t + \varphi)$ a solution to $\frac{\partial^2 u}{\partial t^2} = -nu$?

Prove your answer.

5) In meters, determine u for the following:

i) $\varphi = 0$:

- a) $t = 0 \text{ sec}$
- b) $t = 1 \text{ sec}$
- c) $t = 2 \text{ sec}$
- d) $t = 4 \text{ sec}$
- e) $t = 8 \text{ sec}$
- f) $t = 16 \text{ sec}$

ii) $\varphi = \frac{\pi}{4}$:

- a) $t = 0 \text{ sec}$
- b) $t = 1 \text{ sec}$
- c) $t = 2 \text{ sec}$
- d) $t = 4 \text{ sec}$
- e) $t = 8 \text{ sec}$
- f) $t = 16 \text{ sec}$

iii) $\varphi = \frac{\pi}{8}$:

- a) $t = 0 \text{ sec}$
- b) $t = 1 \text{ sec}$
- c) $t = 2 \text{ sec}$
- d) $t = 4 \text{ sec}$
- e) $t = 8 \text{ sec}$
- f) $t = 16 \text{ sec}$

iv) $\varphi = \frac{\pi}{2}$:

- a) $t = 0 \text{ sec}$
- b) $t = 1 \text{ sec}$
- c) $t = 2 \text{ sec}$
- d) $t = 4 \text{ sec}$
- e) $t = 8 \text{ sec}$
- f) $t = 16 \text{ sec}$

Now Assume:

Further research reveals an enormous horizontal line of identical Afteru particles: We call this line the 'x - axis'.

Each particle remains at its own particular coordinate on this x - axis, but seems to move in some kind of pattern along a perpendicular 'y - axis'.

6) Determine u for each of the following:

i) $\varphi = \frac{\pi x}{4}$, $t = 0 \text{ sec}$

- a) $x = 0 \text{ cm}$
- b) $x = 1 \text{ cm}$
- c) $x = 2 \text{ cm}$
- d) $x = 4 \text{ cm}$
- e) $x = 8 \text{ cm}$
- f) $x = 16 \text{ cm}$

ii) $\varphi = \frac{\pi x}{4}$, $t = \text{sec}$

- a) $x = 0 \text{ cm}$
- b) $x = 1 \text{ cm}$
- c) $x = 2 \text{ cm}$
- d) $x = 4 \text{ cm}$
- e) $x = 8 \text{ cm}$
- f) $x = 16 \text{ cm}$