Oscillation $\longrightarrow$ Propagation

Physics 204

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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:

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

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

when $t = 0$,

$u \equiv u_o = 300$ 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) $t = 0$ sec

b) $t = 1$ sec

c) $t = 2$ sec

d) $t = 4$ sec

e) $t = 8$ sec

f) $t = 16$ sec

g) $t = 32$ 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 $u = u_o \cos(\omega t + \varphi)$ 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) $t = 0$ sec

b) $t = 1$ sec

c) $t = 2$ sec

d) $t = 4$ sec

e) $t = 8$ sec

f) $t = 16$ sec

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

a) $t = 0$ sec

b) $t = 1$ sec

c) $t = 2$ sec

d) $t = 4$ sec

e) $t = 8$ sec

f) $t = 16$ sec

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

a) $t = 0$ sec

b) $t = 1$ sec

c) $t = 2$ sec

d) $t = 4$ sec

e) $t = 8$ sec

f) $t = 16$ sec

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

a) $t = 0$ sec

b) $t = 1$ sec

c) $t = 2$ sec

d) $t = 4$ sec

e) $t = 8$ sec

f) $t = 16$ 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) $\varphi = \frac{\pi x}{4}$, $t = 0$ sec

a) $x = 0$ cm

b) $x = 1$ cm

c) $x = 2$ cm

d) $x = 4$ cm

e) $x = 8$ cm

f) $x = 16$ cm

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

a) $x = 0$ cm

b) $x = 1$ cm

c) $x = 2$ cm

d) $x = 4$ cm

e) $x = 8$ cm

f) $x = 16$ cm