NCERT Analog Assignment

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Question 11.14.17: A simple pendulum of length l and having a bob of mass M is suspended in a car. The car is moving in a circular track of radius R with a uniform speed v. If the pendulum makes small oscillations in a radial direction about its equilibrium position, what will be its time period?
Solution:

TABLE 0
PARAMETERS

Parameter	Description
v	Speed
R	Radius of circular track
M	Mass of bob
g	Acceleration due to gravity
a_c	Centrifugal acceleration
g_e	Effective gravitational acceleration $\sqrt{g^2+a^2}$

$$a_c = \frac{v^2}{R} \tag{1}$$

Time period of a simple pendulum T is given by:

$$T = 2\pi\sqrt{\frac{l}{g_e}} \tag{2}$$

$$= 2\pi\sqrt{\frac{l}{\sqrt{g^2+a_c^2}}} \tag{3}$$

$$= 2\pi\sqrt{\frac{lR}{\sqrt{g^2R^2+v^4}}} \tag{4}$$

Therefore, the time period of the pendulum is $2\pi\sqrt{\frac{lR}{\sqrt{g^2R^2+v^4}}}$ seconds.