

mij Qw`Z MwZ

fygKv

tKvb e`KYv hw` Gi MwZct_i GKwU wbu`0 we`JK wbu`0 mgq cici GKB w`K t`K AwZµg Kti
 Zvntj tm MwZtK chēĚ MwZ etj | mij Qw`Z MwZ chēĚ MwZiB GKwU wełkl ifc| mij Qw`Z
 MwZi aviYv c`v_9eÁvbi LgB ,i"ZcYq Zi½ MwZmn AtbK MwZtKB GKwaK mij Qw`Z MwZi
 Dcwi cvZb wnmte tbqv thtZ cvti | Avevi AtbK tfsZ iwik AvtQ mgtqi mvtctq hv`i cwi eZ0 mij
 Qw`Z MwZi i vkgij vi gZ nq| thgb A.C eZ0xtZ wefe cv_R"i Kvti>U BZ"v` G mtei D`vniY|
 GB BDwbU Avgiv mij Qw`Z MwZ wbtq Avtj vPbv Kie|

cW-1

mij Qw`Z `ú`b I chëË Muz

Dfík`

G cW tkfI Avcib

- | mij Qw`Z Muz KvK etj Zv ej tZ cvi`teb,
- | mewfbæcKvi Muzi msÁv cKik Ki tZ cvi`teb,
- | chëË Muz I `ú`b Muzi msÁv wj LtZ cvi`teb,
- | chëËKvj KvK etj wj LtZ cvi`teb,
- | mij Qw`Z `ú`b i e`eKj bix mgxKiY wj LtZ cvi`teb,
- | mij Qw`Z `ú`b i e`eKj bix mgxKiYi mgvavb wbyq Ki tZ cvi`teb|

8.1.1 t Qw`Z Muz

tKvb GKw MuzKvj e`Kv hwi wbi`e mgq cici tKvb wbi`e w`K GKB w`K t`K AwZµg Kti Zte e`Kv Muzi MuztK chëË Muz etj |

mavivYfite wbi`e mgq cici th Muzi cyvewE NtU, ZvK chëË Muz etj | Nwoi Kwvi Muz, m`hP Pwi w`K c`lexi Muz chëË Muzi D`vniY|

chëË Muzm`ubæKYv th wbi`e mgq cici wbi`e w`K GKB w`K t`K AwZµg Kti ZvK chëËKvj etj | thgb c`lexi chëËKvj 365 w`b 6 NEv|

chëË Muzm`ubæKvb e`zhw` chëËKvj i AfaR mgq tKvb wbi`e w`K Ges emK AfaR mgq Zvi w`cixZ w`K Ptj Zte e`Kv MuztK `ú`b Muz etj | thgb t`vj tKi Muz, w`ustqi m`t`_mshy` fti i Muz BZ`w` |

GKw `ú`biZ e`K GKw cY`ú`b m`ubæKi tZ th mgq j`vM ZvK chëËKvj ev t`vj bKvj etj | GtK T`vivi cKik Kiv nq|

`ú`b Muz m`ubæKvb KYv c`Z GKK mgq hZ` wj cY`ú`b m`ubæKti Zvi msL`vK KYvi K`úv¼ etj | GtK n`vivi cKik Kiv nq| m`Zivs K`úvsk n`t`Q chëËKvj i w`cixZ iwK A`n = $\frac{1}{T}$ K`úvstKi GKK m`vBtKj /tm`KÚ ev n`vR^Q(Hertz)| `ú`biZ e`K Muzct`i th wbi`e w`K tKvb j`w` etj w`µqv Kti bv, ZvK mgv`e`vb ev ga`ve`vb ej v nq|

8.1.2 t mij Qw`Z `ú`b ev Muz (Simple Harmonic Oscillation)

chëË Muzm`ubæKvb e`Kv hwi Ggbfite `ú`Z nq th, KYvi Dci w`µqvKvj ej KYvi mgv`e`vbi Awfglyx nq Ges G etj i gvb me`v mgv`e`vb t`K KYvi mi`Yi mgvbgvWZK nq, Zvntj e`Kv MuztK mij Qw`Z `ú`b etj |

mij Qw`Z `ú`bKvj KwYKvK mij Qw`Z `ú`K (Simple Harmonic oscillator) Ges Gi MuztK mij Qw`Z Muz (Simple Harmonic motion) ej v nq|

8.1.4 t mij Qw`Z `ú` tbi e`eKj bxq (Differential) mgxKi tYi mgvavb

mij Qw`Z `ú` tbi e`eKj bxq mgxKi Y

$$\frac{d^2x}{dt^2} + \omega^2 x = 0 \dots \dots \dots (i)$$

GB mgxKi YwUi GKwU mgvavb n`QÑ

$$x = A \sin(\omega t + \delta) \dots \dots \dots (ii)$$

GwU th mgxKi Y (i) Gi GKwU mgvavb Zv Avgiv w`t`e` Dcv`q h`v`v`B Kw` |

x tK t Gi m`t`c`q e`eKj b K`i cvBÑ

$$\frac{dx}{dt} = \frac{d}{dt} A \sin(\omega t + \delta)$$

$$\text{ev, } \frac{dx}{dt} = A \frac{d}{dt} [\sin(\omega t + \delta)]$$

$$= \omega A \cos(\omega t + \delta)$$

$$\frac{dx}{dt} \text{ tK t Gi m`t`c`q e`eKj b K`i t j}$$

$$\text{ev, } \frac{d^2x}{dt^2} = \frac{d}{dt} \left(\frac{dx}{dt} \right) = \omega A \frac{d}{dt} [\cos(\omega t + \delta)]$$

$$= -\omega^2 A \sin(\omega t + \delta)$$

$$\text{ev, } \frac{d^2x}{dt^2} = -\omega^2 A \sin(\omega t + \delta) \dots \dots \dots (iii)$$

(iii) bs mgxKi tY (ii) bs mgxKi Y e`envi K`i Avgiv cvBÑ

$$\frac{d^2x}{dt^2} = -\omega^2 x$$

$$\text{ev, } \frac{d^2x}{dt^2} + \omega^2 x = 0$$

A_` x = A sin(ωt+δ) mgxKi Y (1) tK w`x K`i

m`Z`vs x = A sin(ωt + δ) mij Qw`Z `ú` tbi e`eKj bxq mgxKi tYi GKwU mgvavb |

mvi mst`q`c

mg`qi m`t`_ e`z` Ae`v`t`bi cwi e`Z`t`K MwZ etj Ges hLb tKvb e`z`w`w`e` mgq cici GKwU w`w`e` w`e` yAwZ`m`g K`i ZLb e`z` MwZ`K ch`q MwZ etj |

Avevi hLb tKvb e`z`mij`t`L`v`q Ggbf`v`e` t`v`j th Zj`Y mi`t`Yi mgv`b`g`w`w`Z`K I w`e`c`i`x`Z`g`y`x` n`q Ges e`w`U w`w`e` mgq cici GKB Ae`v`t`b w`d`t`i Av`t`m ZLb e`z` MwZ`K mij Qw`Z MwZ etj |

cvtVĚi gj`vqb

K. mġVK DĚti i cvtk ġUK ġPý (√) ġ b|

- 1| MġZ ej tZ eySÑ
 (K) mgtqi mġ_ e`ž `vb cġieZĖ|
 (L) mgtqi mġ_ e`ž Ae`vb cġieZĖ bv Kiv|
 (M) tKvbġUB bq|

- 2| mij Qġ`Z `ŵ` tbi tġtġÑ
 (K) ZġY mi tYi mġvbġmġZK I ġecixZġġx
 (L) ZġY mi tYi mġvbġmġZK I mġġġx
 (M) ZġY mi tYi e`vbġmġZK I ġecixZġġx
 (N) tKvbġUB bq|

- 3| mij Qġ`Z MġZi e`eKj bxq mġxKi tYi mġvavb nt`QÑ
 (K) $x = A \sin \omega t$ (L) $x = v_{x0} t + \frac{1}{2} a_x t^2$
 (M) $y = \tan \omega t$ (N) $y = x \sin \omega t$

- 4| tKvbġUi MġZ chġĚ MġZ -
 (K) tij Mvox (L) tġvUi Mvox
 (M) cġ_ex (N) cġm|

msġġB cġġe

- 1| chġĚ MġZi msÁv ġġ Lġ|
- 2| mij Qġ`Z MġZi msÁv ġġ Lġ|
- 3| chġKv tġi msÁv ġġ Lġ|
- 4| mij Qġ`Z MġZi mġxKi YġU ġġ Lġ|
- 5| mij Qġ`Z MġZi e`eKj bxq mġxKi YġUi mġvavb ġġ Lġ|

cW-2

mij Qw`Z `ú`tb KYvi miY, teM I kw³

Dfík

G cW tkfI Avctb

- | mij Qw`Z KYvi miY wK Zv ej tZ cvi`teb,
- | mij Qw`Z KYvi teM i aib wK ijc Zv e`vL`v Ki tZ cvi`teb,
- | mij Qw`Z KYvi MwZ I w`wZ kw³ m`ú`K`eY`v w` tZ cvi`teb,
- | tj LwP`f`i mrvv`th` mij Qw`Z KYvi MwZ eY`v Ki tZ cvi`teb,
- | mij Qw`Z MwZi t`f`f`i tgvU hvšK kw³ a`eK c`vY Ki tZ cvi`teb|

8.2.1 t mij Qw`Z `ú`b mspvš-vevfba`wk

Avgiv Rvb, mij Qw`Z `ú`tb i e`eKj b`xq mgxKi t`Yi GKwU mgvavb n`f`Q

$$x = A \sin(\omega t + \delta)$$

$$A_f\ miY, x = A \sin(\omega t + \delta) \dots \dots \dots (i)$$

x tK t Gi m`f`c`f`q e`eKj b K`i c`vB

$$teM\ v = \frac{dx}{dt} = \frac{d}{dt} (A \sin(\omega t + \delta))$$

$$v = \omega A \cos(\omega t + \delta) \dots \dots \dots (ii)$$

$$(i)\ bs\ mgxKi\ Y\ t_fK\ c`vB\ \sin(\omega t + \delta) = \frac{x}{A}$$

$$\begin{aligned} \text{ev, } \sin^2(\omega t + \delta) &= \frac{x^2}{A^2} \\ \cos(\omega t + \delta) &= \sqrt{1 - \sin^2(\omega t + \delta)} \\ &= \sqrt{1 - \frac{x^2}{A^2}} \\ &= \sqrt{\frac{A^2 - x^2}{A^2}} \end{aligned}$$

(ii) bs mgxKi t`Y cos(ωt+δ) Gi gvb e`vmtq c`vB`N

$$v = \omega A \sqrt{\frac{A^2 - x^2}{A^2}}$$

$$\therefore v = \omega \sqrt{A^2 - x^2} \dots \dots \dots (iii)$$

mij Qw`Z MwZm`ú`ba`KYvi teM miY x Gi Dci w`b`f`k`xj | teM i m`te`P`P gvb m`v`ve`v`tb A`_f` x = 0 tZ c`vI qv hvq|

$$\therefore V_{\max} = \omega \sqrt{A^2 - 0^2}$$

$$A_f, V_{\max} = \omega A$$

(ii) bs mgrKi YtK mgtqi mvtctq] e`eKj b Kti KYvi Zji Y cvl qv hıqN

$$a = \frac{dv}{dt} = \frac{d}{dt} [\omega A \cos(\omega t + \delta)]$$

$$= -\omega^2 A \sin(\omega t + \delta)$$

ev, $a = -\omega^2 x$

mvg`ve`vfb $x=0$ Ges tmLvfb Zji tYi gvb kb` Ges Zji tYi gvb mtePP nte mtePP ne`vfi $x=A$ `vfb

$$a_{\max} = -\omega^2 A$$

FYvZK wPy eSvq Zji Y mi tYi necixZ Awfglx|

$$\therefore a_{\max} = -\omega^2 A$$

8.2.2 t mij Qw`Z `u` tbi tqtT kv3

aiv hıK, `u` biZ KYvi fi m Ges teM v

$$AZGe, MvZkv3 = \frac{1}{2} mv^2$$

$$= \frac{1}{2} m [\omega (\sqrt{A^2 - x^2})]^2$$

$$= \frac{1}{2} m \omega^2 (A^2 - x^2)$$

$$= \frac{1}{2} m \cdot \frac{k}{m} (A^2 - x^2) \quad \left[Qw = \sqrt{\frac{k}{m}} \right]$$

$$= \frac{1}{2} k (A^2 - x^2) \dots \dots \dots (i)$$

e`KYvi mvg`ve`vfb A `vfb $x=0$ `vfb teM mtePP

AZGe, mtePP MvZkv3 nteN

$$K_{\max} = \frac{1}{2} k (A^2 - 0^2)$$

$$= \frac{1}{2} k A^2 \dots \dots \dots (ii)$$

Avevi, e`KYvi teM mefaK ne`vfi A `vfb $x=A$ `vfb mefaK

AZGe, mefaK MvZkv3 nteN

$$K_{\min} = \frac{1}{2} k (A^2 - A^2) = 0 \dots \dots \dots (iii)$$

mZivs mij Qw`Z MvZtZ `u` biZ tKvb KYvi MvZkv3 `ib` nZ mtePP $\frac{1}{2} k A^2$ chS-nZ cıti |

w`vZ kv3 : Avgiv Rvnb mij Qw`Z MvZi tqtT Kvhrıx ej, $F = kx$, [ej evBti i GtR>U KZK chS etj 0-0 ev` t`qv ntqtQ|]

GB ej c0qvM tKvb e^{-x} Ae^{-vb} t_tK x+dx Ae^{-v}b^{-vb}Šm Z ntj KZ.KvR

dw = Fdx

mvg^{ve}-vb t_tK e⁻li miY_x ntj KZ.KvR

$$w = \int_0^x Fdx, \quad w = \int_0^x kx dx, \quad W = \frac{1}{2} kx^2$$

ewnti i tKvb GtRvU GB cwigvY KvR m^{uv} b Kitj Zv e⁻li w⁻zkw³ wntmte m^WÅZ nte/ AZGe mij Qw`Z MwZi t^qt^l ^ubiZ KYvi th tKvb A_{fr} gy^tZ^p efekw³ ev w⁻zkw³ n^tQ

$$U = \frac{1}{2} kx^2 \text{ thLv } x = A \sin(\omega t + \delta) \mid \text{mvg}^{\text{ve}}\text{-v } A_{\text{fr}} \text{ } x=0 \text{ Ae}^{-\text{v}}\text{b KYvUi w}^{-\text{z}}\text{kw}^3 \frac{1}{2} k0^2 = 0$$

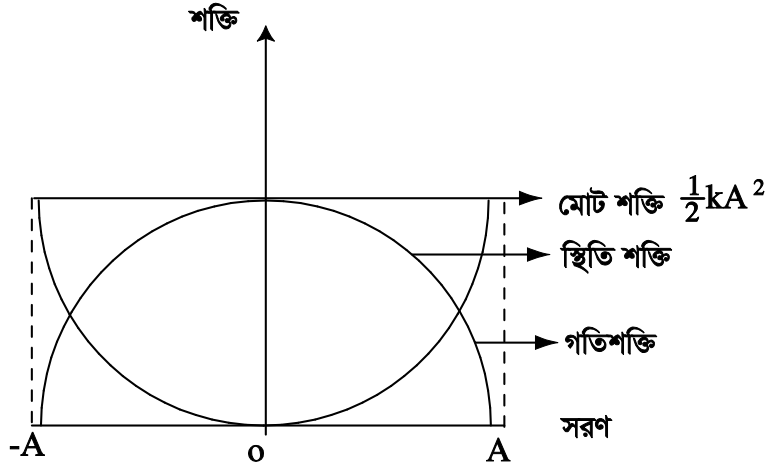
$$U_{\text{min}} = \frac{1}{2} k0^2 = 0 \dots \dots \dots \text{(iv)}$$

me^Wak w⁻ti A_{fr} x = A Ae⁻v

w⁻zkw³ m^te^pp n^te

$$\therefore U_{\text{max}} = \frac{1}{2} kA^2$$

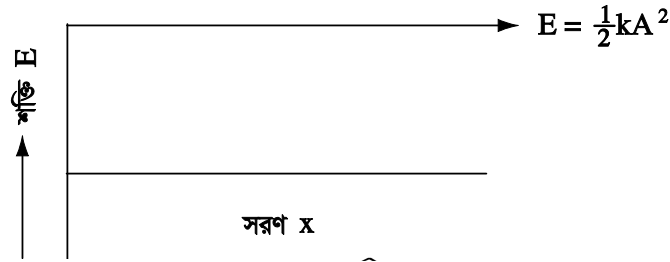
m^zivs mij Qw`Z MwZtZ ^ubiZ KYvi w⁻zkw³ i gv^b me^Wak^W n^tZ m^te^pp $\frac{1}{2} kA^2$ ch^S-n^tZ cv^ti |



ৱপ্টি : 8.1 :

$$\begin{aligned} \text{tgvU hwi}^{\text{š}}\text{K kw}^3 E &= M\text{wZkw}^3 + \text{efekw}^3 \\ &= \frac{1}{2} (A^2 - x^2) + \frac{1}{2} kx^2 \\ &= \frac{1}{2} kA^2 - \frac{1}{2} kx^2 + \frac{1}{2} kx^2 \\ &= \frac{1}{2} kA^2 \dots \dots \dots \text{(v)} \end{aligned}$$

Dc`ii mgxKiY t`tk eSv hvq tgvU hvšK k`³ a`eK|



8.2 নীট :

মেম্বাক বে`ধি MনZk`³ i gvb kb` KšZi`iZk`³ i gvb m`eP`P| AZGe, tgvU k`³ $E = 0 + \frac{1}{2} kA^2 = \frac{1}{2} kA^2$

Avevi mg`ve`v`b i`iZk`³ i gvb kb` KšZi`iZk`³ i gvb m`eP`P $\frac{1}{2} kA^2$

AZGe, tgvU k`³ $E = 0 + \frac{1}{2} kA^2 = \frac{1}{2} kA^2$

$$\therefore E \propto A^2 \text{ [: k GKU a`eK]}$$

tgvU k`³ বে`ধি i e`M`P mgvbg`v`ZK|

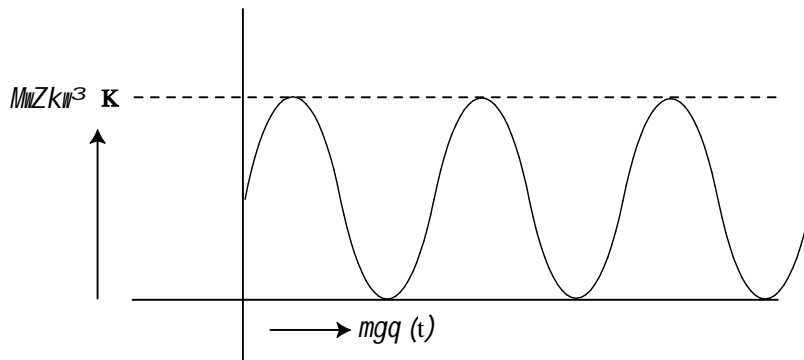
mij Qw`Z MনZi t`t`i`i w`vZk`³, MনZk`³ I tgvU k`³ i mgq ebgv k`³ tj LuP`i Dc`vcb :

mij Qw`Z MনZi Rb`

MনZk`³, $K = \frac{1}{2} mv^2$ eV, $K = \frac{1}{2} m\omega^2 A^2 \cos^2(\omega t + \delta)$

eV, $K = \frac{1}{2} m \frac{k}{m} A^2 \cos^2(\omega t + \delta)$ eV, $K = \frac{1}{2} kA^2 \cos^2(\omega t + \delta)$

AZGe mg`qi m`v`c`i`i K Gi cwi eZ`B i`b`e`c` n`e|



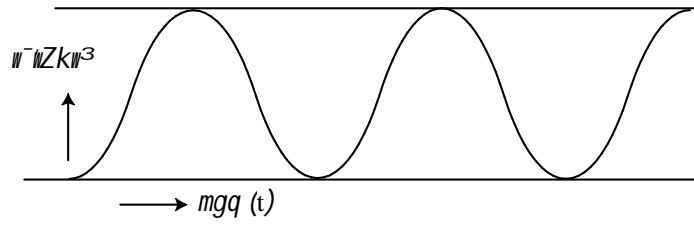
8.3 নীট : MনZk`³ ebgv mgq tj LuP`i

i`iZk`³ i mgxKi YU nj ,

$$U = \frac{1}{2} kx^2$$

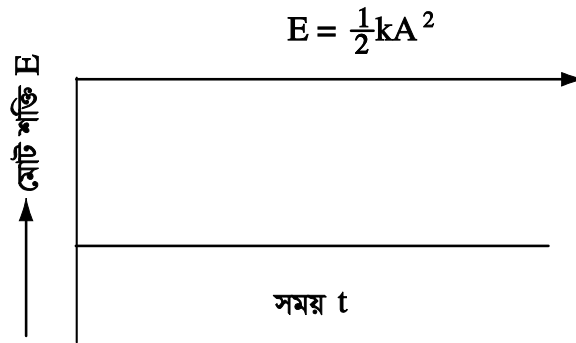
$$U = \frac{1}{2} kA^2 \sin^2(\omega t + \delta)$$

mZi s mgqi Dci U-Gi wbfPkj Zi wbejc:



8.4 wPÎ : wZkw³ ebig mgq tj LwPÎ

mij Qw`Z MwZi tqt tgvU kw³i gvb $\frac{1}{2} kx^2$ gvb mgqi mtcqt AcwewZ _vK | AZGe mgqi mtcqt tgvU kw³i tj LwPÎ nte wbejc



8.5 wPÎ : wZkw³ ebig mgq tj LwPÎ

mvi mstqc

mij Qw`Z `ú`tb miY t $x = A \sin (\omega t + \delta)$

mij Qw`Z `ú`tb teM t $v = \omega A \cos (\omega t + \delta)$

mij Qw`Z `ú`tb ZjY t $a = -\omega^2 A \sin (\omega t + \delta) = -\omega^2 x$

mij Qw`Z `ú`tb wZ kw³ t $U = \frac{1}{2} kx^2$

mij Qw`Z `ú`tb MwZkw³ t $k = \frac{1}{2} mv^2 = \frac{1}{2} k(A^2 - x^2)$

cuVvEi gj`vqb

K. mWk DEti i cuK Wk (√) vPy w b|

1/ mij Qw`Z `ú`#bi t¶t¶ tgvU kw³ E nj N

(K) $\omega A \cos(\omega t + \delta)$ (L) $\frac{1}{2} kA^2 \sin^2(\omega t + \delta)$

(M) $\frac{1}{2} kA^2$ (N) $\frac{1}{2} kA^2 \cos^2(\omega t + \delta)$

2/ mij Qw`Z `ú`#b KYvi miY?

(K) $A \sin(\omega t + \delta)$ (L) $A \sin(\omega t + \delta)$

(M) $K \sin(\omega t + \delta)$ (N) $\omega A \sin(\omega t + \delta)$

3/ mij Qw`Z MwZtZ KYvi tetMi i vnkgvj v nte?

(K) $v = \omega \sqrt{A^2 - x^2}$ (L) $v = k\omega^2$

(M) $v = -\omega^2 x$ (N) $v = \omega A$

L. msu¶¶B c¶æ

1/ mij Qw`Z `ú`b MwZm¶úbae`z tetM tetPP I me¶¶¶¶Kv_vq nte wj L¶|

2/ mij `ú`b MwZm¶úbae`z MwZkw³ I w`wZkw³ i m¶t_ mi¶Yi m¶úK¶j L¶|

3/ mij Qw`Z MwZtZ ZjY I miY Gi g¶a` m¶úK¶K?

cW-3

mij Qw`Z MwZ I eËvKvi MwZi mæúK©

Dfík`

G cW tkfI Avırb

- | mij Qw`Z `ú`b I eËvKvi MwZi gta` mæúK©j LtZ cvi`eb,
- | w`úš Gi `ú`b eYÖv Ki`Z cvi`eb,
- | tjL wPtîi gva`tg w`úš-Gi KihRix fi tei Ki`Z cvi`eb|

8.3.1 t mij Qw`Z `ú`b I eËvKvi MwZi mæúK©

aiv hvK, r e`vımtaP GKıU eËvKvi c`_ GKıU KYv myg tKšıbK `ıwZ w ıbtq MwZkxj wPî 8.3| Aw` Ae`ıvq A_ıP t=0 mg`q KYvıU A ıe`şZ Ges t tm`KÜ ci KYvıU Ae`ıvb P ıe`şZ ntj OA e`ıvımi Dci KYvıU Ae`ıvb t`±i OP Gi Awf`ıC x=OB|

$$\angle AOP = \theta \text{ ntj}$$

$$x = r \cos \theta$$

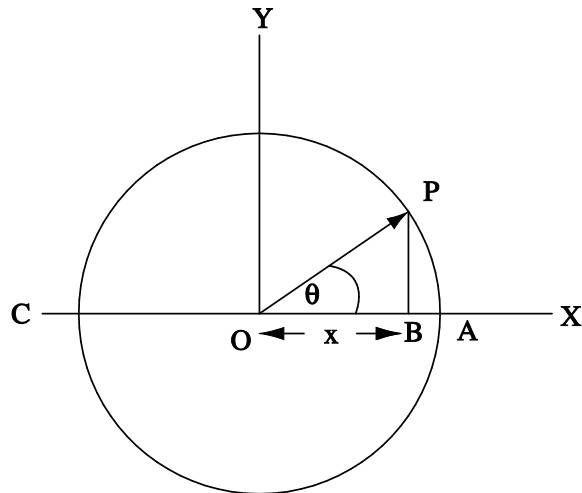
$$wKšZw = \frac{q}{t}$$

$$ev, \theta = \omega t$$

$$\therefore x = r \cos \omega t$$

T mg`q P ıe`şZ 2π `ıZ; AwZıg Kti |

$$\therefore \omega = \frac{2\pi}{T}$$



wPî 8.6:

P KYvıU hLb eËvKvi c`_ Pj`Z `vKte ZLb e`ıvımi Dci Awf`ıC ıe`şZ e`ıvm AC eıveı `ú`Z ntZ `vıK| KYvıUı teM I ZiY ıbııj ıLZ Dcıvq cKıv Kiv hvq

$$teM v = \frac{dx}{dt} = \frac{d}{dt} (r \cos \omega t) = -r \omega \sin \omega t$$

$$Ges ZiY a = \frac{dv}{dt} = \frac{d}{dt} (-r \omega \sin \omega t) = -\omega^2 r \cos \omega t = -\omega^2 x$$

$$\therefore a = -\omega^2 x$$

$$\therefore a \propto -x$$

mZıvs eËvKvi c`_ AveZÖkxj KYvi MwZ mij Qw`Z MwZi kZ`cıY Kti |

mZıvs mij Qw`Z `ú`b ıbtıeş Dcıvq myg eËvKvi MwZi mıt_ mæúK©|

mij Qw`Z MwZ

- (1) mlyg tKŠNYK `wZtZ MmZKij tKvb KYvi tŋŋt eĖvKvi cti e`v̄mi Dci Awftŋc we`v̄d mij
`ú`b MmZ m`ubakŋi |
- (2) mij Qw`Z `ú`tbi tKŠNYK K`uv¼ Avi mlyg eĖvKvi MmZi tKŠNYK `wZ GKB nq|
- (3) mij Qw`Z `ú`b Ges mlyg eĖvKvi MmZi chŋKij GKB nq|
- (4) mij Qw`Z `ú`tbi we`hi eĖĖi e`v̄m̄taŋ mgvb|

w`úšRvbZ `ú`b

w`úš Gi GK cŋš-GKwU `p Ae`v̄tb AvUŋK Aci cŋš-GKwU fvix e`zSŋj tŋ tUŋb tQto w`tj mij
Qw`Z `ú`tbi `úw`Z nŋZ `v̄K| wPŋ 8.4(K)-G GKwU w`úš m̄vaviY Ae`v̄q t`Lv̄bv nŋqŋQ | wPŋ
(L)G w`úšw̄i gŋ cŋš-m fŋi e`zSŋjv̄bi dŋj GwU e cwi gvY cŋw̄iZ nŋq UvbUvb Ae`v̄q
mvg`e`v̄tb `v̄K|

mvg`e`v̄tb w`úšw̄iZ Uvb T₀ nŋj

$$T_0 = mg \dots \dots \dots (i)$$

w`úšw̄i h̄w`Z vi w`wZ`vcK m̄xgvi gŋa` UvbUvb `v̄K Zv̄nŋj ūŋKi m̄f̄v̄bŋŋi,

$$T_0 = k_e$$

GLv̄tb k nŋ`Q w`úšw̄i ej a`eK

$$\therefore mg = k_e \dots \dots \dots (ii)$$

GLb m fiw̄UŋK mvg`e`v̄tb t`ŋK w̄tPi w`ŋK A `i-Zi chŋš-tUŋb tQto t`l qv̄ nŋj | fiw̄U Dj `eivei A
we`v̄i `jŋZ `v̄K| gŋb Kwi tKvb GK mgq mvg`e`v̄tb t`ŋK fiw̄U miY nq y (wPŋ-M) | GB Ae`v̄q
w`úšw̄iZ Uvb T₁ nŋj mg - T₁ = ma

Avevi, ūŋKi m̄f̄ e`envi Kŋi Ñ

$$T_1 = k(y+e)$$

$$\therefore mg - k(y+e) = ma$$

(ii) bs m̄xKiy e`envi Kŋi

$$k_e - k(y+e) = ma$$

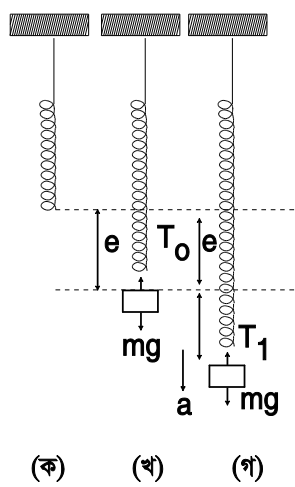
$$k_e - ky - k_e = ma$$

$$-ky = ma$$

$$\therefore ZjY a = -\frac{k}{m} y$$

$$= -\omega^2 y \quad \left[\because \omega = \sqrt{\frac{k}{m}} \right]$$

$$e\text{v}, a \propto -y$$



wPŋ 8.4:

thŋZzjY miŋYi m̄v̄bŋw̄ZK m̄Ziv̄s m fŋi e`w̄d mij Qw`Z `ú`tbi `úw`Z nq| Gtŋŋt tKŠNYK
K`ubv̄¼Ñ

$$\omega = \sqrt{\frac{k}{m}}$$

Ges chiqKvj $T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{m}{k}}$

$= 2\pi \sqrt{\frac{e}{g}}$ [$\therefore mg = ke$]

Sjs-fi m Gi Muz mij Qw`Z`u`b Muz nZ nj wbtw3 kZtjv c0hvR`N

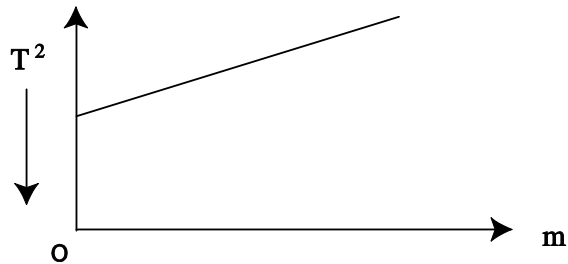
- (1) w`uswUK w`wZ`vcK mxgvi gta` Uvb Uvb KiZ nte|
- (2) `u` tbi we`hi A KYwUi mvg`ve`vq c0hviYe Gi tPtq Kg nZ nte| A`A` A < e
- (3) w`us-Gi fi Dtc`vbxq nZ nte| hw` w`us Gi fi Dtc`v Kiv bv hvq, Zvntj chiqKvj N

$T = 2\pi \sqrt{\frac{m+m_s}{k}}$ (iii)

GLv`b, $m_s = w`us-Gi fi |$

(iii) bs mgxKi YtK eM`Kti cvB`N

$T^2 = \frac{4\pi^2 m}{k} + \frac{4\pi^2 m_s}{k}$ -----(iv)



wefbaefi m Gi Rb` cix`vivi mrvvth` chiqKvj T wbyq Kti w`us-Gi fi m_s wbyq Kiv hvq| GKwU

tj L wP`I m Gi wecixtZ T^2 `vcb KiZ tj LuU GKwU mij tiLv nte| wP`I (8.5)

T^2 At`ji tQ`vsk t`tK w`us-Gi fi m_s wmwve Kiv nq|

mvi mst`c

w`usRwbZ `u` tbi t`j`I chiqKvj $T = 2\pi \sqrt{\frac{e}{g}}$

w`us-Gi fi Dtc`v bv Kti chiqKvj $T = 2\pi \sqrt{\frac{m+m_s}{k}}$

cúVvĚi gj`vqb

K. mġVK DĚti i cútk ġJK ġPý (√) ġ`b|

1| mij Qġ`Z `ú``tbi tġġġġ miY_x Ges ZġY a Gi gġa` mġúKġġ ġ

(K) $a = -kx^2$ (L) $a = kx$

(M) $a = -kx$ (N) $a = -kx - k'x^3$

2| ġ`úš RġbZ `ú``tbi tġġġġ chíġKġġ

(K) $T = 2\pi\sqrt{\frac{e}{g}}$ (L) $T = 2\pi\sqrt{\frac{m}{g}}$

(M) $T = 2\pi\sqrt{mg}$ (N) tġġġġġ bġ

3| ġ`úš-Gi fi Dġcġġġ bġ Kġi chíġKġġ ġ

(K) $T = 2\pi\sqrt{\frac{m_s+m}{k}}$ (L) $T = 2\pi\sqrt{\frac{m}{k}}$

(M) $T = 2\pi\sqrt{m_s/k}$ (N) $T = 2\pi\sqrt{m_s m}$

msġġġ cġġe

1| mij Qġ`Z `ú``b | eġġġġ MġZi gġa` mġúKġġ ġġ Lġ|

2| ġ`úš-Gi Kġġġġġ fi Gi msÁġ ġġ Lġ|

3| ġ`úš-Gi Kġġġġġ fi tei Kġġ Rġ` tġ LġPġġġ Aġb Kġ`b|

cW-4 mij t`vjK

Dŋik

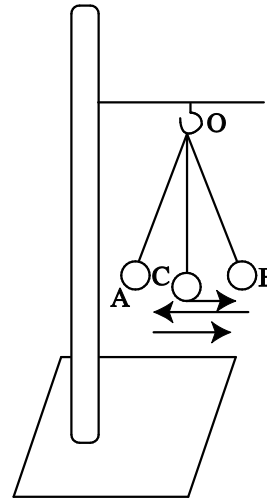
G cW tkŋl Avcibŋ

- | mij t`vj tKi msÁv vj LtZ cvi teb,
- | mij t`vj tKi we`vi, chŋKvj, Káúvŋi msÁv vj LtZ cvi teb,
- | mij t`vj Mvzi `enkó vj LtZ cvi teb,
- | mij t`vj tKi mŋvejx vj LtZ cvi teb,
- | mij t`vj tKi mgxKiY cŋZcv`b Ki tZ cvi teb,
- | mij t`vj tKi mrvvth`g Gi gvb vbYŋ Ki tZ cvi teb|

8.4.1 t mij t`vj K (Simple Pendulum)

GKwU bgbxq, Acŋvi Ykxj, IRbnxb I cvKnxb mŋvi GK cŋš-GKwU ŋž`fvix e`zSj tq w`tj e`w
hŋ`webr evavq Gŋ`K I w`K `jtZ `vtK Zte ZvtK mij t`vj K etj |

wKš ev`te G iKg tKvb mij t`vj K mæe bq|
MwYwZK wmvteŋ mæavi Rb` G aitbi t`vj K
Kíbr Kiv nq| cŋZcŋŋ GKwU Acŋvi Ykxj
mŋvi mrvvth` tKvb `p Aej æb t`tK GKwU fvix
e`zSj tq t`lqv nq|
mŋvmn e`w t`tK mrvvi Y t`vj K ev mij t`vj K ej v
nq|



ŋPŋ 8.6

mij t`vj K mŋvš-KwZcq msÁv

- (1) ee t th ŋž`fvix e`w t`tK mŋvi mrvvth` Sŋvŋv nq ZvtK ee ev wŋŋ etj | ŋPŋ A ee ev wŋŋ|
- (2) Sŋb we`yt th we`yntZ mŋvi mrvvth` eetK Sŋvŋv nq, ZvtK Sŋb we`yetj | ŋPŋ O Sŋb
we`y
- (3) KvhRix`N` t Sŋb we`yntZ etei tK`chš`iZŋK mij t`vj tKi KvhRix`N` ev t`vj tKi
`N` etj | GŋK L ŋvrv cŋvK Kiv nq|

$$L = l + r, \quad l = mŋvi \text{ } \hat{N},$$

$$r = etei e`vmaŋ$$

we`vi t mij t`vj tKi t`vj K wŋŋ Gi ga`ve`vb ntZ Wrtb ev evtg meŋaK th`iZi AwZµg Kŋi
ZvtK Gi we`vi etj |

cY^q vj b t f`vj KivcÚ GK cÚš-t`tk hvĭv`ii" Kti Aci cÚš-ŵtq Avevi cÚg cÚš-ŵtđi Avmđj GK cY^q vj b nq| ŵPĭ eeiŵ B ve`yntZ hvĭv` Kti C I A ve`jZ ŵtq Avevi B ve`jZ ŵtđi Avmđj cY^q vj b nq|

f`vj bKvj ev chġKvj t GKŵ cY^q vj tbi Rb` th mgq jvġM ZvġK f`vj bKvj ev chġKvj etj | GġK T ōviv cġvk Kiv nq|

tmġKŪ f`vj K t th f`vj tKi f`vj bKvj `B tmġKŪ ZvġK tmġKŪ f`vj K etj |

K^{áuv} t GKŵ mij f`vj K cÚZ tmġKŪ hZ, t jv cY^q vj b m^{áub}æKti ZvġK Zvi K^{áuv} etj |

GġK n ōviv cġvk Kiv nq| t tmġKŪ N msL`K cY^q vj b ntj GKK mgġq $\frac{N}{t}$ msL`K cY^q vj b

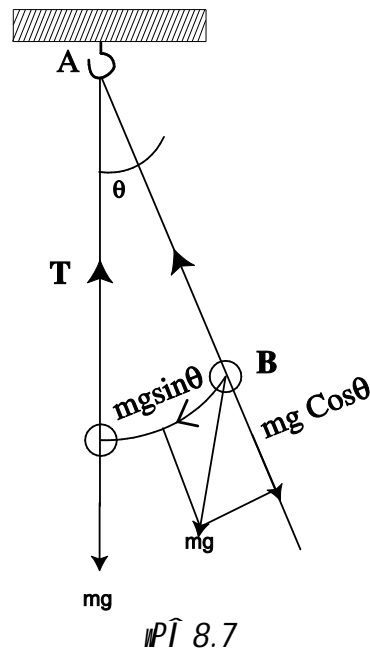
nq| $\therefore n = \frac{N}{t}$

`kv t hv ōviv f`vj tKi th tKvb gyġZ^q Ae`vb I Mvzi ŵ K ŵbt`R Kiv nq ev eSv hvq ZvġK `kv etj |

8.4.2 t mij f`vj tKi MvZ

aiv hvK, GKŵ mij f`vj tKi etei fi m Ges KvhRix $\hat{N}^{\circ} L$ (ŵPĭ 8.7) f`vj KivcÚŵŵ mg`ve`vb OA tZ vKivġtj I Rb mg ŵbtPi ŵ tK ŵŵqv Kti hv mžvi Uvb ōviv cġvgZ nq| ŵcŪŵ hLb mg`ve`vb OA ntZ θ tKivY ŵePyr ntq OB vġb Avġm ZLb ŵcġŪi I Rb mg `ŵD Dcistk fġM ntq hvq| GKŵ mžv eivei mgcos θ Ges Aciiŵ mg`ve`vġbi ŵ tK mgsin θ

mgcos θ mžvi Uvġbi ōviv cġvgZ nq Ges mgsin θ . KvhRix Dcisk ej ŵntmte ŵcŪŵtK mg`ve`vġbi ŵ tK ŵbtq Avġm| mg`ve`vb ntZ f`vj K ŵcġŪi ŵe`vġ x ntj



$\theta = \frac{x}{L}$ -----(i)

KvhRix ej $F = -mgsin\theta$ [thġnZKvhRix ej miġYi ŵecixZ ŵ tK tmġnZz FYiZK ŵPý e`envi Kiv ntqġQ]

$\theta L \approx \theta^2 ntj \sin\theta = \theta t j Lv hvq|$

$\therefore F = -mg\theta$

$= -\frac{mg}{L} x$

KvhrRx etji Rb ZjYa ntj

$$F = ma$$

$$\therefore ma = -mg \frac{x}{L}$$

$$a = -\frac{g}{L} x$$

mbw 0 vtb mbw 0 t`vj tKi Rb $\frac{g}{L}$ GKw a`eK/ GtK ω^2 0vrv cKvk Kijtj N

$$a = -\omega^2 x$$

$$\therefore a \propto -x$$

$$A_{\text{R}} ZjY \propto -m|Y|$$

Gw mij Qw`Z `u` tbi kZp mZivs `f we`hi mij t`vj tKi MwZ mij Qw`Z MwZ, thLvrb

$$\omega^2 = \frac{g}{L}$$

$$\therefore \omega = \sqrt{\frac{g}{L}}$$

mZivs mij t`vj tKi t`vj b Kvj ev chqKvj

$$T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{L}{g}}$$

D`niY

GKw mij t`vj tKi mZvi `N^o98cm Ges t`vj KwctUi e`vma^o.0129m ntj t`vj bKvj wYq Ki |
(cixqY vtb AwFKIR ZjY = 9.8ms⁻²)

Avgiv Rmb,

$$T = 2\pi \sqrt{\frac{L}{g}}$$

$$\therefore = 2 \times 3.14 \times \sqrt{\frac{.9929}{9.8}}$$

$$= 6.28 \sqrt{\frac{.9929}{9.8}}$$

$$= 2 \text{ tm}tK\hat{U}|$$

GLvrb,

$$mZvi \text{ `N}^o \ell = 98\text{cm}$$

$$= 0.98\text{m}$$

t`vj bKvj T=?

$$\text{AwFKIR ZjY, } g = 9.8\text{ms}^{-2}$$

$$\text{wctUi e`vma}^o_r = .0129\text{m}$$

$$L = \ell + r = .98 + .0129 = .9929\text{m}$$

8.4.3 t mij t`vj tKi m`vejx

GKw mij t`vj K Ar we`hi `jtZ vKtj wbt^o mF, tjv tgrb Pj teN

(1) mgKvj mF t tKSwYK we`hi Lg Ar ntj tKvb mbw 0 vtb mbw 0 t`vj tKi cZwU t`vj tbi Rb`
mgvb mgq j vM|

$$A_{\text{R}} g | L a^e vKtj T a^e|$$

(2) $\hat{m} \hat{t} t \hat{K} \hat{S} \hat{W} \hat{Y} \hat{K} \hat{w} \hat{e} \hat{w} \hat{i} \hat{L} \hat{g} \hat{A} \hat{i} \hat{n} \hat{t} \hat{j} \hat{t} \hat{K} \hat{v} \hat{b} \hat{w} \hat{b} \hat{w} \hat{e} \hat{w} \hat{t} \hat{b} \hat{G} \hat{K} \hat{w} \hat{U} \hat{m} \hat{i} \hat{j} \hat{t} \hat{v} \hat{j} \hat{t} \hat{K} \hat{i} \hat{t} \hat{v} \hat{j} \hat{b} \hat{K} \hat{v} \hat{j} \hat{K} \hat{v} \hat{h} \hat{R} \hat{i} \hat{x}$
 $\hat{N} \hat{e} \hat{L} \hat{G} \hat{i} \hat{e} \hat{M} \hat{g} \hat{t} \hat{j} \hat{i} \hat{m} \hat{g} \hat{v} \hat{b} \hat{y} \hat{w} \hat{z} \hat{K} \hat{K} \hat{K}$
 $A_{\hat{L}} \hat{T} \propto \sqrt{\hat{L}} \text{ , } \hat{h} \hat{L} \hat{b} \hat{g} = \hat{a} \hat{e}$

(3) $\hat{A} \hat{w} \hat{f} \hat{K} \hat{i} \hat{x} \hat{g} \hat{Z} \hat{i} \hat{t} \hat{Y} \hat{i} \hat{m} \hat{t} \hat{t} \hat{K} \hat{S} \hat{W} \hat{Y} \hat{K} \hat{w} \hat{e} \hat{w} \hat{i} \hat{L} \hat{g} \hat{A} \hat{i} \hat{n} \hat{t} \hat{j} \text{ (4}^\circ \hat{G} \hat{i} \hat{g} \hat{t} \hat{a} \hat{w} \hat{v} \hat{K} \hat{t} \hat{j} \text{) } \hat{t} \hat{K} \hat{v} \hat{b} \hat{w} \hat{b} \hat{w} \hat{e} \hat{w} \hat{t} \hat{b} \hat{m} \hat{i} \hat{j}$
 $\hat{t} \hat{v} \hat{j} \hat{t} \hat{K} \hat{i} \hat{R} \hat{b} \hat{t} \hat{v} \hat{j} \hat{b} \hat{K} \hat{v} \hat{j} \hat{A} \hat{w} \hat{f} \hat{K} \hat{i} \hat{x} \hat{g} \hat{Z} \hat{i} \hat{t} \hat{Y} \hat{i} \hat{e} \hat{w} \hat{w} \hat{b} \hat{y} \hat{w} \hat{z} \hat{K} \hat{K} \hat{K}$
 $A_{\hat{L}} \hat{T} \propto \frac{1}{\sqrt{\hat{g}}} \text{ [} \hat{h} \hat{L} \hat{b} \hat{L} = \hat{a} \hat{e} \text{]}$

(4) $\hat{f} \hat{t} \hat{i} \hat{i} \hat{m} \hat{t} \hat{t} \hat{K} \hat{S} \hat{W} \hat{Y} \hat{K} \hat{w} \hat{e} \hat{w} \hat{i} \hat{L} \hat{g} \hat{A} \hat{i} \hat{n} \hat{t} \hat{j} \text{ (4}^\circ \hat{G} \hat{i} \hat{g} \hat{t} \hat{a} \hat{w} \hat{v} \hat{K} \hat{t} \hat{j} \text{) } \hat{t} \hat{K} \hat{v} \hat{b} \hat{w} \hat{b} \hat{w} \hat{e} \hat{w} \hat{t} \hat{b} \hat{G} \hat{K} \hat{w} \hat{U} \hat{m} \hat{i} \hat{j}$
 $\hat{t} \hat{v} \hat{j} \hat{t} \hat{K} \hat{i} \hat{t} \hat{v} \hat{j} \hat{b} \hat{K} \hat{v} \hat{j} \hat{w} \hat{c} \hat{t} \hat{U} \hat{i} \hat{f} \hat{i} \text{ , } \hat{A} \hat{v} \hat{K} \hat{w} \hat{Z} \hat{A} \hat{e} \hat{v} \hat{D} \hat{c} \hat{i} \hat{v} \hat{t} \hat{b} \hat{i} \hat{D} \hat{c} \hat{i} \hat{w} \hat{b} \hat{f} \hat{P} \hat{K} \hat{t} \hat{i} \hat{b} \hat{v} \hat{K}$

8.4.4 t`vj b Kv`j i mgxKiY c`Zc`b

GKwU mij t`vj tKi Kv`Rix $\hat{N} \hat{e} \hat{L}$, t`vj bKvj T Ges tKvb $\hat{w} \hat{b} \hat{w} \hat{e} \hat{w} \hat{t} \hat{b}$ AwfKIR Zi`Yi gvb g ntj ,
 mij t`vj tKi $\hat{N} \hat{e} \hat{L}$ m` nZ c`BÑ

$T \propto \sqrt{L}$ -----(i)

Ges AwfKIR Zi`Yi m` nZ c`BÑ

$T \propto \frac{1}{\sqrt{g}}$ ----- (ii)

(i) I (ii) GKt` Kti c`BÑ

$T \propto \sqrt{\frac{L}{g}}$

ev, $T = k \sqrt{\frac{L}{g}}$ -----(iii)

GLv`b k GKwU mgvbywzK $\hat{a} \hat{e} \hat{K} \hat{K}$ | $\hat{w} \hat{b} \hat{w} \hat{e} \hat{w} \hat{t} \hat{b} \hat{w} \hat{b} \hat{w} \hat{e} \hat{w} \hat{t} \hat{b} \hat{N} \hat{e} \hat{L}$ GKwU mij t`vj K $\hat{w} \hat{b} \hat{t} \hat{q} \hat{t} \hat{v} \hat{j} \hat{b} \hat{K} \hat{v} \hat{j} \hat{w} \hat{b} \hat{Y} \hat{g}$
 Kti $\hat{h} \hat{w} \hat{L} \hat{T} \hat{g}$ Gi gvb (iii) bs mgxKi`Y emv`bv nq Zvntj t`Lv hvq $k = 2\pi$,

$\therefore T = 2\pi \sqrt{\frac{L}{g}}$

GUvB mij t`vj tKi t`vj bKv`j i mgxKiY |

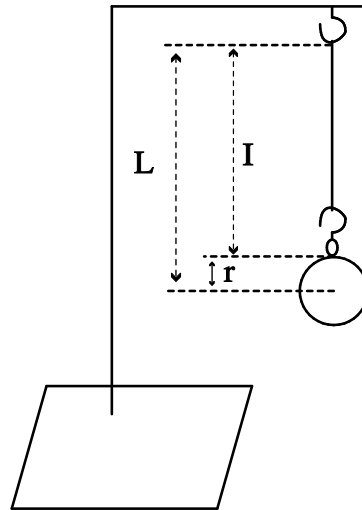
8.4.5 t mij t`vj tKi mnvth` g Gi gvb wbYq

ZEj t AwfKl e t j i c f i t e g y f i t e c o s - e - z t e M e p i n v i t K A w f K l R Z i Y e t j | m i j t` v j t K i t` v j b K v j T K v h R i x ` N ° L G e s A w f K l R Z i t Y i g v b g n t j ,

$$T = 2\pi \sqrt{\frac{L}{g}}$$

$$\text{ev, } T^2 = 4\pi^2 \frac{L}{g}$$

$$\text{ev, } g = 4\pi^2 \frac{L}{T^2} \text{ -----(i)}$$



WPT 8.11

w e w f b e ` N ° L G i R b ` w e w f b e t ` v j b K v j T w b Y q K t i L - T ^ 2 t j L n t Z L / T ^ 2 G i g v b t e i K t i (i) b s m g x K i t Y e m v t j g G i g v b c v l q v h i t e |

Kvhe0vj x

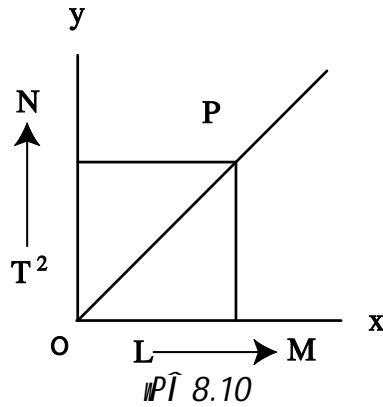
(K) L w b Y q t w g l v i t` d j i m n v t h ` m z v i ` N ° l G e s স্নাইড K` w j c v t m P m n v t h ` e t e i e ` i m a w b Y q K i v n q | e t e i e ` i m v a q = d / 2 t e i K t i K v h R i x ` N ° L = l + x w b Y q K i v n q |

T w b Y q t w b w 0 ` v t b m i j t` v j t K i t` v j K u t K m v g ` v e ` v t` t K 4 ° A t c q l v K g t K S w Y K w e ` t i G K c i t k G g b f i t e G K U z U t b t Q t o t` l q v n q h i t Z G u W ` j y t Z ` v t K | G K u W ` v g v N u o i m n v t h ` 20 e v 25 u W c Y t` v j t b i m g q w b Y q K t i H m g q t K t` v j b m s L ` v w` t q f i M K t i G K u W c Y t` t` v j t b i m g q A_ R t` v j b K v j T t e i K i v n q |

M o L / T ^ 2 w b Y q t m z v i K v h R i x ` N ° L c w i e Z 0 K t i w e w f b e K v h R i x % t N q R b ` t` v j b K v j T w b Y q K t i c 0 Z t` q t` t` v j b K v t j i e M ° A_ R T ^ 2 t e i K i v n q | G K u W O K K v M t R i x A t` q K v h R i x ` N ° L G i w e w f b e g v b G e s y A t` q A v b y w 1 / 2 K t` v j b K v t j i e M ° T ^ 2 G i g v b ` v c b K t i T ^ 2 - L t j L u P T A 1 / 2 b K i v n q | t j L u P T u W g j - w e ` M v g x G K u W m i j t i L v n t e (W P T 8.10) G m i j t i L v i D c i t h t K v b w e ` y t` t` K x A t` q i D c i P M G e s y A t` q i D c i P N j ` v U v b n q | G w e ` y R b ` P M = T ^ 2 l O M = L / L l T ^ 2 G i g v b (i) b s m g x K i t Y e m v t j g G i g v b w b Y q K i v h i t e |

ճշմարտություն

$$g = 4\pi^2 \frac{L}{T^2} = 4\pi^2 \frac{OM}{ON}$$



Եզրակացում

- (i) Ինքնաշարժի շառձուխի 4° աստիճանով քայլերը հաշվարկել
- (ii) Ինքնաշարժի շառձուխի երկարությունը որոշել
- (iii) Ինքնաշարժի շառձուխի զանգվածը որոշել
- (iv) Ինքնաշարժի շառձուխի շառձուխի քայլերի ճշգրտությունը որոշել

Լուծում

1m Ինքնաշարժի շառձուխի քայլերի երկարությունը 30cm է, ինքնաշարժի շառձուխի շառձուխի քայլերի ճշգրտությունը 2% է

Տվյալները,

Տրված,

Ինքնաշարժի շառձուխի $L = 1\text{m}$

Քայլերի հաճախություն $f = 30\text{ min}^{-1}$

$$T = 2\pi \sqrt{\frac{L}{g}}$$

$$= \frac{1}{2}\text{ S}^{-1}$$

Ելք, $T^2 = 4\pi^2 \frac{L}{g}$

Ինքնաշարժի շառձուխի $T = \frac{1}{f} = 2\text{S}^{-1}$

Ելք, $g = 4\pi^2 \frac{L}{T^2}$

Ինքնաշարժի շառձուխի $g = ?$

$$\therefore g = 4 \times (3.14)^2 \frac{1}{(2)^2} = 9.87\text{ m/s}^{-2}$$

Եզրակացում

Ինքնաշարժի շառձուխի քայլերի երկարությունը 30cm է, ինքնաշարժի շառձուխի քայլերի ճշգրտությունը 2% է

Ինքնաշարժի շառձուխի քայլերի երկարությունը 30cm է, ինքնաշարժի շառձուխի քայլերի ճշգրտությունը 2% է

$$\text{Ինքնաշարժի շառձուխի } T = 2\pi \sqrt{\frac{L}{g}}$$

Ինքնաշարժի շառձուխի քայլերի երկարությունը 30cm է, ինքնաշարժի շառձուխի քայլերի ճշգրտությունը 2% է

cuVvEi gj`vqb

K. mWVK DEti i cvtk WJK WPy (v) w`b|

1| L-T² tj LwPti i ckwZ. tKvbW?

(K) AwaeE (L) T Aqtk tQ` Kvix mij ti Lv

(M) Dfq Aqtk tQ` Kvix mij ti Lv (N) gj- we` Mvix mij ti Lv|

2| mij t`vj tKi t`vj b Kv tj i mgxKi Y tKvbW?

(K) T = 2π√ $\frac{L}{g}$ (L) T = √ $\frac{L}{g}$

(M) T = √ $\frac{m}{g}$ (N) T = √Lg

3| Kvhrix `Nent`QN

(K) Sjb we` yt` tK etei fvi tK` chS` i Zi

(L) Sjb we` yt` tK etei Dci chS` i Zi

(M) Sjb we` yt` tK etei wP chS` i Zi|

(N) mZvi `N+ etei e`m

msvB cke

1| mij t`vj tKi msAv wj Lj|

2| we`w, Kuv¼ I t`vj bKv tj i msAv wj Lj|

3| t`vj bKv tj i mgxKi Yw wj Lj|

4| mij t`vj tKi mF, tj v weeZ Ki`b|

5| mij t`vj tKi tKwYK we`w 4° Gi gta` i vLv nq tKb eYv Ki`b|

6| L - T² tj LwPti i ckwZ. wKi fc nte wj Lj|

iPbvj-K cke

1| mij Qw`Z `u`b MwZ e`vL`v Ki`b|

2| mij Qw`Z `u` tbi msAv t` tK Gi e`eKj bxq mgxKi Yw cZcv`b Ki`b|

3| t`Lvb th, x = A sin (wt + δ) mij Qw`Z `u` tbi e`eKj bxq mgxKi tYi GKwU mgvavb|

4| mij Qw`Z `u` tbi tqt KYvi wefe kw³ I MwZkw³ i i wkgvj v wYq Ki`b|

5| tj LwPti mvrth` mij Qw`Z `u` tbi chqKv tj i wefbae` tZ wefekw³ I MwZkw³ i Zvi Zg` eYv Ki`b|

6| t`Lvb th, `f we`w i `u` Z mij t`vj tKi MwZ mij Qw`Z `u`b MwZ|

7| mij t`vj tKi t`vj bKv tj i mgxKi Y T = 2π√ $\frac{L}{g}$ cZcv`b Ki`Y|

8| GKwU mij t`vj tKi mvrth` wKfite tKvb `tbi AwFKI R Zj tYi gvb wYq Ki`teb eYv Ki`b|