

kā

fugKv

Avgiv cÖzbqZ kā Drcbekti _wK Ges kā itb_wK/ kā n‡Q w-Z-vCK gva-tgi e-KYvi j wK
 ev Ab‰N© Zi½/ wKQykā Avgit`i i btZ fij j vtM/ Averi wKQykā ibtj Avgiv wei³ nB/ thgb-
 Avgiv m½xZ ibtZ fij vewm/ cKZct¶ m½xZ wtkI cheE kā Zi½/ kā Zi½ tKib gva"g e-ZxZ
 cëwñZ n‡Z cvi bv/ GB mZ" ci¶v Kti t`Lv hvq/ aiv hvK GKU e`yZK NuV (Electric Bell)
 GKU wQichy tevZtj i tfZi evRvtbv nj/ GB kā Aek" B tkvbu hvte/ wKšzcvuúi mwñvh" tevZtj i
 tfZi tK evqyb" Kiv ntj NuUi kā Avi tkvbu hvte bv/ gva-tgi tfZi w tq kā cëwñZ n‡Z mgq
 j vtM/ gva"g Kib, Zij A_ev evqexq n‡Z cvi/ kā Zi‡hi cÖzdjb, cÖzmi Y BZ" w n‡Z cvi/ |
 GB BDibtU Avgiv kā Zi‡hi wevfbaw` K wbtq Avij vPbv Kie/

cW-1

kiē, kṭāZi I kṭāvEi Zi½mgn, kā mĀvj tbi tKškj, myh̄ kā,
Acmy, myl -t, myh̄ kṭai `eukó̄ |

Dfīk̄

G cW tk̄l Avcib

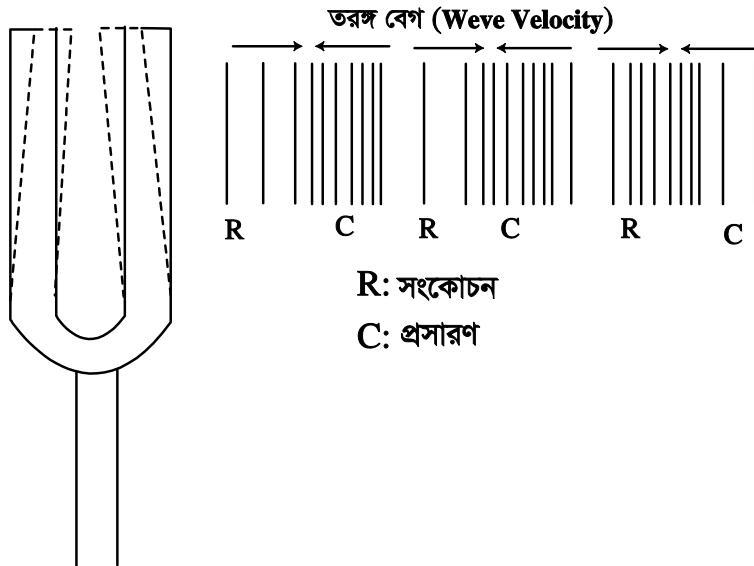
- (1) kiē, kṭāZi I kṭāvEi Zi½i msĀv ej tZ cvi t̄eb,
- (2) kṭai mĀvj b tKškj ēvL v̄ K̄itZ cvi t̄eb,
- (3) myh̄ kā I Acmy K̄ Z̄ eȲ K̄itZ cvi t̄eb,
- (4) myl -t Gi cv_R̄ K̄itZ cvi t̄eb,
- (5) myh̄ kṭai `eukó̄ ibifcb K̄itZ cvi t̄eb,

18.1.1 t kiē, kṭāZi I kṭāvEi Zi½ mgn (Audible, Infrasonic & Ultrasonic Waves)

kāZi½ j̄ K̄ ev Ab%N° h̄išK Zi½/ tK̄b w̄Z̄vcK gvātg tK̄b ēz K̄útbi d̄j kā Zi½ Drcb̄nq Ges evavcB̄ bv nt̄j Z̄ PZ̄PK Q̄otq c̄to/ th gvātg kā Zi½ c̄ewnZ nq tmB gvātg i ēK̄ Ymgn kā Zi½i c̄etni mḡšitj j̄tZ _v̄K̄/ gvāg K̄b, Zij ev evqexq n̄tZ cv̄i / G aitbi j̄ K̄ ev Ab%N° h̄išK Zi½i K̄úvsK 20 Hz t̄tK 20,000 Hz Gi gtā_v̄K̄ Argut̄ i k̄etbī t̄q kṭai Abf̄vZ Rb̄q/ AZGe j̄ K̄ ev Ab%N° h̄išK Zi½i K̄úvsK D³ mxgvi gtā_v̄K̄tj Z̄tK kiē Zi½ ej̄ / th mKj j̄ K̄ ev Ab%N° h̄išK Zi½i K̄úvsK 20 Hz Gi w̄tP tmme Zi½tK kṭāZi (Infrasonic) Zi½ Ges th me j̄ K̄ ev Ab%N° h̄išK Zi½i K̄úvsK 20,000 Hz Gi tek̄ tm me Zi½tK kṭāvEi (Ultrasonic) Zi½ ej̄ v̄ nq/ kṭāZi Zi½ mvavi YZ epr̄ Dr̄mi K̄útbi d̄j Drcb̄nq/ thgb f̄gK̄t̄ui d̄j Drcb̄Zi½ kṭāZi Zi½/

18.1.2 t kā mĀvj tbi tKškj (Mechanism of Propagation of Sound)

kā Zi½ evav bv̄ tctj Dr̄mi PZ̄PK Q̄otq c̄to/ kā mĀvj tbi Ab̄Zg c̄ib gvāg nj evqy Aek̄ K̄b ev Zij c̄v̄t_P̄ gā w̄tqI kā mĀwj Z n̄tZ cv̄i / Z̄te kb̄ gvātg kā mĀwj Z n̄tZ cv̄i bv̄ GK̄U my k̄v̄ K̄útbi d̄j evqy gvāg h̄w̄ Av̄tj w̄oZ nq Z̄te Z̄i c̄K̄Z. K̄ifc? my k̄v̄ K̄v̄ ev̄ hLb mḡtbi w̄tK AM̄hi nq ZLb Z̄ evZ̄mtK Pv̄c t̄l q̄i d̄j w̄b̄qf̄t̄ev̄ evqy NbZ̄ epr̄ cv̄q Ges evqy Nbr̄feb ev̄ evqy -t̄i i mstK̄Pb axti axti mḡtbi w̄tK ḠM̄tq h̄v̄q/ Avevi my k̄v̄ K̄v̄ ev̄ hLb w̄tR̄i w̄tK tdiZ Av̄tm ZLb w̄b̄qf̄t̄ev̄ evqy NbZ̄ n̄m cv̄q Ges evqy Zb̄ȳeb ev̄ c̄h̄vi Y nq/



॥P̄t (18.1) m̄y kj vKvi mnvñth̄ gvātgi ē K̄Yvi ms̄KvPb I c̄hvi t̄Yi ñviv kā Zi t̄½i Drc̄Ē /

Gfite t̄i i evqy ms̄KvPb I c̄hvi Y ch̄qμt̄g nq/ m̄y kj vKvi evū evi evi hLb K̄púZ nte Ges Zv msj M̄e evqy t̄i K̄púb myó Kite ZLb evqy t̄i ms̄KvPb I c̄hvi Y evi evi mvgtbi w̄K ḠM̄t̄q hvte/ w̄KQy t̄i t̄Kib ēw̄w̄ Dc̄w̄ Z _vKt̄j ev kā Zi ½ ai t̄Z m̄t̄g h̄s̄ emvñt̄b v̄Kt̄j kā ai v cōte/

18.1.3 t̄ myh̄ kā Ges Acmy (Musical Sound & Noise)

Avgiv c̄ZibqZ At̄bK ai t̄bi kā i bt̄Z c̄vB/ t̄Kib t̄Kib kā AZ̄S-myk̄te Averi t̄Kib t̄Kib kā AZ̄S-K̄púZKUy hLb t̄Kib kā Zi ½ ibqngZ (Regular), ch̄p̄Ē (Periodic) Ges w̄bi w̄Qbæfv̄te īv̄ h̄q ZLb H kāt̄K myh̄ (Musical) kā ej v nq/ Averi hLb t̄Kib kā Zi ½ AbqngZ nq ZLb H kāt̄K myn̄b ev Acmy (Noise) et̄j /

18.1.4 t̄ myl̄ t̄ (Tone & Note)

mvavi YZ GKvU gv̄t̄ K̄púvsk̄eik̄o kāt̄K my et̄j / GKvak̄ K̄púvsk̄eik̄o h̄M̄cr m̄t̄i mgvnvi t̄K t̄ et̄j / Zt̄e t̄i i gtā gj̄ my (Fundamental tone) Qvov Dcm̄y (Over tone) mḡt̄ni K̄púvsk̄ gj̄ my i K̄púvsk̄i , w̄ZK nt̄j Zt̄e t̄i t̄K nvi tgw̄bKm̄l (Harmonics) et̄j / t̄Kib t̄i nvi tgw̄bKt̄mi msL̄ v hZ teku nte tm̄B t̄ ZZ k̄púZgaj̄ nte/ thgb GKvU nvi tgw̄bqv̄t̄g w̄fbæK̄púvsk̄i AvUvU my _vKt̄Z c̄t̄i /

18.1.5 t̄ myh̄ kt̄ai ^euk̄o (Characteristics of Musical Sound)

myh̄ kt̄ai c̄v̄bZ: w̄ZbU ^euk̄o _v̄K, h̄v (1) ZxeZv (Intensity) (2) Zx̄t̄Zv (Pitch) / (3) , Y (Quality) /

(1) **ZxeZv** t kā cēvtni mgq cēvtni mgKvY gvātgi GKK t̄l̄d̄j i gā w̄tq GKK mgq th c̄w̄gvY k̄w̄³ m̄Aw̄j Z nq Zv̄k k̄tāi ZxeZv (Intensity) ej v nq/ GKB ZxeZvi kā wfbawfbaēw̄³ i wbKU wfbaē Kg gtb ntZ c̄t̄i / ZxeZv Zīt̄i w̄hi I K̄uvs̄ki Dci wfPkyj /
tKvb Zīt̄i w̄hi A K̄uvsK n / ZxeZv nt̄j ,

$$I \propto A^2$$

$$I \propto n^2$$

$$GQrov Drm ntZ tk̄iZvi ^iZjD nt̄j , I \propto \frac{1}{D^2} /$$

(2) **ZxP̄Zv** t k̄tāi ZxP̄Zv k̄etbw̄ t̄qi GKU w̄t̄kl AbyvZ/ K̄uvs̄ki Ici k̄tāi ZxP̄Zv (Pitch)
wfPkyj / th̄ t̄i i K̄uvsK hZ tek̄ tm̄ ZZ ZxP̄Zv

(3) „Y t „Y Øviv GKB ZxeZv I ZxP̄Zv ^i k̄t̄K ci „ui t̄K Avg v Kiv hvq/ myhy k̄tāi „Y
t̄i i Ges nvi tgwbK̄mi Dci wfPkyj /
tKvb ev̄ h̄t̄s̄B GKUgv̄t̄ K̄uvs̄ki my Drcbænq bv̄ eis eūmsL K̄uvs̄ki kā mgb̄q MwZ „B
Avgiv ībtZ c̄vB/ „t̄Yi wfbaZvi Rb̄B ēgv hvq tKvbU tKvb h̄t̄s̄j kā/

mvi ms̄P̄c

k̄le, **k̄tāzi** I **k̄tāv̄Ei** **Zi½** t **Zi½i** **K̄uvsK** 20 Hz **Gi** bxtP; 20 Hz **t̄K** 20,000 Hz **Gi** gta”;
20,000 Hz **Gi** **Dct̄i** **nt̄j** **h̄v̄utg** **k̄tāzi**, **k̄le** I **k̄tāv̄Ei** **Zi½** **etj** /

kā m̄Av̄b t̄K̄sk̄j t **tKvb** **gvātgi** **tfZi** w̄tq **gvātgi** ēK̄Yimḡni **ms̄KvPb** ev̄ NbxFeb **Ges** c̄h̄vi Y
ev̄ Zbfȳetbi ch̄qμμigK AM̄hi nI qvi d̄j kā m̄Aw̄j Z nq/

myhy kā I **Acm̄y** t kā **Zi½** **wbq̄igZ** I **ch̄ēE** **nt̄j** **Zv̄k** **myhy** kā; **Avi** **Zi½** **Awbq̄igZ** **nt̄j**
Zv̄k **Acm̄y** **etj** /

my I „t **GKUgv̄t̄** **K̄uvsK** **w̄k̄o** **k̄t̄K** **my** **etj** / **h̄YcrZf̄te** **GKwaK** **K̄uvsKw̄k̄o** **k̄t̄K** „t
etj /

myhy k̄tāi „**ēk̄o**” t **ZxeZv**, **ZxP̄Zv** I „Y/

citvEi gjvqb

(K) beP K cik mVK DÉti i citk mK wPý (✓) w b

1. kle kā Zi tzi KxúlsK nte?

- (1) 20 Hz t_k 20,000 Hz
- (2) 2000 Hz t_k 20,000 Hz
- (3) 20 Hz t_k 200 Hz
- (4) 50 Hz t_k 50,000 Hz

2. tKvb gva tg kā Zi ½ cēnnZ ntZ citi bv?

- | | |
|-----------------|----------------|
| (1) Kvb gva tg | (2) Zij gva tg |
| (3) evqy gva tg | (4) kb gva tg |

3. kā tKvb ai tbi Zi ½?

- | | |
|----------------------------|------------------|
| (1) Avo Zi ½ | (2) j wK Zi ½ |
| (3) Avo I j wK Zi tzi ngky | (4) tKvb Zi ½ bq |

4. mijhy kā mK ai tbi Zi ½?

- | | |
|----------|---------------------|
| (1) AchE | (2) wekyj we -hi mn |
| (3) chE | (4) we -hi nxb |

5. mijhy ktai eukó KqU?

- | | |
|----------|-----------|
| (1) GKU | (2) w |
| (3) wZbu | (4) PriU/ |

(L) msuPβ cikæ

1. kā mÄij tbi tKškj eYi Ki "b/

2. mij I -tii msAv w b/

3. mijhy ktai wZbu eukó mK mK?

cW-2

-↑K¤ú, -↑K¤úi MwYwZK wefšen, -↑K¤úi cÖqM

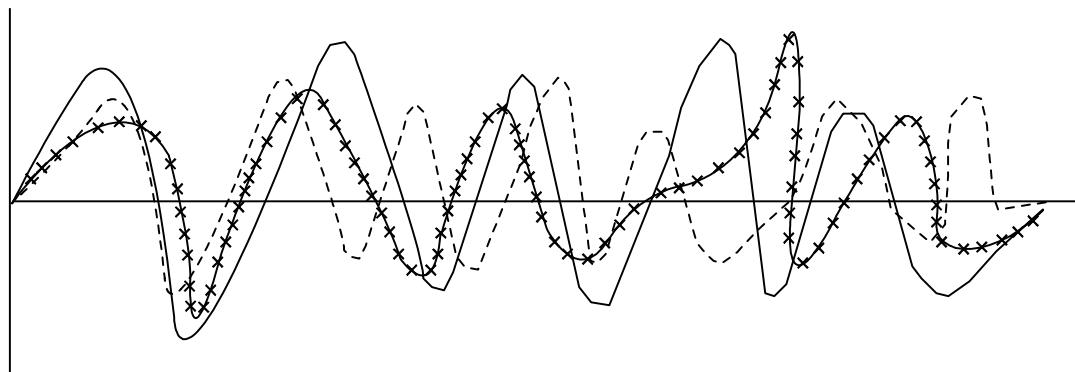
Dfik

G cW tkI Avcib-

- (1) -↑K¤úi msAv ej tZ cvi teb,
- (2) -↑K¤úi MwYwZK wefšen eYDv Ki tZ cvi teb,
- (3) -↑K¤úi cÖqM tKib tKib t¶tÍ nq Zv e§tZ cvi teb /

18.2.1 t -↑K¤ú (Beats)

cÖq mgvb K¤úvsK wewkó I cÖq mgvb Zx¶Zv m¤úbæ` y k j vKifK GKfÍ evRvÍj Drcbæká Zi½ `y i Dcwi cvZtbi dÍj eWZvri nq Ges kā cÖej chqmuig GKevi evto I GKevi Ktg/ kā cÖej i chqmuigK GB nwm-eWtK etj -↑K¤ú (Beat) /



IPÍ t (18.2) `yBw ibKUeZPK¤úvsK wewkó -tii -↑K¤ú

μmipiyZ tiLr I WtUW tiLr KvQvKwQ K¤úvsKtKi `yBw Zi½ Ges Ab` tiLwU Dnitt`i jWx ibt`R Kfí /

18.2.2 t -↑K¤úi MwYwZK wefšen

awi Aí K¤úvsK-cv_R wewkó `y kā Zi½ GKB wtk AMhi ntk Dfq Zit½i weh y_m GKwui K¤úvsK n_1 I Acimui n_2 / th tKib mgq t tZ tKib weyZ mgvev t tK miY h_wutg y_1 I y_2 ntj , Zvt i mgxKi Y wbg wZfite cKik Kiv hq

$$y_1 = y_m \sin 2\pi n_1 t$$

$$y_2 = y_m \sin 2\pi n_2 t$$

Dcwi cvZtbi bWZ Ablyqr,

$$j \ll m i Y, Y = y_1 + y_2$$

$$\begin{aligned} &= y_m \sin 2\pi n_1 t + y_m \sin 2\pi n_2 t \\ &= y_m [\sin 2\pi n_1 t + \sin 2\pi n_2 t] \\ &= 2y_m [\sin \frac{2\pi n_1 t + 2\pi n_2 t}{2} \cos \frac{2\pi n_1 t - 2\pi n_2 t}{2}] \end{aligned}$$

$$[\because \sin A + \sin B = 2 \sin \frac{A+B}{2} \cos \frac{A-B}{2}]$$

$$\begin{aligned} &= 2y_m \sin 2\pi \left(\frac{n_1 + n_2}{2} \right) t \cos 2\pi \left(\frac{n_1 - n_2}{2} \right) t \\ &= Y_m \sin 2\pi \left(\frac{n_1 + n_2}{2} \right) t \\ &= Y_m \sin 2\pi n t \end{aligned}$$

$$GLtb, \left[Y_m = 2y_m \cos 2\pi \left(\frac{n_1 - n_2}{2} \right) t \right], n = \left(\frac{n_1 + n_2}{2} \right) t \quad (18-1)$$

t`Lr hvt'Q jnä Zi½ mij -ú`Z MmZmúaZi½ hvi we-#

$$Y_m = 2y_m \cos 2\pi \left(\frac{n_1 - n_2}{2} \right) t \quad \text{Ges}$$

$$K^{\alpha} \bar{K} \quad n = \frac{n_1 + n_2}{2}$$

$$we-#i \quad Y_m \quad Gi \quad msL^m Z \quad gvb \quad mte^{\rho} P \quad nte \quad hLb, \cos 2\pi \left(\frac{n_1 - n_2}{2} \right) t = \pm 1$$

$$eV, 2\pi \left(\frac{n_1 - n_2}{2} \right) t = 0, \pi, 2\pi, \dots, m\pi$$

$$eV, t = 0, \frac{1}{n_1 - n_2}, \frac{2}{n_1 - n_2}, \dots, \frac{m}{n_1 - n_2}$$

$$AZGe \quad \text{if } c \neq j \quad k \hat{a} \quad tkvbi \quad ga^e eZ^{\rho} mgq \quad \frac{1}{n_1 - n_2} \quad \text{sec.}$$

$$Avvi \quad jnä \quad Zi \neq i \quad ZkeZv \quad me^{\rho} \quad amte \quad hLb, \cos 2\pi \left(\frac{n_1 - n_2}{2} \right) t = 0$$

$$eV, 2\pi \left(\frac{n_1 - n_2}{2} \right) t = \frac{\pi}{2}, \frac{3\pi}{2}, \dots, (2n+1)\frac{\pi}{2}$$

$$eV, t = \frac{1}{2(n_1 - n_2)}, \frac{3}{2(n_1 - n_2)}, \dots, \frac{2m+1}{2(n_1 - n_2)}$$

$$AZGe \quad \text{if } b:k \neq i \quad ga^e eZ^{\rho} mgq \quad \frac{1}{n_1 - n_2} \quad \text{sec.}$$

KvRB cÖZ tmKtÜ kā I Vbvgv Ki te (n₁ - n₂) evi /
 mži vs cÖZ tmKtÜ -tKtúi msL'v = (n₁ - n₂) hrv Drmøtqi Kxústki cV_FK i mgvb /
 Drmøtqi Kxústki cV_R teik ntj cÖZ tmKtÜ extUi msL'v teik nq/ dtj ktai nvm-eix Ly Z
 nq ej ex Avi DcJ ex Kiv hq bvr /

18.2.3 t -t Ktúi cÖqM (Application of Beats)

(1) ev hšj my gj vtv (Tuning of Musical Instruments) t `y er hšj my GKB Kbv
 Zv cixlvi Ki tZ ntj `y hšj K Gkmf_ evRvtv nq Ges j l i Lv nq tKvb -tKtúi myo nq Kbv /
 hrv -tKtúi myo bvr nq, Zte eSjZ nte `y ev hšj my GKB /

(2) ARbV KxústK vYQ : `y my kj vKvi KxústK KvQvKvQ ntj , GKUj KxústK RbV _vKtj
 AciUj KxústK -tKtúi mvnvh vYQ Kiv hq/ awi , RbV KxústK n₁ , ARbV KxústK n₂ /
 mži vs -tKtúi msL'v n ntj n₂ = n₁ ± n , Geri RbV Kxústki my kj vKvi evutZ mgvb tgvg
 j wMfq clyivq `y my kj vKv GKfT evRvtv nq/ hrv t Lv hq -tKxú evix tctqtQ Zte eSjZ nte
 KxústK-cV_R evix tctqtQ A_F n₂ > n₁ / AZGe n₂ = n₁ + n / Averi hrv -tKxú nvm cvq Zte
 tevsv hqte KxústK-cV_R nvm tctqtQ /

$$tmKtÜ, n_2 = n_1 - n$$

(3) LubtZ `y Z Mvimi Aw-Zi vYQ (Detection of Poisonous gases in mines) t `y Z /
 weix evqyc Kti AMB bjt my Drcbaekiv hq/ `y Z evqy NbZi vfbenl qvq myi KxústK vfbæ
 nq/ dtj -tKtúi myo nq/ Kszevqyei x ntj -tKxú myo nq bvr /

D`viniY-1 : ai vKv `y my kj vKvi KxústK h_vutg 256Hz / 252Hz, cÖZ tmKtÜ -tKtúi
 msL'v KZ?

$$mgvavb : cÖZ tmKtÜ -tKtúi msL'v = n_2 - n_1$$

$$GLvtb n_1 = 256 \text{ Hz}, n_2 = 252 \text{ Hz}$$

$$\therefore cÖZ tmKtÜ -tKxú = 256 - 256 = 4$$

IKszARbV Kxústki my kj vKv tgvg AvutK v t j -tKxú eÜ ntq hq/ Dzv th tgvg j wMfq my
 kj vKvi evu frivx Kitj KxústK Ktg, mži vs wZxq my kj vKvi KxústK tekx /

$$A_F n_2 = 258 \text{ Hz}$$

D`viniY-2 : `y my kj vKv GKfT Kpuz Kitj Gi v cÖZ tmKtÜ 2iU Drcbaekti, GKUj KxústK
 -tKxú 256 Hz AciUj evutZ tgvg AvutK v t j -tKxú tkv bvr hq bvr / wZxq Uj KxústK KZ?

$$mgvavb : ai vRbV KxústK n_1$$

$$ARbV KxústK n_1 -tKtúi msL'v n$$

thtnZzclZ tm̄Kt̄U -↑Kt̄úi msL v = 2

Ges n₁ = n₁ ± n

= 256 ± 2 = 258 Hz ev 254 Hz

**D`vniY 3 t `y my kj vKv GKt̄I evRt̄j c̄Z tm̄Kt̄U 4U -↑Kt̄ú myó nq/ GKvJi Kxúvsk 384 Hz/
Aci my kj vKt̄K Nl v nt̄j Averi I c̄Z tm̄Kt̄U 4U -↑Kt̄ú tkvbr hvq/ wZxq my kj vKv Kxúvsk
KZ?**

mgvab t awi 1g my kj vKv Kxúvsk n₁

2q my kj vKv Kxúvsk n₂

-↑Kt̄úi msL v n

Rvbr Ar̄t̄Q, n₂ = n₁ ± n

= 384 ± 4

= 388 Hz ev, 380 Hz

wZxq my kj vKt̄K Nl vi c̄ti Averi c̄Z tm̄Kt̄U 4U -↑Kt̄ú myó nq/

AZGe Nl vi ci n₂ = 384 ± 4 = 388 Hz ev, 380 Hz

my kj vKv ev̄t̄Z Nl v nt̄j Kxúvsk ev̄x cvq/

∴ Nl vi Ar̄t̄M wZxq my kj vKv Kxúvsk 380 Hz Ges Nl evi ci wZxq my kj vKv Kxúvsk 388 Hz.

mv̄ ms̄¶c

**-↑Kt̄ú t cl̄q mgv b ZxeZv I KvQvKmQ Kxúvsk m̄kó `y kā GKB mgq DrcbaKit̄j kā `y i j wā
kā ch̄qμtg tRt̄i Ges Ar̄t̄ -tkvbr hvte/ kt̄ai cl̄et̄j i GiKg ch̄qμtgK nm̄-ev̄x tK -↑Kt̄ú ej v
nq/**

-↑Kt̄úi c̄qM t ev` h̄t̄sj my vqj v̄b, ARvbr Kxúvsk mbY@, Lmbt̄Z `y Z evqy Aw-Zj mbY@/

c̄qvRbq mgvKiY

-↑Kt̄úi j wā mgvKiY t Y = Y_m sin 2π $\left(\frac{n_1 + n_2}{2}\right)$ t

c̄Z tm̄Kt̄U -↑Kt̄úi msL v = n₁ - n₂ [n₁ > n₂ nt̄j]

A ev n₂ - n₁ [n₂ > n₁ nt̄j]

cüVvEi gj̄vqb

(K) `be@P K cikæ

mNK DÉti i cütk mK Pý (✓) w b

1. ~¹K¤ú Drčbante KLb?

(K) `y kṭāi K¤úsK cv_R'' mgvb'' ntj |

(L) `y kṭāi K¤úsK cv_R'' kb'' ntj |

(M) `y kṭāi K¤úsK cv_R'' GKU AciUi 4 , Y ntj |

(N) `y kṭāi K¤úsK GKU AciUi $\frac{1}{4}$, Y ntj |

2. `y ev` hšj my mgvb wKbv eſtZ ntj wK KitZ nte?

(K) ev` hšj `y i Rb wK AitQ wKbv t` LtZ nte

(L) ev` hšj `y GKB mg tq Zix wKbv t` LtZ nte

(M) cikZ tm̄KtU ~¹K¤ú kb'' wKbv t` LtZ nte

(N) cikZ tm̄KtU ~¹K¤úi msL'v 1 wKbv t` LtZ nte |

(L) msWIB cikæ

1. ~¹K¤úi msAv yj Lj

2. ~¹K¤úi cikM wK wK?

CW 3

Ubv Ztii Kxub, Ubv Ztii Avo Zitzi tem

Djik

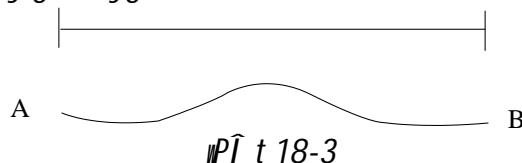
GB CW tkil Avci -

- Ubv Ztii Kxub mxtK RvbZ cviteb,
- Ubv Ztii Avo Zitzi tem Ktmi Dci wbfkxj RvbZ cviteb /

18.3.1 t Ubv Ztii Kxub (Vibration of stretched string)

myg ^tNq Ges Pz cftQ` meikó GKU Zvi tK Ubv Kti `yS-Ave x Kiv nj | G Ae^-lq ZvitK Ubv Zvi ej | Ubv Ztii ^tNq mif_j xFite g,yAvNz Kitj Avo Kxub (Transverse vibration) Dræbænq ev ej v Ptj Avo Zitzi myo nq | Avo Zitzi U`B cftS+ `tK AMhi ntq cft-nz cftZdy Z nte | AvciZZ I cftZdy Z Zitzi myo Kitj Ges Zvi U eub Kxub ntZ _vKte /

18.3.2 t Ubv Ztii Avo Zitzi tem (Velocity of transverse wave in a stretched string) : awi `y w-i we`y gta" myg cftQ` meikó GKU Zvi Ubv Ae^-lq AftQ | Zvi Uj Ubv T



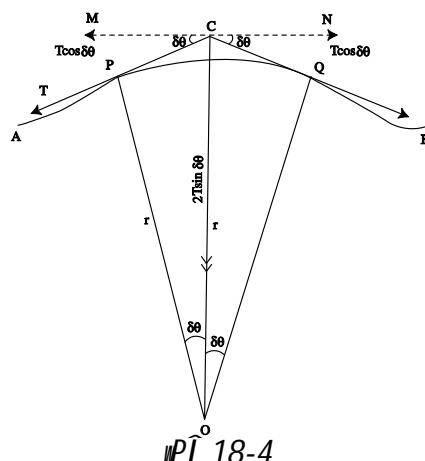
G Ae^-lq Ztii g,yAvNz Kivq Avo Zitzi myo ntqfQ Ges AB H Avo Zitzi GKU Ask | Avo Zitzi evg t_tK Wb w_tK AMhi ntQ | AB Gi Auz Pz Ask PQ |

MP 18-4 G PQ tK tevSvi myavi Rb eo Kti t Lvtbv ntqfQ |

PQ Pz Ask UtK etEi gZ Kibv Kiv hvq | CP Ges CQ tK -ukR aiv Ptj |
mzis CP I CQ eivei Ubv T myavkj

MP 18-4 ∠COP = ∠COQ = θ.

CP eivei myavkj T Ubvbi Dcisk Tsinθ | AbfngK Dcisk Tcosθ h_mytg CO | CM ti Lv eivei myavkj |



AbWtK CQ eivei μqkx ej t. GB etj i Ω Dcsk Tsinδθ WtPi WtK CO eivei Ges AbfugK Dcsk Tcosδθ CNeivei μqkx / CM I CN eivei μqkx ej mgv b I vecixZgyx nI qvq ci -ui tK bvKP Kti t'q / AZGe KvRix ej 2Tsinδθ Ges Bnv CO eivei μqkx /

Ztii GKK ^Nq fi m ntj PQ Astki fi m x r x 2δθ

[∴ PQ Ptci eimva®r, ZvB PQ Ptci ^Nrδθ]

$$\text{CO eivei tK} \cdot gyx ej = mr(2\delta\theta) \times \frac{v^2}{r}$$

$$= 2mv^2 \delta\theta$$

GLitb v teM Zi½ o tK vekó PvC eivei MZkx /

$$\therefore 2Tsin\delta\theta = 2m\delta\theta v^2$$

$$\text{er, } 2T\delta\theta = 2mv^2 \delta\theta$$

[∵ δθ AIZPz etj sinδθ δθ]

$$\text{er, } v^2 = \frac{T}{m}$$

$$\text{er, } v = \sqrt{\frac{T}{m}} \dots \dots \dots \dots \dots \quad (18-2)$$

$$teM = KxusK \times Zi½% N^®$$

$$\text{er, } v = n\lambda$$

$$GLb msúY®ZviU P msL^K eEustk wf^3 ntq Kxub DrccbKtj GtKKU eEustki ^N^® \frac{1}{p}, GLitb$$

| = Ztii ^Nq cZU eEusk AaZi½ ^N^® Wt R Kti /

$$\therefore \frac{1}{p} = \frac{\lambda}{2}$$

$$\text{er, } \lambda = \frac{2l}{p}$$

$$\therefore v = n\lambda ntZ cB,$$

$$\text{er, } v = n \cdot \frac{2l}{p}$$

$$\text{er, } \sqrt{\frac{T}{m}} = n \cdot \frac{2l}{p} \quad \left[18.2 ntZ V = \sqrt{\frac{T}{m}} \right]$$

$$\text{er, } n = \frac{p}{2l} \sqrt{\frac{T}{m}}$$

$$\text{er, } n = \frac{l}{\lambda} \sqrt{\frac{T}{m}} \dots \dots \dots \dots \dots \quad (18-3)$$

$$A_R KxusK = \frac{1}{Zi½% N^®} \sqrt{\frac{Ztii Ub}{Ztii GKK % Nq fi}}$$

D`vniY t f`l qv AvtQ, Zvti i ^N^I = 25 cm = 0.25 m

$$Uvb T = 10\text{kg} \times g = 10\text{kg} \times 9.8 \text{ m sec}^{-2}$$

$$Zvti i GKK ^tN^I fi m = 9.8 \times 10^{-3} \text{ kg/m}$$

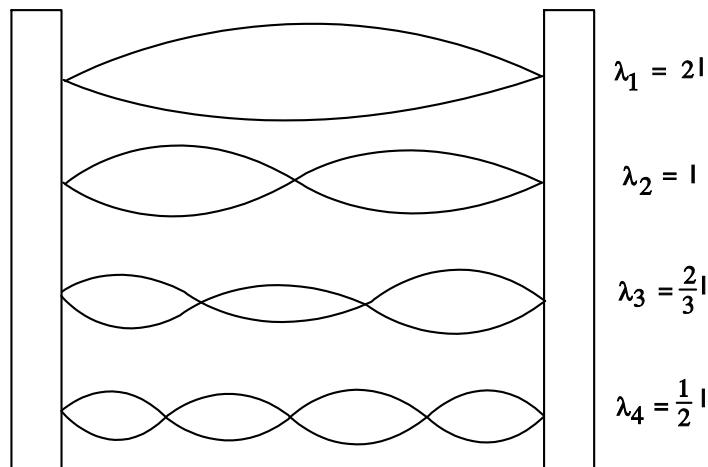
Rvbv AvtQ,

$$\begin{aligned} n &= \frac{1}{2l} \sqrt{\frac{T}{m}} \\ &= \frac{1}{2 \times .25} \sqrt{\frac{10 \times 9.8}{9.8 \times 10^{-3}}} \\ &= 200 \text{ Hz} \end{aligned}$$

18.3.3 t Uvb Zvti vefboaitbi Kxub (Different modes of vibration of stretched string)

‘B c@S-AvUKvbtv Ae^-iq GKU Uvbv Zvti i gvSLvtb AvNvZ Kitj ‘B c@S-ib^-u` we`yI gvSLvtb myu` we`yDrcbante/ G Ae^-iq l = $\frac{\lambda}{2}$ (MP 18.5)

$$n_1 = \frac{1}{\lambda_1} \sqrt{\frac{T}{m}} = \frac{1}{2l} \sqrt{\frac{T}{m}} \quad \dots \dots \dots \dots \dots \dots \quad (18-4)$$



MP t 18-5

tKvb GK c@S-tK GK PZ@sk `#i ZviUtk AvNvZ Kitj ‘B c@S-ib^-u` we`yQovl ga`Lvtb Avi I GKU ib^-u` we`yDrcbante/ G Ae^-iq, l = λ_2

$$n_2 = \frac{1}{\lambda_2} \sqrt{\frac{T}{m}} = \frac{2}{2l} \sqrt{\frac{T}{m}} = 2n_1 \quad \dots \dots \dots \dots \dots \dots \quad (18-5)$$

G tP#T KxuksK gj- KxuksKi w, Y/

GKBfite wZb eEustk ev Pvi eEustk ev Avi I tek fvtM wef^3 Kti ZvitK KxuksZ Kiv hq/ tm Ae^-iq h_wutg n_3 = 3n_1, n_4 = 4n_1 BZw`/

D`vniY 1

GKU Zv*tii fi* 3gm Ges $\sim N^{\circ}$ 60cm / Zv*iWtK KZ etj* Uvbv ntj Gi Avo Kútb Drcba g
Dcm*tyi i KxúvsK nte* 200 Hz?

mgva**b** t f`qv Av*tQ*, Zv*tii i* $\sim N^{\circ}$, l = 60cm = 0.6m

Zv*tii fi*, 3gm = 0.003 kg

$$\therefore Zv*tii GKK \sim tN^{\circ} fi*, m = \frac{0.003}{0.6} = 5 \times 10^{-3} \text{ kg m}^{-1}$$

$$= .5 \times 10^{-2} \text{ kg m}^{-1}$$

1g Dcm*tyi i KxúvsK*, n₂ = 200 Hz

Zv*tii Uvb T aiv hVK/*

$$m\hat{F}gtZ, n_2 = \frac{1}{l} \sqrt{\frac{T}{m}}$$

$$n_2^2 = \frac{1}{l^2} \cdot \frac{T}{m} \quad [eMKf]$$

$$\begin{aligned} T &= n_2^2 l^2 \text{ m} \\ &= (200)^2 \times (0.6)^2 \times 0.5 \times 10^{-2} \\ &= 72 \text{ N.} \end{aligned}$$

mvi ms \ddot{P} lc

Uvbv Zv*tii Kxúb t Uvbv Zv*tii g,yAvNz Kitj Avo Zi½ myo nq/ Uvbv Zv*tii `Bcōš-`pfvte* Avo Kvtbv _vKtj `B cōš-t₁K Zi½ cōZdij Z ntq w-i Zi½ myo nq/ Uvbv Zv*tii GK jy loop, `B* jy, wZb jy BZw nZ c*vti* / G Ae^{-vq} Zi½ %N^oh_vutg zl, l, $\frac{2}{3}$ l; thLvtb | Zv*tii i* $\sim N^{\circ}$ nt_e/**

c $\ddot{v}V\ddot{E}i gj-wqb$

(K) \sim be^{W₃}K c $\ddot{v}\kappa$

mVK D $\ddot{E}ti wK w\ddot{y}$ (v) w b

1. Uvbv Zv*tii g,yAvNz Kitj wK Zi½ Drcba g ?*

(1) j wK Zi½ (2) Avo Zi½

(3) ZwoR PyKxq Zi½ (4) tKvb Zi½ myo nq bv/

(L) ms \ddot{P} B D $\ddot{E}i w b$

1/ Uvbv Zv*tii w-i Zi½ wKf vte Drcba g ?*