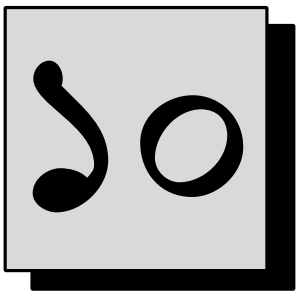


cevnx c`v_

fwgKv

c‡eB ejv n‡q‡Q †h, c`v_‡K cavbZ wZbfv‡M fvM Kiv hvq, h_v- (1) KwVb (2) Zij I (3) evqexq| Zij I evqexq c`v_‡K Avevi cevnx c`v_ e‡j| Kviv Zij I evqexq c`v_ cewnZ n‡Z cv‡i| cevnx c`v‡_i `yB we‡kl ag n‡"Q cô Uvb I mv›`Zv| G Aa¨v‡q Avgiv cô Uvb I mv›`Zv wb‡q Av‡jvPbv Kie|

cvV-1
cô¨Uvb I cô¨kw³

D‡Ïk¨
G cvV †k‡l Avcwb-

- cô¨Uv‡bi D`vniY eYbv K‡i Gi msÁv wjL‡Z cvi‡eb,
- cô¨Uv‡bi gvÎv mgxKiY I GKK wjL‡Z cvi‡eb,
- cô¨-kw³ i msÁv wjL‡Z cvi‡eb,
- cô¨-kw³ i gvÎv mgxKiY I GKK wjL‡Z cvi‡eb,
- cô¨Uvb I cô¨kw³ i g‡a¨ m¤úK© cvcb Ki‡Z cvi‡eb,
- msmw³ ej, Avmäb ej, AvYweK পাল্লার msÁv wjL‡Z cvi‡eb|

10.1.1 cô¨Uvb (Surface Tension)

Zij c`v‡_i GKwU we‡kl ag n‡jv cô¨Uvb|

Avgv‡`i Pvicv‡k Avgiv cô¨Uv‡bi cPwý D`vniY †`L‡Z cvB| †hgb- Avgiv j¶¨ Kwi, cwbi Dci w`‡q gv‡S gv‡S †QvU †QvU †cvKv †ntU †eovq| AvcvZ `wó‡Z †`L‡j g‡b nq, cwbi Dci GKwU cvZjv c`v i‡q‡Q Ges †cvKvgvKo G c`vi Dci w`‡q Pjv‡di Kv‡Q| fvj K‡i j¶¨ Ki‡j †`Lv hvq †h, †cvKvi cv †hLv‡b co‡Q †mLv‡b cwbi cô¨ wKQzv Aebwg‡Z n‡"Q|

cwbi c‡ô GKwU mvB‡K Av‡¯ †i‡L w`‡j †`Lv hvq mvBwU fvm‡Q| mvB‡qi c`v‡_i NbZ cwbi Nb‡Zi †P‡q †ewk nIqv m‡Ë mvBwU fvm‡e Ges mvBwU †hLv‡b cwbi Zj ¯úk Ki‡e †mLv‡b cwbi cô¨ mvgvb¨ Aebwg‡Z g‡b n‡e|

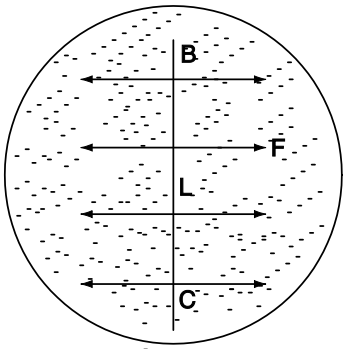
¯í AvqZ‡bi Zij c`v_, †hgb- cwbi †dvUv, wkwki we›`y cvi` we›`y Pvi w`‡K Qwo‡q bv c‡o me`v †Mvjv‡Kvi avivY Kivi †Póv K‡i| †Mvjv‡Kvi AvKwZ‡ZB wbw`ó AvqZ‡bi Zi‡ji Z‡ji †¶Îdj m‡e‡P‡q Kg nq|

Dc‡i ewYZ NUbv ‡_‡K eySv hvq †h, Zij c`v‡_i gy³ Zj Uvbv w¯wZ¯vcK c`vi gZ AvPiY K‡i Ges Gi †¶Îdj me`v msKwPZ Ki‡Z †Póv K‡i| Avi I gše¨ Kiv hvq †h, Zi‡ji gy³ cô¨ eivei GKwU Uvb Av‡Q| GB Uvb‡KB cô¨ Uvb ejv nq|

msÁv t †Kvb Zi‡ji c‡ôi Dci GKwU †iLv Kíbv Ki‡j H †iLvi cwZ GKK ^`‡N¨ †iLvi mv‡_ j¤f v‡e Ges Zij c‡ôi ¯úkK eivei †iLvi Dfq cv‡k †h ej wµqv K‡i Zv‡K H Zi‡ji cô¨Uvb e‡j|

e¨vL¨v t GKwU Zi‡ji c‡ôi Dci L ^`‡N¨i GKwU †iLv Kíbv Kwi| GLb, H †iLvi mv‡_ j¤f v‡e Ges c‡ôi ¯úkK i¡c †iLvi Dfq cv‡k hw` F ej wµqv K‡i, Z‡e-

$$\text{cô¨Uvb } T = \frac{F}{L} \quad \text{.... .... [10-1]}$$



wPÎ: 10-1

D`vniY 1

cwbi Dc‡ii Zj n‡Z 0.05m j¤v GKwU Zvi‡K †U‡b Zzj‡Z mewaK 7.28×10^{-3} N e‡ji c‡qvRb nq| cwbi cÖUvb wbYq Ki“b|

mgvavb

Avgiv Rwb,

cÖUvb, $T = \frac{F}{L}$

$\therefore T = \frac{7.28\times 10^{-3}N}{2\times0.05m}$

$= 72.8\times10^{-3}Nm^{-1}$

GLv‡b,

ej, $F = 7.28\times10\text{-}3N$

‰`N¨, $L = 2\times0.05$ m

†h‡nZzZv‡ii Dfq w`‡K cwb Av‡Q|

10.1.2 : cÖUv‡bi gvÎv

$[cÖUvb] = \frac{ej}{‰`N¨}$

ev, $[T] = \frac{MLT^{-2}}{L} = MT^{-2}$

10.1.3 : cÖUv‡bi GKK

Gg. †K. Gm ev Gm AvB c×wZ‡Z cÖUv‡bi GKK n‡”Q wbDUb/ wgUvi ev Nm^{-1}

10.1.4. cÖkw³ (Surface Energy)

Zij c‡ô GKwU Uvb ev ej me`v wµqv K‡i| G ej Zij Z‡ji †¶Îdj nvm Ki‡Z †Póv K‡i| mZ¨vs Zij c‡ôi †¶Îdj e„× Ki‡Z n‡j H e‡ji wei“‡× wKQyKvR Ki‡Z nq| Zvcgv‡Îv e„× Ki‡Z kw³ e¨wqZ bv n‡j, G KvR w¯wZkw³ wn‡m‡e Zij c‡ô mwÂZ _v‡K| Zij c‡ôi GB kw³ B w¯wZkw³ ev cÖkw³ e‡j|

msÁv t †Kvb GKwU Zij c‡ôi †¶Îdj GK GKK e„× Ki‡Z †h cwigvY KvR m¤úb Ki‡Z nq, Zv‡K H Zi‡ji cÖkw³ e‡j|

$cÖkw³ = \frac{KvR}{†ÿÎdj}$ .... (10-2)

10.1.5 : cÖkw³i gvÎv

$[cÖkw³] = \frac{KvR}{†ÿÎdj}$

$= \left[\frac{ej \times miY}{†ÿÎdj}\right]$

$= \left[\frac{MLT^{-2}\times L}{L^2}\right]$

$= [MT\text{-}^2]$

10.1.6 cô¸kw³ i GKK

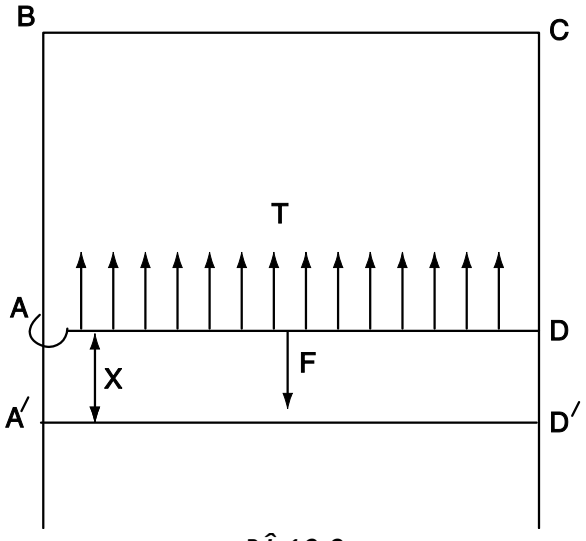
Gg. †K. Gm c×wZ‡Z cô¸kw³ i Rvÿ¹wgUvi ^{2}

$$= \frac{\text{Nm}}{\text{m}^2} = \text{Nm}^{-1}$$ |

A_©vr cô¸kw³ i GKK wbDUb/wgUvi

10.1.7 : cô¸Uvb I cô¸kw³ i g‡a¨ m¤úK

g‡b Kwi, ABCD GKwU Zv‡ii †dg, Gi AB, BC Ges CD evû ¯'i (wPÎ 10.2)| AD GKwU evû hv AB I CD evû eivei Aev‡a Pjv‡div Ki‡Z cv‡i| G †dgwU mvev‡bi cwb‡Z Wvæe‡q Z‡ej Avb‡j AD Ges †d‡gi ga¨eZx As‡k GKwU mvev‡bi †dbvi cvZjv c`v mµó n‡e| G c`v cô¸Uv‡bi Rb¨ †d‡gi c‡Z¨K evû‡K wfZ‡ii w`‡K Uvb‡Z _v‡K| wKšZ AD evû Qvov Ab¨ evû¸wj AvUKv‡bv _vKvq ïaygvÎ AD evû BC evûi w`‡K AMmi n‡e| cô¸Uv‡bi Rb¨B GLv‡b AD evû wfZ‡ii w`‡K AMmi n‡e|



wPÎ 10.2

hw` Zi‡ji cô¸Uvb T Ges AD evûi ^`N¨ l nq, Z‡e cô¸Uv‡bi Rb¨ AD evûi Dci †gvU ej-

$F = 2l \times T$

†Kbbv c`vi Dc‡i I wb‡P `ywU cô¸Av‡Q|

myZivs AD evûi ^`N¨ = l GLb AD-‡K ¯'i ivL‡Z n‡j Gi Dci cô¸Uv‡bi wecixZgyLx mg cwigvY GKwU ej c‡qvM Ki‡Z n‡e|

GLb AD evû‡K ax‡i ax‡i x `i‡Z mwi‡q A′D′ Ae¯'v‡b Avb‡Z H e‡ji wei“‡× wKQyKvR Ki‡Z n‡e|

d‡j c`vi †¶Îdj e„× cv‡e = $2l \times x$ [∵ c`vi `ywU Zj]

∴ m¤úvw`Z Kv‡Ri cwigvY, $w = ej \times miY = F \times x = 2l\,Tx$

myZivs cwZ GKK †¶Îdj e„× Ki‡Z KvR-

$$E = \frac{KvR}{\text{†ÿÎdj}} = \frac{W}{2l\,x} = \frac{2l\,Tx}{2l\,x} = T$$

AZGe, cwZ GKK †¶Îdj e„× Ki‡Z Kv‡Ri cwigvY H Zi‡j cô¸Uv‡bi mgvb|

Avevi, GKK †¶Îdj e„w×‡Z KZ.KvR = GKK †¶Îd‡j mwÂZ

¯wZ k³ = cô k³

∴ †Kvb Zi‡ji cô k³ msL¨vMZfv‡e Zi‡ji côUv‡bi mgvb|

E = T

10.1.8: cô„Uv‡bi ZË m¤úwKZ K‡qKwU iwk

cô„Uv‡bi AvYweK ZË e¨vL¨v `v‡bi c‡e Avgv‡`i K‡qKwU msÁv Rvbv `iKvi| wb‡¤ Zv eYbv Kiv n‡jv-

(1) **msm³ ev mshy³ ej (Cohesive force)t** Avgiv Rwb, AmsL¨ AYy mgb‡q c`v_ MwVZ Ges G Aby‡jv G‡K Aci‡K AvKlY K‡i| GKB c`v‡_i wewfb AYy g‡a¨ cvi¯úwiK G AvKlY ej‡K msm³ ej e‡j| †hgb- B¯úv‡Zi wewfb AYy g‡a¨ cvi¯úwiK AvKlY ej|

(2) **AvmÄb ej (Adhesive force)t** GKwU c`v_‡K Ab¨ GKwU c`v‡_i ms¯ú‡k ivL‡j c`v_ `yBi AYy‡jvi g‡a¨ cvi¯úwiK AvKlY ej Aby¥Z nq| wewfb c`v‡_i AYy‡jvi g‡a¨ cvi¯úwiK AvKlY ej‡K AvmÄb ej e‡j| †hgb- ব্লাক †ev‡W hLb PK w`‡q †jLv nq ZLb PK ব্লাক †ev‡W †j‡M _v‡K| G‡¶‡Î ব্লাক †evW I P‡Ki Aby‡jvi g‡a¨ †h AvKlY ej, ZvB AvmÄb ej|

(3) **AvYweK পাল্লা t `yB AYy g‡a¨ msm³ ej m‡ev"P †h `i‡Z chš Aby¥Z nq Zv‡K AvYweK পাল্লা** e‡j| G `i‡Zi gvb cvq $10^{-10}$ m| GKwU AYyK †K› `K‡i AvYweK পাল্লার mgvb e¨vmva wb‡q GKwU †MvjK Kíbv Ki‡j Zv‡K H AYy cfve †MvjK ev পাল্লা †MvjK (Sphere of attraction) e‡j| †K‡›`i †Kej †Mvj‡Ki wfZ‡ii AYy‡jvi Øviv cfweZ nq| cfve †Mvj‡Ki evB‡ii †Kvb AYyØviv †K›`xq AYyB cfweZ n‡e bv| A_vr evB‡ii †Kvb AYyGes †K›`xq AYyBi g‡a¨ msm³ ej †bB ej‡jB P‡j|

mvi-ms‡¶c

cô„Uvb:- †Kvb Zij c‡ôi Dci GKwU mij †iLv Kíbv Ki‡j H mij †iLvi cwZ GKK ‰`‡N¨i mv‡_ j¤fv‡e Ges c‡ôi ¯úkKi¡c †iLvi Dfq cv‡k †h ej wµqv K‡i Zv‡K H Zij c‡ôi cô„Uvb e‡j|

cô k³t †Kvb GKwU Zij c‡ôi †¶Îdj GK GKK e„w× Ki‡Z †h cwigvY KvR mwaZ nq, Zv‡K H Zij c‡ôi cô k³ e‡j|

msm³ ejt GKB Zij c`v‡_i wewfb AYy g‡a¨ cvi¯úwiK AvKlY ej‡K msm³ ej e‡j|

AvmÄb ejt wewfb Zij c`v‡_i AYy‡jvi g‡a¨ cvi¯úwiK AvKlY ej‡K AvmÄb ej e‡j|

c‡qvRbxq mgvKiY

1. cô„Uvbt $T = \frac{F}{L}$
2. cô k³ t E = T

c‡kvËi gj¨vqb:

K. mwVK DË‡ii cv‡k wUK wPý (√) w`b|

1. wb‡Pi †KvbwU cevnx c`v_?
   (K) KwVb I Zij c`v_ (L) Zij I M¨vmxq c`v_
   (M) KwVb I M¨vmxq c`v_ (N) Zij I প্লাজমা c`v_

2. cô Uv‡bi gvÎv mgxKiY †KvbwU?
   (K) $ML^{-1}T^{-2}$ (L) MT^{-2}
   (M) ML^{-1} (N) MLT^{-1}

3. GKB Zij c`v‡_i wewfb AYyi g‡a¨ cvi¯úwiK AvKIY ej‡K wK ejv nq?
   (K) msmw³ ej (L) AvmÄb ej
   (M) cô‡Uvb (N) mv›`Zv

4. Zi‡ji cô‡Uv‡bi Rb¨ †h ej `vqx-
   (K) AwfKl (L) gnvKl
   (M) msmw³ (N) AvmÄb

L. msw¶ß ck

1. cô‡Uvb Kv‡K e‡j?
2. cô‡Uv‡bi gvÎv mgxKiY †ei Ki“b|
3. cô‡Uv‡bi `yB D`vniY w`b|
4. cô‡kw³ Kv‡K e‡j wjLyb|
5. msk‡w³ I AvmÄb e‡ji msÁv wjLyb|

cvV-2
cô¨Uv‡bi AvYweK ZË I ˆKwkKZv

D‡Ïk¨
G cvV †k‡l Avcwb

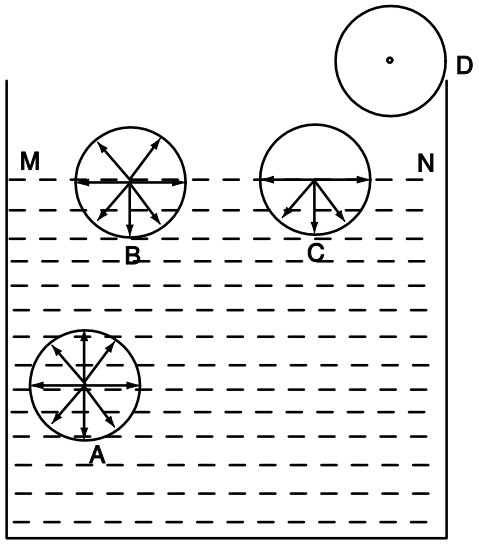
- cô¨Uv‡bi AvYweK ZË e¨vL¨v Ki‡Z cvi‡eb,
- ¯úk †Kv‡Yi msÁv wjL‡Z cvi‡eb,
- ˆKwkKZvi msÁv wjL‡Z cvi‡eb,
- ˆKwkKZv Z‡Ëi eYbv Ki‡Z cvi‡eb|

10.2.1 : cô¨Uv‡bi AvYweK ZË

(Molecular Theory of Surface Tension)

weÁvbx ল্যাপ্লাস mec_g AvYweK Z‡Ëi mvnv‡h¨ cô¨Uv‡bi e¨vL¨v †`b| ল্যাপ্লা‡mi bvg Abyhvv‡i G ZË‡K ল্যাপ্লা‡mi AvYweK ZË I ejv nq| wb‡¤ ZËwUi e¨vL¨v †` Iqv nj:

awi, A, B, C I D †Kvb Zi‡ji PviwU AYy(wPÎ 10.3)| G‡`i g‡a¨ A Zi‡ji Mfx‡i, B Abyi †ewkifvM Ask Zij c¨ôi GKUzwb‡P, C wVK Zij c¨ô Ges D Zi‡ji evB‡i Ae¯Z| cwZwU AYyi Pviw`‡K cfve †MvjK Awa¨K|



wPÎ 10-3

'A' AYyi cfve †MvjK m¤úY©fv‡e Zi‡ji g‡a¨ wbgw¾Z Av‡Q| myZivs A Abyi Ab¨vb¨ AYyØviv Pviw`K †_‡K mgfv‡e AvKó.n‡e| d‡j 'A' AYyi Dci †gvU AvKIY ej kb¨ n‡e Ges AYyi †h Ae¯vq Av‡Q, †m Ae¯v‡ZB _vK‡e|

'B' AYyi cfve †MvjKi Aí Ask Zi‡ji evB‡i Ges †ewkifvM Ask Zi‡ji g‡a¨ Av‡Q| evZv‡mi †P‡q Zi‡j AYyi NbZ †ekx| myZivs wKQyAsk Zi‡ji evB‡i _vKvq Dc‡ii Aí As‡ki AYyi msL¨v A‡c¶v wb‡Pi †ewkifvM As‡k †ewk AYy_vK‡e| d‡j B AYyi GKwU wb¤gyLx jvä msmw³ ej Abyfe Ki‡e|

'C' AYyi wVK Zij c‡ô Ae¯Z| myZivs 'C' AYyi cfve †Mvj‡Ki Aavsk Zij c‡ôi Dc‡i Ges Aavsk Zij c‡ôi wb‡P _vK‡e| AZGe G AYyi †Mvj‡Ki wb‡Pi As‡ki AYyØvi †ekx AvKó.n‡e| d‡j GwU GKwU wb¤gyLx jvä msmw³ ej Øvi AvKwlZ n‡e|

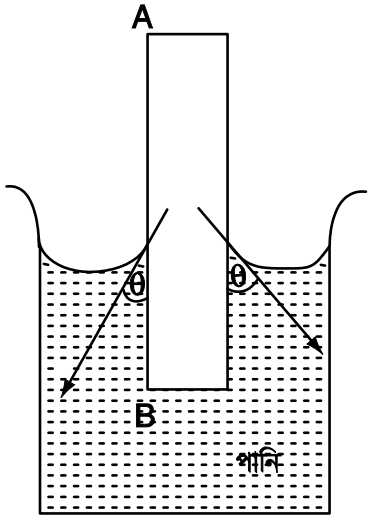
'D' AYyi cfve †MvjK m¤úY¨f‡e Zi‡j i evB‡i Av‡Q| myZivs Gi Dci Zi‡j i Uvb ÔkbœvÕ| d‡j AYyi M¨vm AYy gZ gy³ f‡e wePiY Ki‡e|

Dc‡ii Av‡jvPbv n‡Z eSv hvq †h, MN cô me`v GKwU wb¤gyLx ej ev Uvb Abyfe K‡i| d‡j cô wU wbR¯ †¶Îdj Kgv‡Z Pvq Ges msKvPZ n‡Z cqvm cvq| G ms‡KvPb ceYZv n‡ZB Zi‡j i cô Uv‡bi Drcw Ë nq|

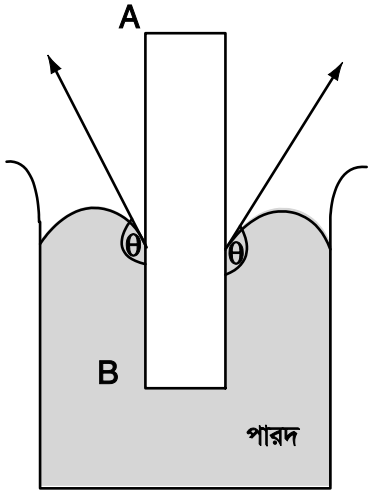
10.2.2 : ¯úk †KvY (Angle of Contact)

GKwU weKv‡i Zij c`v_ wb‡q Gi g‡a¨ GKwU Kv‡Pi `Û Wvev‡j, Zij c`v_ †hLv‡b KwVb c`v_‡K ¯úk K‡i †mLv‡b cô Zj †etiK hvq| Zi‡j i AYy g‡a¨ msmw³ ej Zij‡K Abyfy gK ivLv i †Póv K‡i| wKšz AvmÄb ej Zij cô‡K Dc‡i DVv‡Z ev wb‡P bvgv‡Z †Póv K‡i| AvmÄb ej msmw³ ej A‡c¶v eªËi n‡j ¯úk †KvY m¤‡KvY n‡e| A_vr Zi‡j i cô †etiK Dc‡i DV‡e| msmw³ ej AvmÄb ej A‡c¶v eªËi n‡j ¯úk †KvY ¯‹zj n‡e A_vr Zi‡j i cô †etiK wb‡P †b‡g hv‡e|

Avevi Zij hw` KvPv `ÛwU‡K wfRvq A_vr Zij wU hw` cwb nq Z‡e Zv KvP `‡Ûi Mv †e‡q Dc‡i DV‡e (wPÎ 10.4K), Zij hw` KvP `ÛwU‡K bv wfRvq A_vr Zij wU hw` cvi` nq Z‡e Zv wb‡P †b‡g Av‡m (wPÎ 10.4L)|



wPÎ 10.4 (K)



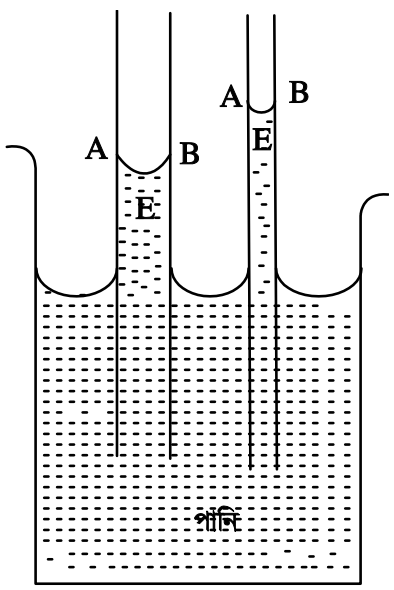
10.4 (L)

msÁv : hw` KwVb I Zij c`v‡_i ¯úk we›`yn‡Z eµvKvi Zij Z‡j †Kvb ¯úkK Uvbv hvq Z‡e ¯úkKwU KwVb c‡ôi mv‡_ Zi‡j i wfZ‡i †h †KvY mvwó K‡i Zv‡K ¯úk †KvY e‡j | wPÎ 10.4(K) Ges 10.4(L) G θ n‡jv ¯úk †KvY|

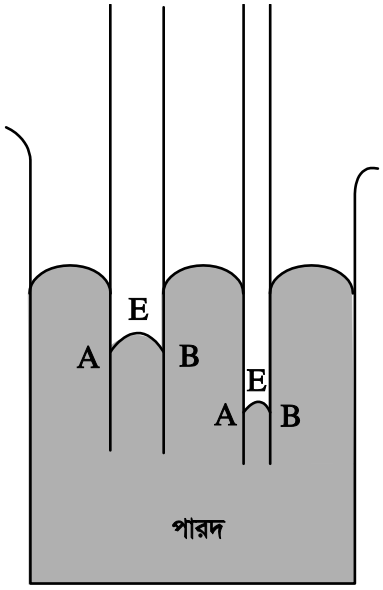
AZGe Dc‡ii wPÎ 10.4(K) †_‡K eSv hvq †h, Zij KwVb KvP `Û‡K wfRv‡j ¯úk‡KvY m¤‡KvY nq A_vr 90° Gi Kg nq Avi Zij KwVb KvP `ÛwU‡K bv wfvR‡j ¯úk †KvY ¯‹zj †KvY A_r 90° †_‡K 180° Gi g‡a¨ nq|

10.2.3: ˆKwkKZv

†K‡ki gZ mi“ wQ`wewkó bj‡K ˆKwkK bj e‡j| `ßi gyL †Lvjv GKwU ˆKwkK bj‡K Zi‡ji g‡a¨ Lvovfv‡e Wzv‡j †`Lv hv‡e †h, b‡ji wfZ‡ii Zij cô evB‡ii Zi‡ji cô n‡Z wKQyDc‡i ev wb‡P i‡q‡Q|



wPÎ : 10-5 (K)



10.5 (L)

g‡b Kwi, GKwU weKv‡i wKQycwb Av‡Q| GLb cwbi g‡a¨ `ywU `ßi gyL †Lvjv duucv KvP bj (GKwU mi“ Ges Aciwu †gvUv) Wzv‡B| cwb †h‡nZzKvP bj `ywU‡K wfRvq, ZvB b‡ji wfZi cwb LwbKUv Dc‡i D‡V hv‡e (wPÎ 10.5 K)|

hw` weKv‡ii g‡a¨ cvi` wbB Z‡e Zv KvP bj `ywU‡K wfRvq bv| b‡ji wfZi cvi` LwbKUv wb‡P †b‡g Avm‡e (wPÎ 10.5 L)|

wPÎ 10.5(K) Ges 10.5(L) j¶¨ Ki‡j Av‡iv eySv hvq †h, ˆKwkK b‡ji ga¨ w`‡q †Kvb Zij c`v‡_i DVv-bvgvi cwigvY b‡ji e¨vmv‡ai Dci wbfi K‡i| b‡ji e¨vmva hZ Kg nq Zij c`v‡_i DVvi ev bvgvi cwigvY ZZ †ewk nq|

msÁv t ˆKwkK b‡ji ga¨ w`‡q †Kvb Zij c`v‡_i DVv ev bvgv‡K ˆKwkKZv e‡j|

10.2.4. ‰KwkKZv ZË

GKwU `ßi gyL †Lvjv Ges myÿg c¯‡”Q` wewkó ˆKwkK bj wbB| awi, bjwUi e¨vmva r| GLb bjwU‡K cwb ev Ab¨ †Kvb Zi‡j (hvi ¯úk †KvY 90^0 Gi †P‡q †QvU) Wzv‡j, b‡ji wfZ‡ii Zi‡ji cô evB‡ii Zij cô ‡_‡K Dc‡i D‡V hv‡e| GLb cô Uvb T Gi Rb¨ Zij cô †etiK AeZj AvKvi avib Ki‡e wPÎ 10.6(K)| Zi‡ji ¯úk †KvY hw` θ nq, Zvn‡j ¯úk †iLvi cwZ we›`yZ cô Uvb T উল্লম্ব †iLvi mv‡_ θ †KvY K‡i wb¤gyL wµqv Ki‡e| wbDU‡bi ZZxq mÎ Abyôv‡i KvPI Zi‡ji Dci GKwU mgvb I wecixZgyLx ej T c‡qvM Ki‡e wPÎ 10. 6 (K)|

G Uvb‡K ci¯úi j¤fv‡e `ywU As‡k wef³ Kiv hvq| GKwU Lvov EaÿgyLx Dcvsk Tcosθ Ges AciwU Gi Awfj¤ w`‡K ewngyLx Abyfvegk Dcvsk| Abyfvegk Dcvsk¸‡jv ci¯úi‡K bvKP K‡i †`q| ïaygvÎ DaÿgyLx Dcvsk KvhKi _v‡K|

myZivs Zi‡ji mv‡_ ¯úk †iLv eivei †gvU EaÿgvKx KvhKi ej = $T\cos\theta \times$ ¯úk †iLvi ^`N¨ = $T\cos\theta \times 2\pi r = 2\pi r\, T\cos\theta$

G Daÿgvkx ej b‡ji g‡a¨ cwb ¯‡¤i IRb‡K avivY K‡i| GLb awi, evB‡ii Zi‡ji Zj †_‡K b‡ji wfZi Zij ¯‡¤i AeZj c‡ôi mewb¤ we›`y chš D"PZv h|

∴ AeZj Ask e¨wZZ ^KwkK b‡j DwÌZ Zij ¯‡¤i AvqZb v n‡j,

$v' = \pi r^2 h$|

eµ As‡ki Zi‡ji AvqZb v' n‡j,

v' = ABCD †Pv‡0i AvqZb − AEB Aa‡Mvj‡Ki AvqZb (wPÎ 10.6(L))|

$$= \pi r^2 \times r - \frac{1}{2} \times \frac{4}{3}\pi r^3$$

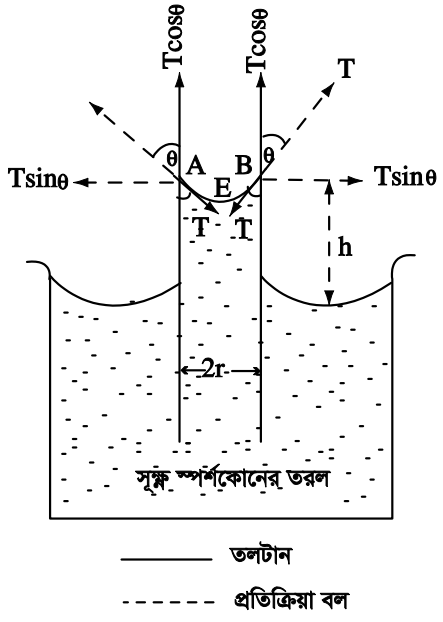
$$= (\pi r^3 - \frac{2}{3}\pi r^3) = \frac{1}{3}\pi r^3$$

∴ D³ ^KwkK b‡j Zi‡ji †gvU AvqZb = $(v+v')$

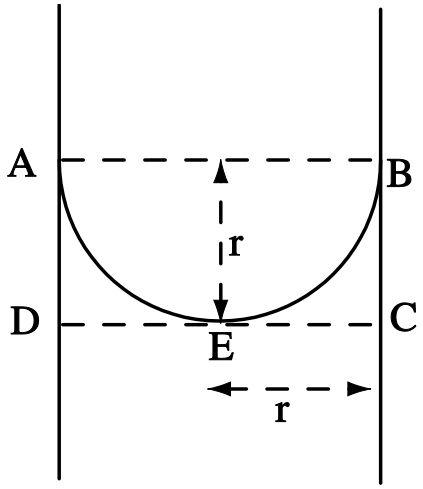
^KwkK b‡j Zi‡ji †gvU IRb = $(v+v')\rho g$

$$= (\pi r^2 h + \frac{1}{3}\pi r^3)\rho g$$

GLv‡b ρ Ges g h_vµ‡g Zij c`v‡_i NbZ I H ¯v‡bi AwfKIxq ZiY|



wPÎ : 10-6(K)



wPÎ : 10-6(L)

myZivs, mvg¨ve¯vq,

$2\pi r T\cos\theta = (\pi r^2 h + \frac{1}{3}\pi r^3)\rho g$

ev, $2T\cos\theta = (rh + \frac{1}{3}r^2)\rho g$

$\therefore T = \frac{r\rho g(h+\frac{1}{3}r)}{2\cos\theta}$ .... (10-3)

hw` r-Gi gvb Lye B †QvU nq, Z‡e $\frac{1}{3}$ r †K D‡c¶v Kiv hvq-

$\therefore T = \frac{hr\rho g}{2\cos\theta}$ .... (10-4)

KvP Ges cwibi †¶‡Î, $\theta = 0$, $\cos\theta = 1$

$\therefore T = \frac{r\rho g}{2}(h+\frac{1}{3}r)$ .... (10-5)

r Gi gvb ¶z`ª nj, $T = \frac{hr\rho g}{2}$

D`vniY 3 : GKwU ˆKwkK KvP bj cwb‡Z Lvov f‡e We‡j cwb b‡j i g‡a¨ 8cm Dc‡i D‡V| cwbi cô Uvb 70×10^{-3} Nm^{-1} n‡j ˆKwkK b‡j i e¨vmva wbYq Ki“b|

g‡b Kwi ˆKwkK b‡j i e¨vmva = r

GLv‡b

$T = 70\times10^{-3} Nm^{-1}$

$\rho = 1\times10^{-3}.....m^{-3}$

$h = 8cm = 8\times12^{-2}m$

$g = 9.8m/s^2$

Avgiv cvB, $T = \frac{hr\rho g}{2}$ ... . (1)

mgxKib (1) G gvb ¸‡jv ewm‡q cvB-

$r = \frac{2T}{h\rho g} = \frac{2\times70\times10\text{-}3}{8\times10^{-2}\times1\times10^{-3}\times9.8}$

$= \frac{2\times20\times10^{-4}}{8\times9.8}$

$= 1.78\times10^{-4}m$

mvims‡¶c

¯úk †KvY: hw` KwVb I Zij c`v‡_i ¯úk we›`yn‡Z eµvKv‡i DwÌZ ev Aebwg Z Zij Z‡j †Kvb ¯úkK Uvbv hvq Z‡e ¯úkKwU KwVb c‡ôi mv‡_ Zi‡j i wfZ‡i †h †KvY mÿ¨ K‡i Zv‡K ¯úk †KvY e‡j|

ˆKwkKZv: ˆKwkK b‡j i ga¨ w`‡q †Kvb Zij c`v‡_i DVv ev bvgv‡K ˆKwkKZv e‡j|

c‡qvRbxq mgxKiY

1. ˆKwkK b‡j DVv ev bvgvi †¶‡Î Zi‡j i cô Uvb :

(K) $T = \frac{r\rho g(h+\frac{r}{3})}{2\cos\theta}$

(L) $T = \frac{r\rho g(h+\frac{r}{3})}{2}$ [θ=0 n‡j]

(M) $T = \frac{hr\rho g}{2}$ [θ=0 n‡j Ges r ÿz`ª n‡j]

c‡kvËi gj¨vqb:

K. mwVK DË‡ii cv‡k wUK wPý (√) w`b|

1. KvP I cwbi ga¨Kvi ¯úk †KvY †Kvb cKv‡ii?
   (K) m¤úvwiK †KvY (L) mg‡KvY
   (M) ¯‹j †KvY (N) m¤‡KvY
2. KvP I cvi‡` i ga¨Kvi ¯úk †KvY †Kvb cKv‡ii?
   (K) m¤‡KvY (L) ¯‹j †KvY
   (M) mg‡KvY (N) m¤úvwiK †KvY
3. ˆKwkK b‡j i e¨vmva †ewk n‡j ˆKwkKZv wK nq?
   (K) ev‡o (L) K‡g
   (M) mgvb _v‡K (N) †Kvb cwZwµqvB nq bv|

L. msw¶ß ck

1. ¯úk †Kv‡Yi msÁv wjLyb|
2. ˆKwkKZvi msÁv wjLyb|

cvV-3
cô¨vb I Gi Dci cfvweKvix welq mgm¨v, mv›`Zv I mv›`Zv ¸YvsK

D‡Ïk¨-

G cvV †k‡l Avcwb-

- Zi‡ji cô¨vb wbY‡qi c×wZ¸‡jvi bvg wjL‡Z cvi‡eb,
- ˆKwkK bj c×wZ‡Z Zi‡ji cô¨vb wbYq Ki‡Z cvi‡eb,
- cô¨-Uv‡bi Dci cfvweKvix welq¸‡jv eYbv Ki‡Z cvi‡eb,
- mv›`Zvi msÁv wjL‡Z cvi‡eb,
- mv›`Zv ¸Yvs‡Ki mgxKiY wjL‡Z cvi‡eb,
- mv›`Zv ¸Yvs‡Ki gvÎv mgxKiY I GKK wjL‡Z cvi‡eb|

10.3.1: Zi‡ji cô¨vb wbYq

(Determination of Surface tension of liquid)

Zi‡ji cô¨vb wbY‡qi Ab¨Zg c×wZ n‡"Q ˆKwkK bj c×wZ|
wb‡¤ ˆKwkK bj c×wZ‡Z Zij c`v‡_i cô¨vb wbYq eYbv Kiv nj-

ZË (Theory):

Avgiv Rwb, cô¨vb, $T = \frac{r\rho g(h+\frac{r}{3})}{2\cos\theta}$

GLv‡b,

T = cô¨vb
r = ˆKwkK b‡ji e¨vmva
ρ = Zij c`v‡_i NbZ
θ = ¯úk †KvY
h = ˆKwkK b‡ji Af¨š‡i Zij Z‡ji D"PZv,
g = AwfKlR Zi

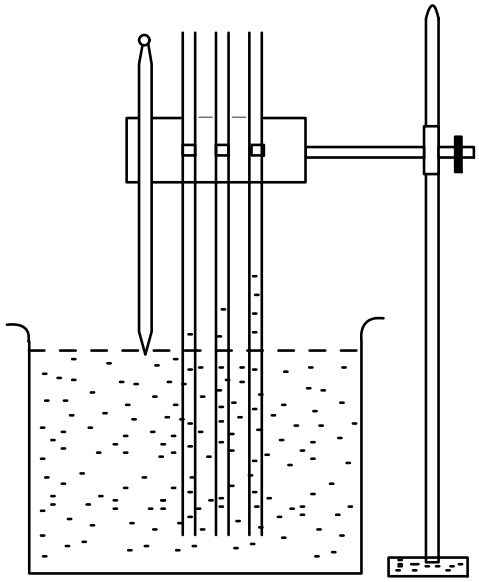
cwb I Kv‡Pi †¶‡Î, $\theta = 0$, $\cos\theta = 1$

Avevi ˆKwkK bj Lye mi" n‡j A_vr r Gi gvb hw` Lye Kg nq| Zvn‡j h Gi Zzjbvq $\frac{r}{3}$ †K D‡c¶v Kiv hvq,

$\therefore \quad T = \frac{rh\rho g}{2}$

ci¶v c×wZ

c_‡g K‡qKwU wewfb e¨vmv‡ai ˆKwkK bj wbB| ˆKwkK bj¸‡jv‡K bvBwUK GwmW I c‡i KwóK †mvWvi `eY w`‡q fvjfv‡e cwi®vi K‡i ïwK‡q wbB| Gici ˆKwkK bj¸‡jv‡K GKwU Kv‡Pi †¤^‡Ui Dci cvkvcwk †gvg w`‡q AvU‡K †`B| bj¸‡jvi cv‡k GKwU `ßi gyL mPv‡jv wcbI †gvg w`‡q AvUKv‡bv nq| bj¸‡jv ci¯úi Ges wc‡bi mv‡_ †hb mgvšivj nq| Gevi ˆKwkK bj¸‡jvi GKcvš Lvovfv‡e ci¶vaxb cwb‡Z Wvæv‡bv nq †hb wcbwUi wb¤cvš cwbi Dcwiwj ¯úk K‡i (wPÎ 10.7)|



wPÎ : 10-7

ˆKwkK wµqvi Rb¨ b‡ji wfZi cwb Dc‡i DV‡e| G Ae¯vq Zij ¯‡¤i kxl‡`‡k b‡ji Mv‡q GKwU Kwji `vM w`B| GKwU Pjgvb AYøx¶Y h‡ši mvnv‡h¨ b‡ji ga¨¯ Zij Z‡ji AeZj c‡ôi cvV Ges wc‡bi wb¤cv‡ši cvV wbB| G `ßi cv‡Vi cv_K¨ n‡Z b‡ji wfZ‡ii Zij ¯‡¤i D”PZv h wbYq Kiv hv‡e| Gici Lyøx mveav‡b Kwj †`qv RvqMwU KwU Ges AYøx¶Y h‡ši Øviv cwZwU KvUv gyLi e¨vm Ges Zv †_‡K e¨vmva wbYq Kwi|

Av‡cw¶K ¸i“Z †evZ‡ji mvnv‡h¨ Zij c`v‡_i NbZ †ei Kwi|

GLb mgxKiY, $T = \frac{r\rho g}{2}\left(h+\frac{1}{3}r\right)$ mgxKi‡Y h,r,g I ρ Gi gvb ewm‡q cô Uvb T wbYq Kwi|

10.3.2: cô Uv‡bi Dci cfveKvix welq

(Factors affecting Surface tension of a liquid)

Zi‡ji cô Uvb †gvUvgyL wb¤wjwLZ welq¸‡jvi Dci wbfikxj-

(i) Zvcgvîv : Zvcgvîvi Dc‡i Zi‡ji cô Uvb wbfi K‡i| mvaviY Zvcgvîv e„× †c‡j Zi‡ji cô Uvb nvm cvq|

(ii) Zi‡ji Dci Ae¯Z gva¨g (Medium above the liquid):

Zi‡ji Dci Ae¯Z gva¨‡gi cKwZi Dci Zi‡ji cô Uvb wbfi K‡i, Rjxq ev‡®úi ms¯úk Avm‡j cwbi cô Uvb cvq 70×10^{-3} Nm^{-1}nq, Avevi evqy ms¯úk Avm‡j, cwbi cô Uvb cvq 72×10^{-3} $N.m^{-1}$ nq|

(iii) `wHZKiY (contamination): Zi‡j †h †Kvb cKvi †Zj ev PweRvZxq c`v_ wgwkZ _vK‡j, Zi‡ji cÖvq nvm cvq|

(iv) `exfZ e¯‘i Dcw¯’wZ (Presence of dissolved substanccs):

Zi‡j †Kvb e¯‘z`exfZ _vK‡j Zi‡ji cÖvq cwiewZZ nq| Zi‡j A¼Re c`v_ `exfZ _vK‡j cÖvq ew× cvq Ges ^Re c`v_ `exfZ _vK‡j cÖvq nvm cvq|

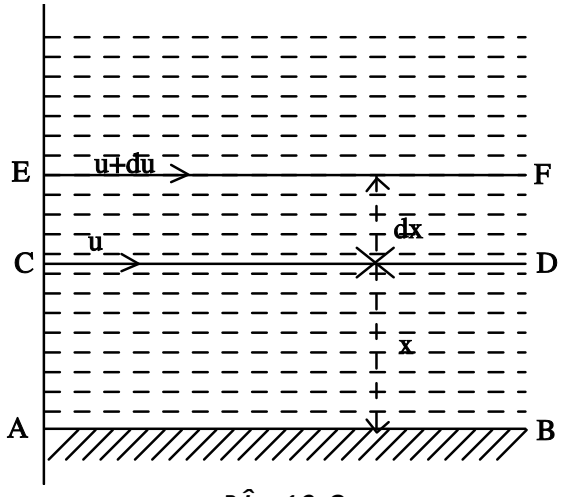
(v) ZwoZwnZKiY : ZwoZwnZ n‡j Zi‡ji cÖvq nvm cvq|

10.3.3 mvùiZv (Viscosity)

mv›`Zv c`v‡_i GKwU we‡kl ag| Zij I evqexq c`v‡_ G ag we`¨vgvb|

G `gxi‡bi c`v_‡K cevnx e‡j| cewnZ nIqvi mgq hw` cevnxi MwZkxj KYv¸‡jv cewni MwZc‡_i mv‡_ mgvšivj fv‡e AMmi nq Z‡e Gi cevn‡K aviv‡iL ev Ae¨vnZ cevn e‡j| Avi hw` KYv¸‡jv AwbqwgZ fv‡e AMmi nq Z‡e Gi MwZ‡K e¨vnZ ev Akvš MwZ e‡j|

GKwU w¯’i Abyfvgvgv Z‡ji Dci w`‡q †Kvb cevnxi aviv‡iL cevn Pj‡Z _vK‡j cevnxi †h ¯’i w¯’i Z‡ji msjM _v‡K Zvi †eM kb¨ nq| †h ¯’i w¯’i Zj n‡Z me‡P‡q `ªæi _v‡K Zvi †eM me‡P‡q †ewk nq| g‡b Kwi, AB GKwU w¯’i Zj| PQ, CD I EF Gi Dci cevnxi wZbwU ¯’i| PQ w¯’i Zj msjM, CD Zvi GKUzDc‡i Ges EF AwaK Dc‡i Aew¯’Z| myZivs PQ ¯‘‡ii †eM cvq kb¨, CD ¯‘‡ii †eM GwU A‡c¶v †ewk Ges EF ¯‘‡ii †eM me‡P‡q †ewk| Dc‡ii ¯’¸‡jv wb‡Pi ¯’¸‡jvi MwZ‡K Ziwb Z K‡i| wKšzcevnxi ¯‘‡ii g‡a¨ NIY ej _vKvi d‡j wb‡Pi ¯’¸‡jv Dc‡ii mv‡_ GKB †e‡M Pj‡Z cv‡i bv, Kg †e‡M P‡j| cevnxi G ag‡K mv›`Zv e‡j|



wPÎ : 10-8

msÁv t †h a‡gi Rb¨ cevnx Zvi Af¨ši¯’ wewfb ¯‘‡ii Av‡cw¶K †eM †iva Kivi †Póv K‡i, Zv‡K H cevnxi mv›`Zv e‡j|

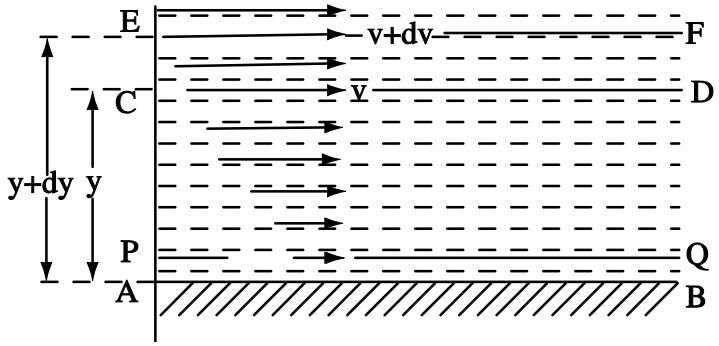
wewfb cevnxi mv›`Zv wewfb| †hgb: cwbi †P‡q gayy mv›`Zv †ewk| Avevi gayy †P‡q AvjKvZivi mv›`Zv †ewk|

mv›`Zv‡K KLbI KLbI cevnxi AvVvZZv ejv nq| †KD †KD mv›`Zv‡K cevnxi Af¨šixY NIY e‡j| Kv‡iY mv›`Zv e‡ji ¯’¡c A‡bKUv NI‡Yi g‡Zv| NIY ej `yB KwVb e¯‘i ga¨Kvi Av‡cw¶K MwZ‡K evav †`q| Aci c‡¶ mv`Zv cevnxi wewfb ¯‘‡ii Av‡cw¶K MwZ‡K evav †`q| NIY ej ¯úk Z‡ji †¶Îd‡ji Dci wbfi K‡i bv| Z‡e mv›`Zv cevnxi ¯’iØ‡qi †¶Îd‡ji Dci wbfi K‡i|

10.3.4: mv›`Zv ¸YvsK

g‡b Kwi, AB GKwU w¯‹i Zj (wPÎ: 10-10)| Gi Dci w`‡q cevnxi avivq‡iL cevn Pj‡Q| cevnxi AwZ wbKUeZx `ywU ¯‹i CD I EF we‡ePbv Kwi|

g‡b Kwi, AB n‡Z CD-Gi `i‡Z y, AB n‡Z EF-Gi `i‡Z (y+dy), Avevi CD ¯‹‡ii †eM v Ges EF ¯‹‡ii †eM (v+dv)|



wPÎ 10.9

∴ `ywU ¯‹‡ii g‡a¨ †e‡Mi cv_K¨ = v+dv–v = dv

Ges `ywU ¯‹‡ii g‡a¨ `i‡Zi cv_K¨ = y+dy–y = dy

∴ cwZ GKK `i‡Z †e‡Mi cwieZb ev `i‡Zi mv‡_ †e‡Mi cwieZ‡bi nvi = $\frac{dv}{dy}$ G nvi‡K †eM Aeµg (Velocity gradient) e‡j|

CD I EF ¯‹iØ‡qi g‡a¨ cevn‡K eva¨ †`qvi Rb¨ ‡e‡Mi wecixZ w`‡K (evgw`‡K) mv›` e‡ji D™e n‡e, awi, mv›` ej = F

weÁvbx wbDUb mv›`Zv msµvš mÆvejx c`vb K‡ib| GB mÆvejx wb¤i¦c:

(i) mv›`Zv ej †¶Îd‡ji mgvbycwZK,

Avr, $F \propto \frac{dv}{dy}$ hLb A w¯‹i|

ii) mv›`Zv ej †eM Aeµ‡gi mgvbycwZK|

Avr $F \propto A \times \frac{dv}{dy}$ hLb A w¯‹i|

∴ Avgiv cvB -

$F \propto A \times \frac{dv}{dy}$ [F, $\frac{dv}{dy}$ I A cwieZbkxj|]

$F = \eta . A\frac{dv}{dy}$ .... (10-8)

†hLv‡b, η GKwU a“eK| G a“eK‡K mv›`Zv ¸YvsK e‡j|

mgxKiY 10-8 n‡Z cvB-

$$\eta = \frac{F}{A} \Big/ \frac{dv}{dy} \text{ .... (10-9)}$$

hw` A =1 GKK Ges †eM Aeµg, $\frac{dv}{dy}$ = 1 GKK nq| Zvn‡j mgxKiY 10-9 n‡Z cvB,

F = η

msÁv t cevnxi `yÕ ¯‡ii g‡a¨ GKK †eM Aeµg eRvq ivL‡Z A_vr GKK `y‡Z Aew¯Z `yÕ ¯‡ii g‡a¨ GKK Av‡cw¶K †eM eRvq ivL‡Z †Kvb GKwU cevnxi GKK †¶Îd‡ji Dci †h cwigvY mv›`Zv ej wµqv K‡i, Zv‡K H cevnxi mv›`Zv ¸YvsK e‡j| G ej cevnxi ¯‡ii ¯úkK eivei wµqv K‡i|

10.3.5 : mv›ùZv ¸Yvs‡Ki gvÎv mgxKiY

Dimension of co-efficient of viscosity)

Avgiv Rwb-

$$F = \eta . A . \frac{dv}{dy}$$

ev, $$\eta = \frac{F}{A}\frac{dx}{dy}$$

∴ gvÎv mgxKiY-

$$[\eta] = \left(\frac{ej \times `iZ}{†ÿÎdj \times †eM}\right) = \left(\frac{MLT^{-2} \times L}{L^2 \times L/T^{-1}}\right)$$

$$= \left(\frac{MLT^{-2} \times L \times T}{L^3}\right)$$

$$= [ML^{-1}T^{-1}]$$

10.3.6: mv›`Zv ¸Yvs‡Ki GKK

mv›`Zv ¸Yvs‡Ki GKK $1N.S.m^{-2}$ ej‡Z e¨vq †h, GK eM wgUvi †¶Îdj wewkó `yÕ cevnx ¯i ci¯úi n‡Z GK wgUvi `‡i Aew¯Z n‡j, G‡`i wfZi GK wgUvi/†m‡KÛ Av‡cw¶K †eM eRvq ivL‡Z GK wbDUb ej chy³ nq|

mvi-ms‡¶c

mv›`Zv t †h a‡gi Rb¨ cevnx Zvi Af¨ši¯ wewfb ¯‡ii Av‡cw¶K †eM †iva Kivi †Póv K‡i, Zv‡K H cevnxi mv›`Zv e‡j|

mv›`Zv ¸YvsK t GKK †eM Aeµ‡g †Kvb GKwU cevnxi GKK †¶Îd‡ji Dci †h cwigvY mv›`Zv ej wµqv K‡i, Zv‡K H cevnxi mv›`Zv ¸YvsK e‡j| G ej cevnx ¯‡ii ¯úkK eivei wµqv K‡i|

c‡qvRbxq mgxKiY

1. mv›`Zv ej t $F = \eta A\frac{dv}{dx}$
2. mv›`Zv M¥vsK t $\eta = \frac{F}{A} / \frac{dv}{dx}$

c‡kvËi gj¨vqb:

K. mwVK DË‡ii cv‡k wUK (√) wPý w`b|

1. *†h a‡gi Rb¨ cevnx Zvi Af¨ši¯ wewfb ¯‡ii Av‡cw¶K †eM †iva Kivi †Póv K‡i, Zv‡K H cevnxi wK ag e‡j?*
   *K. msk*ʷ³ *L. mv›`Zv*
   *M. cô*Uvb *M. w¯wZ¯vcKZv*
2. *mv›`Zv ¸Yvs‡Ki gvÎv mgxKiY †Kvbwu?*
   K. ML^{-1} *L.* $ML^{-2}\,T^{-3}$
   M. $ML^{-1}\,T^{-1}$ *N.* $ML^{-2}\,T^{-1}$
3. *Zvcgvîv evo‡j Zi‡ji cô*Uv‡bi Dci wK cfve c‡o?
   K. kb¨ nq *L. ev‡o*
   M. K‡g *N. AcwiewZZ _v‡K|*

L. msw¶ß ck

1. *cô*Uv‡bi Dci Zvcgvîvi cfve wK?
2. *mv›`Zv I mv›`Zv ¸Yvs‡Ki msÁv wjLyb|*
3. *mv›`Zv ¸Yvs‡Ki gvÎv mgxKiY wjLyb|*

cvV-4
†÷vK‡mi m¤ú‡K© I mv›`Zvi Dci cfvekvix welqmgn¨v

D‡Ïk¨

G cvV †k‡l Avcwb-

- †÷vK‡mi m¤úwU cwZcv`b Ki‡Z cvi‡eb,
- mv›`Zvi Dci Zvcgv‡bi I Pv‡ci cfve e¨vL¨v Ki‡Z cvi‡eb|

10.4.1 : †÷vK‡mi m¤ú‡K© (Stoke's Law)

Avgiv Rwb, coš¿ eZ©AwfKl e‡ji cfv‡e wb‡P co‡Z _v‡K| myZivs hLb †Kvb eZ©gvb wfK‡li Uv‡b wb‡P c‡o ZLb Zij ev M¨v‡mi †h ¯‹¡‡jv eZ©x ms¯ú‡k Av‡m, Zv‡`i‡Kl wb‡Ri mv‡_ †U‡b wb‡q P‡j| d‡j Zij ev M¨v‡mi wewfb ¯‹‡ii g‡a¨ Av‡cw¶K †eM mwó nq| wKšzZij ev M¨v‡mi mv›`Zv H Av‡cw¶K MwZ‡K g›`xfZ Kivi †Póv K‡i| coš¿ eZ©x †eM hZB evo‡Z _v‡K, gva¨‡gi mv›`Zv RwbZ wecixZgyLx ej ZZB ewl× cvq| coš¿ eZ©x AvKvi hw` †QvU nq Z‡e ¯‹í mg‡qi g‡a¨ AwfKl ej mv›`ZvRwbZ wecixZgyLx e‡ji mgvb n‡e| G Ae¯‘q ešÍx †Kvb ZiY _vK‡e bv| wKšÍe¯‘vbwU MwZ RoZvi Rb¨ mg‡e‡M co‡Z _vK‡e| G †eM‡K cwšÍK †eM (Terminal velocity) e‡j|

†÷vKm t`Lvb †h, r e¨vmv‡ai ¶zvKvi †MvjK η mv›`Zv ¸Yvs‡Ki †Kvb gva¨‡gi ga¨ w`‡q v cwšÍK †e‡M co‡Z _vK‡j, gva¨‡gi mv›`ZvRwbZ Kvi‡Y D™¢Z evav`vbKvix ej F Gi ˆewkó¨ wb¤¡ict cwšÍK †eM v, eZ©x e¨vmva, r Ges gva¨‡gi mv›`Zv ¸YvsK, η–Gi Dci wbfikxj|

g‡b Kwi, $F = kv^a r^b \eta^c$ .... *(1)*

K GKwU a“eK

(1) bs mgxKi‡Yi gvÎv we‡ePbv K‡i wjLv hvq

$[MLT^{-2}] = k[LT^{-1}]^a [L]^b [ML^{-1}T^{-1}]^c$ .... (2) [∵ k gvÎvwenxb]

myZivs mgxKi‡Yi Dfq w`K Zzjbv K‡i -

M-Gi gvÎv n‡Z cvIqv hvq, c = 1 .... *(3)*

L Gi gvÎv n‡Z cvIqv hvq, a+b-c = 1 .... *(4)*

T-G gvÎv n‡Z cvIqv hvq, -a-c = -2 .... *(5)*

mgxKiY (3), (4) I (5) n‡Z cvB, a=1, b =1 Ges c=1

†÷vKm MwYZK fv‡e cgvY K‡ib †h,

$k = 6\pi$

mgxKiY (1)-G a,b,c Ges k Gi gvb ewm‡q cvB-

$F = 6\pi\eta rv$ .... *(10-10)*

G m¤úKwU †÷vK‡mi m¤ú‡K© bv‡g cwiwPZ|

D`vniY -1

1×10^{-3} m e¨vmv‡ai GKwU ¶z †MvjK GKwU Zi‡ji ga¨ w`‡q $2\times10^{-2}$m/s cvš †e‡M co‡Q| Zi‡ji mv›`Zv ¸YvsK 0.003 $kgm^{-1}s^{-1}$ GKK| mv›` ej wbYq Ki“b|

awi, mv›`ej =F

†÷vK‡mi m~Î †_‡K

$F = 6\pi\eta rv$

$= 6\times3.14\times0.003\times1\times10^{-3}\times2\times10^{-2}$

$= 113.04\times10^{-8}N$

$= 1.1304\times10^{-6}N$

GLv‡b,

$\eta = 0.003kg/m/s$

$v = 2\times10^{-2}m/s$

$r = 1\times10^{-3}m$

†÷vK‡mi mgxKiY

awi, GKwU †MvjvKvi cZbkxj e¯‘i Dcv`v‡bi NbZ ρ.

myZivs e¯‘wUi IRb = AvqZb × NbZ × AwfKl©R ZiY = $\frac{4}{3}\pi r^3\times\rho\times g$

Ges gva¨‡gi NbZ hw` σ nq, Z‡e

gva¨‡gi EaŸ©gy‡x প্লাবতা $=\frac{4}{3}\pi r^3\times\sigma\times g$

∴ e¯‘i Dci wb¤œgy‡x jwäej = $\frac{4}{3}\pi r^3\rho g-\frac{4}{3}\pi r^3\sigma g$

$= \frac{4}{3}\pi r^3(\rho-\sigma)g$

e¯‘wU cvš‡e‡M co‡Z _vK‡j,

Gi Dci mv›`ZvRwbZ DaŸ©gy‡x ej = wb¤œgy‡x jwäej ev KvhKix IRb

ev, $6\pi\eta rv = \frac{4}{3}\pi r^3(\rho-\sigma)g$

$\therefore v=\frac{2}{9}\times r^2\frac{(\rho-\sigma)g}{\eta}$

GwUB coš e¯‘i Rb¨ †÷vK‡mi mgxKiY

D`vniY-2

$2\times10^{-4}m$ e¨vmv‡ai GKwU mxmvi †MvjK গ্লিসারি‡bi g‡a¨ w`‡q co‡Q| mxmvi I গ্লিসারি‡bi NbZ h_vµ‡g $11.37\times10^3$ Ges $1.26\times10^3$ $kgm^{-3}$ n‡j †MvjKwUi cvš‡eM ewni Ki"b| (গ্লিসারি‡bi mv›`Zvi mnM = $0.54\ kgm^{-1}s^{-1}$)

g‡b Kwi,

cvš †eM = v

Avgiv cvB,

$\eta=\frac{2}{g}\frac{r^2(\rho-\sigma)g}{v}$

ev, $v=\frac{2}{g}\frac{r^2(\rho-\sigma)g}{\eta}$

$v=\frac{2(2\times10^{-4})^2\times(11.37-1.26)\times10^3\times9.8}{9\times0.54}$

$= 1.63\times10^{-3}\ m/s$

GLv‡b

$r = 2\times10^{-4}m$

$\eta = 0.54kgm^{-1}s^{-1}$

ρ= mxmvi NbZ

$= 11.37\times10^3\ kg/m^3$

σ গ্লিসারি‡bi NbZ

$= 1.26\times10^{-3}\ kg/m^3$

$g = 9.8\ m/s^2$

10.4.2: mvùZv ¸Yvs‡Ki Dci Zvcgv‡Îv I Pv‡ci cfve

(Effects of Temperature and pressure on the co-efficient of viscosity)

(1) Zvcgv‡Îvi cfve

(K) Zij c`v_

Zvcgv‡Îv ewY©× †c‡j Zij c`v‡_i mv›`Zv `"Z nvm cvq| D`vniY¯‹i¡c ejv hvq, 80°C Zvcgv‡Îvi cwigvbi mv›`Zv ¸YvsK 0°C Zvcgv‡Îvi cwigvbi mv›`Zv ¸Yvs‡Ki GK ZZxq¯‹vsk|

Zvcgv‡Îvi mv‡_ mv›`Zv ¸Yvs‡Ki m¤ú‡Ki mgxKiYwU n‡jv-

$$\log\eta = A + \frac{B}{T}$$

GLv‡b, η n‡jv mv›`Zv ¸YvsK, T †Kjwfb Zvcgv‡Îv Ges A I B a"eK|

mv›`Zvi AvYweK ZË

Zij hLb cewinZ n‡Z _v‡K, ZLb Gi wewfb ¯‹vi g‡a¨ GK cKvi evav`vbKvix e‡j‡i D™e nq hv Gi cev‡ni †eM Kwg‡q †`q| G ejB mv›`Zv| mvaviYZ AwfKl e‡j‡i cfv‡e Zij wb‡Pi w`‡K co‡Z _vK‡e| wKšzAvš:AvYweK e‡j‡i Kvi‡Y Zi‡j‡i g‡a¨ GK cKvi evav`vbKvix e‡j‡i mij nq| G ej Dc‡ii w`‡K wµqv K‡i| Zvcgv‡Îv ewY©× Kvi‡Y Zi‡j‡i Avš:AvYweK `‹iZ (r) ewY©× cvq G `‹iZ r GKwU wbw`ó gv‡bi ‡ewk n‡j, Avš:AvYweK ej K‡g (Abyôv`Q` 9.3.1)| AZGe Zvcgv‡Îv evovi mv‡_ mv›`ZvsK K‡g, mv›`Zv Kg‡j mv›`Zv ¸YvsKl K‡g (mgxKiY 10.8 `óe¨)|

(L) M¨vmxq c`v_

Zi‡j‡i Dci Zvcgv‡Îvi †h cfve M¨v‡mi Dci wVK Zvi wecixZ cfve †`Lv hvq| M¨v‡mi †¶‡Î Zvcgv‡Îv ewY©× †c‡j mv›`Zv ewY©× cvq| MwZ ZË (Kinetic theory) Abyôv‡i, M¨v‡mi mv›`Zv Gi AYyg‡ni Mo †e‡Mi mgvbycwZK| Avevi Mo ‡eM †Kjwfb Zvcgv‡Îvi eMg‡ji mgvbycwZK|

$\therefore \quad \eta \propto \sqrt{T}$

ev, $\quad \eta = C\sqrt{T}$

GLv‡b, η mv›`Zv ¸YvsK, T †Kjwfb Zvcgv‡Îv Ges C a"eK|

M¨v‡mi AYy‡jvi g‡a¨ Avš:AvYweK `‹iZ A‡bK †ewk| d‡j G‡`i g‡a¨ Avš:AvYweK ej AZ¨š`‹ej| ZvB M¨v‡mi AYy‡jv ¯‹vaxbfv‡e Nyiv †eovq Ges BZ¯‹Z wew¶ßfv‡e msN‡l wjß nq| Zvcgv‡Îv hLb †e‡o hvq M¨vm AYy‡jvi Mo‡eMl †e‡o hvq| d‡j msNll ev‡o| G msNl M¨vm ¯‹vi cev‡n ewa †`q| cev‡n evav`vKvix ejB mv›`Zv| ZvB, Zvcgv‡Îv evo‡j M¨v‡mi mv›`Zv ej Z_v mv›`Zv ¸YvsK ev‡o|

(2) Pv‡ci cfvet

(K) Zij c`v_

Pvc ewY©× †c‡j Zij c`v‡_i mv›`Zv Z_v mv›`Zv ¸YvsK ewY©× cvq|

(L) M¨vmxq c`v_

M¨v‡mi mv›`Zv ev mv›`Zv ¸YvsK Pv‡ci Dci wbfikxj bq|

mvi-ms‡¶c

Zvcgv‡Îv ewY©× †c‡j Zij c`v‡_i mv›`Zv `"Z nvm cvq|

Zvcgv‡Îv ewY©× †c‡j M¨vmxq c`v‡_i mv›`Zv ewY©× cvq|

Pvc ewY©× †c‡j Zij c`v‡_i mv›`Zv ewY©× cvq|

M¨v‡mi mv›`Zvi Dci Pv‡ci †Kvb cfve †bB|

c‡qvRbxq mgxKiY

†÷vK‡mi mÂ‡t $F = 6\pi\eta rv$

†÷vK‡mi mgxKib : $v = \frac{2}{9} \times \frac{r^2(\rho-\sigma)g}{\eta}$

c‡kvËi gj¨vqb:

K. mwVK DË‡ii cv‡k wUK wPý (√) w`b|

1. wb‡Pi †KvbwU †÷vK‡mi mÂ‡?

   K. $F = 6\pi\eta rv$ L. $F = \eta A\frac{dv}{dx}$

   M. $F = \frac{6\pi\eta}{rv}$ N. $F = 6\pi Ar^2$

2. Zvcgv‡Îv evo‡j Zij c`v‡_i mv›`Zv-
   K. ev‡o L. K‡g
   M. AcwievwZZ _v‡K N. †KvbwUB bq|
3. Zvcgv‡Îv evo‡j M¨vmxq c`v‡_i mv›`Zvi Dci wK cfve c‡o?
   K. ev‡o L. K‡g
   M. AcwievwZZ _v‡K N. kb¨ nq|
4. Pvc ewÂ× †c‡j Zij c`v‡_i mv›`Zvi Dci wK cfve c‡o?
   K. ev‡o L. K‡g
   M. AcwievwZZ _v‡K N. kb¨ nq|
5. Pvc ewÂ× †c‡j M¨vmxq c`v‡_i mv›`Zvi Dci wK cfve c‡o?
   K. ev‡o L. K‡g
   M. AcwievwZZ _v‡K N. †KvbwUB bq|

L. msw¶ß ck

1. Zij c`v‡_i mv›`ùZvi Dci Zvcgv‡Îvi cfve wjLyb|
2. M¨vmxq c`v‡_i mvaùZvi Dci Zvcgv‡Îvi cfve wjLyb|

iPbvgj¨K ck

1. cÂUvb Kv‡K e‡j? cÂUvb I cÂ kw³i g‡a¨ m¤úK© cb Ki“b|
2. AvYweK Z‡Ëi mvnv‡h¨ cÂUv‡bi e¨vL¨v w`b|
3. Zi‡ji cÂUvb wbY‡qi ˆKwkK bj c×wZ eYbv Ki“b|
4. cÂUv‡bi Dci cfveKvix welq¸‡jv e¨vL¨v Ki“b|
5. mv›`Zv ¸Yvs‡Ki MwYwZK mgxKiY cwZcv`b Ki“b|
6. †÷vK‡mi mÂwU cwZcv`b Ki“b|
7. †Kvb cevnxi ga¨ w`‡q cZbkxj ¶zvKvi †Mvj‡Ki cvš‡eM Gi iwkgvjv wbYq Ki“b|