

# APPOLO STUDY CENTRE

## ELECTRICITY TAMIL TEST - 8

6 <sup>th</sup> Utk(II)	myF - 2	kpdtpay;
7 <sup>th</sup> Utk(II)	myF - 2	kpdNdhil tpay;
8 <sup>th</sup> KO nj hFj p	myF - 5	kpdtpay;
9 <sup>th</sup> KO nj hFj p	myF - 4	kpdD}l l Kk; kpdNdhil l Kk;
10 <sup>th</sup> KO nj hFj p	myF - 4	kpdNdhil tpay;

6<sup>th</sup>mwptpay;  
nj hFj p- 2  
myF-11kpdtpay;

mwKfk;

ek; mdwhl thotiy; ehk; kpdruhuj j g; gadgLj j fNwhk; ekfF , kkpdrhuk;  
vqfUeJ fpi lffpwJ> mJ vtthW Nti y nrafpwnj d vdwhTJ  
tjaej pUf;fNwhkh? kpdruhuk; , yyhj xU ehi s ekkhy; fwgi d nraJ ghuf;f  
, aYkh? c d; jhj jhtpl k; tpdtpdhy; kpdruhuk; fz Lgtpf;fggl hj fhyfl;lj j j> el  
mwpeJ nfhssyhk; ek; KdNdhufs; ntsprj j wfhf , utiy; vz nz a;  
tjpf;fFi sg; gadgLj j pdhufs; NkYk; twF myyJ fupi a vupnghUshfg;  
gadgLj j p cz T ri kj j du; , dNwh! kpdruhuj j pd; c gNahfj j hy; ekJ  
Nti yfs; vyyhk; RygkhaUf;fpdwd. cyfNk ek; i fary; teJssJ.  
kpdruhuj j hy; , aqFk; kpdrhj dqfs; vi t? kpdruhuj j j j; j qf;spd; toNa fl j j k;  
nghUs;fs; vi t? kpdRwW vdwhy; vdd? kpd;fyd; kwWk; kpd;fy mLf;F vdwhy;  
vdd? thUqfs; , gghl j j pDs; kpdruhuk; gwmp tpu thff; fhz Nghk;

kpd; %yqfs;

nry;tDk> nry;tAk; , uli laufs; mtufs; Mwhk; tFgG gay;fpdwdu;  
Nfhi l tPLKi wi af; fop;f> j qfs; jhj jhtpd; fuhkj j fFr; nrdwdu; mqf  
mtuf;spd; jhj jh khi y MW kz pfF kpd;tj;sfF Nghl;hu; mi j  
ftdij jfnfhz bUej nry;tD; j dJ jhj jhtpl k; kpdnghj j i d mOj j paTl d;  
vtthW kpd;tj;sfF xsp;f;pwJ vdfNfl;hd; jhj jh mti d mUfpYss kpd;thupa  
mYtyfj j fF mi oj j r; nrdwhu; mqf ei lngww ci uahli yf; fNo  
fhz Nghk;

nry;tD; : l ah> vtthW ehk; kpd; nghj j hi d mOj j kNghJ kpd;tj;sfF  
xsp;f;pwJ?

nghw;ahsu; kpdruhuk; j hd; fhuz k;

nry;t d; : ekf;F kpd;rhuk; vq;f;Ue;J fpi l f;f;wJ.

nghw;ahsu : ehk; mdyk;pd;epi yak> el;k;pd;epi yak> fl;yi y> fhwwhi y kwWk;  
#upaxsp Nghdwtw;w;yp;Ue;J k; kpd;rhuk; c w;g; j p nra;f;Nwhk;

nry;t d; : , eepi yaq;fs; v;yyh , l q;f;sp;Yk; c ssdth> l ah?

nghw;ahsu : , yi y. , l j j ;pd; j di ki ag; nghWj Nj ehk; k;pd;epi yaq;fi s  
mi kf;f;Nwhk; vLj ;J f;f;h l ;hf> j k;pf; j j ;pd; neaNty;pa;ry; mj ;f; msT gOgG  
ep;f;f;up fpi l ggj hy; mq;F mdy; k;pd;epi yak; c Uthf;f;gg l ;ssJ.

nry;t d; Mk; ehd; j ;UneyNty;f;F mUf;ry; fhwwhi yfi sg; ghuj j ;Uf;f;Nwd;  
Vndd;ry; mq;F ki yggFj ;pa;ry; fhww nj hl ue;J tRk; j q;f;sp; Nkyhd j ftYf;F  
edw; l ah!

j h j j h : (tll bw;Fr; nry;Yk; topa;ry) , k%yq;f;sp;Ue;J kl ;Lk; hd; kpd;rhuk;  
fpi l f;f;wJ vd ep; epi d;f;f;whah?

nry;t d; : (tll by; Ei oAkng;hOJ Rtuf;fbfhuj i j g; ghuj ;J) j h j j h!  
mf;fbfhuj i j g; ghUq;fs; mJ vt;thW , aq;Ff;wJ?

j h j j h :Mk> mJ , aq;Ftj w;F k;pd;dhwwy; Nj i tggL;f;wJ. Nkw;Fwggpl ;  
%yq;fi sj j t;w> ehk; k;pd;dhwwi y k;pd;f;yd;fs; kwWk; k;pd;f; mLf;Ffs;YUe;J k;  
ngWf;Nwhk;

nry;t d; Mk; j h j j h> ehd; , dW nj up;e;J nfhz ;l twi w nry;t;pa;l k; t;thj ;f;f;g;  
Nghf;Nwd;

kpd;rhuj i j c Uthf;Fk; %yq;fs; k;pd; %yq;fs; vdggLk; gyti fahd k;pd;  
%yq;f;sp;Ue;J kpd;rhuk; ngwggL;f;wJ.

j k;pf; j j ;pd; Kf;f;pa k;pd; epi yaq;fs;

mdyk;pd; epi yaq;fs; (fl Y);u; khtl ;l j j ;ry; neaNty; j ;Uts;@u;  
khtl ;l j j ;ry; vz ;Z u> el;k;pd; epi yaq;fs; (Nryk; khtl ;l j j ;ry; Nkl ;^u> j ;UneyNty;pa;  
khtl ;l j j ;ry; ghgehrk)> mZ k;pd;epi yaq;fs; (fhQ;Guk; khtl ;l j j ;ry; fyghf;fk>  
j ;UneyNty;pa; khtl ;l j j ;ry; \$l q;Fsk)> fhwwhi yfs; (fdd;ahFkup khtl ;l j j ;ry;  
Muy;thankop kwWk; j ;UneyNty;pa; khtl ;l j j ;ry; faj j hW). , twi wj ; j t;w;g;  
gyNtW , l q;f;sp; mi kf;f;gg l ;ss #upaxsj ; j fLfs; %yKk; gutyh;f kpd;rhuk;  
ngwggL;f;wJ.

k;pd; c w;g; j p epi yaq;fs; vt;thW k;pd; c w;g; j p nra;f;pdwd? vdr;  
RUf;f;khff; fhz Nghk;

1. mdyk;pd; ei yaq;fs;

mdyk;pd; epi yaq;f;sp;ry; ep;f;f;up Bry; myyJ thAffi s v;ugg; d; %yK;  
fpi l f;Fk; ntgg Mwwyhy; el;ht; c Uthf;f;ggL;f;wJ. , ej el;ht;pa;hy; l ui gd;  
, aq;Ff;wJ. l ui gd; , aq;Fk; nghOJ , U k;pd;f;hej q;f;S f;F , i l a;ry;  
i t;f;f;gg l ;ss fkg;Rus; Roy;t; j hy; c Uthf;Fk; k;pd;f;hej j ; J ;z ;l yhy; kpd;rhuk;  
c Uthf;f;ggL;f;wJ. , q;F ntgg MwwyhdJ k;pd;dhwwy;hf khwwggL;f;wJ.

2. el;k;pd; epi yaq;fs;

el;k;pd; epi yaq;f;sp;ry; mi z f; fl by;Ue;J ghAk; el;hy; l ui gd; Rowgg l ;L  
kpd;rhuk; c Uthf;f;ggL;f;wJ. , q;F , aff; Mwwy; k;pd;dhwwy;hf khwwggL;f;wJ.  
el;k;pd; epi yaq;fs; mj ;f; fhyk; , aq;f;f;#bai t kwWk; r;f;f;dkhdi t.

### 3. mZ kpd; epi yaqfs;

mZ kpd; epi yaqfs; mZ fFU Mwwi yfnfhz L elhdJ nfhj pff; i tffggLfWJ. , j dhy; c UthFk; elhtpi af; nfhz L lui gd; , affggLfWJ. lui gd; , affjjhy; kpdrhuk; c Uthf;fggLfWJ. , qF mZ fFU MwwyhdJ , aff MwwyhFTk; gpd; kpd;dhwwyhFTk; khwwggLfWJ.

### 4. fhwwhi y epi yaqfs;

fhwwhi yfs; fhwwpd; Mwwyhy; lui gd; RowggLfWJ. , j d%yk; kpdrhuk; c UthfWJ. , qF , aff Mwwy; kpd;dhwwyhFTk; khwwggLfWJ.

#### kpd;fyd;

kpd;fyd; vdgJ Ntj;ahwwi y kpd;dhwwyhFTk; kwWk; xU fUt;ahFk; Neu; kwWk; vj;ukpd; mad;fi sj; juf;\$ba Ntj;ff;ury; kpd;Fsp;ahf vLj;Jf; nfhssggLfWJ. mj;py; , U NtWgl; c Nyhfj; j fLfs; kpd;Ki d;fshfg; nghUj;j ggl L kpd;fyd; c Uthf;fggLfWJ. Ntj;tpi d;fs; %yk; xU kpd; Ki d; Neu;kpd;thahFTk; kww kpd; Ki d; vj;u; kpd;thahFTk; nraygl L kpd;rhuj;j;j; j UfWJ.

nj hl ue;J kpd;Ndhl;l;j;j toq;Fti;j; nghWj;J kpd;fyd;fs; Kj di k kpd;fyd;fs; kwWk; Ji z kpd;fyd;fs; vd , U ti fggLk;

#### Kj di k kpd;fyd;fs;

, tti f kpd;fyd;fi s klz Lk; kpd;Ndwwk; nraa , ayhJ. vdNt> , twi w xU Ki w kl;LNk gadgLj;j , aYk; nghJ thf Kj di k kpd;fyd;fs; rwp; c Ut msTfs; kl;LNk j ahup;fggLf;pd;wd.

v.fh: Rtuf; fb;fhuk; i ff; fb;fhuk; kwWk; NuhNgh nghki kfs; Mf;patw;py; gadgLj;j ggLk; kpd;fyd;fs;

#### Ji z kpd;fyd;fs;

Ji z kpd;fyd; vdgJ gyKi w kpd;Ndwwk; nra;J nj hl ue;J gadgLj;j f;\$baJ. xUKi w gadgLj;j;pa gpd;G> klz Lk; klz Lk; kpd;Ndwwk; nra;aggl L nj hl ue;J kpd;Ndhl;l;k; c Uthf;fggLfWJ. Ji z kpd;fyd;fs;pd; c Utst mj;d; gadgh;l;lg; nghWj;J rwp;ahf myyJ ngur;ahf , Uf;Fk; i fNgr;py; gadgLj;j ggLk; Ji z kpd;fyd;pd; msT c ssqi sast rwp;ahfFTk; fd;uf thfdq;fshd kf;pe;J kwWk; NgUe;J Nghdwtw;py; gadgLj;j ggLk; Ji z kpd;fyd;fs; ngur;ahfFTk; fd;khdi tahfFTk; , Uf;Fk;

v.fh: i fNgr;fs; kb;f;fz;pd;fs; mtru fhy tps;f;Ffs; kwWk; thfdq;fs; Mf;patw;py; gadgLj;j ggLk; kpd;fyd;fs;

#### kpd;fy mLf;F

, uz L myyJ mj;wF Nkwgl;l kpd;fyd;fi s , i z j;J> kpd;fy mLf;F c Uthf;fggLfWJ kpd;fy mLf;F vdgJ gy kpd;fyd;fs;pd; nj hFgg;hFk;

#### kpd;RwWfs;

j hj;jh nry;t;pa;l;k; l;hur; tps;f;F vLj;J tur; nrhy;f;w;hu; l;hur; tps;f;F vLj;J tUKnghOJ fNot;Oe;J kpd;fyd;fs; nts;Na te;J t;pl;d. kpd;fyd;fi s csNs i t;j;J , aff;f;Ak; l;hur; tps;f;F xs;ut;py; y.

l hur; tpsfF gOj i l eJ t p l j h f f; fUj p nry; t p m o j; n j h l q f p d h s; m q f  
t e j m t s J k h k h > k p d; f y d; f i s r u p a h f g; n g h U j j p l h u r; t p s f i f x s p u r;  
n r a j h u;

n r y; t p a p d; K f K k; x s p u e j J. k h k h f h u z j i j f; \$ w p k p d; R w W f s; F w j j  
m t S f f t p s f; f p d h u;

k p d; R w W v d g J k p d; f y j j p d; N e u; K i d a r y p U e; J v j p u; K i d f f k p d; D } l i k;  
n r y; Y k; n j h l u r; r p a h d % b a g h i j a h F k;

k p d; R w W v d g J n g h J t h f g; g p d; t U t d t w w h y; c U t h f; f g g L k;

m) k p d; f y d; (m) k p d; f y m L f F - k p d; N d h l i j i j j; j U k; % y k;

M) , i z g G f; f k g r f s; - k p d; N d h l i j i j v L j J r; n r y.

M) k p d; t p s f F - N g h d w k p d; d h w w i y g; g a d g L j J k; m i k g G >

<) r h t p - k p d; N d h l i j i j j; N j i t a h d N g h J n r Y j j N t h > e p W j j N t h g a d g L k;  
m i k g G. , J k p d; R w W p d; v g g F j p a Y k; , i z f f g g l y h k;

m. j p u e j k p d; R w W

x U k p d; R w W p y; r h t p a h d J j p u e j e p i y a r y; (O F F) , U e j h y; m e j k p d;  
R w W p y; k p d; N d h l i k; n r y y h J. m j j i f a k p d; R w W j p u e j k p d; R w W v d g g L k;  
, j j y; k p d; t p s f F x s p u h J.

M. % b a k p d; R w W

x U k p d; R w W p y; r h t p a h d J % b a (O N) e p i y a r y; , U g g p d; m e j r; R w W p y;  
k p d; N d h l i k; g h A k; v d N t k p d; t p s f F x s p U k; , J % b a k p d; R w W v d g g L k;  
c d f f f; f p i l f f k; v s p a n g h U s; f i s f; n f h z l c d d h y; x U r h t p i a (s w i t c h)  
c U t h f; f K a w r p n r a;

k p d; R w W p d; t i f f s;

1. v s p a k p d; R w W
2. n j h l u p i z g G
3. g f; f , i z g G

1. v s p a k p d; R w W

x U r h t p x U k p d; f y d; k w W k; , i z g G f; f k g p n f h z l c U t h f; f g g L k;  
k p d; R w W v s p a k p d; R w W v d g g L k;

2. n j h l u , i z g G k p d; R w W

x d W f F N k w g l i k p d; t p s f; F f s; n j h l u h f , U f; F k h W r h t p k p d; f y d;  
k w W k; , i z g G f; f k g r f s; % y k; , i z f f g g L k; k p d; R w W n j h l u; , i z g G k p d; R w W  
v d g g L k; , e j k p d; R w W p y; V N j D k; x U k p d; t p s f F g O j i l e j h Y k; k p d; R w W  
n j h l u p y; c s s m i d j J t p s f; F f s k; m i z e J t p L k;

3. g f; f , i z g G k p d; R w W

x d W f F N k w g l i k p d; t p s f; F f s; , i z a h f , U f; F k h W r h t p f s > k p d; f y d;  
k w W k; , i z g G f k g r f s; n f h z l c U t h f; f g g L t J g f; f , i z g G k p d; R w W  
v d g g L k; , e j k p d; R w W p y; V N j D k; x U k p d; t p s f F g O j i l e j h Y k > m e j

, i z ggpy; kww tpsfFs; vupAk; vdNt> tLfsy; gff , i z gG Ki wNa  
gpdgwwggLfjwJ.

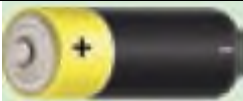
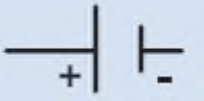



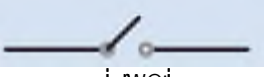

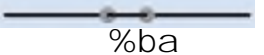

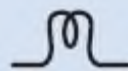


<y; vdDk; xU ti f kbd; kpdrhuj; j c UthfFk; j pvd; nfhz j J. , i t  
kpd;dj pui t ntspapl L vj pufspl kplUeJ j qfi sf; fhj j f; nfhssTk> j qfsJ  
c z i tg; gpbffTk; nrafpdwd.


mkkl i u; vdgJ xU kpdRwwpy; ghAk; kpdNdhil j j pd; msi t mstplk;  
fUtjahFk; , f;fUtjahdJ Rwwpy; nj hl upi z ggpy; , i z f;fggl Ntz Lk;

kpd; nghUl fspd; FwpaLfspd; gl bay;

kpdRwWfsy; ehk; kpd; rhj dqfspd; gl qfi sf; Fwggpl Nilhk; kpfngupa  
kpdRwWfisi g; gl qfshy; FwggplLtJ fbdk; vdNt> mtwi wf; FwpaLfshy;  
FwggplLfjNwhk;

kpdnghUsfspd; FwpaLfspdhy> kpf; ngupa kpdRwWfisi sAk; kpf vsj hf  
ekky; Gupe;Jnfhss KbfwJ.

t. VZ ;	kpdrhj dk;	gl k;	FwpaL	Fwgg
1	kpd;fyd;	 kpd;fyd;		ngupa nrq;Fj j f; NfhL Neu; Ki dahfTk> rpwpa nrq;Fj j fNfhL vj pu; Ki dahfTk; Fwggpl ggLfjpdwd.
2	nj hl u; kpd;fyd; (kpd;fy mLf;F)	 kpd;fy mLf;F		, uz i myyJ mj wF Nkwgl i kpd;fyd;fs; nj hl uhf , i z f;fggl i mi kgG
3	nj hL rhtp j pwej J		 j pwej	nj hLrhtp nraygl h epi y (OFF) (Rwwpy; kpdNdhil i k; nrtyhJ)
4	nj hL rhtp %baJ		 %ba	nj hL rhtp nraygLk; epi y (ON) (RwWk; kpdNdhil i k; ghAk)
5	kpd; tpsf;F			kpd; tpsf;F xsputi yi y
				kpd; tpsf;F xsp;fjwJ.

6	, i z gGf; fkgp			kpd; rhj dq;fi s , i z ffg; gadgLk;
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kpd;fl j j pfs; kwWk; mujj pw; fl j j pfs;

kpd;rhuk; mi dj ;Jg; nghUl ;fspd; to;NaAk; ghAk?

kpd;rhuf;fkgp; a ntl;b gupj ;Jg; ghuf;Fk; nghOJ> c sNs c Nyhfj j hy; Md fkgpAk; mj d; NkygFj pary; NtW xU nghUshy; Md ci wAk; , Uggi j f; fhz yhk; Vd; , t;thW c Uthf;fggl ;LSSJ vd mwpthah?

kpd; fl j j pfs;

fl j j pary; kpd;D}l;l qfs; ghAk; t;Nk kpd;Ndhl;l k; vdggLk; mt;thW venj ej nghUsfs; j d; to;Na kpd;D}l;l qfi sr; nryy mDKj p;f;pdwdNth mtwi w ehk; kpd; fl j j pfs; vd;f;Nwhk;

v.fh. c Nyhfq;fshd j hkpk> , UkG> mYkpd;pak> kwWk; khRgl;l el;> Gtp Nghdwi t.

mujj pw; fl j j pfs; (kpd; fl j j hg; nghUs;fs)

venj ej g; nghUs;fs; j d; to;Na kpd;D}l;l qfi sr; nryy mDKj p;f;ft;py; yNah mtwi w ehk; mujj pw;fl j j pfs; (m) kpd;fl j j hg; nghUs;fs; vd;f;Nwhk;

v.fh : g;sh] bf> fz z hb> kuk> ugg> gb;fhd> vNghi dl; Nghdwi t.

xUtUf;F kpd; mj p;rr; Vwgl;l hy; (Electric shock) mti uf; fhgghww nraa Ntz bai t

I. kpd;mj p;T Vwgl;l f; fhuz khd kpd , i z gi g mi z f;fTk;

II. rht;pary;Ue;J , i z gi gj ; Jz b;f;fTk;

III. kpd;fl j j hg; nghUl ;fi sf; nfhz ;L mti u kpd;fkgp;pd; nj hl ug;py;Ue;J j s;STk;

IV. mtUf;F Kj Yj t; p j e;J> mUf;Yss kUj ;Jtki d;f;f mi oj ;Jr; nryyTk;

j hk] ; Myth vbrd; (g;gutup 11> 1847 Kj y; mfNI hgu; 18> 1931) Xu; mnkup;f;f fz ;Lg;bgghsu;

, tu; 1000 f;Fk; Nkwgl;l c gNahfkhd nghUl ;fi s c Uthf;f;Asshu; mtw;py; gy t;Lfs;py; gadg;Lj j f; \$bai t. kpd; t;ps;fi ff; fz ;Lg;bj j j wfhf ehk; vd;Wk; mti ug; Nghw;Wf;Nwhk;

7<sup>th</sup>, awgjay;  
nj hFj p- 2  
myF- 2 kpdNdhil j tpay;

mwpKfk;

1882-Mk; Mz L epAahuf; efuj j py; #upad; Nkwfpy; ki wAk; Nti saiy; mej  
mj pra epfo;T ei lngwwJ> 9000 tLfsy; 14000 kpd;tpsfffsd; rhtpi a jhk];  
Myth vbrd; jweij Uz k; mi dj j tpsfffsk; vupaj; nj hl qfjd> , J kdij  
, dj j pwF Xu; kpfj; ngupa fz LgpbogghFk> mdwpyUeJ , uT Neu j j pyk; c yfNk  
ntsrrj j pwF tej J.

meepfo;TpwFggjd; gy ehLfs; epAahuffwF mLjjgbahf kpdruhij j tll  
c gNahfj j pwF gadgLj j Mukgij j d> Kj d; Kj yhf 1899-Mk; Mz L , ej pahiy;  
kpdruhuk; gadghl bwF tej J> 1899-Mk; Mz L Vguy; 17-k; ehs; Kj d; mdy; kpd;  
epi yajij j fyfj j h kpd; tpeNahf fofk; Nj hwWtj j J.

1900 Mk; Mz L nr di dary; Ngrpd; ghyj j py; mdy; kpd; epi yak;  
c Uthffggil j j> NkYk> muR mrrfk; nghJ kUj Jtki d> kpd; j z ^uj ggghij  
kwWk; nr di dard; Fwggil j FbaUgGg; gFj pfsYk; kpd; tpeNahfk;  
nraaggil j j> , dW kpdruhkdJ tLfs fF mtrpkhd xdwHfK;

c dJ Mwuk; tFggj y; kpdruhij j j; gwwAk; kpd; %yqfs; gwwAk;  
gbj j jUggLfs> nj homrhi yfs; , aqfTk; kUj Jtr; rhj dkhd nr awi f c apugG  
mi kgGfsYk> jfty; nj hl uG rhj dkhd i fNgrp thndhy kwWk;  
nj hi yffhl rj; ngl bfsYk; Ntshz ; epyqfsy; , UeJ et; , i wffTk> tLfi s  
xspAil j Tk; kpdruhuk; KffpkhdjhFk; kpdruhuk; vdwwhy; vdd? mi jggwwp  
, gNghJ ghugNghk> ntgg Mwwy; kwWk; fhej Mwwy; Nghy; kpdruKk; Xu;  
ti fahd MwwyhFk;

mi dj j j; gUgnghUsfSk; rmpa Jfsfshd mZ ffshy; Mffggil LssJ  
vd mwpej jUgNghk> mZ tpd; i kaggFj pahdJ c l fU vd mi offggLfwJ>  
c l fUthdJ GNuhl j hdfs; kwWk; epAil uhd fi s c s s l f f p a j> GNuhl j hdfs; Neu;  
kpdRi k nfhz j i t> epAil uhd fs; kpdRi kawwi t.

c l fUi tr; Rwwp vj ukpdRi k nfhz j vyf l uhd fs; t l j g; ghi j ay; Rwwp  
tUfj dwd> mZ t p D s ; c s s k p d j l j q f S l d ; nj hl uGi l a Mwwy p d ; Xu;  
ti fNa kpdruhkhFk;

kpd;D}l j k; \$Y}k; vdw myfj dhy; mstpl ggLfwJ> XuyF \$Y}k; vdgJ  
Nj huhakhf 6.242<sup>10<sup>18</sup></sup> GNuhl j hdfs; myyJ vyf l uhd f S f f rkk;

kpd;D}l j k> nghJ thf “q” vdw vOj j hy; Fwfffggk;

**kpdNdhil j k;**

kpd;D}l j qfspd; Xl j Nk kpdNdhil j k; vdgglk> kpdrhj dqfs; , aqf  
Ntz Lk; vdpy> mrrhj dqfs; tonNa kpdNdhil j k; gha Ntz Lk> xU Rwwpy; ghAk;  
kpdNdhil j khdJ xU tpdhb Neu j j py; fl j j p a p d ; VNj Dk; Xu; Gssp tonNa nry;Yk;  
kpd;D}l j j j p d ; ms thy; mstpl ggLfwJ> kpdNdhil j j j p d ; FwpaL '(I) MFk;

**kpdNdhil j j j p d ; myF**

kpdNdhl; j j pd; S.I. myF Mkgpau; MFk; fl j j p apd; VNj Dk; Xu; FWF;F ntl;Lg; guggpy> xU t pdhb Neu j j py; xU \$Y}k; kpd;D}l; k; ghaej hy> mff;fl j j p apy; ghAk; kpdNdhl; k; xU Mkgpau; vdgglk;

$$I = q / t$$

, q;F  
I – kpdNdhl; k; (Mkgpau; - A)  
q–kpd;D}l; k; (\$Y}k;f;sf;py; - C)  
t–vLj;Jf; nfhz; l; fhyk; (t;pehbf;sf;py; - S)

**j hf;fggl; fz f;F**

xU fkgp apd; topNa 30 \$Y}k; kpd;D}l; khdJ 2 epkpl j j p wF ghaej hy; fl j j p topNa nry;Yk; kpdNdhl; j j pd; msT ahJ?

**j e;T:**

kpd;D}l; k; q = 30 \$Y}k;  
Neuk; t = 2 epkpl k; ' 60 t;pehbf;sf;  
= 120 t;pehbf;sf;  
kpdNdhl; k; I = q/t = 30C/120s = 0.25 A

**kuG kpdNdhl; k; kwWk; vyfl uhd;f;sf;pd; XI; k;**

vyfl uhd;f;sf;pd; fz Lg;rbggpwF Kddu> efUk; Neu; kpd;D}l; q;fNs kpdNdhl; j j p wF fhuz k; vd mw;tp;ap; mw;Qu;f;sf; ekg;pd;u>

Neu; kpd;D}l; q;f;sf;pd; , ej , af;fk; kuG kpdNdhl; k; vdW mi of;fggl;f;pwJ.

vyfl uhd;f;sf;pd; fz Lg;rbffgggl; gwF> vyfl uhd;f;sf;pd; XI; k; c z j k apy; kpd;f; y j j pd; vj;u; Ki d apy; , Ue;J Neu; Ki d ti u ei l ngWf;pwJ vd mw;paggl;J. , t;tp;af;fk; vyfl uhd; XI; k; vdW mi of;fggl;f;pwJ.

kuG kpdNdhl; k; vyfl uhd;f;sf;pd; XI; j j p wF vj;u; j pi rapy; mi kAk;

**kpdNdhl; j j j msT;Lj y;**

kpdNdhl; khdJ mkkil; l; u; vdW fUt;pahy; msT;pl ggLf;pwJ. mkkil; l; upd; Ki d;sf; ' + ' kwWk; ' - ' Fw;pa;ll; l; hy; Fw;pf;fggl; bUf;Fk; xU Rww;py; mkkil; l; uhdJ nj hl u; , i z ggpy; kl;Lk; , i z ff;fggl; Ntz; Lk;

kpyyp Mkgpau; myyJ i kfNuh Mkgpau; tukgpy> kpdNdhl; q;f; i s msT;pl gadg;Lk; fUt;pf;sf; kpyyp mkkil; l; u; myyJ i kfNuh mkkil; l; u;f;shf Fw;pggl; ggLf;pd;wd.

1 kpyyp Mkgpau; (mA) = 10<sup>-3</sup> Mkgpau; mj htJ 1/1000 Mkgpau; MFk;  
1 i kfNuh Mkgpau; (µA) = 10<sup>-6</sup> Mkgpau; mj htJ 1/1000000 Mkgpau; MFk;

**j hf;fggl; fz f;F;f;sf;**

Xu; Rww;pd; topNa 0.002A kpdNdhl; k; gha;f;pwJ vd;py> mrRww;py; ghAk; kpdNdhl; j j j i kfNuh Mkgpau;py; \$Wf?





vdw f<sub>p</sub>Nuff vOj j hy; FwpggpL ggLf<sub>p</sub>WJ. k<sub>p</sub>dfl j ;Jj j p<sub>w</sub>d<sub>p</sub>; myF r<sub>h</sub>kd;] ; / kl i u; (s/m)MFk;

**k<sub>p</sub>dj i l vz ; (r)**

nghUs; xdWj d; to<sub>p</sub>Na k<sub>p</sub>dNdhllk; ghatij vttsT tyi kahf vj p<sub>r</sub>f<sub>F</sub>k; vd mstplLf; \$Wk; nghUs<sub>p</sub>d; mbggi l gz Ng mgngghUs<sub>p</sub>d; k<sub>p</sub>dj i l vz ; r (Nuh) vdggLk; k<sub>p</sub>dj i l vz i z j d; k<sub>p</sub>dj i l vdd vz ; vdTk; FwpggpLtu> k<sub>p</sub>dj i l vz z p<sub>d</sub>; Sl myF.

Xk; - kl i u (Ω.m) MFk;

nghUlf<sub>s</sub>p<sub>d</sub>; k<sub>p</sub>dfl j ;Jj j p<sub>w</sub>d; kwWk; k<sub>p</sub>dj i l vz f<sub>s</sub>p<sub>d</sub>; kj p<sub>g</sub>G

nghUs <sub>f</sub> s;	k <sub>p</sub> dj i l vz ; r (Ω.m) 20°C , y;	k <sub>p</sub> dfl j ;Jj j p <sub>w</sub> d; σ(S/m)20°C , y;
ntssp	1.59 × 10 <sup>-8</sup>	6.30 × 10 <sup>7</sup>
j hkpuk;	1.68 × 10 <sup>-8</sup>	5.98 × 10 <sup>7</sup>
Jz i hf;fggl i j hkpuk;	1.72 × 10 <sup>-8</sup>	5.80 × 10 <sup>7</sup>
mYk <sub>p</sub> d <sub>p</sub> ak;	2.82 × 10 <sup>-8</sup>	3.5 × 10 <sup>7</sup>

**k<sub>p</sub>dNdhll j j p<sub>w</sub>Fk; eNuhl i j j p<sub>w</sub>Fkhd xgGi k**

j hkp<sub>r</sub>f; fkgp Nghdw Xu; fljjap<sub>d</sub>; to<sub>p</sub>Na ghAk; vyfluhdf<sub>s</sub>p<sub>d</sub>; XI i Nk k<sub>p</sub>dNdhllk; MFk; ekkhy; vyfluhd<sub>s</sub>p<sub>d</sub>; XI i j j f z l z u KbahJ > Mdhy; xU fkgp<sub>p</sub>d; to<sub>p</sub>Na ghAk; k<sub>p</sub>dNdhll j j j xU Fohap<sub>d</sub>; to<sub>p</sub>Na ghAk; eNuhl i j j j gNghy; ekkhy; fwgid nraJ ghff; , aYk;

k<sub>p</sub>dNdhllk; ghatjwFk; eNuhl i j j p<sub>w</sub>Fkhd xgGi ki a , gNghJ ehk; ghugNghk;

Foha; to<sub>p</sub>Na el; ghAk; Xu; , aeju mi kgghdJ k<sub>p</sub>dNdhllk; ghAk; tjjj p<sub>w</sub>Fk; xgghFk > el; gharRk; , aeju mi kgghdJ Xu; %ba Fohap<sub>d</sub>; to<sub>p</sub>Na el u ntsNawWk; gkg; xdi w csslffp , UfFk > Xu; Fohap<sub>d</sub>; to<sub>p</sub>Na ghAk; eNuhl i j j j d k<sub>p</sub>dNdhll j j p<sub>w</sub>F xgghf fwgid nraJ nfhz i hy; , ej , uz l mi kgGfs<sub>p</sub>Yk; fbffz i gFj pfs; xgghFk;

- FohahdJ k<sub>p</sub>dRw<sub>w</sub>p<sub>y</sub>; css fkgp NghYk; gkg; MdJ k<sub>p</sub>d<sub>r</sub>fyk; NghYk; nraygLf<sub>p</sub>WJ > gkgp<sub>r</sub>dhy; cUthffggLk; mOj j k; MdJ Foha; to<sub>p</sub>Na el u , aqfr; nra<sub>f</sub>p<sub>w</sub>J > Fohap<sub>y</sub>; cUthFk; mOj j khdJ Rww<sub>p</sub>d; to<sub>p</sub>Na vyfluhdfi s , aqfr; nraAk; k<sub>p</sub>d; mOj j j j p<sub>w</sub>F xgghFk;
- FohapDs; J}R kwWk; JUKGfs; gbej pUej hy > mi t eNuhl i j j j j i l nra; tNj hL klLkyyhky; Fohap<sub>d</sub>; xU Ki dffFk; kwnwhU Ki dffFk; , i l Na mOj j NtWghl i l VwgLj Jk > mNj Nghy; k<sub>p</sub>dRw<sub>w</sub>p<sub>y</sub>; mi kffggLk; k<sub>p</sub>dj i lahdJ > k<sub>p</sub>dNdhllk; ghatij j LggNj hL myyhky; xU Ki dffFk; kwnwhU Ki dffFk; , i l Na k<sub>p</sub>dOj j Fi wi t VwgLj Jk > , j dhy; k<sub>p</sub>dj i lap<sub>d</sub>; Fwfnf Mwwy; , ogG Vwgl > mJ ntggkhf nts<sub>p</sub>ggLk;

**k<sub>p</sub>dNdhll qfi s cUthfFk; %yqfs; - k<sub>p</sub>d; Ntj pffyd<sub>f</sub>s; myyJ k<sub>p</sub>d<sub>r</sub>fyd<sub>f</sub>s;**

k<sub>p</sub>d; Ntj pffyNdhL klLkyyhky; mj p<sub>r</sub>f mst k<sub>p</sub>d; gadghl bwF ntgg k<sub>p</sub>d<sub>r</sub>fyd<sub>f</sub>i sAk; ehk; gadglj j f<sub>p</sub>nwhk > , i t , U Ki dfi sg; ngwwpUfFk;

kpd,fydfS; gadgLj j ggLk; NghJ kpd,fydfS; gadgLj j ggLk; NghJ  
kpd,fydfS;D; kpd;D; } l j j c Uthf,ff;\$ba Ntj ptpi d ei l ngWf;wJ.

kpd,rhuj j j NeubahfNth myyJ vsj hfNth ngw Kbahj kpd;  
rhj dqfS fF> kpd,rhuj j j ms;ff;tyy rhj dNk kpd,fydhFk;

**kpd,fydfS;D; ti ffs; - Kj di k kpd,fydfS; kwWk; Ji z kpd,fydfS;**

ek; mdwhl thot;py; nj hi y, aff; NuhNgh nghki kfs> nghki k fhufs>  
fbfhuk> kwWk; i fNgr; Mf;at;w;w;pd; nrayghl bw;fhf kpd,fydfS; kwWk;  
kpd,fymLf; f gadgLj j fNwhk; vyyh rhj dqfS k; kpd,dhwwi y  
c Uthf,ff;dhYk> rpy kpd,fydfS; kl;LNk k;Lk; gadgLj j f;\$bai t> mtw;w;py;  
rpy xwi w gadghL cilait MFk; c dfF mj w;fhd fhuz k; nj upAk;h?  
gadghl bd; mbggi l a;py; kpd,fyq;fi s> Kj di k kpd,fydf; kwWk; Ji z kpd,fydf;  
vd , U ti fggLj j yhk;

**Kj di k kpd,fydf;**

l hu; t;ps;ff;py; gadgLk; c yu; kpd,fydf; Kj di k kpd,fydf;w;F Xu; r;w;ej  
vLj j f;fh;l L MFk> , t;w;w;pd; gadghl bw;F g;w;F , twi w k;Lk; kpd;Ndwwk;  
nraa , ayhJ.

**Ji z kpd,fydfS;**

Ji z kpd,fydfS; Nkhl j hu; thfdq;fs; kwWk; kpd;d;w;w;f;S;py;  
gadgLj j ggL;f;pd;w;d. mtw;w;py; c UthFk; Ntj ptpi dahdJ Xu; k;S;tpi dahi fahy;  
mi t;fi s k;Lk; kpd;Ndwwk; nraa , aYk; yj j ;ak; c Ui s kpd,fydfS;>  
nghj j h;df;S; kpd,fydfS; (button cells) fhu mk;py;kpd,fydfS; Mf;ad gadghl by;  
css kw w ti fahd kpd,fydfS; MFk;

**Kj di k kpd,fydfS fFk; Ji z kpd,fydfS fFkhd NtWghL**

Kj di k kpd,fydf;	Ji z kpd,fydf;
1. Kj di k kpd,fydf;w;F; ei l ngWk; Ntj ptpi dahdJ Xu; k;S;tpi dahFk;	1. Ji z kpd,fydf;w;F; ei l ngWk; Ntj ptpi d Xu; k;S;tpi dahFk;
2. , i t;fi s k;Lk; kpd;Ndwwk; nraa , ayhJ.	2. , i t;fi s k;Lk; kpd;Ndwwk; nraa , aYk;
3. r;w;pa Ni gur;fhul u;fs; i r;f;f;S;f;S; nghki kfs; i f;kpd;t;ps;f;F;f;S; Nghdw r;w;pa rhj dq;fi s , aff;ggadgL;f;pd;w;d.	3. , i t nkhi gy; nj hi yNgr;f;S;> Nfkuh;f;f;S;> fz d;f;S; kwWk; mtru t;ps;f;F;S; Nghdw rhj dq;fi s , aff; gadgL;f;w;J.
4. v.fh. vs;pa Nthyl;h kpd,fydf; Ni d;pay; kpd,fydf; kwWk; nyf;yhQ;r; kpd,fydf; kwWk; c yu; kpd,fydf;	4. v.fh. fhupa mk;py Nrk;f;fydf;> vbrd; Nrk;f;fydf; kwWk; ep;f;fy; - , UKG Nrk;f;fydf;S;

Kj di k kpd,fydf;	Ji z kpd,fydf;			
c yu; kpd,fydf;	yj j ;ak; c Ui s kpd,fydf;	nghj j h;d; kpd,fydf;	fhu / mk;py kpd,fydf;	Nkhl j hu; thfd kpd,fymLf;F

**Kj di k kpd,fydf; - c yu; kpd,fydf;**

c yu; kpd,fydf; MdJ ngUKghyhd kpd; rhj dq;f;S;py; nghJ thfg; gadgLk;  
Ntj p kpd,fydf;S;D; Xu; rhj huz ti fahFk> , J r;w;pa tbt;pyhd vsj ;py; vLj j ;r;



mtu; xU jti s rlyjjwFg; gjpyhf ctuelthy; Jiljj Jz paby; guNrhjidi a kēLk; kēLk; nraj NghJ> mNj Nghdw kpdOjzzjj tpi stj jJ. Nthy|h 1791 , y; j dJ fz Lgpbgi g ntsapl; hu> gpddu; 1800 Mk; Mz by; Kjy; kpdfydhd> thybf; Ftpai y cUthf;fpdhu;

mej Jbggw;fhd MwwyhdJ jti sapd; fhyry; , UeJ cUthdJ vd fUj pdhu> Mdhy; mj wF gpd; tej mtuJ mwptpayhsufshd mnyfrhz ; bNuh Nthy|h khWgl L ekgpdhu;

Nthy|h jputjjy; fi ueJss NtWgl; cNyhfqfNs jti sapd; fhyrd; JyqfYfF fhuz k; vd vLNfhshff; nfhz ; hu;

etbl kpdfyd; fz LgpbggwF mny] hz ; bNuh Nthy|h mtufNs ngupJk; fhuz khdtu; czikapy; , J jti sapd; cliy clw;\$W nraj Mukgjj NghJ Vwgl; Xu; mj pra epfo;thFk;

### kpdrrhtp







ekel kpd; jllgghil vjpuNehffp , UffwJ. vdNt kpdrrhu , oggl vdGJ kwwtufspd; kpdrrhujij gadgLj ; tJ NghdwJ MFk> , j dhy; ekJ kpd;fl ; z k; c au Mukgrf;Fk;

vdNt> ehk; kpdrrhujij kpfTk; vrrupfi fahfg; gadgLj j Ntz Lk> NKYk; Nji tapd; NghJ klLk; kpdrrhujij g; gadgLj j Ntz Lk;

flej tFggry; xU Nrhjidi %yk; Xu; kpdRwwpy; kpdNdhlik; nrYjjTk; kpdNdhlik; gh;tij epWjjTk; vdd nrajha; vdgij cddhy; kēf;fhz Kbfwjh? , t; tFggry; ehk; Xu; kpdRwwpy; kpdNdhlijij ghar; nraaTk; epWjjTk; kpdrrhtpi ag; gadgLj j yhk> tll kpdrrhjdqfisi , aqfr; nraaTk> epWjjTk; gyNtW ti fahd kpdrrhtpfi sg; gadgLj j p , Uggbf;fs> kpdrrhjdqfisi vsj hfTk; ghJ fhggfhTk; , aqfr; nraaTk; epWjjTk; kpdrrhtpfshdJ cjTfwJ.

### kpdRwW

rhtpi ag; gadgLj j p ep cUthf;fpa RwW Xu; vsja RwwhFk> mrRwwpd; czikahd glk; ti utJ kpfTk; fbdkhFk> ehk; tLfsy; gadgLj ; k; kpdrrhjdqfsy; , ijtp kpf; fbdkhd kpdRwWfs; mi kag; ngwwpUf;Fk; mj pf kpd;tsf;Ffs; rhtp kwWk; NtW kpd; cWgGfisi; nfhz ; kpdRwwpd; czikahd tbtjjpi d tpsf;Fk; RwWgglk; cddhy; ti ua , aYkh? mJ kpf vsji kahdj h vd Nahrij j g; gh> mJ kpf vsji kahdj h vd Nahrij ; g; gh> mJ vsji kayy.

jllr; rhtp		khwWr; rhtp		xspUk; rhtp	
gsf; rhtp		uhf;fu; rhtp		j sS rhtp	

mwptpayhsufs; mnrnai y kpfTk; vsji kahf;Ftj wF Ki dej du> Rwwpd; gyNtW kpd; cWgGfisi; Fwggpl vsja FwpaLfi s i fahz ; du>

mfFwpaLfi sg; gadgLj j p ehk; RwWggl k; ti ua KbAk; gl j j y; fhl j ggl Lss thW kpd; tps fF> kpd;fyd; kwWk; kpd; rhtp Nghdwi t FwpaLfs; %yk; Fw p f; fggLk;

kpd;fyd;pd; Fwpa ll by; eSkhd Nfhl hdJ Neukpd;Ki di aAk; FwFpa Nfhl hdJ vj u; kpd;Ki di aAk; Fw p f;Fk; ehk; ti uAk; RwWggl q;f;sy; kpd; c WgGfi sf; Fwpggl , tti fahd FwpaLfi sg; gadgLj j yhk> mt;t hwhd gl k; RwWg; gl k; vdggLk;

**kpd;Rwmpd; ti ffs;**

Nkw;fhz ; Nrhj i dary> ehk; kpd; tps fi fAk; kpd;fyi dAk; gadgLj j p Xu; Rwi w c Uthf;f;Ndhk; kpd; tps fF kwWk; kpd;fyi dg; gadgLj j p ehk; xNu xU kpd;Rwi w klLk; jhd; mi kff KbAk; xdWf;F Nkwgl kpd; tps fFfs; kwWk; kpd;fyd;fi sg; gadgLj j p gy t j q;f;sy; ehk; vz z ww ti fahd RwWf;fi s c Uthf;f , aYk;

**nj hl u; , i z gG RwW**

Xu; kpd; tps fi fAk; kpd;fyi di aAk; gadgLj j p , U ti fahd RwWf;fi s c Uthf;f KbAk> , r; Nrhj i dary; ehk; xUti fahd Rwmp d c Uthf;f; m j i dg; gwwj ; nj upe;J nfhsNthk;

gl j j y; fhl bAssgb , U kpd; tps fFfs> kpd;fyd; kwWk; rhtp Mfpatwi w c s s l f;f;par; Rwi w ftdp RwWg; gl j j y; , UeJ> , U kpd; tps fFfs; m L j j L j J , i z ffggl Lss J nj s rthf;wJ. RwWggl kh d J kpd; tps fF kwWk; kpd;fyd; mi kej pUf;Fk; epi yapi d Fw p f;f;pdwJ. , t t h w h f kpd; tps fFfs; , i z ffggl bUf;Fk; t j j j p w F nj hl u; , i z gG vdW ngau;

j w NghJ , U kpd; tps fFfs; kwWk; kpd;fyd; Mfpatwi w , i z j J Xu; Rwi w c Uthf;f;Nthk; , U kpd; tps fFfs k; x s p u f; p d w d t h ? , U kpd; tps fFfs k; xNu g u f h r j J l d ; x s p u f; p d w d t h ? Xu; kpd; tps fF x s p u e j h y ; m k k p d ; tps f;f;pd; , l j i j k h w w p mi k j j h y ; m t ; tps fF k p f g g u f h r k h f v u p A k h ? kpd; tps f;f;pd; t u p i r i a k h w w p mi k j J > c w W N e h f F .

rpy Nti sfsy; xNu msty; Nj hdWk; kpd; tps fFfs; \$I x s p u t j y ; khWgLk;

vdNt> nj hl u; , i z ggpy; , i z ffggLk; xNu msty; Nj hdWk; kpd; tps fFfs; v g N g h J k ; xNu msty; x s p u t j y i y .

**gff , i z gGr; RwW**

, U kpd; tps fFfs; n t t N t w h d g h i j f s y ; , i z ffggl Lss i j g ; gl k f h l L f w J . , J , u z i h k ; t i f r ; R w w h F k ; , U kpd; tps fFfs k; R w w y ; , i z a h f , i z ffggl Lss j h y ; , j j i f a R w W g f f , i z gGr; R w W v d g g L k ;

**gff kwWk; nj hl u; , i z gGr;RwWfS fF , i l Na c s s x w W i k kwWk; NtWghLfs;**

**%i si a f;surpA l Lk; mwptay;**

c d J t i l b y ; kpd; g O i j r ; r u p n r a A k ; kpd; g z p a h s U f F j p B n u d kpd; m j p u r r p V w g l i h y ; m t i u m t ; t j p u r r p a y ; , U e J k l i f m t i u e l n j h L t h a h ?

kpd; m j p u r r p a y ; , U e J m t i u k l i f < u f f l i l a h y ; m b g g h a h ? kpd; f k g q ; f s y ; kpd; N t i y f s ; n r a A k ; N g h J kpd; g z p G u p N t h u ; V d ; , u g g u ; i f A i w f i s m z p e j p U f ; f ; p d w d u ; ?

mi dj;J gUgnghUs;fS k; mZ vdw mbggi l j; Jfshy; Mf;fggl LssJ  
vd ehk; mw;Nthk; mZ thdJ kpd;D;l;k; ngww Jfs; fi s cssl f;f;AssJ>  
, j;Jfs;f;sy; ngUkghyhdi t mZ f;f;sy; epi yahf mi kej ;Uf;Fk> Mdhy;  
fl;jj;f;sy; (vyyh cNyhfq;f;sy;Yk) xU Fwgg;l mZ f;f;NshL xdwi kahj gy  
Jfs;f;sy; mq;Fk; , q;Fkhf cNyhfq;f;sy; Rww;f; nfhz bUf;Fk> , i t fl;Lwh  
kpd;D;l;q;f;sd; vd mi of;fggl;f;pdwd. mjhtJ mZ f;f;sp;d; rpy vy;f;lh;d;f;s;  
, t;thW mi kagngww;Uf;Fk;

**FWf;F kpd;RwW**

c d; t;l;l;Uf;f;sy; mi kej ;Uf;Fk; kpd;f;kgq;f;sy; rpy Neuq;f;sy; c UthFk;  
j;gngghwpi a e;f;f;L , Uf;f;whah? mej kpd;rh;u j;gngghw; c Uthf; fhuz k;  
c d;f;f; nj;upAkh? kpd;Rww;pd;hy; c Uthf;pw;J> FWf;F; RwW vdgJ , U  
kpd;Ndh;l;k; nry;Yk; fl;jj;f;S;f;F , i lNa VwgLk; k;f;f; Fi wej  
kpd;ji l;ap;dh; VwgLk; kpd;RwW> FWf;F kpd;RwW MFk;

ntybq; nraj;y> FWf;F kpd; Rww;pd; tpi sthf c UthFk; ntggj;j;pd;  
ei l Ki wg; gadghNI MFk;

**kpd; fl;j;J;g; nghUs;f;s; (ew;fl;jj;f;s) kwWk; fhgghd;f;s;**

kpd;Ndh;l;k; fl;j;J;k; gz gpd; mbggi l;ap; nghUl;fi s> kpd;fl;j;J;g;  
nghUs;f;s; kwWk; fhgghd;f;s; myyJ kpd;l;j;hg; nghUs;f;s; myyJ mu;j;pw;  
fl;jj;f;s; vd , U ti fggL;j;j;yhk;

nttNtW mZ f;f;sp;d; vy;f;lh;d;f;s; mZ f;f;is Rww; , aq;f; nttNtwhd  
fl;bdi k vz ; t;j;j;j;g; ngww;Uf;Fk;

cNyhfq;fi sg; Nghdw rpy nghUs;f;sy; mZ f;f;sp;d; nts;f;\$l;l  
vy;f;lh;d;f;s; j;su;thf; gpi z f;fggl;Lssd> NkYk; vy;f;lh;d;f;s> mgngghUl;f;sp;d;  
mZ f;f;S;f;f;pi l;ap; xOq;f;ww Ki wary; Rww; tUk; Vndd;ry> , ej; mrhj;huz  
fl;Lwh vy;f;lh;d;f;s; mj;D;l;dhd; mZ f;f;is t;l;l nts;Naw; mUf;f; , Uf;Fk;  
mZ f;f;S;f;F , i lNa c;ss , i lnt;sp;ry; Rww;t;Uf;pdwd> mi t ngUkghYk;  
fl;Lwh vy;f;lh;d;f;s; vd mi of;fggl;f;pdwd.

f;kgp; tbt;pyhd; cNyhf;j;j; ehk; f;wgi d nraj; nfh;Nthk> cNyhf;j;j;pd;  
, U Ki d;f;S;f;F , i lNa kpd;D;O;j;k; ms;f;f;ggLk; NghJ fl;Lwh vy;f;lh;d;f;s;  
xNu;j;pi rary; , af;fggl;f;pdwd.

vdNt> Xu; ew;fl;jj;pdhd;J mj;f;f; vz z ;f;fi f;aryhd; fl;Lwh vy;f;lh;d;f;sf;  
nf;hz;bUf;Fk> khwhf , aq;Fk; fl;Lwh vy;f;lh;d;f;sf; nf;hz;buhj; nghUs;f;s;  
kpd;Ndh;l;j;j;j;f; ed;F; fl;j;J;k; ew;fl;jj;f;s; myy> mi t;f;s; kpd;Ndh;l;j;j;j;  
fl;jj;h; mu;j;pw; fl;jj;f;s; MFk;

j;su;thf; gpi z f;fggl;l; vy;f;lh;d;f;sf; nf;hz;l; mZ f;f;shy; Md  
nghUs;f;s; fl;jj;f;s; vdg;Lk; fl;jj;f;sy; nts;kpd;D;O;j;k; ms;f;f;ggLk;NghJ  
kpd;D;l;l;j;j;pd; , af;f;j;j;pw;F; k;f;f; Fi wej kpd;ji l;i a fl;jj;f;s; ms;f;f;pdwd.

kpd;D;l;l;q;f;sd; X;l;l;Nk; kpd;Ndh;l;k; MFk; Xu; ew;fl;jj;pdhd;J k;f;f; mj;f;f;  
kpd; fl;j;J;j;pd; nf;hz;l;j;hf , Uf;Fk;

**fhgghd;f;s;**

NghJkhd; fl;Lwh vy;f;lh;d;f;sf; ngwhj; nghUs;f;s; ew;fl;jj;f;s; myy>  
mi t fhgghd;f;s; myyJ mu;j;pw; fl;jj;f;sh;Fk> kpd;fl;jj;hg; nghUs;f;s; myyJ

muj pw; fljj pfs; kpdD}lk; (vyfl uhd;fs) ghat; j wF mj pf kpdj ili af; nfhLf;fpdwd.

fljj pf> kpdD}jjk; msprffggllTld; mJ> vyfl uhd;fi s KLffp tPLfwJ. , j dhy; flLwh vyfl uhd;fS fF , i l Na Nkhj y; Vwgl L vyfl uhd; kwWk; nghUl;fspd; mZ ffs;pd; , affk; ghj pggj l fpwJ.

ngHUs;fspd; kpd;fljjj; j pwhdJ flLwh vyfl uhd;fspd; vZ z pfi fi aAk> mi t vt;thW rj wybf;fggLf;pdwd vdgi j Ak; rhuej pUf;Fk; , ugg; mo;ggghd; kpdNdhlljjj j d; toNa nryy mDkj pggj pyi y. vdNt> , ugg; xU muj pw; fljj p MFk; ngUkghyhd cNyhfqfs; kpdNdhlljjj j d; toNa nryy mDkj pf;fpdwd. mNj rkak> ngUkghyhd mNyhfqfs; kpdNdhllk; j d; toNa nryy mDkj pggj pyi y.

j hkpj j hyhd kpd; fljj pfs> kpf Fi wej kpd; j ili af; nfhz LssJ. , j d; fhuz khf> j hkp;f; fkgpfs; tll kpdRwWfspy; gadgLj j f;pdwd. , tti f fkgpfs; mj pf kpdj ili af; nfhz Lss nghUl;fshy; #oggl L , Uf;Fk; , ej nghUl;fs; nghJ thf nef;othd g;sh] bf;fhy; nraaggLf;pdwd.

rpk; fhuLfs> fz pdpfs> kwWk; ATM fhuLfs; vj dhy; cUthf;fggl Lssd vdW cdfFj; nj upAkh?

rpk; fhuLfs> fz pdpfs> kwWk; ATM fhuLfi s gadgLj j ggLk; rpgGfshdJ rpyr;fhd; kwWk; n[ uNkd;pak; Nghdw Fi wf;fljj pfs; MF;fggl bUf;Fk; Vnddpy> mtwwpd; kpd; flj j j p;wd; kj pggghdJ> ew;fljj pfs; kwWk; fhggghd;fS fFk; , i l aiy; mi kagngw;Uf;Fk;

**kpdNdhlljjj pd; tpi sTfs;**

eb;fs; Mwhk; tFggpy; kpd;rhuj j j g; gadgLj j p gyNtW Nrhi d;fs; nraj pUgg;lf;fs; NkYk; rpy Mut%lLk; cz i kfi s fwwpUgg;lf;fs; Kei j a tFggpy; kpd; t;psf;pd; toNa kpdNdhllk; ghar; nrat; j hy; kpd;t;psf;F xs;prt j fz bUgg;lf;fs> kpd;t;psf;F xs;prtJ kpdNdhlljjj pd; Xu; tpi sthFk;

NkYk> kpdNdhlljjj pdhy; gyNtW tpi sTfs; Vwgl f;pdwd. , gggl ggFj p;ary; mtwwpd; rpy tpi sTfi sf; fhz Nghk;

kpdNdhlljjj pd; %dW kpf Kff;pa tpi sTfshtd;

- . ntgg tpi sT
- . fhej tpi sT
- . Ntj p tpi sT

**ntgg tpi sT**

Xu; fkg;pad; toNa kpdNdhllk; ghAk; NghJ kpd;dhw;wyhdJ ntgg Mwwyhf khwwggLf;pwJ> ntgg%lLk; rhj dq;fs;py; gadgLj j ggLk; nghUshdJ mj pf cUFepi y nfhz l j MFk; ep;Nuhk; mt;ti fahdg; nghUS fF vLj j f;fhll hFk; (ep;ff;py> , UKG kwWk; FNuhk;pak; Nruej fyi t)

kpdNdhlljjj pd; ntgg tpi sthdJ gyNtW nraKi wg; gadghLfi s nfhz l j hFk;

kpd;t;psf;F> nteel; nfhj p;fyd> %o;Fk; el;nfhj p;fyd; Mf;pai t , tti fahd tpi stpi d mbggi lahff; nfhz i t. , rrhj dq;fs;py; mj pf kpdj il nfhz l ntgg%lLk; fkg;pr; RUS; , i z f;fggl bUf;Fk;



kpdNdhl | j j pd; tpi dtpdhy; ntggk; c Uthf;fggLk; epfoNt  
kpdNdhl | j j pd; ntgg tpi sT vdgLk;

**kpdNdhl | j j pd; ntgg tpi si t ghj pfFk; fhuz pfs;**

1. ghAk; kpdNdhl | j j pd; msT
2. kpdj i l
3. kpdNdhl | k; nrYj j ggLk; Neuk;

**kpd; c Ufp**

kpd; c UfpahdJ ngUkghyhd kpdrhj dq;fs;Yk; tll by; gadgLj j ggLk;  
kpdRwWf;spYk; gadgLj j ggLk; Xu; ghJ fhgG rhj dk; MFk; kpd; c UfpahdJ  
gb;fhdy; c Uthf;fggLf;wJ. kpd; c Ufp; kpd; c UF , i oi a , i z ggj wfhf  
, U kpdGss;fi sf; nfhz bUfFk; c Ufp , i oahdJ kpd; Rwwpy; mj pf gS  
VwgLkNghJ c Ufp;Lk;

, j d; tpi sthf kpdRwW Jz bff;ggL tpi ykj gg kpf;f kpdrhj dq;fs;  
kwWk; kpd;fkpfs; gOj i lahky; ghJ fhggf , Uf;f c j Tf;wJ. kpd; rhj dq;fs;py>  
fz z hbahy; Md kpd; c Ufp ngup;k; gadgLj j ggLf;wJ Xu; rpwpa fz z hbf;  
Foha; xdw;Ds; kpd; c UF , i oahdJ , i z fff;ggL bUfFk;

**FW RwW Jz bgghd; - MCBs (Miniature Circuit Breaker)**

mj pf , l q;fs;py; FWRwW Jz bgghdhdJ kpd; c Ufp;sp; khwwhf;g;  
gadgLj j ggLf;wJ. kpd; c Ufp;fi sf; i fahS t;py; mj pf nray;Ki w rpf;fy;fs;  
cssd. kpd; c UF fkgahdJ c Uf;f; j Uz k; kpd;rhuj; j kll gj wF NtW Xu;  
fkg; a khww; mi kff; Ntz ;Lk> nghJ thf , r; nrayhdJ kpfTk; rpf;fyhd  
xdwhFk;

FW RwW Jz bgghdhdJ j hdhfNth kpd;Rwi w Jz bff;f; gz G nfhz ;J>  
kpd;rhuj; j j hdhf kll nl Lf;f;f; tz z k; mj d; , aq;f;f; t; j k; , Uf;f;f;

**kpdNdhl | j j pd; fhej tpi sT**

fhej tpi sT kpdNdhl | j j pd; kwnwhU tpi sT MFk; 1819 -Mk; Mz ;L  
> hd;] ; f;w; bad; vdg;tu; kpdNdhl | j j pd; fhej tpi si t tpsff;pdhu;  
fb;f;fhZ k; nrayghL - 5d; %yk> kpdNdhl | j j pd; fhej tpi si t ed;F Gupe;J  
nfhs; KbAk;

**kpd;fhej q;fs; - kpdNdhl | j j pd; fhej tpi sTpd; gad;fs;**

kpdNdhl | q;fs;pd; fhej; gz G ty; kahd kpd;fhej q;fs; c Uthf;fg;  
gadgL;f;pdwd> kpd;fhej q;fshdJ kUj ;Jtki d;fs;py; fz ; fhaq;fs;py; nghj ;e;J ss  
v/F myyJ , UkGj ; Jfs;fi s e;ff;g; gadgL;f;wJ.

ek; mdwhl thot;py; gadgL;J;k; kpd;rhuj; kz p gS J;f;f; kwWk;  
nj hi yNgr; Nghdw gyNtW rhj dq;fs;py; kpd;fhej q;fs; gadgL;f;pdwd> ehk;  
j wNghJ kpdNdhl | j j pd; fhej t;py; tpi sT vt;thW nj hi yNgr;py;  
gadgL; j ggL;f;wJ vdg;J gw;w; ; nj upe;J f; nfhs;Nthk;

**nj hi yNgr;**

nj hi yNgr;f;sp;py> khWk; fhej tpi sthdJ xU nkyypa c Nyhf;f; j hi s  
(i laghuk) mj ;T;F c l gL;J ;f;wJ. i laghuk;fshsJ fhej q;fshy; <uff;f;\$ba  
xU c Nyhf;f; j hy; nraaggL;f;pdwd.

1. nj hi yNgrpapd; Nfl ghdp; nghUjj ggl Lss fkgprRUSId; i l aghuk; , i z ffggl bUfFk;
2. fkgprfs; topNa kpdNdhl;k; ghAk; NghJ nkdi kahd , UKGg; gli l ahdJ Xu; kpd;fhej khf khwwk; mi l fpwJ.
3. i l aghukhdJ kpd;fhej j j hy; <urf;fggLfpwJ.
4. kWki dary; c ss egu; NgRk; NghJ NgRgtupd; FuyhdJ kpd;Rwwpy; ghAk; kpdNdhl;j;j khwwKwr; nra;f;pdwJ> , ej khwwk; Nfl ghdp; c ss i l aghui k mj ;Twr; nra;J xyji a cz ;hf;FpwJ.

### kpdNdhl;j;j pd; Ntjptpi sT

NtWgl;l flj;j; j;pd; nfhz;l j;ptqfs; topNa kpdNdhl;k; ghAk; NghJ mi t Ntjptpi dfi s VwgLj;Jf;pdwd. , ej epfo;tpw;F kpdNdhl;j;j pd; Ntj p tpi sT vdW ngau; c dJ Nky; tFggpy; kpdNdhl;j;j pd; Ntjptpi sTfs; gwww ed;F mwpe;J nfh;st;f;fs;



8<sup>TH</sup>, awgjay;  
nj hfj p-II  
UNIT - II kpdjay;

**mwKfk;**

mdwhl thoty; ehk; gadgLjJk; mi djJg; nghUsfsk; jdkqfshy;  
flii kffggLssd. xtnthU jdkKk; mZ ffsHy; MdJ. mZ fFNs xU  
jdkjjpd; kfrmpa myF MFk; mZ it mji dtlr; rmpa \$Wfshfg; ghrff  
, ayhJ vd mwptay; mwQh; [hd; lhy; d; fUj pdhh; Mdhy> & j h; Nghhd; j qf  
, io Nrhi dfFggpd; mZ tD; GNuhl;hd> vyfl uhd; kwWk; epAl uhd; Nghdw  
kpdJfsfs; , UggJ fz LgpbffggLJ. nghUsfs;Yss vyfl uhd;fspd; XI;Nk  
kpdNDhl;jj wFF; fhuz khfwJ. , ej kpdNdh;l;k; kpd;dhwwi y myyJ  
kpdruh;j j cUthfFfwJ. kpd;dhwwi y ekKi la mdwhlj; Nji tFS fF ehk;  
gadLjJfNwhk; kpd; t;sf;Ffs> kpd; t;rpwfs> kpd; ryi tg; ngl b> ryi t  
, aej uk; Fshrhj g; ngl b Nghdw c gfuz qfs; kpd; Mwwypdhy; nraygLk;  
rhj dqfSs; rpy MFk; , ej g; ghLjjy; kpd;Jfsfs; gwwpAk; mi t xU  
nghUs;pyUeJ kwnwhU nghUS fF vt;thW , lkhwwki lfpdwd NkYk>  
kpd;RwWfs; kwWk; kpd;Ndh;l;jj pd; tpi sTfi sg; gwwpAk; fwWfnfhss , UfNwhk;

**mZ :**

mZ thdJ GNuhl;hd> vyfl uhd; kwWk; epAl uhd; Mfpa mZ f\$Wfshy; MdJ.  
GNuhl;hd;fSk> epAl uhd;fSk; mZ tpd; i kajj pYss cl;fUtD; c ssd.  
vyfl uhd;fS; cl;fUtpi dr; Rwwp gyNtW tllgghijfsy; RwwptUfpdwd. xU  
mZ tpy; c ss vyfl uhd;fspd; vz z pfi fAk> GNuhl;hd;fspd; vz z pfi fAk;  
rkkhf , UfFk; NkYk> vyfl uhd;fS fFk; GNuhl;hd;fS fFk; , i lNa xU  
fthrrtpi r fhz ggLfwwJ. cl;fUt; mUfpYss tllgghijay; RwwptUK;  
vyfl uhd;fS fFk> cl;fUt;Yss GNuhl;hd;fS fFk; , i lNa typi k kFej  
fthrrp tpi r fhz ggLjtjhy; mtwi w mZ tpyUeJ vsj hf nts;Naww KbahJ.  
Mdhy> nts;tl;gghijay; RwwptUK; vyfl uhd;fS vsj hf mZ it tpi l  
nts;Naww KbaK;

**kpd;Jfsfs; (Charges):**

nghUsfs; xdi wnahdW tpyf;FtjwF myyJ <hgj wFF; fhuz khd mbggi l g;  
gz i gg; ngwwpUfFk; Jfs; kpd;Jfs; vdggLk; (xdi wnahdW <hf;Fk; myyJ  
t;pyf;Fk; gz G kpd;D;l;k; vdggLk) vyfl uhd> GNuhl;hd; Nghdw mZ f\$WfS k;  
, ej g; gz i gg; ngwwpUf;fpdwd. kpd;Jfs;fi s Mf;FNth myyJ mo;f;FNth  
, ayhJ. kpd;Jfs;fi s Neh; kpd;D;l;k; nfhz ;i t kwWk; vj th; kpd;D;l;k;  
nfhz ;i t vd , uz ;lhf ti fggLjjyhk; GNuhl;hd;fS; Neh;kpd;D;l;jj j Ak>  
vyfl uhd;fS; vj th; kpd;D;l;jj j Ak; ngwwpUf;fpdwd.

kpd;Jfs;fS f;pi lNa <hgGtpi r myyJ t;pyf;Ftpi r fhz ggLfwwJ. Xhd  
kpd;Jfs;fS; xdi wnahdW t;pyf;f; nfhs;fpdwd. Ntwpd kpd;Jfs;fS;  
xdi wnahdW fthf;fpdwd.

kpd;D;l;k; \$Yk; (C) vdw myf;pdhy; mstpl ggLfwwJ. j dj; Jf; fhz ggLk;  
Jfs;pd; kpd;D;l;khdJ rpwk kpd;D;l;k; (e) vdf; Fwpggil ggLfwwJ. , j d; kj pgG  
1.602 x 10<sup>-19</sup>\$Yk; MFk; xU vyfl uhd; kwWk; xU GNuhl;hd;py; , UfFk;  
kpd;D;l;jj pd; msT , JNt MFk; GNuhl;hd;pd; kpd;D;l; kj pgG Neh; Fw;ahfTk;  
(+e) vyfl uhd;pd; kpd;D;l; kj pgG vj th;Fw;ahfTk; (-e) , UfFk; GNuhl;hd;fS;pd;

vz z pfi fAk; vyfl uhd:fs:pd; vz z pfi fAk; rkkhf , Uggj hyj hd; xU mZ thdJ kpd; eLepi yi kAl d; fhz ggLf:pwJ.

**kpd:J fs:f:spd; , l khwwk;**

ehk; Vwf:dNt ghj:j gb> xU mZ tpd; ntsptl:gggh j a:y; Rwwp tUk; vyfl uhd:fi s vsj hf mfww KbAk; mtwi w xU nghUs:y; , UeJ kwnwhU nghUS f:F , l khwwk; nraaTk; KbAk; vyfl uhd:fi sg; ngwWfnfhss nghUS; vj th; kpd:D}l:j i j Ak> vyfl uhd:fi s , oej nghUS; Neh; kpd:D}l:j i j Ak; ngWf:pwJ.

fb:f:fhZ k; %dW Ki wfs:y; xU nghUs:yUeJ kwnwhU nghUS f:F kpd:J fs:f:s; , l khwwki l f:pdwd.

- c uha:T %yk; , l khwwk;
- fl j :J y; %yk; , l khwwk;
- kpd:J }z :l y; %yk; , l khwwk;

**c uha:T %yk; , l khwwk;**

rbgpi d mOj j khfj; Nj af:FkNghJ j i y Kbap:UeJ rpy vyfl uhd:fs; rbGf:F; nrdW tL:f:pdwd. vdNt> rbG vj th; kpd:D}l:i ki l f:pwJ. , ej vyfl uhd:fs; rbgpd; Ki dary; xlb; nfh:s:f:pdwd. fhfj:j j rWrpW Jz Lfshff; f:pp:FkNghJ fhfj:j; Jz Lf:spd; Xuqf:s:y; Neh; kpd:J fs:f:S k; vj th; kpd:J fs:f:S k; fhz ggLf:pdwd. rbgpy; , Uf:Fk; vj th; kpd:J fs:f:s; fhfj:j:Jz bd; Xuqf:s:y; , Uf:Fk; Neh; kpd:J fs:f:i s <hf:f:pdwd. MfNt> fhfj:j; Jz Lf:s; rbgpi d Neh:f:p <Hf:f:ggLf:pdwd. rbi g j i yary; Nj af:Fk; NghJ j i yKbap:UeJ vyfl uhd:fs; c uha:t:pd; %yk; rbGf:F , l khwwki l f:pdwd. j i yKb <ukhf , UeJ hy; Kb:f:Fk; rbGf:Fk; , i l Na css c uha:T Fi wAk; rbGf:Fk; , i l Na css c uha:T Fi wAk; , j dhy; j i y Kbap:UeJ rbGf:F , l khwwki l Ak; vyfl uhd:fs:pd; vz z pfi f Fi wAk; rpyti f nghUs:f:i s xdi wnahdW Nj af:FkNghJ kpd:J fs:f:s; , l khwwki l eJ mej g; nghUs:f:spd; NkwgFj :pary; j qf: tL:f:pdwd. , j py:UeJ c uha:t:pd; %yk; kpd:J fs:f:s; , l khwwki l f:pdwd vdgJ nj spthf:pwJ.

kpd; eLepi yary; , Uf:Fk; xU nghUS; vyfl uhd:fi s , oggj hy; kl LNk Nehkpd:D}l:i ki l a nghUshf:pwJ. Nehkpd:J fs:f:i sg; ngwWfnfh:s;tj hy; myy.

nttNtW nghUs:f:i s xdWl d; xdW Nj af:Fk; NghJk; , J Nghdw epfo:Tfi sf; fhz yhk; xU fz z hbj; j z bi d gl:Lj; Jz p:pdhy; Nj af:FkNghJ> fz z hbj; j z byp:Uf:Fk; fl Lwh vyfl uhd:fs; (Free electrons) gl:Lj; Jz p:F , l khwwki l f:pdwd. gl:Lj; Jz p:py:Uf:Fk; vyfl uhd:fi s t:pl fz z hbj; j z byp:Uf:Fk; vyfl uhd:fs; j sh:thfg; gpi z ffggl:LssNj , j w:Ff; fhuz khFk; fz z hbj j z L vyfl uhd:fi s , oggj hy; vyfl uhd:fs:pd; vz z pfi f Fi wTgl:L mJ Nehkpd:D}l:i k; ngWf:pwJ. gl:Lj:Jz p mj pf vyfl uhd:fi sg; ngWtj hy; mJ vj th;kpd:D}l:i k; ngWf:pwJ.

vNghi dl; j z L (ugg; j z L) xdi w vLj:J mji d t:pyFF c Nuhkk; myyJ fkgspahy; Nj af:Fk; NghJ fkgsp:py:Uf:Fk; fl Lwh vyfl uhd:fs; vNghi dl; j z LfF , l khwwk; mi l f:pdwd. vNghi dl; j z byp:Uf:Fk; mZ ffs:pd; ntsptl:gggh j a:y; css vyfl uhd:fi s t:pl> fkgsp:py:Yss mZ ffs:y; css vyfl uhd:fs; j sh:thfNt gpi z ffggl:Lssd. MfNt Fi wej vyfl uhd:fi s ci l a fkgsp Nehkpd:D}l:i ki l f:pwJ. mj pf vyfl uhd:fi sf; nfhz:l vNghi dl; j z L vj th; kpd:D}l:i ki l f:pwJ.

, ej nrayghLf:sp:UeJ rpy nghUs:f:i s xdWl d; xdW Nj af:Fk; NghJ vyfl uhd:fs; xU nghUs:y; , UeJ kwnwhU nghUS f:F , khwwki l tNj hL mi t epfu kpd:D}l:j i j Ak; ngWf:pdwd vdgj j ehk; mwpa KbAk;

Nehkpd;D}l;k; ngww xU fz z hbj; jz bi d kwnwhU Nehkpd;D}l;k; ngww fz z hbj; jz bd; mUNf nfhz L nry;Yk; NghJ mi t xdi w tplL xdW tpyFfpdwd. Mdhy; Neh; kpd;D}l;k; ngww fz z hbj; jz bd; mUNf vj th; kpd;D}l;k; ngww vNghi dl; jz bi df; nfhz L tUkNghJ mi t xdi w xdW fthfpdwd. jz LfS fpi lNa cSS J}uk; Fi wAkNghJ tpyfF tpi r myyJ fthrrp tpi r mj pfhpf;fpdWJ.

vNghi dl; jz bi d fkgspay; Nj afFk; NghJ fkgspay; , UfFk; vyf;lhdf;S; vNghi dl; jz bwF , lkhwwk; mi lfpdwd. , j dhy; , ej vNghi dl; jz L kpd;D}l;k; ngWfWJ. vj th; kpd;D}l;k; ngww vNghi dl; jz bi d fhfj cUi sapd; mUfpy; nfhz L tUkNghJ fhfj cUi sapy; Nehkpd; Jfsfs; cSSjhy; vNghi dl; jz L fhfj cUi si a <hf;fWJ. vNghi dl; jz lhy; fhfj cUi si aj; nj hLkNghJ rpy vj th; kpd;Jfsfshy; vNghi dl; jz bypUe;J fhfj cUi sfFF; fljjggLfpdwd. vdnt fhfj cUi sapYss vj thkpd;Jfsfs; vNghi dl; jz bYss vj thkpd;Jfsfi s vj thf;fpdwd. , j dhy; mi t tpyffki lfpdwd.

kpd;Jfsfi s jqfS fFs; gha mDkj pfFk; nghUs;fs; kpd;fljj pfs; vdggLk; mYkpdjak> jhkuk; Nghdw cNyhfqfs; kpd; fljj pfs fF vLj;Jffhl Lfs; MFk; kpd;Jfsfi s jqfS fFs; vsj hf gha mDkj pf;fhj nghUs;fs; kpd;fhgGg; nghUs;fs; vdggLk; uggh> kuk> nefpog; nghUs;fs; Mfad kpd;fhgGg; nghUs;fS fF vLj;Jffhl Lfs; MFk;

Mfnt Neubahfj; nj hLtd; %yKk; xU nghUs;py; , UfFk; kpd;Jfsfi s kwnwhU nghUS fF kpd;Jfsfi s , lkhwwk; nraAk; Ki wfF flj;Jy; %yk; , lkhwwk; nraj y; vdW ngah;

**kpd;Jz l y; %yk; , l khwwk;**

kpd;D}l;k; ngwhj nghUs; xdwpi d kpd;D}l;k; ngww nghUs; xdwpdhy; nj hLkNghJ mJ kpd;D}l;ki lfpWJ Mdhy> Neubahd nj hLj y; , dwpNa xU nghUi s kpd;D}l;ki lar; nraa KbAk; kpd;D}l;k; ngww xU nghUi s kpd;D}l;k; ngwhj nghUs;pd; mUNf nfhz L nrdW nj hLj y; , dwp mji d kpd;D}l;ki lar; nraAk; epfo;T kpd;Jz l y; %yk; , lkhwwk; nraj y; vdggLk; , kKi wapy; kpd;D}l;k; ngww nghUS fF mUfpy; , UfFk; Ki dapy; mj wF vj p;hd kpd;D}l;Kk; kW Ki dapy; xj j kpd;D}l;Kk; Jz l ggLfpdwd.

vj thkpd;D}l;k; ngww nefpoj; jz bi d kpd; eLepi yapy; , UfFk; xU nefpoj; jz bd; mUfpy; nfhz Ltutk; vj th; kpd;D}l;k; ngww jz bi d kpd;D}l;k; ngwhj jz bd; mUNf nfhz L tUk; NghJ> kpd;D}l;k; ngwhj jz by; , UfFk; vj thkpd;Jfsfs; tpyffki lfpdwd. , j dhy; kpd;D}l;k; mi lahj jz Lg; gFj p;pd; xU gFj p;py; Neh; kpd;D}l;k; Jz l ggLfpWJ. mj d; kWKi dapy; vj th; kpd;D}l;k; Jz l ggLfpWJ. , ejj; jz bi d GtpAl d; , i z fFk; NghJ mi dj;J vj thkpd;JfsfS k; Gtpf;Fr; nrdWtpLfpdwd. , j dhy; kpd;Ndwwk; ngww jz bDs; vj th; kpd;Jfsfs; Ropahfp Nehkpd;Jfsfs; jz L KOtJk; rLhfg; gutp tPLk;

, JNghy Nehkpd;D}l;ki lej jz bi d kpd;D}l;ki lahj jz bd; mUNf nfhz LtUk; NghJ kpd;D}l;ki lahj jz by; , UfFk; vyf;lhdf;S; Nehkpd;D}l;ki lej jz bi d Nehf;fp <hf;fggLf;fpdwd. mj d; tpi sth> mUfPYss Ki dapy; mj pf vj th; kpd;D}l;Kk> nj hi ytpYss Ki dapy; mj pf Neh; kpd;D}l;Kk; Nrhfpdwd. , j dhy; Nehkpd;D}l;ki lej jz LfF mUfpy; , UfFk; Ki dapy; vj th; kpd;D}l;Kk> kW Ki dapy; Nehkpd;D}l;Kk; Jz l ggLfpdwd.

**kpd;Jfsfspd; Xl l k;**

mj pfsT vj th; kpd:D}l;k; (mj pf vz z pfi fapghd vyfl uhd:fs) nfhz l cNyhff; NfhsK; xdWk; c qfSpLk; , Uggj hff; nfhsNthk; , ej , uz l cNyhff; Nfhsqfi sAk; xU cNyhff; fkgpady; , i z fFkNghJ vj th; kpd:D}l;k; ngww Nfhsj j y; , UfFk; \$Lj yhd vyfl uhd:fs; Nehkpd:D}l;k; ngww Nfhsj j j Nehf:fp ghaj; nj hl qFf:pdwd. , UNfhsqfSpYk; , UfFk; vyfl uhd:fs:pd; vz z pfi f rkkhFk; ti u , ej epfo:T nj hl heJ nfhz NI , UfFk; , qF Nehkpd:D}l;k; ngww NfhsK; c ah; kpd:Oj j k; nfhz l j hfTk> vj th; kpd:D}l;k; ngww NfhsK; Fi wej kpd:Oj j k; nfhz l j hfTk> fUj ggLfPwJ. vdNt> vyfl uhd:fs; Fi wej kpd:Oj j Kss gFj papyUeJ mj pf kpd:Oj j Kss gFj pi a Nehf:fg; ghaj nj hl qFf:pdwd. , eepfo:T kpd:Ndh:l;k; (vyfl uhd:fs:pd; Xl;k) vdW mi of:fggLfPwJ. , uz l Nfhsqf:sp; kpd:D}l;k; qfS f:F , i l Naahd NtWghL kpd:Oj j k; (Voltage) myyJ kpd:Oj j NtWghL (Potential difference) vd mi of:fggLfPwJ.

vyfl uhd:fs:pd; fz l gpbggw:F KdG Nehkpd:Jfs:fs; fl j j pfs:pd; topahfg; ghaj:hyj hd; kpd:Ndh:l;k; VwgLfPwJ vd mwQh:fs; fUj pdh; Nehkpd:Jfs:fs; ghAK; j pi r kuG kpd:Ndh:l j j j pd; j pi rahff; fUj ggLfPwJ. kuG kpd:D}l;k; c ah; kpd:Oj j j j j j pUeJ Fi wej kpd:Oj j j j j Nehf:fg; ghafPwJ.

**epi ykpd:fhl b:**

nghUnshdwy; kpd:Jfs:fs; , Uggj j f; fz l wpa; gadgLk; mwrtpay; fUtp epi ykpd:fhl b MFk; 1600 Mk; Mz l tpyy:ak; fpyghl; vdw Mqf:Nya , awgpay; mwQh; Kj dkj yhf epi ykpd:fhl bi a tbt i k j j hh; , JNt> Kj yhtJ mwrtpay; rhj dkhFk; j fi fg; geJ epi ykpd:fhl b> j qf , i y epi ykpd:fhl b vd , uz l ti f epi ykpd:fhl bfs; c ssd. ngUkghYk; kpd:rhuj i j f; fl j j k; nghUs:fi sg; (cNyhfK) gadgLj j j epi ykpd:fhl bfs; tbt i k f:fggLf:pdwd. Xhd kpd:Jfs:fs; xdi wnahdW tpyf:fr; nfhs:f:pdwd kpd:D}l;k; ngww nghUnshdi w cNyhff; Fk:OFF mUf:py; nfhz l tUkNghJ vyfl uhd:fs; mj ppyUeJ nts:Na tUK; myyJ mj d; topNa c sNs nry:Yk; , j d; fhuz khf epi ykpd:fhl b:pd; c sNs , UfFk; cNyhf , i yfs; kpd:D}l;k; l f:pdwd. vj th; kpd:D}l;k; l e j xU nghUi s Fk:OFF mUf:py; nfhz l tUkNghJ> Fk:py; Nehkpd:D}l;k; k; mj d; kWKi dary; , UfFk; cNyhf , i yfs:py; vj th;kpd:D}l;k; k; Jz l ggLf:pdwd. , uz l cNyhf , i z fs:Yk; vj pnuj th; kpd:D}l;k; , Uggj hy; mi t xdi w tpl l xdW tpyf:fr; nry:f:pdwd. , gngHOJ Neh; kpd:D}l;k; l e j nghUs; xdwpi d cNyhff; Fk:OFF mUf:py; nfhz l tUkNghJ cNyhf , i yfs:py; c ss vj th; kpd:D}l;k; qfS; Nky; Nehf:fp efh:f:pdwd. , j dhy; , uz l cNyhf , i yfS k; Neh; kpd:D}l;k; ngwW mi t KdG NghyNt xdi w tpl l xdW tpyf:fr; nry:f:pdwd.

1600 Mk; Mz l tpyy:ak; fpyghl; vdg:tuhy; c Uthf:fggl i epi ykpd:fhl b nthNrh:hpak; vdwi of:fggl i J. cNyhf Crp xdwpi d Nki l nahdwy; nj hqftpl ggl bUe j mi kgNg nthNrh:hpak; vdW mi of:fggl i J. , ej cNyhf CrpahdJ mj dUNf nfhz l tuggLk; kpd:D}l;k; ngww nghUs:fshy; <hf:fggLk;

**j qf , i y epi ykpd:fhl b:**

j qf , i y epi ykpd:fhl bi a 1787 Mk; Mz l Mqf:Nya mwrtpay; mwQh Mgpufhk; ngdl; vdgth; tbt i k j j hh; j qf k> ntssp Mfpa , U cNyhf qfS k; kpr; rwe j kpd:fl j j pfs:hf , Uggj hy; mi t epi ykpd:fhl bary; gadgLj j ggLf:pdwd.

**mi kgG:**

j qf i y epi ykpd:fhl b xU fz z hb [ hbi af; nfhz l ssJ. , j py; g j j i sf; fkgp xdW> xU j fi f topahf nrq:Fj j hf nghUj j j i t f:fggl l ssJ. g j j i sf;

fkgpajd; ntsplKi d gijji sapdhy; Md xU FkpNohL , i z ffgglLssJ. mj d;  
kWki d [ hbapDsNs , UfFk; , uz L j qf , i yfNshL nghUjj ggl LssJ.

**nraygLk; tjk;**

kpd:D}l;k; ngww nghUnshdwpj df; nfhz L gijji sf; Fkpopi dj; nj hLk; NghJ  
mj pypUfFk; kpd:D}l;k; gijji sf; Fkpo; topahf j qf , i yfS fF  
, lkhwwki l fpwJ. , j dhy; , U , i yfS k; xdi w tpi L xdW tpyf; nry; fpdwd.  
, uz L , i yfS k; xNu kpd:D}l;j i j g; ngwWssNj , j wFf; fhuz khFk;

**kpdNdwwk;**

xU nghUSypUeJ kwnwhU nghUS fF kpd:Jfs;fi s , lkhwwk; nra; tJ  
kpdNdwwk; vdggLk; j qf , i y epi ykpd;fhl bary; gijji sf; Fkpo; topahf j qf  
, i yfS fF kpd:Jfs;fs; , lkhwwk; nraaggLfpdwd.

**kpd:Jfs;fk;**

xNu ti fahd kpd:D}l;k; ngww j qf , i yfs; kpd:Jfs;fi s , oeJ tpi Ltj hy;  
rmpU Neuk; foj; j kZ Lk; mUfUNf tUfpdwd. , eepfo;T> kpd:Jfs;fk; vdggLk;  
gijji sf; Fkpi o xUth; j d; i fapdhy; nj hLkNghJ , i yfs; , UeJ  
kpd:Jfs;fs; i ffs; topahf Gtp;F;S; ghafpwJ. , j d; fhuz khfTk; kddpwf;fk;  
ei l ngWf;pwJ.

**kddy; kwWk; , b;**

fkg;sj j py; fhyfi sj; Nj aj J tpi L fj tpd; i fggbi aj; nj hLkNghJ kpd:dj thrrp  
VwgL; tJ kpd:Jfs;fk; %yk; ei l ngWf;pwJ. i fapypUeJ vyf; l uhd;fs; Neh;  
kpd:D}l;k; nfhz l i fggbahy; , Of;fggl; t; j hy; kpd:Jfs;fk; vwgL; fpwJ. kpd;  
mj thrrp vwgL; t; Nghy; j; Nj hdWk; , ej vyf; l uhd;fs;pd; efht; pdhy; ekJ cly;  
xUry vyf; l uhd;fi s , of;fwJ. kpd:Jfs;fk; xU Cl; fj; j py; nghJ thf  
thAf; fs; py; ei l ngWf;pwJ. Nkf; q; fs; py; ei l ngwk; kpd:Jfs;fk; j j wF xU c j huz k;  
kddy; MFk;

Nkf; q; fs; f; fpi l aNyh myyJ Nkf; q; fs; f; Fk; Gtp; F; k; , i l aNyh kpd:Jfs;fk;  
ei l ngWt; j hy; kddy; c Uth; f; pwJ. , bAl d; \$ba ki o ngaAkNghJ fhwW Nky;  
Neh; f; fp Ntfkhf efh; f; pwJ. , ej f; fhwwhdJ kpf; r; r; wpa gd; gg; b; f; q; fi s Nky;  
Neh; f; fp , Oj; J; r; nry; f; pwJ. mNj Neuj; j py; r; wpa ehj; J; s; f; s; Nky; UeJ fb; Neh; f; fp  
efh; f; pdwd. mi t xdWl d; xdW NkhJ kNghJ gd; gg; b; f; q; fs; Neh; kpd:D}l; ki l eJ  
Nky; Neh; f; fp efh; f; pdwd. ehj; J; s; f; s; vj th; kpd:D}l; ki l eJ fb; Neh; f; fp efh; f; pdwd.

, j dhy; Nkf; q; fs; pd; NkwgFj p Nehkpd:D}l; Ki l a Jfs;fshYk; fbgFj p  
vj th; kpd:D}l; Ki l a Jfs;fshYk; epi wej pUf; Fk; , i t , uz Lk; xdWl d; xdW  
rej p; f; Fk; , i t ehj; J; s; f; s; py; c ss vyf; l uhd; fi s gd; gg; b; f; j; j py; c ss Nehkpd;  
Jfs;fs; <h; f; f; pdwd. , j dhy; kpd; rhuk; c Uth; f; p kddy; Nj hdWf; pwJ.

rpyNeuq; fs; py; vj th; kpd:Jfs;fs; epi wej Nkf; q; fs; pd; fbggFj pahdJ ki yfs;  
cahej kuq; fs; fl; l l q; fs; kwWk; kd; j; h; fs; mUNf fhz ggLk; Nehkpd;  
Jfs;fNshL nj hl hG nfhs; f; pdwJ. , ej kpd:Jfs;fk; fhuz khf; mj p; f; gg; bahd  
ntggk; kwWk; j th; ngw; c Uth; f; p ehk; fhz f; \$ba kddy; Nj hdWf; pwJ. , ej  
kpd; dy; pd; %yk; kpf; g; ng; h; pa mst; py; hd kpd; rhuk; kpd:Jfs;fk; ki l eJ 30,000°C  
ntggepi yf; Fk; mj p; f; khd ntggk; c Uth; f; pwJ. mj p; f; mst; py; hd , ej  
ntggj; j pdhy; fhwW tpi uthf th; pt; i l eJ kZ Lk; tpi uthf RUq; F; f; pwJ. fhwW  
tpi uthf RUq; f; p th; pt; j hy; mq; F xU mj thrrp mi y c Uth; f; p kpf; g; ng; h; pa rj; j khf  
nts; gg; L; f; pwJ. , ej rj; j k; , b vd mi of; fg; g; L; f; pwJ.

kddy; xU kuj; j j j; j h; f; Fk; NghJ c Uth; Fk; mj p; f; gl; r ntggj; j pdhy; kuj; j pDs;

c s s e b h d J M t p a h f p k u k ; v h p e J t p L f p w J .

G t g ; g u g g w f k ; N k f q ; f S f f k ; , i l N a c s s J j u k ; m j p f k h f , U g g j h Y k ; x s p a p d ; j p i r N t f k ; x y p a p d ; j p i r N t f j ; j t p l k p f T k ; m j p f k ; v d g j h Y k ; r p y N e u q f s p y ; , b r ; r j j k ; N f l g j w f K d d N u k p d d y ; e k ; f z f S f f J ; n j h p f w J .

k p d d y ; k w W k ; , b A l d ; \$ b a k i o a p d N g h J j w e j n t s p a N y h m y y J k u j j p d ; m b a p N y h e p w g i j j ; j t h f f N t z L k ; f N o m k h e J j i y i a f ; F d e J n f h s t J e y y J . m i j t p l t h f d q f S f f S ; , U g g J g h J f h g g h d J . t h f d q f s p d ; c N y h f g ; g u g G e p i y k p d ; j L g G i w a h f g ; n r a y g l L k p d d y h d J t h f d j j w f S ; m k h e j p U g g t h f i s j h f f h k y ; m J g h J f h f f w J .

**G t j n j h L g G :**

G t j n j h L g G v d g J > k p d r h j d q f s p y ; , U f F k ; k p d f h g G i w f s ; g O j h F k ; N g h J e k f F k p d d j p r r p V w g l h k y ; , U g g j w f h d g h J f h g G e l t b f i f M F k ; k p d d p w f f k ; m i l A k ; k p d d h w w i y F i w e j k p d j i l n f h z l f k g p a p d ; % y k ; G t p f F , l k h w w k ; n r a A k ; K i w N a G t j n j h L g G v d W t i u a W f f g g L f p w J .

g y N t W % y q f s p y U e J k ; e k f F k p d d h w w y ; f p i l f f w J . k p d f y k ; k p d d h w w i y m s p f F k ; x U % y k ; M F k ; R t h f ; f b f h u q f s > m i y N g r p f s > N g h d w t w w p y ; e h k ; k p d f y j i j g ; g a d g L j J f p N w h k ; F s p r h j d g ; n g l b > F s p l b > r y i t , a e j p u k > n j h i y f f h l r p g ; n g l b > k b f f z p d p e h ; n f h j p f y d ; N g h d w i t , a q F t j w f t L f s p y ; t o q f g g L k ; k p d r h u j i j e h k ; g a d g L j J f p N w h k ; t i L c g N a h f g ; n g h U s f s h d n f h j p f y d ; k w W k ; k p d r y i t g ; n g l b N g h d w i t n g h J t h f k p d N d h l l f ; f k g p e L e p i y f ; f k g p k w W k ; G t j n j h L g G f ; f k g p M f p a % d W t i f a h d f k g p f i s f ; n f h z b U f F k ; G t j n j h L g G f ; f k g p a h d J k p d r h j d q f s p d ; c N y h f g ; g u g N g h L , i z f f g g l b U f F k ; v j p h g h u j t j k h f k p d d j p r r p V w g L t i j j ; j L g g j w f h f , t t h W m J , i z f f g g L f p w J .

c j h u z k h f > k p d r y i t g ; n g l b a r y ; k p d N d h l l f ; f k g p a h d J k p d f h g G i w % y k ; K i w a h f g ; g h J f h f f g g l b U f F k ; x U N t i s k p d f r p T % y k ; k p d f h g G i w v h p e J N g h d h y ; k p d N d h l l f ; f k g p a h d J c N y h f g g u g i g j ; n j h L t j w f h d t h a g G s s J . G t j ; n j h L g G f ; f k g p a h d J

c N y h f g g u g g r y ; K i w a h f , i z f f g g l b U f F k N g h J > m j p f g g b a h f t U k ; k p d N d h l l k ; G t p a r y ; k p d d p w f f k ; n r a a g g l L > k p d ; m j p r r p a r y U e J e h k ; g h J f h f f g g L f p N w h k ; G t p a h d J r p w e j k p d f l j j p v d g j h y > g O j i l e j k p d f h g G i w a r y U e J f r p A k ; k p d r h u k ; m j d ; t o p N a g h a e J n r y f w J .

**k p d d y ; f l j j p**

c a u k h d f l l l q f i s k p d d y ; g h j p g G f s p y U e J g h J f h f f c j T k ; x U f U t p k p d d y ; f l j j p M F k ; , e j k p d d y ; f l j j p a r y ; x U c N y h f j ; j z l h d J f l l l j j p d ; N k w g F j p a r y ; f h w W l d ; n j h l h G n f h s S k ; t z z k ; n g h U j j g g l b U f F k ; f l l l q f s ; f l l g g L k N g h J > , e j c N y h f j ; j z L k ; m j p y U e J t U k ; j h k p u f ; f k g p A k ; f l l l j j p d ; R t h f s p y ; n g h U j j g g L k ; j h k p u f ; f k g p a p d ; k W K i d G t p f F m b a p Y s s c N y h f j ; j z l l d ; , i z f f g g l b U f F k ;

k p d d y ; t p O k N g h J m J f l l l j j p d ; N k w g F j p a r y ; , U f F k ; \$ H K i d f i s A i l a c N y h f j ; j z b d h y ; , O f f g g L f p w J . G t p A l d ; , i z f f g g l L s s j h k p u f ; f k g p t o p a h f , e j k p d N d h l l k ; G t p f F s ; g h a f p w J . k p d d y ; j h q f p , y y h t p l i h y ; f l l l j j p d ; k U k p d d y ; N e u b a h f t p O e J f l l l k ; N r j k i l e J t p L k ;

**k p d ; R w W f s ;**



vj nuj th; kpdD}l}k; ngww , uz l c Nyhff; Nfhsqfi s xU c Nyhff; fkgpady; , i z fFk; NghJ Fi wej kpdOj j k; nfhz l Nfhsj j yUeJ mj pf kpdOj j k; nfhz l Nfhsj j wF vyfluhdfs; ghaj; nj hl qFk; vdgi j g; gbJ Nhk; , i j gNhyNt> kpdOj j NtWghL nfhz l xU kpdfyj j pd; , U kpd:thafi sAk; xU c Nyhff; fkgpady; , i z fFkNghJ vj th; kpd:thayUeJ Nehkpd:thafF vyfluhdfs; ghaj nj hl qFk; kpd%yk; xdwpd; xU Ki daryUeJ kwnwhU Ki dfF vyfluhdfs; ghAk; ghi j kpdRwW vdggLk;

xU vsja kpdRwWpy; kpdru %yk; (kpd:fyk)> vyfluhdfs; nry:tj wfhd ghi j (c Nyhff; fkgp)> RwWpy; ghAk; kpdNdhllj j j f; flLggLj j k; rhtp kwWk; kpdruh j j hy; nraygLk; xU rhj dk; (kpdj i l) Mfpa ehdF \$Wfs; fhz ggLk; kpd:fyk> c Nyhff; fkgpfs> rhtp kwWk; kpd; tpsfF Mfpai t , i z ffgglLssd. xU kpd:fyk; myyJ tLfsYss kpdruh; , j j y; kpd%ykhf gadgLj j ggLfWJ. kpdj i l vdgi j kpd:dhwwi yg; gadgLj j k; rhj dj j j f; FwffWJ. kpdRwWpy; kpdNdhllk; ghatj wFk> mi j epWj j tj wFk; kwWk; flLggLj j tj wFk; rhtp gadgLj j ggLfWJ. rhtp %bapUfFkNghJ kpdNdhllk; vj thkpd:thayUeJ kpdRwWYss c Nyhff; fkgp kpd; tpsfF> rhtp MfpatwWpd; topahfg; ghaeJ , Wj j ay; Nehkpd:thi a teji l fWJ. kpd:tpsffYss kpd:pi o topahf kpdNdhllk; ghAkNghJ mJ vhpaj nj hl qFk; , ej ehdF \$Wfi sAk; , uz l topfsy; ehk; , i z ffyhk; mi t nj hl hpi z gG kwWk; gff , i z gG MFk;

<y; (Eel) vdw xU ti fahd tpyhqF kb; 650 thl j ; msTfF kpdruh j j c Uthffp kpd:dhrrpi a VwgLj j k; Mdhy; nj hl hrrpahf mJ kpd:dhrrpi af; nfhlj j f; nfhz bUej hy; mj Di la c l y; , UfFk; kpdD}l}k; KOtJ khf kpd:pwffk; mi l eJ tLk; mj dgi d; mj i dj; nj hLkNghJ kpd:dhrrp Vwgl hJ.

**nj hl hpi z gG:**

xdWfF Nkwgl kpdj i l fi sAk; (kpd; tpsfFfs)> kpdNdhllk; ghatj wF xNu xU ghi j i aAk; nfhz Lss kpdRwW nj hl h; kpdRwW vdggLk; vyfluhdfs; kpdfyj j pd; xU Ki dary; nj hl qfp vej f; fpi sFS kpyyhj %ba kpdRwWpy> kpd; j i l fs; (kpd; tpsfFfs) topahfg; ghaeJ kpdfyj j pd; kWKi di ar; nrdwi l fpdwd. nj hl hpy; c ss mi dj j kpd:\$WFS k; xdwdgd; , i z ffgglLssd. , j dhy> kpdRwWpy; ghAk; kpdNdhllj j pd; kj j gG kpdRwW KOtJk; khwhky; , UfFk; Mdhy; kpdOj j j j pd; kj j ghdJ kpdRwWYss kpdj i l fsy; ghpeJ fhz ggLfWJ.

nj hl hpi z ggpy; kpdfyj j yUeJ kpdD}l}k; (vyfluhd) ghatj wF xNu xU %ba RwW klLNk c ssJ. , j j y; kpdfyk> rhtp kwWk; , uz l kpd:tpsfffs; xdwpd; gpd; xdwhf , i z ffgglLssd. kpdRwWpy; , uz l kpd:tpsffFS k; , i z ffgglbUfFk; thpi rapdgb> mi t xtnthdwpd; topahf vyfluhdfs; ghaeJ nryyk; , i z ggpyss VNj Dk; xU kpd:tpsfif efpptlhy; gpw kpd:tpsffFSfF kpdNdhllk; ghatJ j i l gLk; topffhyqfsy; nj hl h; kpd:tpsfffi s ehk; mi kffpNwhk; nj hl h; , i z ggpyss kpd:tpsffFS s; xU kpd:tpsff gOj i lej hYk; gpw tpsffFS k; vhpahJ. nj hl hpy; , i z ffgglLk; kpd:tpsfffsj d; vz z pfi fi a mj j fggLj j kNghJ kpd:tpsfffsj d; ntsjrrk; Fi weJ nfhz NI tUk; Vnddpy> kpdfyj j yUeJ tUk; kpd; j pd; mj pf vz z pfi fapyhd kpd:tpsfffsy; gfphej nfhs sggLfWJ.

kpdj i l fs; nj hl hpi z ggpy; c ss NghJ xtnthU kpdj i l topahfTk; xNu msT kpdNdhllk; ghatj j Ak> mtwWpfpilNa kpdOj j k; nttNtwhf , Uggi j Ak; ehk; ghjhj Nhk; %dW kpd:tpsfffs; xNu nj hl hpy; , i z ffgglLssj hf ehk; fUJNthk; RwWpd; topahfg; ghAk; kpdNdhllj j j l vdTk; kpd:tpsffFS fF , i l NaAss kpdOj j j j j V<sub>1</sub>, V<sub>2</sub>, V<sub>3</sub>vdTk; vLj j fnfhz l hy> kpd%yj j yUeJ

nfhLf fggLk; kpd dOj jk; V xtnthU kpd; tps fFfs fF , i | NaAss  
kpd dOj j qfs pd; \$Lj YfFr; rkkhf , UfFk;  
 $V = V_1 + V_2 + V_3$

**gf;f , i z gG:**

gf;f , i z gG; xdwf;f Nkwgl; kpd; j i l fs; (kpd; tps fFfs) xdwf;f Nkwgl;  
ghi j fi sf; nfhz; kpd; Rwwpy; , i z f;fggl; f;pdwd. , j dhy; kpd; fyj j pd; xU  
Ki d; ap; Ue;J GwggLk; vyf; l; uhd; fs; xdwf;f Nkwgl; %ba Rwwf; fs; py; ghae;J  
kpd; fyj j pd; kWKi di a mi l; f;pdwd. gf;f , i z gG; kpd; j i l fs f; f; pi | Na  
c ss kpd dOj jk; khwhky; xNu msthf , UfFk; Mdhy; kpd; Rwwpd; topahf;g;  
ghAk; kpd; Ndh; l; k; xtnthU kpd; j i l ap; Yk; gh; p; e;J nttNtW msthf , UfFk;

kpd; Ndh; l; khd; J ABEFA kwWk; ABCDEFA Mf; p; a , U ghi j fs; py; ghae;J nryy  
KbAk; kpd; fyj j py; Ue;J tUk; kpd; Ndh; l; khd; J ABEFA vdw ghi j topahf; Nth  
myy; J ABCDEFA vdw ghi j topahf; Nth ghae;J k; l; Lk; kpd; fy; i d  
te; j i l; f;pdw; J. , j; py; xU kpd; tps fF gOj i l e; j hYk; , uz; l; ht; J kpd; tps fF  
vhp; aKbAk; vdg; i j mw; p; ayhk; Vndd; py; > kpd; Ndh; l; khd; J , uz; l; nttNtW  
ghi j fs; py; gh; a; f; w; J. ehk; tL; fs; py; gad; gL; j j ggLk; kpd; tps fFfs; mi d; j; Jk; gf;f  
, i z gG; , i z f;fggl; Lssd. , j dhy; t; l; by; , UfFk; xU kpd; tps fF vhp; ahky;  
, Ue; j hYk; gw; tps fFfs; vhp; f; pdwd. NkYk; > nj hl hpi z gG; Yss kpd;

**nj hl h; kwWk; gf;f , i z gG; fF fF , i | Na c ss NtWghL:**

nj hl h; , i z gG; Rww	gf;f , i z gG; Rww
kpd; Rww; Yss mi d; j; Jf; \$Wf; spYk; rk mst; yhd kpd; Ndh; l; k; ghAk;	xtnthU \$w; p; Yk; ghAk; kpd; Ndh; l; qfs pd; \$Lj y; kpd; fy; d; py; Ue;J ghAk; kpd; Ndh; l; j j w; Fr; rkkhf , UfFk;
kpd; Rww; pd; xtnthU \$Wf; S fF , i   Naahd kpd dOj j qfs pd; \$Lj y; kpd; fy; d; pd; kpd dOj j j j w; Fr; rkkhf , UfFk;	kpd; Rww; Yss mi d; j; J \$Wf; S f; f; pi   Na c ss kpd dOj jk; Rkkhf , UfFk;
mi d; j; J kpd; \$Wf; S k; xdw; d; gpd; xdwhf , i z f;fggl; bUfFk;	mi d; j; J kpd; \$Wf; S k; gf;f , i z gG; py; , i z f;fg; gl; bUfFk;
VNj Dk; xU Gss; p; py; , i z gG j i l gl; l; hy; kpd; Rww; pd; topahf kpd; Ndh; l; k; ghahJ	VNj Dk; xU kpd; \$W nraygl; hky; , Ue; j hYk; kw; kpd; \$Wf; s; topahf kpd; Ndh; l; k; ghAk;

t; ps fFfi sgNghy; gf;f , i z gG; py; kpd; tps fFfs; kq; f; p; vhp; t; j; py; y. Vndd; py; > xU  
kpd; Rww; G; ghi j ap; y; , UfFk; kpd dOj j NtWghL; j hd; mi d; j; J  
kpd; Rww; Ggh; j fs; pYk; , UfFk;

%dW kpd; tps fFfs; gf;f , i z gG; py; , i z f;fggl; Lss; j hff; fUJNthk; xtnthU  
kpd; tps f; f; pd; pi | Na V vdw kpd dOj jk; c ss; j hfTk; xtnthU kpd; tps f; f; pYk; I<sub>1</sub>,  
I<sub>2</sub>, I<sub>3</sub> vdw kpd; Ndh; l; qfs; gh; a; t; j hfTk; vL; j; J f; nfhz; l; hy; > kpd; fy; d; py; Ue;J ghAk;  
kpd; Ndh; l; khd; J (I), %dW kpd; j i l fs; pd; topahf;g; ghAk; kpd; Ndh; l; j j w; Fr;  
rkkhf , UfFk;

$$I = I_1 + I_2 + I_3$$

**kpd; Ndh; l; j j pd; t; pi sTfs;**

xU fl; j j p; pd; topahf kpd; Ndh; l; k; ghAk; Ngh; J m; J xUr; py; t; pi sTfi s  
VwgL; j; J f; w; J. , i t kpd; Ndh; l; j j pd; t; pi sTfs; vdw mi of; f; ggL; f; pd; d.

kpdNdhl | j j pd; , ej tpi stpdhy; kpdDhwwyhdJ ntgg Mwwy> , aeju Mwwy> fhej Mwwy> Ntjp Mwwy; vd gyNtW Mwwy; fshf khwwki l fpdwJ.

**kpdNdhl | j j pd; Ntjp tpi sT:**

cNyhfqfs; kpdrhujijf; fljJk; vdgi j ehk; mwNthk; , ej r; nrayghL %yk; jptgnghUs;fSk; kpdrhujijf; fljJk; vdgi j ehk; mwpaKbfwJ. fi ury; xdwpd; toNa kpdrhujijr; nrYjJkNghJ fi ury; rpy Ntjtpi dfs; czlhfpdwd. , ej Ntjtpi dfs; kpdrhujijf; fljJk; vyfluhdfi s czL gzZ fpdwd. , JNT kpdNdhl | j j pd; Ntjp tpi sT MFK; fi ury; topahf kpdNdhl | j j r; nrYjJkNghJ fi ury; , UfFk; %yfWfs; Neh; kwWk; vjph; kpd; madpshf Ntjp; rpi j tiltJ kpdDhwgFjjy; vdggLk; kpdDhwgFjjy; gyNtW Ji wfsy; gadgLfwJ. cNyhfqfi s mtwmpd; jhJgnghUs;fspy; UeJ ghj nj Ljjy; kwWk; Jjai kggLJjy; kpdDhwgFjjy; kwWk; Jjai kggLJjy; kpdDhwgFjjy; Ki w gadgLjj ggLfwJ. kpdDhw; gFjjy; kpf Kf; fakhd gad; kpd; Kyhk; GRj y; MFK;

**kpd; Kyhk; GRj y;**

kpdNdhl | j j pd; Ntjtpi stpd; nghJthd gadghL kpd; Kyhk; GRj y; MFK; kpdNdhl | j j g; ghar; nra; t; d; %yk> xU cNyhfjjpd; glyjij kwnwhU cNyhfjjpd; Nkwguggpy; gbai t; f; Fk; epfo; T kpd; Kyhk; GRj y; vdggLk;

kpd; Kyhk; GRj y; gyNtW Ji wfsy; gadgLfwJ. cWjpi; j di kffhf ghyqfs; kwWk; thfdqfsy; ehk; , Ukgpi dg; gadgLjJfwNwhk; Mdhy; , UkgpdkU mhpkhd; VwglL mJ JUggpbfwJ. , Ukgpd; kU VwglL; mhpkhd; kwWk; JUggpbjji yj; j thggj wfhf mj d; kU Jjj ehfggl ykl GrggLfwJ. mJ Nghy> FNuhkpk; gsgsgGj; j di kAi laJ. mJ vsj py; JUggpbggj pyi y. vsj py; , j dkU fwy; tpoH. Mdhy; FNuhkpk; tpi y cahej J. NKYk> FNuhkpi j klLNK gadgLjjp KwwpYkhf xU nghUi s cUthf; Ftj wF mj pf nryT VwglL; vdNt> thfdqfs; c; j; thp ghqfs> Fohafs> vhrthA vhrfydfs; kjj ptz bapd; i fggpbfs> thfdqfs; rffuqfs; Mfpatwi w tpi y kypthd cNyhfjjhy; nraJ> gwF mj d; kU FNuhkpk; NkwGrhf GrggLfwJ.

**kpdNdhl | j j pd; ntgg tpi sT:**

fljjp; topahf kpdNdhl | k; ghAkNghJ> mj py; efUk; vyfluhdfS fFk> mj pYss %yf; \$WfS fFk; , i l Na Fwggpljj Fej mstpy; cuha; T ei l ngWk; , ej epfo; t; d; NghJ kpdDhwwy; ntgg Mwwyhf khwwggLfwJ. , JNT kpdNdhl | j j pd; ntgg tpi sT MFK; mtthW cUthFk; ntggjjpd; mst mf; fkgpahy; toq; fggll kpdjili ag; nghWj J mi kAk;

j hkpuf; fkgp Fi wej mst kpdjili af; nfhz bUggj hy> mJ vsj py; ntggki l t; j; yi y. mNj rkak; kpd; t; s; f; Ffs; y; gadgLj j ggLk; l q; ] l d; myyJ epfNuhk; Mfpatwmpd; nkyypa fkgpfs; mj pf kpdjili af; nfhz Lssd. vdNt> mi t vsj py; ntggki l fpdwd. , j dhy; hd; l q; ] l d; fkgpi a kpd; t; s; f; Ffs; y; k; epfNuhk; fkgpi a nghUs; fi s ntggggLjjg; gadgLk; tll c gNahfg; nghUs; fspYk; gadgLjJfwNwhk; kpdrhujijpd; ntggtpi stpi d gyNtW rhj dqfsy; fhz KbAk; mtwWs; rpy fNo j uggL Lssd.

**kpd; c Ufp**

Fi wthd cUFepi y nfhz l ntsslak; kwWk; fhhlak; fyej cNyhff; fyi tapdhy; jahhf; fggll JzL; f; fkgpNa kpd; cUfp MFK; , j id kpdRwWf; fsp; , i z f; f; yk; , J xU Fwggpl mst kpdrhujij klLNK gadgLjjf; \$baJ. mj pf mstpyhd kpdNdhl | k; , j d; topahfg; ghAkNghJ> , J #lhf cUFptpLfwJ. , J Fi wej cUFepi yi af; nfhz Lssjhy; vsj py; cUfp kpdRwi w j pwej Rwwhf; fptpLk; , j dhy> kpd; rhj dqfs; gojhtJ j th; f; fggLfwJ.

**கப்ட; ரி காவ்யுட;**

கப்ட; ரி காவ்யுட; , Uf;Fk; fkgprRUS; kப்டNdh;l;k; ghAkNghJ mJ  
#lhtjhy> ரி காவ்யுட; #lhf;wJ. , j dhy; nts;ggLk; ntgg Mwwi y  
ntggf;fl;jj y; %ykhf ரி காவ்யுட; ngWf;wJ.

**கப்ட; நஹ் ிஃயுட; (Electric kettle):**

nfhj ிஃயுட; m;bggFj;ப;ப; n;ggNkwWk; rhj dk; i tff;gg;l;bUf;Fk; n;ggNkwWk;  
rhj dj;j;ப;Ue;J nts;ggLk; ntggk; j;ப;tk; KOtJk; ntggrrydk; %yk;  
guTf;pd;wd;J.

**கப்ட; , ] j ிஃயுட; :**

ntggNkwWk; rhj dj;j;ப;ப; to;ப;hf kப்டNdh;l;k; ghAkNghJ c UthFk; ntggkhd;J>  
m;bggFj;ப;ப;Yss fdkhd c Nyhfg; gl;i;l;f;Ff; fl;j;j;ggL;f;wJ. , j dhy> mj d;  
ntgg;epi y mj ிஃயுட; . , ej ntgg Mwwy; Mi l fi sj; Nj aff c j T;f;wJ.





, U Gsssp kpdD}l}qfS fF , i lapy; VwgLk; epi ykpdDpay; tpi r epA}l}d}pd;  
%dwhTJ t}j}papd; mbggi lapy; , aqFf}pwJ. xU kpdD}l}j}j}pd; k}U VwgLk; tpi r  
tpi dahfTk; , dndhU kpdD}l}j}j}pd; k}U vwgLk; tpi r vj}h; tpi dahfTk;  
nraygLf}pdwd.

**kpd; tpi r:**

kpdD}l}qfS f}f}pi lapy; VwgLk; kpd; tpi r (F) , U ti fggLk; xdW fthrrp tpi r>  
kwnwhdW t}y}f}F tpi r Xhpd kpdD}l}qfS; xdi wnahdW t}ul}Lk; Ntwpd  
kpdD}l}qfS; xdi wnahdW ftUk; kpdD}l}qfS f}f}pi lapy; cUthFk; tpi r  
kpd; tpi r vdggLk; , t}tpi r 'nj hLi fapyyh tpi r' (non-contact force) ti fi ar;  
Nrhej J. Vndd}y> kpdD}l}qfS; xdWfnfhdW nj hLj y; , yyhKNyNa , t}tpi r  
nraygLk;

**kpdGyk:**

xU kpdD}l}j}j}j}r; Rwwp mj d; kpd; tpi ri a NtnwhU Nrhi d kpdD}l}k;  
czuf\$ba gFj}pNa kpdGyk; vdggLk; kpdGyk; ngUkghYk; NfhLfshYk;  
kpdGy}j}j}pd; j}pi r mkGf}Fw}f}shYk; Fw}f}fggLf}pdwd.  
xU r}pW Neh; kpdD}l}j}j}pd; k}U nraygLk; tpi rapd; j}pi rNa kpdGy}j}j}pd;  
j}pi rnadf; nfh}ssggLk; vdNt> kpdGy}j}j}f; Fw}f}Fk; NfhLfs; kpd; tpi rf;  
NfhLfs; vdggLf}pdwd. kpd; tpi rf; NfhLfs; xU XuyF Neh; kpdD}l}k; kpdGyk;  
xdwpy; efu KwgLk; j}pi ray; ti uaggLk; Neh; myyJ ti sTf; NfhLfshFk;  
mi t f}wgi df; NfhLfNs. mfNfhLfs}pd; neUf}fk; kpdGy}j}j}pd; t}ypi ki af;  
Fw}f}Fk;

xU j}d}j}j} Neh; kpdD}l}j}j}pd; kpd; tpi rf; NfhLfs; Mutopay; nts}Nehf}f}pAk>  
vj}h; kpdD}l}j}j}pd; kpd; tpi rf; NfhLfs; Mutopay; c sNehf}f}pAk; , Uf}Fk;

xU Gss}p}ay; i t}f}fggLk; xuyF Neh; kpdD}l}j}j}pd}hy; czuggLk; tpi rNa  
mgGss}p}ay; kpdGyk; vdggLk; Neh; kpdD}l}k; xdW kpdGy}j}j}pd; j}pi rap}NyNa  
tpi ri ag; ngWk; vj}h; kpdD}l}k; xdW kpd; Gy}j}j}pd; j}pi rf}F vj}p}hf tpi ri ag;  
ngWk;

**kpd}d}Oj}j}k;**

kpdD}l}qfS f}f}pi lNa kpd; tpi r (ftUk; tpi rNah myyJ t}ul}L tpi rNah)  
, Uej}hYk> mi t mej epi ya}p}NyN , Uj}j}gg}l}Lssd xU kpdD}l}j}j}j}r; Rwwp  
xU kpdGyk; , Uf}Fk; vdgi j} ehk; mw}p}Nthk; , gGy}j}j}p}Ds; , Uf}Fk; gw}p}nj}hU  
kpdD}l}k; tpi ri a cz Uk; kWj}i yahf K}j}y; kpdD}l}k}k; tpi ri a cz Uk;  
, k}k}pdD}l}qfi s epi ye}p}Wj}j}p}XH; mi kgghf i t}ff Nti y nraagg}l} Ntz}Lk;  
, j}d; tpi sthf 'kpd}d}Oj}j}k;' vdwnj}hU mst}l} Nj}hd}Wf}pwJ.

mi dj}J kpd; tpi rf}S f}Fk; vj}p}hf xuyF Neh; kpdD}l}k; xdi w xU Fw}p}gg}l}  
Gss}p}f}Ff; nfhz}L tur; nraaggLk; Nti y kpd}d}Oj}j}k; vdggLk;

**kpdNdh}l}k;**

kpdD}l}k; ngww nghUs; xdww}w}F fl}j}Jk; ghi j} ms}p}f}fgg}l}hy> vyf}l}uhd}fs;  
mj}p}f} kpd}d}Oj}j}j}j}p}Ue}J Fi wthd kpd}d}Oj}j}j}j}p}w}F mgghi j} to}p}Na  
gha}f}pdwd. nghJ}thf kpd}d}Oj}j} NtWgh}l}hd}J> xU kpd}f}y}j}j}pd}h}Nyh myyJ  
kpd}f}y} m}L}f}f}pd}h}Nyh to}q}f}gg}L}f}pwJ. vyf}l}uhd}fs; efUk}NghJ kpdD}l}k;  
cUth}t}j}h}ff; \$Wf}p}Nwhk; mj}ht}J> kpdD}l}k}hd}J efUk; vyf}l}uhd}f}shy;  
cUth}f}pwJ.

**kpdNdh}l}j}j}pd; j}pi r:**

vyf}l}uhd}fs}pd; fz}Lg}p}og}G}f}F Kd; Neh; kpdD}l}qfS}pd; , aff}j}j}y; j}hd;  
kpdNdh}l}k; ml}q}f}p}Ass}J vdW mw}p}t}pay}h}sh; ek}g}pd}h; , J}j}t}W vdgi j} , g}NghJ  
ehk; mw}p}ej}p}Ue}j}hYk; , f}f}U}j}J , d}Dk; guty}hf , Ue}J t}Uf}pwJ. NkYk>

vyfl uhd; fz Lg; g; F; g; d; U; k; p; d; N; d; h; l; j; j; g; g; w; w; m; b; g; g; i; l; g; G; h; j; y; y; v; t; t; j; g; h; j; g; G; k; V; w; g; l; t; y; y; y; N; e; h; k; p; d; D; } | | q; f; s; p; d; , a; f; f; k; 'k; u; G; k; p; d; N; d; h; l; k; v; d; W; k; v; y; f; l; u; h; d; f; s; p; d; , a; f; f; k; 'v; y; f; l; u; h; d; k; p; d; N; d; h; l; k; v; d; W; k; m; i; o; f; f; g; g; L; f; p; d; w; d.

k; p; d; R; w; W; g; g; l; q; f; s; p; y; N; e; h; k; p; d; t; h; i; a; e; l; s; k; h; d; N; f; h; l; j; j; z; b; d; h; Y; k; v; j; t; h; k; p; d; t; h; i; a; r; m; w; a; N; f; h; l; j; j; z; b; d; h; Y; k; F; w; g; g; h; k; p; d; f; y; m; L; f; F; v; d; g; J; x; d; W; f; F; N; k; w; g; l; k; p; d; f; y; q; f; s; p; d; n; j; h; F; j; p; a; h; F; k;

### k; p; d; N; d; h; l; j; j; j; m; s; t; p; L; j; y;

k; p; d; N; d; h; l; j; j; j; p; d; k; j; g; g; i; g; m; s; t; p; L; m; j; d; v; z; z; s; i; t; e; k; k; h; y; F; w; g; g; p; l; K; b; A; k; k; p; d; R; w; w; p; d; x; U; G; s; s; p; i; a; x; U; t; p; d; h; b; a; y; f; l; e; j; n; r; y; Y; k; k; p; d; D; } | | q; f; s; p; d; k; j; g; g; N; g; k; p; d; N; d; h; l; k; v; d; g; g; L; k; m; j; h; t; J; > f; k; g; p; a; p; d; x; U; F; w; g; g; p; l; F; W; f; F; n; t; l; L; g; g; u; g; i; g; q; m; s; T; k; p; d; D; } | | k; t; f; h; y; j; j; y; f; l; e; j; p; U; e; j; h; y; > k; p; d; N; d; h; l; j; j; j; p; d; m; s; T; > l; = q/t

k; p; d; N; d; h; l; j; j; j; p; d; S. I. m; y; F; M; k; g; p; a; h; m; j; d; F; w; a; L; A. 1; M; k; g; p; a; h; v; d; g; J; f; k; g; n; a; h; d; w; p; d; F; W; f; F; n; t; l; L; g; g; u; g; i; g; 1; t; p; d; h; b; a; y; 1; \$; Y; k; m; s; t; p; y; h; d; k; p; d; D; } | | k; f; l; f; F; k; N; g; H; c; U; t; h; F; k; k; p; d; N; d; h; l; k; M; F; k;

$$1 \text{ Mkgpah} = 1 \text{ \$Yk} / 1 \text{ tpdhb (myyJ)}$$

$$1A = 1C/1s = 1C s^{-1}$$

x; U; k; p; d; R; w; w; p; y; m; i; k; A; k; k; p; d; N; d; h; l; j; j; j; p; d; k; j; g; g; i; g; m; s; t; p; l; c; j; T; k; f; U; t; p; m; k; k; l; l; h; v; d; g; g; L; k;

v; e; j; k; p; d; R; w; w; p; y; k; p; d; N; d; h; l; j; j; j; m; s; t; p; l; N; t; z; L; N; k; h; m; j; y; M; k; k; l; l; i; u; n; j; h; l; h; p; i; z; g; g; y; , i; z; f; f; N; t; z; L; k; m; k; k; l; l; h; p; d; r; p; t; g; G; K; i; d; a; p; d; (+) t; o; p; N; a; k; p; d; N; d; h; l; k; E; i; o; e; J; f; U; g; G; K; i; d; a; p; d; (-) t; o; p; N; a; n; t; s; p; N; a; W; k;

f; k; g; n; a; h; d; w; p; d; F; W; f; F; n; t; l; L; g; g; u; g; i; g; 25; \$; Y; k; m; s; t; p; y; h; d; k; p; d; D; } | | k; 50; t; p; d; h; b; f; h; y; j; j; y; f; l; e; j; n; r; d; w; h; y; m; j; d; h; y; t; p; i; s; A; k; k; p; d; N; d; h; l; j; j; j; p; d; m; s; T; v; d; d; ?  
j; h; T;

$$I = q/t = (25 C) / (50 s) = 0.5 C/s = 0.5 A$$

t; p; s; f; F; x; d; w; p; d; t; o; p; N; a; g; h; A; k; k; p; d; N; d; h; l; k; 0.2A. t; p; s; f; F; x; U; k; z; p; N; e; u; k; v; h; e; j; p; U; e; j; h; y; > m; j; d; t; o; p; N; a; g; h; a; e; j; n; k; h; j; j; k; p; d; D; } | | j; j; j; p; d; k; j; g; g; v; d; d; ?  
j; h; T;

$$I = q/t; q = I t$$

$$1 \text{ kZ p} = 1 \times 60 \times 60 = 3600 \text{ s}$$

$$q = I t = 0.2 \text{ A} \times 3600 \text{ s} = 720 \text{ C}$$

### k; p; d; p; a; f; F; t; p; i; r;

e; h; e; p; u; g; g; g; l; l; x; U; F; o; h; a; p; d; , U; K; i; d; f; S; k; , i; z; f; f; g; g; l; L; s; s; j; h; f; f; f; U; J; N; t; h; k; K; O; T; J; k; e; p; u; k; g; p; a; p; U; g; g; p; D; k; > e; h; j; h; d; h; f; N; t; m; e; j; f; F; o; h; a; p; D; s; R; w; w; p; t; u; K; b; a; h; J. k; h; w; h; f; > , i; w; g; g; h; d; (pump) x; d; i; w; F; o; h; a; y; , i; z; j; j; h; y; > m; J; e; l; u; j; j; s; S; t; j; d; %; y; k; F; o; h; a; p; D; s; e; N; u; h; l; k; f; h; z; g; g; L; k; , a; q; F; k; e; l; u; f; n; f; h; z; L; g; a; d; g; L; k; t; i; f; a; y; N; t; i; y; n; r; a; a; , a; Y; k; e; p; r; r; f; f; u; k; x; d; i; w; , i; l; a; y; n; g; h; U; j; j; p; d; h; y; > m; J; R; o; Y; k; m; j; d; %; y; k; n; g; h; w; p; i; s; , a; f; f; K; b; A; k;

m; J; N; g; h; y; > x; U; t; l; l; t; b; t; j; h; k; p; u; f; f; k; g; p; v; y; f; l; u; h; d; f; s; h; y; e; p; u; k; g; p; c; s; s; J. v; d; p; D; k; > m; i; t; v; e; j; f; F; w; g; g; p; l; j; p; i; r; a; p; Y; k; , a; q; F; t; j; y; i; y. m; t; w; i; w; F; w; g; g; p; l; x; U; j; p; i; r; a; y; , a; f; f; > t; p; i; r; n; g; h; U; j; j; p; d; h; y; > m; J; R; o; Y; k; m; j; d; %; y; k; n; g; h; w; p; i; s; , a; f; f; K; b; A; k;

mJNghy> xU tli tbt jhkpuf;fkgp vyfluhdfshy; epukgp c ssJ. vdpDk> mi t vej f; Fwggpl jpi rapYk; , aqFtjpyi y. mtwi w Fwggpl xU jpi rapy; , aff> tpi r xdW Nji tggLfWJ. eh; , i wghd; kwWk; kpd;fy mLfF Mfpatwmpd; xggll L fhl j ggl LssJ.

kpd;fyqfSk> kww kpd;dhwwy; %yqfSk; , i wghidg; NghdW nrayglL> kpd;D}l j qfi sj; jsStjhy; mi t fkgp myyJ fljjpdpd; topNa ghafpdwd. kpd;dhwwy; %yqfspd; , ej jsSk; nrayghL mtwmpd; kpd;dpafF tpi rapdhy; nraaggLfWJ. kpd;dpafF tpi rapd; FwpaLL ε. xU kpd;dhwwy; %yjjpd; kpd;dpafF tpi r vdgJ xuyF kpd;D}l j khD (q) kpd;Rwi w xUKi w Rwwptu nraaggLk; Nti y (W) MFk;

$$\epsilon = W/q$$

, qF W vdgJ nraaggll Nti y kpd;dpafF tpi rapd; SI myF [\_y; /\$Y}k; (JC-1) myyJ Nthyl; (v). kpd;dhwwy; %yk; xdW xU \$Y}k; kpd;D}l j j kpd;Rwi wr; Rwwp mDgg xU [\_i y Nti yi ar; nrajhy; mj d; kpd;dpafF tpi r 1 Nthyl; vdyhk;

xU kpd;fyjjpd; kpd;dpafF tpi r 1.5V. 0.5C. kpd;D}l j j mej kpd;Rwi wr; Rwwp mDggj; Nji tggLk; Mwwy; vt;stT?  
j h;T:  
 $\epsilon = 1.5 \text{ V}; q = 0.5 \text{ C}$   
 $\epsilon = W/q; W = \epsilon \times q = 1.5 \times 0.5 = 0.75 \text{ J}$

**kpd;D}j NtWghL:**

ehk; kpd;fyjjpd; xU Ki dAl d; , dndhU Ki di a klLk; fkgp nfhz L , i z ggJ , yi y. nghJthf> xU kpd; tpsfi fNah> rpw kpd; tprwpi aNah myyJ VNj DK; xU kpd; fUtpi aNah , i z j j gpd; mj d; topNa kpd;Ndhll j j nrYj; JfNwhk; , j dhy> kpd;fyk; myyJ kpd;dhwwy; %yjjpYss Fwggpl msT kpd;dhwwy; xspahwwyhFNth> vejpu MwwyhFNth> ntgg MwwyhFNth khwwggLfWJ. kpd; tpsfF (myyJ , ju gpw kpd; fUtpfs) topahfr; nryYk; xtntu \$Y}k; kpd;D}l j j pdhYk; gpw ti fshf khwwggLk; kpd;dhwwypd; msT mej kpd; fUtpfF; Fwfnf cUthFk; kpd;D}j NtWghl i l r; rhheNj , UffpwJ. kpd;D}j NtWghl bd; FwpaLL V.

$$V = W/q$$

, qF>W vdgJ nraaggll Nti y> mjhtJ gpw ti f Mwwyfshf khwwggll kpd;dhwwypd; msT ([\_y; /\$Y}k; MFk; q vdgJ kpd;D}l j j pd; msT (\$Y}k;). kpd;D}j NtWghL kwWk; kpd;dpafF tpi r , i t , uz bwFNk S.I myF Nthyl; (V) MFk;

xU kpd; #NI wmpdpd; topahf  $2 \times 10^4 \text{ C}$  kpd;D}l j k; ghafpwJ. 5 MJ MJ msT kpd;dhwwy; ntgg Mwwyhf khwwggLfWJ vdpY>#NI wmpdpd; Fwfnf fhz ggLk; kpd;D}j NtWghl i l f; fz ffpLf.  
j h;T:  $V = W/q = 5 \times 10^6 \text{ J} / 2 \times 10^4 \text{ C} = 250 \text{ V}$

kpd;D}j NtWghl i l mstpl cjTk; fUtp Nthyl kl i h; MFk; xU fUtpdpd; Fwfnf fhz ggLk; kpd;D}j NtWghl i l msejpl Nthyl kl i h; xdi w mj wF gff , i z gghf , i z ff Ntz Lk; kpd;tpsfF xdwpd; kpd;D}j NtWghl i l msejpl Ntz LnkdpY> fhl bAssthW mi j , i z j j y; Ntz Lk;

**FwpgG:** Nthyl kl i hpd; rptgG Nehkpi d kpd;Rwwpd; Nehf;Fwp (+) gff; j I Dk; mj d; fUgG vj thki d kpd;Rwwpd; vj thf;Fwp (-) gff; j I Dk; kpd;rhj dj j pWFf; (kpd;tpsfF) Fwfnf , i z ffggl Ntz Lk;



**kpj i l :**

xU kpj; fUtjapd; topNa kpjdhlk; ghatjwF mffUtp msrfFk; vj phggpd; msNt kpjil (R) vdggLk; nttNtW kpj; nghUsfspd; kpjil nttNtwhf , UfFk;

j hkpuk> mYkpjap; c sspil c Nyhfqfspd; kpjil Gwffz pffjjff mstpy; , UfFk; vdNtjhd; mit ewfljjpfs; vd mi offggLfpdwd. khwhf> epfNuhk> ntssla MfirL c sspil nghUsfs; kpjNdhlljjwF mjpf kpjilia msrfpfdwd. mit kpj; fljjhg; nghUsfs; vd mi offggLfpdwd. NkYk> kpjfhgGfs; vdwi offggLk; rpy nghUsfs; (fz z hb> gygbkk; vdw ghyphk> , ugg; kwWk; fhfjk; c sspilit) rpwjk; kpjNdhlljjj; fljjhjit. , tti djJ ti fg; nghUsfSNk gyNtW ti ffsy; gaDssjhFTk; kpjRwWfsy; ghJ fhgGf; fUtpfshFTk; gadgLjj ggLfpdwd.

kpjil apd; SI myF Xk; kwWk; mj d; FwpaL Q MFk; xU fljjj apd; topahf 1 Mkgpah; kpjNdhllk; ghAk; NghJ mj d; Kidfs fpi layhd kpjDObj NtWghL 1 Nthyl; vdp; mej f; fljjj apd; kpjil 1 Xk; MFk;

kpjili ag; gadgLjjj xU kpjRwWpy; nryYk; kpjNdhlljjj; msitf; flLggLjjyhk; , t;thW kpjilia msrfFk; nghUsfSfF 'kpjilaqfs'; vdW ngah; kpjilaqfs; epi yahFTk; , Uffyhk; myyJ khWk; kjpgGila adthFTk; , Uffyhk;

epi yahd kpjilaqfs; xU Fwggpil khwh kjpgGila kpjiliaf; nfhz bUfFk; khWk; kpjilaqfSk; kpjil khwwpSk; ekfFj; NjittggLk; kjpgGila kpjilifisg; ngWk; tz z k; khwwpai kfff; \$bajhf , UfFk;

**Fwgg:**

kpjdjafF tpir - kpjDObj NtWghL , uz bwFkhd NtWghL. , uz ilANK mstpl Nthyl; vdW myifNa gadgLjJtjhy; , itapuz Lk; xdW Nghyj; NjhdWk; Mdhy; czik mJtyy. kpjdhwWy; %yk; xdW kpjRwWp; topNa kpjNdhlljjj; nryYjjhj epi yary; mj d; Kidfs fFf; Fwfnf fhz ggLk; kpjDObjqfspd; NtWghL kpjdjafF tpir vdggLk; khwhf> kpjdhwWy; %ykhDJ kpjUtpfspd; topahfnth myyJ xU kpjRwWpNyh kpjNdhlljjj; nryYjJk; epi yary; mj d; Kidfs fFf; Fwfnf fhz ggLk; kpjDObjqfspd; NtWghL kpjDObj NtWghL vdggLk;

**kpjRwWg; gl k;**

kpj; fkgpapi z gi gf; FwffFTk; kpjRwWfs; njhlghd fz fFfi sj; j hffFTk> kpjRwWg; glqfs; ti uaggLfpdwd.

xU kpjRwWg; gljjj; ehd;F Kffjaf; \$Wfshtd;

1. kpjfyk;
2. , iz gGf; fkgp
3. rhtp
4. kpjil myyJ kpjgS

, ijj; jtpu> gpw kpj; fUtpfSk; xU kpj; RwWpy; gadgLjj ggl yhk; mtwi wf; Fwggj wF rldhd FwpaLL Kiw cUthffggLssJ. xU FwpaLL nkhopi af; fwgJ Nghy; , iJAk; fwwhy> kpjRwWg; glqfisi; GhpeJ nfhs;tJ vspl. kpjRwWfsy; nghJ thf gadgLjj ggLk; FwpaLfs; rpy nfhlffggLssd.

kpjRwWf;fsy; gadgLjj ggLk; nghJ thd FwpaLfs;

குறியீடு	கருவி	குறியீடு	கருவி	குறியீடு	கருவி
	சாவி		இணைக்கப் பட்டுள்ள கம்பிகள்		கால்வனாமிட்டர்
	மின்கலம்		குறுக்கிடும் கம்பிகள்		அம்மீட்டர்
	மின்கல அடுக்கு		நிலையான மின்தடை		வோல்ட் மீட்டர்
	நேர்மின்னோட்ட மூலம்		மாறு மின்தடை (மின்தடைமாற்றி)		இரு வழிச் சாவி
	மாறுமின்னோட்ட மூலம்		மின்னூருகு இழை		தரை இணைப்பான்
	மின் விளக்கு		கம்பிச் சுருள்		மின் தேக்கி
	மின்னழுத்தமாணி		மின் மாற்றி		வெப்பத் தடையம்
	ஒளிசார் மின்தடையம்		குறை கடத்தி டையோடு		மின்சார மணி

gYntW kpdRwWfs;

, U kpdRwWfi sAk; , U kpd; tpsf;Ffs; nj hl hpi z ggpYk; gf:f , i z ggpYk; , i z ffgglLssd. mtwi wg; gwpp j dj j dpahff; fhz Nghk;

nj hl h; , i z gGfs;

nj hl hpi z ggpY; ghAk; kpdNdhlljjj , tti f , i z ggpY; xtntH fUtPAk; (myyJ kpdjilAk) xdi waLjJ xdwHf xNu jlj j j; , i z ffgglLfpdwd. nj hl hpi z ggpY; kpdDjllk; ghatj wF xNunahU ghi j klLNk cSSJ. nj hl hpi z ggpY; nryYk; kpdNdhllk; (l)khwhky; , Uf;Fk; vdgi j , j jypUeJ ehk; mwpayhk; mj htJ nj hl hpi z ggpYss kpdRwvpy; mi dj j g; Gsspsfpyk; xNuasT kpdNdhllk; gha:fpwJ.

gf:f , i z gGr; RwWfs;

gf:f , i z gGr; RwWfsy; xNu kpd;dpafFtpi r %yj;Jld; nttNtW fUtPfs> , uzL myyJ mj wF Nkwgl j lq;fsy; , i z ffgglLfpdwd. , j j i fa Rwvpy; kpdDjllk; ghatj wF xdwHf Nkwgl ghi j fs; cSSd. gf:f , i z gGfsy; xtntH j dj j dp kpdNdhlljjjpd; \$lLj nj hi fahdJ , i z gi g Nehf;fp tUk; (myy) , i z gi g tPL ntsNaWk; Kj di k kpdNdhlljjjpwFr; rkk; NkYk> gf:f , i z gGr; RwWfsy> xtntH fpi sfsYk; fhz ggLk; kpd;Oj j NtWghL rkkhFk;

kpdNdhlljjjpd; tpi sTfs;

xU kpdRwvpy; kpdNdhllk; ghAk; NghJ> gytj tpi sTfi s mJ VwgLj j fpwJ. mtwWs; Kj di kahdi t; ntgg tpi sT> Ntj p tpi sT kwWk; fhej tpi sT. kpdNdhlljjjpd; gha:T 'vj ph;f;fgglLkNghJ'> ntggk; cUthfpwJ. xU fkgpapNyh

myyJ kpdjilajjNyh vyfluhdfs; ,aqFk; NghJ mit jilia  
vjphnfhs;fpdwd. ,ijf; flff Ntiy nraagl NtzLk; ,JNt ntgg  
Mwwyhf khwwggLfwJ. kpdhdwwy; ntgg Mwwyhf khwwggLk; ,eepfo:T [\_y;  
ntggNkwy; myyJ [\_y; ntggtpi sT vdggLk; Vnddpy> ,t;pi si t [\_y; vdw  
mwp;tpayw;Qh; t;phthf Ma;T nrajhh; kpdryi tg; nglb> eP; #Nlwwp> (nuhlb)  
tWjLL cSSp;l kpdntggrhj dqfspd; mbggi lahf ,t;pi sNt tpsqFfwJ.  
kpd; , i z gGf; fkgpfsy; \$l rpwj sT kpdjil fhz ggLthjyhd; vej nthU  
kpd; rhj dKk; , i z gGf; fkgpAk; gadgLj jpa gpd; #lhff; fhz ggLfpdwd.

**ftdk; (vrrhpf) f):**

ntgg tpi sT> Ntjp tpi sT Ma;Tfi s 9V kpd;dpafF tpi r nfhz;l  
kpd;fyqfi sf; nfhz Ljhd; nraa NtzLk; Vnddpy; 9V kpd;fyk; kpd;  
mj phrrpi aj; juhJ.

tLfsy; nfhLffggLk; 220 V khWkpdNdhll;j;jg; gadgLj jf; \$lhJ. mt;thW  
gadgLj jpdhy> ngUk; kpd; mj phrrp Vwgl L cly; ngUkstpy; ghj pffggL f\$Lk;

ghj pasT jhkpu ryNgll fi uryhy; euggggll FLi tia vLjJf; nfhsSTk;  
c yh; kpd; fyjjjy; gadgLj jggLk; fhgd; jz il vLffTk; mj d; xU Ki dary;  
, i z gGf; fkgpi ar; RwwTk; jbkdh jhkpu fkgp xdiw vLjJ Rjjk; nraj  
gpd;dh; Rjj ayhy; edF mbjJ mi jj; jli lahf;fTk; jhkpu fkgp kwWk; fhgd;  
jz L ,uz ilANK jhkpu ryNgllf; fi uryy; mkpoj jTk; fhgd; jz il  
kpd;fyjjpd; vj th; kpd;thAlDk; jhkpu fkgpi a Neh; kpd;thAlDk; , i z fffTk;  
fhgd; jz Lk; jhkpu fkgpAk; mUfy; cssthWk; mNj rkak; xdi wNahdW  
njhlhj tzz Kk; ghjJfnfhsSTk; rwW nghWjjjUeJ ghff;fTk; rpwJ  
NeujjpwFg; gpwF fhgd; jz bd; kU jhkpu; gbtjijf; fhz yhk; , JNt  
kpd;dhwGrR (myyJ kpd; Kyhk; GRjy) vdggLk; , J kpd;Ndhll;j;jpd; Ntjp  
tpi stpdhy; VwglLk; ePfothFk;

, Jti u ehk; ghjj ePfo;Tfsy; kpd;Ndhll;k; vyfluhdfs;pdhy; klLNk  
fljjggLti jf; fz Nl hk; Mdhy> jhkpu ryNgllf; fi uryy; kpd;Ndhll;k;  
ghAKNghJ vyfluhd; kwWk; jhkpu Neh; madp ,uz LNK kpd;Ndhll;j;jf;  
fljjfpdwd. fi uryfsy; kpd;Ndhll;k; fljjggLk; ePfo;T "kpd;dhwGFgG"  
vdggLk; kpd;Ndhll;k; ghAk; fi ury; 'kpd;gF jutk' vdggLk; fi uryy;  
mkpoj jggLk; Neh; kpd;tha; "MNdhL" vdTk; vj th; kpd;tha; "NfhNj hL" vdTk;  
mi offggLfpdwd. , qF Fwggp ggl Ma;ty; jhkpu fkgp MNdhllhfTk; fhgd;  
jz L NfnjhlhfTk; nraygLfpdwd.

kdj clyy; kpd;D;l;j; Jfs;fspd; , affjjhy; kpfTk; tyi k Fdwa  
kpd;Ndhll;k; cUthf;FfwJ. , ij eukG , i z gg iri f vdgh; , jji fa iri ffs;  
kpd; Ntjprnrayfshy; cUthfpdwd. %i saypUeJ gpw cWgGfSfF eukgpay;  
kzlyk; %ykhf , it gaz pffpdwd.

**kpd;Ndhll;j;jpd; fhej tpi sT:**

kpd;Ndhll;k; jhqfpa fljjp mjwFf; Fjjhd jpi ray; xU fhej gGyjij  
cUthf;FfwJ. , ij Na kpd;Ndhll;j;jpd; fhej tpi sT vdgh; mah;]nll;  
(Oersted) vdw mwp;tpayw;Qhpd; fz Lg;bgG kwWk; tyJif fliltpuy; tjp  
Mfpa it , eJg; Gjjfjjjy; 'fhej tpay; kwWk; kpd;fhej tpay;' vdw myfy;  
t;phthf toqf;ggLSSJ.

kpd;Ndhll;j;jpd; jpi r tyJif flil tpy;pdhy; fhz gpf;fggLf;fwJ.  
kpd;Ndhll;j;jpd; jpi r tyJif flil tpy;py; jpi rapYk; fhej gGyjijpd; jpi r  
tyJi fapd; kww tpy;fspd; jpi rapYk; , UfFk;

**kpd;Ndhll;j;jpd; ti ffs;**

ek; mdwhl thotpy; , U tji kpdNdhl:lqfi s ehk; gadgLj:JfNwhk; mi t:  
Nehj pi r kpdNdhl:l k; (dc) kwWk; khWj pi r kpdNdhl:l k; (ac)

**Nehj pi r kpdNdhl:l k;**

kpdRwWfs;py; kpdNdhl:l khDj mj pf kpdOj j j j j pyUe:J Fi wej  
kpdOj j j j j pwF> Neh; kpd:D}l:lqfs; , aqFk; j pi rapy; , UfFk; vdgi j ehk;  
mwpNthk; cz i kary> vyfluhdfs; kpdfyjjpd; vj th; kpd:tharypUe:J Neh;  
kpd:thaf:F efhfpdwd. , U Ki dfs f fi l Na kpdOj j NtWghl:l epi yepWj j  
kpdfy mLfF gadgLf pwJ. Nehj pi r kpdNdhl:l j j j j pd; %yqfs;py; xdW kpdfy  
mLfF MFk; xNu j pi rapy; kpd:D}l:lqfs; , aqFtjhy; VwgLtnj Nehj pi r  
kpdNdhl:l k; MFk; Nehj pi r kpdNdhl:l j j j j pd; gw %yqfs; #hpa kpdfyqfs>  
ntgg kpd:pl:l fs; MfpatthFk; Neh:kpdNdhl:l j j j j f; Fwpf:Fk;  
nfhLffgg:lssJ.

gy kpdZ r; RwWfs; Nehj pi r kpdNdhl:l j j j j g; gadgLj:Jf pdwd. Nehj pi r  
kpdNdhl:l j j j j g; gadgLj:Jp Nti y nraAk; fUt:fs; rpy i fNgr> thndhy:gnl b>  
kpd; tpi rgyi f> kpd:ru thfdqfs; c s s pl:l d MFk;

**khWj pi r kpdNdhl:l k;**

kpd; j il a j j pNyh myyJ kpd; nghUspNyh kpdNdhl:l j j j j pd; j pi r khwp khwp  
, aq:fpdhy; mJ khWj pi r kpdNdhl:l k; vdggLk; fhyj j j g; nghWj:J mJ i rd;  
tbt Ki wapy; khWk; , ayGi laJ. , ej khWghl:l mj thntz; vdw gz i gf;  
nfhz:l tpthpffyhk; xU tpdhbary; khW kpdNdhl:l j j j j py; VwgLk; KO  
Rowr:fi sNa mj thntz; vdgh; khW kpdNdhl:l j j j j py; vyfluhdfs; xNu j pi rapy;  
, aqFtj:pyi y. Vnddpy> kpd; Ki dfs; mj pf kwWk; Fi wej kpdOj j  
kj:ggpi d khwp khwp mi l f pdwd. vdNt> fkg:apy; khWj pi r kpdNdhl:l k; ghAk;  
NghJ vyfluhdfs; KdDk; gpd:Dkhf , aq:Ff pdwd. khWj pi r kpdNdhl:l k;  
nfhLffgg:lssJ.

ek; tLFS fF toqfggLk; kpdNdhl:l k; khWj pi r kpdNdhl:l khFk; Nehj pi r  
kpdNdhl:l j j j j py; kl:LNk , aqff:\$ba rhj dqfi s khWj pi r kpdNdhl:l j j j j py; , aff  
Ntz:Lnkdpy> Kj ypy; khWj pi r kpdNdhl:l j j j j Nehj pi r kpdNdhl:l khf khww xU  
fUt: Nj i t. mj wFg; gadgLk; fUt:pf:F j pUj j j vdw ngah; toffj j j j j py;  
, ffUt:pi a kpdfy j pUj j j j myyJ , z ffp (nghUj j j j) vd mi oggh; khwhf>  
Nehj pi r kpdNdhl:l j j j j khWj pi r kpdNdhl:l khf khwwg; gadgLk; fUt: Nehkhwwp  
(myyJ Gul b) vdggLk; (Nehj pi r kwWk; khWj pi r RwWf:fs;py; gadgLj:J ggLk;

**Nehj pi r kpdNdhl:l j j j j pwF Nkwgl:l khWj pi r kpdNdhl:l j j j j pd; edi kfs;**

khWj pi r kpdNdhl:l j j j j pd; kpdOj j j kj:gi g kpdkhwwp vdw nghwpi af; nfhz:l  
vsj:py; khww , aYk; mj pf njhi yTFS fF khWj pi r kpdNdhl:l j j j j  
mDgGi fary; VwW kpdkhwwpfi sf; nfhz:l kpdOj j j j j c ahj j j a gpd;  
mDgGkNghJ Mwwy; , ogG ntFthff; Fi wfpwJ. Nehj pi r kpdNdhl:l j j j j  
mt:thW mDgg , ayhJ. khWj pi r kpdNdhl:l j j j j vsj:py; Nehj pi r  
kpdNdhl:l khf khww , aYk; Nehj pi r kpdNdhl:l j j j j c Uthf:Ftj j tpi  
khWj pi r kpdNdhl:l j j j j c Uthf:Fj y; vsp. gy ti ffs;py; gadgLk; kpd:fhej j j  
J}z:l i y khWj pi r kpdNdhl:l j j j j pdhy; c Uthf:F KbAk;

**Nehj pi r kpdNdhl:l j j j j pd; edi kfs;**

kpd:Kyhk; GRj y> kpd; J}ai kahf:Fj y> kpd:dr thhj j j y; Mfpatwi w Nehj pi r  
kpdNdhl:l j j j j f; nfhz:l kl:LNk nraa , aYk; Neh; kpd:D}l:l tbt:py; kl:LNk  
kpd:rhuj j j Nr:kpff , aYk;

, ej phty> tLFS fFg; gadgLj j ggLk; khW kpdNdhI j j j pd; kpdOj j k; kwWk; mj pntz; Ki wNa 220 V, 50 Hz MFk; khwhf> mnkhpff l ffp ehLfsy; mi t Ki wNa 110V kwWk; 60 Hz MFk;

**kpdruhuj j pdhy; tpi sAk; Mgj j fS k; Kdndrrhpf i f ei l Ki wS k;**  
kpdruhuj j pdhy; tpi sAk; rpy Mgj j fs; gpd:tUkhW:

1. Nrij ki l ej **kpd;fhgG:** ntwWf;fkpi aj; nj hl hj hfs> ghJ fhgGf; i fAi wfi s mz pJ nfhz NI h kpd; fhgGi la Kf;fhypay; epdW nfhz NI h myyJ , uggh; fhyz pfi s mz pJ nfhz NI hj hd; kpdruhuj j j f; i fahs Ntz Lk;
2. **kpd; nghUj j J thafsy; kpi fgghuNkwvy;** xNu kpd; nghUj j J thary; gy kpd; rhj dqfi sg; nghUj j j hfs;
3. **nghUj j kww Ki way;** kpd; rhj dqfi sg; **gadgLj j j y;** kpd; rhj dqfi s mtwWpd; ti uasTfFj; j Fej thW gadgLj j Ntz Lk; c j huz k; fhWwggj dp nghUj j k; Gssp nj hi yffhl rpg; ngl b nghUj j k; Gssp (Air conditioner point) nj hi yffhl rp ngl b nghUj j k; Gssp i kfNuh mi y mLgG nghUj j k; Gssp c ssp l i t.
4. **<uggj k; kpf;f #oy;** kpdruhuk; c s s , l qfi s eNuh myyJ <uggj Nkh , yyhky; cyheJ ssthW i t j j f; nfhsSTk; Vnddpy; mJ kpd;frptpwF topt FfFk;
5. **Foei j fS fF vlLk; ti fay;** i t j j y; kpdruhuj j pdhy; Foei j fS fF Mgj j Vwgl h tz z k; kpd; nghUj j J thafi s i t f f Ntz Lk;

cyhej epi yary; kdij clypd; kpdjil VwffFi wa 1:00:000 Xk; ek; clypy; j z z h; , Uggj hy> kpd; jil apd; kj rgg rpy E}W Xk; Mff; Fi weJ t pLfpwJ. vdNt> xU kdij cly; , aygnNyNa kpdNdhI j j j j f; fl j j k; ewfl j j pahf c s s J. Mfnt> kpdruhuj j j f; i fahS k; NghJ ehkry Kdndrrhpf i f el tbfj ffi sf; fi l gpbff Ntz Lk;

10th mwrtjay;

myF- 4 kpdNdhI j tpay;

mwrtKfk;

kpdrhuk; gwmp c qfs; fb; tFgGffs; VwfdNt gbjj pUggf; xU fljjp topahf kpdD}l}qfs; , affjij gwmp; \$WtJ kpdNdhI k; MFk; kpdNdhI k; vdgJ xUti fahd Mwwy; kpdNdhI j jpd; gadfs; ek; mdwhl thot; , dwpai kahjj hfTk> j tuff Kbahjj hfTk; , UffwJ. tLfs> fy;tp epWtdqfs> kUj Jtki dfs; kwWk; nj hoprhi yfs; Nghdwtwwy; kpdNdhI j jpd; gadfs; gwmp ebfs; mwpej pUggf; , gghljj; kpdNdhI k; gwmpAk; kpdNdhI j jpdhy; VwgLk; tpi sTfs; gwmpAk; ghuff; , UffpNwhk;

kpdNdhI j k;

xU fljjp (j hkuffk) topahf ghAk; kpdD}l}qfs; (vyfihd;fs;) , affNk kpdNdhI k; MFk; xU fhy;tha; topahf XLk; el u Nghy myyJ cau; mOjj gFj p;UeJ Fi wej mOjj ggFj pi a Nehf; tRK; fhwwpi dgNghy> vyfihd;fs; fljj p; topahf ghaeJ nry;ti j kpdNdhI k; vdf;Nwhk;

kpdNdhI j jpd; jpi rahdJ vyfihd;fs; , affjij p;F vj; jpi r; topahf cau; kpdD}l}qfs; , Uffk; Neuk; Ki d; , UeJ Fi wej kpdD}l}qfs; , Uffk; vj;Ki d Nehf; , Uffk;

kpdNdhI j jpd; ti uai w

kpdNdhI k; I vd;Dk; vOjjhy; FwffggLfwJ. fljjp xdw; xU gFj p; topahf kpdD}l}qfs; ghAk; t; k; kpdNdhI k; vd ti uaWf;ggLfwJ. mjhtJ XuyF Neuj; fljj p; xU FwF ntl;g; gFj pi a fleJ nry;Yk; kpdD}l}qfs; mST kpdNdhI khFk; xU fljj p; FwF ntl;g; gFj p topahf Q mST kpdD}l}k; 't' fhy; fl; nrdwhy; mj; ghAk; kpdNdhI khdJ

$$I = \frac{Q}{t}$$

kpdNdhI j jpd; SI myF

kpdNdhI j jpd; SI myF Mkg; (A). xU \$Yk; kpdD}l}k; xU t; Neuj; fljj p; vjhtJ xU FwF ntl;g; gFj p topahf fleJ nry;Yk; NghJ mff; fljj; ghAk; kpdNdhI k; xU Mkg; vd ti uai w nraaggLfwJ. vdNt

$$1 \text{ Mkg} = \frac{1 \text{ \$Yk}}{1 \text{ t;}}$$

j ;f;ggl j fz f;F 1

12 \$Yk; kpdD}l}k; 5 t; Neuk; xU kpd;sf; topahf gha;fwJ vd; mj d; topahf nry;Yk; kpdNdhI j jpd;mST vdd?

j ;T :



eNuhl; k; kwWk; fhWNwhl; k; gwmp VwfdNt fb; tFgGffs; y; gbj j pUgg; f; s; xU j jz k nghUs; y; , uz L Gss; p; S f; f; pi l Na ntggepi y NtWghL , Uej hy; kl; Lnk mj d; topahf ntggk; ghAk; vdgJ c qfS f; F nj hpAk; , Nj NghdW xU fljj; p; y; , U Gss; p; S f; f; pi l Na kpd; d; Oj j NtWghL , Uej hy; kl; Lnk mej fljj; p; y; kpd; D; } l; k; ghAk; xU fljj; p; y; kpd; D; } l; khdJ c au; kpd; d; Oj j Gss; p; y; UeJ Fi wej kpd; d; Oj j Gss; p; F ghAk;

**kpd; d; Oj j k;**

xU Gss; p; y; kpd; d; Oj j k; vdgJ XuyF Neukpd; D; } l; j; j Kbt; p; y; h nj hi y; t; y; , UeJ kpd; t; pi r; f; F vj; p; hf mgGss; p; F nfhz; Ltu nraaggLk; Nti y vd ti uaWf; f; ggL; f; p; wJ.

**kpd; d; Oj j NtWghL**

, U Gss; p; S f; F , i l Na c ss kpd; d; Oj j NtWghL vdgJ xU Gss; p; y; UeJ kwnwhU Gss; p; F XuyF Neu; kpd; D; } l; j; j kpd; t; p; y; f; F t; pi r; f; F vj; p; hf efuj j nraaggLk; Nti y vd ti uaWf; f; ggL; f; p; wJ.

Q vdw kpd; D; } l; j; j A vdw Gss; p; y; UeJ B vdw Gss; p; F efuj j p c ss j hf fUJNthk; , ej kpd; D; } l; j; j A a; p; y; UeJ B f; F efuj; JtjwF nraaggL; Nti y W vd nfhsNthk; A kwWk; B f; F , i l Na c ss kpd; d; Oj j NtWghL fb; f; fz; l rkdghl by; UeJ ngwggL; f; p; wJ.

$$kpd; d; Oj j NtWghL (V) = \frac{nraaggL; Nti y (W)}{kpd; D; } l; k; (Q)}$$

, uz L Gss; p; S f; F , i l Na c ss kpd; d; Oj j qf; s; p; d; NtWghl; i l Ak; kpd; d; Oj j NtWghL vd \$wyhk;  $V_A$  kwWk;  $V_B$  vdgJ Gss; p; A kwWk; B , y; c ss kpd; d; Oj j qf; s; vd nfhz; l; hy; , t; t; p; uz L Gss; p; S f; F , i l Na Ass kpd; d; Oj j NtWghL

$$V = V_A - V_B (V_A > V_B \text{ v; d; p; y;})$$

$$V = V_B - V_A (V_B > V_A \text{ v; d; p; y;})$$

**Nthyl;**

kpd; d; Oj j k; kwWk; kpd; d; Oj j NtWghl; b; d; myF Nthyl; (V)

xU \$Yk; Neukpd; Ndh; l; j; j xU Gss; p; y; UeJ kwnwhU Gss; p; F kpd; t; pi r; f; F vj; p; hf vL; j; r; nryy nraaggLk; Nti y a; p; d; msT xU [ \_y; v; d; p; y; mgGss; p; S f; f; pi l Na c ss kpd; d; Oj j NtWghL xU Nthyl; MFk;

$$1 Nthyl; = \frac{1 [ _y; ]}{1 \$Yk;}$$

**j; b; f; f; gg; l; fz; f; F 2**

10 \$Yk; kpd; D; } l; j; j xU kpd; Rwwp; Yss , uz L Gss; p; S f; f; pi l Na efuj j nraaggLk; Nti y 100J v; d; p; y; mgGss; p; S f; f; pi l Na c ss kpd; d; Oj j NtWghL v; d; d; ?

**j; b; T;**



$$kpd;D}l; k;Q = 10 \$Yk;$$

$$nraaggl; Nti y W = 100 J$$

$$kpd;D}j; NtWghL V = \frac{W}{Q} = \frac{100}{10}$$

$$vdNt> V = 10 Nthyl;$$

### Xk; tjj p

[ hu[; i rkd; Xk; vdwn [ ukd; , awgpayhsu; kpd;Ndhil;k; kwWk; kpd;D}j; NtWghL Mfpatwppw;fpi l Naahd nj hl ugpi d epWtpdhu; , JNt Xk; tjj p vdgglk;

, t;tj p;pdgb khwh ntggepi yary> fljjp xdwpd; topNa ghAk; r;hd kpd;Ndhil;k; fljjpai upd; Ki d;S f;fpi l Na c;ss kpd;D}j; NtWghl bw;F Neuj f;ty; mi kAk;

$$I \propto V \cdot vdNt > \frac{\text{ael } \ddot{o}}{eR \emptyset} V \text{ khwppp}$$

$$, ej \text{ khwppp } kj \text{ pgG } \frac{1}{R} \text{ MFk;}$$

$$vdNt > I = \frac{\text{ael } \ddot{o}}{eR \emptyset} V$$

$$V = IR$$

, q;F R vdgJ kpd;ji lahFk; xU Fwpggl; nghUS f;F (v.fh epfNuhk) Fwpggl; ntggepi yary; kpd;ji l xU khwppp MFk; kpd;D}j; NtWghL V Ak; kpd;Ndhil;k; l Ak; xdWfnfhdW Neuj f;ty; mi ktjhy; V kwWk; l , i l Naahd ti uglk; xU NeuNfhL MFk;

### xU nghUs;pd; kpd;ji l :

epfNuhk; fkgp xdwpd; d vLj;J mji d xU kpd;fyk> rhtp kwWk; kd; jil khwppp MfpatwWI d; nj hl uhf , i z f;fTk; rhtp %ba epi yary; kpd;ji l khwpppary; khwppp; nra;J gyNtW kpd;D}j; q;fS f;f kpd;Ndhil;jij fz f;f;Lq;fs;

c q;fS f;F fpi ljj  $\frac{V}{1}$  d; kj pgG khwpppahf , Uggi j ftd;Aq;fs; , Nj Nrhjidi a epfNuhk;f;F gj pyhf jhkpu fkgpapi d gadgLjjp nra;J ghUq;fs;

, q;Fk;  $\frac{V}{1}$  d; kj pgG khwpppahf , Uej hYk> xNu kpd;D}j; NtWghl;L;F kpd;Ndhil;jj;pd; kj pgG khWgLtij ftd;Aq;fs; , J Nghy jhkpu fkgp;f;F gj pyhf mYkpd;pa fkgpi a gadgLj;JkNghJk; xNu kpd;D}j; NtWghl;L;F kpd;Ndhil;jj;pd; kj pgG khWgLtij ftd;Aq;fs;

xNu kpd;D}j; j;pw;F nttNtW nghUs;f;S f;F nttNtW kpd;Ndhil; kj pgG fpi ljj;UggJ> nttNtW nghUs;f;S f;F kpd;ji l kj pgG ntNtwhf , U;f;Fk; vdgi j fhl;L;f;w;J.

xU nghUs;pd; topahf kpd;D}l;l;q;fs; ghae;J nry;tij myyJ kpd;Ndhil;k; ghati j vj ;f;Fk; gz G mej nghUs;pd; kpd;ji l MFk;

xU nghUs;pd; kpd;ji l vdgJ xU nghUs;pd; topNa kpd;D}l;l;k; ghati j (mj htJ kpd;Ndhil;k; nry;tij) vj ;f;Fk; gz ghFk; , J nttNtW nghUs;f;S f;F ntNtwhf , U;f;Fk;

$$X_k; t_j \text{ pary} U_e J \frac{V}{I} = R \text{ vd } v O_j \text{ yhk};$$

fljjp xdwpd; Ki dFS fF , i lggll kpdOjj NtWghl bwFk; mj d; topNa nryYk; kpdD}ljjwFk; , i lNaAss j fT fljjpad; kpdjil vd ti uaWf;fggLfWJ.

**kpdjil apd; myF**

kpdjil apd; SI myF Xk; MFk; , J Wvd;Dk; Fwpaill hy; Fwff;fggLfWJ.

xU fljjpad; Ki dFS fFpi lNa cSS kpdOjj NtWghL xU Nthyl;hf , Uf;Fk; NghJ fljjpary; nryYk; kpdNdhllk; xU Mkgpah; vdy; mj d; kpdjil xU Xk; MFk;

$$1 X_k = \frac{1Nthyl;}{1Mk;gpah;}$$

**j h;fggl; fz fF 3**

30 Nthyl; kpdOjj NtWghL nfhz;l xU fljjpad; Ki dFS fF , i lNa 2 Mkgpah; kpdNdhllk; nryfWJ vdy; mj d; kpdjil i a fhz f.

j hT:

$$\text{fljjpary; nryYk; kpdNdhllk; } I = 2 \text{ A,}$$

$$\text{kpdOjj NtWghL } V = 30 \text{ V}$$

$$X_k; t_j \text{ pad; gb } R = \frac{V}{I}$$

$$\text{vdNt } R = \frac{30}{2} = 15 \text{ W}$$

**kpdjil vz ; kwWk; kpd;flj;J vz ;**

**kpdjil vz ;**

xU fljjpad; kpdjil ahDJ (R) mj d; eSjjwF (L) Nehj ftpYk> FwFfntll guggwF (A) vj h j ftpYk; mi kAk;

$$RaL, Ra \frac{1}{A}$$

$$Ra \frac{L}{A}$$

$$\text{vdNt} > R = r \frac{L}{A}$$

r vdgJ xU khwyp , J flj;J nghUspd; j d; kpdjil vz ; vdgglk;

$$\text{rkdghL 4.4 yUeJ } r = \frac{RA}{L}$$

$$L = 1\text{m}, A = 1\text{m}^2 \text{ vdy; } r = R$$

vdNt XuyF eSkk; XuyF FwFntll gugGk; nfhz;l fljjp xdw kpdNdhlljjwF VwgLj;Jk; kpdjil mffljjp nghUspd; j dkpdjil vz ; vd ti uaWf;fggLfWJ.

, j d; myF Xk; kl;h; ( $\Omega\text{m}$ )

xU fljjpad; kpdjil vz ; vdgJ mj d; topNa ghAk; kpdNdhlljjpi d vj h;f;Fk; j pwi d Fwff;Fk; msT MFk; xU Fwggpl; cNyhf nghUS fF kpdjil vz ; khwyp MFk;

kpđ; flj; j pđ; kwWk; kpđ; flj; vz ;

xU nghUspđ; topahf kpđ;D}l;qfs; ghae; nry;tij myyJ kpđ;Ndhil;k; ghatij mDkj pf;Fk; gz G mej nghUspđ; kpđ;flj; j pđ; MFk;

kpđ; jilapđ; jiyfbp kpđ;flj; j pđ; vd ti uaWf;fggLfwJ. vdNt> xU fljjpapđ; kpđ; flj; j pđ; G vdgJ

$$G = \frac{1}{R}$$

, j d; myF ohm<sup>-1</sup>, J mho vdTk; Fwggpl ggLfwJ.  
kpđ; jil vz z pđ; jiyfbp kpđ;flj; j vz ; vdgglk;

$$s = \frac{1}{r}$$

, j d; myF Xk<sup>-1</sup> kP<sup>1</sup>, J Nkh kP<sup>1</sup> vdTk; Fwggpl ggLfwJ.

xU Fwggpl; fljjp nghUS fF, J xU khwyp MFk; kpđ; fljjp vz ; vdgJ xU fljjpapđ; topNa ghAk; kpđ;Ndhil;jjpi d mDkj pf;Fk; jwi d Fwpf;Fk; mST MFk; rpy nghUSfs; kpđ;Ndhil;jj edF flj; k; v.fh. jhkpk> mYkpđ;ak; Kjyad. rpy nghUSfs; kpđ;rhujij fljjhJ (fhgghd;fs) v.fh. fz z hb> kuf;fljil>, uggh; Kjyad. fhgghd;fi s tpl fljjpfS fF kpđ; fljjp vz ; mjpfk; Mdhy; kpđ; jil vz z hdJ fhgghd;fi s tpl fljjpfS fF Fi wT. nghJ thf gadglk; rpy nghUSfspd; kpđ; jil vz ; kjpgG nfhLffggllsSJ.

rpy nghUSfspd; kpđ; jil vz ;

nghUspđ; j di k	nghUS;	kpđ; jil vz ; (Ωm)
fljjp	j hkpk;	1.62 × 10 <sup>-8</sup>
	epf;fy;	6.84 × 10 <sup>-8</sup>
	FNuhkpk;	12.9 × 10 <sup>-8</sup>
fhgghd;fs;	fz z hb	10 <sup>10</sup> Kj y; 10 <sup>14</sup>
	, uggh;	10 <sup>13</sup> Kj y; 10 <sup>16</sup>

**j Hffggll; fz fF 4**

10 kl;h; eBkK> FwF;FntilL gugGk; nfhz;l fkgpđ; kpđ; jil 2 Xk; vdrpy; mj d; 1. kpđ; jil vz > 2. kpđ;flj; j pđ; kwWk; 3. kpđ; fljjp vz ; Mfpatwi w fhz f.

j h;T:

$$eBk>L = 10 k\beta \text{ kpđ; jil } > R = 2 \text{ Xk;}$$

$$FwF;FntilL \text{ gugG} > A = 2 \times 10^{-7} \text{ m}^2$$

$$\text{kpđ; jil vz } > r = \frac{RA}{L} = \frac{2 \cdot 2 \cdot 10^{-7}}{10}$$

$$\text{kpđ; flj; j pđ; } G = \frac{1}{R} = \frac{1}{2} = 0.5 \text{ mho}$$

$$\text{kpđ; flj; j vz ; } s = \frac{1}{r} = \frac{1}{4 \cdot 10^{-8}}$$

$$= 0.25 \times 10^8 \text{ Nkh kP}^1$$

epf;Nuhk; vdgJ kpf cahej kpđ; jil vz ; nfhz;l xU fljjpahFk; , j d; kjpgG 1.5 × 10<sup>-6</sup> Wm. vdNt , J kpđ; ryi tg; nglb> kpđ; #NI wwp Nghdw ntggNkwWk; rhj dqfspy; gadgLfwJ.

**kpj i l fspd; nj hFgG:**

xU kpjRwWpy; flj j p d; kpj; j i l > ghAk; kpjNdhl;l j j j vt;thW ghj p f f w J vdgj i d eb;fs; ; Jti uary; fWwfnfhz Bh;fs; xU kpj j i l i a c i l a v s p a kpjRwW gwWpAk; mwpeJ nfhz Bh;fs; ei l Ki wary; nry r p f f y h d kpjRwWf;fi s eb;fs; vj h n f h s s NehlK; x d W f F N k w g l l kpj; j i l f s p d; n j h F g G f f s; kpjRwWf;fNshL ; i z f f g g l b U f f y h k; ; j i d kpj; j i l f s p d; m i k g G m y y J kpj; j i l a p d; F O k k; v d m i o f f y h k; kpj; j i l f i s ; u z l m b g g i l a h d Ki w f s p y; ; i z f f y h k;

1. nj hl hpi z ggpy; kpj; j i l a h f f i f s;
2. g f f , i z g g p y; kpj; j i l a h f f i f s;

gy kpj i l a h f f i f s; nj hl h; kwWk; g f f , i z g g p y; ; i z f f g g l k; NghJ m t w w p d; nj h F g a d; kpj n j h i l i a f z f f i l k; Ki w N a g p d t U k; g h i T f s p d; e b;fs; f h z y h k;

**kpj i l a h f f i f s; nj hl h; , i z gG:**

xU kpjRwWpy; nj hl h; ; i z gG vdgJ kpj \$ W f i s x d w d; g p d; x d w h f , i z j j xU % b a R w i w c U t h f F t J M F k; nj hl h; R w w p y; kpj N d h l l k h d J x N u x U % b a R w w p d; t o p a h f g h A k; ; e j % b a \$ w w p y; c s s V N j D k; xU G s s p a r y; ; i z g G j i g g l i h y; kpj R w w p d; t o p a h f k p j N d h l l k; g h a h J . v d N t R w w p y; ; i z f f g g l L s s k p j; r h j d q f s; N t i y n r a a h J . t p h f f s p y; g a d g l j j g g l k; x s p U k; n j h l h; t p s f F f s; n j h l h; ; i z g g p y; ; i z f f g g l b U f F k; v d N t > k p j; j i l a h f f i f s; n j h l u h f c s s N g h J x t n t h U k p j; j i l a h f f i p a d; t o p a h f T k; x N u m s T k p j N d h l l k; g h A k;

, qF % d W k p j i l a h f f i f s; R<sub>1</sub>, R<sub>2</sub>kwWk; R<sub>3</sub> nj hl h; ; i z g g p y; ; i z f f g g l L s s J . l v d w k p j N d h l l k; ; e j k p j i l a h f f i f s; t o p N a n r y f w J . k p j i l a h f f i f s > R<sub>1</sub>, R<sub>2</sub>kwWk; R<sub>3</sub> a p d; F W F N F c s s k p d d O j j q f s; K i w N a V<sub>1</sub>, V<sub>2</sub>kwWk; V<sub>3</sub>MfK;

x t n t h U k p j i l f F k; v j p h f c s s k p d d O j j N t W g h l b d; \$ L j i y V v d y h k;

$$V = V_1 + V_2 + V_3$$

k p d d O j j N t W g h l b d; \$ L j i y V v d y h k; r k d g h L f s; (4.7) (4.8) kwWk; (4.9) a p p U e J

$$V = I R_1 + I R_2 + I R_3$$

n j h F g a d; k p j i l v d g J m i d j J k p j i l a h f f i f s f F g j p y h f m N j m s T k p j N d h l l k; R w w p d; t o p N a n r y y m D k j p f F k; x U k p j; j i l a h f f i p a d; k p j i l M F k; ; e j n j h F g a d; k p j i l R s v d g g l k; v d N t

$$V = I R_s$$

r k d g h L f s; (4.10) kwWk; (4.11) y p U e J

$$I R_s = I R_1 + I R_2 + I R_3$$

$$v d N t R_s = R_1 + R_2 + R_3$$

v d N t g y k p j i l a h f f i f s; n j h l h; ; i z g g p y; ; i z f f g g l k; NghJ n j h F g a d; k p j i l j d j j d p k p j; j i l a h f f i f s p d; k p j; j i l f s p d; \$ L j Y f F r k k; v d G h p e J f; n f h s s y h k; r k k j g g c i l a ' n ' k p j i l f s; n j h l h p i z g p y; ; i z f f g g l k; NghJ n j h F g a d; k p j i l ' n R ' M F k;

$$m j h t J > R_s = n R$$





nj hl h; kwWk; gf;f , i z ggr; RwWfS f;F , i l NaAss NtWghL:

mbggi l	nj hl h; , i z gG	gf;f , i z gG
nj hFgad; kpd; j i l	kpf cah; kpd; j i l i a tpl mj pfkhf , Uf;Fk;	kpf Fi wej kpd; j i l i a tpl Fi wthf , Uf;Fk;
kpdNdhl ; k;	nj hFgad; kpd; j i l mj pfkhj yhy; kpd;RwWpy; kpdNdhl ; k; Fi wthf , Uf;Fk;	nj hFgad; kpd; j i l Fi wtj hy; kpd;RwWpy; kpdNdhl ; k; mj pfkhkFk;
, i z gG j i l ggl ; hy;	%ba RwWpy; c s s VnJ Dk; xU Gs;spay; , i z gG j i l ggl ; hy; kpd;RwWpd; topahf kpdNdhl ; k; ghahJ.	xU %ba RwW j wej pUej hYk; kwW %ba RwWf;f;spd; topahf kpdNdhl ; k; ghAk;

