TEST - 8

(ntggk;)

6th Std Term-II	Unit 1	ntggk;
7th Std Term-II	Unit 1	ntggk; kwWk; ntggepiy
8th Std Term-II	Unit 1	ntggk;
9th Std	Unit 7	ntggk;
10th Std	Unit 3	ntgg ,awgpay;
11th Std Term-II	Unit 8	ntggKk; ntgg ,afftpaYk

6th mwtpay;

njhFjp 2
myF – 1 ntggk;

mwpKfk;:

- ntggk ehk midtUk mwpejNj. #hpa xspek clypy gLkngh OJ ehk ntggjij czhfpNwhk. ntggk ekfFg gy topfspy gadgLfpwJ. ntggjij czT rikffg gadgLjJfpNwhk. gorrhW jahhpfifapy ntggjijf Fiwff gdpflbfisr Nrhffpwhk. ekfF venjej %yqfspy ,UeJ ntggk fpilffpwJ vdW ehk ,gnghOJ fhzNghk.

ntgg %yq;fs;:
#hpad;

- #hpad xspiaj jUfpwJ vd ekfFj njhpAk. mJ ntggjijAk jUfpwjh? #hpa xspapy rpwpJ Neuk epdW tplL cdJ jiyiaj njhlLgghh. #lhd cssjyyth? Mk› #hpad xspNahL ntggjijAk jUfpwJ. ,jdhyjhd› Nfhil ntapypy ntwWf fhyfSld rhiyapy elggJ fbdkhf cssJ.

vhpjy;:

- kufflil› kznz znza› epyffhp› fhp› nglNuhy› vhpthA Nghdwtwiw vhpggjdhy ntgg Mwwiyg ngwyhk. cdJ tlby czT rikffj Njiahd ntgg Mwwy vjid vhpjJg ngwggLfpwJ?

cuha;jy;:

· cdJ ,U cssqiffisAk xdWld xdW NrhjJ curTk. jwNghJ cdJ cssqiffisf fddjjy itjJg ghh. vtthW czhfwha? ,UgugGfs xdNwhnlhdW cuhAknghOJ ntggk ntsggLfwJ. Mjfhy kdjd xU fwfis xdNwhnlhdW curr nraJ neUgig cUthffdhd.

kdrhuk;

· kdNdhllk xU fljjad tohfg ghAknghOJ ntgg Mwwy cUthfwJ. kd ,]jhgnglb› kd ntggffyd› kd eh#Nlww Nghdwit ,ejj jjJtjjyjhd ,aqFfdwd.

ntggk;

· vyyhg nghUlfsYk %yf$WfshdJ mjhtNyh myyJ ,affjjNyh cssd. mtwiw ek fzfshy ghhff ,ayhJ. nghUlfis ntggggLjJk nghOJ mjy css %yf$Wfsd ,ej mjhTk› ,affKk mjfhffdwd. mNjhL nghUsd ntggeiyAk cahfwJ.

· vdNt› ntggk vdgJ xU nghUsd ntggeiyia caurnraJ› %yf$Wfis Ntfkhf ,aqf itfff$ba xU tifahd Mwwy vd ehk GheJnfhssyhk.

·
ntggk vdgJ xU nghUsyy. mJ ,ljjid Mffukggjyiy. xy› xs kwWk kdrhujjidg Nghy ,JTk xU tif MwwyhFk.

· xU nghUsy mlqfAss %yf$Wfsd ,aff MwwNy ntggk vd mioffggLfwJ. ntggjjd SI myF [_y MFk. fNyhh vdw myFk ntggjij msffg gadgLjjggLfwJ.

#lhd kwWk; Fsuhd nghUlfs;

· ekJ mdwhl thoty gyNtW tifahd nghUsfis ehk ghhffNwhk. mtwwy ry #lhdit› ry Fshrrahdit. venjejg nghUsfs kwwtwiwtl mjf #lhf ,Uffdwd vdgij vtthW ehzaggJ?

· ehk mUeJk mstwFj Njeh #lhf cssjh? myyJ ghyhdJ jah cUthff Ntzba msTfFf Fshrraileassjh? vdgjid ekJ iffshy njhlLgghhjJ czhfNwhk. Mdhy rhahd ntggeiyia cu ekJ njhL czhT ekgfjjdikAilaJ?

ntggeiy:
ntggeiyad; tiuaiw

v xU nghUs vej msT ntggkhf myyJ Fshrrahf cssJ vdgjid mstLk msTfF ntggeiy vdW ngah.

v ntggeiyad SI myF nfytd MFk. nryra]› /ghud`l Nghdwit gw myFfs MFk. nryra] vdgJ nrdbfNul vdTk mioffggLfwJ.

v nttNtW ntggeiyay css xU nghUsfs xdiwnahdW njhLkNghJ ntggkhdJ vejj jiraay ghafwJ vdgjid mtwwd ntggeiy ehzaffwJ.

v rhjhuzkhf miwntggeiyay css ehd ntggeiy Rkhh 30ºC mstLy ,UfFk. eiur #LgLjJk NghJ ntggeiy mjfhjJ› mJ 100ºC y

nfhjpjJ euhtpahf khWfpwJ. eiuf Fsphtpf Fk NghJ ntggepiy Fiwaj njhlqfp 0ºC y gdpfflbahf ciwfpwJ.

(FwpgG 30ºC vdgij 30 bfph nryrpa] myyJ 30 bfph nrdbfpNuL vd crrhpff NtzLk)

eyhtpd $wW rhpah?

· A, B vdw ,U Kfitfspy 80C ntggepiy nfhzl eh cssJ. A, BKfitfspYss eiu Cvdw fhyp KfitfFs CwwTk. jwNghJ Kfit Capd ntggepiy vdd? eyh 160ºC vdf $Wfpwhs.

Mggphffhtpyss> ypgpahtpy> 1922 k tUljjpy xU ehs> fhwwpd ntggepiyahdJ 59ºC vdf fzpffgglbUffpwJ. mzlhhlbf fzljjpd ntggepiyjhd cyfpNyNa kpff Fiwej ntggepiyahf mstplgglLssJ. mJ Njhuhakhf -89ºC vdf fzffplgglLssJ. ntggepiy ehpd ciwepiyfFf Fiwthf ,UfFk nghOJ vjphFwp (-) cgNahfggLjjggLfpwJ. ehpd ciwepiy 0ºC vdf fzffplggLfpwJ. euhdJ 0ºC ntggepiyapy gdpfflbahf khWfpwJ vdwhy 89ºC vdgJ vej msTfFf Fspuhf ,UfFk vdgjid rpejpJg ghh. ekJ clypd ruhrhp ntggepiy 37ºC MFk. fhwwpd ntggepiy 15ºC Kjy 20ºC mstpy ,UfFknghOJ ekJ cly Fsphrrpahf czhfpwJ.

cdJ fpuhkk myyJ efujjpy Fsphfhyjjpy ,uT ntggepiy vej msTfF ,UfFk vdgjid kjpggplTk

ntggk; kwWk; ntggepiy

· ntggKk ntggepiyAk xdwyy> mit ,U khWgll fhuzpfs:

v ntggepiyahdJ xU nghUspYss mZffs myyJ %yf$Wfs vttsT Ntfjjpy ,aqFfpdwd myyJ mjphfpdwd vdgijg nghWjjJ.

v ntggkhdJ ntggepiyia klLkyy> xU nghUspy vttsT %yf$Wfs cssd vdgijAk nghWjjJ.

v ntggepiyahdJ %yf$Wfspd ruhrhp ,aff Mwwiyf Fwpgg pLk Xh mstL. ntggkhdJ mgnghUspy mlqfpAss %yf$Wfspd nkhjj ,aff Mwwiyf Fwpgg pLk XH mstL.

v ntgg Mwwiy ehk fNyhhpapy mstplyhk. xU fpuhk ehpd ntggepiyia xU bfph nrdbfpNul cahjjggadgLk ntgg msT xU fNyhhp MFk.

ntggk; guTjy; ehkl;lKk> ntggepiyAk; Xh; xggL:

· ntggepiyahdJ ntgg Mwwy ghAk jpiria ephzapffpwJ vdgij ehk mwpNthk. eh caukhd gFjpapypUeJ jhothd gFjpffg ghatijgNghy> ntgg MwwyhdJ cahej ntggepiyapy css nghUspypUeJ> Fiwej ntggepiyapy css nghUSfFf fljjggLfpwJ.

· euhdJ caukhd ,ljjpypUeJ gssjij Nehffpg ghAk. mJ vejggffk eh mjpfkhf cssJ. vejggffk eh Fiwthf cssJ vdgjidg nghWjjyy. mJ Flilapypue J nghpa ehjNjffjJfFk ghayhk> myyJ

ehjNjffjjpypUeJ Flilia Nehffpak ghayhk. eh kllNk ehghAk jpiriaj jhkhdpffpwJ.

- ehkllk ehghAk jpiriaj jhkhdpggJ Nghy› nghUsfspd ntggepiy› ntgg Mwwy ghAk jpiriaj jhkhdpffpwJ.

- A,Bvdw ,U nghUlfisf fUtNthk. A apd ntggepiy mjpfkhfTk B apd ntggepiy FiwthfTk cssJ. A kwWk B ia xdWld xdW njhlhGfF nfhzL tUknghOJ› ntggkhdJ ntgggnghUs A apypUeJ Fspnghus B fFg ghafpwJ. ,uzL nghUsfSk xNu ntggepiyfF tUk tiu ntggk njhlheJ ghpkhwwk nraaggLk.

ntggepiy› ntggk ghAk jpiriaj jhkhdpffpwJ.

1. e xU #lhd fhggpf FLitiaf ifapy gpbjJssha. ntgg Mwwy›

2. cd clypypUeJ fhggpfFr nryfpwjh? myyJ
3. fhggpapypUeJ cd clYfFg ghafpwjh?

- xU Nfhil ehspy e ntspapy epwfpwha. ntsp ntggepiyahdJ 40ºC mstpy cssJ (kdpj clypd ruhrh ntggepiy 37ºC) ntgg Mwwyhdj.

1. cd clypypUeJ fhwW %yf$WfSfFg ghafpwjh?
2. fhwW %yf$Wfspypuej cdJ clYfFg ghafpwjh?

- e xU Fsphfhy ehspy ntll ntspapy epwfpwha. ntsp ntggepiyahdJ23ºC mstpy cssJ.ntgg Mwwyhdj
1. cd clypypUeJ fhwW %yf$WfSfFg ghafpwjh? myyJ
2. fhwW %yf$Wfspypuej cd clYfFg ghafpwjh?

- xU nghUs kwnwhU nghUspd ntggepiyia ghjpfFkhdhy mit ,uzLk ntggjnjhlhgpy cssd vdyhk. ntggjnjhlhgpy css ,UnghUlfspd ntggepiyAk rkkhf ,Uejhy mit ntggrrkepiyapy cssd vdggLfpwJ. ,U nghUlfs ntggrrkepiyapy cssNghJ xdwpd ntggepiy kwnwhdiw ghjpggjpyiy.

- vLjJffhllhf. Fsphrhjdg nglbapypUeJ vLjJ rikayiw Nkilapy itffggll ghyghjjpuKk› rikayiw NkilAk ntggjnjhlhgpy cssd. Fwpggll Neujjpwfg gpd mit xNu ntggepiyfF tUfpdwd. mgNghJ mit ntggrrkepiyapy cssd.

jpzpkg; nghUspfs; tphptiljy;

- rhk Xh ,Wffkhd [hbiaj jpwff Kayfpwhd. Mdhy ,aytpyiy. mtd khkhtplk cjtp Nflfpwhd. khkh rwpJ RLeiu [hbapd %bapy Cwwr nrhyfpwhh. rhk mtthNw nrafpwhd Mfh! [hb vspjpy jpweJ tpllNj!

cdfF ,ggbggll mDgtk cssjh? ,Wffkhf %lggll cdJ Ndh%bia e vtthW jpwggha?

xU jfulgghtpy Mzpia mbffTk› Mzpia ntspapy vLffTk. Mzpiar jpUkgr nrYjjpj JisahdJ Mzp GFk msTfFg nghpjhf cssjh vd MuhaTk. gpd Mzpia ntspapy vLjJ Xh ,Lffpahy gpbjJ nkOFthjjpr Rlhpy ntggggLjjTk.

- nghUsfs ntggggLjJk nghOJ tpthtileJ Fspht;fFk nghOJ RUffkilfpdwd. mwwpd esk> guggsT myyJ fd mstpy VwgLk khwwkhdJ ntggepiy khwwjijg nghWjjJ.

- xU nghUis ntggggLjJknghOJ mJ tpthtiltij mgnghUspd ntgg tpthtiljy vdfpNwhk.

els; kwWk; gUk; tpht;T:

- xU jpzkg nghUSfF tiuaWffggll tbtk cssJ. vdNt mijr #LggLjJk NghJ mJ vyyh gffqfspYk; tpthtilfpwJ. mjhtJ ehk nraa Ntzbaj vddntdwhy xU kpjtzbr rffujjpd fkgpiar #LgLjJtjhd.

els; tpht;T:
xU kpdtpsfF> kpdfyd> nkOFthjjp> kpjtzbr rffuffkgp> ehzak kwWk ,U kufflilfs Mfpatwiw vLjJfnfhsSqfs.
kpjtzbr rffuffkgpapd xU Kidia xU kufflilapd Nky itjJ mjDld kpdfkgpiag nghUjjTk.

kpjtzbr rffuffkgpAk> kpdfkgpAk kufflilapy ,izAk ,ljjpy> mit efuhky ,Uff xU rpW fyiy gljjpy fhlbathW itffTk. kpjtzbr rffuffkgpapd kW Kidia mLjj kufflilapd Nkyjsjjpwf ,izahf tUkgbahf itffTk. ehazjjpd Nky kpdfkgpiar Rwwp mj ,uzlhtJ kufflilapd Nky itjJ epiy epWjjTk.

ehazjjpy Rwwggll kpdfkgpfFk kpjtzbr rffuffkgpapd KidfFk ,ilapy xU kpdfyidAk> kpd tpsfifAk nghUjjTk. kpjtzbr rffuffkgpapd KidAk. ehzaKk xdWld xdW njhLknghOJ kpdRwW KoikaileJ kpdtpsfF xspfpwJ. kpdtpsfF xsputpyiy vdpy kpdRwW KOikailtjpyiy vdgJ nghUs. vdNt kpdRwW KOikaileJssjh vdgjidr rhpghhffTk. (FwpgG – kpdRwWfs gwwpehk kpddpay ghljjpy tpthfg gbff ,Uffpnwhk) jwnghOJ ehzajJfFk kpjtzbr rffuffkgpfFk ,ilapy xU jhis itjJ> jhspd jbkDfF ,izahd ,ilntspia cUthffTk. jwnghOJ kpdtpsfF xspfpwjh? fhuzk vdd?

mjd esk> guggsT> fd msT Nghdwit mjpfhpffpdwd.

- ntggjjpdhy nghUspd esjjpy VwgLk mjpfhpgG estpht;T vdWk> nghUspd gUkdpy VwgLk mjpfhpgG gUktpht;T vdTk mioffggLfpwJ.

- khlL tzbapd rffujjpd ,UkG tisajijr rffujJld nghUjJk Kd mij ntggggLjJtJ Vd? jzlthsjjpd ,U ,UkGg ghsqfSfF ,ilapy rpwJ ,ilntsp tplggLtJ Vd?

,fNfstpfSffhd tpilia XH MaT %yk Njlyhkh?

ntgg tpht;pd; gad;fs;
kurrf;fujjpd; kJ ,UkG tisaj;ijg; nghUj;Jjy;

- kurrffujjpd tpllkhdJ ,UkG tisajjpd tpllijijtpl rwWg nghpajhf ,UfFk. vdNt ,UkGtisajij kurrffujjpd kJ kpf vspjhfg nghUjj ,ayhJ.

- ,UkG tisajij Kjypy cahej ntggepiyfF ntggggLjj NtzLk. ntggjjpdhy ,UkG tisak tpht;ilAk. ,gnghOJ vspjhf kurrffujjpd kJ ,UkG tisajijg nghUjj KbAk. gpwF ,UkG tisajijf Fshejeh nfhzL cldbahf Fspht;fFk nghOJ> ,UkGtisak cldbahfr

RUqFfpwJ. vdNt ,UkG tisakhdJ kurrffujjpd kJ› kpf ,Wffkhfg nghUeJfpwJ.

fiuahzp:

- ,uzL cNyhfjjfLfis xdwpizff filahzp gadgLfpdwJ. edF ntggggLjjggll filahzpia jfLfspd Jis topNa nghUjjp filahzpapd mbggff Kidiar Rjjpaiyf nfhzL mbjJ kWGwk xU Gjpa jiyggFjp cUthffggLfpwJ. FspUknghOJ RUqFtjhy› mJ ,uzL jfLfisAk ,Wffkhfg gpbjJf nfhsfpdwJ.

jbkdhd fz;zhb Ftis tphpjy;:

- fzzh ntggjij mhpjpw fljJk nghUshFk. #lhd ehpid fzzhbf Ftisapy CwWknghOJ› Kfitapd clGwk cldbahf tphptilAk› mNjNeujjpy Kfitapd ntspgGwk RwWgGwjjpd ntggepiyapy ,Uggjhy tphptiltjpyiy. vdNt KfitahdJ rkkhf tphptilahj fhuzjjhy tphry VwgLfpwJ.

kpd;rhuf; fkgpfs;:

- kpdfkgqfSfF ,ilNa css kpdrhuf fkgpahdJ Nfhilffhyqfspy njhathfTk. Fsphfhyqfspy NeuhfTk ,Uffpdwd. ,jwfhd fhuzk ntggk mjpfkhf cssnghOJ› cNyhfqfs tphptilfpdwd. Fsphfhyqfspy cNyhfqfs RUqFfpdwd. vdNt gUtepiyfF Vwg kpdrhuffkgpapd esjjpy VwgLk khwwjijf fzffplL kpdfkgqfspy kpdrhuffkgpia rwW njhathfg nghUjJfpdwdh.

v mUfpYss Gifgglqfspy xU ghyjjpd ,izgGggFjp Nfhil kwWk Fsphfhyqfspy glkhffgglLssJ.

fzf;fplLfs;:

1. ehd xU Kfitapy xU ypllh ehpid vhpthA mLggpy itjJ ntggggLjJk NghJ mJ leJ epkplqfspy nfhjepiyia milejJ. vdJ ezgd miu ypllh ehpid kpdrhu mLggpy itjJ ntggggLjjpdhd. mJTk rhpahf leJ epkplqfspy nfhjepiyia milejJ.
   vJ leJ epkplqfspy mjpf ntggjijj jejJ?
   1. vhpthA mLgG 2. kpdrhu mLgG
      vjjid klqF mjpfk vdW $w KbAkh?

2. xU ypllh eiu 30ºC ,y ,UeJ 31ºC fF khwwj NjitggLk ntgg Mwwy xU fNyhhp vdwhy› xU ypllh eiu 30ºC ,y ,UeJ 25ºC fF khwwj NjitggLk ntgg Mwwy vttsT?

epidtpy; nfhs;f:

v ekJ Kjdik ntgg Mwwy %yk #hpadhFk. vhpjjy› cuhaT kwWk kpdrhuk Nghdwtwwpd %yKk ehk ntgg Mwwiyg ngWfpNwhk.

v nghUlfis ntggggLjJkNghJ mjpy css %yf$Wfspy ,ej mjphTk› ,affKk mjpfhpfpdwd. mNjhL nghUspd ntggepiyAk cahfpwJ.

v xU nghUspy mlqfpAss %yf$Wfspd ,aff MwwNy ntggk vd mioffggLfpwJ.

v ntggjjpd SI myF [_y MFk.

v xU nghUs vej msT ntggkhf myyJ Fspfhrrpahf cssJ vdgjid mstpLk msTfF ntggepiy vdW ngah.

v ntggepiyapd SI myF nfytpd MFk.

v nttNtW ntggepiyapy css ,UnghUlfs xdWld xdW njhLkghJ ntggkhdJ vejj jpirapy ghafpwJ vdgjid mtwwpd ntggepiy ephzapffpwJ.

v xU nghUs kwnwhdwpd ntggepiyia ghjpfFkhdhy mit ntggj njhlhgpy cssd vdyhk.

v ntggj njhlhgpy css ,UnghUsfspd ntggepiyAk rkkhf ,Uejhy mit ntggrrkepiyapy cssd vdyhk.

v nghUsfs ntggggLjJkngh OJ tphtileJ Fsphtpfk nghOJ RUffkilfpdwd. xU nghUis ntggggLjJkngh OJ mJ tphtiltij mgnghUspd ntggtphtiljy vdfpNwhk.

v xU jpzkg nghUSfF Fwpggpl tbtk cssJ. vdNt mijr #LgLjJkngh OJ mJ vyyh gffqfspYk tphtilfpwJ. mjhtJ mjd esk› guggsT› fd msT Nghdwit tphtilfpdwd.

7thmwtay;
njhFj 2
myF – 1
ntggk; kwWk; ntggepiy

mwKfk;

· ntspgGwk Fshrrpahf cssNghJ ekJ cly Fspuhy eLqFfpwJ. ,NjNghy ntspgGwk ntggkhf cssNghJ ekfF tpahffpwJ. ,fFshrrapidAk ntggjjpidAk eqfs vtthW Jyypahf mstLthfs?

· ekJ mdwhl thotpd gy epfoTfspy ntggepiyahdJ Kffpa gqfhwWfpwJ. cjhuzkhf ekJ cly ,aff nrayghLfs> fhyepiy kwWk czT rikjjy Nghdw gy epfoTfs ntggepiyapid nghUjJ khWgLfpdwd. xU nghUspd ntggk myyJ Fshrrapd mstL ntggepiy vd mioffggLfpwJ.

· xU nghUspy csss Jfsfspd ruhrh ,aff Mwwypd kjpgNg ntggepiy MFk. ntggepiyahdJ xU nghUspy csss mZffs vttsT Ntfkhf ,aqFfpdwd. vdgNjhL njhlhGajhFk.

ntggepiyapd; myFfs;

· ntggepiyapid msff %dW tifahd myFfs gadgLjjggLfpdwd. mit: nryrpa]> ghud`l kwWk nfytpd MFk.

· nryrpa]: nryrpa] myfhdJ ºC vd vOjggLfpwJ. cjhuzkhf 20ºC. ,J ,UgJ bfhp nryrpa] vd gbffggLfpwJ. nryrpa] myfhdJ nrdbfpNul vdTk mioffggLfpwJ.

ghud;`l;:

· ghud`l myfhdJ ºF vd vOjggLfpwJ. cjhuzkhf 25ºF ,J ,UgjijeJ bfhp ghud`l vd gbffggLfpwJ.

nfy;tpd;

· nfytpd myfhdJ K vd vOjggLfpwJ. cjhuzkhf 100 K. ,J E}W nfytpd vd gbffggLfpwJ.

ntgge piyapd; SI myF nfy;tpd; (K) MFk.
ntgge piyapid mstpLjy;

· xU nghUspy csss %yf$Wfspd ruhrh ,aff Mwwy mjd ntgge piyahFk. mjhtJ xU nghUs mjpf ntgge piyapid nfhzbUejhy mgnghUspy csss %yf$Wfs mjpf Ntfjjpy ,aqfpf nfhzbUfFk.

· Mdhy ,qF Nfstp vddntdpy ntgge piyapid vtthW msggJ vdgjhFk? vejnthU nghUspd %yf$WfSk kpfr rpwpaitahFk. vdNt mtwwpid gFgghaT nraJ> ,affjjpid (,aff Mwwy) fzffplL mjd %yk ntgge piyapid msggJ fbdkhd xdwhFk. vdNt ehk khwW topKiwfisg gadgLjjp klLNk xU nghUspy csss %yf$Wfspd ,aff Mwwypid msff ,aYkl.

- jpzkg nghUsfSfF ntggjjpid mspfFk NghJ mit tpthtilAk vd ehk KddNu mwpeJsNshk. mNjNghy jputKk nggjjpdhy tpthtilAk. foffzl nrayghlbd %yk mjid mwpeJnfhssyhk. ntggepiykhdpapy csspjputkhdJ ntggggLjJk NghJ tpthtilfpwJ. Fspfrrp milAk NghJ RUqFfpwJ. ,jd %yk ntggepiyahdJ mstplggLfpwJ. jpzkk kwWk jputqfspy ntggjjpdhy VwgLk tpisTfis ehk thAffspYk fhzKbAk.

ntggepiykhdp

- ntggepiyapid msff gutyhfg gadgLjjggLk fUtp ntggepiykhdpahFk.

- gytifahd ntggepiykhdpfs fhzggLfpdwd. mtwWs rpy ntggepiykhdpfs Fwpggpll tif jputk epuggggll nkyypa fzzhb Foypidf nfhzLssd.

- Vd ghjurk myyJ Myf`hy ntggepiykhdpfspy gadgLjjg gLfpdwJ?

- ngUkghYk ghjurk myyJ Myf`hy Mfpa jputqfs ntggepiykhdpfspy gadgLfpdwd. Vnddpy mtwwpd ntggepiyfspy khwwk VwgllhYk mit jput epiyapNyNa njhlheJ fhzggLfpdwd. NkYk rpwpa mstpy ntggepiyapy VwgLk khWghLk mjjputqfspd fd mstpy khwwjjpid VwgLjjf$bajhf cssJ.

- ntggepiykhdpapy csspjputqfspd fd mstpy VwgLk ,kkhwwjjpid msggjd %yk ehk ntggepiyapid mstpLfpNwhk.

ghjurjjpd; gzpGfs;

v ghjurk ruhf tpthtilfpwJ. (xNu msT ntgg khwwjjpwF mjd esjjpy VwgLk khwwKk xNu msTilajhf ,UffpwJ)

v ,J xspCLLUthjJ kwWk> gsgsgghdJ.
v ,J fzzhb Fohapd Rthfspy xllhJ

v ,J ntggjjpid edF fljjf$baJ.

v ,J mjpf nfhjepiyAk (357ºC) Fiwej ciwepiyAk (-39ºC) nfhzlJ. vdNt mjpf neLffjjpdhyhd ntggepiyfis msff ghjurk gadgLfpwJ.

Myf`hypd; gzpGfs;

v Myf`hy -100ºC fFk Fiwthd ciwepiyia nfhzLssJ. vdNt kpff Fiwej ntggepiyfis msff gadgLfpwJ.

v xU bfhp nryrpa] ntgepiy cahtpwF ,jd tpthtilAk jdik mjpfkhFk.

v ,jid mjpf mstpwF tzz%ll KbAk. Mjyhy> fzzhb FohafFs ,jjputjjpid njspthf fhz ,aYk.

ntggepiykhdpapd; tiffs;

- fhwW> cly ntgepiy> czT kwWk gy nghUsfspd ntggepiyfis msff ehk gyNtW tifahd ntggepiykhdpfis gadgLjJfpNwhk. mtwWs

kUjJt ntggepiykhdpAk› Matf ntggepiykhdpAk nghJthf gadgLjjggLk ntggepiykhdpfshFk.

kUj;Jt ntggepiykhdp:

- ,ttif ntggepiykhdpahdJ tLfs› kUjJtkidfs Nghdw ,lqfspy kdpj clypd ntggepiyia msff gadgLfpwJ. kUjJt ntggepiykhdpfspd Fohapdpy xU FWfpa tisT fhzggLfpwJ. ,f FWfpa tisthdJ ntggepiykhdpia Nehahspapd thapypUeJ vLjjTld ghjurkhdJ kzL Fkpopffs nrytijj jLffpwJ. vdNt ekkhy ntggepiyia vspjhf Fwpjfnfhss ,aYk. ghjur

- ,iofF ,UGwKk ,uzL ntggepiy msTNfhyfs fhzggLfpdwd. mtwwpy xdW nryrpa] msTNfhy kwnwhdW ghud`l msTNfhyhFk. ghud`l mstlhdJ nryrpa] mstlbid tpl Elgkhdj vdw fhuzjjpdhy clypd ntggepiyahdJ F (ghud`l)y msffggLfpwJ. kUjJt ntggepiykhdpaJ Fiwejglr ntggepiyahf 35ºC myyJ 94ºF ntggepiyiaAk mjpfglr ntggepiyahf 42ºC myyJ 108ºF ntggepiyAk msfff$baJ.

- kUjJt ntggepiykhdpapid gadgLjJkNghJ Nkwnfhss Ntzba Kdndrrhpfif eltbfiffs

  - v ntggepiykhdpapidg gadgLjJtjwF KdGk gpdGk fpUkpehrpd jputjjpdhy edF fOt NtzLk.
  - v ghjur kljjpid fNo nfhzL tUtjwfhf ntggepiykhdpia xU rpy Kiw cjw NtzLk.
  - v mstplj njhlqFk Kd ghjur kllkhdJ 35ºC myyJ 94ºF fo ,Uff NtzLk.
  - v ntggepiykhdpapd Fkpo gFjpapy ntggepiykhdpia gpbfff $lhJ.
  - v cqfs fzzpwF Neuhf ghjur kljjpid itjJ gpwF mstlbid vLff NtzLk.
  - v ntggepiykhdpapidf ftdkhf ifahs NtzLk. fbdkhd guggpy ntggepiykhdp Nkhjpdhy mJ cileJtplf$Lk.
  - v ntggepiykhdpapid vhpaf$ba nghUsfSfF mUfpNyh myyJ Neubahf #hpa xspapd fNoh itfff$lhJ.

Matf ntggepiykhdp:

- Matf ntggepiykhdpahdJ gsspapy myyJ gpw Matfqfspy mwptpay MaTfSffhf ntggepiyapid msff gadgLfpwJ. njhopwrhiyfspYk Matf ntggepiykhdp gadgLjjggLfpwJ. kUjJt ntggepiykhdpiaf fhlbYk mjpf kjpgG nfhzl ntggepiyapid msff ,J gadgLjjggLfpwJ. ,ttif ntggepiykhdpapd fzzhb jzLk› FkpOk kUjJt ntggepiykhdpiaf fhlbYk nghpajhFk. NkYk ,jpy FWfpa tisT fhzggLtjpyiy. Matf ntggepiykhdpahdJ –10ºC Kjy 110ºC tiuapyhd nryrpa] msTNfhypidf nfhzLssJ.

- Matf ntggepiykhdpapid gadgLjJkNghJ Nkwnfhss Ntzba Kdndrrhpfif eltbfiffs:

  - ntggepiyapid mstpLkngh J ntggepiykhdpapid rhaffhky Neuhf itff NtzLk.

kUjpJt ntggepiykhdpfpFk; Matf ntggepiykhdpfpFk; ,ilNa cspsNtWghLfs;

kUjpJt ntggepiykhdp	Matf ntggepiykhdp
kUjJt ntggepiykhdpahdJ 35ºC Kjy 42ºC tiu myyJ 94ºF Kjy 108ºF tiu mstlbidf nfhzLssJ.	Matf ntggepiykhdpahdJ nghJthf -10ºC Kjy 110ºC tiu mstpLgglbUfFk
ghjur kllkhdJ jhdhfNt fo ,wqfhJ. mjpy csspFWfpa tisthdJ ghjur klljjpid fo ,wqfhky ghJfhffpwJ.	FWfpa tisT ,yyhj fhuzjjpdhy ghjur kllkhdJ jhdhfNt fo ,wqfptpLk
ghjurjjpid fo nfhzL tu ntggepiykhdpapid cjw NtzLk.	ghjur klljjpid fNo nfhzLtu ntggepiykhdpapid cjw Ntzbajpyiy.
,J cly ntggepiyapid msff gadgLfpwJ.	,J Matfjjpy gyNtW nghUsfspd ntggepiyia msff gadgLfpwJ.

- vgnghUspd ntggepiyapid msff NtzLNkh mgnghUshdJ KOtJk ntggepiykhdpapd Fkopid midjJ gffqfspYk #oeJ csspNghJ klLNk mstlbid vLff NtzLk.

kdpjhfs nttNtW cly ntggepiyapid ngwWss Nghjpyk mthfspd ruhrhp cly ntggepiy 37ºC (98.6ºF) MFk. NkYk xtnthUtUk xNu kjpggpyhd ntggepiyapid ehs KOtJk ngwW ,Uggjpyiy. ehk nraAk NtiyfSfF VwgTk Gw #oYfF Vwwhw NghyTk ekJ cly ntggepiyahdJ ehs KOtJk rpwpJ cahtJk jhotJkhf csspJ.

bp[plply; ntggepiykhdp:

- ghjur ntggepiykhdpapid gadgLjJtjpy eilKiwapy rpy rpffyfs fhzggLfpdwd. ghjurk erRj jdik thaejJ. NkYk ntggepiykhdpahdJ cileJtpllhy ghjurjjpid mgGwggLjJtJk fbdkhFk. ,diwa fhyfllqfspy ghjurjjpid gadgLjjhj bp[plly ntggepiykhdpahdJ gadgLjjggLfpwJ. ,J ekJ clypy ,UeJ ntspNaWk ntggjjpid Neubahf msfff$ba Xh czhtpapid nfhzLssJ. ,jd%yk ehk clypd ntggepiyapid msff KbAk.

ftdpfpTk;

- mUz #lhd ghypd ntggepiyapid kUjJt ntggepiykhdpia gadgLjjp msejwpa Kawrp nrajhd. mtdJ Mrphah mtthW nratJ $lhJ vd jLjJtpllhh

cqfs; clypd; ntggepiyapid fzfpLjy:
fpUkpehrpd; jputjjpidf nfhzL Kjypy cqfspd ntggepiykhdpapid fOtpfnfhssTk. ntggepiykhdpapd Kidapid edF ifapy gpbjJfnfhzL rpyKiw cjwTk. ,jd %yk ghjurkhdJ fokpllpjpwF ,wqFk. mjd kllkhdJ 35ºC (95ºF) fF fo csspjh vdgij cWjp nraJfnfhssTk. ,gNghJ ntggepiykhdpapid cqfs ehffpwF mbapNyh myyJ Njhsglilf F

mbaNyh itffTk. xU ekljjwF gwF ntggeiykhdaid vLjJ mstlbid FwffTk. ,ej mstL cqfs clyd ntggeiyaid FwfFk. cqfs clyd ntggeiy vttsT?

- kUjJt ntggeiykhdaid ehk kdjhfsd ntggeiyaid jtu gw nghUsfsd ntggeiyaid msff gadgLjjf$lhJ vd mwTWjJfNwhk. NkYk mjid ntsrrjjy gLkgb myyJ vhAk nghUsfSfF mUfNyh itff $lhJ vd $WfNwhk. Vd? Vnddwhy ghjurjjd mjfkhd tht dhy cUthFk mOjjjjd fhuzkhf ntggeiykhdahdJ cileJtlf$Lk.

ntggeiykhdaiy gadgLjjggLk; mstLfs; nryra]; mstL Kiw

- Rtld ehlL thdayshsh Mzlu] nryra] vdgthd ngahdhy 1742 Kjy ,ej myflL KiwahdJ

Matf ntggeiykhdaidg gadgLj;Jjy:

- v xU gffhy ehid vLjJf nfhssTk.
- v Matf ntggeiykhdaid vLjJfnfhzL mjd FkohdJ ehy %of ,UfFkhW itffTk. mjid nrqFjjhf eWjj itffTk. FkohdJ KOtJk ehy %of ,Uggjid cWj nraJfnfhssTk. NkYk FkohdJ gffhd mbggFjaidNah myyJ RthggFjaidNah njhlhjthW ghhjJfnfhssTk.
- v ghjurk Nky VWtjid cwW NehffTk. mJ eiyjjdikaid milejTld mstlbid vLffTk.
- v #lhd ehidg gdgLjj Nrhjidaid jUkgr nraaTk

b[ly; ntggeiykhdaid gadgLj;Jjy:

1. ntgg eiykhdad Kidaid fUkehrd nfhzL Rjjk nraaTk (#lhd ehid gadgLjj Ntzlhk)
2. “ON” nghjjhid mOjjTk.
3. ntggeiykhdaad Kidaid thaggFj ehffd mbay› myyJ Njhsglilaid mbay vd VjhtnjhU ,ljjdy itffTk.
4. mNj eiyay ntggeiykhdaid gg vdw Xir tUktiu itjjUffTk. (Vwjjho 30 tehbfs)
5. jiuay njhAk ntggeiyaid FwjJf nfhssTk
6. ntggeiykhdaid mizjJtlL› ehidf nfhzL fOt ghJfhgghf itffTk.

- nryra] vd mioffggLfwJ. mjwF Kddhy ,ej mstlL Kiw nrdbfNuL vd mioffggLfwJ. ,ttif ntggeiykhdaad msTNfhyhdJ ehid ciweiy ntggeiyaid (0ºC) Mukg kjgghfTk ehid nfhjeiy ntggeiyaid (100ºC) ,Wj kjgghfTk nfhzL mstlgglLssJ. fNuff nkhoay nrdlk vdgJ 100 vdw kjggidAk fNul] vdgJ gbfs vdgijAk FwfFk. ,ttuzL thhjijfSk ,izeJ nrdbfNuL vdw thhjij cUthdJ.

ghud;`ly; msstlL Kiw:

- kdpj clypd ntggepiyapid msff ghud`l mstlL Kiw nghJthf gadgLjjggLfpwJ. n[hkd kUjJth Nldpay Nfghpay ghud`l vdgthpd ngahpdhy ,ttstlL Kiw mioffggLfpwJ. ghud`l mstlL Kiwapy ehpd ciwepiy 32ºF kwWk ehpd nfhjpepiy 212ºF vd vLjJfnfhssggLfpwJ. vdNt ghud`l ntggepiykhdpapd msT NfhyhdJ 32ºF ypUeJ 212ºF tiu mstpIgglLssJ.

nfy;tpd; msstlL Kiw:

tpyypak yhhL nfytpd vdgthpd ngahpdhy ,ttstlL Kiw

ngUk rpWk ntggepiykhdp: xU ehspd mjpfglr kwWk Fiwejglr ntggepiyapid msffg gadgLk ntggepiykhdpahdJ ngUk rpWk ntggepiykhdp vd mioffggLfpwJ.

- mioffggLfpwJ. ,J ntggepiyapid msfff$ba SI mstlL KiwahFk. ,ej myF KiwahdJ K vdw vOjjpdhy FwpffggLfpwJ. jdpr Rop ntggepiyapy ,UeJ ,jd mstlL Kiwapd kjpgGfs njhlqFtjhy jdprRop ntggepiykhdp vdTk mioffggLfpwJ.

vz; fz f;fLfs; jhf;fggl;l fz f;Ffs;

- 68□F ntggepiy kjpggpid nryrpa] kwWk nfytpd kjpggwF khwWf. nfhLffgglLssit
ntggepiyapd kjpgghdJ ghud`lby = F = 68› nryrpa] mstlL Kiwapy
ntggepiyapd kjpgG = C = ?
nfytpd mstlL Kiwapy ntggepiyapd kjpgG = K = ?

$$\frac{(F-32)}{9}=\frac{C}{5}$$

$$\frac{(68-32)}{9}=\frac{C}{5}$$

$$C = 5\times\frac{36}{9}=20^{\circ}C$$

K = C + 273.15 = 20 + 273.15 = 293.15

- ghud`l mstlbwFk nryrpa] mstlbwFk css njhlhGk› nfytpd mstlbwFk nryrpa] mstlbwFk css njhlhGk fNo nfhLffgglLssJ.

$$\frac{(F-32)}{9}=\frac{C}{5}, K = 273.15 + C$$

%dW Kjdikahd ntggepiy mstlL Kiwfspy rpy nghUsfspd ntggepiyfs fNo nfhLffgglLssd.

ntggepiy	nryrpa]; mstlL(K)	ghud;`ly; mstlL(ºC)	nfy;tpd; mstlL(ºF)

eh‰d nfhj‰e‰iy	100	212	373.15
eh‰d ciwe‰iy	0	32	273.15
kd‰j cly‰d ruhrh‰ ntgg e‰iy	37	98.6	310.15
miw ntgg e‰iy (ruhrh‰)	72	23	296.15

cyf‰d ngUkghdikahd kd‰jhfs mdwhl thot‰y ntgge‰iyfis msff nryr‰a] mstlL Kiwa‰id gadgLjJf‰dwdh. nfyt‰d mstlL KiwahdJ jd‰rRo‰ mstlL Kiw klLk myy. 1ºC ntgge‰iy khwwk Vwgllhy 1 K ntgge‰iy khWghL VwgLk tifa‰y nfyt‰d mstlL Kiw tbtikffgglLssJ. ,jd %yk 273.15 vdw kj‰gg‰id nryr‰a] mstlLld $lLtjd %ykhfNth myyJ fo‰ggjd %ykhfNth ehk k‰f vs‰ikahf nryr‰a] mstlL Kiwa‰id jd‰rRo‰ mstlL (nfyt‰d) KiwfF khww‰fnfhss ,aYk. Mdhy Iff‰a mnkh‰ff ehLfs‰y ghud`l mstlL Kiwa‰id gadgLjJf‰dwdh. ghud`l mstlL Kiwa‰id jd‰rRo‰ (nfyt‰d) mstlL KiwfF khwWtJ vs‰ikahdjhf ,yiy.

,jid rh‰nraa mthfs uhdfd mstlL Kiwa‰id gadgLjJf‰dwdh. f‰sh]Nfh gyfiyffofjj‰d nghw‰a‰ayhsh kwWk ,awg‰ayhsuhd uhdfd 1859 Mk MzL ,kKiwa‰id mw‰KfggLjj‰dhh. ,J jd‰r#o‰ mstlL KiwahFk. NkYk 1ºR y VwgLk khwwk 1ºF fF rkkhFk tifa‰y tbtikffgglLssJ. vdNt ghud`l mstlL Kiwa‰id gadgLjJgthfSfF jd‰rRo‰ mstlL Kiw Njitggllhy mthfs R= F + 459.67 vdw thagghlbid gadgLjj‰ uhdfd KiwfF kj‰gg‰id vs‰ikahf khww‰f nfhss ,aYk.

vdNt nryr‰a] kj‰gg‰y ntgge‰iy = 20ºC
nfyt‰d ntgge‰iy = 293.15 K

2. vej ntgge‰iya‰y nryr‰a] kwWk ghud`l mstLfs xNu kj‰gg‰id nfhzbUfFk.

nfhLffgglLssit

nryr‰a] kwWk ghud`l kj‰gGfs rkkhFk. mjhtJ

$$F = C, \frac{(F - 32)}{9} = \frac{C}{5}$$

(or)

$$\frac{(C - 32)}{9} = \frac{C}{5}$$

$(C - 32) \times 5 = C \times 9$

$5C - 160 = 9C$

$4C = -160$

$C = F = -40$

nryr‰a] kwWk ghud`l mstlby rkkhd ntgge‰iya‰d kj‰gG = - 40

nfhLffgglLss ntgge‰iyfis khww‰ mikffTk.

1. 45ºC = …… ºF
2. 20ºC = …….ºF
3. 68ºF = …….ºC
4. 185ºF = …….ºC

5. 0ºC = …….K
6. -20ºC = …….K
7. 100K = …….ºC
8. 27215K = …….ºC

epidtpy; nfhs;f.

1. xU nghUspd ntggjjpidAk Fspfhrrpiaak mstpLtijNa ehk ntggepiy vd miofpNwhk.

2. ntggepiyapid msff %dW tifahd myFfs gadgLjjggLfpdwd. mit : bfhz nryrpa]› ghud `l kwWk nfytpd MFk.

3. ntggepiyapd SI myF nfytpd (K) MFk.

4. ntggepiykhdpay css jputkhdJ ntggggLjJk NghJ tpztilfpwJ› Fspfhrp milAk NghJ RUqFfpwJ. jutjjpd ,ggzghdJ ntggepiykhdpay ntggepiyapid msffg ggadgLfpwJ.

5. ghud `l› nfytpd kwWk nryrpa] mstLfSfF ,ilNa css njhlhG

$$\frac{(F-32)}{9}=\frac{C}{5}$$

K = 273.15 + C

8th mwptpay;
njhFjp –II
myF – 1 ntggk;

mwpKfk;

· ekikr Rwwp Ass midjJg nghUsfSk mZffs kwWk %yf$Wfshy Mdit. ,ej mZffs kwWk %yf$Wfs vgnghOJk mjhTWk ,affjpy cssd. ,ej ,affjpd %yk mit xU tif Mwwiyg ngwWssd. mJNt ntgg Mwwy vdggLfpwJ. ,ej ntgg Mwwy ntggkhd nghUspypUeJ Fshrrpahd nghUSfF myyJ xU nghUspd ntggkhd gFjpapypUeJ Fshrrpahd gFjpfFg guTfpwJ. xU nghUSfF toqfggLk ntgg Mwwy mjpYss mZffs kwWk %yf$Wfspd Mwwiy mjpfhpffpdwJ.

· vdNt mit NkYk mjpTwj njhlqFfpdwd. mjpTUk ,ej mZffs kwWk %yf$Wfs mUfpYss gpw mZffs kwWk %yf$Wfspd kJ mjpthpid VwgLjJfpdwd. vdNt ntgg MwwyhdJ nghUspd xU gFjpapypUej kwnwhU gFjpfFg guTfpwJ. ,ej ntgg MwwyhdJ nghUsfspy gy khwwqfis VwgLjJfpdwJ. ,jid ekJ mdwhl thotpy ehk fhzKbAk. ,ijggwp ,gghljjpy gapy ,Uffpwhfs. NkYk ntgg fljjggLjy kwWk ntggepiy khwwjij mstpLjy Mfpatwiwg gwpAk fwf ,Uffpwhfs.

ntgg Mwwypdhy; VwgLk; tpisTfs;

· xU nghUspwF ntgg Mwwiy mspfFk NghJ› mJ mgnghUspy gy khwwqfis czLgz Zfpwj. %dW Kffpakhd khwwqfis ek mdwhl thotpy ehk fhzyhk. mitahtd›
1. tphptiljy
2. ntggepiy cahT
3. epiy khwwk

tphptiljy;

xU cNyhfggeJ kwWk mjwFg nghUjjkhd tpllKila xU cNyhf tisajjpid vLjJf nfhssTk. mggejpid mej tisajjpwFs nrYjjTk. cNyhfggejhdJ cNyhf tisaajjpwFs vspjhfr nrytij cqfshy fhzKbAk. mjid rpwJ Neuk mttisajjpd kJ itffTk. rpy epkplqfspy geJ tisajjpypUeJ fNo tpOtijf fhzKbAk.

,eepfotpy #lhd cNyhfggeJ Kjypy tisajjpwFs Eioatpyiy. rpwJ Neuk flej gpwF csNs Eiofpwj. ,J vggb? gejpid ntggggLjJk NghJ mjpYss mZffs kwWk %yf$Wfs ntgg Mwwiyg ngWfpdwd. gpwF mit mjphtilaj njhlqfp xdiwnahdW

,uapy jzlthsqfspy rpwJ ,ilntspy ,Uggij eqfs ghhjjpUgghfs. mJ Vd vdW njhpAkh? ,Ukgpdhy nraaggll jzlthsqfs Nfhil fhyqfspy ntggjjpd jhffjjpdhy tphptilfpdwd. Mdhy mtthW tphptilAk NghJ jzlthsjjpy ,ilntspy tplgglL cssjhy vejtpj ghjpgGk mjpy VwgLtjpyiy.

· typffpj jsSfpdwd. ,jdhy gejhdJ tphptilfpwJ. vdNt› mJ cNyhf tisajjpwFs Eioatpyiy. rpwJ Neujjpy ntgg Mwwiy RwWgGwjjpwF mspggjhy mggeJ jdJ gioa epiyfF kzLk tUfpwJ. vdNt

tisajjwFs Eiofw J. ,jyUeJ jlgnghUsfis ntggggLjJk NghJ mit thtilfdwd vdgij ehk mwaKbfwJ. ,ej thT jutk kwWk thAffsYk VwgLfwJ. Mdhy thAffsy ,J mjfkhf ,UfFk.

ntggepiy cahT:

- Kfitay css eiu ntggggLjJk NghJ ehy css mZffs ntgg Mwwiyg ngWfdwd. ,ej ntgg Mwwy eH %yf$Wfsd ,aff Mwwiy mjfhffr nrafwJ. eh %yf$Wfs mjf Mwwiyg ngWknghOJ mtwwd ntggepiy mjfhffwJ. ,jyUeJ ntgg Mwwy xU nghUsy ntggepiy cahit VwgLjJfwJ vdgij mwa Kbfw J.

- gdfflbay css eh %yf$WfSfF ,ilNaahd fthrr tir mjfkhf cssJ. vdNt mit kfTk neUffkhf cssd. gdfflbia ntggggLjJk NghJ eh %yf$WfSfF ,ilNaahd fthrr tir Fiwtjhy gdfflb cUf euhf khWfwJ. eiu ntggggLjJkNghJ eH %yf$WfSfF ,ilNaahd fthrr tir NkYk Fiwtjhy mJ euhtahf khWfwJ. euhtahdJ RwWgGwjjwFr nrytjhy ehd msT Fiwfw J. ,ej efoTfsyUeJ xU nghUswF ntgg Mwwiy msfFk NghJ mgnghUsd eiyay khwwk VwgLfwJ vdgij mweJnfhss Kbfw J. mgnghUsy css ntgg Mwwiy efFkNghJ vjhjjiray khwwk VwgLfwJ.

- xU nghUsyUeJ ntgg Mwwiy vLfFkNghNjh myyJ mgnghUSfF ntgg Mwwiy msfFk NghNjh mgnghUshdJ xU eiyayUeJ kwnwhU eiyfF khwwk milfwJ. ntgg Mwwy fhuzkhf nghUsfsy foffhZk khwwqfSs VjhtJ xU khwwk Vwglyhk.

  - v jlgnghUs jutkhf khWjy (cUFjy)
  - v jutk thAthf khWjy (Mtahjy)
  - v jlgnghUs thAthf khWjy (gjqfkhjy)
  - v thA jutkhf khWjy (Fshjy)
  - v jutk jlgnghUshf khWjy (c iwjy)
  - v thA jlgnghUshf khWjy (gbjy)

,awifahfNT Gtad kJ jzkk jutk thA Mfa %dW eiyfsYk fhzggLfdw xNu gUgnghUs eH MFk.

ntggg ghkhwwk:

- xU nghUSfF ntgg Mwwiy msfFk NghJ mJ mgnghUsd xU gFjayUeJ kwnwhU gFjfF ghkhwwk milfwJ. xU nghUsd eiyiag nghWjJ ntggg ghkhwwk %dW tjqfsy eilngWfwJ. ntggg ghkhwwk eilngWk %dW tjqfshtd:

  - v ntggf fljjy
  - v ntggr rydk
  - v ntggf fjhtrR

- Kfitay css fuzbad kWKid vtthW #lhfwJ? #lhd eHYss ntgg MwwyhdJ fuzbad xU Kidayw UeJ kwnwhU KidfFf fljjggllNj ,eefotwFf fhuzk MFk. fuzb Nghdw jlgnghUsfsy mZffs kfTk neUffkhf mikeJssd. ntggjjd %yk ,aff MwwiygngwW mjhtilAk eh %yf$Wfs fuzbaYss mZffSfF ntggjijf fljj mtwiwAk mjhTwr nrafdwd. ,ej mZffs

mUfpYss mZffis mjphTwr nrafpdwd. ,tthW ntgg Mwwyhd J fuzbapd xU Kidapypueh kW KidfFf fljjggLfpJ.

- ntggfflijy epfoT xU fljjpapd ,uzL KidfSfSffpilNa myyJ nttNtW ntggepiyapy> Mdhy xdWld xdW njhlhgpYss ,uzL jplgnghUsfSffpilNa epfofpwJ. jplgnghUsfspy mjpf ntggepiyapYss gFjpapypUeJ Fiwej ntggepiyapYss gFjpfF mZffs myyJ %yf$Wfspd ,affk ,yyhky ntgg Mwwy guTk epfoT ntggf fljjy vdW tiuaWffggLfpwJ.

cNyhfqfs midjJk rpwej ntggf fljjpfshFk. ntggjij vspjhff fljjhj nghUsfs ntggk fljjhg nghUsfs (myyJ) fhgghdfs vdW mioffggLfpdwd. kuk> jfif> gUjjp fkgsp fzzhb> ,uggh Mfpait ntggk fljjhg nghUsfshFk.

mdpwhl thopty; ntggfpfljpjy;

- cNyhfjjhyhd ghjjpuqfspy ehk czT rikffpNwhk. rikay ghjjpujij ntggggLjJk NghJ> ntgg MwwyhdJ ghjjpujjpypUeJ czTg nghUSfFf fljjggLfpwJ.

- ryitg nglbiaf nfhzL Jzpia ryit nraAk NghJ ryitg nglbapypUeJ ntgg Mwwy JzpfFg guTfpwJ.

- rikay ghjjpuqfspd ifggpb gpshjbf myyJ kujjpdhyhd nghUsfshy nraaggIbUffk. Vnddpy mit ntggjijf fljJtjpyiy.

- ,fY} vdggLk gdp tLfspy csgFjapd ntggepiy RwWgGwjijtpl mjpfkhf ,UffK. Vnddpy gdpfflb ntggjij kpfTk mhpjhff fljjf$baJ.

ntggr; rydk;

- ghjjpujjpYss eiu ntggggLjJk NghJ> ghjjpujjpd mbggFjapYss eh %yf$Wfs ntgg Mwwiyg ngwW NkyNehffp efhfpdwd. gpwF> NkwgFjapYss eH %yf$Wfs fNo efheJ ntggkilfpdwd. ,ej tpjkhd ntggf fljjYfF ntggr rydk vdW ngah. tspkzlyjjpYss thAffSk ,kKiwapd %yNk ntggkilfpdwd. xU nghUis ntggggLjJkNghJ> cah ntggepiyapYss gFjapypUeJ Fiwej ntggepiyapYss gFjpfF %yf$Wfspd ,affjjpdhy ntggk fljjggLk KiwfF ntggr rydk vdW ngah. ntggr rydk jputqfs kwWk thAffspy eilngWfpwJ.

mdpwhl thopty; ntggr; rydk;

- v epyffhpW kwWk fly fhwW Mfpa epfoTfs cUthtjwF ntggr rydNk fhuzk MFk.

- v ntggr rydk %yfkhfNt fhwwhdJ xU gFjapypUeJ kwnwhU gFjpfF ,lk ngahfpwJ.

- v ntggffhpW gY}dfspy ntggr rydk %yk ntggk fljjggLtjhy gY}d NkNy cahfpwJ.

v Fsphrhjdg nglbapy› Fsphej fhwW foNehffp ,lk ngaheJ› #lhd fhwiw ntggr rydk %yk ,lkhwwk nrafpwJ.

ntggf; fjphtlrR:

· ntggf fjphtrR vdgJ ntgg Mwwy guTk %dwhtJ tpjk MFk. jplgnghUspy ntggf fljjy %ykhfTk› jputk kwWk thAffspy ntggr rydk %ykhfTk ntgg Mwwy guTfpwJ. Mdhy ntwwpljjpy ntggf fjphtrR %yk ntgg Mwwy guTfpwJ. #hpadpypUeJ ntspggLk ntgg Mwwy ntggf fjphtrR %yNkguTfpdwJ. ntgg MwwyhdJ xU ,ljjpypUeJ kwnwhU ,ljjpwF kpdfhej miyfshfg guTk Kiw ntggf fjphtrR vdW tiuaWffggLfpwJ.

mdwhl thotpy; ntggf; fjphtlrR:

v #hpadplkpUeJ ntgg Mwwy ntggf fjphtrR %yk Gkpia tejilfpwJ.

v neUggpwF mUfpy epwFk NghJ ntggf fjphtrR %yk ehk ntggjjpid czhfpNwhk.

v fUgG NkwgugGila nghUsfs ntggf fjphtrRfis VwFk jdikAilajhf cssd. vdNt› rikay ghjjpujjpd mbggFjpapy fUgGepw tzzk GrggLfpwJ.

v ntzik epwkhdJ ntggf fjphtrrpid vjpuhspffpdwJ. vdNt jhd› Nfhil fhyqfspy ntzik epw Milfis cLjJkhW ehk mwpTWjjggLfpNwhk.

ntgg Mwwy guTtij ek fzfshy fhz KbAk. 500ºC ntggepiyfF xU nghUis ntggggLjJk NghJ fjphtrrhdJ kqfpa rptgG epwjjpy ekJ fzfSfFj njhpa MukgpffpwJ. mgnghOJ ek Njhypd %yk ntggjjpid czuKbAk. NkYk ntggggLjJk NghJ› fjphtrrpd msT mjpfhpffpdwJ. mgnghOJ MuQR kwWk kQrs epwjijj njhlheJ ,Wjpahf mgnghUs ntsis epwjjpy xspUk.

ntgg mstpay;

· ,Jtiu ntgg Mwwypd tpisTfs gwwp ehk ghhjNjhk. xU nghUSfF ntgg Mwwiy mspfFk NghJ mjd ,awgpay gzGfspy khwwk VwgLfpdwJ. jpl epiyapYss eh (gdpfflb) jput epiyfFk› jput epiyapYss eh Mtp epiyfFk khwwkilfpdwd. ,itahTk ntggjjpdhy VwgLk ,awgpay khwwqfs MFk. ,NjNghy ntgg Mwwy Ntjpapay khwwqfisAk VwgLjJfpwJ. nghUsfspy VwgLk ,awgpay kwWk Ntjpapay khwwqfisg gwwpj njhpeJ nfhstjwF› mgnghUspy css ntgg Mwwypid mstpl NtzLk. ,tthW nghUsfspy eilngWk ,awgpay kwWk Ntjpapay epfoTfspy css ntgg Mwwypd kjppgpidf fzffpLk KiwfF ntgg mstpay vdW ngah.

ntggepiy:

· xU nghUs #lhd cssjh myyJ Fsphrrpahf cssjh vdgij mwpa cjTk ,awgpay msT ntggepiy MFk. ,J ntggepiykhdpiaf nfhzL mstplggLfpwJ. ntggepiyia mstpl %dW tpjkhd msTNfhyfs gadgLjjggLfpdwd.

v nryrpa] msTNfhy
v /ghud`l msTNfhy
v nfytpd msTNfhy

· Nkwfzl msTNfhyfSs› nfytpd msTNfhNy nghJthfg gadgLjjggLfpwJ. ,ijg gwwp cah tFgGfspy eqfs tphpthfj njhpeJnfhssyhk.

ntggjijpd; myF:

· ntggk vdgJ xU tifahd Mwwy vdgJ ekfFj njhpAk. Mwwypd SI myF [_y. vdNt ntggjijAk [_y vDk myfpy Fwpggplyhk. ,J Jvdw vOjjhy FwpggplggLfpwJ. ntggjij mstpl nghJthfg gadgLjjggLk myF fNyhhp MFk.

1 fpuhk epiwAss ehpd ntggepiyia 1ºC cahjjj Njitggk ntgg Mwwypd msT 1 fNyhhp vd tiuaWffggLfpwJ. fNyhhp kwWk [_y Mfpa myFfSffpilNaahd njhlhG gpdtUkhW FwpggplggLfpwJ. 1 fNyhhp = 4.189 J.

czTg nghUsfspy css Mwwypd msT fpNyh fNyhhp vDk myfhy FwpggplggLfpwJ. 1 fpNyh fNyhhp = 41200 J (Njhuhakhf)

· nghJthf› nghUs xdW VwFk myyJ ,ofFk ntggjjpd msthdJ %dW fhuzpfshy ephzaffggLfpwJ.

v nghUspd epiw
v nghUspd ntggepiyapy VwgLk khwwk
v nghUspd jdik

· xtnthU nghUSk xU Fwpggpll ntggepiyia miltjwF mtwwpwF nttNtW msT ntgg Mwwy NjitggLfpwJ. ,J mgnghUspd ntgg VwGjjpwd vdW mioffggLfpwJ.

· xU nghUspd ntggepiyia 1ºC myyJ 1ºK cahjjj Njitggk ntgg Mwwypd msT mgnghUspd ntgg VwGjjpwd vd tiuaWffggLfpwJ. ,J C vdw vOjjhy FwpggplggLfpwJ. ntgg VwGjjpwd›

$$C = \frac{\text{Njitggk ntgg Mwwypd msT}(Q)}{\text{ntggepiy cahT}(D\mathit{T})}$$

$$C = \frac{Q}{D\mathit{T}}$$

ntgg VwGjjpwdpd myF fNyhhp /ºC ,jd SI myF JK^{-1}MFk.

fzf;fL 1

· xU cNyhfjjpd ntgepiy 30ºC Mf cssJ. mjwF 3000 J msTss ntgg Mwwy mspffggLkNghJ mjd ntgepiy 40ºC Mf capfpwJ vdpy› mjd ntgg VwGjjpwidf fzffpLf.

jhpT:

ntgg VwGjjpwd $C = Q/\Delta T$

,qF Q = 3000 J
ΔT = 40ºC – 30ºC = 10ºC =10K
vdNt C = 3000 / 100 = 300JK^{-1}
cNyhfg gejd ntgg VwGjjwd 300 JK^{-1}MFk.

fz f;fL 2

· xU ,UkGg gejd ntgge;iyia 1 K cahjJtjwF 500 JK^{-1} ntggk Njitgg Lf;wJ. mjd ntgge;iyia 20K cahjJtjwFj Njitahd ntgg Mwwiyf fz ff;Lf.

jhkT:

ntgg VwGjj;wd C' = Q/T
$Q = C \times \Delta T$
,qF C' = 500 JK^{-1}
ΔT = 20 K
Q = 500 × 20 = 10000 J
Njitahd ntgg Mwwy 10000 J MFk.

jd; ntgg VwGj;j;wd;

· XuyF e;iwAila nghUs;d ntgg VwGjj;wNd mgnghUs;d jdntgg VwGjj;wd vd mioffggLf;wJ.

1 f;Nyhf;uhk e;iwAss nghUs xdw;d ntgge;iyia 1ºC myyJ 1K msT cahjjj Njitgg Lk ntgg Mwwy;d msNt mgnghUs;d jd ntgg VwGjj;wd vd tiuaWffggLf;wJ. ,J C vdw vOjjhy Fwpgg;lggLf;wJ.

jd ntgg VwGjj;wd›

$$C = \frac{\text{Njitgg Lk ntgg Mwwy;d msT}(Q)}{\text{e;iw}\ (m)\acute{}\ \text{ntgge;iy cahT}\ (D\mathit{T})}$$

C = Q/ m × ΔT
,jd SImyF $JKg^{-1}K^{-1}$

fz f;fL 3

· 2 kg e;iwAss eh;d ntgge;iyia 60ºC y;UeJ 70ºC Mf cahjjj Njitgg Lk ntgg Mwwy;d msT 84000J vd;y› eh;d jd ntgg VwGjj;wd;d kj;gigf fz ff;Lf.

jhkT:

jd ntgg VwGjj;wd C = Q / m × ΔT
,qF Q = 84000 J
m = 2 kg
ΔT = 70ºC – 60ºC = 10ºC = 10K
C = 84000 / 2 × 10 = 4200 J Kg^{-1} K^{-1}
eh;d jd ntgg VwGjj;wd 4200 J Kg^{-1} K^{-1}MFk.

fz f;fL 4

· xU cNyhfjjid jd ntgg VwGjjwdid kjgG 160JKg^{-1}K^{-1}. 500 fuhk eiwAss cNyhfjjid ntggeiyia 125ºC yUeJ 325ºC Mf cahjjj Njitggk ntgg Mwwyid kjgigf fzffLf.

jhT:

jd ntgg VwGjjwd $C = Q/m \times \Delta T$

$Q = C \times m \times \Delta T$

,qF $C = 10\ J\ KgK^{-1}$

$m = 500\ g = 9.5\ kg$

$\Delta T = 325ºC - 125ºC = 200ºC = 200\ K$

vdNt› $= 160 \times 0.5 \times 200 = 16000\ J$

Njitggk ntgg Mwwyid kjgG = 16000 J

fNyhh kl;lh:

· nghUs xdwidhy Vwfggll myyJ ,offggll ntggjjid mstlg gadgLjjggLk cgfuzk fNyhh kllh MFk. ,J ntggk kwWk kdrhujij edF fljJk jdikAila cNyhfqfshd jhkuk myyJ mYkdajjhy Md ghjjujijf nfhzLssJ. ntgg Mwwiy RwWgGwjjwF msggjd %yk ntgg ,ogG VwgLtijj jLggjwfhf ,J ntggjijf fljjhj xU fydy itffgglLssJ. ,ffydid %baid kJ ,lzL Jisfs cssd. xU Jisaid toahf nghUsid ntggeiyia mstLtjwF ntggeiykhdAk› kwnwhU Jisaid toNa ghjjujjYss jutjijf fyfFtjwF xU fyffAk itffgglLssJ. ghjjujjDs ntgg VwGjjwidf fzffl Ntzba jutkhdJ eugggglLssJ. kdfkgaDs kdrhujijf fljJtjd %yk ,jjutkhdJ ntggggLjjggLfwJ. ,ijg gadgLjj xU jutjjid ntgg VwGjjwdid kjggidf fzfflyhk.

Kjy Kjyhf 1782 Mk MzL Mdnlhad ytha]ah kwWk gaNu irkd yhgyh] Mfnahuhy› Ntjaay khwwqfshy VwgLk ntgg Mwwyid msit mstl gdfflb fNyhh kllh gadgLjjggllJ.

ntggf; flLggLj;jp:

· xU nghUs myyJ ,ljjid ntggeiyia khwhky itggjwfhf gadgLjjggLk rhjdk ntggf flLggLjj (njhNkh]lhl) MFk. ‘njhNkh]lhl’ vdw nrhy› ,uzL fNuff thhjijfsyUeJ ngwggllJ. ,jy ‘njhNkh’ vDk nrhy ntggk vdWk ‘]lhl’ vdDk nrhy mNj eiyay ,UggJ vdWk nghUsgLk. ntggkilAk myyJ Fshrraila lAk cgfuzqfsy ehzaffggll xU Fwggll ntgg eiyia miltjwfhf ,it gadgLjjggLfdwd. ,it› xU Fwggll ntggeiyia milejTld mej cgfuzjij nraygl itffdwd. myyJ eWjjtfdwd. flllqfsYss #Nlwwy› miwfsd ika RNlwwy› fhwWggjdhff (Air conditioner), eh #Nlww kwWk rkayiwaYss Fshgjd› Ezziy mLgG Mfa mikgGfsy ntggf flLggLjj gadgLjjggLfwJ. ry rkaqfsy ntggf flLggLjj czhtahfTk› ntgg eiy mikTfisf flLggLjJk flLk gLjjahfTk nraygLfwJ.

ntggf; Flit (ntwwlf; FLit):

· ntggf FLit (ntwwlf FLit) vdgJ mjy css nghUsid ntggeiyia mjd RwWgGwjjid ntggeiyiatl mjfhjJtlhky myyJ FiweJtlhky ezl Neuk itjjUfff$ba ntggjijf fljjhj Nrkgf

fydhFk. ,jDs ,jDs itffgglLss jutjjd ntggepiyia ezl Neuk khwhky fhggNjhL mjd Ritapy khwwk VwglhkYk ,J ghJfhffwJ.

ntwwplfFlit Kjd Kjypy 1892 Mk MzL]fhlyheJ mwptpayhsh rh N[k] jpthh vdgtuhy fzLgpbffgglIJ. mtiuf fTutg gLjJk tpjkhf ,J jpthh FLit (Dewar Flask) vdWk mioffggLfwJ. ,J jpthh ghlby vdTk mioffggLk.

ntggf; FLit Ntiy nra;Ak; tpjk;

- ntwwplf FLit ,uzL RthfisF nfhzl xU fydhFk. mjd csGwkhdJ rytuhy MdJ. ,uzL RthfSfFk ,ilNaahd ntwwlk cssJ. mJ ntggrrydk kwWk ntggffljjy MFpa epfoTfshy ntgg Mwwy ntspNa guthky ,Uff cjTfwJ. RthfSfF ,ilNa rwpjsT fhwW ,Uggjhy ntspGwjjpypUeJ csGwjjwFk csGwjjypUeJ ntspGwjjwFk ntggk fljjggLtjpyiy. FLitapd NkwgFjpaYk foggFjpaYk ,uzL RthfSk ,izfpdw ,ljjpy klLNk ntggffljjy %yk ntggkhdJ fljjgglKbAk. FLitapYss rpyth Rth ntggffjph trrpid kzLk FLitapYss jutjjwNf mDgGtjhy ezl Neuk jutk #lhf ,UffwJ.

epidtpy; nfhspf:

- ntggkhdJ nghUspd xU gFjpapy ,UeJ kwnwhU gFjpfFg guTfwJ.
- xU nghUspwF ntgg Mwwy mspffggLk NghJ tphtiljy ntggepiy cahT kwWk epiy khwwk Mfpa epfoTfs eilngWfpdwd.
- xU nghUis ntggggLjJkNghJ mZffs Mwwypidg ngWtjhy mit mjphTwj njhlqFk. ,ej mjphTfs kww mZffs kwWk %yf$Wfspd kJ mjphtpid VwgLjJfpdwd.
- cUFjy Mtpahjy gjqfkhjy Fsphtpjjy ciwjy kwWk gbjy Nghdwit ntggjjpdhy ehpy VwgLk epiy khwwqfshFk.
- ntgg Mwwy ghpkhwwk milAk %dW tpjqfshtd: ntggf fljjy ntggr rydk ntggf fjphtrR.
- jplgnghUspy ntggf fljjy %ykhfTk jutk kwWk thAffspy ntggr rydk %ykhfTk ntgg Mwwy guTfwJ. Mdhy ntggf fjphtrR ntwwpljjpy guTfwJ.
- xU nghUspy VwgLk ntgg Mwwy VwG myyJ ,ogG %dW fhuzpfshy ephzaffggLfwJ. nghUspd epiw nghUspd ntggepiy khwwk nghUspd jdik.
- ntggepiyia mstpl %dW tpjkhd msTNfhyfs gadgLjjggLfpdwd. nryrpa] msTNfhy /ghud`l msTNfhy nfytpd msTNfhy.
- xU nghUspdhy Vwfggll myyJ ,offggll ntggjjpid mstplg gadgLjjggLk cgfuzk fNyhpkllh MFk.

9th mwptpay;
myF – 7
ntggk;

mwpKfk;

· ekikr RwwpapUfFk midjJg nghUlfSk %yf$Wfshy fllikffgglLsd. ,ej %yf$Wfs ,affjjpy ,Uggjhy ,aff Mwwiyg ngwwpUfFk. xtntnhU %yf$Wk mjidr RwwpapUfFk kww %yf$WfNshL VwgLjJk <hgG tpirapdhy epiy MwwiyAk› ngwwpUfFk. ,aff Mwwy kwWk epiyahwwy Mfpatwwpy $lLjnjhifNa %yf$Wfspd mf Mwwy MFk. #lhd nghUlfspy %yf$W mf Mwwy mjpfkhfTk Fsphej nghUlfspy FiwthfTk ,UfFk.

· ,ej mf MwwyhdJ mjpf ntggepiy ,UfFk ,ljjpypUeJ Fiwej ntggepiy ,UfFk ,ljjpwFg ghaeJ nryYk. ,ej mf Mwwy xU nghUspypUeJ ntspggglk nghOJ› mJ ntgg Mwwy vdggLfpwJ. ,ejg ghljjpy ntggkhdJ xU ,ljjpy ,UeJ kwnwhU ,ljjpwF vtthW guTfpwJ vdgijg gwwp gbff ,UffpNwhk. NkYk ntggjjpd tpisTfs› ntgg VwGjjpwd› nghUlfspy VwgLk epiy khwwk kwWk csSiw ntggk MfpatwwiwG gwwpAk gbff ,UffpNwhk.

ntggj;jpd; tpisTfs;

xU nghUis ntgggLjJk NghJ fofffzl tpisTfs VwgLk.

· tphptilljy: xU nghUis ntgggLjJk NghJ mejg nghUspYss %yf$Wfs mjpf Mwwiyg ngwW mjphtilaj njhlqFk ,jdhy mUfpy ,UfFk %yf$WfSk mjphtilaj njhlqFk. vdNt tphptilljy VwgLfpwJ. ntapy fhyqfspy mjpf ntgg Mwwy ,uapy jzlthsqfis tphptilar nrafpdwJ. ,uapy ghijfspy rpwpa ,ilntsp tplgglbUggij› eqfs ghhjjpUgghfs jplgnghUlfis tpl jputg nghUlfs mjpfkhf tphptilAk. MdhYk› thAgnghUlfs ,it ,uzilAk tpl mjpfkhf tphptilAk.

· epiy khwwk: gdpfflbia ntgggLjJk NghJ mJ euhf khWfpwJ. NkYk ntgggLjjpdhy eh Mtpahf khWfpwJ. mNfNt jplgnghUis ntgggLjJk NghJ jputgnghUshf khWfpwJ. NkYk ntgggLjJk NghJ mJ thA epiyfF khWfpwJ. ntggepiyiaf FiwfFk NghJ jiyfo khwwk VwgLfpwJ.

· ntggepiy khwwk: xU nghUSfF ntgg Mwwiy mspfFk NghJ mejg nghUspYss %yf$wpd ,aff Mwwy mjpfhpffpwJ. %yf$Wfs mjphtiltjhy nghUspd ntggepiy mjpfhpffpwJ. mejg nghUis FsphtpfFk NghJ ntgg Mwwy ntspNawp mjd ntggepiy FiwfpwJ.

· Ntjpapay khwwk: ntggk xU tifahd Mwwyhf ,Uggjhy mJ Ntjpapay khwwjjpy ngUk gqF tfpffpwJ. Ntjp tpidfs njhlqFtjwF ntgg Mwwy NjitggLfpwJ. mJNghy Ntjptpidfspd NtfjijAk ntgg MwwNy jhkhdpffpwJ. tpwfpid vhpjJ mjd %yk fpilfFk ntggjjpidg gadgLjjp ehk czT rikffpNwhk. ,ej ntgg MwwNy czitg gfFtkhf rikffg gadgLfpwJ. ,itahTk› ntggjjpdhy VwgLk Ntjpapay khwwqfshFk.

ntggk; guTjy;

· xU nghUspy ,UfFk ntggkhdJ mNj ,ljjpy jqfp ,UffhJ. mjpf ntggjjpy ,UfFk nghUlfs ntggjiij ,oeJ FsphtilAk. mJNghy

Fs;hej nghUlfs RwWgGwjj;y ,UeJ ntggjijg ngwW ntggkilAk. nttNtW ntgge;iya;y css ,uzL nghUlfis xdW Nrhjjhy› mj;f ntgge;iya;y ,UfFk nghUs;y;UeJ Fiwej ntgge;iya;y css nghUSfF ntgg Mwwy guTf;wJ.

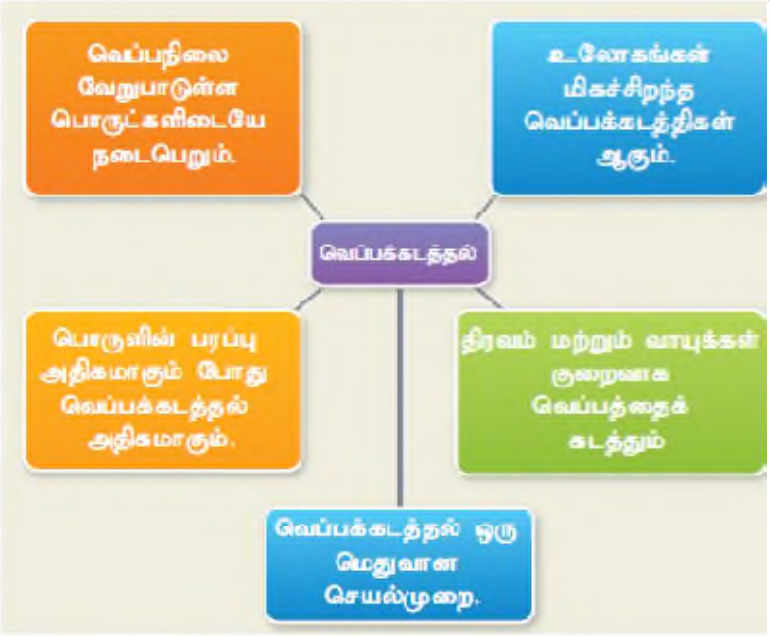
r;y Neuqfs;y eha jdJ ehfif nts;Na njhlqft;lLf nfhzNl Rthr;ggijg ghhjj;Ugghfs. mggb Rthr;fFk NghJ mjd ehff;y;UfFk <uggjk j;utkhf khw› g;d Mt;ahf;tLk. j;ute;iy thA e;iyfF khw ntgg Mwwy Njitggk. ,ej ntgg Mwwy eha;d ehff;y ,UeJ ngwggLf;wJ. ,tthW eha jd ehff;y ,UfFk jd ntggjij nts;Naww; jdidf Fs;ht;jJfnfhsf;wJ.

ntggkhdJ %dW to;fs;y guTf;wJ›
1. ntggf fljjy 2. ntggr rydk 3. ntggf fj;htrR

ntggf; fljjy;:

- j;lgnghUlfs;y %yf$Wfs k;fTk neUffkhfTk ,affk ,yyhkYk mikej;UfFk. j;lgnghUs;d xU Kida;id ntggggLjJk NghJ mej Kida;y ,UfFk %yf$Wfs ntgg Mwwiy clftheJ jqfs e;iya;y ,UeJnfhzNl KdDk g;dDkhf Ntfkhf mj;htilf;dwd. mj;htilAk NghJ mUf;y ,UfFk %yf$WfSfF ntgg Mwwiyf fljJf;dwd. ,jdhy mUf;y;UfFk %yf$WfSk mj;uj njhlqFf;dwd. j;lgnghUs;y ,UfFk midjJ %yf$WfSk ntgg Mwwiyg ngwWfnfhsSk tiu ,ej e;foT njhlheJ eleJ nfhzNla;UfFk.

- ,tthW mj;f ntgge;iya;y css xU nghUs;y;UeJ Fiwthd ntgge;iya;y css xU nghUSfF %yf$Wfs;d ,affk;dw; ntggk guTk e;foT ntggf fljjy vdggLk.



mdwhl thofifa;y ntggf fljjy:

1. cNyhfqfs k;frr;wej ntggf fljj;fs. mjdhyjhd› mYk;d;ag ghjj;uqfis rikaYfFg gadgLjJf;Nwhk.

2. ghjurk r;wej ntggfljj;ahf ,Uggjhy mij ntgg e;iykhd;a;y gadgLjJf;Nwhk.

3. ehk Fsphfhyqfspy fkgsp Milfis cLjJfpNwhk. fkgsp xU mhpjw fljjp vdNt clypd ntggjij ntsg Gwjjpwff fljjhky itjjpUfFk.

jhkpuk› mYkpdpak› gpjjis kwWk ,UkG Mfpa ehdF cNyhff fkgpfis vLjJf nfhsSqfs. fkgpfspd xU Kidapy jfFrrp xdwpid nkOfpd cjtpNahL nghUjjp tpLqfs. kWKidia ntggggLjJk NghJ rpwpJ Neujjpy jrFrrp fNo tpOeJtpLk. fkgp topahf ntggk fljjgglL fkgpapd Kid nkOfpd cUfepiyia milejJk jfFrrp fNo tpOeJ tpLk. ,ej Nrhjidiar nraAk NghJ jhkpuf fkgpapy xlbapUfFk jfFrrp Kjypy fNo tpOeJ tpLfpwJ. ,ej ehdF cNyhfqfspy jhkpuk mjpf fljJk jpwd ngwWssij ,J fhlLfpwJ. njhlheJ mYkpdpak› gpjjisapy ,UfFk jfFrrpfs fNo tpOtijAk filrpahf ,Ukgpy xlbapUfFk jfFrrp fNo tpOtijAk fhzyhk.

ntggr; rydk;

- NkNy Fwpggplgg lLss nraygh lby fzzhbf Ftisapd mbggFjpapy ,UfFk jzzh %yf$Wfs ntggjjpidg ngwwTld NknyOkgp tUfpdwd. NkNy ,UfFk jzzh %yf$Wfs fo Nehffp tUfpdwd. ,JNghdw epfoT thAffspYk eilngWfpwJ. thAffis ntggggLjJk NghJ ntgg %yjjpwF mUfpy css %yf$Wfs Kjypy ntggkileJ tphtilfpdwd. mjdhy mtwwpd mlhjjp FiwfpwJ. ,jjifa %yf$Wfs NkNy nryyr nryy fdkhd %yf$Wfs fNo ntgg%yjjpwF mUfpy tUfpdwd. ,qF› %yf$Wfspd czikahd ,affjjhy ntggk guTfpwJ.

- xU jputjjpd mjpf ntggKss gFjpapy ,UeJ Fiwthd ntggKss gFjpfF %yf$Wfspd czikahd ,affjjhy ntggk guTtij ntggr rydk vdyhk.

mdpwhl thof;ifapy; ntggr; rydk;

- #lhd fhwW gY}dfs: ,jjifa gY}dfspd mbggFjpapy ,UfFk fhwW %yf$Wfs ntggkileJ Nky Nehffp efuj njhlqFk. ,jdhy #lhd fhwW gY}dpd csNs epukGfpwJ. mlhjjp Fiwej #lhd fhwwpdhy gY}d NkyNehffpr nryfpwJ. #lhd fhwW NkyNehffpr nrytjhy gY}dpd NkwgFjpapy ,UfFk Fsph fhwW foNehffp efhfpwJ. ,ejr nray njhlheJ eilngwWfnfhzNl ,UfFk.

- **epyf; fhwpWk; fly; fhwpW:**

gfyNeuqfspy epyggugG› fly eiutpl mjpfkhf #lhfpwJ. ,jdhy epyggugpy css #lhd fhwW NkNy vOkGfpwJ. fly guggpypUeJ Fsphej fhwW epyjij Nehffp tRfpwJ. ,jid fly fhwW vdfpNwhk. ,uT Neuqfspy epyggugG fly eiutpl tpiutpy Fsphtilfpwj. fly guggpy css #lhd fhwW Nkny vOkg› epyggugpypUeJ Fsphej fhwW fly gFjp Nehffp tRfpwJ. ,jid epyffhwW vdfpNwhk.

fhwpNwhl;lk;

- fhwwhdJ› mOjjk mjpfkhd gFjpapyUeJ mOjjk Fiwthd gFjpfFr nryYk. #lhd fhwW NknyOkgpr nrytjhy mqF Fiwej mOjjk cUthfpwJ. MfNt Fspej fhwW mjpf mOjjg gFjpapy ,UeJ Fiwej mOjjg gFjpia Nehffp efhfpwJ. ,JNt fhwNwhlljij cUthfFfpwJ.

GifNghf;fpfs;

- rikay miwfspYk njhopwrhiyfspYk caukhd GifNghffpfis itjjpUggijg ghhjjpUgghfs. #lhd fhwW mlhjjp Fiwthf ,Uggjhy vspjhf tspkzlyjjpwFr nrdW tpLfpwJ.

ntggf; fjphtlrR:

- vej xU gUgnghUspd cjtpAkpdwp ntgg Mwwy xU ,ljjpy ,UeJ kwnwhU ,ljjpwFg guTtij ehk ntggf fjphtrR vdfpNwhk. ,ej Kiwapy #lhd nghUlfspy ,UeJ ntggkhdJ miyfshf vyyhj jpirfspYk guTfpwJ. ntggf fljjYk› ntggr rydKk ntwwpljjpy eilngwhJ. mitfs eilngw gUgnghUlfs NjitggLk. Mdhy ntggffjph trR eilngw gUgnghUlfs Njitapyiy. ,jdhy ntwwpljjpy $l ntggffjphtrR eilngWk. ntggf fjphtrir xspapd jpirNtfjjpy nryyf$ba kpdfhej miyfshfTk fUjyhk. ntgg Mwwy xU ,ljjpy ,UeJ kwnwhU ,ljjpwF kpd fhej miyfshf guTk epiyia ntggffjphtrR vdfpNwhk.

guTk epiyia ntggffjphtrR vdfpNwhk.

- #hpadplkpUeJ fpilfFk ntgg Mwwy ntggffjphtrR %ykhfNt tUfpwJ. O K ntggepiyfF mjpfkhf ,UfFk vyyhg nghUlfspypUeJk ntggf fjphtrR vwgLk. rpy nghUlfs ntggjij ckpOk› kww rpy nghUlfs ntggjij clftUk.

tpwF mLgigg gadgLjJk NghJ ntggk guTk %dW topfisAk ehk ghhffyhk. tpwfpid vhpfFk NghJ xUKidapy ,UeJ kWKidfF ntggfflljjy %yk ntggk guTfpwJ. vhpAk tpwfpd NkwgFjpapy ,UfFk fhwW ntggkhfp NknyOeJ nrytjhy ntggrrydk %yk ntggk fljjggLfpwJ. ntggf fjphtrrpdhy mLggpypUeJ tUk ntggjij ehk czu KbfpwJ.

mdpwlh thof;ifapy; ntggf; fjphtlrR:

1. ntsis epw Milfs rpwej ntgg gpujpgypgghdfs MFk. Nfhil fhyqfspy mit ek cliy Fsphrrpahf itjjpUffpdwd.

2. rikay ghjjpuqfspd mbggFjpapy fWgG epw tzzjijg Grpapyugghhfs. fWgG epwkhdJ mjpf fjphtrrpid clftUk.

3. tpkhdjjpd Gwggll kpfTk gsgsgghf ,UfFk. ,jdhy #hpadpypUeJ tpkhdjjpd kJ tpOk fjphtrrpd ngUkgFjpahdJ gpujpgypffggLfpwJ.

ntgg epiy:

- xU nghUspd ntggk myyJ Fsphrrpapd msitjjhd ehk ntggepiy vdfpNwhk. xU nghUspd ntggk mjpfhpfFk NghJ ntgg epiyAk mjpfhpfFk.

ntggepiyapd; myF:

· ntggepiyapd SI myF nfytpd (K) jpdrh gdghlby nryrpa] (°C) vdw myFk gadgLjjggLfpwJ. ntggepiykhdpapd cjtpAld ntggepiy mstplggLfpdwJ.

ntggepiy mstLfs:
ntggepiyia mstpLtjwF %dW mstLfs gadgLjjggLfpdwd.

i. /ghud`l mstL
ii. nryrpa] myyJ nrdbfpNuL mstL
iii. nfytpd mstL myyJ jdpjj mstL

· /ghud`l mstL: /ghud`l mstlby 32°F ciwepiyg Gsspahf Tk. 212°F Mtpahjy Gsspahf Tk epiyepWjjgglLssd. ,ej ,uzL Gsspf Sffpil Na css ,ilntspw 180 gFjpfshfg gphffgglLssd.

· nryrpa] mstL: nryrpa] mstlby 0°C ciwepiyg Gsspahf Tk>100°C Mtpahjy Gsspahf Tk epiyepWjjgglLssd. ,ej ,uzL Gsspf Sffpil Na css ,ilntspw 100 gFjpfshfg gphffgglLssJ.

· nryrpa] mstlil /ghud`l mstlhf khwWtjwFj Njitahd rkdghL:

$$F = \frac{9}{5}C + 32$$

/ghud`l mstlil nryrpa] mstlhf khwWtjwFj Njitahd rkdghL:

$$C = \frac{5}{9}(F - 32)$$

nfytpd; mstL (jdpjj mstL):

· nfytpd mstL> jdpjj mstL vdWk toqfggLfpwJ. nfytpd mstlby O K vdgJ jdpr Rop ntggepiy MFk. xU nghUspd %yf$Wfs kpffFiwej Mwwiyg ngwwpUfFk NghJ ,UfFk ntggepiy jdpr Rop ntggepiy MFk. 273.16 K ntggepiyapy ehpd jpl> jput kwWk thA epiyfs xdwpizeJ fhzggLk. ehpd Kkikg Gsspapd 1/273.15 gqF xU nfytpd MFk. nryrpa] kwWk nfytpd msT tLfspilNaahd njhlhG K = C + 273.15

jdpr; Rop ntggepiy :

· xU thAtpd mOjjKk fd msTk fUjjpaypy Ropahf khWk ntggepiyfF jdpr Rop ntggepiy vdW ngah. nfhLffgglLssJ.

· midjJ tifahd thAffspd mOjjKk -273.15°C ntggepiyapy Ropahfptpk ,jidj jhd jdpr Rop ntggepiy myyJ OK vdfpNwhk.

· %dW tif ntggepiy msTtLfspYk rpy mbggil ntggepiyfs nfhLffgglLssd.

· %dW tif ntggepiy msT Nfhyfspy rpy mbggil ntggepiyfs:

ntggepiy	nfytpd;	nryrpa];	ghud;`l;
ehpd nfhjepiy	373.15	100	212
gdpfflbapd cUFepiy	273.15	0	32
jdprRop	0	-273	-460

ntggepiy			

1. ntggepiy mstlil khwWf.

i. 25°C I nfytpd mstlbwF khwWf.

ii. 200 K I °C mstlbwF khwWf.

jhT:

i. TK = T°C + 273.15

TK = 25 = 273.15 = 298 15 K

ii. T°C = TK – 273.15

T°C = 200 – 273.15 = -73.15 °C

2. ntggepiy mstlil khwWf

i. 35°C I ghud ` l (°F) mstlbwF khwWf.

ii. 14°F I °C mstlby vOJf.

jhT

i. T°F = T°C × 1.8 + 32

T°F = 25°C × 1.8 + 32 = 77°F

ii. T°C = (T°F – 32) / 1.8

T°C = (14°F – 32) / 1.8 = -10°C

jd; ntgg VwGj; jpwd;:

· Gkpad epyggugG fhiy Neuqfspy Fsphrpahf Tk kjpa Ntisfspy #lhfTk ,Uggij czhejpUgghfs. Mdhy Vhpay ,UfFk jzzhpd NkwgugG fhiyapYk kjpa Ntiyapyk XusTfF xNu ntggepiyapy jhd ,UfFk. epuggugGk ehggugGk #hpadplkpUeJ xNu mstpy ntggjijg ngwwhYk mtwwpd ntggepiyfs khWfpdwd. ntggjij clftUk kwWk ntsptplk gzGfs ,uzbwFk NtWgLfpdwd. nghJthf ntggjij ntsptplk myyJ clftUk gzG %dW fhuzpfshy jhkhdpffggLfpwJ.

1. nghUspd epiw
2. nghUspy VwgLk ntggepiy NtWghL
3. nghUspd jdik

fNo nfhLffgglLss cwWNehffyfs %yk ,jid mwpeJ nfhssyhk.

cwpWNehf;fy; 1:

· xU ypllh eiu xU Fwpggpll ntggepiyfF cahjJtjwFj Njitahd ntggkhdJ› miu ypllh eiu mNj ntggepiyfF cahjJtjwFj Njitahd ntggjij tpl mjpfkhf ,UfFk.

· vdNt› nghUs clftUk ntggkhdJ mjd epiwiag nghWjJ mikAk›Q vdgij clftUk ntggkhfTk›m vdgij nghUspd epiwahfTk vLjJf nfhzlhy›

Qαm

cwpW Nehf;fy; 2:

· 250 kpy epid 100°C ntggepiyfF cahjJtjwFj NjitggLk ntggjijtpl Fiwthd ntggNk mNj msT epid 50°C nryrpa] ntggepiyfF cahjJtjwFj NjitggLk. vdNt› nghUs clftUk ntggkhdJ mjd ntggepiy NtWghlilg nghUjJ mikAk. Q vdgij clftuggll ntggkhfTk›ΔT I ntggepiy NtWghlhfTk vLjJf

nfhz lhy›Qα∆T,ej ,uzL e‰foTfisAk xgg‰lLg ghhfFk NghJ xU nghUs clftUk myyJ nts‰t‰Lk ntggjj‰d msT mjd e‰iw kwWk ntgge‰iy NtWghL Mf‰atwiwg nghWjJ mikAk vdgj nj h‰f‰wJ.

$$Q\alpha = m\Delta T$$
$$Q = mC\Delta T$$

- Nkwfzl rkdghlbdgb nghUlfs nts‰t‰Lk myyJ clftUk ntggk ntgge‰iyiag nghWjJ mikAk vdgJ nj h‰f‰wJ. ,qF Fw‰gg‰lggLk C vdw t‰f‰j khw‰y‰ nghUs‰d jd ntgg VwGj j‰wd MFk.

$$C = Q / m\Delta T$$

- vdNt› xuyF e‰iwAss (1kg) nghUs‰d ntgge‰iyia xU myF (1°C or 1 K) cahjjj Njitahd ntgg Mwwy‰d msT mjd jd ntgg VwGjj‰wd vdggLk. jd ntgg VwGj j‰wd‰d SI myF Jkg^{-1}K^{-1} MFk. J/kg°C kwWk J/g°C myFfisAk gadgLjJNthk.

- vyyh t‰jkhd nghUlfs‰Yk mj‰f jd ntgg VwGj j‰wd nfhzl nghUs eh. eh‰d jd ntgg VwGj j‰wd 4200 J/kg°C vdNt› jdDila ntgge‰iyia cahjJtjwF eh mj‰f ntggjij vLjJfnfhsSk. mjdhy jhd thfdqfs‰y ,UfFk ntggk jz‰fFk mikTfs‰y eh Fs‰ht‰gghdhfg gadgLjjggLf‰wJ. NkYk njho‰wrhiyfs‰Yk ,aej‰uqfs‰Yk VwgLk ntggjijj jz‰ggjwFk eh gadgLf‰wJ. Vh‰a‰d NkwgFj‰ay ,UfFk eh‰d ntgge‰iy gfy Neujj‰Yk ngh‰Jk khwhky ,Uggjwfhd fhuzKk ,JNt.

3. 3 f‰.f‰ eh‰d ntgge‰iyia 10°C y‰UeJ 50°C fF mj‰fh‰ffj Njitggk ntgg Mwwy vttsT? (eh‰d jd ntgg VwGj j‰wd 4200 JKg^{-1} K^{-1})

jhT:

nfhLffgglLss juTfs

$m = 2\ Kg, \Delta T = (50 - 10) = 40°C$

nfyt‰d‰y khwWk nghOJ

$(323.15.283.15) = 40K$

$C = 4200\ J\ Kg^{-1}\ K^{-1}$

Njitahd ntggk›

$Q = m \times C \times \Delta T = 2 \times 4200 \times 40 = 3,36,000\ J$

gyNtW e‰iyfs‰y ,UfFk eh‰d jd ntgg VwGj j‰wd msT fNo nfhLffgglLssJ.

eH (j‰ute‰iy) = 4200 JKg^{-1} K^{-1}

gd‰fflb (j‰l e‰iy) = 2100 JKg^{-1} K^{-1}

euht‰ (thA e‰iy) = 460 JKg^{-1} K^{-1}

ntgg Vwgj; j‰wd;

- ,gNghJ jd ntgg VwGj j‰wd gww‰ njs‰T ngww‰Ugghfs. xU f‰Nyhf‰uhk e‰iwAss xU nghUis 1°C ntgge‰iyfF cahjJtjwFf nfhLffggLk ntgg MwwNy jd ntgg VwGj j‰wd. xU nghUs‰d e‰iw KOtijAk 1°C ntgge‰iyfF cahjJtjwFj Njitggk ntgg Mwwy ntgg VwGj j‰wd MFk. vdNt› xU nghUs‰d ntgge‰iyia 1°C cahjJtjwFj Njitahd ntgg Mwwy ntgg VwGj j‰wd MFk. ,jid C vdf Fw‰gg‰lyhk.

$$\text{ntgg VwGj j‰wd} = \frac{\text{Njitahd ntgg Mwwy}}{\text{ntgge‰iy khwwk}}$$

ntgg VwGj jwdid SI myF J/K ,jid Cal/°C, kcal/°C myyJ J/°CvdTk Fwggilyhk.

4. xU ,UkGf FzLfF mjDila ntggeiyia 20°C caujjf nfhss 5000 J ntgg Mwwy nfhLffggLfwJ. mej ,UkGf Fzbd ntgg VwGj jwd vttsT?

jhT:

nfhLffggILss juTfs

Q = 5000 J, t = 20°C = 20K

$$\text{ntgg VwGj jwd} = \frac{\text{Njitahd ntgg Mwwy,Q}}{\text{ntggeiy khwwk,t}}$$

$$= \frac{5000}{20} = 250 JK^{-1}$$

eiy khwwk:

- nghUshdJ xU eiyaiy ,UeJ kwnwhU eiyfF khWk eifoitNa ehk eiy khwwk vdfNwhk.

- vLjJffhllhf› rhjhuz ntggeiyaiy eH %yf$Wfs› juteiyaiy ,UfFk 100°C ntggeiyfF eiu ntggggLjJk NghJ mJ euhtiahf khWfwJ. euhtithA eiyaiy ,UffwJ. ntggeiyiaf FiwfFk NghJ kzLk euhf khWfwJ. ntggeiyia 0°C fF FiwfFk NghJ gdfflbahf khWfwj› gdfflb jil eiyaiy ,UffwJ. gdfflbia ntggggLjJk NghJ kzLk euhf khWfwJ. ,tthW ntggeiyaiy khwwk VwgLk NghJ eh jdJ eiyia khwwfnfhsfwJ. eiy khwwjjiy eifOk nrayKiwfis tisfFfwJ.

cUFjy; - ciwjy;

- xU nghUs ntggjij clftheJ jil eiyaiyUeJ jut eiyfF khWk eifoT cUFjy MFk. xU jilgnghUs jd eiyia juteiyfF khwWk ntggeiy cUFeiy vdggLk. ,jd kW jir eiykhwwk ciwjy MFk. mjhtJ xU nghUs ntggjij ntsitilL jut eiyaiy ,UeJ jileiyfF khWk eifoT ciwjy MFk. vej ntggeiyaiy jutgnghUs jilgnghUshf khWfwNjh mej ntggeiy ciweiy MFk. eiug nghWjjtiu cUFeiy kwWk ciweiy ,uzLk 0°C MFk.

Mtiahjy; - Fsihjy;

- xU nghUs ntggjij clftheJ jut eiyaiy ,UeJ thA eiyfF khWk eifoT Mtiahjy MFk. vej ntggeiyaiy jutgnghUs thAeiyfF khWfwNjh mej ntggeiy mjd nfhjeiy MFk. thA eiyaiy ,UfFk xU nghUs ntggjij ntsitilL jutkhf khWk eifoT Fsihjy MFk. vej ntggeiyaiy thA jd eiyia jut eiyfF khwWfwNjh mej ntggeiy xLff eiy MFk. eUfF nfhjeiyAk xLff eiyAk 100°C MFk.

gjqifkhjy;

- cyh gdfflb› mNahbd› ciwej fhhgd il MfirL› ehgjyid Nghdw jilgnghUlfis ntggggLjJk NghJ jut eiyfF khwhky Neubahf thA

epiyfF khwptLfpdwd ,tthW> ntggggLjJk NghJ jplgnghUlfs Neubahf thA epiyfF khWk epfoT gjqfkhjy vdggLfpwJ.

· ntggepiy khWknghOJ ntggjjpd msitg nghWjJ xU nghUspd epiykhwwjjpd nttNtW gbepiyfs fhzgpffgglLssd.

cs;Siw ntggk;

rpy fdrJu tbt gdpfflbj JzLfis vLjJ xU fzzhbf Ftisapy NghlL tpLqfs. xU ntggepiykhdpiag gadgLjjp mjd ntggepiyiaf FwpjJf nfhsSqfs. mJ 0°C vdf fhlLk. ,gNghJ fzzhbf Ftisia ntggggLjJqfs. ntggepiykhdp fhlLk ntggepiyia njhlheJ ftdpAqfs. gdpfflb euhf khWk tiu ntggepiykhdp 0°CfhlLk. mjd gpd ntggepiy 100°C tiu mjpfhpfFk. gpddh vttsT jhd ntggggLjjpdhYk eH %OtJk MtpahFk tiu ntgg epiykhdpapy ntggepiy 100°C ntgg epiyiaj jhzlhky ,UfFk.

· 'csSiw' vdgJ kiwejpUggJ vdggLk. MfNt csSiw ntggk vdgJ kiw ntggk myyJ kiwejpufFk ntgg Mwwy vdggLk.

· gdpfflb cUfp euhf khWk tiu ntggepiy khwhky 0°CfhlbaJ. mJNghy eH 100°C milej gpddUk vttsT mjpf ntggjijf nfhLjjhYk mjd ntgg epiy 100°C Mf ,UejJ. Vd ,tthW eilngWfpwJ?

· xU nghUs jdepiyia khwwpfnfhsSk NghJ xU Fwpggpll msT ntggjij clfthfpwJ myyJ ntsptpLfpwJ. ,ej ntgg Mwwy csSiw ntggk vd mioffggLfpwJ. ntggepiy khwhj epiyapy xU nghUs jd epiyia khwwpf nfhsSk NghJ clftUk myyJ ntspapLk ntgg Mwwy csSiw ntggk MFk.

· cUFjy epfotpd NghJ ntggkhdJ clftuggllL mNj ntggkhdJ ciwjy epfotpd NghJ (ntggepiyapy vej tpj khwwKk ,yyhky) ntsptplggLk ,ej ntggjij cUFjypd csSiw ntggk vdfpNwhk. ,J Nghy Mtpahjypd NghJ ntggkhdJ jputjjpdhy clftuggLfpwJ. mNj msT ntggk Fspjy epfotpd NghJ euhtpadhy (ntggepiyapy vej tpj khwwKk ,yyhky) ntspaplggLk. ,ej ntggjij MtpahFjypd csSiw ntggk vdfpNwhk.

jd; cs;Siw ntggk;

· csSiw ntggjij xuyF epiwfF tiuaWjjy mjid jd csSiw ntggk vdyhk. ,jid L vdw Fwpalbdhy Fwpggplyhk. Q vdgij clftuggll myyJ ntsptplggll ntggjjpd msthfTk>m vdgij nghUspd epiwahfTk fUjpdhy> jd csSiw ntggk foffzl rkdghlby Fwpggplyhk. L = Q/m.

5 fpfp gdpfflb cUFtjwF vttsT ntgg Mwwy Njit? (gdpfflbapd jd csSiw ntggk = 336 Jg^{-1})

jHT

nfhLffgglLss juTfs

m = 5 fpfp = 5000 fp, L = 336 Jg^{-1}

Njitggk ntgg Mwwy = m × L

= 5000 × 336

= 1680000 J myyJ 1.68 × 106 J

5. 100°C ntggepiyapy ,UfFk eiug gadgLjjp 2 fpf epiwAss gdpfflbAld Nrhjj fyitia 0°C tiu Fspht pff vttsT nteeh Njitggk?

ehpd jd ntgg VwGjjpwd = 4.2 JKg^{-1}K^{-1} kwWk gdpfflbapd csSiw ntggk = 336 Jg^{-1}

jhT:

nfhLffgglLss juTfs:

gdpfflbapd epiw = 2 kg = 2000 g

m vdgJ nteehpd epiwnadf.

,oej ntggk = ngwWf nfhzl ntggk

$$m \times C \times \Delta t = m L$$

$$m \times 4.2 \times (100 - 0) = 2000 \times 336$$

$$m \times \frac{2000 \acute{} 336}{4.2 \acute{} 100}$$

= 1600 f myyJ 1.6 fpf

· xU nghUs jpl› jput› thA Mfpa epiyfspy xdwpypUeJ kwnwhdWfF khWkNghJ ntggepiy khwhky clftUk myyJ ntspapl ggLk ntgg Mwwy jd csSiw ntggepiy MFk. jd csSiw ntggjjpd Sl myF J/kg.

epidtpy; nfhspf.

v mjpf ntggepiyapy css xU nghUspypUeJ Fiwthd ntggepiyapy css xU nghUSfF ntggk guTfpwJ.

v ntggk %dW topfspy guTfpwJ. ntggf fljjy› ntggrrydk› ntggffjphtrR. .

v ntggfflljjy jplgnghUlfspYk› ntggrrydk jput kwWk thAgnghUlfspYk eilngWfpdwd.

v ntggffjphtrR kpdfhej miyfshf guTfpwJ.

v ntggepiyia msggjwF %dW mstLfs gadgLjjggLfpdwd. ghud ` l mstL› nryrpa] myyJ nrzbfpNuL mstL› nfytpd mstL.

v xU nghUs clftUk myyJ ntsptpLk ntgg Mwwypd msT nghUspd epiw› ntggepiy NtWghL kwWk nghUspd jdik Mfpa %dW fhuzpfisg nghWjJ mikAk.

v jd ntgg VwGjjpwdpd Sl myF JKg^{-1} K^{-1}

v ntgg vwGjjpwdpd Sl myF J/K.

v jd ntgg VwGjjpwid C vdWk ntgg VwGjjpwid C^{1} vdWk Fwpffpwhk.

v ntggepiy› mOjjk kwWk ntggg guty Mfpatwiwg nghWjJ gUgnghUis xU epiyapy ,UeJ kwnwhU epiyfF khwwyhk.

10th mwtpay;
myF – 3
ntgg ,awgpay;

mwpKfk;:

· midjJ capdqfSk thotjwFj Njitahd Kjdikahd ntgg Mwwy #hpadplkpUeJ fpilffpwJ. ntgg Mwwy vdgJ fhuzp kwWk ntggepiy vdgJ tpisT. midjJ capdqfSk cah thotjwF Fwpggpll ntggepiy NjitggLfpwJ. rikayiwapy J}zLjy mLggpy itffggLK ghjjpujjpd mbggFjp v/fpdhy nraaggIbUggjd fhuzk cqfSfFj njhpAkh? ekkpy midtUfFk ntgg Mwwy kwWk ntggepiy gwwp nghJthd Ghpjy czL. Mdhy ,gghljjpy mwtpaypd fzNzhljjpy ntggepiy kwWk ntgg Mwwy Mfpatwiw njhpeJ nfhss csNshk. NkYk ntgg Mwwy ghpkhwwk vtthW eilngWfpwJ. vdgij gwwpAk ntg Mwwypdhy VwgLk tpisTfisg gwwpAk gbff csNshk.

ntgg epiy:

· xU nghUspy ,UfFk ntggjjpd msT ntggepiy vd tiuaWffggLfpwJ. Fspfhrrpahd nghUistpl #lhd nghUspd ntggepiy mjpfk. xU nghUs RwWggwjJld ntggr rkepiyapy cssjh myyJ ,yiyah vdW $Wk gzigAk ntgg epiy vd tiuaWffyhk (%yf$Wfspd ruhrhp ,aff Mwwy ntggepiy MFk). ntggepiy vdgJ xU nghUspd ntggk vjjpirapy guTfpwJ vdgij Fwpggpl Lk gzG MFk. ntggepiy vdgJ xU]Nfyhh msT MFk. ntggepiyapd SI myF nfytpd. NkYk nryrpa] (°C) kwWk /ghud `l (°F) Mfpa myFfSk ntggepiyia msffg gadgLjjggLfpwJ.

ntgg epiyapd; jdpjj msTNfhy; (nfytpd; msTNfhy):

· nfytpd msTNfhypYss jdprRop ntgg epiyiag nghWjJ mstplggLk ntggepiyia jdpjj msTNfhy vd miofpNwhk. msTNfhy vdgJ gzilia vejputpay fUjJggb› ntgg ,afftpaypd ,affqfs KbTfF tUfpdw ntggepiyahd Rop ntggepiyia nfhzl xU KOikahd ntggepyi msTNfhy MFk. ,J ntgg ,afftpaypd ntggepiy vdWk miofffggLfpwJ. ntgg ,afftpaypd ntggepiyapd Xh myF vdgJ ehpd KkikgGsspay 1/273.16 gqF MFk. xU bfhp nryrpa] ntggepiy NtWghL xU nfytpDfF rkkhFk.

NtWgll ntggepiy msTNfhyfSfF ,ilNaahd njhlhG:
nryrpa]pypUeJ nfytpd K = C + 273
/ghud `lbypUeJ nfytpd K = (F + 460) × 5/9
O K = -273°C

ntgg rkepiy:

,uzL myyJ mjwF Nkwgll nghUsfSffpilNa vej ntgg Mwwy ghpkhwwKk ,yiy vdpy mejg nghUsfs ntggr rkepiyapy cssJ vdW nghUs. ntggepiy NtWghlbdhy ntgg Mwwy xU nghUspypUeJ kwnwhU nghUSfFg guTfpwJ. xNu ntggepiyapy css ,uzL nghUsfs xdNwhnlhdW njhLkhW itffggllhy vdd epfOk? ,ej ,uzL nghUlfSk ntggr rkepiyapid milAk tiu #lhd nghUspypUeJ Fspfhej epiyapy css nghUSfF njhlheJ ntgg Mwwy ghpkhwwk eilngWk.

Fspfhrrpahd nghUs› #lhd nghUs cld njhlhgpy css NghJ› ntgg Mwwy #lhd nghUspypUeJ Fspfhrrpahd nghUSfF ghpkhwwk milAk. ,jdhy

Fs;hrr;ahd nghUs;d ntgge;iy cauTk> #lhd nghUs;d ntgge;iy FiwaTk nraf;wJ. ,ej ,uzL nghUsfSk rk ntgge;iya;id milAk tiu ,J njhlheJ e;fOk

ntgg Mwwy;

- xU Nfhgiga;y css #lhd ghy;id r;wJ Neuk Nkira;d kj itjjhy> vdd e;fOk? #lhd ghy;d ntggk r;wJ Neujj;wFg g;wF FiwAk. ,Nj Nghy xU ghlby;y css Fs;hrr;ahd eh;id r;wJ Neuk Nkira;d kJ itfFkNghJ mjDila ntgge;iy e;wJ mj;fh;fFk. ,ej e;foTfs;y;UeJ ehk vdd njh;eJ nfhsf;Nwhk? #lhd ghy;y;UeJ Mwwyhd J RwWgGwjj;wFg guTf;wJ. mLjj e;fot;y Mwwy RwWgGwjj;y;UeJ eH css ghlbYfF guTf;wJ. ,ej MwwiyNa ntgg Mwwy vdyhk. vdNt #lhd nghUs Fs;hrr;ahd nghUs;wF mUf;y itffggllhy> #lhd nghUs;y;UeJ Fs;hrr;ahd nghUs;wF gh;khwwk milAk MwwNy ntgg Mwwy vd mioffggLf;wJ.

- vdNt> ntgg Mwwy vdgJ xU tifahd Mwwy> ,J ,U NtW ntgge;iya;y css ,uzL nghUlfSfF ,ilNa gh;khwwk milf;wJ. ntgg Mwwy;id rhjhuzkhf 'ntggk' vdTk mioffyhk.

- vdNt> ntgg Mwwy vdgJ xU tifahd Mwwy. ,J ,U NtW ntgge;iya;y css ,uzL nghUlfSfF ,ilNa gh;khwwk milf;wJ. ntgg Mwwy;id rhjhuzkhf 'ntggk' vdTk mioffyhk.

- xU nghUs ntggjj;id czhtjwFk> mejg nghUs ntggk miltjwFk ntgg Mwwy xH fhuz;ahf nraygLf;wJ. ntgge;iy mj;fkhf css nghUs;y;UeJ ntgge;iy Fiwthf css nghUs;wF ntgg Mwwy guTk ,ej e;fot;wF ntggggLjJjy vdW ngah. ntggf fljjy> ntggr rydk kwWk ntggf fj;htry Mf;a vjhtJ xU to;fs;y ntgggguty eilngWf;wJ. ntggk vdgJ Xh]Nfyhh msT MFk. ntgg Mwy clfthjy myyJ nts;a;Ljy;d SI myF [{y (J) MFk.

- ntgg Mwwy gh;khwwjj;d NghJ Fiwej ntgge;iya;y css xU nghUs ntggggLjjggLf;wJ. ,JNghy mj;f ntgge;iya;y css xU nghUs Fs;ht;ffg gLf;wJ. ,jdhy r;y Neuqfs;y ntgg Mwwy gh;khwwk vdgJ Fs;ht;jjy vdTk Fw;gg;lggLf;wJ. Mdhy gy e;foTfs;y Fs;ht;jjy vdgjwFg gj;yhf ntggggLjJjy vdNw gadgLjjggLf;wJ. xU nghUs;y;y;UeJ kwnwhU nghUs;wF ntgg Mwwy gh;khwwk milAk NghJ> ,uzL nghUsfs;y xdw;y ntgge;iy FiwaNth myyJ mj;fh;ffNth nraf;wJ.

ntgg mwwy; khwwjj;jp; r;wgG mk;rq;fs;:

1. ntggk vgNghJk ntgge;iy mj;fkhf css nghUs;y;UeJ ntgge;iy Fiwthf css nghUSfFg guTk
2. xU nghUis ntggggLjJ NghNjh myyJ Fs;ht;fFk NghNjh nghUs;d e;iwa;y vej khwwKk VwgLtJ ,y iy.
3. vej xU ntgg gh;khwwjj;Yk> Fs;hr;ahd nghUs;dhy Vwfggll ntggk> #lhd nghUs;dhy ,offggll ntggjj;wFr rkk.
   Vwfggll ntggk = ,offggll ntggk

ntgg Mwwy;d; g;w myFfs;:

- ntgg Mwwy;d SI myF [{y. eilKiwa;y r;y ,ju myFfSk gadgLjjggLf;dwd. mit

fNyhh:

- xU fuhk epiwAss ehd ntggepiyia 1°C cahjjj Njitggk ntgg Mwwyd msT xU fNyhh vd tiuaWffggLfwJ.

fNyhfNyhh:

- xU fNyhfuhk epiwAss ehd ntggepiyia 1°C cahjjj Njitggk ntgg Mwwyd msT 1 fNyhfNyhh vd tiuaWffggLfwJ.

ntgg Mwwyd; tisTfs:

- xU nghUswF Fwggll msT ntgg Mwwiy msfFk NghJ› mgnghUshdJ xdW myyJ mjwF Nkwgll foffzl khwwqfSfF clgLk.
  - nghUsd ntggepiy caUk
  - jl epiyaYss xU nghUs jut epiyfNfh myyJ jut epiyaYss xU nghUs thA epiyfNfh khwwk milAk.
  - ntggggLjJk NghJ nghUshdJ thtilAk

- xU nghUsd ntggepiy cahthdJ mgnghUswF msffggll ntgg Mwwiyr rhhejJ. NkYk ,J nghUsd jdik kwWk epiwiag nghWjJ khWgLkl. ntgg Mwwydhy nghUsd ntggepiy cahtJ gwwAk kwWk epiy khwwk gwwAk Keija tFgGfsy gbjJsNshk. gdtUk ghTfsy ntgg Mwwydhy nghUs vtthW thtilfdwJ vdgijg gwwg ghhgNghk.

nghUsy; ntgg thT:

- xU nghUswF Fwggll msT ntgg Mwwiy msfFk NghJ mej nghUsd ghkhzk (esk myyJ gugG myyJ gUkd) mjfhfFk. ntggepiy cahthy nghUsd ghkhzjjy VwgLk khwwNk mgnghUsd ntgg thT vd mioffggLfwJ. jutqfsy (v.fh. nkhFh) vwgLk ntgg thtid #lhd ehy itffggll ntggepiykhday fhzyhkl. vdNt› midjJ tjkhd nghUlfSk (jl› jut kwWk thA) ntggjjdhy thtilAk.

jlg; nghUsy; ntgg thT:

- jlgnghUis ntggggLjJk NghJ mZffs Mwwyidg ngwW Ntfkhf mjhTWfwJ. ,jdhy jlg nghUshdJ thtilfwJ. xU nghUis ntggggLjJk NghJ› ntggepiy khwwjjdhy VwgLk ntgg thT jut kwWk thAg nghUsfis xggLk NghJ jlgnghUsy FiwT. ,jwFf fhuzk jlgnghUsd fbdjjdikNa MFk.

jlgnghUsy VwgLk ntgg thtid tiffs

1. es ntgg thT
2. gugG ntgg thT
3. gUk ntgg thT

els; ntgg thT:

- xU jlgnghUis ntggggLjJjyd tisthf› mgnghUsd esk mjfhggjhy VwgLk thT es ntgg thT vdggLk.

· XuyF ntggepiy cahthy nghUspd esjjpy VwgLk khwwjjpwFk XuyF esjjpwFk css jfT es ntgg tpjpT Fzfk vd mioffggLk. ,jd SI myF nfytpd^{-1} es ntgg tpjpT Fzfjjpd kjpgG nghUSfF nghUs khWgLk.

· es khWghlLfFk› ntggepiy khWghlLfFk css njhlhgpid gpdtUkhW Fwpggplyhk.

$$\frac{\Delta L}{L_o} = a_L \Delta T$$

ΔL - esjjpy VwgLk khwwk

Lo - czikahd esk

ΔT - ntggepiyapy VwgLk khwwk

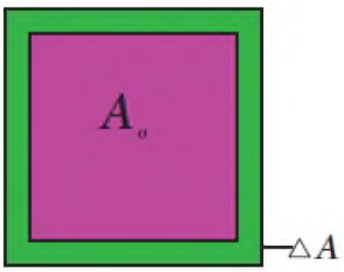
α_L - esntgg tpjpT Fzfk

gugG ntgg tpjpT:

· xU jplgnghUis ntggggLjJjypd tpisthf› mgnghUspd gugG mjpfhpggjhy VwgLk tpjpT gugG ntgg tpjpT vdggLk. gugG ntgg tpjpid gugG ntggtpjpT Fzfjjpd %yk fzffplyhk.

· XuyF ntggepiy cahthy nghUspd guggpy VwgLk khwwjjpwFk XuyF guggpwFk css jfT gugG ntgg tpjpT Fzfk vd mioffggLk. ,jd kjpgG nghUSfF nghUs khWgLk. ,jd SImyF nfytpd^{-1}

· gugG khwwjjpwFk ntgg epiy khwwjjpwFk css njhlhgpid gpdtUk rkdghlbd %yk mwpayhk.



$$\frac{\Delta A}{A_o} = a_A \Delta T$$

ΔA - guggpy VwgLk khwwk

A_O - czikahd gugG

ΔT - ntggepiyapy VwgLk khwwk

α_A - gugG ntgg tpjpT Fzfk

gUk ntgg tpjpT:

· xU jplg nghUis ntggggLjJjypd tpisthf mgnghUspd gUkd mjpfhpggjhy VwgLk tpjpT gUk ntgg tpjpT vd vdggLk. es ntgg tpjpT kwWk gugG ntgg tpjptpidg Nghy› gUk ntgg tpjptpid gUk ntgg tpjpT Fzfjjpd %yk fzffplyhk.

· XuyF ntggepiy cahthy nghUspd gUkdpy VwgLk khwwjpwFk xuyF gUkDfF css jfT gUk ntgg tpht Fzfk vd mioffggLk. ,jd SI myF nfytpd^{-1}

· gUk khwwjpwFk ntggepiy khwwjpwFk css njhlhgpid gpdtUk rkdghL %yk mwpayhk.

$$\frac{DV}{V_o} = a_v DT$$

ΔT = gUkdpy VwgLk khwwk
Vo = czikahd gUkd
ΔT = ntggepiyapy VwgLk khwwk
α_v = gUk tpht Fzfk

· nghUSfFg nghUs gUk ntgg tpht Fzjjpd kjpgG khWgLk. rpy nghUsfspd gUk ntgg tpht Fzfjjpd kjpgGfs nfhLffgglLssJ.

rpy nghUsfspd gUk ntgg tpht Fzfjjpd kjpgG

t.vz	nghUspd ngah	gUk ntgg tpht Fzfjjpd kjpgG (K^{-1})
1.	mYkpdpak	7×10^{-5}
2.	gpjjis	6×10^{-5}
3.	fzzhb	2.5×10^{-5}
4.	eh	20.7×10^{-5}
5.	ghjurk	18.2×10^{-5}

jputk; kwWk; thAtpy; ntgg tpht:

· jput myyJ thAg nghUsfis ntggggLjJk NghJ mtwwpYss mZffs Mwwypidg ngwW tpyfF tpirfF clgLfpwJ. nghUs tphtiltjd msT nghUSfF nghUs NtWgLk. xU Fwpggpll msT ntgg Mwwy mspffggLk NghJ thAtpy VwgLk ntgg tpht jpl kwWk jputg nghUsfis tpl mjpfkhfTk› jplg nghUis xggpLk NghJ jputg nghUsfspy mjpfkhfTk ,UfFk. gUk ntgg tpht Fzfjjpd kjpgG jputjjpy ntggepiyiar rhhejjyy. Mdhy thAtpy› ,jd kjpgG ntgg epiyiar rhheJ mikAk.

· xU nfhsfydpy css jputjjpid ntggggLjJk NghJ nfhsfydpd topahf ntgg Mwwyhdj jputjjpwF mspffggLfpwJ. vdNt ntgg Mwwypd xU gFjp nfhsfyd tphtiltjwFk› kjKss Mwwy jputjjpid tphtilar nratjwFk gadgLfpwJ. ,jypUeJ jputjjpy VwgLk czikahd tphit Neubahf fzffpl ,ayhJ. vdNt jputjjpy VwgLk ntgg tphtpid czik ntgg tpht kwWk Njhww ntgg tpht vd ,Utopfspy tiuaWffyhk.

czik ntgg tpht:

· vej xU nfhsfyDk ,yyhky Neubahf jputjjpid ntggggLjJk NghJ VwgLk ntgg tpht czik ntgg tpht vdggLk.

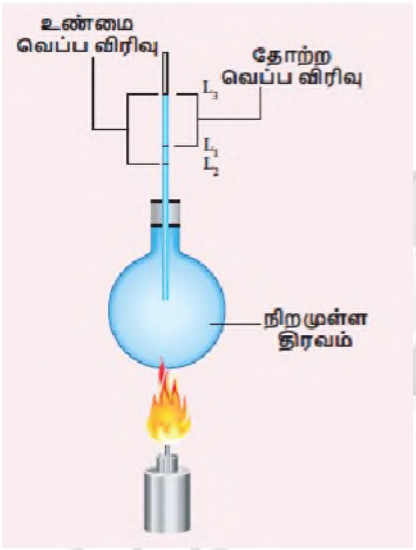
· XuyF ntggepiy cahthy jputjjpy mjpfhpfFk czik gUkDfFk mjjputjjpd xuyF gUkDfFk css jfT czik ntgg tpht Fzfk vd mioffggLk. ,jd myF

Njhww ntgg tpT:

- nfhsfyd ,yyhky jputjjpid Nubahf ntggggLjj KbahJ. ,jdhy eilKiwapy nfhsfydpy itjNj jputjjpid ntggggLjj NtzLk. mspffggll ntgg Mwwypd xU gFjp nfhsfyid tpptila nratjwFk kjKss Mwwy jputjjpid tpptilar nratjwFk gadgLfpwJ. vdNt› ,eepfotpy eqfs fhzgJ jputjjpd czikahd ntgg tpT myy. nfhsfydpd tpptpid nghUlgLjjhky jputjjpd Njhww tpid klLk fzffpy nfhstNj jputjjpd Njhww ntgg tpT vd mioffggLk.

- XuyF ntggepiy cahthy jputjjpy mjpfhpfFk Njhww gUkDfFk mjjputjjpd XuyF gUkDfFk css jfT czik Njhww tpT Fzfk vd mioffggLk. ,jd SI myF nfytpd^{-1} MFk.

- czik ntgg tpT kwWk Njhww ntgg tpT fzfpLtjwfhd Nrhjid:



- czik ntgg tpT kwWk Njhww ntgg tpT fzfpl Ntzba jputjjpid nfhsfydpy epugp Nrhjiia njhlqfyhk. ,gnghOJ nfhyfydpy css jputjjpd epiyia L_1vd FwpjJfnfhssyhk. gpwf nfhsfyd kwWk jputjjpid fhlbAssthW ntggggLjjggLfpwJ. njhlffjjpy nfhsfydhJ ntgg Mwwiyg ngwW tpptilAk. mgNghJ jputjjpd gUkd Fiwtjhfj NjhdWk. ,gnghOJ ,ej epiyia L_2 vdf FwpjJfnfhssyhk. NkYk ntggggLjJk NghJ jputkhdJ tpptilfpwJ. jwNghJ jputjjpd epiyia L_3vdf FwpjJfnfhssyhk. epiy L_1 kwWk L_3 fF ,ilNaahd NtWghL Njhww ntgg tpT vdTk› epiy L_2 kwWk L_3 ,ilNaahd NtWghL czik ntgg tpT vdTk mioffggLfpwJ. vgNghJk czik ntgg tpT Njhww ntgg tpit tpl mjpfkhf ,UfFk.

$$\text{czik ntgg tpT} = L_3 - L_2$$

$$\text{Njhww ntgg tpT} = L_3 - L_1$$

thAf;fspd; mbggil tpjp:

- thAffspd mOjjk› fd msT kwWk ntggepiy Mfpatwiw njhlhGgLjJk %dW mbggil tpjpfs fNo nfhLffgglLssJ. mit
  1. ghapy tpjp
  2. rhhy] tpjp
  3. mtNflNuh tpjp

ghaiy; tpjp :

- khwh ntggepiyaiy> xU Fwpggpll epiwAila thAtpd mOjjk mtthAtpd gUkDfF vjphjjftpy mikAk

  Pα1/V

- khwh ntggepiyaiy> khwh epiwAila eyypayG thAtpd mOjjk kwWk gUkd Mfpatwwpd ngUfFjnjhif khwpy; vdTk tiuaWffyhk.

  mjhtJ PV = khwpy;

rhhy]; tpjp (gUk tpjp)

- gpnuQR mwptpay mwpQh N[ff] rhhy] vdgth ,ttpjpapid epWtpdhh. ,ttpjpapd gb> khwh mOjjjjpy thAtpd gUkd mtthAtpd ntggepiyfF Nehjjftpy mikAk.

  mjhtJ VαT

  myyJ $\frac{V}{T}$ = khwpy;

mtNfl;Nuh tpjp:

- mNthNflNuh tpjpapd gb> khwh ntggepiy kwWk mOjjjjpy thAtpd gUkd mtthAtpy css mZffs myyJ %yf$Wfspd vz zpfiffF Nehjjftpy ,UfFk.

mjhtJ Vαn

(myyJ) $\frac{V}{n}$ = khwpy;

- xU Nkhy nghUspy css nkhjj mZffspd vz zpfif mNthNflNuh vz vd tiuaWffggLk. ,jd kjpgG 6.023×10^{23} / Nkhy.

thAf;fs;

- thAffis ,ayG thAffs kwWk eyypayG thAffs vdW ,U tiffshfg gphpffyhk.

,ayG thAf;fs:

- Fwpggpll fthrrp tpirapdhy> xdNwhnlhdW ,iltpid GhpeJ nfhzbUfFk mZffs myyJ %yf$Wfs mlqfpa thAffs ,ayG thAffs vd mioffggLk. kpf mjpfsT ntggk myyJ kpff Fiwej msT mOjjjij cila ,ayG thAffs eyypayG thAffshf nraygLk. Vnddpy ,eepiyapy mZffs (m) %yf$WfSffpilNa vttpj fthrrp tpirAk nraygLtJ ,yiy.

eyypayG thAf;fs:

- xdnwhnlhdW ,iltpid Ghpahky ,UfFk mZffs myyJ %yf$Wfis csslffpa thAffs eyypayG thAffs vd mioffggLk.

- Mdhy eilKiwapy vej thAffSk eyypayG jdik thaejJ myy. vyyh thAtpd %yf$WfSk mitfSffpilNa Fwpggpljjff msTfF ,iltpid Ghfpdwd. Mdhy ,ej ,iltpidfs Fwthd mOjjk kwWk cah ntgg epiyapy tY FiweJ fhzggLfpdwd. Vnddpy eyypayG

thAffsy mZffs myyJ %yf$WfSff ilNaahd fthrr tiraid tyik FiwT. vdNt ,ayG thAit Fiwthd mOjjk kwWk cah ntgg eiyay eyyayG thA vdf Fwggly hk.

· eyyayG thAffs ghay tjp rhhy] tjp kwWk mtNflNuh tjfSfF clgLfdwd. ,ej tjfs ahTk thAtd mOjjk› gUkd› ntggeiy i kwWk mZffsd vz zfif Mfatwwf wF ,ilNaahd njhlhig jUfdwd. xU Fwggll eiyay css eyyayG thAty Nkwfzl midjJ fhuzfSk xU Fwggll kjgigf nfhzbUfFk. mjd eiyay khwwk VwgLk NghJ xdW myyJ mjwF Nkwgll fhuzfsd kjgGfsYk khwwk VwgLfwJ. ,ej khwwjij NkwfhZk %dW tjfSk njhlhGgLjJfdwd.

eyyayG thAr; rkdghL

· eyyayG thAffsd gzGfis (mOjjk› gUkd› ntggeiy kwWk mZffsd vz zfif) njhlhG gLjJk rkdghL mtthAffsd eyyayG rkdghL MFk. xU eyyayG thAthdJ ghay tjp rhhy] tjp kwWk mtNflNuh tjfSfF clgLk.

ghay tjggb
PV = khwy
rhhy] tjggb›
V/T = khwy
mtNflNuh tjggb
V/n = khwy
rkdghL kwWk rkdghLfsyUeJ
PV/nT = khwy

· Nkwfzl ,ej rkdghL thA ,izrkdghL vd mioffggLk. μ Nkhy msTss thAtidf nfhzbUfFk thAffsy css nkhjj mZffsd vz zfif mtNflNuh vz zd (N_A)μ klqfwF rkkhFk. ,ej kjgghdJ rkdghL gujal›

mjhtJ $n = \mu N_A$
rkdghL gujal›
$PV / \mu N_A T =$ khwy

,ej khwy Nghyl]Nkd khwy ($k_B = 1.381 \times 10^{-23} JK^{-1}$)vd mioffggLfwJ.

$PV/\mu N_A T = k_B$
$PV = \mu N_A k_B T$

,qF›$\mu N_A k_B = R$, ,J nghJ thA khwy vd mioffggLk. ,jd kjgG 8.31 J $mol^{-1}K^{-1}$

$P_V = RT$

eidtiy; nfhs;f

· ntgg Mwwy clftujy myyJ ntsaLjyid SImyF [{y (J)

· ntgg MwwyhdJ vgnghOJk ntgg eiy mjfkhf css nghUsyUeJ ,UeJ ntggeiy Fiwthf css nghUswF guTk.

· xU nghUsy ,UfFk ntggjjd msT ntggeiy vd tiuaWffggLfwJ. ,jd SI myF nfytid (K)

- midjJg nghUlfSk ntggggLjJk NghJ foffzl xdW myyJ mjwF Nkwgll khwwqfSff clgLfpdwd.

  - o nghUspd ntggepiy caUk
  - o jpl epiyapYss xU nghUs jput epiyfNfh myyJ jput epiyapYss xU nghUs thA epiyfNfh khwwk milAk.
  - o ntggggLjJkNghJ nghUshdJ tpthtilAk

- midjJ tifahd nghUsfSk (jpl› jput kwWk thA) ntggggLjJk NghJ tpthtilAk.

- xU Fwpggpll msT ntggepiy caUk NghJ› jputjjpy VwgLk tpthT jplgnghUis tpl mjpfkhfTk› thAffspy VwgLk tpthT jpl kwWk jput nghUlfspy VwgLk tpthit tpl mjpfkhf ,UfFk.

- vej xU nfhsfydfSk ,yyhky Neubahf jputjjpid ntggggLjJk NghJ VwgLk tpthT czik ntgg tpthT vdggLk.

- nfhsfydpd tpthtpid nghUlgLjjhky jputjjpd Njhww tpthtpid klLk fzffpy nfhstNj jputjjpd Njhww ntgg tpthT vd mioffggLk.

- jputjjpwF Fwpggpll msT ntgg Mwwy mspfFk NghJ VwgLk czik ntgg tpthT› Njhww ntgg tpthtpid tpl mjpfkhf ,UfFk.

- xdNwhL xdW ,iltpid Ghpahky ,UfFk mZffs myyJ %yf$Wfis csslffpa thAffNs eyypayG thAffs vdggLk.

- eyypayG thArrkdghL PV = RT. ,J thAffspd epiyrrkdghL vdTk mioffggLk. ,jpy R vdgJ nghJ thA khwpy 8.31Jmol^{-1} K$_{-1}$) MFk.

jhf;fggl;l fzf;Ffs;
vLj;Jfhl;L

- 70 kpy nfhsssT css nfhsfydpy 50 kpy jputk epuggggllssJ. jputk mlqfpa nfhsfyid ntggggLjJk NghJ jputjjpy epiy nfhsfydpy 50 – kpy-ypUeJ 485 kpy Mf Fiwfpwj. NkYk ntggggLjJk NghJ nfhsfydpy jputjjpd epiy 51.2 kpy Mf caUfpwJ vdpy jputjjpd czik ntgg tpthT kwWk Njhww ntgg tpthitf fzffpLf.

jhT:

jputjjpd Mukg epiy $L_1 = 50$ kpy
nfhsfydpd tpththy jputjjpd epiy $L_2 = 48.5$ kpy
jputjjpd ,Wjp epiy $L_3 = 51.2$ kpy
Njhww ntgg tpthT $L_3 - L_1$
= 512 kpy – 50 kpy =1.2 kpy
czik ntgg tpthT $= L_3 - L_2$
= 51.2 kpy – 48.5 kpy = 2.7 kpy

vLj;Jf;fhl;L 2

· khwhj ntggepiyaiy cssthAtid mOjjjij ehdF klqF mjifhifFkNghJ› mtthAtid gUkd 20 cc (V_1, cc) yiUeJ V_2cc Mf khWfiwJ vdiy› gUkd V_2 cc itf fzffiLf.

jhiT:

njhlff mOjjk (P_1) = P
,Wji mOjjk (P_2) = 4P
njhlff gUkd (V_1) = 20 cc = 20 cm^3
,Uji gUkd (V_2) = ?
ghaiy tijaid gb›

PV = khwiyi
$P_1V_1 = P_2V_2$

$$V_2 = \frac{P_1}{P_2} \times V_1$$

$$= \frac{P}{4P} \times 20cm^3$$

V_2 = 5 cm^3

11TH , awgpay;
njhFjp – 2
myF – 8

ntggKk; ntgg ,af;ftpaYk; (Heat and Thermodynamics)

ntggk; kwWk; ntgge;iy:

mwpKfk;:

ntgge;iy kwWk ntgg ,ttuzLk> mdwhl thotpy kpf Kfpag gqfhwWfpdwd. midjJ capdqfSk rhtu nraygLtjwF mtwwpd cly ntgge;iyia xU Fwpggll mstpy guhkhpjjy mtrpakhFk. czikapy capdqfs thotjwFj Njitahd ntgge;iyia #hpaNd jUfpwJ. ,awifiag GHpeJ nfhstjwF kpfTk mbggilahdJ ntgge;iy kwWk ntggjijg gwwpa Ghpjyhfk. ntgge;iy> ntggk Nghdwtwiw tpsfFk ,awgpaypd xU gphpNt ntgg ,afftpay> ,ej myfpy toqfgglLss fUjJffs ntggk> Fspfhrr; kwWk ntgge;iyia ntggjjpypUeJ NtWgLjjpg ghggjwF JizGhpAk. ntgg ,afftpaypy css ntggk kwWk ntgge;iy ,ttuzLk xdWld xdW neUqfpaj njhlhGila nttNtW ,awgpay msTfshFk.

ntggjjpd; clfUjJ

Fiwej ntgge;iyapYss nghUspd kJ> mjpf ntgge;iyapYss nghUis itfFk NghJ> mjpf ntgge;iyapYss nghUspypUeJ Fiwej ntgge;iyAss nghUSfF jddpirahf Mwwy ghpkhwwk vwgLk. ,tthwwYfF ntgg Mwwy myyJ ntggk vdW ngah. ,tthwwy ghpkhww epfoNt ntggggLjJjy vdW mioffggLk. ,ej ntgggghpkhwwjjpdhy rpy Neuqfspy nghUspd ntgge;iy caUk myyJ khwwk Vwglhky mNj ntgge;iyapNyNa ebfFk.

ntggk vdgJ Mwwy msT vdw jtwhd Ghpjy rpy Neuqfspy VwgLtJzL. ",J kpfTk ntggkhd jzzh; ",J ntggk Fiwej jzzh" Nghdwit nghUsww thffpaqfshFk. Vnddpy> ntggk vdgJ xU msT myy; mJ cah ntgge;iyapYss nghUspypUeJ Fiwej ntgge;iy css nghUSff ghAk ghpkhww MwwyhFk. ntggggLjJk epfoT KbTwwg gpddh ntggk vdw thhjijia ehk gadgLjjf$lhJ. ntggk vdgJ ghpkhwwkilAk Mwwiy FwpfFNkadwp nghUspy Nrkpjjitffgglkss Mwwiyf Fwpffhj.

vLjJffhlL:

a. ,ej Vhapy mjpf kio cssJ.

b. Ftisapy css #lhd Njehpy mjpf ntggk cssJ.

,ttuzL $wWfspy css jtW vJ?

jhT:

kiongho pAk NghJ> Nkfqfspypypy UeJ Vhp jzziug ngWfpwJ. kio ngho ptJ epdwTld Vhp KdG ,Uejij tpl mjpfj jzziug ngwwpUfFk. ,qF kio vdgJ Nkfqfspypypy UeJ jzziug ngWk xU nrayhFk. kio ngho ptJ xU msT myy. khwhf kio Nkfqfs jzzuhf khwwkileJ VhpfF nrytijf FwpfFk. vdNt Vhapy mjpf kio cssJ vdW $WtJ jtwhFk. khwhf Vhapy mjpfj jzzh cssJ vdW $WtNj nghUjjkhdjhFk.

Ftisapy cssNjeh ntggggLjJtjhy mLggpypUeJ ntggjijg ngWfpwJ. Njeiu ,wffp itjjTld mJ Kdgpejijtpl mjpf mf Mwwiyg ngwwpUfFk. ntggk vdgJ cah ntgge;iyapYss nghUspypUeJ> Fiwej ntgge;iyapYss nghUSfF Mwwy nrytijf Fwpffpwj. ntggk XH msT

myy. vdNt Ftisa‰y css Njeh‰y mj‰f ntggk cssJ vdW $Wtij t‰ Ftisa‰y css Njeh mj‰f #lhf cssJ vdgNj nghUjjkhdjhFk.

Ntiya‰d; cl;fUj;J:

cqfs‰d ,uzL cssqiffisAk xdWld xdW NjafFkNghJ› mtww‰d ntgge‰iy cahtij fhzyhk. cqfs cssqiffs‰d kJ xU Ntiy nraaggLf‰wJ. mej nraaggll Ntiyahyjhd ntgge‰iy caheJssJ. jwNghJ cqfs cssqiffis fddjj‰d kJ itfFkNghJ› fddjj‰d ntgge‰iy cahtijf fhzyhk. Vnddwhy cssqiffs‰y ntgge‰iy fddjj‰y ntgge‰iyia t‰l mj‰fk. mjdhy ntggk cssqifa‰y‰UeJ fddjj‰wF ghaf‰wJ. NkNy $wggll vLjJffhlby‰UeJ ehk mw‰tJ vddntdwhy cssqiffs‰d ntgge‰iy cahejJ nraaggll Ntiya‰dhy› fddjj‰d ntgge‰iy cahejJ cssqiffs‰y‰UeJ› fddjj‰wF ntggk gh‰khwwgglljhy› jhd ,it fhllgglLssd.

mikgG xdw‰d kJ Ntiy nraaggLk NghJ r‰y Neuqfs‰y› mikgg‰d ntgge‰iy caUk.

myyJ r‰y Neuqfs‰y mNj e‰iya‰y ebfFk. ntggjijg NGhdNw NtiyAk xU msT myy. mJ Mwwiy gh‰khwWk xU nrayhFk. vdNt ,ejgnghUs mj‰f Ntiyiag ngwWssJ myyJ Fiwej Ntiyiag ngwWssJ Nghdw thff‰aqfisg gadgLjjf$lhJ.

mikgG› #oy‰d kJ xU Ntiyiar nraJ mr#oYfF Mwwiy khwwk nraAk myyJ #oy› mikgg‰d kJ xU Ntiyia nraJ mej mikgg‰wF Mwwiy khwwk nraAk. vdNt xU nghUs‰y‰UeJ kwnwhU nghUSfF Ntiy %ykhf Mwwiy khwWtjwF mtt‰uzL nghUsfSk nttNtW ntgge‰iya‰y ,Uff Ntzba mtr‰ak‰yiy.

ntgge‰iya‰d; cl;fUj;J:
ntgge‰iy vdgJ nghUnshdw‰d #Ljdik myyJ Fs‰hjjdikiaf Fw‰ggjhFk. #lhf css nghUnshdw‰d ntgge‰iy cahej kj‰gigg ngww‰UfFk. ,uzL nghUsfs ntggj njhlhg‰y css NghJ mitfSff‰ilNa ghAk ntggjj‰d j‰iria ntgge‰iy jhkhd‰ff‰wJ.

ntgge‰iya‰d SImyF nfyt‰d (K)

Fw‰gG: ntgg ,afft‰ay‰Yk mOjj myF thAffs‰d ,afft‰aw nfhsif ,uzbYk› ehk vej fzffl nraAk NghJ› ntgge‰iyia nfyt‰d myf‰y klLNk gadgLjj Ntz Lk.

eilKiwa‰y nryr‰a] (°C) kwWk /ghud`l (°F) vdw msTfs gadgLjjggLf‰dwd.

ntgge‰iykhd‰iaf nfhzL (Thermometer) nghUs‰d ntgge‰iyia msejw‰ayhk.

xU ntgge‰iy mst‰Lk Kiwa‰y‰UeJ kwnwhU ntgge‰iy mst‰Lk KiwfF khwWtjwfhd fzfflL Kiwfs nfhLffgglLssd.

gUg‰nghUs‰d; ntgggg z‰Gfs;:
gha‰y; t‰jp rhh‰y]; t‰j‰ kw‰Wk; ey‰y‰ay‰G thA t‰jp:

gUkd V nfhzl nfhsfyd‰y Fiwej mOjjjj‰y (mlhjj‰) css thA xdw‰idf nfhzL e‰fojjggll Nrhjida‰y‰UeJ g‰dtUk KbTfs f‰ilff‰dwd.

- khwh ntggepiyapYss thA xdwpd mOjjk› mjd gUkDfF vjphtpfpjjjpypUfFk $P \mu \frac{1}{v}$, jid ,uhghl ghapy (Robert Boyle) vdgth (1627 – 1691) fzlwpejhh. vdNt ,ttpj ghapytpj vd mioffggLfpwJ.

ntggepiyia xU mstpLk; Kiwapypl;UeJ kwpnwhU mstpLk; Kiwfpl;F khwpWtjwpfhd topKiw

mstpLk; Kiw	nfy;tpd; KiwfpF	nfy;tpd; Kiwapypl;UeJ kwpw KiwfpF
nryrpa]	K = °C + 273.15	°C = K – 273.15
ghud ` l	K = (°F + 459.67) ÷ 1.8	°F = (K 1.8) – 459.67
mstpLk Kiw	ghud ` l KiwfF	ghud ` l Kiwapypl;UeJ kww KiwfF
nryrpa]	°F = (1.8 × °C) + 32	°C = (°F – 32) ÷ 1.8
mstpLk Kiw	nryrpa] KiwfF	nfytpd Kiwapypl;UeJ kww KiwfF
ghud ` l	°C = (°F – 32) ÷ 1.8	° F = (1.8 ×°C) + 32

- khwh mOjjjjpypUeJ thA xdwpd gUkd› mjd ntggepiyfF (nfytpd) Nehjjftypl;UfFk. $V \mu T$
- ,jid [hf] rhhy] (Jacques Charles) (1743-1823) vdgth fzlwpejhh. vdNt ,ttpj rhhy] tpj vdW mioffggLfpwJ. ,ttpuzL tpjpfisAk xdwpizfFkNghJ gpdtUk rkdghL fpilfFk

PV = CT ,qF C vdgJ NehfFwp nfhzl khwpypahFk.

,ej NehfFwp khwpy; Cnfhsfyd;Yss Jfsfspd vz zpfiffF Nehtpfpjjjpy ,UfFk vdgij gpdtUk tpthjjjpd %yk mwpayhk. xjj gUkd V, mOjjk P kwWk ntggepiy T, nfhzl xNu tifahd thAthy ,ttpuzL nfhsfydfSk epuggggllLssd vdf. ,uzL nfhsfydpYk css thA NkNy Fwpggpllss PV = CT vdw rkdghlbd gb nraygLk. ,ttpuzL

jdpjjdpahd nfhsfyidAk fhlbAssthW xNu mikgghff fUjpdhy mtthAtpd mOjjk kwWk ntggepiy XNu kjpggpidg ngWk Mdhy gUkDk kwWk ntggepiy Jfsfspd vz zpfifAk ,uzL klqfhFk.

MfNth thAtpd gUkd 2V kwWk Jfsfspd vz zpfif 2C. vdNt eyypayT thAr rkdghL $\frac{P(2V)}{T} = 2C$. ,rrkdghL ekfF czhjJtJ vddntdwhy NehfFwp khwpy; Cfzbgghf thAtpYss Jfsfspd vz zpfifia rhhejpUfFk vdgjhFk. NkYk ,jd ghpkhzk $\left[\frac{PV}{T}\right] = JK^{-1}$,ej NehfFwp khwpy; Cl Jfsfspd vz zpfif (N) apd k klqF vd vOjyhk. ,qF k vdgJ nghJ khwpypahd Nghyl]nkd khwpypahFk. (1.381×10^{-23} JK^{-1})

PV = NkT

rkdghL l Nkhyfspd mbggilapYk vOjyhk.

thA xdW µ Nkhyfs nfhzl Jfsfisg ngwwpUejhy› mtthAtpYss nkhjjjJfsfspd vz zpfifia gpdtUkhW Fwpggplyhk.

$N = \mu N_A$

,qF N_A vdgJ mtfhlNuh vz ($6.023 \times 10^{23}\ mol^{-1}$) MFk. rkdghL ,y css N ,d kjpgig gujpaLkNghJ PV = µ NAkT vdff;ilfFk. ,qF $N_Ak = R$ vdgJ nghJ thAkhwpy; vd mioffggLk. ,jd kjpgG 8.314 J/mol. K.
vdNt µ Nkhy nfhzl eyypayG thA xdwpd thAr rkdghlil gpdtUkhW vOjyhk.

,rrkdghlbwF eyypayG thAtpd epiyrrkdghL (equation of state) vdW ngah. ,rrkdghL rkepiyapYss ntgg ,afftpay mikgG xdwpd mOjjk> gUkd kwWk ntggepiyia xdWld xdW njhlhGgLjJfwJ.
vLjJffhlL
8 km njhiytpyUeJ kpjptzbapd %yk gsspfF tUk khztpapd> kpjptzbapd rffujjpd fhwwOjjk 27°C ,y 240 kPa. mkkhztp gsspia milejTld rffujjpd ntggepiy 39°C vdpy rffujjpd fhwwOjjjjpd kjpggpidf fhzf.

jhT:
rffujjpy css fhwwpid eyypayG thAthff fUjpdhy> thA %yf$Wfspd vz zpfifAk rffujjpd gUkDk ,qF khwpypahFk. vdNt 27°C ntggepiyapYss thA %yf$Wfs $P_1V_1 = NkT_1$,ylrpa thAr rkdghlilAk>39°C ntggepiyapYss thA %yf$Wfs $P_2V_2 = NkT_2$vdw ,ylrpa thAr rkdghlilAk epiwT nraAk.

,qF T_1 kwWk T_2 vdgJ nfytpd ntggepiy MFk.

$$V_1 = V_2 = V$$

$$\frac{P_1V}{P_2V} = \frac{NkT_1}{NkT_2}$$

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

$$P_2 = \frac{T_2}{T_1}P_1$$

$$P_2 = \frac{312K}{300K} \times 240 \times 10^3 Pa = 249.6kPa$$

vLjJf;fhl;L
37°C cly ntgg epiyAila kdpjnuhUth Rthrpfk NghJ> mthpd Eiuauypy 5.5 ypllh fhwW 1 tsp kzly mOjjjjpy (1 atm = 101 kPa) csNs nryfpwJ. kdpjhpd Eiuaypy css Mf]p[d %yf$Wfspd vz zpfifiaf fzffpLf. (FwpgG : fhwwpy 21% Mfrp[d cssJ)
jhT:
Eiuauypy css fhwiw Xh eyypayG thAthff fUjp eyypayG thAr rkdghlilg gadgLjjp thA %yf$Wfspd vz zpfifiaf fzffplyhk.

$$PV = NkT$$

,qF thAtpd gUkd ypllhpy nfhLffgglLssJ. xU ypllh vdgJ 10 cm gff msT nfhzl fdrJuf nfhs fydpd gUkDfFr rkk vdNt>

1 ypllh = 10 cm × 10 cm × 10 cm = $10^{-3}\ m^3$

$$N = \frac{PV}{kT} = \frac{1.01 \times 10^5\, Pa \times 5.5 \times 10^{-3}\, m^3}{1.38 \times 10^{-23}\, JK^{-1} \times 310 K}$$

N = 1.29 × 10²³%yf$Wfs

fzffplggll N kjpggpy 21% klLNk Mf]p[d %yf$WfshFk. vdNt nkhjj Mf]p[d %yf$Wfspd vz zpfif

$$= 1.29 \times 10^{23} \times \frac{21}{100}$$

Mf]p[d %yf$Wfspd vz zpfif = 2.7 × 10²² %yf$Wfs

vLj;Jf;fhl;L:

xU Nkhy msTss VNjDk xU thAtpd gUkid gbjju ntggepiy kwWk mOjjjjpy (SPT) fhzf. NkYk mNj %yf$Wfspd gUkid miwntggepiy (300K) kwWk xU tspkzly mOjjjjpy (1 atm) fzffpLf.

gbjju ntggepiy kwWk mOjjjjpy› ntggepiy (T = 273 K myyJ 0°C) kwWk mOjjk (P = 1 atm myyJ 101.3 kPa)

eyypayG thArrkdghlil ,qF gdgLjJk NghJ $V = \frac{mRT}{P}$

,qF $m = 1 mol$ kwWk R = 8.314 J/mol.K. ,kkjpgGfis rkdghlby gpujpaplk NghJ

$$V = \frac{(1 mol)(8.314 \frac{J}{mol} K)(273 K)}{1.013 \times 10^5\, Nm^{-2}}$$

$$= 22.4 \times 10^{-3}\ m^3$$

ehk mwpej gb 1 ypllh (L) = 10^{-3} m^3.

,jypUeJ 1 Nkhy msTss vej xU eyypayG thAtpd gUkd 22.4 ypllh vd ehk mwpeJ nfhssyhk.

miw ntggepiyapy xU Nkhy msTss thAtpd gUkidffhd 22.4 yplliu $\frac{300K}{273K}$ My ngUff NtzLk. mtthW fzffpLk NghJ› thAtpd gUkd 24.6 ypllh vdffpilfFk.

vLjJffhlL:

cdJ tFggiwapy css fhwwpd epiwia ,ayG ntggepiy kwWk mOjjjjpy (NTP) fzffpLf. ,qF ,ayG ntggepiy vdgJ miw ntggepiyiaAk› ,ayG mOjjk vdgJ xU tspkzly mOjjjijf (1 atm) FwpfFk.

jhT:

tFggiw xdwpd ruhrhp msT KiwNa 6m esk›5 m mfyk kwWk 4 m caukhFk. vdNt miwapd gUkd V = 6 × 5 × 4 = 120m^3 MFk. ,ggUkdpy css Nkhyfspd vz zpfifiaf fzffpl Ntz Lk.

miw ntggepiyapYss (300K) xU Nkhy thAtpd gUkd 24.6 ypllh. vdNt›

%yf$Wfspd vz zpfif

$$m = \frac{120 m^3}{24.6 \times 10^{-3} m^3} \approx 4878 mol$$

fhwwpy 21% Mf]p[d›78% ielu[d kwWk 1% Mhfhd› i`lu[d› `ypak kwWk nrdhd Nghdw thaffspd fyit cssJ. fhwwpd %yf$W epiw 29 gmol^{-1} vdNt miwapy css fhwwpd nkhjj epiw m = 4878 × 29 = 141.4 kg MFk.

ntgg VwGjjpwd; kwWk; jdntgg VwGjjpwd; (Hat capacity and specific heat capacity)

27°C ntggepiyapYss eH kwWk vziz ,ttpuzilAk rk mstpy vLjJfnfhzL 50°C ntggepiyia milAk tiu ,ttpuzilAk ntggggLjjTk. 50°C ntggepiyia miltjwfhd Neujijj jdpjjdpNa fzlwpaTk. ,ttpuzL NeuqfSk eprrak xdwhf ,UffhJ. vzizAld xggpLkNghJ eh mjpf Neujij vLjJfnfhsSk. ,jpypUeJ 50°C ntggepiyia mila vziziatpl eUfF mjpf ntggk Njit vdgij ehk mwpayhk. ,gNghJ ,uzL klqF ehpid vLjJfnfhzL mjd ntggepiy 50°C milAk tiu ntggggLjjp mjwfhd Nejij fzlwpAk NghJ› mJ VwfdNt fzlwpaggl Neujijg NghdW ,Uklqfhf ,UggijAk ehk mwpayhk.

nfhLffggll nghUspd ntggepiy›T apypUeJ T + ΔT Mf cahjj Njitggk ntggjjpd msNt 'ntgg VwGjjpwd" vd tiuaWffggLfpwJ.

$$\text{ntgg Vwgjjpwd } S = \frac{DQ}{DT}$$

xU fpNyhfpuhk epiwAila nghUspd ntggepiyia xU nfytpd myyJ 1°C cahjj Njitggk ntggjjpd msNt› jd ntgg VwGjjpwd vd tiuaWffggLfpwJ.

$$Q = ms\Delta T$$

$$\text{vdNt } s = = \frac{1}{m}\left(\frac{DQ}{DT}\right)$$

,qF s vdgJ nghUspd jdntgg VwGjjpwdhFk. ,jd kjpgG nghUspd jdikiar rhhejNjadwp msit rhhejjyy.

ΔQ = ntggjjpd msT

ΔT = ntggepiy khwwk

m = nghUspd epiw

jdntgg VwGjjpwd SI myF J kg^{-1} K^{-1}MFk. ntgg VwGjjpwd› jd ntgg VwGjjpwd› jd ntgg VwGjjpwd ,uzLk NehfFwp nfhzl msTfs MFk.

ehpd jdntgg VwGjjpwd ngUk kjpgigg ngwWssij mwpayhk. ,jd fhuzkhfjjhd kpd cwgjjp epiyaqfs kwWk mZffU ciyfspYk ehpid Fsp&lbahf (Coolant)gadgLjJfpNwhk.

rpy nghJthd nghUs;fspd; jdntgg VwGjjpwd; (20°C **ntggepiy kwWk;** 1 atm **mOjjjpy;**)

nghUs;	**jd; ntgg VwGjjpwd;** (Jkg^{-1}K^{-1})
fhwW	1005
<ak	130
jhkpuk	390
,UkG (v/F)	450

f z zhb	840
mYkpdpak	900
kdpj c l y	3470
eh	4186

ntgg VwGjjpwd myyJ jdntgg VwGjjpwd vdgJ nghUsfspy nghjpeJss ntggjjpd msitf Fwpggit myy. Vnddpy ntggk vdgJ cah ntgg epiyapYss nghUspypUeJ Fiwej ntggepiy css nghUSfF ghAk xU ghpkhww MwwyhFk. vdNt ntgg VwGjjpwd vdgijtpl mf Mwwy VwGjjpwd vdgNj rhpahd gjkhFk Mdhy neLqfhykhf ,tthjijfs toffjjpy cssjhy mtwiw mggbNa ehk gadgLjJfpNwhk.

xU epiwAila ,uzL nttNtW nghUsfis xNu tjjjpy ntggggLjJk NghJ› Fiwej jdntgg VwGjjpwDila nghUspd ntggepiy Ntfkhf mjpfhpfFk. ,NjNghdW mtwiw Fspht pfFk NghJk› Fiwej jdntgg VwGjjpwDila nghUs Ntfkhf Fspht ilAk

thAffspd gzGfisggwwp gbfFkNghJ› Nkhyhh (%yf$W) jdntgg VwGjjpwd (molar specific heat capacity) eilKiwapy gadgLjjggLfpwJ. Nkhyhh (%yf$W) jdntgg VwGjjpwid gpdtUkhW tiuaiw nraayhk. xU Nkhy msTss nghUspd ntggepiyia 1K myyJ 1°C cahjJtjwFj Njitggk ntgg Mwwypd msNt Nkhyhh (%yf$W) jdntgg Vwgjjpwd vdggLk. ,jidg gpdtUkhW vOjyhk.

$$C = \frac{1}{m}\left(\frac{DQ}{DT}\right)$$

,qF C vdgJ nghUspd Nkhyhh (%yf$W) jdntgg Vwgjjpwidf Fwpffpwj. NkYk µ vdgJ nghUspy css %yf$Wfspd Nkhy vz zpfifiaf Fwpfk.

Nkhyhh (%yf$W) jdntgg VwGjjpwdpd myF J mol^{-1} K^{-1}MFk. ,JTk xU NehfFwp nfhzl msthFk.

jpl› jput kwWk; thAf;fspd; ntgg tpht:

ntggepiy khwwjjpdhy nghUsfspd tbtk› gugG kwWk gUkdpy VwgLk khwwNk ntgg tpht vdggLk.

nghUsfspd %dW epiyfSk (jpl› jput kwWk thA) ntggggLjJkNghJ tpht ilAk. jplgnghUnshdiw ntggggLjJkNghJ mjd mZffs mtwwpd rkepiyg Gsspiag nghUjJ Ntfkhf mjpht ilfpdwd. kww nghUsfSld xggpLk NghJ jplgnghUsfspd mstpy VwgLk khwwk Fiwthdjhfk. ,uapy tzbfspd ,Ugggghijfspy rpy ,lqfspy rpwpa ,ilntspg tplgglbUfFk. Vnddpy Nfhil fhyqfspy ,UgGgghij tpht ilAk. mtthW ntgge piy khwwqfspd NghJ vspjhf tpht ilaTk› RUqfTk Vww tifapy ghyqfspYk› ,UgGgghijfspYk tpht ilAk ,izgGfs fhzggLk.

jputqfspd %yf$wpil tpir› jplgnghUsfspd %yf$wpil tpiria tplf Fiwthf ,UfFk. vdNt mit jplgnghUsfistpl mjpfkhf tpht ilAk. ,ejg gzgpd mbggilapyjhd ghjur ntgge piykhdp nraygLfpwJ.

thA %yf$Wfisg nghUjjtiu mtwwpd %yf$wpiltpir fpllljjll Gwffzpffk mstpNyNa ,UfFk. vdNt mit jplgnghUsfistpl kpf

mjpfkhf tphpTilAk. vLjJffhllhf #lhd fhwW milffgglLss gY}dfspy css fhwW %yf$Wfis ntggggLjJk NghJ mit tphpTileJ mjpf ,ljij miljJfnfhsSk.

ntggepiy cahthy nghUsfspd ghpkhzjjpy VwgLk mjpfhpgNg ntggtphpT vdggLk.

esjjpy VwgLk tphpT es tphpT (Linear expansion) vd mioffggLk. ,NjNghdW guggpy VwgLk tphpT gugG tphpT (Area expansion) vdTk› gUkdpy VwgLk tphpT gUk tphpT (Volume expansion) vdTk mioffggLk.

elspy; tphpT:

jplgnghUsfspy›ΔT vdw rpW ntggepiy khwwjjhy esjjpy VwgLk rpW khwwk $\left(\frac{\Delta L}{L}\right)$› ahdJ ΔTfF Nehtpfjjjpy ,UfFk.

$$\frac{\Delta L}{L} = a_L \Delta T$$

vdNt $a_L = \frac{\Delta L}{L \Delta T}$

,qF $\alpha_L$es tphpTfFzfk

ΔL = esjjpy VwgLk khwwk

L = njhlff esk

ΔL = ntggepiyapy Vwgll khwwk

vLjJf;fhl;L:

gpuhd] ehlbYss ,Ukghy nraaggll <gps NfhGujjpd cauk fplljll 300 m MFk. gpuhd] ehlbd Fspfhyjjpd ntggepiy 2°C kwWk Nfhilffhyjjpd ruhrh ntggepiy 25°C ,ttpuzL gUt epiyfSffpilNa <gps NfhGujjpd caujjpy VwgLk khwwjijf fzffpLf. ,Ukgpd es tphpTf Fzfk $\alpha = 10 \times 10^{-6}$ per°C

jhT:

$$\frac{\Delta L}{L} = a_L \Delta T$$

$$\Delta L = a_L L \Delta T$$

,WffkhdJ %lggllLss fzzhbfFtisapd %bia vspjhfjjpwff› mjid #lhd jzzhpy mUNf rpwJ Neuk itjjpUff NtzLk. gpddh mjid vspjhfj jpwffyhk. Vnddpy fzzhbf Ftisapd %bapd ntgg tphpT fzzhbiatpl mjpfkhf ,UggjhFk.
Ntfitffggll #lhd Klilia Fspnej jzzhpy NghlL mjd xlbid chpjjhy mJ Klilapypy UeJ vspjhf gphpeJ tUk. Vnddpy Klil kwWk XL xtnthdWk nttNtW ntggtphpitg ngwwpUggjhFk.

ΔT = 10 × 10-6× 300 × 23 = 0.69 m = 69 cm

gugG tphpT:

ΔT vdw rpwa ntggepiy khwwjjhy nghUspd guggpy VwgLk gugGjjphpG $\left(\frac{\Delta A}{A}\right)$

MdJ ΔTfF Nehtpfjjjpy ,UfFk. ,jidg gpdtUkhW Fwpggplyhk.

$$\frac{\Delta A}{A} = \alpha_A \Delta T$$

vdNt› $\alpha_A = \frac{\Delta A}{A \Delta T}$

,qF α_A gugG tphpTf Fzfk

ΔA = guggpy VwgLk khwwk

A = njhlffg gugG

ΔT = ntggepiyapy Vwgll khwwk

gUk tphpT:

ΔT vdw rpwpa ntggepiy khwwjjpdhy› nghUspd gUkdpy VwgLk gUkjjphG $\left(\frac{\Delta V}{V}\right)$ MdJ ΔT fF Nehtpfpjjjpy ,UfFk.

$$\frac{\Delta V}{V} = \alpha_V \Delta T$$

vdNt› $\alpha_v = \frac{\Delta V}{V \Delta L}$

,qF α_V = gUk tphpTf Fzfk

ΔV = gUkdpy VwgLk khwwk

V = njhlffggUkd

ΔT = ntggepiyapy Vwgll khwwk

jplgnghUsfspd es tphpT› gugG kwWk gUk tphpTf Fzqfspd myF $°C^{-1}$ myyJ K^{-1}

nfhLffggll nghUSfF
$\frac{\Delta L}{L} = \alpha_L \Delta T$ (es tphpT)
$\frac{\Delta A}{A} \approx 2\alpha_L \Delta T$ (gugG tphpT » 2 ×es tphpT)
$\frac{\Delta V}{V} \approx 3\alpha_L \Delta T$ (gUk tphpT = 3 ×es tphpT)

ehpd Kuzgll tphpT (Anomalous Expansion of Water):
rhjhuz ntggepiyfspy jpulqfis ntggggLjJkNghJ tphptilAk kwWk FsphtpfFk NghJ RUqFk. Mdhy eh ,jwF Kuzhd xU gzigg ngwWssJ. 0°C Kjy 4°C tiu ntggggLjJkNghJ jzzh RUqFfpwJ. jzziu miw ntggepiyapyUeJ FsphtpfFk NghJ 4°C ntggepiyia milAk tiu mjd gUkd FiwAk. 4°C ntggepiyfFf fNo mjidf FsphtpfFk NghJ mjd gUkd mjpfhpfFk. NkYk mjd mlhjjp FiwAk. mjhtJ ntggepiyapy eh ngUk mlhjjpiag ngWk. ehpd ,ejjjdikNa ehpd Kuzgll tphpT vd mioffggLfpwJ.

Fsph ehLfspy› Fsphfhyjjpd NghJ Vhpfspd NkwgugG ntggepiy mjd mbgGw ntggepiyia tpl FiweJ fhzggLk fhllggLssJ. Vnddpy jpl ehpd (gdpfflb) mlhjjp rhjhuz ehpd mlhjjpiatplf FiwT›4°C ntggepiyfFk fNo ciwej eh (gdpfflb) rhjhuz ehpd NkNy kpjeJ VHpfspd NkwguggpwF tUk. ,jwFffhuzk ehpd Kuzgll tphpthFk. Vhpfs kwWk Fsqfspd NkwgugG

ciweJ gdpfflbfshy %lgglbUggpDk› mbapy csseH ciwahky ,UeJ ehtho capdqfisf fhfFk.

epiy khwwk;
nghJthf midjJg nghUsfSk jpl› jput kwWk thA vdw %dW epiyfspy fhzggLk. ntggggLjJk NghJ myyJ Fspt pfFk NghJ nghUsfs xU epiyapypUeJ kwnwhU epiyfF khwwkilAk

vLj;Jf;fhl;L:

1. cUFjy (jpl epiyapypUeJ jput epiyfF)
2. Mtpahjy (jput epiyapypUeJ thA epiyfF)
3. gjqfkhjy (jpl epiyapypUeJ Neubahf thA epiyfF)
4. ciwjy (jput epiyapypUeJ jpl epiyfF)
5. RUqFjy (thA epiyapypUeJ jput epiyfF)

cs;S iw ntgg VwGj;jpwd; (Latent Heat Capacity):

ghjpuk xdwpYss ehpid ntggggLjJk NghJ mjd nfhjpepiyahd 100°C ntggepiyia milAk tiu› mjd ntggepiy caUk. mjdgpdG nkhjj eUk Mtpahfk tiu mjd ntggepiy khwhky epiyahf ,UfFk. ,ej epfotpd NghJ ntggk njhlhrrpahf eUfF ghafpwJ. ,Uggpdk mjd ntggepiy› nfhjpepiyiatpl mjpfhpffhky mNj epiyapy ebffpwJ ,JNt csS iw ntgg VwGjjpwdpd ,ayghFk.
XuyF epiwAila nghUspd epiyia khwWtjwFj Njitggk ntggjjpd Mwwypd msNt› nghUspd csS iw ntgg VwGjjpwd vd tiuaWffggLfpwJ.

$$Q = m \times L$$

vdNt› $$L = \frac{Q}{m}$$

,qF›L = nghUspd csS iw ntgg VwGjjpwd
Q = ntggjjpd msT
m = nghUspd epiw
csS iw ntgg VwGjjpwdpd S I myF
Jkg^{-1}MFk

epiykhwwjjpd NghJ ntggjijf nfhLffNth myyJ effNth NehejhYk› mjd ntggepiy khwhky njhlheJ mNj epiyapy ebfFk.

- jpl – jput epiy khwwjjpwfhd csS iw ntggk› cUFjypd csS iw ntggk (Latest heat of fusion (L_1) vd mioffggLk.
- jput – thA epiy khwwjjpwfhd csS iw ntggk› Mtpahjypd csS iw ntggk (Latest heat of vaporisation) (L_v)
- jpl – thA epiy khwwjjpwfhd csS iw ntggk› gjqfkhjypd csS iw ntggk (Latest heat of sublimation) L_s)

KgGs;sp (Triple point)::
nfhLffggll nghUnshdwpd %dW epiyfSk (jpl› jput kwWk thA) ntgg ,affr rkepiyapy csNghJ› mgnghUspd ntgepiy kwWk mOjjNk nghUspd KgGss; vd mioffggLfpwJ.

eh‰d KgGss‰ 273.1 K kwWk gFj‰ Mt‰ mOjjk (Partial vapour pressure) 611.657 gh] fyhFk.

ntgg mstl‰bay;

ntgg ,afft‰ay mikgg xdw‰id ntggggLjJkNghJ› mttikgg‰y‰UeJ nts‰gggLk ntggjij myyJ mttikgg‰dhy clftuggLk ntggjij msfFk xU nraNy ntgg mstlbay vd mioffggLk. cah ntgg e‰iya‰Yss nghUnshdiw Fiwej ntgge‰iya‰Yss nghUnshdWld Nrhj Jitf Fk NghJ› cah ntgge‰iya‰Yss nghUs ,oej ntggk› Fiwej ntgge‰iya‰Yss nghUs VwWfnfhzl ntggjj‰wF rkkhFk. #oYfF vtt‰jkhd ntggKk fljjgglhJ. ,jidf fz‰j Kiwa‰y g‰dtUkhW Fw‰gg‰lyhk.

$$Q_{vwG} = -Q_{,ogG}$$

$$Q_{VwG} + Q_{,ogG} = 0$$

Vwfggll ntggk myyJ ,oej ntggjij ntggkhd‰iaf (Calorimeter) nfhzL msffyhk. nghJthf ntggkhd‰ vdgJ fhlbAsthW eh e‰uggggll ntggfhggL nraaggll nfhsfydhFk.

cah ntgge‰iya‰Yss (T_1) khj‰h‰ nghUs xdw‰id› miw ntgge‰iya‰y (T_2) ntggkhd‰a‰y css eh‰y %ofitff Ntz Lk. r‰w‰J Neujj‰wFgg‰ddh eH kwWk ntggkhd‰ ,uzLk T_f vdw ,Wj‰ ntgge‰iyia milAk. ntggkhd‰ fhgg‰lgglLssjhy› cah ntgge‰iy khj‰h‰ nghUs ,oej ntggKk. Fiwej ntgge‰iy eh VwWfnfhzl ntggKk rkkhFk

$$Q_{VwG} = -Q_{,ogG}$$

Fw‰alL kuig ,qF ftd‰ff Ntz Lk. ntgg ,ogG vj‰hf Fw‰a‰Yk› ntgg VwG NehfFw‰a‰Yk Fw‰gg‰lgglLssd.

$$Q_{VwG} = m_2 s_2 (T_f - T_2)$$

$$Q_{,ogG} = m_1 s_1 (T_f - T_1)$$

,qF s_2 kwWk s_1 vdgit KiwNa eh kwWk khj‰h‰g nghUs‰d jd ntgg Vwgjj‰wdfshFk.
vdNt›

$$m_2 s_2 (T_f - T_2) = -m_1 s_1 (T_f - T_1)$$

$$m_2 s_2 T_f - m_2 s_2 T_2 = m_1 s_1 T_f + m_1 s_1 T_1$$

$$m_2 s_2 T_f - m_1 s_1 T_f = m_2 s_2 T_2 + m_1 s_1 T_1$$

,Wj‰ ntgge‰iy $T_f = \dfrac{m_1 s_1 T_1 + m_2 s_2 T_2}{m_1 s_1 + m_2 s_2}$

vLjJffhlL:
50°C ntgge‰iya‰Yss 5L eh›30°C ntgge‰iya‰Yss 4L eUld fyffggLf‰wJ. eh‰d ,Wj‰ ntgge‰iy vdd? ,qF eh‰d jd ntgg VwGjj‰wd 4184 $J kg^{-1} K^{-1}$ vdf.

jhT:
g‰dtUk rkdghlil ehk gadgLjjyhk.

$$T_f = \frac{m_1 s_1 T_1 + m_2 s_2 T_2}{m_1 + s_1 + m_2 s_2}$$

m_1 = 5L = 5kg kwWk m_2 = 4L = 4kg, $s_1 = s_2$

NkYk T_1 = 50°C = 323 K kwWk T_2 = 30°C = 303 K
vdNt

$$T_f = \frac{m_1T_1 + m_2T_2}{m_1 + m_2} = \frac{5' 323 + 4' 303}{5+4} = 314.11K$$

T_f = 314.11 K – 273 K » 41°C

50°C kwWk 30°C ntggepiyfspy c s s rk msT ehpid ($m_1 = m_2$) xdWld xdW fyfFkNghJ› ,Wjp ntgg epiy ,ttpuzL ntggepiyfspd ruhrhpahFk.

$$T_f = \frac{T_1 + T_2}{2} = \frac{323 + 303}{2} = 313K = 40°C$$

xNU ntggepiyapy (30°C) c s s ,uzL eh khjphpfis xdWld xdW fyfFkNghJ mtwwpd ,Wjp ntggepiyAk 30°C MFk. ,jpypUeJ ehk mwpeJ nfhstJ vddntdwhy ,ttpuzL eH khjphpfSk ntggrrkepiyapy cssd. vdNt ,uzbwFk eLNt vttpjkhd ntggghpkhwwKk eilngwtpyiy vdggjhFk.

thAffs myyJ jputqfis xdWld xdW fyfFk NghJ mffyitapd ,Wjprrkepiy ntggepiy mgnghUsfspd epiwfs› jd ntgg VwGjjpwdfs kwWk ntgepiyfisr rhhejpUfFk vdgij ,qF epidtpy nfhss NtzLk. NkYk rk msTss xNu nghUsfis xdWld xdW fyfFkNghJ klLNk ,Wjp ntgg epiyahdJ jdpjjdp ntgepiyfspd ruhrhp kjppgpwF rkkhFk.

ntgg khwpwk; (Heat Transfer):

ehk mwpejgb ntggk vdgJ xUtif ghpkhww MwwyhFk. mtthwwy ntgepiy NtWghlbd fuzkhf xU nghUspypUeJ kwnwhU nghUSfF khwwggLk. ntgg khwwk %dW topfspy eilngWk mit ntggffljjy› ntggr rydk kwWk ntggffjphtrR MFk.

ntgepiy NtWghlbd fhuzkhf nghUsfSffpilNa Neubahf ntggkhwwk VwgLk epforrpfF ntggffljjy vdW ngah. ,uzL nghUsfis xdWld xdW njhlLfnfhzbUfFkhW itfFkNghJ› cah ntgepiyapYss nghUspypUeJ› Fiwej ntgepiy c s s nghUSfF ntggk khwwggLfpwJ. ntggjij vsjhfj jd topNa fleJ Nghf mDkjpfFk nghUsfSfF ntggffljjpfs vdW ngah.

ntggf; fljJjjpwd; (Thermal Conductivity):

ntggjijf fljJk jpwDfF ntggffljJjjpwd vdW ngah.

khwhepiy epgejidapy xuyF ntgepiy NtWghlby› xuyF jbkd nfhzl nghUspd topNa xuyF guggpwFr nrqFjjhf c s s jpirapy fljjggLk ntggjjpd msNt› nghUspd ntggffljJjjpwd vd mioffggLfpwJ.

khwhepiyapy› ntggffljJ tjk Q, ntgepiy NtWghL ΔT kwWk FWfF ntlLggugg A Mfpatw WfF Nehjjftpyk› fljjpapd esjjpwF (L) vjphjjftpyk ,UfFk. ntggk fljJk tjjij gpdtUkhW Fwpggplyhk.

$$\frac{Q}{t} = \frac{KADT}{L}$$

,qF K vdgJ ntggffljjy vz MFk.

(,jid nfytpd ntgg epiy K vdj jtwhfg GhpeJnfhssf$lhJ)

ntggffljJjjpwdpd SI myF Js^{-1} m^{-1} K^{-1}myyJ Wm^{-1} K^{-1}

khwhepiy (Steady state):
vej epiyapy› midjJ ,lqfspYk ntgepiy xU khwh kjppgpid milfpwNjh kwWk vej ,ljjpypUeJk vttpjkhd ntggKk ghpkhwwgglhky cssNjh

meepiyNa khwh epiy vd mioffggLfpwJ.

nghJthf nghUs;fspd; ntggf;fljJj;jpwd; (W m^{-1} K^{-1}) **,y;** 1 atm

nghUs;	**ntggf;fljJj;jpwd;**	**nghUs;**	**ntggf;fljJj;jpwd;**
ituk	2300		0.2
ntsspy	420	kufflil	0.17
jhkpuk	380	`ypak	0.152
mYkpdpak	200	nkdikahd ,uggh	0.042
v/F	40	jzzh	0.56
gdpfflb	2	fhwW	0.023
fzzhb	0.84		
nrqfy	0.84		

ntggffljJjjpwd nghUspd jdikiar rhhejJ. vLjJffhllhf ntsspy kwWk mYkpdpak cahej ntggf fljJjjpwidg ngwWssjhy mit rikay ghjjpuqfs nraaggadgLfpdwd.

ntggr; rydk; (Convection):

jputqfs kwwk thAffs Nghdw ghakqfspy css %yf$Wfs czikahd efhtpdhy ntgg Mwwy khwwggLk epfoT ntggrrydk vd mioffggLfpwJ. ,ej ntggrrydjjpy %yf$Wfs vttpj flLgghbdwp xU ,ljjpypUeJ kwnwhU ,ljjpwF efhfpdwd. ,eepfoT ,awifahfNth myyJ Gwtpir fhuzkhfNth Vwglyhk.

rikay ghjjpujjpy nfhjpfFk jzzh ntggrrydjjpwF xU rpwej cjhuzkhFk. ghjjpujjpd mbapy css jzzh mjpf ntggjijg ngwW mjd fhuzkhf tpptileJ mlhjjp FiwAk. ,ej Fiwej mlhjjpapd fhuzkhf %yf$Wfs Nkwgugig Nehffpr nryYk. mNj Neujjpy Nkwgugg pYss %yf$Wfs Fiwej ntgg MwwiygngWtjhy mtwwpd mlhjjp mjpfkhf ,UfFk. vdNt mit ghjjpujjpd mbggffjjpwF tUk. ,eepfoT njhlheJ eilngWk. ,tthW %yf$Wfs NkYk. fOk efhtij ntggrryd Xllk (Convection current)vdW mioffpdNwhk. miw xdwpid ntJntJgghf itff ehk miwr#Nlwwpiag gadgLjJfpNwhk. #NlwwpfF mUNf css fhwW %yf$Wfs ntggkileJ tpptilAk mjdhy mtwwpd mlhjjp FiweJ miwapd NkwgFjpfFr nryYk. mNj Neujjpy mlhjjp mjpfKss Fspnej fhwW mbggFjpfF tUk. ,tthW VwgLk fhwW %yf$Wfspd njhlh Rowrpa› ntggrryd Xllk vd mioffggLfpwJ.

ntggf;fjph; tlrR:

#lhf css rikfFk mLgG xdwpd mUNf ekJ iffis elbdhy ntggjij czuyhk. ,qF #lhf css mgnghUisj njhlhkNyNa ehk ntggjij czhfpNwhk. Vnddpy ,qF #lhf css rikfFk mLggpypUeJ ntggkhdJ ntggffjphtrR %yk ekJ iffSfF tUfpwJ. #hapdpypUeJk ntgg Mwwiy ehk ,Nj Kiwapyjhd ngWfpNwhk. ,ffjphtrR ntwwpljjpd topNa gazpjJ Gtpia milfpwJ. vej tpjkhd Clfjjpd cjtpAk ,dwp xU nghUspypUeJ kwnwhU nghUSfF Mwwiy khwWtJ fjphtrrpd xU rpwgGg gzghFk. Mdhy ntggffljjy kwWk ntggrrydk ,ttpuzbYk ntgg Mwwiy khwwk nratjwF Clfk mtrpak vdgij ftdpffTk.

ntggffjphtrR vdgJ

xU nghUs;y;UeJ kwnwhU nghUSfF k;dfhej miyfs;dhy ntggk guTk e;foT MFk.

1. #h;ad;y;UeJ tUk #h;af fj;htrR Mwwy
2. miw #Nlww;a;y;UeJ tUk ntggffj;htrR

gfy Neuqfs;y› #h;affj;hfs fly eiut;l Ntfkhf e;yjij #NlwWk ,jwFffhuzk e;yjj;d Fiwthd jdntgg VwGjj;wd MFk. ,jd t;isthf e;yggugg;y css fhwW t;h;tileJ mjd mlhjj; FiweJ NkNy nrdWt;Lk. mNj Neujj;y flwgugg;Yss Fs;hej fhwW e;yjij Nehff; tRk ,jidNa fly fhwW (sea breese) vdW mioff;dNwhk. ,uT Neuqfs;y flwgugig t;l e;yggugG Ntfkhf Fs;hrr; milAk (e;ugguggd Fiwej jdntgg VwGjj;wd) ,jd t;isthf flwgugg;Yss fhwW t;h;tileJ mjd mlhjj; FiweJ NkNy nrdWtLk. mNj Neujj;y e;yggugg;Yss mlhjj; mj;fkhd Fs;hejfhwW fliy Nehff; tRK ,jidNa e;yffhwW (land breeze) vdW mioff;dNwhk.

nghJthf ntgge;iy gUg nghUsfSld klLNk (j;l› j;ut kwWk thA) njhlhGilaJ vdw nghJffujJ cssJ. Mdhy ntggfj;htrRk xU ntgg ,afft;ay mikgghFk. ,jwF edF tiuaWffggll ntgge;iyAk› mOjjKk czL. #h;ad;y;UeJ tUk flGydhFk fj;htrr;d ntgge;iy 5700 K. ,jid Gt; f;lljjll 300K ntgge;iyAss mfrr;tgG fj;htrrhy nts;fF (Space) kzLk ck;of;wJ.

e;Al;ld;d; Fs;hT t;j;:

e;Alld;d Fs;hT t;j;a;dgb nghUnshdw;d ntgg ,ogG tjk› mgnghUSfFk #oYfFk css ntgge;iy NtWghlbwF Neht;f;jj;y ,UfFk.

$$\frac{dQ}{dt}\mu -(T - T_s)$$

Neujij nghUjJ ntggk njhlheJ FiweJ nfhzNl nrytij vj;hfFw; fhlLf;wJ.

,qF. T = nghUs;d ntgge;iy

T_s = #oy;d ntgge;iy

fhllgglLss tiugljj;y;UeJ njhlffjj;y FsjhT tjk mj;fkhfTk g;ddh ntgge;iy FiwafFiwa FiwthfTk cssij njs;thf czuyhk.

m e;iwAk›s jdntgg VwGjj;wDk css nghUnshdiwf fUJ. mjd ntgge;iy T vdf. #oy;d ntgge;iyia T_s vdf. dt vdw r;wa Neu ,ilnts;a;y Vwgll ntgge;iyfFiwT dT vd;y ntgg ,ogg;d msT

$$dQ = msdT$$

rkdghL ,UGwKk dt my tFff

$$\int_0^{\infty} \frac{dT}{T - T_s} = -\int_0^{t} \frac{a}{ms} dt$$

$$\frac{dQ}{dt} = \frac{msdT}{dt}$$

e;Alld;d Fs;hT t;j;a;y;UeJ

$$\frac{dQ}{dt}\mu -(T - T_s)$$

$$\int_0^{\infty} \frac{dT}{T - T_s} = -\int_0^{t} \frac{a}{ms} dt$$

$$\frac{dQ}{dt} = -a(T - T_s)$$

,qF a vdgJ Nehf;Fw; khw;y;.

rkdghLfs kwWk ,UeJ

$$-a\,(T - T_s) = ms\,\frac{dT}{dt}$$

$$\frac{dT}{T - T_s} = \frac{a}{ms}dt$$

rkdghL ,d ,UGwKk njhifggLjJf.

$$\int_{0}^{t} \frac{dT}{T - T_s} = -\int_{0}^{t} \frac{a}{ms}dt$$

$$\ln (T - T_s) = -\frac{a}{ms}t + b_1$$

,qF b_1xU khwpypahFk. ,uzL gffKk mLfFf FwpaL vLjjhy ekff fpilggJ

$$T = T_s + b_2 e^{-\frac{a}{ms}t}$$

,qF $b_2 = e^{b1}$ = xU khwpyp

vLjJffhlL:

27°C ntggepiy css miw xdwpy css #lhd eh 92°C ypUeJ 84°C ntggepiyfF Fsph 3 epkplqfis vLjJfnfhsfpwJ. mNj eH 65°C ypUeJ 60°C ntggepiyfFf Fiwa vLjJfnfhs Sk Neujijf fzffpLf.

3 epkplqfspy #lhd ehpd ntggepiy 8°C FiweJssJ. 92°C kwWk 84°C ,d ruhrhp ntggepiy 88°C ,J miw ntggepiyiatpl 61°C mjpfkhf cssJ. rkdghL gadgLjjpdhy

$$\frac{dT}{T - T_s} = \frac{a}{ms}dt \text{ myyJ } = \frac{dT}{dt} = \frac{a}{ms}(T - T_s)$$

$$\frac{8°C}{3\min} = \frac{a}{ms}(61°C)$$

,NjNghdW 65°C kwWk 60°C,d ruhrhp ntggepiy 62.5°CMFk. ,J miw ntggepiyia tpl 35.5°C mjpfkhf cssJ.

$$\frac{5°C}{dt} = \frac{a}{ms}(35.5°C)$$

,ttpuzL rkdghLfisAk tFffFk NghJ

$$\frac{\frac{8^oC}{3\min}}{\frac{5^oC}{dt}} = \frac{-\frac{a}{ms}(61^oC)}{-\frac{a}{ms}(35.5^oC)}$$

$$\frac{8 \times dt}{3 \times 5} = \frac{61}{35.5}$$

$$dt = \frac{61 \times 15}{35.5 \times 8} = \frac{915}{284} = 3.22 \text{ நிமிடம்}$$

ntgg khwwj;jpd; tpjpfs; (Laws of Heat Transfer):

ntggghpkhwwj;jpwfhd ghpnth]; l; nfhs;if (Prevost theory of Heat Exchange):

O K ntggepiyiajjtpu midjJ ntggepiyfspYk vyyhg nghUsfSk ntggffjphtrir ckpofpdwd. ,NjNghdW #oypy ,UeJ ntggffjphtrir clfthfpdwd. vLjJffhllhf eqfs ahuhtJ xUtiuj njhLkNghJ mth cqfs tpuyfs ntggkhf myyJ Fspnrrpahf cssij czhthh.

cah ntggepiyapYss nghUnshdW› #oypUeJ ngWk ntggjij tpl mjpf ntggjij #oYfF fjphtrrpd %yk nfhLfFk. ,NjNghdW Fiwej ntgg epiyapYss nghUnshdW ,ofFk ntggjijtpl mjpf ntggjij #oypUeJ ngwWfnfhsSk.

ghpnth]l ntggrrkepiyf fUjij fjphtrRfFg gadgLjjpdhh. mjdgb midjJg nghUsfSk ntggffjphtrir ntspggLjJfpdwd. Mdhy Fspnrrpahf css nghUistpl› cah ntggepiyg nghUsfs mjpf ntggffjphtrir ntspapLk. xU Fwpggpll Neujjpy ,uzL nghUsfspd ntgggghpkhwW tjKk rkkhFk. ,eepiyapy ,ttpuzL nghUsfSk ntggr rkepiyapy cssd vdf $wyhk.

Ropnfytpd ntggepiyapy klLNk nghUsfs ntgg ckpoit epWjJfpdwd. vdNt ghpnth]bd nfhsifapdgb #oypd jdik vjjifajhf ,UejhYk› midjJk nghUsfSk Ropnfytpd ntggepiyfF Nky css midjJ ntggepiyfspYk ntggffjphtrir ckpOk

]pnl/ghd; Nghy;l;]pnkd; tpjp (Stefan Boltzmann law):

]nl/ghd Nghyl]nkd tpjapdgb› fUgnghUspd XuyF gugg pdhy xuyF Neujjpy

KOikahd fUknghUshf ,yyhj nghUsfSfF

$$E = e\sigma T^4$$

,qF 'e' vdgJ gugg pd ckpojpwd MFk.

xU Fwpggpll ntggepiy kwWk miyesjjpy nghUspd gugg pdhy fjphtrggLk MwwYfF› mNj ntggepiy kwWk miyesjjpy KOffUknghUspdhy fjphtrggLk MwwYfFk css jfNt ckpojpwd vd tiuaWffggLfpwJ.

tpadpd; ,lgngahr;rp tpjp (Wien's Displacement Law):

cyfpYss midjJg nghUsfSk fjphtrir ckpofpdwd. mffjphtrRfspd miyesqfs nghUsfspd nfytpd ntggepiyiar rhhejpUfFk. ckpoggLk fjphtrRfs nttNtW miyesqfisg ngwwpUfFk. NkYk mttiyesqfspd nrwpTk (intensity) nttNtwhdit.

tpadpd tpjpggb› xU fUgnghUs fjphtrrpdhy ckpoggLk ngUkrnrwpT nfhzl miyesk (l_m) mffUknghUspd nfytpd ntggepiyfF (T) vjhtpfpjjpy ,UfFk.

tpadpd tpjpggb› xU fUknghUs fjphtrrpdhy ckpoggLk ngUkrnrwpT nfhzl miyesk (l_m) mffUk nghUspd nfytpd ntggepiyfF (T) vjhtpfpjjpy ,UfFk.

$$l_m \mu \frac{1}{T} (or) l_m = \frac{b}{T}$$

,qF›b vdgJ tpad khwpy› ,jd kjpgG 2.898×10^{-3} mK

,jypUeJ ehk mwpeJ nfhstJ vddntdwhy nghUspd nfytpd ntggepiy caUkNghJ ngUkrnrwpT miyesk (l_m) kpffhej epwkhiyapd Fiwej miyesjij (ngUk mjphntz) Nehffp ,lngahrrp milAk.

Nkwfzl tiugljjpypUeJ ngUkr nrwpT miyesk l_m nfytpd ntggepiyfF vjphtpfpjjpy ,Uggij mwpayhk. ,ttisNfhlbwF fUkngUs fjphtprR tisNfhL vdW ngah.

tpadp tpjpAk; ekJ ghh;itAk;:

ekJ fzfshy kpdfhej epwkhiyapy css fz ZW gFjpia klLk (400 nm Kjy 700 nm tiu) ghhffKbtjd fhuzk vdd?

xU nghUSk fjphtrir ckpOk. vdNt #hpaDk fjphtrir ckpOk. NkYk mjd gugG ntggepiy fpllpjjll 5700 K. ,kkjpgig rkdghL gpujpapLk NghJ›

$$l_m = \frac{b}{T} = \frac{2.898' 10^{-8}}{5700} » 508nm$$

,JNt ngUkrnrwptpwfhd miyesk MFk. #hpadpd gugG ntggepiy Njhuhakhf 5700 K vd cssjh mjwfhd fjphtrR epwkhiy neLffk 400 nm Kjy 700 nm tiu fhzggLk. ,JNt kpdfhej epwkhiyapd fz ZU gFjpahFk.

kdpj ,dk ,ejf fjphtrir clftheJjhd ghpzhk tshrrp milejJ. vdNt kdpjffzfs #hpa epwkhiyapy css fz ZU gFjpia klLNk czu KbAk. mfrrptgG gFjpiaNah myyJ X fjph epwkhiyiaNah czu KbahJ.

ekfF mUfpy css rhpa] (Sirius) (ntggepiy 9940 K) vdw tpzkd mUfpy css Nfhspy kdpj ,dk Njhdwp ,Uejhy mthfspd fzfs kpdfhej epwkhiyapy css Gw Cjhffjphfis czu KbAk. ,jid rkdghL gadgLjjp mwpeJ nfhssyhk.

vLj;Jf;fhl;L:

A vdw fUkngUs xdwpd fjphtrRjjpwd E_A. NkYk ,J l_A vdw miyesjjpwF ngUk Mwwy fjphtrggLfpwJ. B vdw kwnwhU fUkngUspd fjphtrRjjpwd $E_B = N E_A$; $\frac{1}{2} l_A$ vdw miyesjjpwF B fUkngUspy ,UeJ fjph trggLfpwJ vdpy N ,d kjpgigf fhzf?
tpadpd ,lngahrrp tpjpapypUeJ
$l_{max} T =$ khwpy; ,J A kwWk B vdw ,uzL fUkngUsfSfFg nghUeJk.

,qF $l_B = \frac{1}{2} l_A$

$l_A T_A = l_B T_B$. ,qF $l_B = \frac{1}{2} l_A$

$$\frac{T_B}{T_A} = \frac{l_A}{l_B} = \frac{1}{\frac{1}{2}} = 2$$

$T_B = 2T_A$

]nl/ghd - Nghy]lnkd tpjpapypUeJ

$$\frac{E_B}{E_A}=\left(\frac{T_B}{T_A}\right)^4=(2)^4=16=N$$

fUkngh Us B, fUkngh Us A it tpl Fiwej miyesjijNa ckpOk. vdNt fUkngh Us A it tpl mjpf Mwwy nfhzl fjphtprir fUkngh Us B ckpOk.

ntgg ,afftpay; mwpKfk;

ehk Keija gphpTfspy ntggk> ntggepiy kwWk nghUsfspd ntggggzGfisg gwwp gapdNwhk. ntgg ,afftpay vdgJ ,awgpaypd xU gphpthFk. ,ggphpT Ntiyia ntggkhfTk kwWk ntggjij Ntiyahf Tk khwWtjpy css tpjpfis tpthpffpwJ. ntgg ,afftpaypd tpjpfs ghapy> rhhy]> nghD}ypp [{y> fpshrpa]> nfytpd> fhhNdh kwWk n`ykN`hyl] Nghdw mwptpay mwpQhfspd %dW E}wwhzL fhy MaTfspd mbggilapy KiwggLjjggl ljhFk.

mdwhl thotpy ekikrRwwp eilngWk midjJ epfoTfSk Vd ekJ clypaff epfoTfs $l ntgg ,afftpay tpjpfSfF clglL eilngWfpdwJ. vdf $wpdhy mJ kpifahfhJ. vdNt ntgg ,afftpay vdgJ ,awgpaypd XH ,dwpaikahj gphpthFk.

ntgg ,afftpay; mikgG:

ntgg ,afftpay mikgG (Thermodynamic system) vdgJ ,ggpugQrjjpy tiuaWffggll xU gFjpahFk. NkYk mOjjk (P), gUkd (V), kwWk ntggepiy (T) Nghdw Kffpa vzzpfifapylqfpa Jfsfspd (mZffs kwWk %yf$Wfs) njhFgNg ntgg ,afftpay mikgghFk. kjKss ,ggpugQrjjpd gFjpNa #oy (Surrounding) vdggLk. ,ttpuzLk Xh vyiyahy gphpffgglLssd.

vLj;Jf;fhl;Lfs;:

Xh ntgg ,afftpay mikgG vdgJ> jpl> jput> thA kwWk fjphtrR Nghdw vej tbtpYk ,Uffyhk.

ntgg ,afftpay; mikgG	#oy;
thspapy css jzzh	jpwejntspl
miw xdwpDs css fhwW %yf$Wfs	miwfF ntspapy css fhwW
kdpj cly	jpwejntspl
flypy css kd	fly eh

ntggrrkepiy (Thernal equilibrium):

miw xdwpy xU Nfhgigapy #lhd Njeh itffgglhy> NjehpypueJ ntggk #oYffFf fljjggLk. rpwpJ Neujjpwf gpdG #lhd NjeH #oypd ntgge piyfF rkkhd ntgge piyia milAk. ,jd gpdG NjehpypueJ #oYfNfh myyJ #oypypueJ NjeUfNfh ntggg ghpkhwwk VwglhJ. NjeUk #oYk ntggrrkepiyia milej tpllij ,J fhlLfpwJ.

,U mikgGfs xdWfnfhdW ntggrrkepiyapy cssJ vdpy mttpuzL mikgGfSk xNu ntgge piyapy ,Uff NtzLk. NkYk mJ Neujijg nghUjJ khwhky ,Uff NtzLk.

vejputpay; rkepiy (Mechanical equilibrium):

gp]lDld css thA miljJ itffgglLss nfhsfyd xdiwf fUJf. mggp]ldpd kJ epiw xdiw itfFk NghJ foNehffpa Gtpahg G tpirapd fhuzkhf gp]ld foNehffp efheJ rpy Vww ,wffjjpwFg gpdG epwFk. gp]ld

xU Gj;a ,ljij milAk. thAt;d Nky Nehff; t;ir› foNehff; Gt;ahgg t;iria rkd nraAk. ,ee;iya;y ,ttikgig vej;ut;ay rke;iya;y cssJ vdf$wyhk. mikgG xdW vej;ut;ay rke;iya;y cssJ vd;y› vtt;jkhd rkdnraagglhj t;irAk ntgg ,afft;ay mikgg;d kJ nrayglf$lhJ.

Ntj;r;rke;iy(Chemical equalibrium):

xdWld xdW njhlhg;Yss ,uzL ntgg ,afft;ay mikgGfSff;ilNa vtt;j njhFgad Ntj;t;idAk eilngwt;yiy. vd;y mtt;U mikgGfSk Ntj;rrke;iya;y cssJ vdyhk.

ntgg ,af;ft;ay; rke;iy (Thermodynamic equilibrium):

,uzL mikgGfs ntgg ,afft;ay rke;iya;y cssd vd;y› mtt;uzL mikgGfSk xdWfnfhdW ntgg› vej;ut;ay kwWk Ntj;r rke;iya;y ,Uff NtzLk. ntgg ,afft;ay rke;iya;y kgngU (Macroscopic) khw;fshd mOjjk› gUkd kwWk ntgge;iy Mf;ait xU e;iyahd kj;gg;idg ngww;Uff NtzLk. NkYk mit fhyjijg nghWjJ khwhky ,Uff NtzLk.

ntgg ,af;ft;ay; e;iy (Thermodynamic state variables):

,aej;ut;ay;y j;irNtfk› cejk kwWk KLffk Nghdwit ,aqFk nghUnshdw;d e;iyia t;sffggadgLf;dwd. (njhFj; 1 ,y ,twiwg gww; Gh;eJnfhzbUgghfs) ntgg ,afft;ay;y› ntgg ,afft;ay mikgG xdw;d e;iyia t;thffFk khw;fs;d njHFgg;wF ntgg ,afft;ay khw;fs vdW ngah.

vLjJffhlLfs: mOjjk› ntgge;iy› gUkd› mf Mwwy Nghdwit.

,ej khw;fs;d kj;gG ntgg ,afft;ay mikgg;d rke;iyia KOtJkhf t;thff;dwd. ntggk kwWk Ntiy ,it ntgg ,afft;ay e;iy khw;fs myy khwhf ,it nraykhw;fs MFk. (Process variables). ntgg ,afft;ay khw;fs ,uzL tifggLk mit: msTr rhhGss khw; (Extensive variable) kwWk msTr rhhgww khw; (Internsive variable).

vLjJffhlL: gUkd› nkhjj e;iw› vdlNuhg; (Entropy), mf Mwwy› ntgg VwGjj;wd Nghdwit.

msTr rhhgww khw; ntgg ,afft;ay mikgg;d msT myyJ e;iyiar rhhej;UffhJ.

vLjJffhlL: ntgge;iy› mOjjk› jdntgg VwGjj;wd› mlhjj; Nghdwit.

e;iyr; rkdghL (Equation of state):

e;iy khw;fis xU Fw;ggll Kiwa;y njhlhGgLjJk rkdghL› e;iyrrkdghL vdW mioffggLf;wJ. ,ee;iyrrkdghL ntgg ,afft;ay mikgnghdw;d rke;iya;y e;iy khw;fSfF ,ilNa css njhlhig KOtJkhf t;thff;wJ. ntgg ,afft;ay mikgG rke;iya;y ,yiynad;y› ,ee;iyr rkdghL mikgg;d e;iyia t;thffhJ. ntgg ,affrrke;iya;y css e;yy;ayG thA (idealgas) xdW PV = NkT vdw e;iyr rkdghlbdhy Fw;ggjggLf;wJ. ,qF ehdF NgusT khw;fSk (P, V,T kwWk N) e;iyrrkdghlbdhy xdWld xdW njhlhGgLjjggllssd. ,rrkdghlbYss VNjDk xU khw;ia klLk khww ,ayhJ. vLjJffhllhf thA e;ukg;Ass nfhsfyd;d g;]lid mOjJk NghJ› thAt;d gUkd FiwAk. Mdhy mjd mOjjk mj;fhffFk myyJ thAit ntggggLjJkNghJ mjd ntgge;iy caUk. thAt;d mOjjk kwWk gUkDk cauyhk.

epiyrrkdghlbwfhd kwnwhU vLjJffhlL thdlhthy] rkdghL MFk. ntgg ,affr rkepiyapy css ,ayGthAffs (Real gases) ,rrkdghlbwF clgLk.

miw xdwpYss fhwW %yf$Wfs thdlhthy] epiyrrkdghlbwF KOtJkhf flLggLfpdwd. ,Ugg pDk miwntggepiyapy Fiwej mlhjjpAss fhwW %yf$Wfis ehk Njhuhakhf eyypayG thAthff (Ideal gas) fUJfpNwhk.

ntgg ,afftpaypd Ropt pjp (Zeroth Law of Thermodynamics):

ntgg ,afftpaypd Ropt pjpapdgb›A kwWk B› vdw ,uzL mikgGfs C› vdw %dwhtJ mikgGld ntggrrkepiyapy ,Ugg pd A kwWk B vdw ,uzL mikgGfSk xdWfnfhdW ntggr rkepiyapy ,UfFk.

njhlffjjpy nttNtW ntggepiyapy css A, B kwWk C vdw %dW mikgGfisf fUJf. A kwWk B ,uzL mikgGfSk xdWld xdW vttpjkhd ntggjnjhlhigAk ngwwpUff tpyiy.

Mdhy› mit xtnthdWk C vdw %dwhtJ mikgGld jdpjjdpNa ntggjnjhlhgpy cssd. rpwpJ NeujjpwpFggpwF A kwWk B vdw ,uzL mikgGfSk jdpjjdpNa C Ald ntggr rkepiyapy ,UfFk.

milejpUggij ,J fhlLfpwJ. ,k%dW mikgGfSk xUKiw ntggrrkepiyia milejgpdG mtwwpwfpilNa vttpjkhd ntggg ghpkhwwKk ,UffhJ Vnddpy mk%dWk xNu ntggepiyapy ,UfFk. ,jid fzpjnkhopapy gpdtUkhW Fwpggplyhk. $T_A = T_C$kwWk $T_B = T_C$vdpy›$T_A = T_B$MFk. ,qF T_A, $T_B$kwWk $T_C$vdgit A,B kwWk C vdw %dW mikgGfspd ntgge piyfshFk.

mikgGfs xdWld xdW ntggrrkepiyapy cssdth ,yiyah vdgijffhlLk xU gzNg ntggepiyahFk.

ntgg ,afftpaypd Ropt pjpahdJ ntggepiyiaf fzlwpaggadgLfpwJ. vLjJffhllhf ntggepiykhdp xdiw ehffpd mbapy itjJf nfhsSk NghJ ntggepiykhdp clYld ntggrrkepiyia milAk. ,eepgejidapdgb ntggepiykhdpapd ntggepiy cly ntggepiyfFr rkkhf ,UfFk ,jd mbggilapyjhd ekJ clypd ntggepiy fzlwpaggLfpwJ.

nghUnshdiwj njhlLgghhfFk NghJ mgnghUs vttsT #lhf myyJ Fspfhrrpahf ,Uggij mwpa ntggepiy JizGfpwJ. ek czhT cWgGfisg gadgLjjp nghUspd ntggepiyiaf fzlwpa KbAkh?

ekJ ntWk fhyfspy xdiw jiutphggpd kJk kwnwhU fhiy tOtOgghd XLfs gjpffggll jiuapd (Tiled floor) kJk itfFkNghJ› tOtOgghd jiuapy itjJss fhy› jiutphggpd kJ itffgglLss fhiy tpl mjpff Fspfhrrpia czUk.
Mdhy ,qF jiu kwWk jiutphgG ,uzLk xNu miwntggepiyapy ,Uggij ftdpff NtzLk. ,jwFf fhuzk jiutphgig tpl tOtOgghd jiufFk ek fhYfFkpilNa kpf Ntfkhf ntgggghpkhwwk VwgllJ vdgijNa fzpffpwJ. ntggepiykhdp xdiw jiu kwWk jiutphggpd kJ itjJ ghhfFkNghJ ,uzLk xNu ntggepiyapy cssij mwpayhk.

mf Mwpwy; (U)

ntgg ,aff mikgG xdwpd mf Mwwy vdgJ mikggpd epiwikajijg nghUjJ mikggpYss midjJ yfWfspd ,aff Mwwy kwWk epiy Mwwyfspd $LjYfFr rkkhFk.

,lngahT ,affk› Rowr ,affk kwWk mjhtaffk Mfatwiw csslffa %yf$W ,affjjdhy VwgLk Mwwy› mf ,aff Mwwy (EK) vdggLk.
%yf$WfSffilNa VwgLk fthrr kwWk tyfF tirahy vwgLk Mwwy› mf eiyahwwy (E_P) vdggLk.

vLjJffhlL: gi z gghwwy (Bond energy)
vdNt mf MwwyhdJ gdtUkhW vOjggLfwJ.

vdNt mf MwwyhdJ gdtUkhW vOjggLfwJ.

$$U = E_K + E_P$$

- eyyayG thA%yf$WfSffilNa vttjkhd ,iltidAk ,yiy vdW fUJtjhy mtwwd mf Mwwy KOtJk mf ,aff Mwwy tbtNyNa ,UfFk. ,J ntggeiy› Jfsfsd vz zfif Mfatwiwr rhejUfFk. Mdhy ,J gUkidr rhhejjyy. Mdhy thdlh thy] thAffs Nghdw ,ayG thAffSfF ,J nghUejhJ.

- mf Mwwy xU eiykhw MFk. ,J ntgg ,aff mikggd ,Wjeiy kwWk njhlffeiy ,twiw klLNk rhhejUfFk. vLjJffhllhf jz zhd ntggeiy 30°C ,y ,UeJ 30°C Mf ntggggLjJtjd %ykhfNth myyJ fyfFtjd %ykhfNth cahjjggLfwJ. mjd ,Wj mf MwwyhdJ› jz zH vtthW 40°C ntggeiyia milejJ vdw toKiwia rhhejUffhky mjd ,Wj ntggeiyia klLNk rhhejUfFk.

ntgg ,afftay mikggd mf MwwyhdJ mikggYss xtnthU %yf$wd xoqfww ,affjjdhy VwgLk ,aff MwwiyAk› mtwwd Ntjaay mikggdhy VwgLk eiyahwwy ,twiw klLNk rhhejUfFk vdgij edF GheJ nfhss NtzLk. mikgG KOtjwFkhd nkhjj ,aff Mwwy myyJ mikggd <hgG eiy Mwwy Nghdwit mikggd mf Mwwyd xU gFj vdW jtwhff fUjf$lhJ.

a. xNu ntggeiy kwWk mf MwwYila ,uzL thA eugggglll nfhsfydfisf fUJf. mtwwy xdW jiuaYk› kwnwhdW ,affjjYss ,uay tzbaYk itffggLfwJ. ,uay tzbay css thAfnfhsfyd ,uayd Ntfjjy ,aqfdhYk mjd csNs css thA %yf$Wfsd mf Mwwyy vttj cahTk Vwgltyiy.

b. xNu ntggeiy kwWk mf MwwYila ,uzL thA eugggglll nfhsfydfisf fUJf. mwwy xdW jiuaYk› kwnwhdW h caujjYk itffggLfdwJ. h caujjYss thAf nfhsfydd <hgGeiy Mwwy mjfnkdDk ,ej mjfhgG› thAtd mf Mwwyy vttj khwwjijAk vwgLjjhJ.

vLjJfflL
xU thsp KOtJk css rhjhuz eUld› xU Ftis RLeiu fyfFk NghJ ntggk vjjiraay guTk?

cdJ tilfF cha tsffk jUf.
thsaay css rhjhuz eiuffhlbYk› Ftisaay css #lhd ehd ntggeiy mjfk ,UggDk Ftisaay css RLehd mf Mwwiy tl thsp ehd mf Mwwy mjfk. Vnddy mf Mwwy Xh msTr rhhGss ntgg ,afftay khw MFk. mJ mikggd msT myyJ eiwiar rhhejjhFk.

thsp ehd mf Mwwy mjfk vdDk› Ftisaay css RLehy ,UeJ ntggk thsp eUfF ghAk. ,jwFffhuzk ntggk vgNghJk cah ntggeiyaYss nghUsyUeJ jho ntggeiyaYss nghUSfFg ghAk. NkYk ,J mikggd

mf Mwwiyr rhhejjyy. nghUSfF ntggk khwwggll cld mtntggk nghUsid mf Mwwyhf khwtiLk. vdNt nghUs ntggjij ngwWssJ vdgijtil "nghUs xU Fwggll msT mf Mwwiyg ngwWssJ" vdW $WtNj rhiahd KiwahFk. mikgG xdwid mf Mwwiy mjifhiggjwF xU riwej toiKiw ntggggLjJtJ MFk. ,J gidtUk gljjiy fhllgglLssJ.

,qF kif Kffiakhf ftdjjiy nfhss NtzbaJ ntggk vgNghJk mf Mwwiy mjifhiff NtzLk vdw mtriak ,yiy. ntggeiiy khwh eifotiy (Isothermal eyyiayG thAtid csNs ntggk ghaejhYk mjd mf Mwwyiy vttij cahTk VwglhJ vdgij ehk giddhyf fwf csNshk.

[{yid; ntgg ,aejiutiay; rkhdk; (Joule's Mechanical Equivalent of Heat):

nghUnshdwid ntggeiiyia mjid ntggggLjJtjd %yk cahjjyhk myyJ mgnghUsid kJ Ntiy nratjd %yk cahjjyhk. gjindllhk E}wwhzby N[k] [{y vdw mwtiay mwQh ,aejiu Mwwiy mf MwwyhfTk› mf Mwwiy ,aejiu MwwyhfTk khww KbAk vdW ei&gjjhh. mthid Matid fhlbAssthW ,uzL eiwfs faiW xdwid toiNa JLgG rffujJld (Paddle wheel) ,izffgglLssd. GtiahgG tirahy ,uzL eiwfSk h J}ujjiwF fNotUkNghJ 2 mgh msT eiiy Mwwiy ,uzL eiwfSk ,offidwd.

eiwfs fNo tUk NghJ ehiDs css JLgG rffuk RwWk. vdNt JLgG rffujjiwFk eUfFk ,ilNa XU cuhaT tirjNjhdWk. ,J ehid ntggeiiyia cahjJk. ,qF <hgG eiiy Mwwy (Gravitational potential energy) ehid mf Mwwyhf khwwkiltij ,J czhjJfiwJ. GtiahgG tirahy nraaggll Ntiyaidhy ehid ntggeiiy caheJssJ. czikaiy ntggjij nfhLggjhy VwgLk mNj tiisit ,aejiujijf nfhzL nraaggLk Ntiyaidhy VwgLjj KbAk vdW [{y ei&gjJsshh. 1 fiuhk eiwAila eHid ntggeiiyia 1°C cahjj 4.186 J Mwwy NjitggLk vdW [{y fzlwejhh. goqfhyqfsiy ntggkhdJ fNyhhi (Calorie) vdw myfidhy msffgglJ.

$$1\ \text{cal} = 4.186\ \text{J}$$

,jwF [{yid ntgg ,aejiutiay rkhdJ vdW ngah.

N[k] [{yid fhyjjiwF KdG› ntggk vdgJ fNyhhif (Caloric) vdw ghaeNjhLk Xh jiutk vdWk kffs fUjidhhfs. ,jjiutk cah ntggeiiyaiy css nghUsiyiUeJ› Fiwej ntggeiiyaiYss nghUSfF ghAk vdTk fUjidhhfs. fNyhhif jiutf fUjjidgb cah ntggeiiygnghUsiy mjif fNyhhif jiutKk› Fsihrriahd nghUsiy Fiwej fNyhhif jiutKk cssd. Vnddiy ntggk vdgJ Xh msT vdW mthfs fUjiaNjahFk. Mdhy jwfhyjjiy ehk ntggk vdgJ Xh msT myy mJ ghikhwwif nfhssggLk Xh ghikhww Mwwy vdW GheJ nfhzbUffiNwhk. vdNt "ntgg ,aejiutiay rkhdk" vdgJ Xh jtwhd giuNahfkhFk. Vnddiy ,aejiu Mwwy vdgJ Xh msthFk. vej xU nghUSk mjifkhfNth myyJ FiwthfNth ,aejiu Mwwiyg ngwwiUffyhk. Mdhy ntggjjiwF ,J nghUejhJ. Vnddiy ntggk vdgJ XH msT myy. ,UejNghjiYk ,ejg giuNahfk njhdW njhlNl eilKiwaiy ,UeJtUtjhy mJ jwNghJk gidgwwggLfiwJ. ,jd rhiahdg giuNahfk '[{yid mf Mwwy - ,aejiutiay Mwwy rkhdk" vdgNjahFk. mbggilaiy [{y ,aejiu MwwiyNa mf Mwwyhf khwwiAsshh. [{yid JLgG rffu Matiy eiwfsid <hgGeiiy Mwwy› JLgG rffujjid Roy ,aff Mwwyhf khwwkileJ› giddh ehid mf Mwwyhf khwwkilfiwJ.

vLj;Jf;fhl;L:

khz th xUth fhiyr rpwWzbahf 200 czT fNyhh (foodcalorie) MwwYila czit czfpwhh. mth mtthwwiy fpzwwpyUeJ jzziu ,iwjJ gsspay; css kuqfSfF CwWtjd %yk nrytopffyhk vdf fUJfpwhh. mtthW nrytopff NtzLnkdwhy vjjid kuqfSfF mth jzziu Cww KbAk? ,qF fpzwwpd Mok 25 m, Fljjpd nfhsssT 25 L, xtnthU kujjpwFk xU Flk eH Cww NtzLk vdf. (elfFk NghJ nrytopffggLk MwwiyAk› Fljjpd epiwiaAk Gwffzpffk) g = 10ms-2vdf fUJf.

jhT:

fpzwwpyUeJ 25 L jzziu ,iwggjwF mthpd mf Mwwiyg gadgLjjp GtpahgG tpirfF vjpuhf Ntiy nraa NtzLk.

jzzhpd epiw = 25 L = 25 kg (1 L = 1 kg)

25 kg epiwAila jzziu ,iwff nraa Ntzba Ntiy = jzzuhy ngwggLk <hgG epiy Mwwy

$$W = mgh = 25 \times 10 \times 25 = 6250\ J$$

fhiyr rpwWzbahy ngwggll Mwwy = 200 czT fNyhh = 200 kcal.

$$1\ kcal = 10^3 \times 4.186\ J$$

$$= 200 \times 10^3 \times 4.186\ J = 8.37 \times 10^5\ J$$

,tthwwiyf nfhzL khzth 'n' Flqfs eiu fpzwwpyUeJ ,iwffpwhh vdf fUJf. khz tuhy nrytopffggLk nkhjj Mwwy $= 8.37 \times 10^5\ J = nmgh$ vdNt

$$n = \frac{8.37 \acute{} 10^5 J}{6250 J} \gg 134$$

,qF n vdgJ jzzh Cwwggl Ntzba kuqfspd vzzpfifia $l Fwpffpwj.

fhiyr rpwWzb klLk czL tplL 134 Flk eiu ,iwff KbAkh? epyrrak KbahJ. czikapy kdpj cly czT Mwwy KOtijAk Ntiyahf khwwhJ. Vnddpy Njhuhakhf kdpj clypd gaDWjpwd 20% MFk. mjhtJ 200 czT fNyhhpapy 20% klLNk Ntiyahf khwwkilAk. vdNt 134 Flqfspy 20% vdgJ 26 Flqfs klLNk. vdNt mkkhzth czl rpwWzbfF ,izahf nraa Kbej Ntiyapd msT 26 Flqfs eiu ,iwggNj MFk.

kjKss Mwwy ,ujj Xlljjpwfk kww clypd kww cWgGfspd ,affjjpwFk gadgLjjggLfpwJ. NkYk xU Fwpggll msT czT Mwwy tzhf ,offggLk vdgij epidtpy nfhss NtzLk.

ekJ clypd gaDWjpwd Vd 100% ,yiy? ,jwfhd tpilia eqfs gphpT 8.9 ,y mwpeJ nfhsthfs.

ntgg ,afftpaypd; Kjy; tpjp:

Mwwy khwhtpjapd $wNw ntgg ,afftpaypd Kjy tpjp MFk. epA+lldpd ,afftpaypy Mwwy khwhjjdik nghpa nghUsfspd ,aff Mwwy kwWk epiy Mwwiy csslffpAssJ. Mdhy ntgg ,afftpaypd Kjy tpjp ntggjijAk csslffpAssJ. ,ttpjapd gb mikggpd mf Mwwy khWghlhdJ (ΔU), mikggpwFf nfhLffggll ntggjjpwFk (Q) #oypd kJ mttikgG nraj NtiyfFk (W) css NtWghlbwFr rkkhFk. fzpjnkhopapy ,jidg gpdtUkhW Fwpggplyhk.

,jidg gdtUkhW Fwggl yhk.

$$\Delta U = Q - W$$

ntgg ,afftay mikggd mf Mwwiy› ntggggLjjNah myyJ Ntiy nraNjh khww ,aYk. ,jid fNo css mlltizay fhzyhk.

mikggd csNs ntggk ghajy	mf Mwwy mjfhfFk
mikggyUeJ ntggk ntsNaWjy	mf Mwwy FiwAk
mikggd kJ Ntiy nraaggLk NghJ	mf Mwwy mjfhfFk
mikggdhy Ntiy nraaggLk NghJ	mf Mwwy FiwAk

ntgg ,afftayd Kjy tjia gadgLjJtjwfhd FwalL kugid mwKfggLjjyhk. ,J fNo css mlltiz kwWk Fwggl LfhllgglLssJ.

ntgg ,afftay; Kjy; tjjiag gadgLj;Jtjw;fhd FwalL kuG

mikgG ntggjijg ngWk NghJ	Q NehfFw
mikgG ntggjij ,ofFk NghJ	Qvjhf Fw
mikggd kJ Ntiy nraaggLk NghJ	Wvjhf Fw
mikgG Ntiy nraAk NghJ	W NehfFw

nghJthf thAffisf nfhzNl› ntgg ,afftayd Kjytj tsffggLfwJ. Mdhy ,ttj vyyhtwwwFk nghJthdJ. NkYk jutqfs kwWk jlgnghUsfsfFk ,ttjiag gadgLjj KbAk.

ry Gjjfqfsy $\Delta U = Q + W$ vd ntgg ,afftayd Kjytj Fwggl bUfFk. ,qF mikggdhy nraaggll Ntiy vjhfFwahfTk› mikggd kJ nraaggll Ntiy NehfFwahfTk fUjggLk. ,it ,uzLNk rhahd FwalL kuGfs jhd. ,twwy VNjDk xU FwalL kugid ehk gdgwwyhk.

vLj;Jf;fhl;L

kdjnuhUth 2 kg epiwAila ehid JLgG rffujijf nfhzL fyfFtjd %yk 30 kJ Ntiyiar nrafwhh. Vwjjho 5 kcal ntggk ehyUeJ ntsggl L nfhsfydd gugG toNa ntggffljjy kwWk ntggf fjhtrrd %yk #oYfFf fljjggLfwJ vdy mikggd mf Mwwy khWghlilf fhzf.

jhT:

mikggd kJ nraaggll Ntiy (ehidf fyfFtjd %yk kdjuhy nraaggll Ntiy) W = -30 kJ = -30,000 J

mikggyUeJ ntggk ntsggLfwJ›Q = -5

$$\text{kcal} = 5 \times 4184\ \text{J} = -20920\ \text{J}$$

ntgg ,afftayd Kjy tjiag gadgLjJkNghJ

$$\Delta U = Q - W$$

$$\Delta U = -20{,}920\ \text{J} - (-30{,}000)\ \text{J}$$

$$\Delta U = -20{,}920\ \text{J} + 30{,}000\ \text{J} = 9080\ \text{J}$$

,qF› mikggid kJ nraaggll Ntiyiatil ntgg ,ogG Fiwthf cssJ. vdNt mf Mwwy khWghL NehfFwahFk. ,J mikggid mf Mwwy mjfhjjijf fhlLfwJ.

vLj;Jf;fhl;L

nkyNyhllg gawria (Jogging) jdKk nratJ clyeyjij Ngzffhf Fk vdgJ ehkwejNj. eqfs nkyNyhllg gawray

<LgLk NghJ 500 kJ Ntiy cqfshy nraaggLfwJ. NkYk cqfs clyyUeJ 230 kJ ntggk ntsNawfwJ vdy› cqfs clyy VwgLk mf Mwwy khWghlilf fzffLf.

jhT:

mikggidhy nraaggll Ntiy (ekJ cliy mikgG vdW fUJf)

W = + 500 kJ

mikggyUeJ (ekJ cly) ntsNawwggll ntggk Q = -230 kJ

clyy VwgLk mf Mwwy khWghL

= ∆ U = - 230 kJ – 500 kJ = - 730 kJ

vjhfFwahdJ ekJ clyd mf Mwwy FiwejJ vdgijf fhlLfwJ.

knkJ efo;T (Quasi – static Process) :

VgUkd›P mOjjk kwWk Tntggeiyay csseyyayG thA mikggidf fUJf. eyyayG thA milffggll cUisaid g]ld ntsNehffi efhjJkNghJ eyyayG thAtd gUkdy khwwk vwgLk. ,jd tisthf ntggeiyaYk mOjjjjYk khwwk VwgLk. Vnddy› ,k%dW khwfSk (P.T kwWk V) PV = NkT vdw eiyrrkdghlbdhy njhlhGgLjjgglLssd. eiw xdwid g]ldd kJ itfFk NghJ› mJ g]lid jBnud foNehffi mOjJk. ,eeiyay g]lDfF kf mUNf css gFjaid mOjjk› mikggid kww gFjfsy css mOjjjij tl mjfkhf ,UfFk. ,J thAtd rkeiyawwjjdikiaf (non-equilibrium) fhlLfwJ. thA rkeiyia kzLk milAk tiu mtthAtd mOjjk› ntggeiy myyJ mf Mwwiyf fzlwa ,ayhJ. Mdhy g]lid kf nkJthf mOjJk NghJ xtnthU flljjYk mikgG› #oYld rkeiyay ,UfFk. ,eeiyay ehk eiyr rkdghlilf nfhzL mikggid mf Mwwy› mOjjk myyJ ntggeiyiaf fzffl ,aYk. ,ttifahd efotwF knkJ efoT vdW ngah.

knkJ efoT vdgJ kfkf nkJthf eilngWk Xh efothFk. ,eefoT KbAktiu mikgG› #oYld ntggrrkeiy› ,aejur rkeiy kwWk Ntjrrkeiyay ,UfFkgb jdDila khwfshd (P.V.T) Mfatwwd kjgGfis kf nkJthf khwwfnfhsSk. tiuaWff ,ayhj msT nkJthf VwgLk ,kkhwwjjdhy mikgG vgNghJk rkeiyjjdikia xlbNa fhzggLk.

vLjJffhlL:

knkJ efotwF Xh vLjJffhlLj jUf.

gUkd V, mOjjk P kwWk ntggeiy T cila thA xdW nfhsfydy miljJ itffgglLssJ vdf. gljjy fhlbAssthW g]ld kJ xtnthU kzJfshfg NghLkNghJ g]ld csNehffi kf nkJthf efUk. ,eefotid flljjll knkJ efothff fUjyhk.

(xtnthU kzJfshfg g]ldd kJ NghLkNghJ VwgLk knkJ efoT)

gUkdy; khwwk; VwgLk; NghJ nraaggl;l Ntiy:

efUk g]lidf nfhzl thA e¤uggggll cUis xdiwf fUJf. knkJ e¤fot¤y cssthW thA t¤ht¤ilejJ g]lid dx njhiyT nkJthfj jsSf¤wJ.

,qF knkJ e¤fot¤d mbggila¤y thA t¤ht¤ilf¤wJ. vdNt xtnthU fzjj¤Yk mOjjk› ntgge¤iy kwWk mf Mwwy Mf¤ait xU Fw¤ggll kj¤ggidg ngww¤UfFk.

thAthy g]ld kJ nraaggll r¤wa Ntiy

$$dW = Fdx$$

thAthy g]ld¤d kJ nrYjjggll t¤ir F = PA. ,qF A vdgJ g]ld¤d gugigAk PvdgJ thA g]ld¤d kJ nrYjJk mOjjijAk Fw¤ff¤wJ.

rkdghL g¤dtUk khww¤aikffyhk

$$dW = PA\,dx$$

Mdhy›Adx = dV = thAt¤d t¤ht¤dhy Vwgll gUkd khWghL vdNt thA t¤ht¤ilejjhy nraaggll r¤wa Ntiy

$$dW = PdV$$

,qF dV NehfFw¤ vdgij ftd¤ff Ntz Lk. Vnddy gUkd mj¤fh¤ff¤wJ. nghJthf thAt¤d gUkd V_i y¤UeJ V_f tiu mj¤fh¤ggjhy nraaggll Ntiyia g¤dtUkhW Fw¤gg¤lyhk.

$$w = \int_{V_i}^{V_f} PdV$$

mikgg¤d kJ Ntiy nraagglbUgg¤d wvj¤hfFw¤ kj¤gigg ngWk.

rkdghL mOjjk P,njhiff Fw¤albwF csNs cssijf ftd¤ff Ntz Lk. mikgg Ntiy nraAk NghJ mOjjkl khw¤y¤ahf ,Uff Ntzba mtr¤ak¤yiy vdgij ,J czhjJf¤wJ. njhifalL kj¤ggidf fhz e¤iyr rkdghlilg gadgLjj¤ mOjjjij gUkd kwWk ntgge¤iya¤d rhhghff Fw¤ggl Ntz Lk.

PV tiuglk;

mOjjkP kwWk gUkd V ,itfSfF ,ilNa tiuaggLk Xh tiuglNk PV tiuglkhFk. thA t¤ht¤ilAk NghJ mtthAthy nraaggll Ntiyia PV tiugljijf nfhzL fzff¤lyhk myyJ thA mKffggLk NghJ mtthAt¤d kJ nraaggll Ntiyiaf fzff¤lyhk. myF 2 ehk fwwgb tisNfhlbwFf fNo css gugG r¤Wk vyiya¤y¤UeJ ngUk vyiytiu css rhhg¤d njhifalL kj¤gigj jUk. ,NjNghdW PV tiugljj¤d fNo css gugG thA t¤ht¤ilAk NghJ myyJ mKffggLk NghJ nraaggll Ntiyiaf nfhLfFk. PV tiugljj¤d tbtk ntgg ,afft¤ay e¤fot¤d jdikiar rhhejJ.

vLj¤Jf¤fhl¤L

e¤iyahd ts¤kzly mOjjjjj¤y css thAt¤d gUkd 1m^3y¤UeJ 2m^3Mf t¤ht¤ilf¤wJ vd¤y› g¤dtUtdtwiwf fhzf.

a. thAthy nraaggll Ntiy

b. ,tNtiyffhd PV tiuglk

jhT:

mOjjk P = 1 atm = 101 kPa, V_f = 2 m^3kwWk V_i = 1 m^3

rkdghL ,UeJ

$$W = \int_{V_i}^{V_f} PdV = P\int_{V_i}^{V_f} dV$$

,qF PvdgJ XH khwpypahFk. vdNt ,J njhifalbwF ntspNa cssJ.

$$W = P(V_f - V_i) = 101 \times 10^3 \times (2-1) = 101\ kJ$$

mOjjk khwpypahf cssjhy gljjpy fhllgglLssthW PV tiuglk Xh NehfNfhlhf ,UfFk. mej NehfNfhlLfF fNo css gugG nraaggll NtiyfFr rkkhFk.

thAtpd; jd; ntgg VwGj;jpwd;

nfhLffggll mikggpd jdntgg VwGjjpwd mttikggpd fllikgG kwWk %yf$Wfspd jdikiaf fzlwptjpy Kffpag gqfhwWfpdwJ. jplgnghUs kwWk jputqfSfF khwhf thAffs ,uzL jdntgg VwGjjpwdfisg ngwWssd. mit› mOjjk khwhj jd ntgg VwGjjpwd (s_p) kwWk gUkd khwhj jdntgg VwGjjpwd (s_v).

jd; ntgg VwGj;jpwd;

mOj;jk; khwhj; jd; ntgg VwGj;jpwd; (S_p)

mOjjk khwh epiyapy 1 kg epiwAila nghUspd ntggepiyia 1K myyJ 1°C cahjjj Njitggk ntggjjpd msT mOjjk khwhjjdntgg VwGjjpwd vd mioffggLk. mikggpid ntggggLjJk NghJ thAtpwF ntggk mspffggLfpwJ. khwh mOjjjjpy thA tphptilfpwJ.

,eepfotpy nfhLffggll ntggjjpd xU gFjp Ntiy nraa (tphptila) gadgLfpwJ. NkYk kjk css gFjp thAtpd mf Mwwiy mjpfhpggjwFg gadgLfpwJ.

gUkd; khwhj; jdntgg VwGj;jpwd; (S_v)

gUkd khwh epiyapy 1kg epiwAila nghUspd ntggepiyia 1K myyJ 1°C cahjjj Njitggk ntggjjpd msT› gUkd khw jd ntgg VwGjjpwd vdW mioffggLk. thAtpd gUkd khwhj epiyapy nfhLffggLk ntggk mikggpd mf Mwwy mjpfhpggjwF klLNk gadgLfpwJ. fhlbAssthW vttpj NtiyAk nraagglhJ.

khwh mOjjjjpy thAtpd ntggepiyia cahjJtjwFj Njitggk ntggjij tpl› khwh gUkdpy css thAtpd ntggepiyia cahjJtjwFj Njitggk ntggk Fiwthd J. NtWtifapy $WNthkhapd $S_p$vgNghJk S_vl tpl mjpfkhFk.

Nkhyhh; jd; ntgg VwGj;jpwd;fs;

rpy Neuqfspy Nkhyhh jdntgg VwGjjpwdfisf (C_p, C_v) fzffpLtJ› ekfF kpfTk gaDssjhf mikAk.

khwhggUkdpy 1 Nkhy msTss nghUspd ntggepiyia 1K myyJ 1°C cahjJtjwFj Njitggk ntggjjpd msNt› gUkd khwh Nkhyhh jd ntgg VwGjjpwd (C_v) MFk. khwh mOjjjjpy ntggepiyia cahjJtjwFj Njitggk ntggjjpd msT mOjjk khwh Nkhyhh jdntgg VwGjjpwd (C_P)

khwhggUkdpy *m*Nkhy msTss thAtpwFf nfhLffggLk ntggjij Q vdWk› mjdhy VwgLk ntggepiy NtWghlil ΔT vdTk nfhzlhy

$$Q = \mu C_v \Delta T$$

vd vOjyhk.

,k khwhgUk e¤fot¤wF ntgg ,afft¤ay¤d Kjy t¤j¤iag gadgLjj¤dhy (W = 0, Vndd¤y dV = 0),

$$Q = \Delta U - O$$

vdf f¤ilfFk.

,twiw xgg¤Lk NghJ

$\Delta U = \mu Cv\Delta T$ myyJ $C_v = \frac{1DU}{mDT}$

ΔT a¤d vyiy Ro¤a¤id milAk NghJ $(\Delta T \to 0)$, ehk

$$C_v = \frac{1dU}{mdT}$$

vd vOjyhk.

,qF ntgge¤iy kwWK mf Mwwy ,uzLNk e¤iy khw¤fs. vdNt› Nkfzl rkdghL midjJ e¤foTfSfFk nghUjjkhdjhFk.

Nkah; njhlhG (Meyar's Relation):

µ Nkhy msTila eyy¤ayG thA nfhsfyd Xdw¤y miljJ itffgglLssJ. mtthAt¤d gUkd V, mOjjk P kwWk ntgge¤iy T vdf. khwhggUkd¤y thAt¤d ntgge¤iy dT msT cahjjggLf¤wJ. ,qF thAthy vtt¤j Ntiy Ak nraaggl t¤yiy. vdNt mikgg¤wFf nfhLffggll ntggk mf Mwwiy klLNk mj¤fh¤fFk. mf Mwwy¤y Vwgll khwwjij dU vdf.

$C_v$vdgJ gUkd khwh Nkhyhh jdntgg VwGjj¤wd vd¤y rkdghL g¤dtUkhW vOjyhk.

$$dU = \mu C_v dT$$

khwh mOjjjj¤y thAit ntggggLjJk NghJ› mtthAt¤d ntgge¤iy cahT dT vdTk› mikgg¤wFf nfhLffggll ntggjj¤d msT 'Q' vdTk. ,ee¤fot¤dhy gUkd¤y vwgll khwwk 'dV' vdTk nfhzlhy

$$Q = \mu C_p dT$$

,ee¤fot¤dhy nraaggll Ntiy

$$W = PdV$$

Mdhy› ntgg ,afft¤ay¤d Kjyt¤j¤ggb

$$Q = dU + W$$

rkdghLfs

$$\mu C_p dT = \mu C_v dT + PdV$$

vdf f¤ilfFk

Nkhy eyy¤ayG thAt¤wF e¤iyrrkdghlil g¤dtUkhW vOjyhk.

$$PV = \mu RT \Rightarrow PdV + VdP = \mu RdT$$

,qF mOjjk khwhJ› vdNt dP = 0.

$PdV = \mu RdT$

$C_P dT = C_v dT = RdT$

$C_p = C_v + R$ (or) $C_P - C_V = R$

,jnjhlhg¤wF Nkah njhlhG vdW ngah.

khwh mOjjjjy eyyayG thAtd Nkhyhh jdntgg VwGjjwd› gUkd khwh Nkyhh jdntgg VwGjjwd kwWk R Mfatwwd $LjYfFr rkkhFk vdgij ,jnjhlhG ekfFf fhlLfwJ.

NkYk ,jnjhlhgyUeJ› mOjjk khwh Nkhyhh jdntgg VwGjjwd (C_p), gUkd khwh Nkhyhh jdntgg VwGjjwidtl (C_v) vdNghJk mjfk vdgij ehk GheJ nfhssyhk.

ntgg ,afftay; efoTfs; (Thermodynamic Processes):

ntggeiy khwh efoT (Isothermal process):

,eefotpy ntggeiy Xh khwh kjggidg ngwwUfFk. Mdhy ntgg ,afftay mikggd mOjjKk› gUkDk khwwkilAk.

ehkwejgb eyyayG thArrkdghL

$$PV = \mu RT$$

,eefotpy T Xh khwyp. vdNt ntggeiy khwh efotwfhd eiyrrkdghL

$$PV = khwyp$$

,ej rkdghL ekfF czhjJtJ
thA xU rkeiy eiyaypUeJ (P_1, V_1) kwnwhU rkeiy eiyfFr (P_2, V_2) nryYk NghJ gdtUk njhlhG nghUeJk vdgNj

$$P_1V_1 = P_2V_2$$

,qF PV = khwyp. vdNt P, MdJ V Ald vjh tfpjjnjhlhigg ngwWssJ. mjhtJ $(P\mu\frac{1}{V})$,jypUeJ PV tiuglk Xh mjgutisak (hyperbola) vd mwayhk.

khwh ntggeiyay tiuaggLk mOjjk - gUkd tiugljij ntggeiy khwh tiuglk (Isotherm) vdNw mioffyhk.

knkJ ntggeiy khwh tpT kwWk knkJ ntggeiy khwh mKffk ,twwwfhd PV tiuglqfs fhllgglLssd.
ehk mwejgb eyyayG thA xdwd mf Mwwy mtthAtd ntggeiyia klLk rhheJssJ.

vdNt› Xh ntggeiy khwh efotpy mf MwwYk XH khwypahFk Vnddy ntggeiy ,qF khwhky cssJ. vdNt dU myyJ $\Delta U = 0$. ntggeiy khwh efotwfhd ntgg ,afftaypd Kjy tpj gdtUkhW vOjggLfwJ.

$$Q = W$$

rkdghL ,UeJ ntggeiy khwh efotpy thAtwFf nfhLffggLk ntggk GwNtiyfF klLnk gadgLfwJ vdgij ekfF czhjJfwJ. mikgG xdwDs ntggk ghAk NghJ mttikggd ntggeiy vgNghJk caUk vdw jtwhd Ghpjy cssJ. ntggeiy khwh efotpy ,J czikayy. ntggeiy khwh mKffk VwgLk NghJ cUisad csNs gpjld jssggLfwJ. ,J mf Mwwiy mjfhpfFk. Mdhy ,ej mf Mwwy mjfhpgG ntggjnjhlhgdhy mikggwF ntspNa nrdW tpLfwJ.

vLj;Jf;fhl;Lfs;

1. jzziu ntggggLjJk NghJ› mjd nfhjeiyaypy jzzUfF vttsT ntggjij msjjhYk jzzh KOtJkhf euhtpahf khWk tiu mjd

ntggepiy caUtjpyiy. ,NjNghdW ciwepiyapy csS gdpfflb cUfp jz zuhf khWk NghJk gdpfflbfF ntggjijf nfhLjjhYk mjd ntggepiy caUtjpyiy.

2. ekJ clypd midjJ tshrpij khwwqfSk xU khwh ntggepiyapNyNa (37°C) eilngWfpdwd.

ntggepiy khwh epfotpy; nraaggllpl Ntiy:

eyypayG thA xdwpidf fUJf. khwh ntggepiyapy› knkJ epfotpy vdw njhlff epiyapyUeJ vdw ,WjepiyfF mjid tpthtila mDkjpffTk. ,eepfotpy thAthy nraaggll Ntiyia ehk gpdtUkhW fzffplyhk.

rkdghL ,Uej thAthy nraaggll Ntiy›

$$W = \int_{V_i}^{V_f} PdV$$

,eepfoT knkJ epfothf csSjhy xtnthU epiyapYk thAthdJ #oYld rkepiyapy ,UfFk. ,qF thA eyypayG thAthfTk xtnthU epiyapYk #oYld rkepiyapy csSjhYk eyypayG thAr rkdghlil ,qF ehk gadgLjjp mOjjjij gUkd kwWk ntggepiyapd rhhghf vOjyhk.

$$P = \frac{mRT}{V}$$

rkdghL ,y gpujpapLk NghJ

$$W = \int_{V_i}^{V_f} \frac{mRT}{V} dV$$

$$W = mRT \int_{V_i}^{V_f} \frac{dV}{V}$$

rkdghL T njhifalbwF ntspNa itjjpUfff fhuzk ntggepiy khwh epfoT KOikfFk ,J khwpyahFk.
rkdghL njhifggLjJk NghJ
,qF Vwgll gUkd tpthT xh ntggepiy khwh tpthfFk.

$$W = mRT\, In\left(\frac{V_f}{V_i}\right)$$

NkYk $\frac{V_f}{V_i} > 1$ vdgjhy $In\left(\frac{V_f}{V_i}\right) > 0$ MFk.
vdNt› ntggepiy khwh tpthtpy thAthy nraaggll Ntiy NehfFwp MFk.

rkdghL ntggepiy khwh mKffjjpwFk nghUeJk› Mdhy ntggepiy khwh mKffjjpy $\frac{V_f}{V_i} < 1$ vdNt $\ln\left(\frac{V_f}{V_i}\right) < 0$ vdNt› ntggepiy khwh mKffjjpy thAtpd kJ nraaggll Ntiy vjphfFwp MFk. PV tiugljjpy› ntggepiykhwh tpthtpd NghJ thAthy nraaggll Ntiy tiugljjpwFf fNo csS gugGwpFr rkk vdgJ fhllgglLssJ.

,NjNghdW ntggepiy khwh mKffjjpy PV tiugljjpwFf fNo csS gugG thAtpd kJ nraaggll NtiyfFrrkkhFk. ,J vjphFwpapy Fwpggplggl Lk.

ntggepiy khwh epfotpy nraaggll Ntiyiaf fzffplkNghJ› epfoT

xU knkJ e¡foT vd ehk fUJNdhk. ,J xU knkJ e¡fothf ,yiynad¡y e¡iyr rkdghL $P = \frac{mRT}{V}$ ia rkdghL g¡uj¡a¡l ,ayhJ. Vnddy eyy¡ayG thA tj¡ rke¡iyaww e¡foTfSfFg nghUejhJ. Mdhy rkdghL knkJthf e¡fohj ntgge¡iy khwh e¡foTfSfFk nghUeJk. Vnddy mOjjk kwWk gUkd Nghdw e¡iykhw¡fs eyy¡ayG thAt¡d njhlff kwWk ,Wj¡ e¡iyfis klLNk rhhej¡UfFk› ,Wj¡e¡iyfis milej to¡Kiwia rhhej¡UffhJ. rkdghL njhifggLjJtjwF klLNk ehk knkJ e¡fothf fUj¡Ndhk.

vLj¡Jf¡fhl¡L:

300 K ntgge¡iya¡Yss 0.5 Nkhy thA xdW njhlffggUkd 2L ,y ,UeJ ,Wj¡ggUkd 6 L fF ntgge¡iy khwh e¡fot¡y t¡h¡tilf¡wJ vd¡y› g¡dtUtdtwiwf fhzf.

1. thAthy nraaggll Ntiy?
2. thAt¡wFf nfhLffggll ntggjj¡d msT?
3. thAt¡d ,Wj¡ mOjjk? (thAkhw¡y¡R = 8.31 J mol^{-1} K^{-1})

j¡h¡T:

ehk mw¡ejgb thAthy nraaggll Ntiy Xh ntgge¡iy khwh t¡h¡thFk.

,qF $\mu = 0.5$

$$W = 0.5\,mol \times \frac{8.31J}{mol.K} \times 300K \times \ln\left(\frac{6L}{2L}\right)$$

$$W = 1.369\,kJ$$

,qF Ntiy NehfFw¡a¡y cssijf ftd¡ff NtzLk. Vnddy thAthy Ntiy nraaggLssJ.

ntgg ,afft¡ay¡d Kjy tj¡ggb› ntgge¡iy khwh e¡fot¡y mikgg¡wFf nfhLffggLk ntggk Ntiy nratjwFg gadgLjjggLf¡wJ.

vdNt›Q = W = 1.369 kJ

,qF QTk NehfFw¡ahFk. Vnddy ntggk mikgg¡wFs nryf¡wJ.

ntgg e¡iy khwh e¡fot¡wF

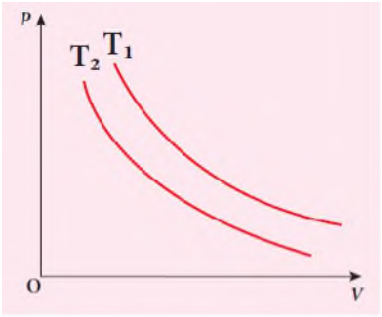
$P_iV_i = P_fV_f = \mu RT$

$$P_f = \frac{mRT}{V_f} = 0.5mol \times \frac{8.31J}{mol.K} \times \frac{300K}{6 \times 10^{-3}m^3}$$

= 207.75 kPa

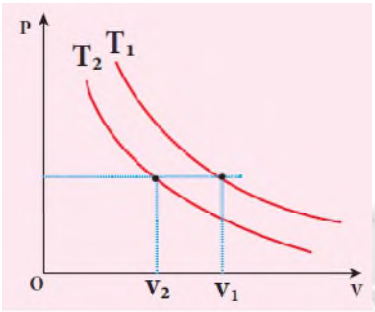
vLj¡Jf¡fhl¡L:

fNo fhllggLss PV tiuglk nttNtW ntgge¡iyfs¡y eilngWk ,uzL ntgge¡iy khwh e¡foTfisf Fw¡ff¡dwd. ,uzL ntgge¡iyfs¡y cahej ntgge¡iy vJ vdgijf fzlw¡f.



jhT:

cah ntggepiy tisNfhlilf fhzgjwF gljjpy fhlbAssthW xmrRfF ,izahf fpiljjsf Nfhlbid tiua NtzLk. ,J khwh mOjjjpwfhd NfhL MFk.



khwh> mOjjf Nfhlbid ntlLk nrqFjJf NfhLfSffhd gUkdfs V_1kwWk V_2 Mfpait> xNu mOjjjpy css gUkdfisf Fwpffpdwd.

khwh mOjjjpy mjpf gUkDss thAtpy ntggepiyAk mjpfkhf ,UfFk. gljjpypUeJ V_1> V_2vdNt>T_1> T_2vd mwpayhk. nghJthf ntggepiy khwh epfoTfspy ntggepiy Fiwthf css tisNfhLfs MjpgGsspfs mUNf mikAk.

ntgggghpkhwwkpypyh epfoT (Adiabatic Process):

,eepfotpy vttpjkhd ntggKk mikggpwF csNsNah myyJ mikggpypUeJ ntspNath nryyhJ (Q = O) Mdhy thA jdDila mf Mwwiyg gadgLjjp tpthtilAk myyJ ntspgGw Ntiyapdhy thA mKffkilAk. vdNt ntgggghpkhwwkpyyh epfotpy mikggpd mOjjk> gUkd kwWk ntgghpiy ,twwpy khwwk Vwglyhk.

xU ntgggghpkhwwkpyyh epfotpwF ntgg ,afftpaypd Kjy tpjp $\Delta U = W$ vd vOjyhk. ,jypUeJ ehk mwpeJnfhstJ vddntdwhy thA mjd mf Mwwiyg gadgLjjp Ntiy nraAk myyJ thAtpd kJ Ntiy nraaggLL mjd mf Mwwy mjpfhpfFk.

ntgggghpkhwwkpyyh epfotpid gpdtUk Kiwfisg gadgLjjp epfojj ,aYk.

1. mikgG ntgg Mwwiy #oYfFf fljjhjthWk myyJ #oypypUeJ vttpjkhd ntgg MwwYk mikggpwFs nryyhjthWk mikggpid ntggffhgG (Thermally insulating) nraa NtzLk.
   vLjJffhllhf> ntggffhgG nraaggll cUisapy css thA ntgggghpkhwwkpyyh Kiwapy mKffggLfpwJ myyJ ntgggghpkhwwkpyyh Kiwapy tpthtilfpwJ.

2. vtt‰j ntggffhgGk mww e‰iya‰y #oYfF ntggjijf fljj ,ayhjthW k‰ff FWf‰a Neujj‰y k‰f Ntfkhf e‰foT Vwgllhy mJTk xU ntgggh‰khwwk‰yyh e‰foT.

(a) kwWk (b) ,twiw t‰sfFf‰dwd.

vLjJffhlLfs: ntgggh‰khwwk‰yyh e‰fot‰wfhd e‰iyr rkdghL

ntgggh‰khwwk‰yyh e‰fot‰wfhd e‰iyr rkdghL

PV^{γ} = khw‰y‰

,qF γvdgJ ntgggh‰khwwk‰yyh mLfFffFw‰ MFk. ($\gamma = C_p/C_v$) ,J thAt‰d ,ayigg nghUjjjhFk.

rkdghL ,UeJ ehk mw‰tJ vddntdwhy› thA xU rke‰iy e‰iya‰y‰UeJ (P_i, V_i) kwnwhU rke‰iy e‰iyfF (P_f, V_f) ntgggh‰khwwk‰yyh Kiwa‰y nryYkNghJ mtthA g‰dtUk e‰gejidfF clgLk.

$$P_i V_i^{\gamma} = P_f V_f^{\gamma}$$

ntggg gh‰khwwk‰yyh t‰h‰T kwWk mKfF e‰fot‰wfhd tiugljijAk ntggg gh‰khwwk‰yyh tisNfhL (adiabat) vdNw mioffyhk. ntgge‰iy khwh e‰fot‰wfhd PV tiuglk kwWk fhllgglLss ntggg gh‰khwwk‰yyh e‰fot‰wfhd PV tiuglKk f‰lljjll xNu khj‰h‰ahf cssd. Mdhy ntgggh‰khwwk‰yyh e‰fot‰wfhd tisNfhL› ntgge‰iy khwh e‰fot‰wfhd tisNfhlilt‰l rwNw nrqFjjhf fhzggLk.

T kwWk V lg nghUjJ rkdghL ehk rwNw khww‰aikffyhk. eyy‰ayG thAr rkdghlby‰UeJ mOjjk

,jid rkdghL gu‰j‰a‰l› ekfF f‰ilggJ $\frac{mRT}{V}Vg$ = khw‰y‰ (myyJ)

$\frac{T}{V}Vg = \frac{\text{khw‰y‰}}{mR}$ vdf f‰ilfFk.

,qF µRvdgJk xU khw‰y‰› vdNt ,jidg g‰dtUkhW vOjyhk.

$TV^{\gamma-1}$ = khw‰y‰

thA xdW njhlffr rk e‰iya‰y‰UeJ (T_i, V_i) ,Wj‰ rk e‰iyfF (T_f, V_f) ntgggh‰khwwk‰yyh Kiwa‰y nryYkNghJ mJ g‰dtUk rkdghlil e‰iwT nraAk.

$$T_i V_i^{g-1} = T_f V_f^{g-1}$$

vdgij rkdghL ekfF czhjJf‰wJ.

ntggg gu‰khwwk‰yyh e‰fot‰wfhd e‰iyr rkdghlil T kwWk P a‰idg nghUjJk vOjyhk.

$T^g P^{1-g}$ = khw‰y‰ (8.39)

rkdghL (8.39) wfhd e‰&gzjij eqfNs Kawr‰ffyhk.

iffs‰dhy mOjjggLk gkg‰idg gadgLjj‰ k‰j‰tzbr rffujj‰wF fhwwbggij ehk mid tUk mw‰ej‰UgNghk. gkg‰d csNs css V gUkDila fhwiw› ts‰kzly mOjjjj‰Yss kwWk 27°C miw ntgge‰iya‰y css ntgg ,afft‰ay mikgG vdW fUJf. K‰j‰tzb rffujj‰y fhwiwr nrYjJk Kid %lgglLssJ. vdW fUJf. fhwwhdJ mjd njhlffggUkd‰y‰UeJ

ehdfy xU gqF ,WjggUkDfF mOjjggLfwJ vdwhy mjd ,Wj ntggeiy vdd? rffujjd fhwW nrYjJk Kid %lgglLssjhy fhwW rffujjDs nryy KbahJ. vdNt ,qF fhwwbfFk efotid ntggggukhwwkyyh mOffkhff fUjyhk. fhwWfF (g= 1.4)

jukT:

fhwwbfFk efoT ntggggukhwwkyyh mKffkhf fUjggLfwJ. gUkd nfhLffgglLssJ. vdNt ntggeiyiaf fzffl NtzLk. ,qF rkdghL (8.38) lg gadgLjj NtzLk.

$$T_i V_i^{g-1} = T_f V_f^{g-1}$$

$$T_i = 300K\,(273 + 27°C = 300\,K)$$

$$V_i = V \;\&\; V_f = \frac{V}{4}$$

$$T_f = T_i \left(\frac{V_i}{V_f}\right)^{g-1} = 300\,K \times 4^{1.4-1} = 300K \times 1.741$$

T2 » 522 K myyJ 249°C

,ej ,Wj ntggeiy eud nfhjeiyia tl mjfk. vdNt kjtzbay rffujjwF ifggkgidg gadgLjj fhwwbfFk NghJ fhwW eugGk Kidiaj njhLtJ Mgjjhdjhfk.

gjlid kf Ntfkhf mOjJkNghJ cUthFk ntggjjid FWfa Neujjy #oYffFf fljj ,ayhJ. vdNt thAtd ntggeiy tiuthf caUk. ,J gljjy fhllgglLssJ. ,jjjJtk Bry ,aejuqfsy gadgLjjggLfwJ. fhwW-nglNuhy fyitia ntggggukhwwkyyh Kiway kf Ntfkhf mKfFkNghJ mffyitad ntggeiy jggwWk msTfF kf Ntfkhf caUk.

ntggggukhwwkyyh efotiy nraaggll Ntiy KOikahf ntggffhgGr nraaggll Rtu› mbggugG nfhzl cUisaDs css µ Nkhy eyyayG thAitf fUJf. A FWfF ntlLg gugG nfhzl cuhatww ntggffhgGg ngww gjld cUisay nghUjjggLssJ.

ntggg gukhwwkyyh Kiway mikgG (P_i, V_i, T_i) vdw njhlff eiyayUeJ (P_f, V_f, T_f) vdw ,Wjeiyia milAkNghJ nraaggll Ntiy W vdf.

$$W = \int_{V_i}^{V_f} PdV \qquad (8.40)$$

ntggggukhwwkyyh ,eefoT xU knkJ efoT vdffUJf› xtnthU eiyaYk eyyayG thA tjd ,qF nghUeJk.

,eegejidaid mbggilay› ntggggukhwwkyyh efotid eiyr rkdghL PV^g = khwy (myyJ) $P = \frac{khwy}{V^g}$,jid rkdghL (8.40),y gujaLkNghJ

$$W = PdV$$

$$/W_{adia} = \int_{V_i}^{V_f} \frac{khw/y/}{V^g} dv$$

$$= khw/y/ \int_{V_i}^{V_f} V^{-g}$$

$$= khw/y/ \left[\frac{V^{-g+1}}{-g+1}\right]_{V_i}^{V_f}$$

$$= \frac{khw/y/}{1-g}\left[\frac{1}{V_f^{g-1}} - \frac{1}{V_i^{g-1}}\right]$$

$$= \frac{1}{1-g}\left[\frac{khw/y/}{V_f^{g-1}} - \frac{khw/y/}{V_i^{g-1}}\right]$$

$$= \frac{khw/y/}{1-g}\left[\frac{1}{V_f^{g-1}} - \frac{1}{V_i^{g-1}}\right]$$

$$/W_{adia} = \frac{1}{1-g}\left[\frac{P_f V_f^g}{V_f^{g-1}} - \frac{P_i V_i^g}{V_i^{g-1}}\right]$$

$$W_{adia} = \frac{1}{1-g}\left[P_f V_f - P_i V_i\right]$$

eyy/ayG thA t/j/a/y/UeJ›

$P_f V_f = \mu R T_f$ kwWk $P_i V_i = \mu R T_i$

,jidr rkdghL (8.41) ,y g/uj/a/LkNghJ

$$/W_{adia} = \frac{mR}{g-1}\left[T_i - T_f\right]$$

ntgggu/khwwk/yyh t/u/t/y› thAthy nraaggll Nt i y W_{adia} xU NeufFw/ kj/gghFk. ,qF $T_i > T_f$, vdNt ntgggu/khwwk/yyh t/u/t/y thA Fs/urr/a i lAk.

ntgggu/khwwk/yyh mKffjj/y› thAt/d kJ Nt i y nraaggLk mjhtJ W_{adia} xU NeufFw/ kj/gghFk. ,qF $T_i > T_f$, vdNt ntgggu/khwwk/yyh t/u/t/y thA Fs/urr/a i lAk.

ntgggu/khwwk/yyh mKffjj/y› thAt/d kJ Nt i y nraaggLk mjhtJ W_{adia} xU vj/ufFw/ kj/gghFk. ,qF $T_i < T_f$, vdNt ntgggu/khwwk/yyh mKffjj/y thAt/d ntgge/i y caUk.

Fw/gG

ntggggukhwwkyyh efotY Xu knkJ efothff fUj rkdghL (8.41) kwWk (8.42) Mfa ,uzLk rkdghLfis ehk tUtjNjhk. ,eefoT knkJ efothf ,yiynadwhYk ,ttuzL rkdghLfSk nghUjjkhd rkdghLfNsahFk. Vnddy eiykhwfs P,V kwWk TMfait njhlff kwWk ,Wj eiyfis klLNk rhuejit. mit ,Wjeiyia milej toKiwiar rhuejjyy. njhifalYffhf klLNk ehk knkJ efoT vdW fUjNdhk. glk (8.32) ,y fhllgglLss ntggggukhwwkyyh efotY PV tiugljjwF fNo c s s gugG› ,eefotY nraaggll nkhjj Ntiyiaf nfhLfFk.

ntggeiy khwh tisNfhL kwWk ntggggukhwwkyyh tisNfhL ,twwwfilNaahd NtWghlil GueJ nfhssNt T_i kwWk T_f ntggeiyfSffhd ntggeiy khwh tisNfhlLld› NrujJ ntggggukhww kww tisNfhLk glk (8.32) ,y fhllgglLssd.

ntgggukhwwkyyh efotwfhd tisNfhL› ntggeiy khwh tisNfhlil tl nrqFjjhhf ,UfFk. Vnddy vgNghJk $\gamma > 1$ MFk.

mOjjk khwh efoT
(Isobaric Process)

,J khwhj mOjjjjy VwgLk xU ntgg ,afftay efothFk. ,eefotY mOjjk khwyahf ,UejhYk› ntggeiy› gUkd kwWk Mf Mwwy Nghdwit khwyfs myy. eyyayG thAr rkdghlbyUeJ.

$$V = \left(\frac{\mu R}{P}\right) T$$

$$\text{Here } \frac{\mu R}{P} = \text{khwy}$$

mOjjk khwh efotY› nfytd ntggeiy gUkDfF Neutfjjjy ,UfFk.

$V \alpha T$(mOjjk khwh efoT) (8.44)

mOjjk khwh efotY V - T tiuglk MjgGss toNarnryYk Xu NeufNfhlhf mikAk vdgij Nkwfzl rkdghL czujJfwJ.

thA xdW (V_i,T_i) vdw eiyaYUeJ (V_f,T_f) vdw eiyfF khwh mOjjjjy nryYkNghJ gdtUk rkdghlil eiwT nraAk.

$$\frac{T_f}{V_f} = \frac{T_i}{V_i}$$

mOjjk khwh efotwfhd vLjJffhlLfs thAit ntggggLjJkNghJ thA ntggkileJ gddu mJ gjlidj jsSfwJ. vdNt thAthdJ tskzly mOjjk kwWk Gtaug tir ,twwd $LjYfFr rkkhd Xu tiria g]ldd kJ nrYjJfwJ vdy ,eefoT Xu mOjjkkhwh efothFk.

ekJ tlL rikay miwa¡y eilngWk ngUkghyhd rikay e¡foTfs mOjjk khwh e¡foTfs MFk. j¡wej ghjj¡ujj¡y

czt¡id rikfFkNghJ czt¡wF NkNy css mOjjk vgNghJk ts¡kzly mOjjjj¡wFr rkkhFk.

glk 8.35,y fhlbAssthW mOjjk khwh e¡fot¡wfhd PV tiuglk gUk mrRfF ,izahfr nryYk Xu f¡iljjsf NfhlhFk. gUkd FiwAk mOjjk khwh e¡fot¡id glk 8.35 (a) fhlLf¡wJ.

gUkd mj¡fu¡fFk mOjjk khwh e¡fot¡id glk 8.35 (b) fhlLf¡wJ.

mOj¡jk; khwh e¡fot¡y; nra¡aggl¡l Ntiy thAthy; nra¡aggl¡l Ntiy

$$W = \int_{V_i}^{V_f} P dv \qquad (8.46)$$

$$W = P\int_{V_i}^{V_f} dv \qquad (8.47)$$

mOj¡jk; khwh e¡fot¡y> mOj¡jk; Xu; khw¡y¡ahFk;. vdNt P njhifa¡l¡bw¡F nts¡Na cs¡sJ.

$$W = P[V_f - V_i] = P\Delta V \qquad (8.48)$$

,qF>ΔV vdgJ gUkd¡y Vwgll khwwjijf Fw¡ff¡wJ. ΔV vj¡ufFw¡ahf ,Uejhy>W vj¡ufFw¡ah ,UfFk. ,J thAt¡d kJ Ntiy nraaggLf¡wJ vdgijf fhlLf¡wJ. ΔV NeufFw¡ahf ,Uejhy> W NeufFw¡ahFk. ,J thAthy Ntiy nraaggLf¡wJ vdgijf fhlLf¡wJ.

rkdghL (8.48)l eyy¡ayG thAr rkdghlilg gadgLjj¡ khww¡ mikffyhk.

PV = µRT myyJ $V = \frac{mRT}{P}$

,jidr rkdghL (8.48) ,y gu¡j¡a¡LkNghJ

$$W = mRT_f\left(1 - \frac{T_i}{T_f}\right) \qquad (8.49)$$

vdf f¡ilfFk.

PV tiugljjy> mOjjk khwh tisNfhlbwFf fNo css gugG> mOjjk khwh e¡fot¡dhy nraaggll NtiyfFr rkkhFk. glk 8.36 ,y fhllgglLss e¡oy¡lggll gFj¡ thAthy nraaggll NtiyfFr rkkhFk.

mOj¡jk; khwh e¡fot¡w¡fhd ntgg ,af¡ft¡ay; Kjy; tj¡j¡ia gd¡tUkhW vOjyhk;.

$$\Delta U = Q - P\Delta V \qquad (8.50)$$

,uzL nttNtW mOjjqfs; eilngWk mOjjk khwh e;foTfSffhd V - T tiuglk fNo fhllgglLssJ. ,twWs vee;foT cau mOjjjj;y eilngWk vdW fz lw;f.

j¡uT

eyy;ayG thAr rkdghlby;UeJ›

$$V = \left(\frac{mR}{P}\right)T$$

V – T tiuglk Mj;gGss; to;Nar nryYk Xu NeufNflhFk.

$$mjd\ rhaT = \frac{mR}{P}$$

V – T tiugljj;d rhaT› mOjjjj;wF vj;ut;fjj njhluGilaJ MFk. rhaT ngUkkhf ,Ugg;d› mOjjk Fiwthdjhfk. ,qF P_1 ,d rhaT P_2 it t;l mj;fk. vdNt $P_2 > P_1$.

T a;id x mrr;Yk V a;id y mrr;Yk itjJ ,ttiugljij tiuej;Uejhy› $P_2 > P_1$ Mf ,UfFkh? r;ej;jJ cdJ t;iliaf $Wf.

vLj¡Jf¡fhl¡L 8.20

27°C ntgge;iya;y css 1 Nkhy eyy;ayG thA 1 MPa mOjjjj;y cUis xdw;Ds miljJ itffgglLssJ. mjd gUkd ,UklqfhFk tiu mjid t;utila mDkj;jJ g;ddu foffzltwiwf fzff;Lf.

(a) (i) ,ggUk t;uT ntgggg;ukhwwk;yyh Kiwa;y elejhy› thAthy nraaggll Ntiy vdd?

(ii) ,ggUk t;uT mOjjk khwh Kiwa;y elejhy› thAthy nraaggll Ntiy vdd?

(iii) ,ggUk t;uT ntgge;iy khwh Kiwa;y elejhy› thAthy nraaggll Ntiy vdd?

(b) Nkwfzl %dW e;foTfs;Yk› vee;fot;y mf Mwwy;y ngUk khwwk milf;wJ kwWk vee;fot;y r;Wk khwwk VwgLf;dwJ.

(c) ,k%dW e;foTfSffhd PV tiugljij tiuaTk.

(d) ,k%dW e;foTfs;y vee;fot;y ntggk thATfF mj;f ntggk ms;ffgglbUfFk kwWk vee;fot;y thATfF Fiwthf ntggk ms;ffgglbUfFk?

$$g = \frac{5}{3}\ \text{kwWk}\ \ R = 8.3\ J\ mol^{-1}K^{-1}$$

j¡uT:

(a) (i) ntgggg;ukhwwk;yyh e;fot;y mikgg;dhy nraaggll Ntiy

$$W_{adia} = \frac{mR}{g-1}(T_i - T_f)$$

,Wj; ntgge;iy T_f lf fzlw;a ntgggg;ukhwwk;yyh e;iyrrkdghL.

$T_f V_f^{g-1} = T_i V_i^{g-1}$ lg gadgLjj Ntz Lk.

$$T_f = T_i\left(\frac{V_i}{V_f}\right)^{g-1} = 300\times\left(\frac{1}{2}\right)^{\frac{2}{3}}$$

$$= 0.63\times 300K = 189.8K$$

$$W = 1\times 8.3\times\frac{3}{2}(300-189.8) = 1.37\ \text{kJ}$$

(ii) mOjjk khwh e¤fot¤y mikgg¤dhy nraaggll Ntiy

$$W = P\Delta V = P(V_f - V_i)$$

NkYk $V_f = 2V_i$ vdNt $W = 2PV_i$ V¡lf fzff¤l› eyy¤ayG thAr rkdghlil njhlffe¤iyfFk gadgLjj Ntz Lk $P_iV_i = RT_i$

$$V_i = \frac{RT_i}{P_i} = 8.3\times\frac{300}{1}\times 10^{-6} = 24.9\times 10^{-4}m^3$$

mOjjk khwh e¤fot¤d NghJ nraaggll Ntiy $W = 2\times 10^6\times 24.9\times 10^{-4} = 4.9$ KJ

(iii)ntgge¤iy khwh e¤fot¤y mikgg¤dhy nraaggll Ntiy

$$W = mRT\ln\left(\frac{V_f}{V_i}\right)$$

ntgge¤iy khwh e¤fot¤y njhlff miw ntgge¤iy xU khw¤y¤ahFk.

vdNt $W = 1\times 8.3\times 300\times ln(2) = 1.7$ kJ

(b) ,k%dW e¤foTfisAk xgg¤lLg ghufFkNghJ mOjjk khwh e¤fot¤y nraaggll Ntiy› ngUkkj¤gigAk› ntgggukhwwk¤yyh e¤fot¤y nraaggll Ntiy r¤Wkj¤gigAk ngwWssd.

(c) ,k%dW e¤foTfSffhd PV tiugglk fNo fhllgglLssJ.

AB tisNahlbwFf fNo css gugG = mOjjk khwh e¤fot¤ty nraaggll Ntiy

AC tis NfhlbwFf fNo css gugG = ntgge¤iy khwh e¤fot¤y nraaggll Ntiy

AD tisNfhlbwFf fNo css gugG = ntgggu¤khwwk¤yyh e¤fot¤y nraaggll Ntiy

PV tiugljj¤y AB tisNfhlbwFf fNo css gugG kww tisNfhLfs¤d gugigt¤l mj¤fk. vdNt mOjjk khwh e¤fot¤y nraaggll Ntiy ngUkkj¤gigAk ntgggu¤khwwk¤yyh e¤fot¤y nraaggll Ntiy kj¤gigAk ngwWssd.

ntgggu¤khwwk¤yyh e¤fot¤y mikgg¤wF vtt¤jkhd ntggKk nryyt¤yiy mNjNghdW mikgg¤y¤UeJ vtt¤jkhd ntggKk nts¤NawTk ,yiy. ntge¤iy khwh e¤foTld xgg¤LkNghJ mOjjk khwh e¤fot¤y nraaggll Ntiy mj¤fk vdNt ntggKk mj¤fk.

gUkd; khwh e‰fo;T
(Isochoric process)

mikgg‰d gUkid khwh kj‰gghff nfhzL nraaggLk ntgg ,afft‰ay e‰foT gUkd khwh e‰foT vdW mioffggLk. ,ee‰fot‰y mOjjk› ntgge‰iy kwWk mf Mwwy Mf‰ait njhlueJ khwwkilAk.

gUkd khwh e‰fot‰wfhd mOjjk - gUkd tiuglk› mOjj mrRfF ,izahf tiuaggLk xU ,izf NfhlhFk.

gUkd khwh e‰fot‰wfhd e‰iyr rkdghlil g‰dtUkhW vOjyhk.

$$P = \frac{\text{æ}nR\text{ö}}{\text{ç}V\text{÷}\text{è}\text{ø}}T \qquad (8.51)$$

,j‰y‰UeJ mOjjk› ntgge‰iyfF (nfyt‰d) Neujjft‰y ,UfFk vd ehk mw‰ayhk. gUkd khwh e‰fot‰wfhd P-T tiuglk Mj‰gGss‰ to‰Nar nryYk Xu NeufNfhlhFk. (P_i,T_i) vdw njhlffgGss‰a‰y‰UeJ thA (P_f,T_f) vdw ,Wj‰gGss‰fF khwhggUkd‰y nryYkNghJ mikgG g‰dtUk rkdghlil e‰iwT nraf‰wJ.

$$\frac{P_i}{T_i} = \frac{P_f}{T_f} \qquad (8.52)$$

gUkd khwh e‰fot‰y›$\Delta V = 0$ vdNt W = 0 ntgg ,afft‰ay‰d Kjyt‰j‰ahdJ

$$\Delta U = Q \qquad (8.53)$$

vdW vOjggLf‰wJ.

,j‰y‰UeJ ehk mw‰tJ vddntdwhy mikgg‰wFf nfhLffggLk ntggk mf Mwwiy klLNk mj‰fu‰fFk. ,jd t‰isthf ntgge‰iy caUk NkYk mOjjKk mj‰fu‰fFk.

mikgG xdW khwh gUkd‰y jdJ ntggjij ntggk fljJk Rtu‰d %ykhf #oYfFf nfhLff‰wJ vd‰y› mikgg‰d mf Mwwy FiwAk. ,jd gadhf ntgge‰iy FiwAk. NkYk mOjjKk FiwAk.

vLj‰Jf‰fhl‰Lfs;

1. fNo css gljj‰y fhlbAssthW %lggll ghjj‰ujj‰y czT ghjj‰ujj‰d %b e‰uht‰ahdy r‰w‰J Nky Nehff‰jjssggLk. ,jwFfhuzk ghjj‰ujij %biafnfhzL %ba g‰dG gUkd xU khwh kj‰gg‰idgngWk ntggk njhlheJ ms‰ffggLkNghJ mOjjk mj‰fu‰fFk ,jdhy euht‰ Nky Nehff‰r nrdW %bia NkyNehff‰j jss Kawr‰fFk.

2. Nkhllhu irff‰s› fhu Nghdw jhd‰aqf‰ thfdqfs‰y css nglNuhy ,aej‰uk ehdF e‰foTfis Nkwnfhs Sk. Kjy‰y glk (a) y fhlbAssthW g‰]ld ntgggu‰khwwk‰yyh e‰fot‰d %yk xU Fw‰gg‰ll gUkDfFk RUqFk. ,uzlhtjhf glk (b) ,y fhlbAssthW (fhwW + vu‰nghUs) fyita‰d gUkid khw‰y‰ahf itjJfnfhzL ntggk nfhLffggLf‰wJ. ,jd t‰isthf

ntggepiyAk mOjjKk mjpfupfFk. ,J xU gUkd khwh epfothFk. %dwhtJ epfotpy glk (c) ,y fhlbAssthW ntggg gupkhwwkpyyh tpuT VwgLfpwJ. ehdfhtJ epfotpy glk (d) ,y fhlbAssthW gp]lid ,affhky gUkd khwh epfoT kzLk VwglL ntggk ntspNawwggLfpwJ.

vLj;Jf;fhl;L 8.21

500g eh› 30°C ntggepiyapy;UeJ 60°C ntggepiyfF ntggggLjjggLfpwJ vdpy eupd mf Mwwy khWghlilf fzffpLf. (,qF eupd tpuptpid Gwffzpffk NkYk eupd jdntgg VwGjjpwd 4184 Jkg^{-1}K^{-1})

jpuT

eupd ntggepiyia 30°C ,y ,UeJ 60°C fF caujJkNghJ VwgLk eupd tpuptid Gwffdpffpwhk. vdNt ,eepfotpid Xu gUkd khwh epfothff fUjyhk. gUkd khwh epfotpy nraaggLk Ntiy RopahFk. NkYk mspffggLk ntggkhdJ mf Mwwiy mjpfupggjwF klLNk gadgLjjggLk.

$$\Delta U = Q = ms_v\Delta T$$

eupd epiw = 500 g = 0.5 kg

ntggepiy khwwk = 30 K

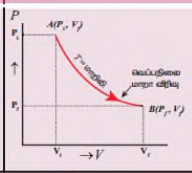
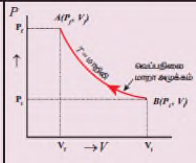
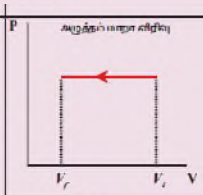
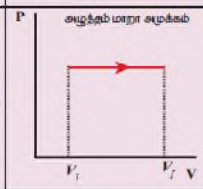
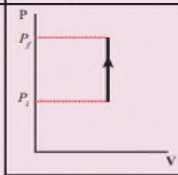
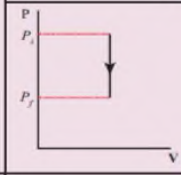
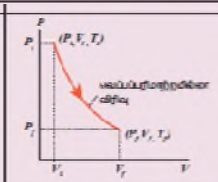
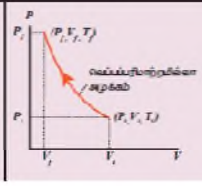
ntggk Q = 0.5 × 4184 × 30 = 62.76 KJ

Rowrp epfoT (Cyclic Process)

,ttif ntgg ,afftpay epfotpy› ntgg ,afftpay mikgG xU epiyapyUeJ njhlurrpahf khwwkileJ ,Wjpapy jdJ njhlff epiyia kzLk milAk. MikgG jdJ njhlff epiyiaNa kzLk miltjhy

gyNtW ntgg ,af;ftpay; epfoTfspd; RUf;fk;

t.vz;	epfoT		ntggk;	ntggepiy kwWk; mf Mwwy;	mOj;jk;
1.	ntggepiy khwh epfoT	tphpT	Q > 0	khwpy	FiwfpwJ
		mKffk	Q < 0	khwpy	mjpfhpffpwJ
2.	mOjjk khwh epfoT	tphpT	Q > 0	mjpfhpffpwJ	khwpy
		mKffk	Q < 0	FiwfpwJ	khwpy
3.	gUkd khwh epfoT		Q < 0	mjpfhpffpwJ	mjpfhpffpwJ
			Q < 0	FiwfpwJ	FiwfpwJ
4.	ntgggghpkhwwkpyyh epfoT	tphpT	Q = 0	FiwfpwJ	FiwfpwJ
		mKffk	Q = 0	mjpfhpffpwJ	mjpfhpffpwJ

	பருமன்	நிலைச் சமன்பாடு	செய்யப்பட்ட வேலை (நல்லியல்பு வாயு)	(PV – வரைபடம்
	அதிகரிக்கிறது	PV = மாறிலி	$W = \mu RT\, ln\left(\frac{V_f}{V_i}\right) > 0$	
	குறைகிறது		$W = \mu RT\, ln\left(\frac{V_f}{V_i}\right) < 0$	
	அதிகரிக்கிறது	$\frac{V}{T}$ = மாறிலி	$W = P[V_f - V_i] = P\Delta V > 0$	
	குறைகிறது		$W = P[V_f - V_i] = P\Delta V < 0$	
	மாறிலி	$\frac{P}{T}$ = மாறிலி	சுழி	 
	அதிகரிக்கிறது	PV^{γ} = மாறிலி	$W = \frac{\mu R}{\gamma - 1}(T_f - T_i) > 0$	
	குறைகிறது		$W = \frac{\mu R}{\gamma - 1}(T_f - T_i) < 0$	

mf Mwwy;y Vwgll khWghL Ro;ahFk. Rowr; e;fot;y mikgg;wFs ntggk nryYk> mNj NghdW mikgg;y;UeJk ntggk nts;NaWk. ntgg ,afft;ayd Kjy t;j;a;y;UeJ> mikgg;wF khwwggll njhFggad ntggk thAthy nraaggll Ntiyf Fr rkkhFk.

$$Q_{net} = Q_{in} - Q_{out} = W \text{ (Rowr; e;fot;wF)}$$

Rowr; e;fo;t;w;fhd PV **tiuglk;**

Rowr epfotpwfhd PV tiuglk xU %lggll tisNfhlhFk.

thAthdJ Rowr epfotpid Nkwnfhsfpwj vdffUJf. ,eepfotpy thA xU tpjT kwWk mKffjjpwFg gpdT jdJ njhlff epiyia milfpwJ.

gUkd V_1 ypUeJ V_2fF thA tpjtilAk NghJ thAthy nraaggll Ntiy W_1 vdf. ,tNtiy fhllgglLsss CBA tisNfhlbwFf fNo css gugGwFr rkkhFk.

gUkd V_2 typUeJ V_1 fF thA RUqFkNghJ thAtpd kJ nraaggll Ntiy W_2 vdf. ,tNtiy fhlbAssthW ADC tisNfhlbwFf fNo css gugGwFr rkkhFk.

,ej Rowr epfotpd %yk nraaggll njhFgad Ntiy = $W_1 - W_2$fhllgglLssd tisagghijapd eLNt css grir ewkplggll gugGwFr rkkhFk.

vdNt Rowr epfotpy nraaggll njhFgad Ntiy Ro myy. nghJthf njhFgad Ntiy NehfFwpapy myyJ vjhFwpapy ,UfFk.
njhFgad Ntiy NehfFwpapy ,Uggpd> mikggpdhy nraaggll Ntiy> mikggpd kJ nraaggll Ntiyia tpl mjpfkhf ,UfFk.

njhFgad Ntiy vjhfFwpapy ,Uejhy mikggpdhy nraagglhy Ntiy> mikggpd kJ nraaggll Ntiyiatplf Fiwthf ,UfFk.

NkYk Rowr epfotpy nraaggll njhFgad Ntiy NehFwpahf ,Uggpd ,eepfotpd tiuglk tyQRopahf mikAk. Rowr epfotpy nraaggll njhFgad Ntiy vjhfFwpahf ,Uggpd ,eepfotpd tiuglk ,lQRopahf mikAk.
css epfoT tyQRo jpirapy nraygLfpwJ.

vLjJf;fhl;L

ntgg ,afftpay mikggpd tiuglqfs gljjpy fhllgglLssd. xtnthU RwW epfotpwFkhd nkhjj Ntiyiaf fzffpLf.

jhT:
NehT a) %lgglllg ghijapd jpir ,lQRopahf cssJ. ,jpypUeJ> mikggpd kJ nraaggll Ntiy> mikggpdhy nraaggll Ntiyiatpl mjpfkhFk. BC tisNfhlbwFf fNo css gugG thAtpd kJ nraaggll Ntiyiaf nfhLfFk (mOjjk khwh mKffk). NkYk DA tisNfhlbwFf fNo css gugG mikggpdhy nraaggll nkhjj Ntiyiaf nfhLfFk.

BC tisNfhlbwFf fNo css gugG = nrttfk BC 12 tpd gugG = $1 \times 4 = -4$ J ,qF vjhfFw mikggpd kJ nraaggll Ntiyiaf Fwpffpwj.

DA tisfNfhlbwFf fNo css gugG = $1 \times 2 = +2$ J
RwW epfotpdhy nraaggll njhFgad Ntiy = $-4 + 2 = -2$ J

NehT (b): %lggll ghijapd jpir tyQRopahf cssJ. vdNt nraaggll Ntiyapd njhFgad kjpgG NehfFwpahFk. mikggpd kJ nraaggll Ntiy> mikggpdhy nraaggll Ntiyia tplf FiwthdJ vdgij ,jpypUeJ mwpayhk.

BC tisNfhlbwFf fNo css gugG thAtpd kJ nraaggll Ntiyiaf nfhLfFk (mOjjk khwh mKffk) NkYk AB tisNfhlbwFf fNo css gugG mikggpdhy nraaggll nkhjj Ntiyiaf nfhLfFk.

AB tisNfhlbwFf fNo css gugG =(BC12) nrttfjjpd gugG +(A B C)

KfNfhz jjpd gugG = $(1' 2)+\frac{1}{2}' 1' 2=+3J$

BC tisNfhlbwFf fNo css gugG nrttfjjpd gugG = $1\times 2=2J$

Rowrp epfotpy nraaggll njhFgad Ntiy =1J , J xU NehfFwp kjpgghFk.

NehT (c) %lggll ghijapd jpir ,lQRopahf cssJ. vdNt njhFgad Ntiy vjphfFwpahFk. mikggpd kJ nraaggll Ntiy mikggpdhy nraaggll Ntiyia tpl mjpfk vdW ,JfhlLfpwJ. AB tisNfhlbwFf fNo css gugG thAtpd kJ nraaggll Ntiyiaf nfhLfFk. (mOjjk khwh mKffk) NkYk CA tisNfhlbwFf fNo css gugG mikggpdhy nraaggll nkhjj Ntiyiaf nfhLfFk.

AB tisNfhlbwFf fNo css gugG = nrttfjjpd gugG =4 ' 1=-4J

CA tisNfhlbwFf fNo css gugG =nrttfjjpd gugG KfNfhz jjpd gugG = $(1' 2)+\frac{1}{2}' 1' 2=+3J$

RwWepfotpdhy nraaggll nkhjj Ntiy =-1J. , J xU vjphfFwp kjpgghFk.

ntgg ,afftpay; Kjy tpjpapd; tukGfs;

ntggk kwWk Ntiy ,it xdwpypUeJ kwnwhdwhf khwwkilAk jdikia ntgg ,afftpaypd Kjy tpjp rpwgghf tpsffpAssJ. Mdhy mit khwwkilAk jpirapid tpsfftpyiy.

vLj;Jf;fhl;lhf›

#lhd nghUSld› Fspnej nghUnshdiw ntggjnjhlhgpy itfFk NghJ ntggk vgNghJk #lhd nghUspypUeJ Fspnej nghUSfFg ghAk. ,jwF vjphjjpirapy ntggk ghahJ. Mdhy ntgg ,afftpaypd Kjy tpjpggb ntggk #lhd nghUspypUeJ Fspnej nghUSfNfh myyJ Fspnej nghUspypUeJ #lhd nghUSfNfh ga KbAk. Mdhy ,awifahfNt ntggk vgNghJk cah ntggepiyapypUeJ Fiwej ntggepiyfFjjhd ghAk.

fhhfspy css gpNufFfis mKfFk NghJ VwgLk cuhatpdhy fhh epdW tpLfpwj. cuhaTfF vjpuhf nraaggLk Ntiy ntggkhf khwwkilAk. Mdhy ,tntggk fhhpd ,aff Mwwyhf kzLk khwwkiltjpyiy. vdNt ntgg ,afftpaypd Kjy tpjp ngUkghdikahd ,awif epfoTfis tpsffgNghJkhdjhf ,yiy.

kls; epfo;T (Reversible process):

ntgg ,afftpay epfoT xdW› mJ eilngww ghijfF vjphjjpirapy nrayglL› mikgGk #oYk jdDila njhlff epiyia mila KbAkhdhy mjjifa ntgg ,afftpay epfoit ks epfoT vdW mioffyhk.

vLjJffhlL: knkJ ntggepiy khwh tphpT› RUstpyypy kpf nkJthf eilngWk mKffk kwWk tphpT.

kls; epfo;T eilngWtjw;fhd epgepjidfs;

1. ,rnrayKiw k‰f k‰f nkJthf eilngw Ntz Lk.

2. nrayKiw eilngwW KbAk tiu mikgGk› #oYk njhlheJ vej‰ut‰ay› ntggt‰ay kwWk Ntj‰a‰ay rke‰iya‰y ,Uff Ntz Lk.

3. cuhaT t‰ir› ghf‰ay t‰ir› k‰djil Nghdw Mwwy ,ogG VwgLjJk t‰irfs VJk ,Ufff$lhJ.

midjJ ks e‰foTfSk knkJ e‰foTfs jhd. Mdhy midjJ knkJ e‰foTfSk ks efoTfshf ,Uff Ntzba mtr‰ak‰yiy. vLjJffhllh› g‰]lid k‰f nkJthf mOjjk NghJ cUisa‰d RtUfFk› g‰]lDfFk ,ilNa cuhaT t‰ir ,Uejhy r‰w‰jsT Mwwy #oYfF ,offggLk. ,tthwwiy kzLk ngw ,ayhJ. vdNt ,J knkJ e‰fothf ,UejhYk ks e‰foT ,yiy.

k‰sh e‰foT (Irreversible process):

,awif e‰foTfs midjJk k‰sh e‰foTfshFk. ,jjifa e‰foTfis PV tiugljj‰y Fw‰ggl ,ayhJ. Vnddy k‰sh e‰fot‰d xtnthU flljj‰Yk mOjjk› ntgge‰iy Nghdwtww‰wF Fw‰ggll kj‰gG ,UffhJ.

ntgg ,aff t‰ay e‰foT xdw‰d Mwwy khwhjjdikffhd $wNw› ntgg ,aff t‰ay‰d Kjy t‰j‰ahFk. vLjJffhllhf› #lhd nghUnshdiw Fs‰hrr‰ahd nghUs‰d kJ itfFk NghJ› ntgg Mwwy #lhd nghUs‰y‰UeJ Fs‰hrr‰ahd nghUSfF ghaf‰wJ. Vd ntggk Fs‰hrr‰ahd nghUs‰y‰Uej #lhd nghUSfF ghat‰yiy? Fs‰hrr‰ahd nghUs‰y‰UeJ #lhd nghUSfF ntgg Mwwy ghatijAk ntgg ,aff t‰ay‰d Kjy t‰j‰ mDkj‰ff‰wJ. vLjJffhllhf 5 J Mwwy #lhd nghUs‰y‰UeJ #lhd nghUSfF ghaejhYk njhFgad mikgg‰d nkhjj Mf Mwwy khwhJ. Mdhy 5 J ntggk Fs‰hrr‰ahd nghUs‰y‰UeJ ntggkhd nghUSfF vgNghJk ghahJ.

,awifahfNt ,J Nghdw e‰foTfs xU j‰ira‰d klLNk eilngWk. vj‰hjj‰ira‰y eilngWtj‰yiy. ,ee‰foTfs vejj j‰ira‰y eilngww‰hYk mikgg‰d nkhjj Mwwy khwhky ,UfFk. ,Ugg‰Dk vj‰hj‰ira‰y ,ee‰foT eilngwhJ vdgij ,qF ftd‰ff Ntz Lk. ntgg ,aff t‰ay‰d Kjy t‰j‰ xU ,awif e‰foT vj‰hjj‰ira‰y Vd eilngWtj‰yiy vdgjwfhd t‰sffjijf nfhLfft‰yiy.

vdgjwfhd t‰sffjijf nfhLfft‰yiy.

gj‰ndllhk E}wwhzbd mw‰t‰ay Nkijfs vj‰hjj‰ira‰y xU e‰foT eilngwhjjwfhd t‰sffjijf nfhLff Kidejhhfs. mjd gadhf ,awifa‰d xU Gj‰a t‰j‰a‰idf fzlw‰ejhhfs. mJjhd ntgg ,aff t‰ay‰d ,uzlhk t‰j‰. ,ej ,uzlhk t‰j‰a‰dgb ntggk vgNghJk #lhd nghUs‰y‰UeJ Fs‰hrr‰ahd nghUSfFj jhdhfNt ghAk ,jid ntgg ,aff t‰ay‰d ,uzlhk t‰j‰a‰d f‰shr‰a] $wW vdW miogghhfs.

vLj‰Jf‰fhl‰L:
k‰sh nrayKiwffhd r‰y vLjJffhlLfisf $Wf.
,awifahf eilngWk midjJ e‰foTfSk k‰sh e‰foTfs MFk r‰y Mht%lLk vLjJffhlLfis ,qF fhzNghk.

1. thA miljJ itffggll FLitia j‰wejTld› FLita‰y ,Uej thA %yf$Wfs nkJthf miw KOtJk gu Tf‰dwd. mit kzLk FLitfF tUtj‰yiy.

2. Ngdh ikjJs nrhlL xdiwj jzzhy tLkNghJ› ikjJs jzzhy nkJthf guTk. ,ej guta ikjJs kzLk xdW NruhJ.

3. rwNw caukhd ,ljjyUeJ tOk nghUs jiuia milej cld› nghUsd nkhjj ,aff Mwwy jiuad %yf$Wfsd ,aff Mwwyhf khwwkilfwJ. mjy xU rWgFj xy Mwwyhf ,offggLfwJ. jiuad Mwwiy kzLk xdwizjJ nghUs jhdhfNt NkNy nryy ,ayhJ.

ntgg ,afftayd Kjy tjjadgb NkNy $wggll midjJ eforrfSk vjhjjjiray elffTk rhjjaKzL. Mdhy ntgg ,afftayd ,uzlhk tjj ,eeforrfis vjhjjjiray elff mDkjffhJ. ,awifad Kffa tjjfsy ntgg ,afftayd ,uzlhk tjjAk xdwhFk. ,ttjj ,awif efoTfs eilngWk jjiria jhkhdffwJ.

ntgg ,aejuk (Heat Engine)
,ej etd njhoyElg cyfy› NghfFtujjy jhdaqfj ,aejuqfsd gqF KffajJtk thaejjhFk. Nkhllhh irffjsfs kwWk fhhfsy ,aejuqfs cssd. mit nglNuhy myyJ Briy cssllhfg ngwWf nfhzL rffuqfis RowWk Ntiyiar nrafjdwd. ngUkghdikahd ,aejuqfsd gaDWjwd 40% Nky ,yiy. ,aejuqfsd gaDW jwDffhd mbggil flLgghLfis ntgg ,afftayd ,uzlhk tjjjhd jhkhdffwJ. vdNt ,uzlhk tjjajdg GhjeJ nfhss› ntgg ,aejuqfisg GhjeJ nfhstJ mtrjakhFk.

Njfjf (Reservoir):
kjf mjfkhd ntgg VwGjjwd nfhzl ntgg ,afftjay mikgG vdW ,jid tiuaWffyhk. NjffjayUeJ ntggjij vLjjhYk myyJ NjffjfF ntggjij msjjhYk Njffjad ntggejiy khwhJ.

vLjJfjfhljL:
xU lksh #lhd eiu› Vhj ehy Cwwjdhy Vhjad ntggejiy cauhJ. ,qF ,ej Vhjaid Njffjahff fUjyhk.

xU Ftisay css #lhd Njeh jwej ntsjay cssNghJ mJ #oYld ntggr rkejiyia milfwJ. Mdhy #oyjd ntggejiyay Fwggljjff vej khwwKk Vwgltyiy. vdNt #oiy ,qF Njffjahff fUjyhk.
ntgg ,aejujij gjdtUkhW tiuaiw nraayhk.

ntggjij csslhfg ngwW› Rowrj efoit Nkwnfhstjd %yk mtntggjij Ntiyahf khwWk xU fUtjNa ntgg ,aejuk MFk xU ntgg ,aejujjwF %dW gFjfs cssd mit

1. ntgg %yk
2. nraygLnghUs
3. ntgg Vwgj

xU ntgg ,aejujjjd jll tiuglk
1. ntgg %yk ,J ,aejujjwF ntggjij msjfFk. ,jid vgNghJ cah ntggejiyaNyNa T_H itjjjUff NtzLk.

2. nraygL nghUs - ,J thA myyJ jzzh Nghdw xU nghUshFk. ,J msjffggLk ntggjij Ntiyahf khwWk.

   ntgg ,aejujjwfhd Xh vsja cjhuzk euhtj ,aejukhFk. goqfhyjjjy ,uay tzbfis ,aff ,eeuhtj ,aejuk gadgllJ. ,jy nraygL nghUshf jzzh gadgllJ. ,J vhAk eyffhjayUeJ ntggjij ngwW

eiu euht ahf khwWk. ,ej euht ,ua y t z ba d rffu j i j r roww ,ua y t z b i a ,afFk.

ntgg Vwg ntgg ,aej uk N t i y nraj g d r w jsT ntgg j i j (Q_L) ntgg Vwg fF nfhLfFk. ,j i d vgNghJk jho ntgge i ya NyNa (T_L) i t j j Uff N t z Lk.

vLjJffhllhf› jhd aqf ,aej uqfs y ntgg Vwg ahf nraygLtJ miwntgge i ya Yss RwWgGwr #oyhFk. jhd aqf ,aej uk iryd]rh (G i fNghff) to ahf ntgg j i j RwWGwj j wF nts NawWk ntgg RwWGwj j wF nts NawWk. ntgg ,aej uk Rowr e fot y (Cylic process) nraygLf wJ.

miwntgge i ya Yss RwWGwr #oyhFk. jhd aqf ,aej uk iryd]rh (G i fNghff) to ahf ntgg j i j RwWGwj j wF nts NawWk. ntgg ,aej uk Rowr e fot y (Cylic process) nraygLf wJ. Rowr e foT KbAww g d dh ntgg ,aej uk njhlff e i yfF tUk. ntgg j i j nts Naww a g dG ntgg ,aej uk xU RwW KbeJ mjd njhlff e i yfF tUtjhy ntgg ,aej u j j d mf Mwwy khwwk Ro ahFk. ($\Delta U = o$)
xU Rowr e fot y nraaggll N t i yfFk (nts aL) VwWfnfhssggll ntgg j j wFk (c ssL) c ss t f jk ntgg ,aej u j j d gaDW j wd vd t iuaiw nraaggLf wJ.

nraygL nghUnshdW ntgg %y j j y UeJ $Q_H$myF ntgg j i j g ngwW W myF N t i y nraj g d› mJ ntgg Vwg fF ms j j ntggk $Q_L$myF vdf.

c ssL ntggk = nraaggll N t i y + nts Nawwggll ntggk

$$Q_H = W + Q_L$$

$$W = Q_H - Q_L$$

vdNt ntgg ,aej u j j d gaDW j wd

$$h = \frac{nts\,aL}{c\,ssL} = \frac{W}{Q_H} = \frac{Q_H - Q_L}{Q_H}$$

$$h = 1 - \frac{Q_L}{Q_H}$$

,qF Q_H, Q_L kwWk W ,i t m i d j Jk NehFw ahf c ssi j ,qF f t d ffTk. ,ej Fw alL K i wi ajhd ehk ,qF g dgww N t z Lk.

,qF Q_L< $O_H$vdgjhy gaDW j wd vgNghJk 1 I t lf F iwthfNt ,UfFk. ,j y UeJ Vwffggll ntggk KOikahf N t i yahf khwwkilat yiy vdgij GH eJ nfhssyhk. ntggk KOikahf N t i yahf khWtjwF r y mbggilf flLgghLfis ntgg ,afft ay d ,uzlhkt j ms ff wJ. ntgg ,afft ay ,uzlhk t j a d ntgg ,aej uf$wW myyJ nfyt d /g shqf $wiw g d tUkhW t iuaiw nrayhk.

nfy t d; /g shq f; $wW

xU Rowr ntgg e fot y (Cyclic Process) Vwfggll ntggk KOt i jAk N t i yahf khwWk vej xU ntgg ,aej u j i jAk ehk tbtikff ,ayhJ.

,f$ww y UeJ 100% gaDW j wd nfhzl vej xU ntgg ,aej uKk ,gg ugQrj j y rhj j ak ,y i y vdgij ehk mw eJ nfhssyhk.

ntgg ,afft ay d Kjy t j a dgb› ntgge i y khwh e fot y. nfhLffggll ntggk KOtJk N t i yahf khwwkilf wJ. (Q = W) vd y ntgg ,afft ay d

,uzlhk tjpad $wWfF Kuzhf cssjh? ,yiy. Vnddpy ntggepiy khwh tpT vdgJ xU Rowrp epfoT ,yiy (Non – Cyclic prosess) ,eepfoTfspd klLNk ntggk KOikahf Ntiyahf khwwkilfpwJ. Mdhy ntgg ,afftpaypd ,uzlhk tpjpad gb Rowrp epfotpy (Cyclic Process) eilngWk epfoTfspy nfhLffggll ntggjpy xU Fwpggpll msT klLNk Ntiyahf khwwkilfpwJ $(h<100\%)$"vdNt midjJ ntgg ,aejpuqfSk Rowrp epfotpy ,aqFtjhy nfhLffggll ntggjij KOikahf Ntiyahf khwWtjpyiy.

vLj;Jf;fhl;L:
xU ntgg ,aejpuk mjd Rowrp epfotpd NghJ 500 J ntggjij ntgg%yjjpypUeJ ngwWfnfhzL xU Fwpggpll Ntiyia nraj gpddh 300 J ntggjij #oYfF (ntgg Vwgpff) nfhLffpwJ. ,eepgejidfspdgb mej ntgg ,aejpujjpd gaDW jpwidf fhzf.
jhT:
ntgg ,aejpujjpd gaDWjpwd

$$\eta = 1 - \frac{Q_L}{Q_H}$$

$$\eta = 1 - \frac{300}{500} = 1 - \frac{3}{5}$$

$$\eta = 1 - 0.6 = 0.4$$

ntgg ,aejpujjpd gaDWjpwd 40% ,jypUeJ ntgg ,aejpuk nfhLffggll ntggjjpy 40% klLNk Ntiyahf khwwpAssJ vdgij mwpayhk.

fhhNdh ,ylrpa ntgg ,aejpuk; (Carnot's Ideal heat engine):
xU ntgg ,aejpujjpd gaDWjpwd 100% ,yiy vd Kejpa gphtpy ehk gapdNwhk. mtthW ,UfFk glrjjpy xU ntgg ,aejpujjpd mjpfglr gaDWjpwd vdd? 1824 Mk MzL fhhNdh vdw gpnuQR nghwpahsh› ntggKyk kwWk ntgg Vwgpff SffpilNa RwW nrayKiwapy nraygLk. ks epfoT ntgg ,aejpuk (Reversible heat engine) mjpfglr gaDWjpwidg ngwwssJ vd ep&gpjjhh. ,ej ,aejpuNk fhhNdh ,aejpuk vdW mioffggLfpwJ.

,uzL ntggepiyfSffpilNa Rowrp epfothf› nraygLk ksepfoT ,aejpuk fhhNdh ,aejpukhFk.

fhhNdh ,aejpuk ehdF Kffpagghfqfisg ngwWssJ. mit gpdtUkhW.

1. **ntgg %yk;** khwh cahntggepiyapy css ntgg %ykhFk. ,jypUeJ ntggepiykhwhky vttsT ntggjijAk ngw KbAk.
2. **ntgg Vwg;** khwhj Fiwej ntggepiyapy css xU nghUshFk. ,J vttsT ntggjijAk VwWfnfhsSk.
3. **ntggf;fhgG Nkil:** KOikahd ntggf fhgG nghUspdhy ,kNkil nraaggLbUfFk. ,kNkil topNa ntggk fljjgglhJ.
4. **nraygLk; nghUs:** KOikahd ntggk fljjhj RthfisAk KOikahd ntggk fljJk mbgghfjijAk nfhzLss cUisapy

milJ itffgglLss eyy;ayG thAthFk. ntggf fljjh kwWk cuhatww g;]ld xdW cUisAld nghUjjgglLssJ.

fhhNdh RwW:

fhhNdh Rww; nrayghL nghUs ehdF njhlhrr;ahd ks e;foTfis Rowr; Kiwa;y e;fojJf;wJ.

nrayghL nghUs;d njhlff mOjjk kwWk gUkid P_1, V_1vdf.

e;foT A → B (P_1, V_1, T_H) Kjy (P_2, V_2, T_H) tiua;yhd knkJ ntgge;iy khwh e;foT: cUis ntgg %yjj;d kJ itffggLf;wJ. ntggk ntgg %yjj;y;UeJ cUisa;d mbggugg;d to;Na nraygL nghUSfF (eyy;ayG thAfF) ghaf;wJ. ,J xU ntgge;iy khwh e;fothFk. vdNt nraygL nghUs;y mf Mwwy vtt;j khwwKk VwglhJ. ngwggll ntggjj;dhy thAt;d gUkd mj;fh;fFk. g;]lid k;f nkJthf NkNy tUtjwF mDkj;ff Ntz Lk. (knkJ e;fot;d mbggila;y) thAt;d gUkd V_1 y;UeJ V_2 fF mj;fh;fFk. mjd mOjjk P_1y;UeJ P_2fF FiwAk NghJ thAt;dhy nraaggll Ntiy W vdf. ,J PV-tiugljj;y ABghijahf Fw;ffgglLssJ.

thAt;dhy nraaggll Ntiy

$$Q_H = W_{A\to B} = \int_{V_1}^{V_2} P\,dV$$

,ee;foT knkJ e;fothf cssjhy eyy;ayG thA mjd ,Wj; e;iyia milAk tiu ntgg%yjJld rke;iya;y ,UfFk.

ntgge;iy khwh t;ht;dhy nraaggll Ntiy rkdghL Fw;gglgglLssJ.

$W_{A\to B} = nRT_H \ln\left(\frac{V_2}{V_1}\right) = AB$ tis NfhlbwFf fNo css gugG ,J fhllgglLssJ.

e;foT B → C (P_2, V_2, T_H) Kjy (P_3, V_3, T_L) tiua;yhd knkJ ntgggh;khwwk;yyh t;hT.

cUis ntggffljjh Nkil kJ itffggLf;wJ g;]lid Nky Nehff; efu mDkj;ff Ntz Lk. thA ntgggh;khwwk;yyh Kiwa;y t;ht;iltjhy mjd gUkd V_2y;UeJ V_3fF mj;fh;fFk mjd mOjjk P_2t;y;UeJ P_3fFf FiwAk ntgge;iy T_LMFk. PV tiugljj;y ,ej ntgggh;khwwk;yyh t;hT BC tisNfhlhf fhllgglLssJ. ,ej ntgggh;khwwk;yyh e;foT knkJ e;fothf eilngwwjhy› eyy;ayG thA ,ee;foT KOtJk rke;iya;y ,UfFk. NkYk ,J xU ks e;foT vdgijAk ,J fhlLf;wJ.

rkdghL ,UeJ ntgggh;khwwk;yyh t;ht;dhy thAthy nraaggll Ntiy

$$W_{B\to C} = \int_{V_2}^{V_3} PdV = \frac{\mu R}{\gamma - 1}[T_H - T_L] = BC$$

tisNfhlbwFf fNo css gugG

e;foT C → D

(P_3, V_3, T_1) Kjy (P_4, V_4, T_L) tiua;yhd knkJ ntgge;iy khwh mKffk fhllgglLssJ.

cUis› ntgg Vwg;a;d kJ itffggLf;wJ. thAt;d mOjjk P_4 kwWk mjd gUkd V_4l milAk tiu thA ntgge;iy khwh mKffjj;wF clgLf;wJ. ,J PV tiugljj;y CD tisNfhlbdhy Fw;gglgglLssJ.

$$\therefore W_{C\to D}=\int_{V_3}^{V_4} PdV=\mu RT_L \ln\left(V_4/V_3\right)=-\mu RT_L \ln\left(\frac{V_3}{V_4}\right)$$

=-CD tisNfhlbwFf fNo css gugG

,ej ntgggghpkhwwkpyyh mKffjjpYk thAtpd kJ nraaggll Ntiy vjphfFwpahFk.
fhllgglLssJ.
nraygL nghUspd kJ xU KO Rwwpy nraaggll njhFgad Ntiy W vdf.
W = thAthy nraaggll Ntiy – thAtpd kJ nraaggll Ntiy
$= W_{A\to B} + W_{B\to C} - W = W_{C\to D} - W_{D\to A}$

,qF $W_{B\to C} = W_{D\to A}$
$W = W_{A\to B} - W_{C\to D}$
KO RwWfF fhhNdh ,aejpujjhy nraaggll njhFgad Ntiy
$W = W_{A\to B} - W_{C\to D}$
xU KO RwWfF nraygL nghUshy (eyypayG thA) nraaggll njhFgad Ntiy PV tiugljjpy css ABCD vdw %lggll tisNfhlbdhy #oggll guggpwFr rkk vdgij rkdghL fhlLfpwJ.

kpf Kffpakhf ftdpff Ntzba xdW› xU KO RwWfFg gpddh nraygL nghUs jdJ njhlff ntggepiy T_Hl milfpwJ. ,jypUeJ ehk mwpeJ nfhstJ vddntdwhy xU KO RwWfFggpddh nraygL nghUspd (eyypayG thAtpd) mf Mwwy khWghL Ropvdgjhfk.

fhhNdh ,aejpujjpd gaDWjpwd;
xU KO RwWfF nraygL nghUspdhy (eyypayG thA) nraaggll NtiyfFk› ntgg %yjjpypUeJ ngwggll ntggjjpd msTfFk css tpfjk fhhNdh ,aejpujjpd gaDWjpwd vdW tiuaWffggLfpwJ.

$$h=\frac{\text{nraaggll Ntiy}}{\text{ngwggll ntggk}}=\frac{W}{Q_H}$$

ntgg ,afftpaypd Kjy tpjpapypUeJ
$W = Q_H - Q_L$
$\therefore h=\frac{Q_H - Q_L}{Q_H}=1-\frac{Q_L}{Q_H}$
ntggepiy khwh epfotpd epgejidia gadgLjJk NghJ

$$Q_H=\mu RT_H \ln\left(V_2/V_1\right)$$
$$Q_L=\mu RT_L \ln\left(V_3/V_4\right)$$

vdg ngwyhk.
,qF Q_L y vjphfFwpahy ehk Fwpggl tpyiy. Vnddpy ntgg VwgpfF ntspNawwpa ntggjjpd vzzstpwF klLNk Kffpajjtk mspffggLfpwJ.

$$\therefore \frac{Q_L}{Q_H} = \frac{T_L \ln\left(V_3/V_4\right)}{T_H \ln\left(V_2/V_1\right)}$$

ntgggh‰khwwk‰yyh e‰fot‰d e‰gejidia gadgLjJk NghJ

$$T_H V_2^{g-1} = T_L V_3^{g-1}$$

$$T_H V_1^{g-1} = T_L V_4^{g-1}$$

,ttuzL rkdghLfiAk tFffk NghJ

$$\left(\frac{V_2}{V_1}\right)^{g-1} = \left(\frac{V_3}{V_4}\right)^{g-1}$$

vdf f‰ilfFk ,j‰y‰UeJ

$$\frac{V_2}{V_1} = \frac{V_3}{V_4}$$

vd mw‰ayhk.

$$\frac{Q_L}{Q_H} = \frac{T_L}{T_H}$$

vdf f‰ilfFk

gaDWj‰wd $h = 1 - \frac{T_L}{T_H}$

Fw‰gG: $T_L$kwWk T_H,ttuzLk nfyt‰d myf‰y klLNk Fw‰ffggLf‰dwd.

Kf;f‰a KbTfs;

1. ŋ vgnghOJk 1 I t‰lf Fiwthf ,UfFk. Vnddy T_L MdJ T_H I t‰lf FiwT› ,j‰y‰UeJ ehk mw‰eJfnfhstJ vddntdwhy gaDWj‰wd vgNghJk 100% ,UffhJ. T_L=OK (Ro‰ ntgge‰iy) ntgg e‰iya‰y cssNghJ klLNk gaDWj‰wd 1 myyJ 100% MFk. ,J eilKiwa‰y rhjj‰akwwjhFk.

2. fhhNdh ,aej‰ujj‰d gaDWj‰wd› nraygL nghUisr rhhejjyy. ,J ntgg %yk› ntgg Vwg‰ ,tww‰d ntgge‰iyfisr rhhejjhFk. ,ttuzbd ntgge‰iyfs‰d NtWghL ngUknkd‰y› gaDWj‰wDk ngUkkhf ,UfFk.

3. $T_H = T_L$vdw ŋ = 0 e‰iya‰y vdNt vej xU ,aej‰uKk ntgg %yKk› ntgg Vwg‰Ak xNu ntgge‰iya‰y css NghJ ,aqfhJ.

4. fhhNdh Rww‰d midjJ e‰foTfSk ks e‰foTfshFk. vdNt fhhNdh ,aej‰uk xU ks ntgg ,aej‰ukhFk (Reversible heat engine). vdNt mjd gaDWj‰wDk ngUkkhFk. Mdhy eilKiwa‰y css Bry ,aej‰uk› nglNuhy ,aej‰uk kwWk euht‰ ,aej‰uqfSk RwW e‰fot‰y ,aqFf‰dwd. Mdhy mit KOikahd ks ntgg ,aej‰uqfs myy. vdNt mtww‰d gaDWj‰wd› fhhNdht‰d gaDWj‰widt‰lf FiwthfNt ,UfFk. ,jidf fhhNdh Njwwjijf nfhzL tiuaiw nraayhk.

"khwh ntgge‰iya‰Yss ,uzL ntgg%yqfSff‰ilNa› fhhNdh ,aej‰uk klLNk ngUk gaDWj‰widg ngww‰UfFk. kww midjJ ,ayG ,aej‰uqfs‰d gaDWj‰wDk› fhhNdh ,aej‰ujj‰d gaDWj‰widt‰lf FiwthfNt ,UfFk'.

vLj;Jf;fhl;L:

250°C ntgge;iya;Yss euht; ,aej;ujijg gadgLjj; jzzh euht;ahf khwwggLf;wJ. euht;a;dhy Ntiy nraaggl;L› #oYfF 300 K ntgge;iya;y ntggk nts;NawwggLf;wJ. vd;y› euht; ,aej;ujj;d ngUk gaD}W j;widf fhzf.

jhT:

euht; ,aej;uk fhhNdh ,aej;uk myy. Vndd;y euht; ,aej;ujj;y nraaggLk Rowr; e;foTfs midjJk KOikahd ks e;foTfs myy. ,Ugg;Dk ,jid xU fhhNdh ,aej;uk vdffUj; mjd ngUk gaDWj;widf fzff;lyhk.

$$h = 1 - \frac{T_L}{T_H} = 1 - \frac{300K}{523K} = 0.43$$

euht; ,aej;ujj;d ngUk gaDWj;wd 43% MFk. nfhLffggll ntggjj;y 43% klLNK gadjUk Ntiyahf khwwggLf;wJvdgij ,J fhlLf;wJ. kjKss 57% ntggk nts;NawwggLf;wJ. Mdhy eilKiwa;y e;uht; ,aej;ujj;d gaDWj;wd 43% t;lf FiwthFk.

vLj;Jf;fhl;L:

A kwWk B vdw ,uzL fhhNdh ,aej;uqfs nttNtW ntgge;iya;y nraygLf;dwd.

A fhhNdh ,aej;ujj;d ntgg %yk kwWk ntgg Vwg;a;d ntgge;iyfs KiwNa 150°C kwWk 100°C ,NjNghdW B ,aej;ujj;wF 350°C kwWk 300°C ,twWs vej ,aej;ujj;d gaDWj;wd FiwthdJ?

jhT:

A ,aej;ujj;d gaDWj;wd $= 1 - \frac{373}{423} = 0.11$

A ,aej;ujj;d gadWj;wd 11% MFk.

B ,aej;ujj;d gaDWj;wd $1 - \frac{573}{623} = 0.08$

B ,aej;ujj;d gaDWj;wd 8% klLNk.

,uzL ,aej;uqfs;Yk css ntgg %yk kwWk ntgg Vwg;a;d ntgge;iy NtWghLfs rkkhf ,UejhYk mtww;d gaDWj;wdfs rkk;yiy. Vndd;y gaDWj;wd ntgge;iyfs;d t;fjjijr rhhejit› NtWghlilr rhhejjyy. vej ,aej;uk Fiwej ntgge;iya;y ,aqFf;wNjh mjd gaDWj;wd ngUkkhf ,UfFk.

fhh;y gadgLjjggLk Bry ,aej;uqfs kwWk Nkhllhh thfdqfs;y gadgLjjggLk nglNuhy ,aej;uqfs› Mf;aitmidjJk eilKiw ntgg ,aej;uqfs. Bry ,aej;ujj;d gaDWj;wd mj;f glrkhd 44% MFk. nglNuhy ,aej;ujj;d ngUk gaDWj;wd 30% MFk. vndd;y ,it ey ,ayG ,aej;uqfs (fhhNdh ,aej;uqfs) myy. ,tww;d gaDWj;wd ntgg ,afft;ay;d ,uzlhk t;j;ahy flLggLjjggLf;wJ.

jwfhyjj;y Nkhllhh irff;s xdW 1 L nglNuhYfF 50 km njhiyT gaz;ff;wJ. mjhtJ 1L nglNuhy;y 30% klLNk ,aej;u Ntiyahf khwwkilf;wJ. kjKss 70% nglNuhy gadww ntggkhf #oYfF nts;NawwggLf;wJ.

vdlNuhg (Entropy) **kwWk ntgg ,afftayd ,uzlhk tjp:**

rkdghL yUeJ $\frac{Q_H}{T_H}=\frac{Q_L}{T_L}$ vdW mweNjhk. $\frac{Q}{T}$ vdw ,ej msT vdlNuhg vdW mioffggLfwj. ntgg ,afftay mikggd kf Kffaggz Gfsy xdW vdlNuhg MFk. ,J xU eiy khw MFk. $\frac{Q_H}{T_H}$ vdgJ ntgg %yjjyUeJ fhhNdh ,aejuk ngwWfnfhzl vdlNuhg> vdgJ fhhNdh ,aejuk ntgg Vwgf F ntsNawwa vdlNuhg MFk. xU ks efoT ,aejujjwF (fhhNdh ,aejuk) ,ttuzL vdlNuhg fSk rkkhFk. vdNt xU KO RwWfF fhhNdh ,aejujjd vdlNuhg khwwk RoahFk. ,J rkdghL e&gffgglLssJ. Bry kwWk nglNuhy ,aejuqfs Nghdw eilKiw ,aejuqfs ks efoT ,aejuqfs myy. mit vdw rkdghlil eiwT nrafdwd. ,jd mbggilay ntgg ,afftayd ,uzlhk tjpia NtW tifay $wyhk.

",awifay eilngWk midjJ nrayKiwfsYk (kshefoTfs)> vdlNuhg vgNghJk mjfhfFk. ks efoTfsy klLNk vdlNuhgad kjgG khwhJ. ,awif efoTfs eilngWk jpiria vdlNuhgjhd jhkhdffwJ.

ehk kzLk vwnfdNt Nfll tdhtwF tUNthk.

Vd ntggk vgNghJk cah ntggeiyaYUeJ Fiwej ntggeiyfFg ghafwJ? Vd vjhjjpiray ghatjyiy? Vnddy ntggk #lhd nghUsyUeJ> Fshej nghUSfF ghAkNghJ vdlNuhg caUk. ntggk FshejnghUsyUeJ #lhd nghUSfF ghAk NghJ vdlNuhg FiwAk. mtthW vdlNuhg FiwtJ ntgg ,afftayd ,uzlhk tjfF vjuhdJ.

vdlNuhgia xU mikggy ,UfFk "xOqfwwj jdikad mstL" vdWk mioffyhk. midjJ ,awif efoTfs eilngWk nghOJk xOqfwwjjdik vgNghJk caheJnfhzNl nryYk.

thA miljJ itffgglLss fzzhbf FLit xdiwf fUJf. FLitad csNs thA ,UfFk tiu mjd xOqfwwjjdik FiwT. mtthW miw KOtJk gutpa gdG mjd xOqfwwjjdik mjfhfFk. NtWtifay $WNthkhad thA fzzhb FLitay ,UfFk tiu mjd vdlNuhg FiwT> mNj thA miw KOtJk gutpa gddh mjd vdlNuhg mjfk. thA %yf$Wfs FLitfF kzLk tejhy vdlNuhg FiwAk. ntgg ,afftayd ,uzlhk tjpadgb ,ej efoT rhjjpakyy. ,Nj tsffk jzzhy guTk ikfFk nghUeJk. Ngdh ik jzzhy gutpaTld mjd vdlNuhg mjfhfFk. gutpa Ngdh ik %yf$Wfs kzLk xdwizeJ ikjJspia cUthffhJ. midjJ ksh efoTfsYk vdlNuhg caUk tzzk ,awif efoTfs eilngWfdwd.

Fshrhjdg nglb (Refrigerator):

vjhjpiray nraygLk xU fhhNdh ,aejuNk Fshrhjdg nglbahFk. nraygLnghUs $T_L$vdw Fiwej ntggeiyaYss Fsh nghUsyUeJ (ntgg Vwg) $Q_L$msT ntggjij ngwWf nfhsfwJ. mKffadhy (Compressor) nghUsd kJ W vdw Fwggll msT Ntiy nraaggll> $Q_H$msT ntggjij ntgg %yjjwF nraygL nghUs ntsNawWfwJ. mjhtJ $T_H$ntggeiyaYss #oYfF ntsNawWfwJ.
,ij Fshrhjdgnglbf F gffjjy ewFkNghJ ntJntgghd fhwiw czuyhk. ntgg ,afftayd Kjy tjpaYUeJ

$$Q_L + W = Q_H$$

Kbthf Fsphrhjdgnglb NkYk Fsphrrp milfpwJ. #oy (rikayiw) myyJ (tspkzlyk) ntggkilfpwJ.

nrayjpwd; Fzfk; (Coefficient of Performance) (COP)

Fsphrhjdg nglbapd nrayjpwid mstpLtJ nrayjpwd FzfkhFk (COP). FsphnghUspypUeJ ngwggll ntggjjpwF (ntgg Vwgp) mKffapdhy nraaggll Gw NtiyfFk (W) css jfT nrayjpwd Fzfk vdW tiuaWffggLfpwJ.

$$COP = b = \frac{Q_L}{W}$$

rkdghL ,UeJ

$$b = \frac{Q_L}{Q_H - Q_L}$$

$$b = \frac{1}{\frac{Q_H}{Q_L} - 1}$$

Mdhy ehk mwpejgb $\frac{Q_H}{Q_L} = \frac{T_H}{T_L}$

,rrkdghlbid gpujpapLkNghJ gpdtUk rkdghlbidg ngwyhk.

$$b = \frac{1}{\frac{T_H}{T_L} - 1} = \frac{T_L}{T_H - T_L}$$

Fsphrhjdg nglbapd nrayjpwd Fzfjjpypl;UeJ gpdtUtdtwiw ehk mDkhdpffyhk.

1. COP mjpfkhf ,Uejhy Fsphrhjdg nglb rpwgghf ,aqFk. xU eyy Fsphrhjgnglbapd (COP) fpllijjll 5 Kjy 6 tiu ,UfFk.

2. Fsphrhjdg nglbapd Fsp&lLk gFjpapd (Cooling camber) ntggepiyfFk> #oypd (miwapd) ntggepiyfFk css NtWghL Fiwahf ,Uejhy> Fsphrhjdgnglbapd COP mjpfkhf ,UfFk.

3. Fsphrhjdgnglbapy GwNtiy nraaggll> Fsphrrpahd nghUspypUeJ ntggk vLffgglL ntggkhd nghUSfFf nfhLffggLfpwJ. GwNtiy ,yyhky ntgg Mwwy Fsphrrpahd nghUspypUeJ ntggkhd nghUSfFg ghahJ. ,J ntgg ,afftpaypd ,uzlhk tpjpfF vjpuhdJ myy. Vnddpy ntggk RwWgGwjjpYss fhwWfFf nfhLffggLfpwJ. NkYk nkhjj vdlNuhgp (Fsphrhjdgnglb + #oy) vgNghJk caUk.

Fsphrhjdgnglb xdwpd COP ahdJ 3 MFk. 200 J ntggjij Fsphrhjdgnglbapypl;UeJ ntspNaww NtzLnkdpy vttsT Ntiy nraaggl NtzLk?

jhT:

$$\text{COP} = b = \frac{Q_L}{W}$$

$$W = \frac{Q_L}{COP} = \frac{200}{3} = 66.67J$$

Nfhilffhyjjy ehk kzghidj jzziu Fbffggad gLjJfNwhk. kzghidahdJ mjDsNs Cwwggll jzzhd ntggeiyia Fiwffwj. kzghidia Fshrhjdgnglbahff (Refrigerator) fUjyhkh? fUjKbahJ. Vnddwhy ntgg vejujjwNfh myyJ Fshrhjdgnglbfnfh Rowr eifoT (Cyclic process) kf Kffa Njit MFk. kzghidaiy elfFk Fshtiffk eifothdJ xU Rowr eifotyy. gzghid Rtwwiy css Ezza Jisfsiyiuej eh %yf$Wfs ntsiNaWtjhy csskUfFk euhdJ Fshtiffggl fwJ. eh %yf$Wfs Jistoiahf RwWgGw#oYfF ntsiNawiagid jiUkgTk gzghidfFs tUtjiyiy. kzghidaiy ntggkhdJ Fshej ehiyiuej. ntsigGw tsikzlyjJfF fljjggllhYk. ,J ntgg ,afftiayid ,uzlhk tijfF Kuzhf ,yiy. VNddiy kzghidfFs ,UfFk (jzzH + ntsigGw tsikzlyk) Nrhej xU ntgg ,afftiay mikgghf fUjidhy ,jd vdlNuhgi vgNghJk mjifhiffwJ.

gRik ,yiy tiisT (Green house effect)

Gtiaiy kdijd caih thotjwF Gtiiar #oeJss tsikzlyjjid gqF msggwiaJ tsikzlyjjid NkwgFjaid ntggeiiy -19°C mjd mbggFjaid ntggeiiy +14°C. tsikzlyjjid Nkwgugguiy iuej mbggugGfF tUkNghJ ntggeiiy 33°C msTfF caUfidwJ. ,jwFf fhuzk tsikzlyjjiYss riy thAffshFk. ,tthAffSfF gRik ,yy thAffs vdW ngah› ,ttistwF gRik ,yy tiisT vdW ngah.

gRik ,yy thAffsiy Kjdikahdit CO_2, eH %yf$W›Ne, He, NO_2, CH_4, Xe, Kr, XNrhd kwWk NH_3Nghdwitahfk. CO_2, kwWk ehk %yf$widj jtihjJ kww %yf$Wfs nrhwg mstiNyNa tsikzlyjjiy cssd. #hiadiy ,UeJ tUk eiwkhiyaiy #hiaffjihtrR fzZU gFjaiy (Visible region) ,UffwJ. ,ffjihtrRfis Gti clftheJ kzLk mfrritgG fjihfshf ntsiaiLfwJ.

CO_2kwWk ehk %yf$Wfs mfrritgGf fjihfis edF clftUk. Vnddiy mit ielu[d kwWk Mfi[Dld xggiLk NghJ mjif mjihTW Rjejiu ,afff$Wfisg ngwWssd mit mfrritgGf fjihfis clfthtjhy jhd tsikzlyk ntJ ntJgghf cssJ.

1900 ,y ,UeJ kdijdid nrayghLfshy tsikzlyjjiYss CO_2 tid msT 20% Kjy 40% tiu mjifhijJssJ. CO_2 cUthtjwfhd Kjdikahd %yk Gijgbk vhinghUsfis vhiggjhFk. cyfk KOtJk jhdiaqfi ,aejiuqfsid gadghL mjifhijjiUggNj ,jwFf fhuzkhFk. tsikzlyjjiy ,ej CO_2 tid msT mjifhijjiUggjhy› Gtiaid ruhrhi ntggk 1°C caheJssJ. ,jwF cyfntggkakhjy (Global warming) vdW ngah. Mhlbf kwWk mzlhhbf gFjifsiy css gdiggh iwfs cUFtjwF ,ej cyf ntggkakhjNy fhuzkhFk. NkYk CO_2 tid msT flyiYk mjifhijJssJ. ,J flytho caihidqfSfF kifTk Mgjjhdjhfk.

CO_2cld NrhjJ kwnwhU kif Kffiakhd gRik ,yy thA FNshNuh GNshNuh fhhgdhFk (CFC) ,J Fshrhjgnglbfsiy Fshtigghdhf cyfk KOtJk gadgLjjggLfwJ. kdijd cUthfFk gRik ,yy thAffs 55 rjtjk CO^2, 24 rjtjk CFC thAffs›6 rjtjk ielu[d Mfi]L kwWk 15 rjtjk kjNjd MFk. CFC thAffs XNrhd glyjjiy mjif ghjigGfis VwgLjJfidwd.

CO_2, kwWk CFC thAffsid msitf flLggLjJtjwfhd Kawrifsiy cyfiYss gyNtW ehLfs <LglLsd. Gijgbk vhinghUsfSfF khwwhf Gijgbkww vhinghUsfis jhdiaqfi vejiuqfsiy gadgLjJtjwfhd

Muharrpfs njhlheJ eilngwW tUfpdwd. tshrrpailej ehLfshd USA kwWk lNuhggpa A+dpad ehLfs ngUksT CO_2l ntspaLfpdwd.

2020 fFs CO_2, ckpoit ngUksT Fiwggjwfhf cyf ehLfSffpilNa gyNtW xggejqfs Nghlgg lLssd. ,Uggpdk cyf ntggkakhjy xU jqF tpistpfFk epfoT vd ngUkghyhd ehLfs czutpyiy.

- #lhd nghUspypUeJ› Fsphrrpahd nghUSfF ghAk ,Utif ghpkhww MwwNy ntggkhFk. ,Uggpdk ntggk Nrkpjj itffggLk Xh Mwwy mstyy.
- xU nghUspypUeJ kwnwhU nghUSfF Mwwiy khwwf$ba nryNy Ntiy vdggLk.
- nghUspd ntgg msit (Hotness) mstpLtJ ntggepiyahFk. ntgge piyahdJ ntggk ghAk jpiriaj jhkhdpffpwJ.
- eyypayG thA tpjp PV = NkT myyJ PV = µRT MFk. ntgg ,affr rkepiyfF klLNk eyypayG thA tjp nghUeJk. ntgg ,affr rkepiyaww epfoTfSfF ,ttpjp nghUejhJ.
- eyypay:G thA tpjp PV = NkT myyJ PV = µRT MFk. ntgg ,affr rkepiyfF klLNk eyypayG thA tjp nghUeJk. ntgg ,affr rkepiyapy epfoTfSfF ,ttpjp nghUejhJ.
- nghUnshdwpd ntggepiyia 1°C myyJ 1K cahjJtjwFj Njitggk ntggjjpd msNt ntgg VwGjjpwd vdggLk. ,J S Fwpggplggfpwj.
- 1 Nkhy msTss nghUspd ntggepiyia 1°C myyJ 1K cahjJtjwFj Njitggk ntggjjpd msNt Nkhyhh jdntgg VwGjjpwd MFk. mJ C vdf Fwpggplggfpwj.
- ntggepiy khWghlbdhy nghUspd tbtk› gugG kwWk gUkd Nghdwtwwhy VwgLk khwwk ntgg tpTT vdggLk.
- jzzh Kuzgll tpTggzigg ngwWssJ.
- nghUspd epiykhwwjjpwFj Njitggk Mwwypd msT mgnghUspd kiwntgg VwGjjpwd vdggLk.
- ntgg ,aff mikgG xdwpid ntggggLjJk NghJ› mttikgG VwWfnfhzl myyJ mttikggpypUeJ ntspNawwggll ntggjjpd msit mstpLk KiwfF› ntgg mstlby vdW ngah.
- ntggkhwwkhdJ ntggffljjy› ntggrrydk kwWk ntggffjphtrR Mfpa %dW Kiwfspy eilngWfpwJ.
-]nl/ghd - Nghylnkd tpjp: $E = \sigma T^4$kwWk tpad tpjp $\lambda_{max} T = b$
- ntgg ,affr rkepiyfs: ntggrrkepiy› ,ejputpay rkepiy kwWk Ntjprrkepiy.
- ntgg ,aff khwpfs: mOjjk› ntgge piy› gUkd› mf Mwwy kwWk vdlNuhgp.
- ntgg ,afftpaypd Roptpjp: ,uzL nttNtW nghUsfs jdpjjdpNa %dwhtJ nghUSld ntggr rkepiyapy ,Uejhy› mttpuzL nghUsfSk jdfFsNsNa ntggrrkepiyapy cssJ vdf fUjyhk. ,ttpuzL mikgGfspd ntgge piy rkkhFk.

- ntgg ,aff mikgg Yss %yf$Wfs d ,aff Mwwy kwWk e iyahww y ,tww d $LjNy mf MwwyhFk.
- [{y ,aej u Mwwiy› ntgg ,aff mikgg d mf Mwwyhf khww ffhlbdhh.
- Mwwy khwhf $ww d xU tbtNk ntgg ,afft ay d Kjy t j ahFk. ,tt j ntgg ,aff mikgg d ntggjij csslff AssJ.
- knkJ e foT vdgJ tiuaWff ,ayhj msT nkJthf eilngWk Xh e fothFk. ,ee fot y mikgG vgNghJk #oYld rke iya y ,UfFk.
- mikgg d gUkd khWkNghJ mikgg dhy nraaggll Ntiy W = $\int P dV$
- PV tiugljj y tis NfhlbwFf fNo css gugG› mikgg dhy nraaggll Ntiy myyJ mikgg d kJ nraaggll NtiyfFr rkkhFk.
- Mwwy khwhf $ww d xU tbtNk
- ntgge iy khwh e foT T = khw y
- mOjjk khwh e foT P = khw y
- gUkd khwh e foT: V = khw y
- ntgggh khwwk yyh e foT Q = 0
- mOjjk khwh e fot y nraaggll Ntiy ngUkk kwWk ntgggh khwwk yyh e fot y nraaggll Ntiy r WkkhFk.
- Rowr e foT xdw d mf Mwwy khWghL Ro ahFk
- Rowr e fot y nraaggll njhFgad Ntiy›PV tiugljj Ds %lggll tisNfhlbd gugGfFr rkkhFk.
- ks e foT Xh ,ylr a nrayKiwahFk. eilKiwa y rhjj ayiy.
- ,awif e foTfs midjJk ksh e foTfshFk.
- xU ntgg ,aej uk ntgg %yjj y UeJ ntggjijgngwW Ntiy nraJ› Fiwej msT ntgg Mwwiy ntgg Vwg fFf nfhLff wJ.
- fhhNdh ,aej uk Xh ks e foT ,aej ukhFk ,jd gaDW j wd k f mj fk. NtW vej eilKiw ,aej uqfSfFk fhhNdh ,aej ujijg Nghdw gaDWj wd ,yiy.
- Fs hgjdgnglb vdgJ vj hjj ira y nraygLk xh fhhNdh ,aej ukhFk eilKiwa y gadgLjjggLk Fs hgjdgnglba d nrayj wd Fzfk (COP), ,ylr af Fs hgjdnglba d nrayj wd Fzfjijt lf FiwthFk.