

Ae`vi cwi eZB

fvgKv

mvaviYZ c`v_©KwB, Zij I evqexq GB wZb Ae`vq _vKtZ cıfi | th Ae`vq _vKtZ bv tKb wefkI
 cıııqvi gva`tg c`v_#K GK Ae`v t_tK Ab` Ae`vq tbqv hvq | c`vt_# GK Ae`v t_tK Ab` Ae`vq
 ifcıršıı Z nı qvi G NUbıfk Ae`vi cwi eZB ejv nq | thınZzZıvcMıZıe`ıvq e`z Ae`v ej tZ Avgıv
 eıS _ııK Pıv (P), AvqZb (v), I δ Zıvcgııv (T) Øıııv cKıııKZ Ae`v | ZıB KLbı c`vt_# wZb
 Ae`vfk KııB `kv (Solid phase), Zij `kv (Liquid phase) I evqexq `kv (Gaseous phase) ejv nıq
 vfk | G BDııbıU Gme `kvi A# Ae`vi cwi eZB I `kv ııbtq Avıj vPbv δ Kııv nıe |

cW - 1

Ae-vi cwieZB, Mj b I Kwbxfeb, Mj b¼i Dci P¼ci c¼ve, Av¼c¼K m¼Zvc ev j¼bZvc |

15.1.1 t Ae-vi cwieZB t- c`v_°th Ae-viqB _vKk bv tKb kw³ c¼qum ev AcmiY Kti c`v_°K GK Ae-v t_¼K Ab` Ae-viq ifcvšii Z Kiv hvq |

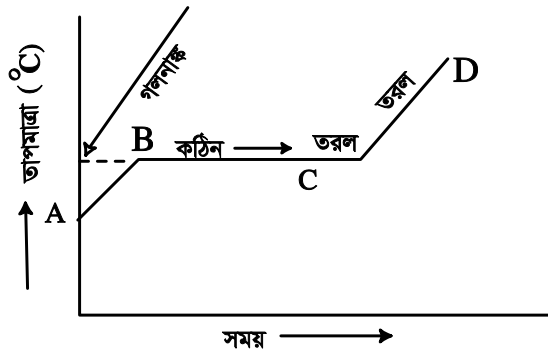
thgb t Zvc c¼qum Kti eid¼K cmbtZ Ges cmbtK Rjxq evt°ú ifcvšii Z Kiv hvq | Avevi Zvc AcmiY Kti Rjxq ev°ú¼K cmbtZ Ges cmbtK eitd ifcvšii Z Kiv hvq | c`vt_° GK Ae-v t_¼K Ab` Ae-viq ifcvšii Z nl qvi G NUbv¼K Ae-vi cwieZB ejv nq |

Kwlb Ae-v t_¼K Zij Ae-viq ifcvšii c¼µqv¼K Mj b (Melting or fusion) etj | Gi necixZ c¼µqv A_° Zij t_¼K Kwlb Ae-viq ifcvšii c¼µqv¼K Kwbxfeb (Solidification) etj | tKvb c`vt_° Zij Ae-v t_¼K evqexq Ae-viq cwieZB¼K ev°úxfeb etj |

¼bv° Zi¼ji ev°ú ev M¼vm¼K Zij Ae-viq ifcvšii c¼µqv¼K Nbxfeb (condensation) ev Zij xKiY (Liquifaction) ejv nq |

Avevi ¼KQy¼K-c`v_°Kwlb Ae-v t_¼K m¼vmi ev°úxfZ n¼Z cv¼i | thgb t Kc° I b¼vc_¼vj b | Kwlb Ae-v t_¼K m¼vmi ev°úxfeb c¼µqv¼K Da¼evZb ejv nq |

15.1.2 t Mj b I Kwbxfeb t hLb tKvb Kwlb c`vt_°Zvc c¼qum Kiv nq, Gi Zvcgv¼v ev¼ cvq | Z¼e c`vt_° hLb Ae-všii nq ZLb m¼viiYZ: Zvcgv¼v cwieZB nq bv | GK¼U ¼bv° Zvcgv¼v Kwlb c`v_¼ Mj tZ `ii` Kti Ges hZ¼b ch¼-bv mgM¼c`v_¼ M¼j Zi¼j ifcvšii Z n¼q, ZZ¼b ch¼-Zvc c¼qum m¼¼j Zvcgv¼v H Ae-viq ¼`i _¼K | Kwlb t_¼K Zi¼j ifcvšii G c¼µqv¼K Mj b etj Ges th Zvcgv¼v c`v_¼ Mj tZ `ii` Kti tm Zvcgv¼v¼K H c`vt_° Mj b¼ ejv nq |

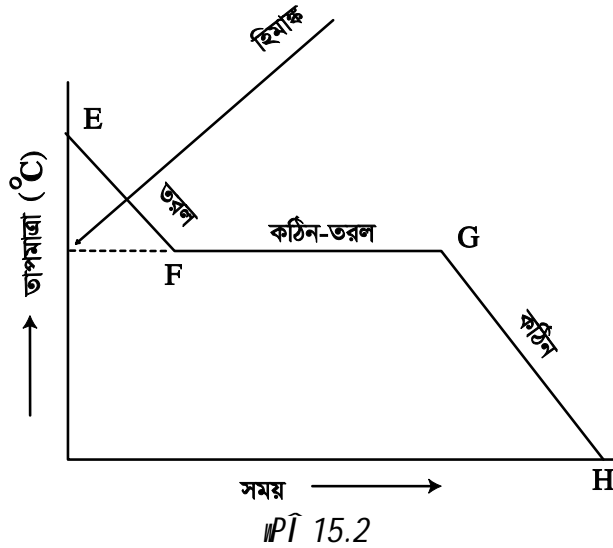


¼P¼ 15.1

Zvc c¼qum Ae-vnZ _vK¼j m¼úY¼v¼e M¼j hvevi ci M¼j Z Zi¼ji Zvcgv¼v Avevi ev¼ tctZ _vK¼e | Kwlb t_¼K Zi¼j ifcvšii t¼¼¼ Zvcgv¼v ebvg mgq tj L¼P¼ A¼b Ki¼j 15.1 ¼P¼¼i gZ n¼e |

Gevi M¼j Z Zij c`v_¼¼K kxZj Ki¼j c¼¼g Gi Zvcgv¼v n¼m tctZ _¼K Ges GK¼U ¼bv° Zvcgv¼v tct¼¼ Kwlb n¼Z `ii` Kti | m¼úY¼Zij Kwlb ifcvšii Z bv nlqv ch¼-Zvcgv¼v AcmieZB _vK¼e | GB Zvcgv¼v¼K ¼ng¼¼ etj | kxZj xKiY Ae-vnZ _vK¼j m¼úY¼v¼e Kwlb

ifcvšhi Z nI qvi ci Zvc eRfbi gva`tg Avevi ZvcgvÁv nvm tctZ `vKte| Zij t`K KwB ifcvš-
 ti i t`fÁ ZvcgvÁv ebgq tj LwPÁ A¼b Ki tj tj LwPÁU 15-2 bs wPÁi gZv nte|



wb`w` Pw`c tKvb KwB c`v`th ZvcgvÁvq Mj tZ `i` Kti, ZvtK H c`v`P Mj b¼ (Melting point)
 etj | Mj b¼ Pw`ci Dci wbfPkwj | `rfweK Pw`c KwB c`v`P Mj b¼tK `rfweK Mj b¼ etj |
 c`v`P Mj b¼ etjZ `rfweK Mj b¼tKB eSvq| eitdi `rfweK Mj b¼ 0°C ev 273.15K| wb`w`
 Pw`c tKvb Zij c`v`th KwB nZ `i` Kti ZvcgvÁvq RgtZ `i` Kti, ZvtK H Zitj i wngv¼ etj |
 mkj ùwKvKvi (Crystalline) c`v`P Mj b¼ I wngv¼ GKB `vtK|

15.1.3 Mj b¼i Dci Pw`ci c`ve t th me c`v`KwB t`K Zitj ifcvšhi Z nI AvqZb ewx cvq
 tm me c`v`P Pvc ewx tZ Mj b¼ ewx cvq| thgb: tgvq I miv dvi | th me c`v`KwB t`K Zitj
 ifcvšhi Z nI AvqZb nvm cvq tm me c`v`P Pvc ewx tZ Mj b¼ nvm cvq| thgbt eid, tjvnr I
 wemgv_|

15.1.4 t AvtcwÁK mBZvc ev jxbZvc (Specific Latent Heat) t e`z Ae`vi cwieZfbi mgq Zvc
 c`qvM ev Zvc Acmvi Y Ae`vnrZ `vKtj I e`z ZvcgvÁv ewx ev nvm NtU b¼| MpxZ Zvc ev emRZ Zvc
 e`z Ae`vi cwieZB NUv`bvi KvtR e`q nq| ZvcgvÁv w`i `vtK etj Avgiv etjZ cwi, Ae`v
 cwieZfbi mgq e`zKZR. MpxZ ev emRZ Zvtci emn`K cKvk tbB| ZvB G Zvc tK mBZvc ev jxb
 Zvc ejv nq|

Mj tbi AvtcwÁK mBZvc t Mj b¼ ZvcgvÁv w`i ti tL 1 kg fti tKvb KwB c`v`K KwB Ae`v
 t`K m`uYfPc Zij Ae`vq ifcvšhi Z KitZ th Zvtci c`qvRb nq ZvtK H c`v`P Mj tbi
 AvtcwÁK mBZvc etj | Mj tbi Av: mBZvc tK L_f ðviv cKvk Kiv nq|

AvtcwÁK mBZvtci GKK J kg⁻¹ |

`rfweK Pw`c, eid Mj tbi AvtcwÁK mBZvc, $L_f = 336 \text{ KJ Kg}^{-1}$

m wKtj wMög fi wewkó tKvb KwB e`zK Mj vZ c`qvRbxq Zvtci cwi gvb, $Q = mL_fJ$

15.1.5 t eid Mj tbi Avtciwlg mßZvc wbYq

wgkY cxiwZ t G cixwlg K'ij wiugUvtii gta" th bvwmb ev Avtj vokuU e"euZ nq, Gi mw_t mi" Zvtii Rvj mshy _vtK| cwiwvi I i" Kti bvwmbmn K'ij wiugUvtii fi wbYq Kiv nq| Zvici Gi GK ZZxqisk wKQyDò cwb w tq cYKti Avevi fi wbYq Kiv nq| wZxq fi t_tK clg fi wetaVM Kti cwb fi wbYq Kiv nq| _vtgwgUvtii mivvth" G cwb Zvcgviv wbYq Kiv nq| KtqKwU tQvU tQvU eitdi UKiv fvj Kti atq tPvl KvMR w tq gtd K'ij wiugUvtii gta" tdtj t`qv nq| Zvici bvwmb w tq cwb bvtZ nq| bvwmbi Rvtji wbtP eitdi UKiv, tju ti tL Ggbfvte bvtZ nte thb eitdi UKiv cwb Dci fvtZ bv cvti | axti axti eid Mj tZ _vtK Ges cwb Zvcgviv mgk KgtZ _vtK| mawb"eid Mj hvevi ci wgti bi mebwreZvcgviv _vtgwgUvtii mivvth" givc nq| Gevi cbivq fi wbYq Kiv nq| G fi t_tK wZxq fi wetaVM w tq eitdi fi wbYq Kiv nq|

aiv hvK,

$$K'ij\ wiugUvtii\ fi = m_1\ kg$$

$$cwb\ fi = m_2\ Kg$$

$$cwb\ Avtciwlg\ Zvc = S_2\ JKg^{-1}K^{-1}$$

$$K'ij\ wiugUvi\ I\ cwb\ Zvcgviv = \theta_1\ ^0\ C$$

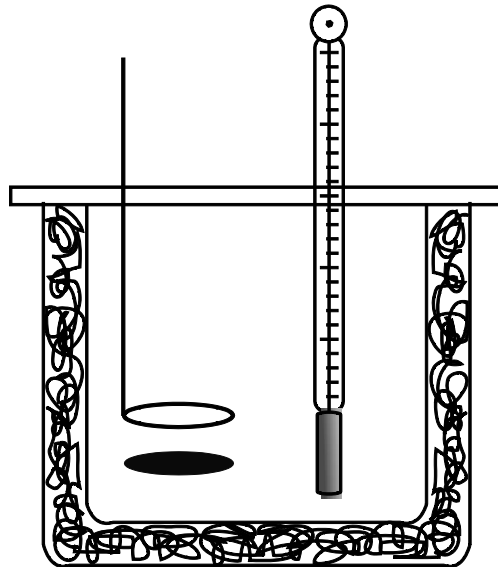
$$K'ij\ wiugUvtii\ Dci\ v\ tbi\ Avtciwlg\ Zvc = s$$

$$JKg^{-1}\ K^{-1}$$

$$wgk\ t\ Yi\ mebwreZvcgviv = \theta\ ^0\ C$$

$$eitdi\ fi = m\ Kg$$

$$eid\ Mj\ tbi\ Avtciwlg\ mßZvc = L_f\ JKg^{-1}$$



wPî : 15.3

$$AZGe, eid\ KZR.MwvZ\ Zvc = mL_f + m \times S_2 (\theta - 0)J = mL_f + Ms\theta$$

$$K'ij\ wiugUvi\ KZR.eivRZ\ Zvc = m_1 \times S(\theta_1 - \theta) J$$

$$cwb\ KZR.eivRZ\ Zvc = m_2 \times S_2 (\theta_1 - \theta) J$$

$$Ab" tKvb\ fvte\ Zvtci\ Av\ vb\ cDvb\ bv\ ntj, MwvZ\ Zvc = eivRZ\ Zvc,$$

$$A_w\ mL_f + m \times s_2 \theta = m_1 \times S(\theta_1 - \theta) + m_2 S_2 (\theta_1 - \theta)$$

$$ev, mL_f + m s_2 \theta = (\theta_1 - \theta) (m_1 S + m_2 \delta S_2)$$

$$ev, mL_f = (\theta_1 - \theta) (m_1 S + m_2 \times S_2) - m \delta S_2 \theta$$

$$ev, L_f = \left\{ \frac{(m_1 S + S_2 m_2)(\theta_1 - \theta)}{m} - S_2 \theta \right\} JKg^{-1}$$

Wvb\ ctwgi\ i\ wkw, tju\ vi\ gvb\ eivm\ t\ q\ L_f\ Gi\ gvb\ wbYq\ Kiv\ hvq|

$$\begin{aligned}
 c_{mb} KZ\mathbb{R}.e_{WR}\mathbb{Z} Z_{vc} &= c_{mb} f_i \times c_{mb} A_{v:} Z_{vc} \times Z_{vc} g_{v\hat{T}vi} c_{v_R} \\
 &= 5 \times 4200 \times (30 - \theta) J \\
 &= 21000 (30 - \theta) J
 \end{aligned}$$

$$A_{b''} t_{Kvb} f_{v\hat{T}e} Z_{v\hat{T}ci} A_{v''} v_b c_{0vb} b_{v} n_{tj} e_{WR}\mathbb{Z} Z_{vc} = M_{p,x} Z_{vc}$$

$$\therefore 21000 (30 - \theta) = 336000 + 4200 \theta$$

$$e_{v}, 630000 - 21000 \theta = 336000 + 4200 \theta$$

$$e_{v}, -21000 \theta - 4200 \theta = 336000 - 630000$$

$$e_{v}, -25200 \theta = -294000$$

$$\therefore \theta = \frac{294000}{25200} = 11.67^{\circ} C$$

mvi mst¶c

Ae^{-vi} cwi eZ⁰ t c^{-v} t_P GK Ae^{-v} t_K Ab'' Ae^{-v} q ifcvšš Z nI qvK Ae^{-vi} cwi eZ⁰ ej v nq |

Mj b^v t ubv⁰ P_t t_{Kvb} K_{wb} c^{-v} t_h Z_{vc} g_{v\hat{T}vq} Mj tZ i i'' Kti, Z_{v\hat{T}K} H c^{-v} t_{P} Mj b^v etj |}}}

Mj t_{bi} A_{v\hat{T}c} ¶K m_β Z_{vc} t Z_{vc} g_{v\hat{T}vi} cwi eZ⁰ b_{v} N_U t_{q} GKK f_{ti} i t_{Kvb} K_{wb} c^{-v} t_{P} K_{wb} Ae^{-v} t_{K} Z_{ij} Ae^{-v} q ifcvšš Z n_{Z} th Z_{v\hat{T}ci} c_{0} q_{v} R_{b} q} Z_{v\hat{T}K} D³ c^{-v} t_{P} Mj t_{bi} A_{v\hat{T}c} ¶K m_β Z_{vc} etj | Mj t_{bi} A_{v:} m_β Z_{vc} t_{K} L_{f} 0_{vi} v c_{K} v_{k} K_{iv} nq |}}}}}}}}}}}}}}}}}}}}}}}}}}}}

$$\text{vimeK } P_{t} \text{ eid } Mj \text{ t}_{bi} A_{v\hat{T}c} \text{ ¶K } m_{\beta} Z_{vc} = 3.36 \times 10^5 \text{ Jkg}^{-1}$$

$$m \text{ t}_{KwR} f_{ti} i t_{Kvb} K_{wb} e^{-K} Mj \text{ v}_{Z} c_{0} q_{v} R_{b} q_{Z} v_{\hat{T}ci} cwi g_{vY} = mL_f \text{ J}$$

c_{v\hat{T}vE}i g_j-vq_b

K. m_{wk} D_E t_i i c_{v\hat{T}k} w_{k} (\sqrt{v}) v_{p} y_{v} w_{b} |}}}}

(1) eid Mj t_{bi} A_{v\hat{T}c} ¶K m_β Z_{vc} t_{Kvb} u_{J} ?}}}}}

- (K) 336 KJ kg⁻¹ (L) 336 J kg⁻¹
- (M) 226 KJ kg⁻¹ (N) 226 J kg⁻¹ k⁻¹

(2) 0⁰ C Z_{vc} g_{v\hat{T}vi} 2g eid 0⁰ C Z_{vc} g_{v\hat{T}vi} c_{wb} t_{Z} c_{wi} b_{Z} n_{Z} c_{0} q_{v} R_{b} q_{Z} v_{c} KZ?}}}}}}}}}}}

- (K) 672J (L) 672 kJ
- (M) 972 kJ kg⁻¹ (N) 672 J kg⁻¹

L | m_s ¶B c_{k} ce}

- (1) Mj b^v t_{bi} i m_s A_{v} u_{j} L_{g} |}}}}
- (2) Mj t_{bi} A_{v\hat{T}c} ¶K m_β Z_{vc} K_{v\hat{T}K} etj ?}}}}

cW - 2

ev[®]úxfeb I Nbxfeb, ev[®]úvqb, ùlbb, ev[®]úvqb I ùlbbi gta` cv_R`, ùlbbv¼i Dci Pvc c`ve, ev[®]úxfetbi AvtcvK mßZvc |

veiqe`z

15.2.1 t ev[®]úxfeb I Nbxfeb t tkvb c`vt_9 Zij Ae`v t_#K evqexq Ae`vq ifcvšw Z nl qvi c`v_9ev[®]úxfeb etj | Avi H evqexq c`v_9K D³ wbi`8 Zij i ev[®]ú etj | Zij i ev[®]úxfeb `vite ntZ cvti | h_v t ev[®]úvqb I ùlbb |

wecixZfite, ev[®]úKl Zij xFZ Kiv hvq | ùlbbv¼i ZvcgvÎv w`i ti#L th mßZvc MhY Kti Zij ev[®]úxfZ nq, GKB ZvcgvÎvq tm cwi gvY mßZvc eR⁸ Kti ev[®]ú Zij xFZ nte |

15.2.2 ev[®]úvqb t th tkvb ZvcgvÎvq Zij c`vt_9 DcwiZj t_#K axti axti Zij i ev[®]ú cwiYZ nl qv#K ev[®]úvqb etj | Zij c`vt_9ev[®]úxfZ nl qvi Rb` c`v_9Rbxq kw³ Aewkó Zij t_#K A_ev cwi cvk_#t_#K MhY Kti | Zij Zij i t`v_9dj tewk ntj ev[®]úvqb `Z nq | th cvt_#i tLjv g#Li t`v_9dj tewk tm cvt_#i ivLv Zij ZvovZwmo ev[®]úxfZ nq | me Zij i ev[®]úvq#bi nvi mgvb bq | wbi`8 ZvcgvÎvq th me Zij ZvovZwmo ev[®]úxfZ nq, Zvt`i D0vqx (Volatile) c`v_9etj | B_vi, tebivRb, tc#Uvj BZ`w` D0vqx Zij |

15.2.3 t ùlbb t tkvb Zij c`vt_9Zvc c`v_9M Kiti Gi ZvcgvÎv evx cvq | evotZ evotZ GKilU wbi`8 ZvcgvÎvq tc#Qvtj Zij c`v_9U d#Z`i` Kti Ges `Z ev[®]ú cwiYZ nq | Zvc c`v_9M Zij c`vt_9 `Z ev[®]ú cwiYZ nl qv#K ùlbb etj | hZvjb chS-bv m#úY`Zij ev[®]ú cwiYZ nq, ZZvjb chS-ZvcgvÎv Acwi ewZ`_vtK | GKilU wbi`8 Pvc I wbi`8 ZvcgvÎvq Zij c`vt_9 me Ask t_#K `Z evqexq Ae`vq cwiYZ nl qv#KB ùlbb etj |

wbi`8 Pvc th wbi`8 ZvcgvÎvq ùlbb msNwUZ nq ZvtK ùlbbv¼i etj | `rfimeK Pvc Zij c`vt_9 ùlbbv¼i#K `rfimeK ùlbbv¼i etj | c`vt_9 ùlbbv¼i ej tZ Avgiv `rfimeK ùlbbv¼i#KB ev# | cwi bi `rfimeK ùlbbv¼i 373.15 K ev 100⁰ C

15.2.4 t ev[®]úvqb I ùtbi gta[®] cv_R

ev [®] úvqb	ùtbi
1 ùtbi GKUW `*Z cùmqv	1 ev [®] úvqb GKUW axi cùmqv
2 ev [®] úvqb Zi tji Dcwi Zj t_ tK msNwUZ nq	2 ùtbi Zi tji mKj Ask t_ tK N tU
3 ev [®] úvqbi mgq Zi tji ZvcgvT v nwm cvq	3 ùtbi mgq Zi tji ZvcgvT v w`i _v tK
4 me ZvcgvT v tZB Zij c`v t_ P ev [®] úvqb N tU	4 w b w` t P v t c GKUW w b w` t ZvcgvT v q Zi tji ùtbi N tU
5 ev [®] úvqbi mgq Zij c`v t_ P tKvb eyey m w o n q b v	5 ùtbi K v t j Zij c`v t_ P g t a [®] e y e y m w o n q

15.2.5 : ùtbi tbi Dci P v t c i c f v e

mKj c`v t_ P t q t i P v c e v o t j ùtbi t b i e r t o | P v c K g t j ùtbi t b i K t g | r f m e K P v t c c m b i ùtbi t b i 373.15 K e v 100⁰ C r f m e K P v c A t c q v K g P v t c 100⁰ C Z v c g v T v i t p t q K g Z v c g v T v q c m b d t U |

15.2.6 : ev[®]úvqbi Av t c w i t K m b Z v c

w b w` t P v t c G K K f t i i (1 kg) t K v b c`v t_ P Z v c g v T v ùtbi t b i t i t L Z i j t_ t K e v q e x q A e`v q c w i Y Z K i t z t h Z i t c i c t q v R b , Z v t K e v r f e t b i A v t c w i t K m b Z v c e t j | G t K L v t h i v m w P Z K i v n q |

$$\begin{aligned} r f m e K P v t c c m b i e v r f e t b i A v t c w i t K m b Z v c &= 2260 \times 10^3 \text{ J kg}^{-1} \\ &= 2260 \text{ kJ kg}^{-1} \end{aligned}$$

m kg f i w e m k o t K v b Z i j c`v t_ P e v r f e t b i K i t z c t q v R b i q Z v c Q = m L v

15.2.7 : c w b i e v r f e t b i A v t c w i t K m b Z v c w b Y t

c i x i Y t w b w` t i m i v t h` G K U W c w i t i i I i` t K` i j w i n g U v t i i f i w b Y t K i v n q | G i c i K` i j w i n g U v t i i` t Z Z x q v s k c m b t h i v c Y t K t i f i w b Y t K i v n q | G` t f t i i c v` R` t_ t K c w b i f i t e i K i v n q |

G K U W _v t g i n g U v t i i m i v t h` c m b I K` i j w i n g U v t i i Z v c g v T v w b Y t K i v n q |

G K U W e o K v t P i c v t i (F) w K Q y c w i g v Y c m b t b l q v n q | c v t i i g l y G K U W w` h y w Q w c w` t q e U K i v n q | w Q w c i w Q t` i g a` w` t q G K U W U A v K w Z i K v P b j (T) G i G K U W e v u G g b f v t e K v P c v t i c t e k K i v t b v n q t h b b j w c m b i D c w i Z j t_ t K m i v g v b` D c t i _v t K | c m b D E B K i v n t j K v P b j w` t q e v r f e t b i c e v i n Z n q |

mKg er⁰ú 100°C Zvcgvîvi er⁰ú t_#K 100°C Zvcgvîvi cwb#Z cwiYZ n#Z eWRZ Zvc = mL_v
Joule

$$100^0 \text{ C Zvcgvîvi cwb (er}^0\text{ú t_#K `Zix) } \theta^0 \text{ C Zvcgvîvq tbtg Avm#Z eWRZ Zvc} \\ = m \times S_2(100 - \theta) \text{ J}$$

$$\text{K'vj wiugUvi KZR.MpxZ Zvc} = m_1 S (\theta - \theta_1) \text{ J}$$

$$\text{cwb KZR.MpxZ Zvc} = m_2 \times S_2 (\theta - \theta_1) \text{ J}$$

Ab` tKvb Dcwtq Zv#ci Av`vb c#vb bv ntj ,

$$\text{eWRZ Zvc} = \text{MpxZ Zvc}$$

$$\therefore mL_v + m \times S_2 (100 - \theta) = m_1 S (\theta - \theta_1) + m_2 \times S_2 (\theta - \theta_1)$$

$$\text{ev, } mL_v = m_1 S (\theta - \theta_1) + m_2 \times S_2 (\theta - \theta_1) - S_2 m(100 - \theta)$$

$$= (\theta - \theta_1) (m_1 S + S_2 m_2) - S_2 m (100 - \theta)$$

$$\therefore L_v = \left\{ \frac{(\theta - \theta_1) (m_1 S + S_2 m_2)}{m} - S_2 (100 - \theta) \right\} \text{ JKg}^{-1}$$

mZKZv

(1) er⁰ú d#`i AvMg bjw#K fij fv#e Kzwevnx c`v_#v`#q tX#K ivL#Z n#e, hv#Z btj i g#a`
c#vwnZ er⁰ú NbrfZ n#Z bv cv#i |

(2) K'vj wiugUv#i i g#a` er⁰ú c#ek Kiv#bvi bjw# tek j`# n l qv D#PZ, thb K'vj wiugUv#i i Mf#ti
cwb i g#a` Wz#bv`_v#K | Zv bv ntj er⁰ú hLb`Z MvZ#Z tei nq, Gi MvZi Rb` K'vj wiugUv#i i cwb
wQU#K covi m#`ebv`_v#K |

(3) K'vj wiugUvi I evY#i i g#a` GKw# c#wRvb cvZ (p) ivL#Z n#e, hv#Z K'vj wiugUvi tKvb Zvc
M#Y Ki#Z bv cv#i |

(4) K'vj wiugUvi #K Kzwevnx c`v_#v`#v AveZ ivL#Z n#e |

(5) K'vj wiugUvi #K hZB Zvc A#wiZ K#i ivLv tnvK bv tKb, Zvici I K'vj wiugUvi t_#K Zvc
#qRvbZ #w# wKQyv wKQy#_#K hvq | ZvB w#`#j wLZ c#`#qv Aej`b Ki#Z n#e |

cwbmn K'vj wiugUv#i i c#_ugK Zvcgvîv K#j Zvcgvîvi K#qK wMw# w#P bvgv#bv nq | cieZ#Kv#j ÷xg
Pvj bv Kivi ci cwb i Zvcgvîv K#j Zvcgvîv A#c#jv wK ZZ wMw# e#x cvl qvi mv#_ mv#_ L bj #K
K'vj wiugUvi t_#K tei K#i w#Z nq | G#Z c#_#g K'vj wiugUvi cwi cvk#_#K th Zvc M#Y K#i, w#Zxq
ch#q cwi cv#k#Zvc eR#bi gva`#g Zv c#ugZ nq |

D`niY

1/ 0.25 kg fi wekó GKwU Zivvi K`ij wiugUv`ti 0.4 kg cmb I 0⁰ C Zivcgv`Ivi 0.05 kg eid AvtQ/ K`ij wiugUv`ti i gta` i` Rj xq ev`ú Pvj bv Kiv ntjv hZ`fb chS-bv ugk`Yi Zivcgv`Iv 20⁰ C Zivcgv`Ivq tcS`QtZ/ tKvb cKvi Zivc nvm NtUvb wefePbv Kti KZUKzRj xq ev`ú NbxvZ ntqtQ wby` Ki`b/

(Zivvi Av: Zivc = 400 JKg⁻¹ K⁻¹), cmbi Avtci`fK Zivc = 4.2×10³ JKg⁻¹ K⁻¹ eid Mj`tbi Avtci`fK mBZivc = 3.36×10⁵ JKg⁻¹, cmbi ev`úxfetbi Avtci`fK mBZivc = 2.26×10⁶ JKg⁻¹

aiv hivK,

Rj xq ev`úú fi = m kg

eid Mj`tZ c`qvRbxq Zivc = eitdi fi × eid Mj`tbi Avtci`fK mBZivc = .05 × 336000J = 168000J

eid Mjv cmb KZR.MpxZ Zivc = eid Mjv cmbi fi × cmbi Avtci`fK Zivc ∞ Zivcgv`Ivi epx = (0.05 × 4200 × 20)J = 4200J

cmb KZR.MpxZ Zivc = cmbi fi × cmbi Avtci`fK Zivc × Zivcgv`Ivi epx = (0.4 × 4200 × 20)J = 33600J

K`ij wiugUvi KZR.MpxZ Zivc = K`ij ix ugUv`ti i fi × Zivvi Avtci`fK Zivc × Zivcgv`Ivi epx = (0.25 × 400 × 20)J = 2000J

Rj xq ev`ú NbxvZ ntq cmbtZ cwiYZ ntZ eivRZ Zivc = Rj xq ev`úú fi × ev`úxfetbi Avtci`fK mBZivc = m × 2260000J

100⁰ C Zivcgv`Ivi cmb 20⁰ C Zivcgv`Ivq tcS`QtZ

eivRZ Zivc = m × s × Δθ

$$= m \times 4200 \times (100 - 20)J$$

$$= 336000mJ$$

MpxZ Zivc = eivRZ Zivc

$$168000 + 4200 + 33600 + 2000 = 2260000m + 336000m$$

$$ev\ 259600m = 56600$$

$$\therefore m = \frac{56600}{259600} \text{ Kg}$$

$$= 0.0218 \text{ Kg}$$

D`niY-2

0⁰ C Zivcgv`Ivi 0.3 Kg eidtK 100⁰ C Zivcgv`Ivi ev`úú cwiYZ KitZ KZUKzZivc c`qvRb? eid

Mj`tbi Avtci`fK mBZivc 3.36×10⁵ JKg⁻¹, cmbi Avtci`fK Zivc 4.2× 10³ JKg⁻¹ K⁻¹,

ev`úxfetbi Avtci`fK mBZivc 2.26× 10⁶ JKg⁻¹

GLv`tb, wZb ch`q Zivc tkwv Z nq/

(M) 0⁰ C ZvcgvĪvi cmbi ZvcgvĪv 100⁰ C G DVtZ cĪqvRbxq Zvc,

$$Q_3 = m \times s \times (100-0)J$$

$$= 1.5 \times 4200 \times 100J$$

$$= 630000 J$$

GLvfb,

$$S = \text{cmbi Av: Zvc} = 4200J \text{ kg}^{-1} \text{ K}^{-1}$$

(N) 100⁰ C ZvcgvĪvi cmb 100⁰ C ZvcgvĪvi evf^úú cwiYZ ntZ cĪqvRbxq Zvc

$$Q_4 = m \times L_v$$

$$= 1.5 \times 2260000 J$$

$$= 3390000 J$$

GLvfb,

$$L_v = \text{cmbi ev}^ú\text{xfetbi m}^ú\text{Zvc}$$

$$= 2260000J$$

$$\therefore \text{tgvU Zvc } Q = Q_1 + Q_2 + Q_3 + Q_4$$

$$= 47250+504000+630000+3390000$$

$$= 4571250 J$$

$$= 4571.25 \text{ k J}$$

mvi mstĪc

ĪtĪbvĪ t ũbv Ī Prtc th ũbv Ī ZvcgvĪvq ĪtĪb msNūUZ nq ZvtK ĪtĪbvĪ etj |

ĪfmeK Prtc cmbi ĪtĪbvĪ 373.15K ev 100⁰ C

ev^úxfetbi AvtcwĪK m^úZvc t ũbv Ī Prtc GKK fĪi (1kg) tKvb c`v`P ZvcgvĪv ĪtĪbvĪ w`i tiĪL Zij t`ĪK evqexq Ae`vq cwiYZ KiĪZ th Zvtci cĪqvRb, ZvtK ev^úxfetbi AvtcwĪK m^úZvc etj | GĪK L_v ũviv mĪPZ Kiv nq|

$$\text{ĪfmeK Prtc cmbi ev}^ú\text{xfetbi AvtcwĪK m}^ú\text{Zvc} = 2260 \times 10^3 \text{ JKg}^{-1}$$

$$= 2.26 \times 10^6 \text{ JKg}^{-1}$$

m kg fi ũekó tKvb Zij c`v`K ev^úxfZ KiĪZ cĪqvRbxq Zvc

$$Q = mL_v$$

cvĪVĪi gj`vqb

K. mĪK DĪĪi cvĪk ũK (√) ĪPý ũ b|

1| ũbv Ī Prtc th ZvcgvĪvq cmb dĪĪZ i i" KĪi tm ZvcgvĪvĪK ũK etj ?

(K) ĪtĪbvĪ (L) ũgvĪ (M) Mj bvĪ (N) Īa ũe`y

2| th Zvc e`z ZvcgvĪvi cwi eZĪ bv NūUĪq Zij t`ĪK evf^úú ifcivšwi Z KĪi ZvtK ũK etj ?

(K) evRZ Zvc (L) AvtcwĪK Zvc
(M) ev^úxfetbi AvtcwĪK m^úZvc (N) Mj Ībi AvtcwĪK m^úZvc

3| GK MĪg cmbĪK i agvĪ dĪĪZ KZUKzZvc cĪqvRb?

GBP.Gm.um tc00g

(K) 336 J

(L) 2260 J

(M) 226 J

(N) 3360 J

L. msuŋB cŋke

(1) ev⁰úvqb I ùŋ#bi gta" cv_R" D#x Ki"b|

(2) ev⁰úxfetbi AvtcuŋK mŋZvc eYŋv Ki"b|

cW - 3

Zij-erqerq `kvi p-v $\hat{P}\hat{T}$; $\mu\hat{S}$ -Zvcgv \hat{T} v, $\mu\hat{S}$ -Pvc I $\mu\hat{S}$ -AvqZb,
Pvc -Zvcgv \hat{T} v `kv $\hat{P}\hat{T}$, \hat{T} a \hat{v} e`y

D \hat{T} k`

G cW tk \hat{T} Avcub -

- | $\mu\hat{S}$ -Zvcgv \hat{T} vq Zij-erqerq `kvi p-v $\hat{P}\hat{T}$ m \hat{S} utK \hat{e} vL \hat{v} \hat{v} \hat{T} Z cviteb,
- | $\mu\hat{S}$ -Zvcgv \hat{T} v, $\mu\hat{S}$ -Pvc I $\mu\hat{S}$ -AvqZb eY \hat{v} Ki \hat{T} Z cviteb,
- | Pvc- Zvcgv \hat{T} v `kv $\hat{P}\hat{T}$ A \hat{v} b Ki \hat{T} Z cviteb,
- | \hat{T} a \hat{v} e`y e \hat{v} L \hat{v} Ki \hat{T} Z cviteb|

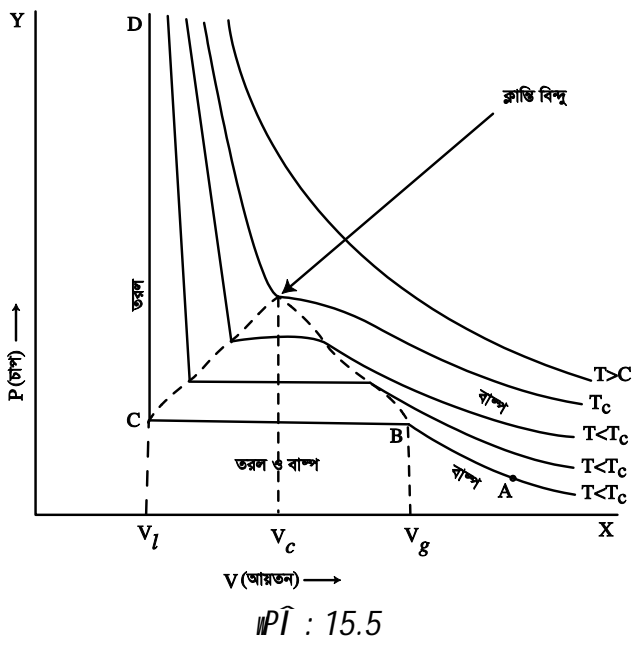
15.3.1 t Zij erqerq `kvi p-v $\hat{P}\hat{T}$

c`v \hat{P} K \hat{v} b, Zij I erqerq Ae \hat{v} tK K \hat{v} b `kv, Zij `kv I erqerq `kvi ejv nq| Pvc c \hat{v} q \hat{v} M
A \hat{v} aK \hat{v} sK c`v \hat{P} K erqerq Ae \hat{v} t \hat{T} K Zij Ae \hat{v} rq ifcv \hat{S} i Z Kiv hvq|

tK \hat{v} b GK \hat{v} Zi \hat{T} i Ams \hat{S} ut \hat{S} er \hat{v} u \hat{v} \hat{v} btq cix \hat{v} Kiv n \hat{T} j Atc \hat{v} KZ.Kg Zvcgv \hat{T} v t \hat{T} K ii" K \hat{T} i
D \hat{P} Zi Zvcgv \hat{T} vq G \hat{v} i Pvc e \hat{v} vg AvqZ \hat{T} bi t \hat{T} L \hat{v} $\hat{P}\hat{T}$ tKgb n \hat{T} e Zv 15.5 bs $\hat{P}\hat{T}$ t \hat{v} qv n \hat{T} j v|

p-v t \hat{T} L \hat{v} $\hat{P}\hat{T}$ T Zvcgv \hat{T} vq Ams \hat{S} ut \hat{S}
er \hat{v} u \hat{v} i Ae \hat{v} tK A \hat{v} e`y \hat{v} iriv t \hat{v} L \hat{v} t \hat{v} n \hat{T} j |

Gevi er \hat{v} u \hat{v} tK \hat{v} i Zvcgv \hat{T} vq ti \hat{T} L
msbgZ Kiv n \hat{T} j GK mgq er \hat{v} u \hat{v} m \hat{S} ut \hat{S}
n \hat{T} e| G m \hat{S} ut \hat{S} Ae \hat{v} t p-v $\hat{P}\hat{T}$ B \hat{v} e`y
 \hat{v} iriv t \hat{v} L \hat{v} t \hat{v} n \hat{T} j | msbgb Ae \hat{v} vnZ \hat{v} K \hat{T} j
m \hat{S} ut \hat{S} er \hat{v} u \hat{v} Zi \hat{T} j c \hat{v} iYZ n \hat{T} e| G mgq
Pvc Ac \hat{v} ie \hat{v} Z \hat{v} \hat{v} K \hat{T} e| $\hat{P}\hat{T}$ BC tiLv
NbrFeb e \hat{v} vt \hat{v} Q| BC tiLv eivei Zij I
m \hat{S} ut \hat{S} er \hat{v} u \hat{v} mig \hat{v} e \hat{v} rq Ae \hat{v} vb K \hat{T} i |
A \hat{v} G Ae \hat{v} rq Zij I m \hat{S} ut \hat{S} er \hat{v} u \hat{v}
mnve \hat{v} b K \hat{T} i | BC mij \hat{T} iLv eivei
NbrFeb \hat{v} i Pvc I \hat{v} i Zvcgv \hat{T} vq
msN \hat{v} UZ nq|



15.3.3 t Pvc- ZvcgvĀv`kv ĩPĀ

Pvc ZvcgvĀv`kv ĩPĀ c`v`ġ ĩwfbæ`kv ĩwfbævte cĶĳk Kiv hvq|

ĩwfbæDòZvq tKvb Ziĳi ev^úxq Pvc tgtc P-T tjL AvKĳj H Ziĳi`kv ĩPĀ cvlqv hvq| P-T tjL ĩPĀ ĩmivth`Kĳb, Zij I evqexq`kvi cĳieZĪ t`Lvĳv hvq| 15-6 bs ĩPĀ OA tiLv Zij I ev^úui mvg`ve`vi tiLv, OB tiLv Kĳb I Ziĳi mvg`ve`vi tiLv Ges OC tiLv Kĳb I ev^úui mvg`ve`vi tiLv eSvq| th tKvb Kĳb c`v`ġ`ĳk th tKvb Pvc me mgq ĩKQybv ĩKQyEaĳevZb NtU| ĩKšzEaĳevZb GZ Kg nq th mntR Zv eSv hvq bv| CO tiLmU eiĳdi ev^úPvc ĩbĳ`R KiĳQ| eiĳdiI cĪZ`K DòZvq mĳbv`Ī ev^úPvc AvĳQ hv DòZv eĳx ĩmĳ` ĩmĳ` eĳx cvq| CO ĳiLv GB eĳx ĩbĳ`R KiĳQ|

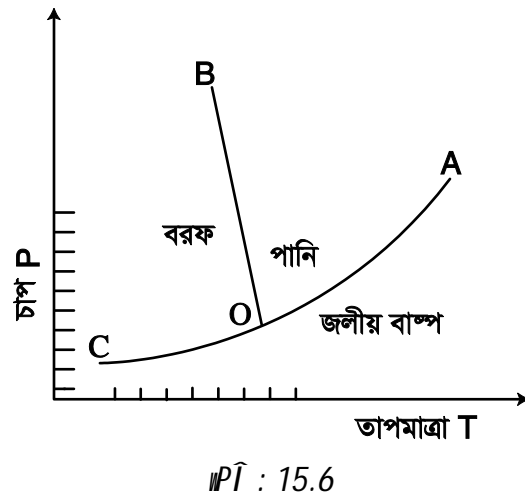
OB tiLv ĩbĳ`R KiĳQ δ Pvc ĩmĳ` ĩmĳ` ĩngvsk ev Mj bsvĳKi cĳieZĪ| Pvc eĳx tctj Mj bsvK mvgvb`nĳm cvq|

GKB tjL ĩPĀ Kĳb-Zij, Zij-evqexq I Kĳb-evqexq`kvi mvg`ve`vq P-T tiLv Aĳb Kĳi tiLv, ĳĳĳk eĳaZ Kiĳj Ggb GKĳU ĩe`ycvlqv hvq, thLvĳb ĩZbĳU mvg`ve`vi tiLv ĩgĳj Z nq|

H ĩe`ĳk Āa ĩe`y(Triple point) ejv nq|

Āa ĩe`ĳZ GKĳU ĩbv`Ī Pvc I ZvcgvĀvq c`v`ġ`ĳk ĩZbĳU`kv mvg`ve`vq mve`vb Kĳi| ĩPĀ 15.6-G O ĩe`yĀa ĩe`y

cĳibi Āa ĩe`y 0.01⁰ C (273.16 K) Ges Āa ĩe`ĳZ Pvc 4.6 mm cvi`| cĳibi`kv ĩPĀ (Phase diagram) 15-6 bs ĩPĀ t`Lvĳv ntĳĳQ|



cvVvEi gj'iqb

K. mWK DEti i cvk WK (√) vPy v b|

(1) μmš-ve` yKvbwK ej v nq?

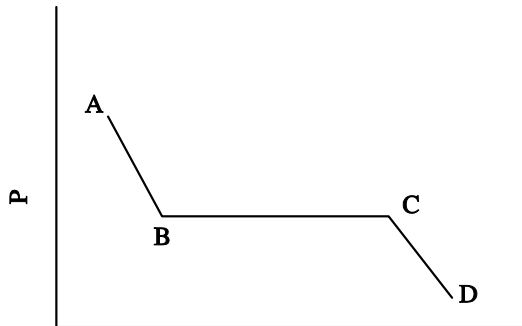
(K) ei tdi Mj bv¼K

(L) Zi tji ùb¼K

(M) Áa ve` tK

(N) Ggb GK ZvcgvT v th ZvcgvT vi EtaYm'vm tK Pvc cM Kti Zij xFZ Kiv hvq bv|

2) vb tPi tj L vP t i tKvb Ask Kvb Zi tji mig' ve v eSvq?



(K) AB Ask

(L) BC Ask

(M) CD Ask

(N) ABC Ask

3) 31.1⁰ C ZvcgvT v KveB-WvB A- vBW Gi -

(K) Áa ve` y

(L) μmš-ve` y

(M) ùb¼K

(N) Mj bv¼K

L. msuB cke

1| μmš-ZvcgvT v eYv Ki "b|

2| `kv vP t Kv tK etj | `kv vP t Gt k cmbi Áa ve` yc k Ki "b|

iPbvj-K cke

1| Mj b I Kvbxfv eYv Ki "b|

2| Mj tbi Av tcv tK mZvc Kv tK etj ? ei d Mj tbi Av: mZvc vbY c vj x eYv Ki "b|

3| ev'xfv I Nbvxfv e vL v Ki "b|

4| ev'vqb I ùb tbi gta" cv R" eYv Ki "b|

5| ev'xfv tbi Av: mZvc Kv tK etj ? ev'xfv tbi Av tcv tK mZvc vbY c vj x eYv Ki "b|

6| Zij evqexq `kvi P-v vP t eYv Ki "b Ges μmš-ve` ye vL v Ki "b|

7| M'v tmi μmš-a eK, vj WK WK? cZ tKi eYv Ki "b|

8| P-T `kv vP t e vL v Ki "b Ges `kv vP t Áa ve` yeYv Ki "b|

MwvZK cĕœ

- 1/ hw` Mj tbi Av: mßZvc $3.36 \times 10^5 \text{ Jkg}^{-1}$ nq Zvntj 200g eid Mj vtZ KZUKzZvc cĕqvRb?
- 2/ 0^0 C Zvcgvĭvi 20g eid tK 100^0 C Zvcgvĭvi ev t`ú cwi YZ Ki tZ KZUKzZvc cĕqvRb?
 (ei tdi Av tcvĭĭK Zvc = $2100 \text{ Jkg}^{-1} \text{ K}^{-1}$, eid Mj tbi Av tcvĭĭK mß Zvc = $3.36 \times 10^5 \text{ Jkg}^{-1}$, cmbi ev`úxfetbi Av tcvĭĭK mß Zvc = $2.26 \times 10^5 \text{ Jkg}^{-1}$)
- 3/ -20^0 C Zvcgvĭvi 1kg eid tK
 (K) 0^0 C Zvcgvĭvi cmb tZ cwi YZ Ki tZ
 (L) 30^0 C Zvcgvĭvi cmb tZ cwi YZ Ki tZ Ges
 (M) 100^0 C Zvcgvĭvi ev t`ú cwi YZ Ki tZ KZUKzZvc cĕqvRb?
 (ei tdi Av: Zvc = $2100 \text{ Jkg}^{-1} \text{ K}^{-1}$, cmbi Av: Zvc = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$)
 eid Mj tbi Av tcvĭĭK mß Zvc = $336 \times 10^3 \text{ J kg}^{-1}$
 cmb ev`úxfetbi Av: mß Zvc = $2260 \times 10^3 \text{ J Kg}^{-1}$)
- 4/ 0^0 C Zvcgvĭvi 2.1 kg eid 40^0 C Zvcgvĭvi 5.9kg cmbi m t` ngkv tbi ntj v| ngk tYi Zvcgvĭv KZ n tē? [eid Mj tbi Av tcvĭĭK mß Zvc = $3.36 \times 10^5 \text{ Jkg}^{-1}$, cmbi Av tcvĭĭK Zvc = $4.2 \times 10^3 \text{ Jkg}^{-1} \text{ K}^{-1}$]
- 5/ 4.2kg fi nekó GKw Zvgvi K`vj wi ngv tē 70^0 C Zvcgvĭvi 1.62kg cmbi g t` 0^0 C Zvcgvĭvi 1.0kg eid t t` qv ntj v| Pgv š-Zvcgvĭv KZ n tē?
 (Zvgvi Av: Zvc = $380 \text{ J kg}^{-1} \text{ K}^{-1}$)