PHY6B10:THERMODYNAMICS

A Part

1. define mechanical coordinates and thermodynamic coordinates
2. what are the properties involved in the of microscopic description of a system
3. what is meant by microscopic point of view
4. what are macroscopic coordinates
5. what are the properties of macroscopic coordinates
6. state zeroth law of thermodynamics
7. what is an adiabatic wall? give examples
8. define thermal equilibrium of a system
9. define temperature
10. what is a diathermic wall? give an example
11. define triple point of water
12. what is meant by equilibrium of a system
13. what is the limitation of equation of state
14. diffferentiate between intensive and extensive variables
15. what is the principle of ideal gas thermometer
16. define non equilibrium state
17. what is meant by chemical equilibrium of a system
18. what is meant by mechanical equilibrium of a system
19. what is an equation of a state
20. what is a hydrostatic system
21. write down the expression for work done by a hydrostatic system
22. what is a quasi static process
23. what are the indications of PV diagram
24. what is a PV diagram
25. distinguish between external workdone and internal work done
26. distinguish between adiabatic work and diathermic work
27. define adiabatic wall and diathermic wall
28. what are the significance of first law of thermodynamics
29. state first law of thermodynamics

30. define heat
31. distinguish between work and heat
32. what is meant by internal energy of a thermodynamic system
33. what are the sign conventions used in first law of thermodynamics
34. define molar specific heat capacity
35. what is meant by heat capacity
36. define thermodynamic heat
37. define specific heat capacity. what is its unit
38. define joule coefficient
39. draw Pv versus P graph at constant temperature in the range of boiling point of water
40. define molar gas constant
41. write down the equations that ideal gas satisfy.
42. define ideal gas
43. show that the internal energy of a syatm remsins the same when it undergoes free adiabatic expansion
44. what is meant by adiabatic free expansion
45. under what condition ideal gas equation is valid
46. write down the virial series expansion of real gas and explain the symbols
47. on what all thermodynamic cordinates the internal energy of real gas depend
48. write down the expresssion for internal energy of a monoatomic ideal gas
49. what is the exceptional behaviour of Cp of hydrogen atom
50. what are isotherm
51. write down the properties of molar heat capacities of monatomic gases
52. write down the properties of molar specific heat capacities of ideal gas
53. write down the mayers relation and explain the symbols used
54. write down the properties of molar specific heat capacities of diatomic gases
55. write down an expression for average kinetic energy of gas and explain the terms
56. Give Planck's statement of second law of thermodynamics.
57. Give Kelvin's statement of second law of thermodynamics.
58. What is the principle of heat engine?
59. What is heat engine?
60. What are the limitations of first law of thermodynamics?

61. Distinguish between internal and external comustian engines.
62. A heat engine cannot attain 100% efficiency. Explain why?
63. Define the efficiency of a heat engine.
64. Give two examples each of internal and external combusitan engines.
65. What are the three basic essential things required to convert work into heat?
66. Give Kelvin-Planck statement of second law of thermodynamics.
67. What is the principle of refrigerator?
68. what is meant by equivalence of Kelvin - Planck and Clausius statement
69. what is meant by Carnot cycle.
70. Distinguish between Reversible and Irreversible process.
71. A Carnot engine working between 127°C and 27°C. What is the efficiency
72. calculate the efficiency of an engine that absorbs heat at 800K and exhausts it at 200K.
73. Efficiency of Carnot engine independent of working substance. Justify it
74. What are the conditions to be satisfied for a reversible process?
75. What is a reversible process? Give two examples.
76. What is an irreversible process? Give two examples.
77. Define Carnot engine.
78. What is Carnot's theorem?
79. Define thermodynamic scale.
80. Define the coefficient of performance of refrigerator.
81. Define absolute zero of thermodynamic scale.
82. Define entropy. What is its unit?
83. Express entropy change of ideal gas in terms of pressure and temperature.
84. what is work diagram?
85. Express entropy change of ideal gas in terms of pressure and volume.
86. express entropy change of ideal gas in terms of temperature and pressure. Express entropy change of ideal gas in terms of pressure and temperature. Express entropy change of ideal gas in terms of pressure and volume. What enables us to draw TS diagram?
87. State Clausius' theorem for a reversible process.
88. xpress entropy change of ideal gas in terms of temperature and pressure.
89. What is a TS diagram?
90. Draw isochoric and isobaric curve on a TS diagram.

91. Show that entropy is a constant for a reversible adiabatic process.
92. What are the advantages of TS diagram over PV diagram?
93. What enables us to draw TS diagram?
94. Draw a TS diagram for a Carnot cycle.
95. Give two examples for internal mechanical irreversibility process.
96. Define internal mechanical irreversible process.
97. Distinguish between isentropic process and adiabatic process.
98. When a system is said to undergo thermal irreversible process?
99. Give two examples of chemical irreversible process. 23. When a system is said to undergo thermal irreversible process? 24. Give two examples of thermal irreversible process. 25. State Clausius' theorem. 26. Write down the Clausius mathematical statement of second law and explain the symbols. 27. In general isentropic does not mean that adiabatic. Justify. 28. Distinguish between isentropic process and adiabatic process. 29. What is meant by entrop
100. What is external mechanical irreversibility process?
101. . Write down the Clausius mathematical statement of second law and explain the symbols.
102. Mention four types of irreversibility processes
103. What is meant by entropy change of the universe'?
104. Give two examples of thermal irreversible process.
105. Give two examples of external mechanical ireversibility process.
106. In general isentropic does not mean that adiabatic. Justify.
107. What is meant by chemical irreversibility process?
108. What is meant by entropy principle
109. State Clausius' theorem.
110. What is the significance of thermodynanmic potential?
111. Show that $(\partial A/\partial V)_T$=-P and $(\partial A/\partial T)_V$=-S
112. What it Legendre transformation?
113. show that Enthalpy H is a function of (S,P)
114. What is the connection between throttling process and enthalpy?
115. What are thermodynamic potentials?
116. What are thermodynamic functions?
117. What is enthalpy? Give two of its properties.
118. What is joule thomson expansion or throttling process
119. Show that $(\partial G/\partial P)_T$=V and $(\partial G/\partial T)_P$=-S

120. What is Gibbs function? Give two of its properties.
121. What is Hemholtz free energy? Give two of its properties.
122. Show that Helmholtz function of a system remains constant during reversible isothermal - isochoric process
123. Write down the four Maxwells relationships.
124. Discuss the conditions for exact differencial.
125. Show that Gibbs function remains constant during reversible isothermal - isobaric process
126. Distinguish between gas and vapour.
127. What is phase change?
128. What is triple point?
129. Write down TdS equations and explain the symbols.
130. Define the sublimation curve, vapourisation curve and fusion curve.
131. Draw a PV diagram for a pure substance.
132. What is the relation between Clausius-Clapeyron equation and phase diagram?
133. What is a phase diagram?
134. What is regelation?
135. Draw the density curve of liquid and vapour
136. Distinguish between triple point and normal melting point of ice.
137. Draw phase diagram for pure water.
138. Distinguish between PT and PV diagrams.
139. What is meant by a pure substance?
140. Write the expression for Clausius - Clapeyron equation. Explain the terms.
141. what is meant by First order phase transition.

B Part

142. Distinguish between macroscopic and microscopic points of vieW.
143. How equilibrium of two separate systems (X, Y) and (X', Y) be defined?
144. stablish the concept of temperature on the basis of zeroth law of thermodynamics.
145. establish the concept of temperature on the basis of zeroth law of thermodynamics
146. Explain how do you check whether or not two beakers of water are in equilibrium using zeroth law of thermodynamics
147. distinguish between heat and work
148. derive an expression for work done during isothermal process

149. define specific heat of a gas at a constant pressure and a constant volume explain why Cp>Cv for a gas define 1 calorie of heat what is a reservoir how to achieve quasi static flow of heat

150. Show that adiabatic slope is steeper than isothermal slope.

151. Show that adiabatic elasticity is y times isothermal elasticity.

152. derive the equation of state of a quasi-static adiabatic process.

153. show that adiabatic workdone is equal to change in internal energy

154. Briefly explain how to convert heat into work. Under isothermal process it is not possible to convert heat into work indefinitely. Explain.

155. Distinguish heat engine and Refrigerator

156. Prove that the Kelvin-Planck and Clausius statements are equivalent.

157. Prove Clausius inequality theorem.

158. State second law of thermodynamics. Briefly explain the mechanism of refrigerator that leads to Clausius statement of second law.

159. State and explain 2nd law of thermodynamics

160. Explain the Carnot cycle with a neat diagram.

161. Derive the expression for the efficiency of a Carnot engine

162. Distinguish between Reversible and Irreversible process.

163. A Carnot engine absorbs 100J of heat from a reservoir at the temperature of the boiling point of water and rejects heat to a reservoir at the temperature of the triple point of water. Find the heat rejected, the work done by the engine and the thermal efficiency.

164. Explain the TS diagram for a carnot cycle

165. Hydrogen is used in a Carnot cycle as a working substance. Find the efficiency of the cycle if as a result of an adiabatic expansion. (a) the gas volume increase by 2 times. (b) the pressure decreases by two times

166. Show that the efficiency of Carnot engine can never be 100%

167. What is a Carnot engine? Explain the working of a Carnot engine?

168. A Carnot engine whose temperature of the source is 400K takes 800 J of heat at this temperature and reject 600J of heat to the sink. What is the temperature of the sink and efficiency of the engine

169. A reversible engine with efficiency (1/5) that converts one fifth of heat which it absorbs at source into work. When the temperature of the sink is reduced by 77 °C, its efficiency is doubled. Compute the temperature of the source and sink.

170. The efficiency of a ideal engine is 0.2. If the temperature of the sink is lowered by 20°C, the efficiency becomes 0.25. Find the temperature of the source and sink.

171. Define thermodynamic scale and Show that ratio of two temperatures on this scale is equal to the ratio of the heat absorbed to the heat rejected.

172. A Carnot engine whose efficiency is 10% is used as a refrigerator. Find the coefficient of performance.

173. What is a refrigerator? Explain the working of a refrigerator?

174. state and prove Carnot's theorem and corollary.

175. show that the ideal gas temperature and the thermodynamic temperature scale are numerically equal

176. Explain the reason for the modification of ideal gas equation.

177. Prove Clausius' theorem for a reversible cyclic process.

178. Derive the expression for the change in entropy of a perfect gas.

179. Prove that entropy is a state function.

180. Show that for a Carnot cycle entropy remains constant.

181. Derive an expression for the entropy of ideal gas in terms of temperature and volume.

182. What is meant by Thermodynamic potentials. Explain its properties.

183. Explain Throttling process. Show that Enthalpy remains constant during this process.

184. Compare the properties of Internal energy and Enthalpy of a hydrostatic system.

185. Explain Joules - Thomason expansion ( Throttling process)

186. Starting from internal energy U, derive the remaining thermodynamic functions using Legendre transformation.

187. Using Max wells relation show that $C_P-C_V=T(\partial P/\partial T)_V\,(\partial V/\partial T)_P$
Deduce $C_P-C_V=R$ for a perfect gas.

188. Derive the condition for exact differential

189. Derive any two Maxwells relations

190. Explain the properties of Thermodynamic potentials.

191. From the Maxwells equation show that for a perfect gas $(\partial U/\partial V)_T=0$

192. Show that the first TdS equation may be written as $TdS = CvdT+(\beta/k)TdV$

193. For a system undergoes a reversible isothermal change of pressure, calculate the amount of heat transferred and the work done

194. Explain the PT diagram for a pure substance : Phase diagram.

195. Explain PV and PT diagram for a pure substance in detail

196. Show that the differential of the thermodynamic potential U may be written as $dU=(C_P-PV\beta)dT + V(kP-\beta T)dP$

197. If the pressure on 15 $cm^3$ of mercury at 20°C is increased reversibly and isothermally from 0 to 1000 atm; calculate the heat transferred. $ß=1.81x\ 10^{-4}\ K^{-1}$ . 1 atm=$1.01x\ 10^5$ Pa

198. One mole of van der waals gas undergoes a reversible isothermal expansion from volume $V_1$ to $V_2$ . Calculate the amount of heat transferred.

199. Derive the expression for the change in temperature when the system undergoes a reverse adiabatic change of pressure.

200. Derive first and second TdS equations.

201. Derive 3rd TdS equation

202. Discuss the PV diagram for a pure substance.

203. Explain First order phase transition.

204. Derive the Clausius - Clapeyron equation.

205. Discuss the first order phase transition in detail.

206. Discuss the Phase diagram for pure water in detail.

207. Calculate the boiling point of water under a pressure of two atmospheres. It is given that the boiling point of water under a pressure of one atmosphere is 373.2K. Latent heat of vapourisation is 539 cal/g. Specific volume of water is 1 cc and specific volume of steam is 1674 cc.

208. Calculate under what pressure ice freezes at 272 K if the change in specific volume when 1 Kg of Water freezes is $91 \times 10^{-6} m^3$. Latent heat of ice $3.36 \times 10^5 JKg^{-1}$.

209. Discuss the phase diagram for water

210. Calculate the change in temperature of boiling water when the pressure is increased by 2.712 cm of Hg. The normal boiling point of water at atmospheric pressure is 100°C. Latent heat of steam is 537 cal/g and specific volume of steam1674 cc.

211. Calculate the melting point of ice under a pressure of 2 atmospheres. It is given that the melting point of ice under one atmospheric pressure is 273.16 K. Latent heat of fusion of ice is 79.6 cal/g and at the melting point specific volume of ice is 1.0908 cc and that of water is 1.0001 cc. One atm $=1.013 \times 10^6$ dynes $cm^{-2}$.

212. Explain the Clausius Clapeyron equation and phase diagrams

213. Explain the principle behind ice skating. and show that pressure increases the boililng point also increases.

C Part

214. starting from quasi static flow of heat explain how will you measure heat

215. explain thermal equilibrium using zeroth law of thermodynamics

216. explain how do you find ideal gas temperature using a constant volume gas thermometer

217. What do you mean by Quasi static adiabatic process. Obtain an expression for equation of state interms of (P,V) , (P,T) and (T,V)

218. efine quasi static process. Calculate the work done during quasi static isothermal process and Quasi static adiabatic process.

219. Define Quasi static process. Explain different type of quasi static processes. Derive an expression for work in changing the volume of hydrostatic system.

220. Explain the carnot engine and carnot cycle operations. Calculate the expression for efficiency of the engine.

221. Explain the working of a refrigerator? State and prove Carnot's theorem.

222. Discuss the theory of Thermodynamic scale of temperature. Show that the ideal gas temperature and the thermodynamic temperature scale are numerically equal

223. discuss the concept of entropy and obtain an equation of ideal gas

224. discuss reversible part of second law and explain th concept of entropy

225. State and prove Clausius theorem for entropy and write down Clausius mathematical formulation

226. explain the relation of entropy and irreversibilty by considering mechanical and thermal irreversibilities

227. discuss heat and entropy in reversible process and then establish principle of entropy increase

228. Derive the expression for the change in entropy of perfect gas in terms of T and V, T AND P

229. Explain Joule Thomson expansion and show that and that enthalpy remains constant during this process . Also discuss the properties of enthalpy.

230. what is meant by thermodynamic potentials? Derive Maxwell's four thermodynamics relations.

231. Derive first and second TDS equations. And show how the intrinsic energy varies with volume in perfect gas and real gas.

232. Explain PV and PT diagram for a pure substance in detail

233. Derive first and second TDS equations. Discuss its applications

234. Discuss the first order phase transition in detail.

235. Discuss the Phase diagram for pure water in detail.

D Part

E Part