

True-false questions for the Introductory part of the

Physical Chemistry 1

exam in the spring semester of 2017/2018

1. Gases have a fixed volume.
2. Solids and liquids have fixed volumes.
3. The units of pressure in SI is atm.
4. In an ideal gas, there is no attraction or repulsion between the particles.
5. Under isothermal conditions, the pressure of a system does not change.
6. The equation $pV = nRT$ is valid for any gas independently of the conditions.
7. The equation $pV_m = RT$ is valid for any ideal gas.
8. The critical temperature depends on the pressure.
9. Mixtures of real gases behave like a single real gas.
10. Mixtures of ideal gases behave like a single ideal gas.
11. The van der Waals equation describes the properties of real gases under certain conditions.
12. The compression factor of a gas is used to characterize boiling point elevation.
13. At constant pressure, the volume of an ideal gas is inversely proportional to the temperature.
14. At constant temperature, the volume of an ideal gas is inversely proportional to the pressure.
15. The Virial equation of state is more general than the ideal gas law.
16. The partial pressure of a gas is the same as the overall pressure in every two-component system.
17. A permeable wall makes matter of exchange impossible.
18. A diathermic wall allows energy exchange between the system and the environment.
19. In an adiabatic change, no heat is exchanged between the system and its environment.
20. An extensive property is independent of the size of the system.
21. An intensive property is independent of the size of the system.
22. Under isochoric conditions, the pressure of a system does not change.
23. An endothermic reaction absorbs heat from the environment.
24. An exothermic reaction absorbs heat from the environment.
25. Expansion work can be calculated from the temperature and volume change of a system.
26. Expansion work can be calculated from the volume change and pressure of a system.
27. The absolute value of internal energy cannot be determined.
28. The conservation of energy law can be expressed in many different forms.
29. The internal energy of an isolated system is constant.
30. A calorimeter is often used to measure volume changes of chemical reactions.
31. Heat capacity is the first derivative of internal energy with respect to temperature.
32. The enthalpy of a reaction is basically the same as the heat at constant pressure.
33. The heat capacity of a system is always negative.
34. In physical chemistry, the term "standard state" only refers to standard pressure.
35. The standard enthalpy of formation for any element is zero.
36. Freezing and condensation are exothermic processes.
37. Melting is usually an exothermic process.
38. The enthalpy of reaction only depends on the initial and final state, but not on the path.
39. The net enthalpy change of a cyclic process is always positive.
40. The standard enthalpy of a reaction can be calculated from combustion enthalpies.
41. The heat capacity at constant volume is the same for all monatomic ideal gases.
42. The Born-Haber cycle can be used for determining lattice enthalpies.
43. The Born-Haber cycle cannot be used for determining hydration enthalpies.
44. Enthalpy is defined using the temperature and entropy of a process.
45. Phase transitions are not usually accompanied by enthalpy changes.
46. Phase transitions are not usually accompanied by changes in internal energy.
47. Phase transitions are typically accompanied by changes in enthalpy.

48. Heat is only transferred spontaneously from a hotter object to a cooler object.
49. Work can be done by both spontaneous and non-spontaneous processes.
50. Heat cannot be transformed into work entirely in any process.
51. The entropy of an isolated process always decreases.
52. Work is usually needed to force non-spontaneous processes.
53. Entropy is defined as the ratio of reversible heat exchange and temperature.
54. The value of a state function only depends on the actual state of the system and not on its history.
55. The usual units for entropy is Pa.
56. The usual units for entropy is J K^{-1} .
57. The usual units for molar internal energy is g mol^{-1} .
58. The usual units for molar internal energy is J mol^{-1} .
59. Boltzmann's constant appears in the statistical definition of entropy.
60. Reversible adiabatic processes are isentropic.
61. The temperature does not change during an adiabatic process.
62. The molar entropy of evaporation is about the same for most liquids.
63. The Carnot efficiency is independent of temperature.
64. Heat engines convert mechanical work into heat.
65. Heat pumps transfer heat from a colder object to a hotter one.
66. The entropy change of a chemical process tends to zero as the temperature tends to zero.
67. The absolute value of entropy cannot be determined.
68. The fundamental equation are only valid for ideal gases in thermodynamics.
69. The Gibbs free energy of a spontaneous process decreases at constant pressure and temperature.
70. The Helmholtz energy of a spontaneous process decreases at constant volume and temperature.
71. The Gibbs energy usually increases with increasing temperature.
72. The entropy of a substance usually increases during evaporation.
73. The chemical potential is important only if the composition of a system changes.
74. In equilibrium, the chemical potentials of all components must be the same in each phase.
75. The chemical potential is the same as the molar Gibbs free energy in any system.
76. The chemical potential is the same as the partial molar Gibbs free energy in any system.
77. The chemical potential is not related to enthalpy changes at all.
78. The chemical potential of an ideal gas depends linearly on $\ln p$ and the proportionality factor is RT .
79. Fugacity is a kind of effective pressure that replaces pressure in non-ideal systems.
80. The usual units used for fugacity is K / m .
81. The Gibbs-Duhem equation is valid in any system in thermodynamics.
82. Raoult's law connect the properties of ideal solutions to the properties of the pure components.
83. The partial molar volumes of all components are always positive in any system.
84. The free energy of mixing is always zero for ideal gases.
85. The entropy of mixing is always zero for ideal gases.
86. The internal energy of mixing is always zero for ideal gases.
87. The enthalpy of mixing is always zero for ideal gases.
88. Freezing point depression is one of the colligative properties.
89. The boiling point elevation of a solution is dependent on the identity of the solute.
90. The freezing point depression of a solution is dependent on the identity of the solvent.
91. The excess function in a mixture is the difference between the measured real and ideal values.
92. Henry's law is valid in any solution.
93. The activity of the solvent and the solute is often defined in different ways.
94. Activity plays the same role in solution as fugacity does in the gas phase.
95. Raoult's law and Henry's law are different but are used to describe similar phenomena.
96. The chemical potential of a component can be changed independently of the other components.
97. At high pressure, the chemical potential of real gases is higher than for an ideal gas.
98. The entropy of a perfect crystalline solid is zero at zero temperature.
99. The entropy of a gas is zero at zero temperature.
100. Osmosis is the movement of solute molecules from one solution to another.

101. The lever rule is useful in one-component systems.
102. The lever rule is useful in two-component systems.
103. The lever rule is useful in three-component systems.
104. A phase is a macroscopic part of a system which shows identical properties everywhere.
105. $F + P = C + 2$ is a mathematical formula used to express the phase rule.
106. The phase rule can only be used in ideal mixtures.
107. Four phases may exist in a one-component system in equilibrium.
108. A eutectic mixture does not freeze at all.
109. An azeotrope boils without any change in compositions.
110. Incongruent melting is the phenomenon when a solid can only be melted by decomposing it.
111. Triangle phase diagrams usually show pressure changes.
112. Triangle phase diagrams usually only show composition changes.
113. It is impossible for three phases to co-exist in a three-component system.
114. In a three component, single phase system, the number of degrees of freedom is 1.
115. In a single component, three-phase system, the number of degrees of freedom is 0.
116. The phenomenon of eutectic halt can be detected on cooling curves.
117. Reaction Gibbs energy has a maximum in chemical equilibrium.
118. The reaction Gibbs energy can be calculated from the chemical potentials.
119. The reaction quotient in equilibrium is called the equilibrium constant.
120. Equilibrium constants cannot be determined from electrode potentials.
121. The forward and reverse reactions do not stop in equilibrium, but their rates are identical.
122. Le Chatelier's principle describes the response of the equilibrium system to external stress.
123. Le Chatelier's principle describes the rates of chemical reactions.
124. Le Chatelier's principle describes the electromotive forces of electrochemical cells.
125. The equilibrium constant of an endothermic reaction increases with temperature.
126. The equilibrium constant of a reversible process increases when more reactants are added.
127. The van't Hoff equation describes the dependence of the equilibrium constant on pressure.
128. The van't Hoff equation describes the dependence of the equilibrium constant on temperature.
129. In ammonia synthesis, the conversion is independent of the pressure.
130. Endergonic reactions do not proceed spontaneously.
131. It is impossible to prepare a solution of cations without any anions present.
132. Electrolytes do not dissolve in water.
133. Electrolytes produce ions upon dissolution in water.
134. By convention, the hydroxide ion has zero enthalpy of formation.
135. The activity coefficients of individual ions cannot be determined experimentally.
136. The Debye-Hückel law describes the non-ideal behavior of non-electrolytes.
137. The primary variable in the Debye-Hückel law is called ionic strength.
138. The ionic strengths of 0.10 mol/dm³ solutions of KBr and NaCl are different.
139. In a Galvanic cell, the two electrode compartments must be connected electronically.
140. In a Galvanic cell, electricity causes a spontaneous reaction to occur.
141. The cathode is always the negative electrode.
142. The anode is always the positive electrode.
143. The anode is always the site of oxidation.
144. The cathode is always the site of reduction.
145. The Nernst equation describes the dependence of the electrode potential on the concentrations.
146. The Nernst equation describes the dependence of the electrode potential on the pressure.
147. Standard reaction free energies can be determined from cell potentials.
148. The electromotive force is the cell potential in the absence of any current.
149. Galvanic cells are not used any more in everyday life.
150. The lithium ion battery is not a Galvanic cell.
151. The standard hydrogen electrode is a reference point in electrochemistry.
152. The conductivities of both weak and strong electrolytes depend on their concentration.
153. The Kohlrausch law is valid for strong electrolytes.

154. The molar conductivity of a strong electrolyte increases as the concentration decreases.
155. The molar conductivity of a weak electrolyte decreases as the concentration decreases.
156. Ostwald's dilution law is valid for strong electrolytes.
157. The mobility of an ion is the ratio of the drift speed and the electric field.
158. Dynamic electrochemistry often uses current density instead of current.
159. The current density is defined as current divided by the amount of substance.
160. Overpotential is usually the difference between the actual and equilibrium potentials.
161. The Tafel equation connects current density with overpotential.
162. The Tafel equation is based on experimental observations.
163. The Butler-Volmer equation can be simplified to give the Tafel equation.
164. The Butler-Volmer equation gives the potential as a function of concentrations.
165. The limiting current density can be measured at high overpotentials.
166. Fick's first law describes the thermal conductivity of substances.
167. Fick's second law is partial differential equation.
168. The rate of a chemical reaction is usually based on concentration changes.
169. The rate equation gives the rate as a function of temperature.
170. The rate equation gives the rate as a function of reactant concentrations.
171. The rate of a reaction is a derivative with respect to entropy.
172. Reactions faster than 1 s cannot be investigated at all.
173. Machine mixing of two solutions can be achieved in 1 ps.
174. The stopped flow method is used to measure partial molar volumes.
175. The stopped flow method is used to measure the kinetics of fast reactions.
176. The order of reaction is always identical to the stoichiometric coefficient.
177. The half-life of any process is independent of the initial concentration.
178. The half-life of a first order process is independent of the initial concentration.
179. The kinetic curve characterizing a first order process is called exponential.
180. The kinetic curve characterizing a second order process is called exponential.
181. In zeroth order kinetics, the rate does not depend on the concentration.
182. In consecutive reactions, the product of the first process is the reactant of the second.
183. In parallel reactions, the product of the first process is the reactant of the second.
184. The steady state approximation can be used to simplify complicated rate equations.
185. The van't Hoff method is suitable to determine rate equations.
186. The Michaelis-Menten equation is typically used in enzyme kinetics.
187. The Arrhenius equation is only used in enzyme kinetics.
188. Rate constants tend to decrease as the temperature increases.
189. Hydrogen bromide is formed from its elements in a second order reaction.
190. Hydrogen bromide is formed from its elements in a complicated chain reaction.
191. The activation energy can be determined directly from the rate equation.
192. The activation energy can be determined from the Arrhenius equation.
193. In a chain reaction, the same radical reacts with several different substances.
194. Catalysts never influence the equilibrium constant of a process.
195. An autocatalyst is a reactant and catalyst at the same time.
196. The Eyring equation uses collision numbers to estimate a second order rate constant.
197. In diffusion limited reactions, every collision leads to reaction.
198. In energy limited reactions, every collision leads to reaction.
199. A rate constant in solution may depend on the pressure.
200. The transition state is another name for an intermediate.