

CONTENTS

Preface	vii
Acknowledgements	ix
1. GENERAL PROPERTIES OF THERMOLUMINESCENCE	1
Q1. What is radio-thermoluminescence (RTL) ?	1
Q2. How is it possible to decide if the TL response vs dose is linear or not?	1
Q3. What is an activator ?	1
Q4. What is the annealing procedure?	1
Q5. What is the meaning of the term “ afterglow ”?	2
Q6. What is anomalous fading ?	2
Q7. What is the calibration factor ?	2
Q8. How is the calibration factor , Φ_C , defined? .	2
Q9. How is the phosphor sensitivity , S , defined?	3
Q10. How do we set the heating rate for determining the kinetics parameters relative to a TL glow peak?	3
Q11. How can a trap be considered stable at room temperature?	3
Q12. What is the optical bleaching of the TL signal?	3
Q13. What is the light-induced fading ?	4

Q14.	What is the phototransferred TL ?	4
Q15.	What is the optically induced TL ?	4
Q16.	What is the method called “ in vivo dosimetry ”?	4
Q17.	How do we perform the “ in vivo dosimetry ”?	4
Q18.	What is the aim of “ in vivo dosimetry ”?	5
Q19.	What is the meaning of TPS ?	5
Q20.	How are the entrance dose , D_{entrance} , and the exit dose , D_{exit} , defined?	5
Q21.	How is the surface dose , D_{surface} , defined?	5
Q22.	What is the intrinsic precision of a TL dosimeter?	5
Q23.	Which are the parameters that affect the reproducibility of a given thermoluminescent material associated to a given readout system?	6
Q24.	How can the reproducibility evaluated?	6
Q25.	What is the thermal treatment for thermoluminescent dosimeters?	6
Q26.	Why is the thermal treatment important?	6
Q27.	Which types of heating systems are encountered in TLD readers?	6
Q28.	How does the contact readout system work?	7
Q29.	How does the non-contact readout system work?	7
Q30.	Which type of heating cycle has to be used for kinetics studies?	7
Q31.	What is the definition of fading ?	7
Q32.	What is the fading factor ?	7
Q33.	How do we calculate the fading factor ?	8
Q34.	Is there an expression which takes into consideration the competition between fading and irradiation at the same time?	8

Q35. Is there a **desensitization** effect caused by UV exposure? 8

Q36. Is there a thermoluminescence transferred effect as a consequence of the UV exposure? 9

Q37. What is the meaning of the term “**regeneration**” for a given peak? 9

Q38. Can a pressure applied on a thermoluminescent sample cause some effect? 9

Q39. Which kind of **stress** applied to a sample can affect its thermoluminescent emission? 9

Q40. Which are the possible **excitation agents** in thermoluminescence? 9

Q41. Is heat an **excitation agent** for **thermoluminescence**? 10

Q42. How do we distinguish between **luminescence** and **incandescence** emissions? 10

Q43. Are there any differences in temperatures of occurrences between **thermoluminescence** and **incandescence**? 10

Q44. Which are the most **sensitive thermoluminescent materials**? 10

Q45. How do we carry out **thermoluminescence spectra** measurements? 11

Q46. What is the effect of the **linear energy transfer (LET)** on the thermoluminescence response? 11

Q47. What are the effects of high **LET** radiation on the thermoluminescence emission? 11

Q48. Is there any intrinsic thermoluminescence **sensitivity** to UV rays exposure? 11

Q49. Are the **glow curves** obtained after UV rays exposure the same as the ones obtained after X or gamma irradiation? 12

- Q50. Is the **thermoluminescence sensitivity** to UV rays exposure the same as that of X or gamma irradiation? 12
- Q51. Is there a special procedure to enhance the **UV sensitivity** of phosphors? 12
- Q52. Does the thermoluminescent glow curve shape depend on the **UV wavelength**? 12
- Q53. Is there a **UV effect** on phosphors already irradiated using X or gamma radiation? 12
- Q54. Which are the effects of the **heating rate** on the peak characteristics? 13
- Q55. Why does the thermoluminescent intensity decreases as the **heating rate** increases? 14
- Q56. What is the **thermal quenching** effect? 14
- Q57. How can the **thermal quenching** effect be explained? 14
- Q58. How can the **thermal quenching** effect be studied? 14
- Q59. Can an **electric field** have an effect on thermoluminescence when applied to a phosphor sample? 14
- Q60. What is the order of magnitude of the **electric field** to be applied to a phosphor to get the effects? 15
- Q61. What are the factors affecting the thermoluminescent emission when an **electric field** is applied to a phosphor? 15
- Q62. What is the **detection threshold**? 15
- Q63. How do we calculate the **detection threshold**? 15
- Q64. In which way do we measure the **zero-dose**? 16
- Q65. How to calculate the **zero-dose** reading? 16
- Q66. How is the **net reading** of N dosimeter irradiated at the same dose defined? 16

Q67.	How is it possible to repeat a thermoluminescent experiment reported in literature to get the same results?	16
Q68.	What is fluorescence ?	17
Q69.	Is fluorescence decay temperature dependent?	17
Q70.	What is the mechanism of fluorescence ?	17
Q71.	What is phosphorescence ?	18
Q72.	Is phosphorescence dependant on temperature?	18
Q73.	Why does the phosphorescence depends on temperature?	18
Q74.	How should the spectrum of the emitted thermoluminescent light be?	19
Q75.	Which glow peak characteristics are affected by the heating rate ?	19
Q76.	What is the main problem in the preparation of artificial thermoluminescent materials ?	19
Q77.	Which are the main techniques for growing single thermoluminescent crystals ?	19
Q78.	In which way can polycrystalline TL materials be prepared?	19
Q79.	Are the thermoluminescent materials poor or good thermal conductors?	20
Q80.	How can the temperature difference between the two faces of a thermoluminescent chip be estimated?	20
Q81.	What are the factors affecting the sensitivity of a thermoluminescent instrument?	20
Q82.	Which factors can affect the glow curve of a thermoluminescent material?	20
Q83.	How do we define the superlinearity in the plot TL vs Dose?	21

- Q84. Is there any expression for a quantitative measure of the **superlinearity**? 21
- Q85. What kind of indication does the **superlinearity** index give? 22
- Q86. What is the **supralinearity** index $f(D)$? 22
- Q87. How is the **supralinearity** index $f(D)$ defined? 22
- Q88. What is the physical reason that the area under a thermoluminescent **glow peak** is proportional to the dose absorbed by the TL dosimeter? 22
- Q89. What is the meaning of **physicochemical stability** for a dosimetric material? 23
- Q90. What is **tribothermoluminescence**? 23
- Q91. Which are the characteristics of a **first order peak**? 23
- Q92. Which are the characteristics of a **second order peak**? 26
- Q93. What are the procedures if **contamination** of the thermoluminescent dosimeters is suspected? 27
- Q94. Which are the main applications for the **integrating dosimeters**? 27
- Q95. What are the main practical characteristics which must be considered when choosing a **dosimetric system**? 28
- Q96. To which quantities is the **emitted light**, $L(\lambda)$, from a dosimeter proportional to? 28
- Q97. To which quantities is the **light generated** in the dosimeter **per unit absorbed dose**, $P(\lambda)$, proportional to? 29
- Q98. To which quantities is the **geometrical-optical factor**, K , a function of? 29
- Q99. To which parameters is the fraction of the **total light sum** measured, K_2 , a function of? 30

Q100. How do we express analytically the **light** $L(\lambda)$ **emitted** by an irradiated dosimeter and reaching the PM tube of the reader? 30

Q101. How can be the **dose distribution** through a dosimeter simulated? 30

Q102. How do we simulate the **self-attenuation of light** output by the dosimeter? 31

Q103. What is the **photon energy response** curve? 31

Q104. What is the behavior of the **photon energy response** curve as a function of the photon energy? 32

Q105. What is the so called **individual correction factor**, S_i ? 32

Q106. What is the **relative intrinsic sensitivity factor**? 32

Q107. What is the practical meaning of the **individual correction factor**, S_i ? 32

Q108. How to calculate the **individual correction factor**? 33

Q109. Which are the factors that affect the dosimeter **background**? 33

Q110. Can the thermoluminescent dosimeters show any **self-dose** effect? 33

Q111. How do we carry out an estimation of the **self-dose** effect, if any? 34

Q112. What is a **thermally disconnected trap**? . 34

Q113. What is the **correction factor**? 34

Q114. How do we calculate the **correction factor**? . 34

2. THEORY OF THERMOLUMINESCENCE 35

Q115. What is the **activation energy**? 35

Q116. What is the **Arrhenius' equation**? 35

- Q117. How do we describe the **absorption of light** in a solid? 35
- Q118. What is the **Lambert-Beer law**? 35
- Q119. What is the meaning of **GOT model**? 36
- Q120. Which of the different **thermoluminescent models** is the simplest? 36
- Q121. What is the meaning of **OTOR**? 37
- Q122. Are the **GOT** and the **OTOR** models different? 37
- Q123. What is the **OTOR model**? 37
- Q124. What are the variables used in the **OTOR model**? 37
- Q125. What are the **differential equations** in the **OTOR model**? 38
- Q126. What is the meaning of the quantity $\frac{dn}{dt}$ in the differential equations of the **OTOR model**? . 38
- Q127. What is the meaning of the quantity $\frac{dn_C}{dt}$ in the differential equations of the **OTOR model**? 39
- Q128. What is the term describing the **thermal excitation** of the electrons leaving the trap? . 39
- Q129. What is the physical meaning of the differential equations governing the **OTOR model**? 39
- Q130. How do we solve the differential equations of the **OTOR model**? 40
- Q131. Which cases are described by the **OTOR model**? 40
- Q132. Which is the equation giving the **maximum condition** for a first order glow peak? 40
- Q133. Which is the equation giving the **maximum condition** for a second order glow peak? . . . 41
- Q134. Which is the equation giving the **maximum condition** for a general order glow peak? . . . 41
- Q135. What is the **tunneling** phenomenon? 41

Q136. Why can the **initial rise method** be expressed by the equation $I(T) \propto \exp\left(-\frac{E}{kT}\right)$? 42

Q137. What is the **interactive model**? 42

Q138. What is the meaning of **IMTS**? 42

Q139. What is the band model for the **interactive thermoluminescence** process? 42

Q140. Which equations describe the **interactive thermoluminescent** process? 43

Q141. What is the physical meaning of the equations governing the **interactive thermoluminescent** process? 44

Q142. What is the **assumption required for first and second order TL kinetics**? 44

Q143. Is there a general description of thermoluminescence from which it is possible to obtain the various **kinetics orders**? 45

Q144. Why does the **Adirovitch model** not allow us to obtain the general order kinetics? 45

Q145. Is there any experimental evidence for a **kinetics order** less than one? 45

Q146. What is the common assumption leading to **kinetics orders** larger than one? 45

Q147. What is the **Adirovitch** theory? 46

Q148. What is the energy level diagram used by **Adirovitch**? 46

Q149. What are the equations of **Adirovitch**? 46

Q150. Can the **Adirovitch** theory be extended to the thermoluminescence process? 47

Q151. What are **intrinsic defects**? 47

Q152. Can **irradiation** produce **defects** in a crystal? 48

Q153. Which the **extrinsic** or **impurity defects** are? 48

Q154. Who introduced the **first order kinetics** model? 48

- Q155. What are the assumptions of the **first order kinetics**? 48
- Q156. What is the band model used by Randall and Wilkins to describe the **first order kinetics process**? 49
- Q157. What is the meaning of the variables used in the **Randall and Wilkins model**? 49
- Q158. What is the **first order** equation? 49
- Q159. What is the meaning of the terms comparing in the **first order** equation? 50
- Q160. How obtain the **first order** expression for the thermoluminescence intensity? 50
- Q161. What is the expression for the thermoluminescence intensity in the case of **first order kinetics**? 50
- Q162. Who introduced the **second order kinetics** model? 50
- Q163. Which are the assumptions of the **second order kinetics**? 51
- Q164. What is the band model used by Garlick and Gibson to describe the **second order kinetics process**? 51
- Q165. What is the meaning of the variables used in the **Garlick and Gibson model**? 51
- Q166. What is the **second order** kinetics equation? 52
- Q167. What is the meaning of the terms comparing in the **second order** equation? 52
- Q168. How to obtain the **second order** expression for the thermoluminescence intensity? 52
- Q169. What is the expression for the thermoluminescence intensity in the case of **second order kinetics**? 52

Q170. Who introduced the **general order kinetics** model? 53

Q171. What is the band model used by May and Partridge to describe the **general order kinetics process**? 53

Q172. In which cases can a **general order kinetics** can be used? 53

Q173. What is the meaning of the variables used in the **May and Partridge model**? 54

Q174. What is the **general order kinetics** equation? 54

Q175. What is the meaning of the terms in the **general order** equation? 54

Q176. How do we obtain the **general order** expression for the thermoluminescence intensity? 55

Q177. What is the expression for the thermoluminescence intensity in the case of **general order kinetics**? 55

Q178. Can the **general order** equation

$$\frac{dn}{dt} = n^b \frac{s}{N} \exp\left(-\frac{E}{kT}\right)$$

give the first and the second order kinetics? . . . 55

Q179. There is any **thermoluminescent model** which considers that both electrons and holes may be released from their traps at the same time and in the same temperature interval? . . . 55

Q180. Which is the **Schön-Klasens** model? 56

Q181. What is happening if the trapped holes are released during **thermal stimulation**? 56

Q182. What is the consequence of canceling **recombination centers**? 56

Q183. What are the rate equations of the **Schön-Klasens** model? 56

- Q184. Who solved the rate equations based on the model of **Schön-Klasens**? 58
- Q185. What kind of assumptions were made by **Braunlich and Scharmann** in solving the rate equations based on the **Schön-Klasens** model? 58
- Q186. Can the **recombination** take place without transition of electrons into the conduction band? 59
- Q187. Who mathematically described the **localized transitions**? 59
- Q188. How to define the **isothermal decay** of the thermoluminescent signal? 60
- Q189. In what way is the **faded thermoluminescence** dependent on the trapped charges? . . 60
- Q190. In what way does the measured thermoluminescence intensity during an **isothermal decay** depend on the trapped charges? 60
- Q191. What is the best way to describe the **fading** characteristics of a phosphor? 61
- Q192. Is there any correlation between the lifetime of a trapping level and the **concentration of the activators** in a phosphor? 61
- Q193. What is the difference between the **frequency factor s** and the **pre-exponential factor s'** ? 61
- Q194. Is there a relationship between the **frequency factor** and the **pre-exponential factor**? . . 61
- Q195. Is the **pre-exponential factor** depending on temperature? 62
- Q196. In what way is the **pre-exponential factor** temperature dependent? 62
- Q197. Which expression gives the **probability rate of escape** of the carriers from a trap? 62

Q198. Is there any relationship between the **probability rate of escape**, p , and the **life time**, τ , of the charge carriers in the trap? . . . 63

Q199. What is the physical meaning of the **frequency factor**? 63

Q200. What is the order of magnitude of the **frequency factor**? 63

Q201. What is the possible range of the values of the **frequency factor** encountered in thermoluminescent materials? 63

Q202. Is the **frequency factor** s dependent on temperature? 63

Q203. What kind of relationship exists between the **frequency factor** and the temperature? . . . 64

Q204. What is the mathematical relation between the **frequency factor** and the temperature? . 64

Q205. What is the first order detrapping rate when the **frequency factor** is temperature dependent? 64

Q206. What is the first order expression for the **thermoluminescence intensity**, I , when the **frequency factor** is temperature dependent? 64

Q207. What is the temperature T^* at which the **electron escape probability** is 1 sec^{-1} ? . . 65

Q208. Which are the criteria that should be checked for a **second order** peak? 65

Q209. What are the criteria that should be checked for a peak following a **general order** kinetics? 65

Q210. What is the possible error on the **geometrical factor** μ ? 66

Q211. What is the physical significance of the nature of the **glow curve**? 66

- Q212. What are the **storage sites** called? 67
- Q213. What is the meaning of the **peak temperature**? 67
- Q214. What are the criteria to be fulfilled to be sure that a **glow peak** follows **first-order kinetics**? 67
- Q215. What is the physical situation for **first order kinetics**? 67
- Q216. What is the physical situation for **second order kinetics**? 67
- Q217. How do we recognize at a first sight if a TL **glow peak** is following a **first** or a **second order process**? 68
- Q218. Who proposed the **two-trap model**? 68
- Q219. How many processes are involved in **thermoluminescence (TL)** and in **optically stimulated luminescence (OSL)**? 68
- Q220. In what way does the **excitation stage** and/or the **read-out stage** influence the TL and the OSL emissions? 68
- Q221. Are there any models to explain **superlinearity**? 69
- Q222. What is the energy levels model describing the **competition** during excitation? 69
- Q223. Who proposed the model concerning **competition** during excitation? 69
- Q224. What are the equations governing the **competition** during excitation? 70
- Q225. What is the energy levels model used to describe the **competition** during readout? . . 71
- Q226. What are the equations governing the **competition** during readout? 71
- Q227. Is there any model to explain the **optical bleaching** of thermoluminescence? 72

Q228. In what way are the various models for **optical bleaching** different among them? . . . 72

Q229. According to the model of one-trap/one-recombination-center (see figure below), what are the equations for **optical bleaching**? . . . 72

Q230. What is the optical equation of the **GOT model**? 73

Q231. What is the model of Chen for **optical bleaching**? 73

Q232. Which are the hypotheses of Chen’s model for **optical bleaching**? 73

Q233. What is the model of McKeever for **optical bleaching**? 74

Q234. What are the hypotheses of the McKeever model for **optical bleaching**? 74

Q235. What is the simplest model for **phototransferred** thermoluminescence (PTTL)? 74

Q236. What are the functions of the shallow and deep traps in the model of **phototransferred** thermoluminescence? 75

Q237. Is there a mathematical description for the **phototransfer** phenomena? 75

Q238. Who suggested an approximated expression for the **integral** $\int_0^\tau \exp\left(-\frac{E}{kT'}\right) dT'$ comparing with thermoluminescence theory? 76

Q239. What kind of approximation has to be used for the **integral** $\int_0^\tau \exp\left(-\frac{E}{kT'}\right) dT'$ comparing in the thermoluminescence theory? 76

Q240. How many terms of the **asymptotic series** are necessary for a good approximation of the integral? 76

Q241. How do we explain the observed **thermoluminescent properties** of a solid? 76

- Q242. How does the **energy band model** of solids work for thermoluminescence? 77
- Q243. What is the expression of the **TL intensity** for the one trap-one recombination center? . . . 77
- Q244. Is it possible to estimate the **shift in temperature** for a second order peak as a function of the delivered dose? 78
- Q245. Is it possible to estimate the **shift in temperature** for a general order peak as a function of the delivered dose? 78
- Q246. Is there any practical expression which gives the **TL intensity** for a first order peak? . . . 79
- Q247. Is there any practical expression which gives the **TL intensity** for a second order peak? . . . 79
- Q248. How to define the intrinsic **thermoluminescence efficiency**? 79
- Q249. How much is the typical **thermoluminescent efficiency** induced by ionizing radiation? 79
- Q250. There is any expression giving the intrinsic **thermoluminescence efficiency**? 80
- Q251. There is any theoretical formulation giving the **general order** kinetics equation of an isolated thermoluminescent peak where the pre-exponential factor results are independent of the dose of irradiation? 80
- Q252. What is the new **general order** kinetics equation introduced by Rasheedy? 81
- Q253. What is the expression for the **trapped electrons** as obtained from the Rasheedy's equation? 81

Q254. What is the equation for the **thermo-luminescence intensity** according to the Rasheedy's equation? 81

Q255. What is the equation for the **fluorescence** decay? 82

Q256. What is the main characteristic of the decay equation of the **fluorescence**? 82

Q257. How do we express the **life time** of the free carriers? 82

Q258. What is the meaning of the **quasi-equilibrium (QE)** assumption? 82

Q259. How do we express analytically the **quasi-equilibrium (QE)** assumption? 83

Q260. Why is the **quasi-equilibrium (QE)** assumption very important? 83

Q261. Is there any other meaning of the **QE assumption**? 83

Q262. Can the **cavity theory** for photons be applied to the thermoluminescent dosimeters? 83

Q263. What are the assumptions of Burlin for the **cavity theory** applied to TLDs? 84

Q264. How is the **half-life** of a trap defined? 84

Q265. What is the **half-life** expression for a first order process? 84

Q266. What is the effect on the **half-life** of changing the activation energy value and keeping the temperature as a constant and for a given value of the frequency factor? 84

Q267. Is there any expression for the **half-life** in the case of the second order kinetics process? 85

Q268. What is the difference between the **half-life** for a first order kinetics and the one for the second order? 85

- Q269. What is the consequence on the **half-life** for a second order kinetics which is inversely proportional to the initial concentration of the trapped charges? 85
- Q270. Is the increase of the **half-life** as a function of time only related to a second order kinetics? 85
- Q271. What is the effect of introducing **defects** and **impurities** in a crystal? 86
- Q272. How is the **luminescence efficiency** defined? 86
- Q273. What is the meaning of **radiative transition**? 86
- Q274. What is the meaning of **non-radiative transition**? 86
3. KINETICS METHODS 87
- Q275. Are there any **approximate methods** for calculating the activation energy by just using the peak temperature at the maximum? 87
- Q276. What is the **Initial Rise** method? 87
- Q277. What is the mathematical expression used for the **Initial Rise** method? 88
- Q278. How does the **Initial Rise** method work? . . 88
- Q279. What is a typical plot of the **Initial Rise method**? 89
- Q280. Other than the Initial Rise method, is there any other method based on the low temperature tail of a TL peak in determining the activation energy? 89
- Q281. How does the Ilich's method work? 89
- Q282. What is the expression for the activation energy determined by the **Ilich's method**? . 90
- Q283. What is the maximum possible **error in the activation energy** determined using the Ilich method? 90

- Q284. Is the two **heating rates method** independent from the frequency factor? 90
- Q285. There is any method which enables us to separate **overlapped peaks** in the glow curve? 90
- Q286. How does **McKeever's method work?** . . . 90
- Q287. What is the **method of Sweet-Urquhart?** . 91
- Q288. What is the experimental procedure of the **method of Sweet-Urquhart?** 91
- Q289. Which is the experimental condition for getting good results in the application of the **variable heating rate method** of analysis? . 91
- Q290. If a thermoluminescent material shows an **isothermal decay** law of the form t^{-1} , what kind of kinetics is this supposed to be? 91
- Q291. In which case of a TL glow curve analysis is a **thermal cleaning** necessary? 92
- Q292. Are there any methods based on the TL **peak area** for determining the activation energy? . 92
- Q293. When is it possible to use the **peak area** methods? 92
- Q294. What is the expression for the activation energy determined using the **area** of a first order peak? 92
- Q295. What is the expression for the activation energy calculated using the **area** of a general order peak? 92
- Q296. What is the expression of E using the method based on two different **heating rates?** 93
- Q297. Who proposed the method based on various heating rates? 93
- Q298. Can the **various heating rates** methods be applied to a general order kinetics? 93

- Q299. Who developed the **isothermal decay** method for a first order kinetics? 93
- Q300. What is the expression for determining the **activation energy** from an **isothermal decay** experiment, in the case of a first order kinetics? 93
- Q301. Can the **isothermal decay** be applied when a general order kinetics is involved? 94
- Q302. Which are the methods based on the **peak shape**? 94
- Q303. What are the expressions for the **peak shape method**? 95
- Q304. Who generalized the **peak shape** methods? 96
- Q305. Which method was used by Chen to obtain the expressions for the **peak shape** procedure? 96
- Q306. On which assumption can be used the **peak shape** methods? 96
- Q307. What are the **geometrical parameters** of an isolated glow peak? 97
- Q308. What is the main parameter, related to a peak, used by Chen to obtain the expressions for the **general order kinetics**? 98
- Q309. Which are the values of the **symmetry factor μ** ? 98
- Q310. Are intermediate values possible for the **symmetry factor**? 98
- Q311. Which are the expressions of Chen for the **peak shape method**? 98
- Q312. Is it possible to get a plot of the kinetics order as a function of the **symmetry factor**? 99
- Q313. Does the Chen's expressions for the **peak shape** have a theoretical basis? 99

Q314.	Who provided a theoretical foundation to the peak shape methods?	99
Q315.	What are the new peak shape expressions obtained by Kitis and Pagonis?	100
Q316.	Do the various peak shape methods give the same values of E ?	100
Q317.	Among the peak shape methods, which are more precise?	100
Q318.	Is there a reliability criteria for testing the goodness of the activation energy values obtained by the peak shape methods?	100
4.	OPTICALLY STIMULATED LUMINESCENCE	103
Q319.	What is Optically Stimulated Luminescence (OSL) ?	103
Q320.	How do we correlate the luminescence from a material, obtained by using the OSL technique, to the dose received by the material?	103
Q321.	Which are the modes of stimulation in OSL ?	103
Q322.	What is the meaning of CW-OSL mode?	104
Q323.	How do we perform the CW-OSL mode?	104
Q324.	What is the meaning of LM-OSL ?	104
Q325.	How do we perform the LM-OSL mode?	104
Q326.	What is the meaning of POSL ?	104
Q327.	How do we perform the POSL mode?	104
Q328.	There is the simplest model for OSL ?	105
Q329.	What are the rate equations describing the charge flow in the simplest OSL model?	105
Q330.	Is there a mathematical model for LM-OSL mode?	106
Q331.	What is the equation for the OSL intensity in case of general order kinetics?	106

- Q332. Other than the one trap-one recombination center model, are there more complex models for **OSL**? 107
- Q333. What is the equation for the **OSL intensity** when a competing deep trap is considered? . . 107
- Q334. What is the equation for the **OSL intensity** when a competing shallow trap is considered? 107
- Q335. What is the equation for the **OSL intensity** when the model of competing recombination center is adopted? 108
- Q336. What is an important parameter in **OSL measurements**? 109
- Q337. How is it possible to determine the **wavelength** of the excitation light? 109
- Q338. Is there any relationship between TL and **OSL traps**? 109
- Q339. Can the **OSL** experiments be performed using a linear increase of the stimulating light? . . . 109
- Q340. How does the **Bulur method** work? 110
- Q341. What is the model used by Bulur for **OSL** experiments? 110
- Q342. What is the first order kinetics equation for the **OSL** process in the Bulur model where the excitation intensity increases linearly with time? 110
- Q343. What is the **luminescence intensity** according to the first order equation given by Bulur, with the excitation intensity increasing linearly with time? 111
- Q344. What is the second order kinetics equation for the **OSL** process in the Bulur model where the excitation intensity increases linearly with time? 111

Q345. What is the **luminescence intensity** according to the second order equation given by Bulur, with the excitation intensity increasing linearly with time? 112

Q346. What is the general order kinetics equation for the **OSL** process in the Bulur model where the excitation intensity increases linearly with time? 112

Q347. What is the **luminescence intensity** according to the general order equation given by Bulur, with the excitation intensity increasing linearly with time? 113

5. LUMINESCENCE DATING 115

Q348. What is **luminescence dating**? 115

Q349. What are the **types of luminescence dating** techniques? 115

Q350. Why are we able to date potteries using **luminescence techniques**? 115

Q351. What is the principle of **luminescence dating**? 116

Q352. How is the **radiation energy** information stored in a crystal? 116

Q353. What is the origin of the **natural radiation** absorbed by an archaeological object? 117

Q354. What is the mathematical expression for the **age calculation** using the thermoluminescence technique? 117

Q355. How to express the **annual dose rate**? 117

Q356. Considering the various radiation components, how to rewrite the **age expression**? 118

- Q357. Are the **sensitivities** of the various radiations related in some way? 118
- Q358. According to the assumption for the sensitivities, how should we rewrite the age expression? 118
- Q359. How do we measure the **dose rate** for the different types of radiation? 119
- Q360. How do we calculate the **absorbed dose per year**? 119
- Q361. What are the techniques to be used for the **annual dose rate** calculation? 119
- Q362. Which materials can be dated using **luminescence techniques**? 119
- Q363. What are the limits for the archaeological age using **luminescence technique**? 120
- Q364. What is the **paleodose**? 120
- Q365. What is the **equivalent dose**? 120
- Q366. What are the **thermoluminescence dating techniques**? 120
- Q367. How do we **prepare a sample** for dating? . . 120
- Q368. What is the **quartz inclusion technique**? . 121
- Q369. What are the advantages of the **quartz inclusion technique**? 121
- Q370. What is the **fine-grain technique**? 121
- Q371. What is the **pre-dose technique**? 121
- Q372. What is the advantage of the **pre-dose technique**? 122
- Q373. What is the **subtraction dating technique**? 122
- Q374. What is the advantage of the **subtraction technique**? 122
- Q375. What is the **zircon inclusion technique**? . . 122
- Q376. What is the advantage of the **zircon inclusion technique**? 122

Q377. What is the **phototransferred thermoluminescence (PTTL)** method? 123

Q378. What is the **plateau test**? 123

Q379. Which are the basis of the **plateau test**? 123

Q380. What is the **anomalous fading**? 124

6. MISCELLANEA 125

Q381. What is the **radio-luminescence (RLL)**? 125

Q382. What is the meaning of **TSEE**? 125

Q383. How does **TSEE** work? 125

Q384. Does the **TSEE** effect concern the whole sample? 125

Q385. What is the meaning of **TS Cond**? 126

Q386. How does **TS Cond** work? 126

Q387. What is the meaning of **TSP**? 126

Q388. How does **TSP** work? 126

Q389. What is the meaning of **TSC**? 126

Q390. How does **TSC** work? 126

Q391. What kind of polarization originated in **TSC** experiment? 127

Q392. What is the **orientational polarization**? 127

Q393. What is the **space charge polarization**? 127

Q394. What is the **interfacial polarization**? 127

Q395. Who first described a **luminescence phenomenon**? 127

Q396. Who first gave an accurate description of **luminescence**? 128

Q397. Who then gave a further description of **luminescence** after the first observation of Boyle? 128

Q398. Who carried out the first experiments on **luminescence**? 128

Q399.	Who studied the luminescence after Hanksbee and Wall?	128
Q400.	Who introduced the term thermoluminescence?	129
Q401.	What is the meaning of ESR ?	129
Q402.	To which fields can ESR be applied?	129
Q403.	What is the time range of the ESR dating?	129
Q404.	What are the applications of thermoluminescence in the analysis of food ?	129
Q405.	In what way is it possible to check if a certain type of food has been irradiated or not?	130
Q406.	In what way is thermoluminescence and optically stimulated luminescence different in application in the field of irradiated food ?	130
Q407.	What are the main characteristics of the glow curves obtained from irradiated food ?	130
Q408.	How is it possible to carry out kinetics studies on the glow curves produced by irradiated food ?	131
Q409.	What kind of deconvolution should be applied to the glow curves from irradiated food ?	131
BIBLIOGRAPHY		133
INDEX		139
AUTHOR INDEX		143