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# Rate Coefficients for Low-Energy Electron Dissociative Attachment to Molecular Hydrogen.

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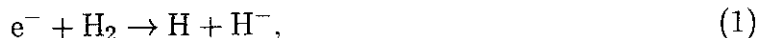
## Abstract

Calculation of rate constants for dissociative electron attachment to molecular hydrogen is reported. The calculation is based on an improved nonlocal resonance model of Čížek, Horáček and Domcke which takes fully into account the nonlocality of the resonance dynamics and uses potentials with correct asymptotic forms. The rate constants are calculated for all quantum numbers  $v$  and  $J$  of the target molecules and for electron temperature in the range 0-30 000 K.

**Keywords:** dissociative attachment, hydrogen molecule, rate constant, nonlocal dynamics

# 1 Introduction

The system  $\text{H}_2^-$  is the most fundamental molecular anion. It is unstable, with a very short lifetime ( $\tau \sim 10^{-15}$  s). The dynamics of this complex which is important in a number of collisional processes is still not well understood. As examples of the most studied processes we mention dissociative attachment (DA)



vibrational excitation (VE)



associative detachment (AD)



and, for scattering energies higher than the electron affinity of H, also collisional detachment (CD)



Understanding of these processes is important for a number of practical applications. AD and DA determine the thermal equilibrium densities of  $\text{H}^-$  ions and  $\text{H}_2$  molecules in many astrophysical plasmas. Neutral molecules produced in AD are vibrationally excited and the emission spectra of such molecules are quite different from those of molecules excited by ultraviolet pumping or shock excitation [1]. DA of electrons to molecular hydrogen is thought to be the primary source of the  $\text{H}^-$  ions produced in hydrogen plasmas. These ions may serve for the generation of neutral particle beams, the injection of ions into controlled thermonuclear devices, or for electromagnetic propulsion of space vehicles.

In the early models of the  $\text{H}_2^-$  dynamics the interaction between the nuclei was described in the local-complex-potential approximation [2]–[4], with empirically adjustable parameters and later with *ab initio* potentials [5], [6]. The importance of nonlocal effects was pointed out in [6]. Recently, the dynamics of nonlocal models has been studied [7], [8], [9], [10], [11], [12], [13], for DA and VE in  $\text{H}_2$ .

The present work is based on an extension of the nonlocal resonance theory to treat the DA to rotationally excited molecules. The existing nonlocal resonance model for the  $\text{H}_2^-$  dynamics [7], [9] is modified [14] to account for the long-range behaviour of the  $\text{H}_2^-$  potential-energy function. DA, VE and AD processes can thus be treated within a single model with no adjustable parameters.

We present only a brief outline of the theory here. A more detailed description of the computational procedures and results will be given elsewhere.

## 2 Basic theory

The calculation of the rate constants is based on the use of an improved nonlocal resonance model [14]. Let us start with a very brief description of the nonlocal resonance model (for details see [15]).

## 2.1 Nonlocal resonance model

The nonlocal resonance model is based on the assumption that a temporary molecular negative-ion state (resonance) is formed and that this resonance accounts for the coupling of the electronic scattering dynamics with the nuclear motion [16]. The resonance is represented by a square-integrable discrete state  $|\varphi_d\rangle$  which interacts with a continuum of scattering states  $|\varphi_\varepsilon\rangle$  via coupling matrix elements  $V_{d\varepsilon}$ .  $|\varphi_d\rangle$  and  $|\varphi_\varepsilon\rangle$  are assumed to be diabatic states, that is, their wave functions vary smoothly with the internuclear distance  $R$ . The second essential ingredient of the nonlocal resonance model is the explicit consideration of threshold effects which enter through the threshold expansion of the energy-dependent width function

$$\Gamma(\varepsilon) = 2\pi|V_{d\varepsilon}|^2 \quad (5)$$

and the associated level shift  $\Delta(\varepsilon)$  [16].

The basic equation of the nonlocal resonance theory is the wave equation describing nuclear motion in the short-lived anion state [15]

$$[T_N + V_d(R) - E]\Psi_d(R) + \int d\varepsilon \int dR' V_{d\varepsilon}(R) G_0(R, R'; E - \varepsilon) V_{d\varepsilon}^*(R') \Psi_d(R') = -V_{d\varepsilon_i}(R) \chi_{v_i}(R) \quad (6)$$

with

$$G_0(R, R'; E) = \langle R | (E - T_N - V_0 + i\epsilon)^{-1} | R' \rangle. \quad (7)$$

Here  $V_0(R)$  and  $V_d(R)$  are the potential energy functions of the target state and the discrete state, respectively.  $\chi_{v_i}(R)$  is the wave function of the initial vibrational state of the target molecule,  $\varepsilon_i$  is the energy of the incoming electron, and  $E$  is the total energy of the collision complex.  $G_0$  is the Green's function for nuclei motion in the target state,  $T_N$  being the radial nuclear kinetic energy operator.

The second term on the left hand side of Eq.(6) plays the role of a complex, energy-dependent and nonlocal effective potential for the radial nuclear motion. It accounts for the decay of the electronic resonance state through the coupling with the electronic scattering continuum.

The cross section for dissociative attachment of an electron of energy  $\varepsilon_i$  to a molecule in the vibrational state  $|\chi_v\rangle$  is given by [15]

$$\sigma_{DA}(E) = \frac{4\pi^3}{k_i^2} |\langle \Psi_d | V_{d\varepsilon_i} | \chi_v \rangle|^2, \quad (8)$$

where  $\Psi_d$  is now the solution of Eq.(2) in which the right hand side is set to zero.

In practice, the nuclear wave function  $\Psi_d(R)$  is represented by a partial wave expansion with respect to rotational angular momentum and the Lippmann-Schwinger equation corresponding to the wave Eq.(6) is solved for the individual partial wave components. For this purpose, the very efficient Schwinger-Lanczos continued-fraction method [17] is

employed. The efficiency of this method allows the cross sections to be calculated on a very fine mesh of collision energies.

The nonlocal resonance model is characterized by the three functions  $V_0(R)$ ,  $V_d(R)$  and  $V_{de}(R)$ . The target potential - energy function  $V_0(R)$  can directly be obtained by ab initio calculations or by fitting spectroscopic data. The functions  $V_d(R)$  and  $V_{de}(R)$  representing the  $H_2^-$  resonance (at short internuclear distance) and the  $H_2^-$  bound state (at intermediate and large internuclear distances) have been obtained [14] by a joint fitting of the ab initio  $^2\Sigma$  eigenphase sum and accurate ab initio calculations of the  $H_2^-$  potential energy function at intermediate internuclear distance. All parameters of the model are thus determined by ab initio calculations.

## 2.2 Rate constants

Generally, the rate constant for the reaction in gas is defined as

$$k = \int_0^{\infty} v f(v) \sigma(v) dv \quad (9)$$

where  $f(v)$  is a normalized distribution of the relative velocities  $v$  and  $\sigma(v)$  is the cross section of the reaction. Here the Maxwellian distribution is assumed for electrons

$$f(v) = 4\pi v^2 \left( \frac{\mu}{2\pi kT} \right)^{3/2} e^{-\frac{\mu v^2}{2kT}} \quad (10)$$

where  $\mu$  is the reduced mass of the particles.

## 3 Dissociative attachment

### 3.1 Dissociative attachment cross sections.

The main emphasis of this work is on the calculation of rate constants for DA process. It is however instructive to discuss briefly the underlying cross sections. In Figure 1, the calculated DA cross sections are plotted assuming nonrotating molecular target for some values of the vibrational quantum number  $v$ . A typical feature of DA process in molecular hydrogen is the rapid increase of the cross sections with increasing vibrational energy of the target. This feature is clearly demonstrated in Figure 1. The peak cross section increases at increasing vibrational excitation  $v$  up to  $v=8$ . This feature is used for example as a diagnostic tool in [18].

In Figure 2 the DA cross sections are plotted for rotationally excited target molecules,  $J=10$ . As observed the rotational excitation also makes the DA process more efficient. At this rotational state the highest DA cross section is obtained at a lower vibrational excitation state,  $v=7$ . This trend continues and at  $J=15$ , the highest DA cross section is obtained at  $v=5$ , see Figure 3.

In Figure 4 the DA cross sections are shown for vibrationally excited target,  $v=1$ , and a set of rotational quantum numbers  $J$ . At high  $J$  the DA cross section attains huge values.

### 3.2 Calculated rate constants

The calculated rate constants are plotted in Figure 5 as a function of the electron temperature  $T$  for hydrogen molecules in their ground vibrational state,  $v=0$ , and  $J=0, 1, \dots, 30$ .

The calculated rate constants are in Tables 1-51. The data tables in electric files are available at URL=<http://dpc.nifs.ac.jp/DB/DA/>.

## 4 Conclusions

Rate constants for the process of dissociative attachment are calculated at a range of electron temperatures  $T=0-30\,000$  K for hydrogen molecules by the means of an improved nonlocal resonance model for all rotational and vibrational states ( $v, J$ ) of the hydrogen molecules.

## Acknowledgement

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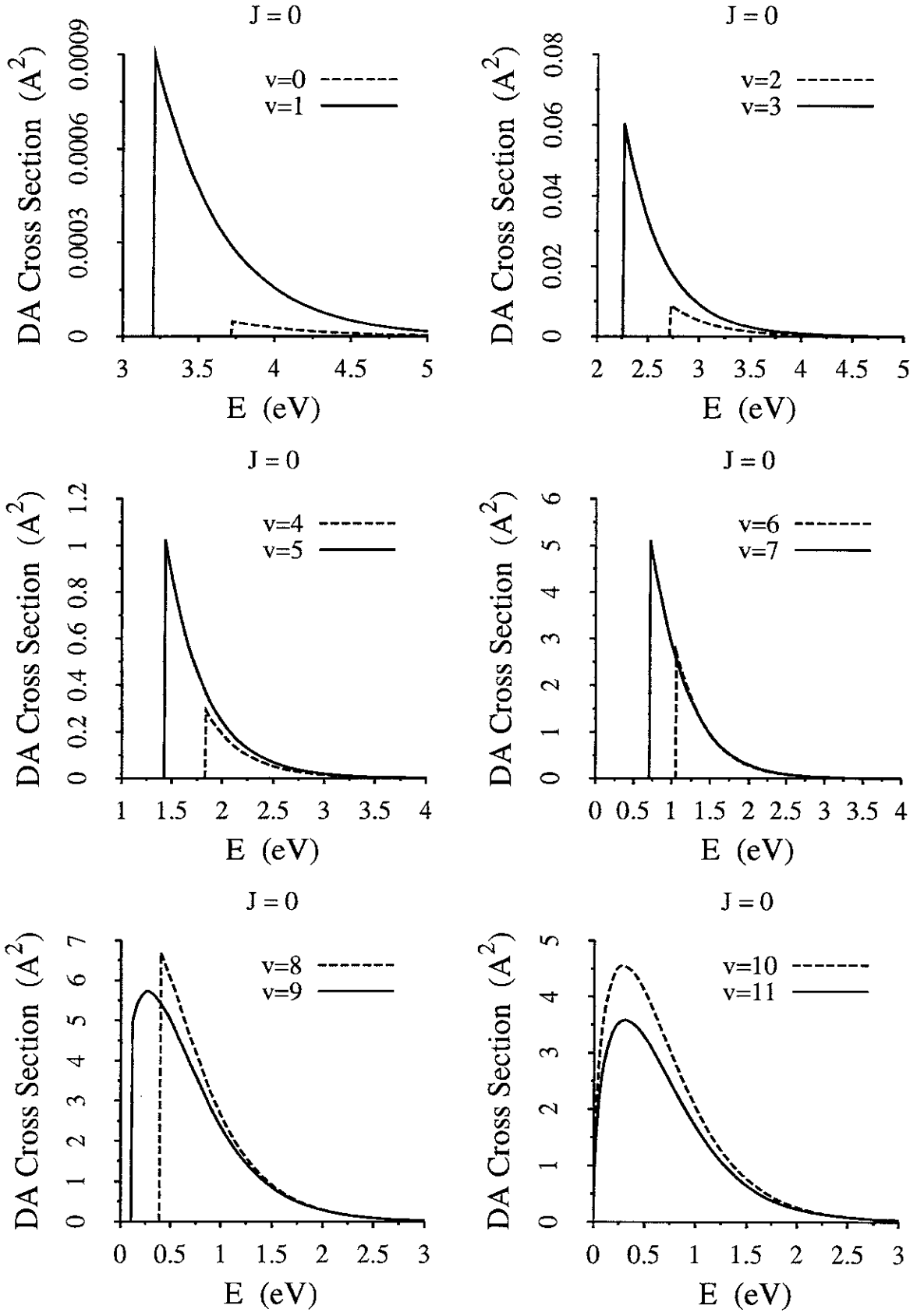


Figure 1: DA cross section for initial vibrational target states  $v = 0, 1, \dots, 11$  for nonrotating hydrogen molecule.



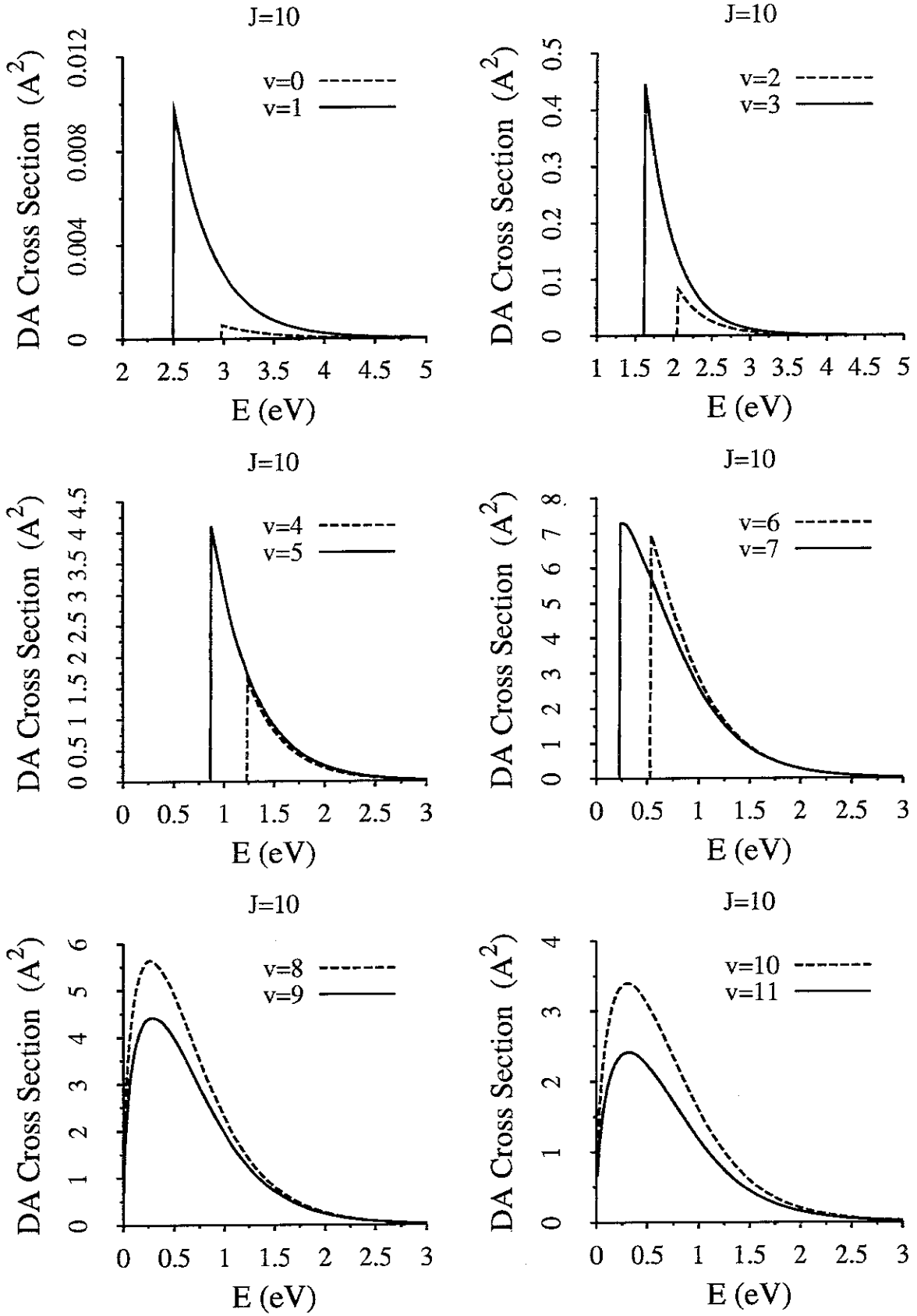


Figure 2: DA cross section for initial vibrational target states  $v=0,1,\dots, 11$  for rotating hydrogen molecule. The rotational state was  $J=10$ .

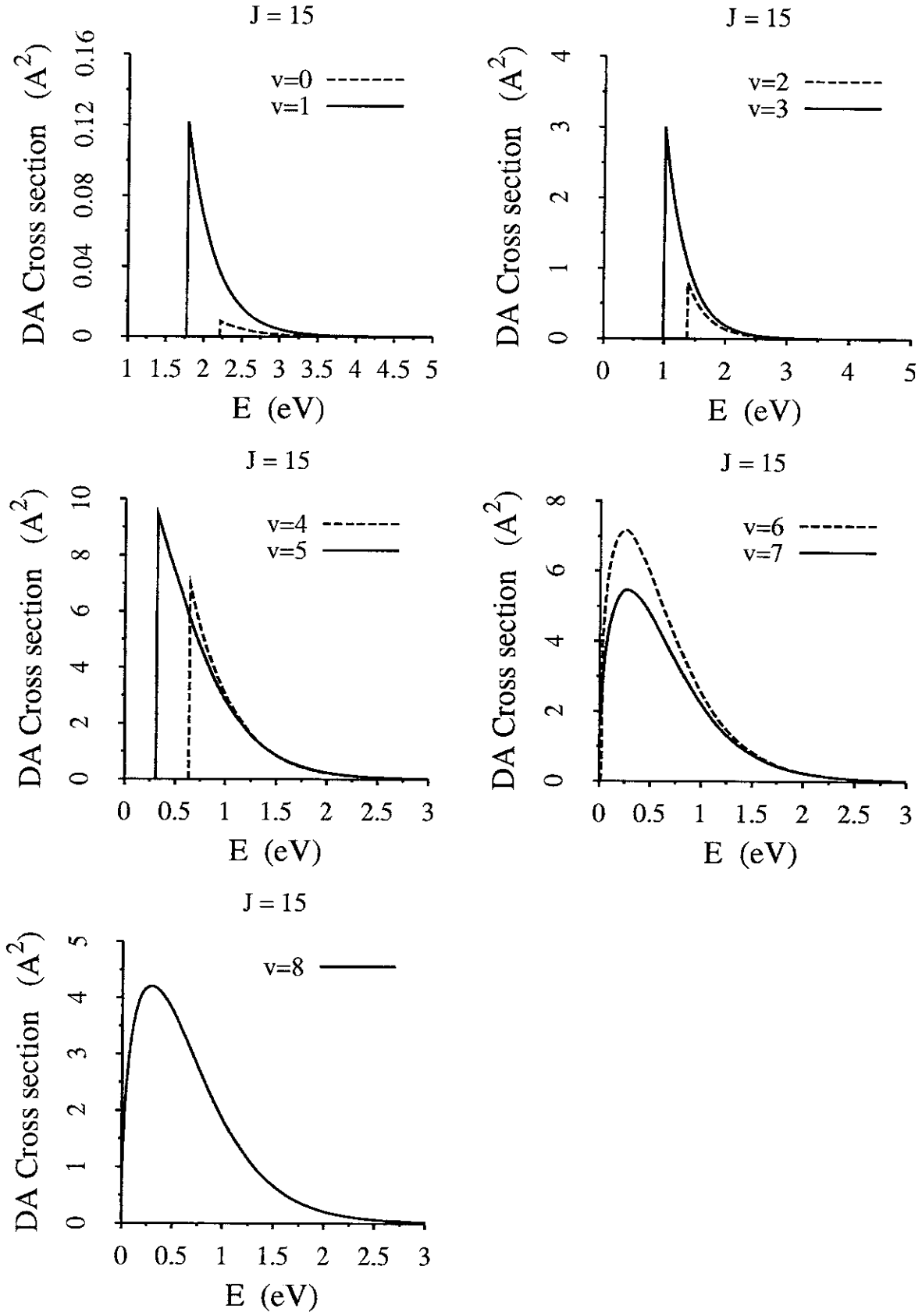


Figure 3: The same as for Figure 2 but for a higher rotational state,  $J=15$ .

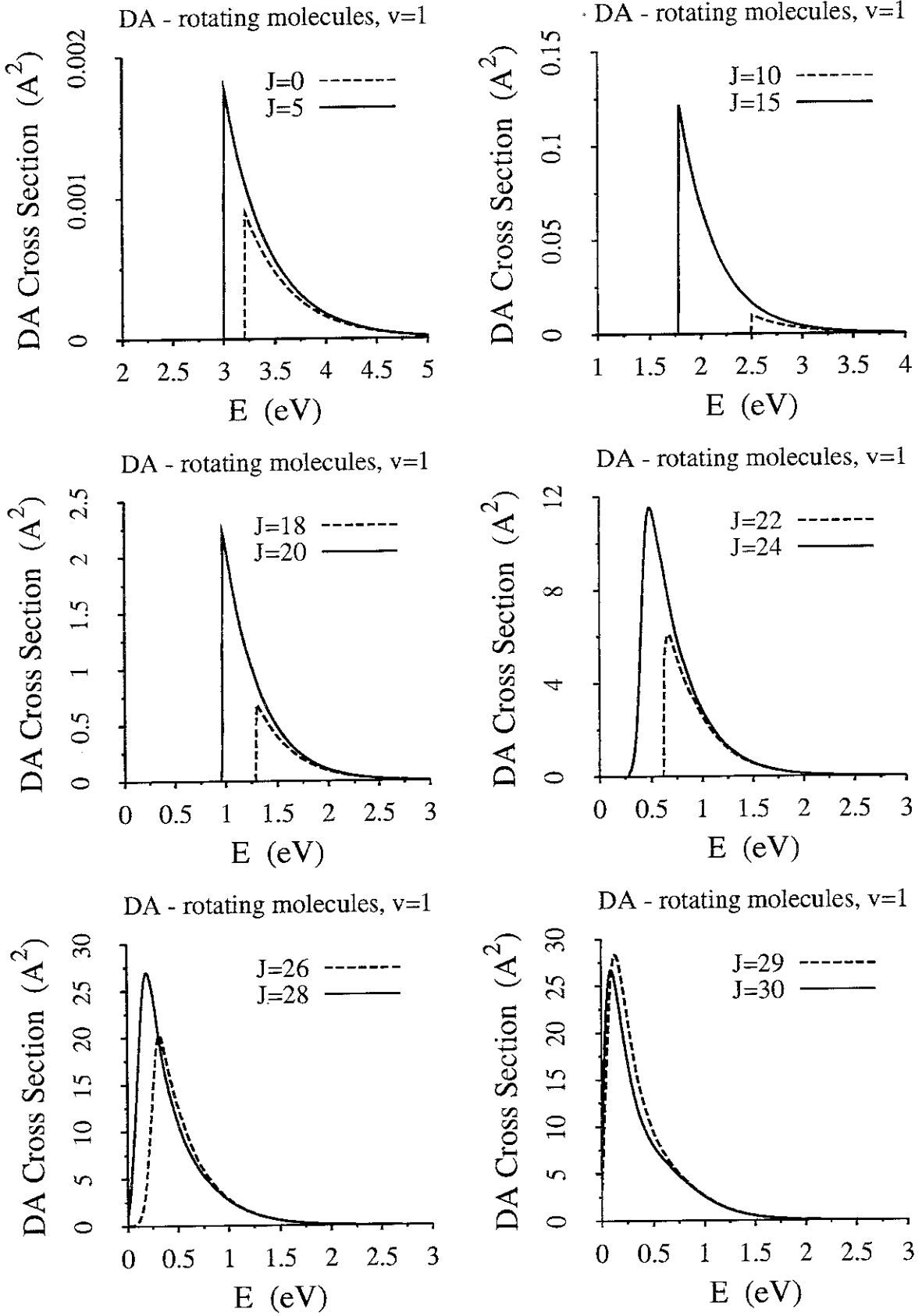


Figure 4: DA cross section for rotating hydrogen molecules,  $J=1, \dots, 30$  assuming excited vibrational state  $v = 1$  of the target.

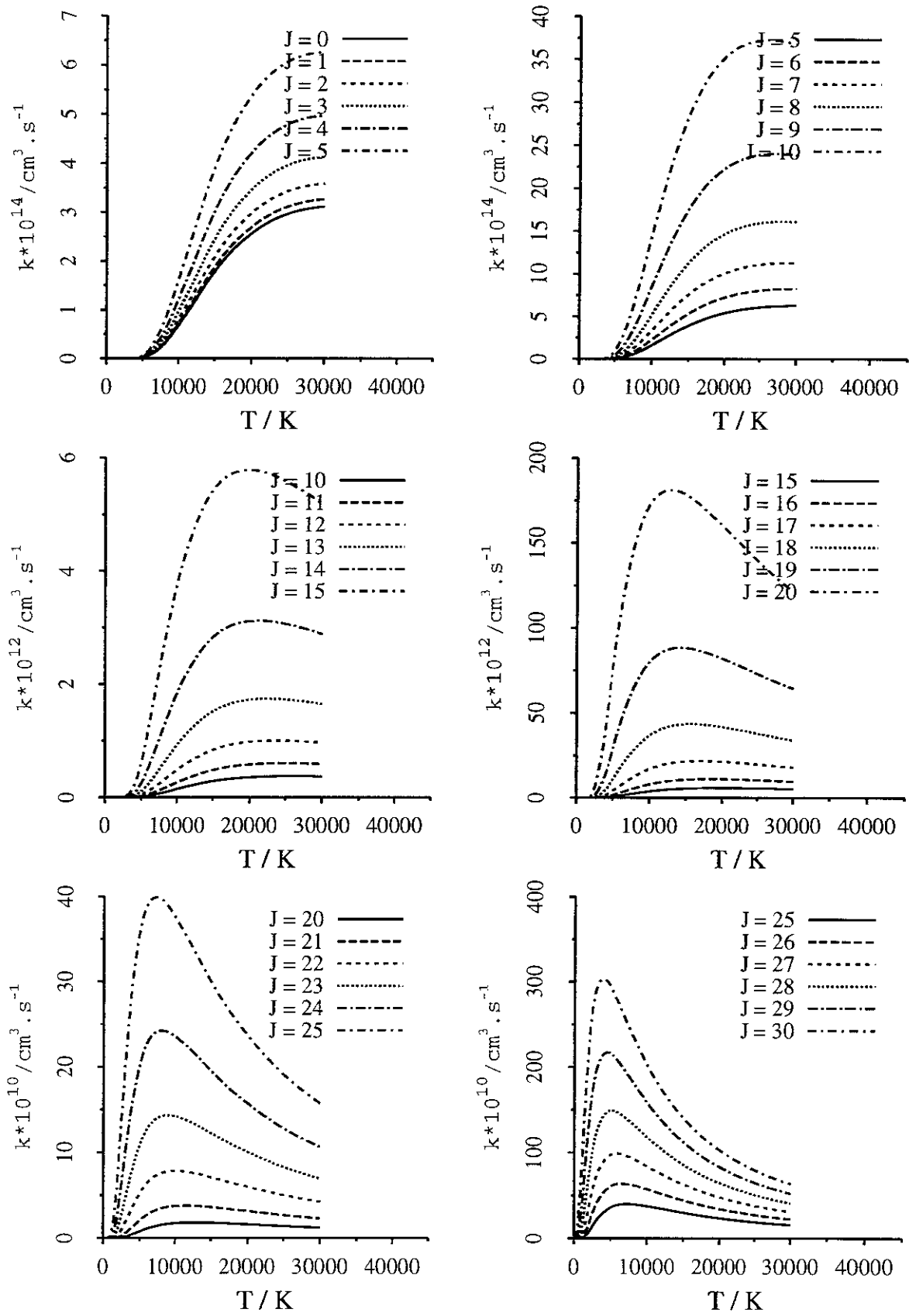


Figure 5: DA rates for ground vibrational state  $v=0$  and various rotational states  $J$ .

Table 1. Rate constant for hydrogen molecule in  $v=0$  and  $J=0-5$  states. "2.9050-29" means  $2.9050 \times 10^{-29}$ .

T(K)	$v=0, J=0$	$v=0, J=1$	$v=0, J=2$	$v=0, J=3$	$v=0, J=4$	$v=0, J=5$
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	---	---	---	---
600	---	---	---	---	---	---
700	---	---	---	---	---	---
800	---	---	---	---	---	---
900	---	---	---	---	---	---
1000	---	---	---	---	---	1.3898-29
1100	2.9050-29	3.5147-29	5.1973-29	9.3909-29	2.0303-28	5.2986-28
1200	7.2548-28	8.6698-28	1.2497-27	2.1720-27	4.4655-27	1.0947-26
1300	1.0988-26	1.2995-26	1.8330-26	3.0829-26	6.0740-26	1.4122-25
1400	1.1238-25	1.3172-25	1.8237-25	2.9823-25	5.6651-25	1.2586-24
1500	8.3964-25	9.7653-25	1.3306-24	2.1233-24	3.9078-24	8.3464-24
1600	4.8620-24	5.6164-24	7.5456-24	1.1787-23	2.1100-23	4.3539-23
1700	2.2826-23	2.6211-23	3.4779-23	5.3312-23	9.3133-23	1.8641-22
1800	8.9990-23	1.0278-22	1.3488-22	2.0333-22	3.4756-22	6.7709-22
1900	3.0627-22	3.4815-22	4.5239-22	6.7178-22	1.1262-21	2.1415-21
2000	9.2003-22	1.0413-21	1.3411-21	1.9648-21	3.2367-21	6.0218-21
2100	2.4834-21	2.7999-21	3.5772-21	5.1770-21	8.3940-21	1.5312-20
2200	6.1124-21	6.8672-21	8.7094-21	1.2465-20	1.9922-20	3.5693-20
2300	1.3885-20	1.5549-20	1.9589-20	2.7754-20	4.3776-20	7.7155-20
2400	2.9406-20	3.2833-20	4.1111-20	5.7705-20	8.9926-20	1.5613-19
2500	5.8552-20	6.5199-20	8.1177-20	1.1297-19	1.7411-19	2.9813-19
2600	1.1040-19	1.2263-19	1.5189-19	2.0971-19	3.1990-19	5.4083-19
2700	1.9834-19	2.1979-19	2.7092-19	3.7133-19	5.6108-19	9.3740-19
2800	3.4125-19	3.7734-19	4.6305-19	6.3037-19	9.4411-19	1.5601-18
2900	5.6487-19	6.2335-19	7.6175-19	1.0304-18	1.5307-18	2.5036-18
3000	9.0305-19	9.9467-19	1.2108-18	1.6282-18	2.4002-18	3.8883-18
3100	1.3991-18	1.5383-18	1.8657-18	2.4951-18	3.6518-18	5.8633-18
3200	2.1068-18	2.3127-18	2.7954-18	3.7190-18	5.4065-18	8.6081-18
3300	3.0918-18	3.3886-18	4.0827-18	5.4053-18	7.8083-18	1.2335-17
3400	4.4317-18	4.8501-18	5.8259-18	7.6779-18	1.1025-17	1.7288-17
3500	6.2173-18	6.7950-18	8.1388-18	1.0680-17	1.5250-17	2.3745-17
3600	8.5524-18	9.3349-18	1.1151-17	1.4573-17	2.0699-17	3.2016-17
3700	1.1554-17	1.2596-17	1.5008-17	1.9537-17	2.7611-17	4.2442-17
3800	1.5352-17	1.6716-17	1.9870-17	2.5772-17	3.6249-17	5.5390-17
3900	2.0088-17	2.1849-17	2.5911-17	3.3491-17	4.6894-17	7.1254-17
4000	2.5915-17	2.8158-17	3.3320-17	4.2925-17	5.9847-17	9.0449-17

Table 1. (continued)

T(K)	$v=0, J=0$	$v=0, J=1$	$v=0, J=2$	$v=0, J=3$	$v=0, J=4$	$v=0, J=5$
4100	3.2997-17	3.5817-17	4.2296-17	5.4317-17	7.5421-17	1.1341-16
4200	4.1506-17	4.5010-17	5.3048-17	6.7921-17	9.3944-17	1.4058-16
4300	5.1623-17	5.5931-17	6.5794-17	8.4000-17	1.1575-16	1.7242-16
4400	6.3534-17	6.8775-17	8.0759-17	1.0283-16	1.4119-16	2.0938-16
4500	7.7429-17	8.3747-17	9.8171-17	1.2467-16	1.7061-16	2.5194-16
4600	9.3502-17	1.0105-16	1.1826-16	1.4981-16	2.0435-16	3.0055-16
4700	1.1195-16	1.2090-16	1.4126-16	1.7852-16	2.4276-16	3.5566-16
4800	1.3296-16	1.4349-16	1.6741-16	2.1107-16	2.8618-16	4.1771-16
4900	1.5674-16	1.6903-16	1.9692-16	2.4774-16	3.3493-16	4.8714-16
5000	1.8346-16	1.9771-16	2.3002-16	2.8877-16	3.8934-16	5.6435-16
5500	3.6758-16	3.9495-16	4.5665-16	5.6793-16	7.5642-16	1.0798-15
6000	6.4987-16	6.9652-16	8.0119-16	9.8804-16	1.3034-15	1.8372-15
6500	1.0441-15	1.1167-15	1.2789-15	1.5677-15	2.0491-15	2.8574-15
7000	1.5568-15	1.6620-15	1.8964-15	2.3113-15	2.9988-15	4.1433-15
7500	2.1874-15	2.3316-15	2.6517-15	3.2160-15	4.1459-15	5.6824-15
8000	2.9296-15	3.1184-15	3.5364-15	4.2706-15	5.4744-15	7.4509-15
8500	3.7727-15	4.0110-15	4.5373-15	5.4583-15	6.9623-15	9.4174-15
9000	4.7033-15	4.9951-15	5.6378-15	6.7592-15	8.5837-15	1.1547-14
9500	5.7066-15	6.0547-15	6.8202-15	8.1520-15	1.0312-14	1.3803-14
10000	6.7672-15	7.1738-15	8.0662-15	9.6149-15	1.2119-14	1.6150-14
11000	9.0014-15	9.5279-15	1.0680-14	1.2670-14	1.5872-14	2.0990-14
12000	1.1299-14	1.1945-14	1.3354-14	1.5780-14	1.9667-14	2.5842-14
13000	1.3573-14	1.4334-14	1.5990-14	1.8833-14	2.3369-14	3.0539-14
14000	1.5762-14	1.6630-14	1.8517-14	2.1746-14	2.6883-14	3.4969-14
15000	1.7822-14	1.8789-14	2.0886-14	2.4468-14	3.0151-14	3.9061-14
16000	1.9727-14	2.0783-14	2.3070-14	2.6968-14	3.3137-14	4.2778-14
17000	2.1464-14	2.2599-14	2.5054-14	2.9230-14	3.5828-14	4.6107-14
18000	2.3027-14	2.4232-14	2.6835-14	3.1254-14	3.8223-14	4.9053-14
19000	2.4420-14	2.5685-14	2.8415-14	3.3044-14	4.0331-14	5.1630-14
20000	2.5647-14	2.6964-14	2.9802-14	3.4610-14	4.2167-14	5.3859-14
21000	2.6718-14	2.8079-14	3.1009-14	3.5967-14	4.3749-14	5.5767-14
22000	2.7643-14	2.9041-14	3.2048-14	3.7129-14	4.5096-14	5.7378-14
23000	2.8434-14	2.9862-14	3.2932-14	3.8113-14	4.6230-14	5.8721-14
24000	2.9102-14	3.0554-14	3.3674-14	3.8936-14	4.7169-14	5.9821-14
25000	2.9658-14	3.1129-14	3.4288-14	3.9611-14	4.7932-14	6.0703-14
26000	3.0112-14	3.1598-14	3.4786-14	4.0154-14	4.8539-14	6.1390-14
27000	3.0476-14	3.1972-14	3.5181-14	4.0579-14	4.9005-14	6.1904-14
28000	3.0758-14	3.2261-14	3.5482-14	4.0898-14	4.9345-14	6.2264-14
29000	3.0966-14	3.2473-14	3.5700-14	4.1123-14	4.9575-14	6.2488-14
30000	3.1109-14	3.2617-14	3.5844-14	4.1264-14	4.9706-14	6.2591-14

Table 2. Rate constant for hydrogen molecule in v=0 and J=6-11 states.

T(K)	v=0, J=6	v=0, J=7	v=0, J=8	v=0, J=9	v=0, J=10	v=0, J=11
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	---	---	---	---
600	---	---	---	---	---	---
700	---	---	---	---	---	---
800	---	---	---	---	---	7.6352-29
900	---	---	1.5329-29	1.0110-28	7.7246-28	6.9017-27
1000	4.7153-29	1.9089-28	9.1400-28	5.1750-27	3.3564-26	2.5133-25
1100	1.6453-27	6.0191-27	2.5737-26	1.2861-25	7.2947-25	4.7273-24
1200	3.1572-26	1.0615-25	4.1305-25	1.8599-24	9.4336-24	5.4196-23
1300	3.8261-25	1.1977-24	4.3028-24	1.7740-23	8.1858-23	4.2470-22
1400	3.2320-24	9.5161-24	3.1927-23	1.2205-22	5.1928-22	2.4687-21
1500	2.0460-23	5.7125-23	1.8062-22	6.4665-22	2.5645-21	1.1302-20
1600	1.0247-22	2.7312-22	8.1986-22	2.7717-21	1.0335-20	4.2629-20
1700	4.2327-22	1.0828-21	3.1048-21	9.9779-21	3.5239-20	1.3708-19
1800	1.4891-21	3.6729-21	1.0111-20	3.1064-20	1.0453-19	3.8603-19
1900	4.5770-21	1.0927-20	2.9003-20	8.5584-20	2.7581-19	9.7218-19
2000	1.2543-20	2.9078-20	7.4689-20	2.1255-19	6.5880-19	2.2268-18
2100	3.1160-20	7.0338-20	1.7538-19	4.8296-19	1.4451-18	4.7029-18
2200	7.1115-20	1.5669-19	3.8028-19	1.0164-18	2.9453-18	9.2600-18
2300	1.5078-19	3.2497-19	7.6944-19	2.0012-18	5.6316-18	1.7156-17
2400	2.9975-19	6.3308-19	1.4654-18	3.7172-18	1.0183-17	3.0140-17
2500	5.6311-19	1.1673-18	2.6464-18	6.5600-18	1.7533-17	5.0529-17
2600	1.0062-18	2.0503-18	4.5595-18	1.1065-17	2.8905-17	8.1284-17
2700	1.7199-18	3.4490-18	7.5346-18	1.7928-17	4.5854-17	1.2605-16
2800	2.8254-18	5.5827-18	1.1996-17	2.8025-17	7.0286-17	1.8917-16
2900	4.4798-18	8.7301-18	1.8472-17	4.2426-17	1.0447-16	2.7570-16
3000	6.8795-18	1.3235-17	2.7604-17	6.2399-17	1.5106-16	3.9138-16
3100	1.0265-17	1.9511-17	4.0149-17	8.9417-17	2.1303-16	5.4253-16
3200	1.4922-17	2.8044-17	5.6983-17	1.2515-16	2.9372-16	7.3607-16
3300	2.1183-17	3.9392-17	7.9096-17	1.7145-16	3.9675-16	9.7933-16
3400	2.9431-17	5.4183-17	1.0759-16	2.3035-16	5.2602-16	1.2800-15
3500	4.0091-17	7.3117-17	1.4366-16	3.0401-16	6.8561-16	1.6461-15
3600	5.3636-17	9.6952-17	1.8860-16	3.9475-16	8.7978-16	2.0856-15
3700	7.0579-17	1.2651-16	2.4379-16	5.0497-16	1.1129-15	2.6066-15
3800	9.1468-17	1.6264-16	3.1064-16	6.3712-16	1.3893-15	3.2172-15
3900	1.1689-16	2.0627-16	3.9064-16	7.9372-16	1.7135-15	3.9252-15
4000	1.4744-16	2.5832-16	4.8529-16	9.7729-16	2.0897-15	4.7380-15

Table 2. (continued)

T(K)	v=0, J=6	v=0, J=7	v=0, J=8	v=0, J=9	v=0, J=10	v=0, J=11
4100	1.8376-16	3.1975-16	5.9611-16	1.1903-15	2.5222-15	5.6629-15
4200	2.2648-16	3.9152-16	7.2461-16	1.4353-15	3.0149-15	6.7065-15
4300	2.7626-16	4.7461-16	8.7228-16	1.7145-15	3.5719-15	7.8751-15
4400	3.3375-16	5.6996-16	1.0406-15	2.0304-15	4.1966-15	9.1742-15
4500	3.9959-16	6.7853-16	1.2310-15	2.3850-15	4.8925-15	1.0609-14
4600	4.7442-16	8.0122-16	1.4447-15	2.7804-15	5.6625-15	1.2184-14
4700	5.5885-16	9.3891-16	1.6832-15	3.2185-15	6.5095-15	1.3903-14
4800	6.5350-16	1.0924-15	1.9475-15	3.7010-15	7.4359-15	1.5768-14
4900	7.5892-16	1.2626-15	2.2388-15	4.2295-15	8.4438-15	1.7784-14
5000	8.7566-16	1.4501-15	2.5581-15	4.8053-15	9.5350-15	1.9950-14
5500	1.6457-15	2.6699-15	4.6031-15	8.4300-15	1.6278-14	3.3075-14
6000	2.7582-15	4.3989-15	7.4401-15	1.3340-14	2.5179-14	4.9927-14
6500	4.2356-15	6.6577-15	1.1079-14	1.9512-14	3.6125-14	7.0163-14
7000	6.0751-15	9.4307-15	1.5477-14	2.6840-14	4.8876-14	9.3257-14
7500	8.2533-15	1.2674-14	2.0550-14	3.5164-14	6.3123-14	1.1859-13
8000	1.0733-14	1.6326-14	2.6192-14	4.4297-14	7.8522-14	1.4555-13
8500	1.3466-14	2.0314-14	3.2287-14	5.4042-14	9.4737-14	1.7352-13
9000	1.6404-14	2.4562-14	3.8715-14	6.4207-14	1.1145-13	2.0197-13
9500	1.9495-14	2.8996-14	4.5364-14	7.4617-14	1.2837-13	2.3044-13
10000	2.2690-14	3.3547-14	5.2133-14	8.5115-14	1.4527-13	2.5854-13
11000	2.9223-14	4.2758-14	6.5680-14	1.0586-13	1.7821-13	3.1249-13
12000	3.5707-14	5.1794-14	7.8791-14	1.2564-13	2.0907-13	3.6210-13
13000	4.1928-14	6.0372-14	9.1090-14	1.4394-13	2.3719-13	4.0651-13
14000	4.7745-14	6.8317-14	1.0235-13	1.6048-13	2.6223-13	4.4540-13
15000	5.3078-14	7.5532-14	1.1247-13	1.7515-13	2.8414-13	4.7884-13
16000	5.7885-14	8.1980-14	1.2142-13	1.8797-13	3.0299-13	5.0712-13
17000	6.2160-14	8.7662-14	1.2922-13	1.9900-13	3.1896-13	5.3065-13
18000	6.5914-14	9.2606-14	1.3594-13	2.0836-13	3.3231-13	5.4987-13
19000	6.9173-14	9.6857-14	1.4164-13	2.1620-13	3.4326-13	5.6527-13
20000	7.1968-14	1.0047-13	1.4642-13	2.2266-13	3.5208-13	5.7728-13
21000	7.4338-14	1.0349-13	1.5036-13	2.2787-13	3.5901-13	5.8632-13
22000	7.6319-14	1.0598-13	1.5355-13	2.3199-13	3.6427-13	5.9280-13
23000	7.7949-14	1.0800-13	1.5607-13	2.3513-13	3.6808-13	5.9704-13
24000	7.9264-14	1.0959-13	1.5800-13	2.3742-13	3.7063-13	5.9937-13
25000	8.0297-14	1.1080-13	1.5941-13	2.3896-13	3.7207-13	6.0004-13
26000	8.1080-14	1.1168-13	1.6035-13	2.3984-13	3.7257-13	5.9931-13
27000	8.1641-14	1.1227-13	1.6090-13	2.4017-13	3.7225-13	5.9738-13
28000	8.2005-14	1.1260-13	1.6109-13	2.4000-13	3.7123-13	5.9444-13
29000	8.2197-14	1.1270-13	1.6098-13	2.3941-13	3.6961-13	5.9064-13
30000	8.2238-14	1.1261-13	1.6060-13	2.3845-13	3.6748-13	5.8611-13

Table 3. Rate constant for hydrogen molecule in  $v=0$  and  $J=12-17$  states.

T(K)	$v=0, J=12$	$v=0, J=13$	$v=0, J=14$	$v=0, J=15$	$v=0, J=16$	$v=0, J=17$
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	---	---	---	2.0037-28
600	---	---	---	1.1467-28	5.0848-27	2.5842-25
700	---	8.0515-29	1.8593-27	4.8337-26	1.3489-24	4.2366-23
800	9.7845-28	1.4450-26	2.4007-25	4.4397-24	8.7541-23	1.9166-21
900	7.0086-26	8.1012-25	1.0418-23	1.4782-22	2.2247-21	3.6789-20
1000	2.1187-24	2.0129-23	2.1090-22	2.4207-21	2.9353-20	3.8779-19
1100	3.4218-23	2.7689-22	2.4534-21	2.3675-20	2.4056-19	2.6449-18
1200	3.4551-22	2.4457-21	1.8846-20	1.5737-19	1.3799-18	1.3020-17
1300	2.4316-21	1.5369-20	1.0523-19	7.7746-19	6.0183-18	4.9887-17
1400	1.2890-20	7.3933-20	4.5742-19	3.0430-18	2.1168-17	1.5704-16
1500	5.4483-20	2.8727-19	1.6279-18	9.8879-18	6.2697-17	4.2249-16
1600	1.9161-19	9.3853-19	4.9252-18	2.7627-17	1.6153-16	1.0007-15
1700	5.7931-19	2.6588-18	1.3038-17	6.8171-17	3.7107-16	2.1343-15
1800	1.5442-18	6.6892-18	3.0882-17	1.5170-16	7.7484-16	4.1722-15
1900	3.7026-18	1.5230-17	6.6619-17	3.0945-16	1.4932-15	7.5791-15
2000	8.1143-18	3.1856-17	1.3274-16	5.8634-16	2.6879-15	1.2938-14
2100	1.6465-17	6.1968-17	2.4711-16	1.0430-15	4.5644-15	2.0939-14
2200	3.1260-17	1.1323-16	4.3384-16	1.7568-15	7.3710-15	3.2368-14
2300	5.6025-17	1.9594-16	7.2385-16	2.8223-15	1.1395-14	4.8080-14
2400	9.5468-17	3.2333-16	1.1552-15	4.3506-15	1.6955-14	6.8974-14
2500	1.5563-16	5.1172-16	1.7728-15	6.4671-15	2.4398-14	9.5967-14
2600	2.4395-16	7.8054-16	2.6282-15	9.3095-15	3.4084-14	1.2996-13
2700	3.6933-16	1.1522-15	3.7788-15	1.3025-14	4.6380-14	1.7184-13
2800	5.4207-16	1.6518-15	5.2866-15	1.7766-14	6.1651-14	2.2239-13
2900	7.7381-16	2.3070-15	7.2172-15	2.3688-14	8.0250-14	2.8238-13
3000	1.0774-15	3.1471-15	9.6383-15	3.0945-14	1.0251-13	3.5243-13
3100	1.4667-15	4.2031-15	1.2619-14	3.9688-14	1.2874-13	4.3310-13
3200	1.9563-15	5.5067-15	1.6227-14	5.0060-14	1.5922-13	5.2484-13
3300	2.5616-15	7.0900-15	2.0530-14	6.2193-14	1.9419-13	6.2797-13
3400	3.2982-15	8.9850-15	2.5591-14	7.6211-14	2.3385-13	7.4273-13
3500	4.1816-15	1.1223-14	3.1470-14	9.2221-14	2.7837-13	8.6924-13
3600	5.2276-15	1.3833-14	3.8224-14	1.1032-13	3.2788-13	1.0075-12
3700	6.4513-15	1.6844-14	4.5901-14	1.3058-13	3.8245-13	1.1575-12
3800	7.8674-15	2.0283-14	5.4548-14	1.5308-13	4.4214-13	1.3191-12
3900	9.4898-15	2.4173-14	6.4202-14	1.7785-13	5.0695-13	1.4919-12
4000	1.1331-14	2.8536-14	7.4894-14	2.0493-13	5.7686-13	1.6758-12

Table 3. (continued)

T(K)	$v=0, J=12$	$v=0, J=13$	$v=0, J=14$	$v=0, J=15$	$v=0, J=16$	$v=0, J=17$
4100	1.3404-14	3.3391-14	8.6651-14	2.3433-13	6.5182-13	1.8704-12
4200	1.5720-14	3.8755-14	9.9491-14	2.6607-13	7.3174-13	2.0752-12
4300	1.8286-14	4.4640-14	1.1343-13	3.0013-13	8.1651-13	2.2898-12
4400	2.1113-14	5.1057-14	1.2846-13	3.3648-13	9.0598-13	2.5137-12
4500	2.4207-14	5.8013-14	1.4461-13	3.7510-13	1.0000-12	2.7463-12
4600	2.7574-14	6.5514-14	1.6184-13	4.1593-13	1.0984-12	2.9873-12
4700	3.1218-14	7.3562-14	1.8017-13	4.5892-13	1.2010-12	3.2359-12
4800	3.5143-14	8.2156-14	1.9957-13	5.0401-13	1.3076-12	3.4916-12
4900	3.9349-14	9.1293-14	2.2002-13	5.5112-13	1.4180-12	3.7538-12
5000	4.3839-14	1.0097-13	2.4149-13	6.0019-13	1.5319-12	4.0221-12
5500	7.0470-14	1.5711-13	3.6326-13	8.7174-13	2.1471-12	5.4332-12
6000	1.0367-13	2.2493-13	5.0560-13	1.1784-12	2.8172-12	6.9133-12
6500	1.4254-13	3.0224-13	6.6331-13	1.5081-12	3.5159-12	8.4061-12
7000	1.8594-13	3.8655-13	8.3112-13	1.8499-12	4.2204-12	9.8680-12
7500	2.3265-13	4.7543-13	1.0042-12	2.1943-12	4.9131-12	1.1267-11
8000	2.8149-13	5.6666-13	1.1783-12	2.5336-12	5.5804-12	1.2583-11
8500	3.3139-13	6.5832-13	1.3502-12	2.8621-12	6.2131-12	1.3801-11
9000	3.8143-13	7.4884-13	1.5171-12	3.1754-12	6.8049-12	1.4916-11
9500	4.3086-13	8.3698-13	1.6772-12	3.4708-12	7.3524-12	1.5925-11
10000	4.7906-13	9.2180-13	1.8290-12	3.7464-12	7.8540-12	1.6830-11
11000	5.7004-13	1.0789-12	2.1045-12	4.2351-12	8.7203-12	1.8343-11
12000	6.5199-13	1.2172-12	2.3405-12	4.6411-12	9.4137-12	1.9497-11
13000	7.2389-13	1.3358-12	2.5377-12	4.9695-12	9.9525-12	2.0345-11
14000	7.8566-13	1.4354-12	2.6987-12	5.2283-12	1.0357-11	2.0935-11
15000	8.3773-13	1.5173-12	2.8271-12	5.4263-12	1.0648-11	2.1315-11
16000	8.8083-13	1.5832-12	2.9268-12	5.5722-12	1.0844-11	2.1522-11
17000	9.1583-13	1.6351-12	3.0018-12	5.6739-12	1.0961-11	2.1592-11
18000	9.4365-13	1.6748-12	3.0556-12	5.7386-12	1.1014-11	2.1551-11
19000	9.6515-13	1.7038-12	3.0913-12	5.7725-12	1.1015-11	2.1423-11
20000	9.8116-13	1.7237-12	3.1119-12	5.7810-12	1.0973-11	2.1227-11
21000	9.9242-13	1.7359-12	3.1197-12	5.7685-12	1.0898-11	2.0978-11
22000	9.9960-13	1.7416-12	3.1170-12	5.7390-12	1.0795-11	2.0688-11
23000	1.0033-12	1.7417-12	3.1055-12	5.6956-12	1.0671-11	2.0368-11
24000	1.0040-12	1.7371-12	3.0867-12	5.6411-12	1.0531-11	2.0025-11
25000	1.0022-12	1.7288-12	3.0621-12	5.5777-12	1.0378-11	1.9666-11
26000	9.9834-13	1.7172-12	3.0326-12	5.5074-12	1.0216-11	1.9297-11
27000	9.9265-13	1.7029-12	2.9993-12	5.4316-12	1.0046-11	1.8922-11
28000	9.8548-13	1.6865-12	2.9629-12	5.3516-12	9.8722-12	1.8543-11
29000	9.7707-13	1.6683-12	2.9241-12	5.2687-12	9.6952-12	1.8165-11
30000	9.6764-13	1.6487-12	2.8834-12	5.1836-12	9.5167-12	1.7788-11

Table 4. Rate constant for hydrogen molecule in v=0 and J=18-23 states.

T(K)	v=0, J=18	v=0, J=19	v=0, J=20	v=0, J=21	v=0, J=22	v=0, J=23
100	---	---	---	---	---	7.7476-29
200	---	---	---	---	---	4.3952-22
300	---	---	---	4.4611-28	7.5254-25	1.0738-18
400	---	3.6313-28	1.0001-25	3.1484-23	9.2404-21	1.1647-16
500	2.1016-26	2.2410-24	2.2454-22	2.4802-20	2.5596-18	2.6442-15
600	1.3742-23	7.3813-22	3.7690-20	2.0731-18	1.0682-16	2.4490-14
700	1.3870-21	4.5669-20	1.4407-18	4.8198-17	1.5142-15	1.2934-13
800	4.3609-20	9.9512-19	2.1877-17	5.0436-16	1.0943-14	4.6944-13
900	6.3077-19	1.0825-17	1.7969-16	3.1027-15	5.0512-14	1.3101-12
1000	5.3019-18	7.2452-17	9.6072-16	1.3168-14	1.7045-13	3.0198-12
1100	3.0047-17	3.4083-16	3.7607-15	4.2684-14	4.5819-13	6.0308-12
1200	1.2675-16	1.2312-15	1.1656-14	1.1308-13	1.0389-12	1.0786-11
1300	4.2621-16	3.6312-15	3.0201-14	2.5659-13	2.0669-12	1.7690-11
1400	1.1996-15	9.1340-15	6.7986-14	5.1561-13	3.7116-12	2.7073-11
1500	2.9288-15	2.0234-14	1.3679-13	9.4033-13	6.1414-12	3.9169-11
1600	6.3723-15	4.0431-14	2.5129-13	1.5852-12	9.5096-12	5.4111-11
1700	1.2610-14	7.4226-14	4.2833-13	2.5050-12	1.3944-11	7.1931-11
1800	2.3063-14	1.2699-13	6.8604-13	3.7514-12	1.9539-11	9.2578-11
1900	3.9472-14	2.0476-13	1.0428-12	5.3697-12	2.6357-11	1.1593-10
2000	6.3860-14	3.1396-13	1.5163-12	7.3973-12	3.4425-11	1.4180-10
2100	9.8459-14	4.6113-13	2.1227-12	9.8621-12	4.3736-11	1.6997-10
2200	1.4563-13	6.5263-13	2.8760-12	1.2782-11	5.4259-11	2.0020-10
2300	2.0778-13	8.9441-13	3.7876-12	1.6166-11	6.5940-11	2.3221-10
2400	2.8727-13	1.1918-12	4.8659-12	2.0013-11	7.8706-11	2.6576-10
2500	3.8634-13	1.5493-12	6.1168-12	2.4314-11	9.2469-11	3.0056-10
2600	5.0705-13	1.9706-12	7.5430-12	2.9056-11	1.0714-10	3.3636-10
2700	6.5122-13	2.4586-12	9.1447-12	3.4216-11	1.2260-10	3.7292-10
2800	8.2039-13	3.0150-12	1.0920-11	3.9769-11	1.3877-10	4.1001-10
2900	1.0158-12	3.6409-12	1.2863-11	4.5686-11	1.5553-10	4.4742-10
3000	1.2385-12	4.3362-12	1.4970-11	5.1937-11	1.7279-10	4.8496-10
3100	1.4889-12	5.1004-12	1.7231-11	5.8487-11	1.9044-10	5.2245-10
3200	1.7676-12	5.9320-12	1.9638-11	6.5303-11	2.0840-10	5.5973-10
3300	2.0745-12	6.8290-12	2.2181-11	7.2353-11	2.2657-10	5.9667-10
3400	2.4093-12	7.7890-12	2.4850-11	7.9601-11	2.4488-10	6.3315-10
3500	2.7718-12	8.8088-12	2.7633-11	8.7016-11	2.6324-10	6.6906-10
3600	3.1611-12	9.8853-12	3.0519-11	9.4566-11	2.8160-10	7.0431-10
3700	3.5765-12	1.1015-11	3.3496-11	1.0222-10	2.9988-10	7.3882-10
3800	4.0169-12	1.2193-11	3.6554-11	1.0996-10	3.1804-10	7.7254-10
3900	4.4812-12	1.3417-11	3.9682-11	1.1774-10	3.3602-10	8.0539-10
4000	4.9681-12	1.4683-11	4.2867-11	1.2555-10	3.5377-10	8.4352-10

Table 4. (continued)

T(K)	v=0, J=18	v=0, J=19	v=0, J=20	v=0, J=21	v=0, J=22	v=0, J=23
4100	5.4762-12	1.5985-11	4.6101-11	1.3336-10	3.7127-10	8.3735-10
4200	6.0042-12	1.7320-11	4.9373-11	1.4115-10	3.8846-10	8.6838-10
4300	6.5506-12	1.8685-11	5.2674-11	1.4891-10	4.0533-10	8.9844-10
4400	7.1139-12	2.0075-11	5.5994-11	1.5661-10	4.2185-10	9.2753-10
4500	7.6926-12	2.1486-11	5.9325-11	1.6424-10	4.3800-10	9.5564-10
4600	8.2852-12	2.2915-11	6.2660-11	1.7178-10	4.5376-10	9.8274-10
4700	8.8903-12	2.4358-11	6.5990-11	1.7922-10	4.6911-10	1.0089-09
4800	9.5063-12	2.5813-11	6.9309-11	1.8656-10	4.8405-10	1.0340-09
4900	1.0132-11	2.7274-11	7.2612-11	1.9377-10	4.9856-10	1.0581-09
5000	1.0766-11	2.8741-11	7.5891-11	2.0086-10	5.1264-10	1.0812-09
5500	1.4012-11	3.6050-11	9.1775-11	2.3413-10	5.7652-10	1.1828-09
6000	1.7285-11	4.3120-11	1.0648-10	2.6346-10	6.2968-10	1.2626-09
6500	2.0473-11	4.9757-11	1.1975-10	2.8872-10	6.7287-10	1.3233-09
7000	2.3498-11	5.5846-11	1.3147-10	3.1002-10	7.0711-10	1.3678-09
7500	2.6311-11	6.1331-11	1.4164-10	3.2767-10	7.3353-10	1.3987-09
8000	2.8884-11	6.6197-11	1.5034-10	3.4199-10	7.5321-10	1.4183-09
8500	3.1207-11	7.0456-11	1.5767-10	3.5338-10	7.6717-10	1.4287-09
9000	3.3278-11	7.4137-11	1.6374-10	3.6219-10	7.7631-10	1.4316-09
9500	3.5105-11	7.7280-11	1.6869-10	3.6876-10	7.8142-10	1.4284-09
10000	3.6700-11	7.9930-11	1.7263-10	3.7341-10	7.8318-10	1.4204-09
11000	3.9258-11	8.3929-11	1.7798-10	3.7800-10	7.7887-10	1.3935-09
12000	4.1083-11	8.6482-11	1.8062-10	3.7780-10	7.6704-10	1.3568-09
13000	4.2306-11	8.7898-11	1.8122-10	3.7420-10	7.5030-10	1.3146-09
14000	4.3043-11	8.8430-11	1.8031-10	3.6823-10	7.3047-10	1.2693-09
15000	4.3394-11	8.8287-11	1.7830-10	3.6065-10	7.0883-10	1.2230-09
16000	4.3441-11	8.7633-11	1.7550-10	3.5201-10	6.8628-10	1.1767-09
17000	4.3251-11	8.6596-11	1.7214-10	3.4273-10	6.6342-10	1.1313-09
18000	4.2879-11	8.5278-11	1.6841-10	3.3310-10	6.4069-10	1.0872-09
19000	4.2368-11	8.3757-11	1.6443-10	3.2332-10	6.1837-10	1.0448-09
20000	4.1752-11	8.2095-11	1.6032-10	3.1356-10	5.9664-10	1.0041-09
21000	4.1059-11	8.0339-11	1.5613-10	3.0392-10	5.7563-10	9.6530-10
22000	4.0310-11	7.8525-11	1.5194-10	2.9448-10	5.5540-10	9.2837-10
23000	3.9524-11	7.6682-11	1.4778-10	2.8528-10	5.3599-10	8.9328-10
24000	3.8713-11	7.4830-11	1.4369-10	2.7636-10	5.1741-10	8.5999-10
25000	3.7888-11	7.2986-11	1.3968-10	2.6775-10	4.9966-10	8.2842-10
26000	3.7059-11	7.1162-11	1.3576-10	2.5944-10	4.8271-10	7.9849-10
27000	3.6230-11	6.9368-11	1.3196-10	2.5145-10	4.6655-10	7.7011-10
28000	3.5408-11	6.7610-11	1.2827-10	2.4377-10	4.5115-10	7.4321-10
29000	3.4597-11	6.5893-11	1.2470-10	2.3640-10	4.3647-10	7.1770-10
30000	3.3798-11	6.4221-11	1.2126-10	2.2934-10	4.2247-10	6.9350-10



Table 5. Rate constant for hydrogen molecule in v=0 and J=24-29 states.

T(K)	v=0, J=24	v=0, J=25	v=0, J=26	v=0, J=27	v=0, J=28	v=0, J=29
100	---	---	2.9130-25	4.7735-18	7.9875-14	3.3792-12
200	2.8782-25	8.7559-22	2.0666-18	2.6238-15	5.3444-13	1.4698-11
300	7.9176-20	9.8931-18	9.9765-16	7.2984-14	2.9046-12	4.7337-11
400	4.8973-17	1.5702-15	4.1664-14	8.8158-13	1.3747-11	1.3505-10
500	2.4638-15	3.8525-14	5.1007-13	5.6178-12	4.9777-11	3.2812-10
600	3.4421-14	3.4457-13	2.9816-12	2.2002-11	1.3583-10	6.7092-10
700	2.6801-13	1.6831-12	1.0914-11	6.1374-11	2.9563-10	1.1843-09
800	9.3548-13	5.5707-12	2.9302-11	1.3532-10	5.4413-10	1.8643-09
900	2.8112-12	1.4154-11	6.3504-11	2.5258-10	8.8536-10	2.6891-09
1000	6.7602-12	2.9817-11	1.1805-10	4.1757-10	1.3141-09	3.6285-09
1100	1.3815-11	5.4744-11	1.9593-10	6.3053-10	1.8192-09	4.6500-09
1200	2.4980-11	9.0603-11	2.9837-10	8.8833-10	2.3862-09	5.7228-09
1300	4.1102-11	1.3840-10	4.2502-10	1.1856-09	2.9998-09	6.8202-09
1400	6.2794-11	1.9846-10	5.7431-10	1.5159-09	3.6453-09	7.9199-09
1500	9.0402-11	2.7053-10	7.4382-10	1.8721-09	4.3095-09	9.0041-09
1600	1.2402-10	3.5387-10	9.3062-10	2.2473-09	4.9808-09	1.0059-08
1700	1.6351-10	4.4744-10	1.1316-09	2.6353-09	5.6497-09	1.1075-08
1800	2.0855-10	5.4995-10	1.3435-09	3.0302-09	6.3082-09	1.2045-08
1900	2.5871-10	6.6003-10	1.5635-09	3.4271-09	6.9502-09	1.2963-08
2000	3.1343-10	7.7628-10	1.7887-09	3.8217-09	7.5710-09	1.3827-08
2100	3.7213-10	8.9730-10	2.0166-09	4.2106-09	8.1671-09	1.4636-08
2200	4.3418-10	1.0218-09	2.2450-09	4.5908-09	8.7360-09	1.5390-08
2300	4.9897-10	1.1486-09	2.4721-09	4.9601-09	9.2761-09	1.6088-08
2400	5.6590-10	1.2766-09	2.6963-09	5.3167-09	9.7865-09	1.6733-08
2500	6.3441-10	1.4048-09	2.9162-09	5.6595-09	1.0267-08	1.7326-08
2600	7.0397-10	1.5323-09	3.1307-09	5.9874-09	1.0717-08	1.7870-08
2700	7.7411-10	1.6585-09	3.3390-09	6.2998-09	1.1137-08	1.8365-08
2800	8.4439-10	1.7827-09	3.5404-09	6.5965-09	1.1529-08	1.8816-08
2900	9.1443-10	1.9044-09	3.7344-09	6.8772-09	1.1892-08	1.9224-08
3000	9.8389-10	2.0232-09	3.9206-09	7.1421-09	1.2228-08	1.9592-08
3100	1.0525-09	2.1386-09	4.0987-09	7.3912-09	1.2538-08	1.9921-08
3200	1.1199-09	2.2505-09	4.2687-09	7.6250-09	1.2823-08	2.0216-08
3300	1.1860-09	2.3585-09	4.4305-09	7.8438-09	1.3084-08	2.0477-08
3400	1.2506-09	2.4627-09	4.5841-09	8.0480-09	1.3322-08	2.0707-08
3500	1.3136-09	2.5627-09	4.7295-09	8.2381-09	1.3539-08	2.0909-08
3600	1.3747-09	2.6587-09	4.8669-09	8.4146-09	1.3735-08	2.1083-08
3700	1.4340-09	2.7505-09	4.9965-09	8.5781-09	1.3913-08	2.1233-08
3800	1.4913-09	2.8381-09	5.1184-09	8.7292-09	1.4072-08	2.1359-08
3900	1.5466-09	2.9217-09	5.2329-09	8.8683-09	1.4214-08	2.1463-08
4000	1.5999-09	3.0011-09	5.3402-09	8.9961-09	1.4341-08	2.1548-08

Table 5. (continued)

T(K)	v=0, J=24	v=0, J=25	v=0, J=26	v=0, J=27	v=0, J=28	v=0, J=29
4100	1.6511-09	3.0765-09	5.4405-09	9.1131-09	1.4452-08	2.1614-08
4200	1.7003-09	3.1480-09	5.5341-09	9.2198-09	1.4549-08	2.1663-08
4300	1.7474-09	3.2156-09	5.6212-09	9.3168-09	1.4633-08	2.1696-08
4400	1.7925-09	3.2795-09	5.7021-09	9.4045-09	1.4705-08	2.1714-08
4500	1.8355-09	3.3397-09	5.7771-09	9.4836-09	1.4765-08	2.1719-08
4600	1.8766-09	3.3964-09	5.8464-09	9.5543-09	1.4814-08	2.1711-08
4700	1.9157-09	3.4497-09	5.9103-09	9.6173-09	1.4853-08	2.1692-08
4800	1.9529-09	3.4997-09	5.9690-09	9.6728-09	1.4883-08	2.1662-08
4900	1.9882-09	3.5465-09	6.0227-09	9.7215-09	1.4904-08	2.1623-08
5000	2.0218-09	3.5902-09	6.0717-09	9.7635-09	1.4917-08	2.1574-08
5500	2.1638-09	3.7667-09	6.2539-09	9.8884-09	1.4877-08	2.1221-08
6000	2.2679-09	3.8832-09	6.3491-09	9.8991-09	1.4704-08	2.0734-08
6500	2.3406-09	3.9519-09	6.3781-09	9.8270-09	1.4440-08	2.0164-08
7000	2.3875-09	3.9830-09	6.3573-09	9.6960-09	1.4116-08	1.9547-08
7500	2.4136-09	3.9850-09	6.2994-09	9.5235-09	1.3754-08	1.8909-08
8000	2.4231-09	3.9645-09	6.2143-09	9.3228-09	1.3370-08	1.8265-08
8500	2.4195-09	3.9268-09	6.1097-09	9.1038-09	1.2975-08	1.7627-08
9000	2.4054-09	3.8763-09	5.9913-09	8.8736-09	1.2578-08	1.7002-08
9500	2.3833-09	3.8162-09	5.8636-09	8.6377-09	1.2183-08	1.6396-08
10000	2.3549-09	3.7492-09	5.7300-09	8.4000-09	1.1796-08	1.5810-08
11000	2.2852-09	3.6022-09	5.4550-09	7.9299-09	1.1050-08	1.4709-08
12000	2.2050-09	3.4471-09	5.1802-09	7.4778-09	1.0354-08	1.3703-08
13000	2.1199-09	3.2909-09	4.9134-09	7.0507-09	9.7099-09	1.2788-08
14000	2.0335-09	3.1378-09	4.6588-09	6.6515-09	9.1178-09	1.1958-08
15000	1.9481-09	2.9904-09	4.4185-09	6.2806-09	8.5747-09	1.1205-08
16000	1.8650-09	2.8498-09	4.1931-09	5.9372-09	8.0773-09	1.0521-08
17000	1.7851-09	2.7168-09	3.9824-09	5.6196-09	7.6215-09	9.8994-09
18000	1.7088-09	2.5914-09	3.7859-09	5.3262-09	7.2036-09	9.3332-09
19000	1.6363-09	2.4735-09	3.6029-09	5.0551-09	6.8200-09	8.8162-09
20000	1.5676-09	2.3628-09	3.4326-09	4.8043-09	6.4672-09	8.3433-09
21000	1.5028-09	2.2591-09	3.2739-09	4.5721-09	6.1422-09	7.9096-09
22000	1.4415-09	2.1619-09	3.1261-09	4.3569-09	5.8423-09	7.5109-09
23000	1.3837-09	2.0707-09	2.9883-09	4.1571-09	5.5651-09	7.1436-09
24000	1.3292-09	1.9852-09	2.8596-09	3.9714-09	5.3083-09	6.8045-09
25000	1.2779-09	1.9050-09	2.7394-09	3.7986-09	5.0701-09	6.4908-09
26000	1.2294-09	1.8297-09	2.6269-09	3.6374-09	4.8486-09	6.1999-09
27000	1.1837-09	1.7589-09	2.5216-09	3.4869-09	4.6424-09	5.9297-09
28000	1.1405-09	1.6923-09	2.4228-09	3.3462-09	4.4501-09	5.6782-09
29000	1.0997-09	1.6295-09	2.3301-09	3.2144-09	4.2703-09	5.4437-09
30000	1.0612-09	1.5704-09	2.2429-09	3.0909-09	4.1021-09	5.2246-09

Table 6. Rate constant for hydrogen molecule in  $v=0$  and  $J=30-31$  states and  $v=1$  and  $J=0-3$  states.

T(K)	$v=0, J=30$	$v=0, J=31$	$v=1, J=0$	$v=1, J=1$	$v=1, J=2$	$v=1, J=3$
100	4.2546 -11	2.6613 -10	---	---	---	---
200	1.4600 -10	7.8945 -10	---	---	---	---
300	3.6401 -10	1.6652 -09	---	---	---	---
400	7.8472 -10	2.9946 -09	---	---	---	---
500	1.4808 -09	4.7795 -09	---	---	---	---
600	2.4727 -09	6.9364 -09	---	---	---	---
700	3.7314 -09	9.3460 -09	---	---	---	---
800	5.1997 -09	1.1891 -08	---	---	---	---
900	6.8124 -09	1.4473 -08	6.6218 -29	8.1565 -29	1.2690 -28	2.4627 -28
1000	8.5079 -09	1.7018 -08	3.8761 -27	4.6948 -27	7.0445 -27	1.2948 -26
1100	1.0234 -08	1.9471 -08	1.0751 -25	1.2844 -25	1.8709 -25	3.2891 -25
1200	1.1950 -08	2.1798 -08	1.7037 -24	2.0121 -24	2.8594 -24	4.8440 -24
1300	1.3623 -08	2.3977 -08	1.7559 -23	2.0537 -23	2.8581 -23	4.6920 -23
1400	1.5231 -08	2.5995 -08	1.2909 -22	1.4973 -22	2.0467 -22	3.2709 -22
1500	1.6759 -08	2.7849 -08	7.2447 -22	8.3428 -22	1.1228 -21	1.7529 -21
1600	1.8196 -08	2.9538 -08	3.2655 -21	3.7368 -21	4.9611 -21	7.5888 -21
1700	1.9538 -08	3.1068 -08	1.2290 -20	1.3985 -20	1.8346 -20	2.7561 -20
1800	2.0783 -08	3.2446 -08	3.9804 -20	4.5070 -20	5.8494 -20	8.6478 -20
1900	2.1929 -08	3.3678 -08	1.1361 -19	1.2807 -19	1.6463 -19	2.3993 -19
2000	2.2980 -08	3.4774 -08	2.9128 -19	3.2704 -19	4.1680 -19	5.9961 -19
2100	2.3938 -08	3.5743 -08	6.8120 -19	7.6208 -19	9.6370 -19	1.3703 -18
2200	2.4807 -08	3.6594 -08	1.4717 -18	1.6410 -18	2.0605 -18	2.8987 -18
2300	2.5593 -08	3.7337 -08	2.9677 -18	3.2992 -18	4.1159 -18	5.7343 -18
2400	2.6299 -08	3.7979 -08	5.6348 -18	6.2470 -18	7.7471 -18	1.0698 -17
2500	2.6931 -08	3.8530 -08	1.0147 -17	1.1221 -17	1.3840 -17	1.8954 -17
2600	2.7492 -08	3.8996 -08	1.7438 -17	1.9238 -17	2.3608 -17	3.2088 -17
2700	2.7989 -08	3.9385 -08	2.8746 -17	3.1645 -17	3.8652 -17	5.2169 -17
2800	2.8426 -08	3.9704 -08	4.5664 -17	5.0167 -17	6.1011 -17	8.1811 -17
2900	2.8806 -08	3.9959 -08	7.0170 -17	7.6946 -17	9.3199 -17	1.2422 -16
3000	2.9135 -08	4.0155 -08	1.0466 -16	1.1456 -16	1.3824 -16	1.8320 -16
3100	2.9416 -08	4.0299 -08	1.5195 -16	1.6605 -16	1.9966 -16	2.6321 -16
3200	2.9653 -08	4.0395 -08	2.1529 -16	2.3491 -16	2.8153 -16	3.6928 -16
3300	2.9850 -08	4.0447 -08	2.9836 -16	3.2508 -16	3.8838 -16	5.0706 -16
3400	3.0009 -08	4.0460 -08	4.0523 -16	4.4092 -16	5.2522 -16	6.8271 -16
3500	3.0134 -08	4.0437 -08	5.4034 -16	5.8718 -16	6.9750 -16	9.0288 -16
3600	3.0227 -08	4.0382 -08	7.0844 -16	7.6892 -16	9.1100 -16	1.1746 -15
3700	3.0292 -08	4.0298 -08	9.1458 -16	9.9151 -16	1.1718 -15	1.5053 -15
3800	3.0330 -08	4.0188 -08	1.1640 -15	1.2605 -15	1.4863 -15	1.9026 -15
3900	3.0344 -08	4.0054 -08	1.4621 -15	1.5817 -15	1.8609 -15	2.3741 -15
4000	3.0336 -08	3.9900 -08	1.8145 -15	1.9610 -15	2.3021 -15	2.9278 -15

Table 6. (continued)

T(K)	$v=0, J=30$	$v=0, J=31$	$v=1, J=0$	$v=1, J=1$	$v=1, J=2$	$v=1, J=3$
4100	3.0307 -08	3.9726 -08	2.2266 -15	2.4041 -15	2.8167 -15	3.5713 -15
4200	3.0260 -08	3.9535 -08	2.7039 -15	2.9169 -15	3.4110 -15	4.3124 -15
4300	3.0197 -08	3.9329 -08	3.2520 -15	3.5052 -15	4.0914 -15	5.1584 -15
4400	3.0118 -08	3.9110 -08	3.8762 -15	4.1746 -15	4.8642 -15	6.1167 -15
4500	3.0025 -08	3.8879 -08	4.5815 -15	4.9304 -15	5.7352 -15	7.1939 -15
4600	2.9920 -08	3.8637 -08	5.3729 -15	5.7777 -15	6.7101 -15	8.3966 -15
4700	2.9803 -08	3.8386 -08	6.2550 -15	6.7214 -15	7.7942 -15	9.7308 -15
4800	2.9676 -08	3.8127 -08	7.2320 -15	7.7661 -15	8.9924 -15	1.1202 -14
4900	2.9539 -08	3.7860 -08	8.3081 -15	8.9158 -15	1.0309 -14	1.2815 -14
5000	2.9394 -08	3.7588 -08	9.4869 -15	1.0174 -14	1.1748 -14	1.4575 -14
5500	2.8571 -08	3.6161 -08	1.7021 -14	1.8204 -14	2.0893 -14	2.5686 -14
6000	2.7639 -08	3.4682 -08	2.7447 -14	2.9284 -14	3.3443 -14	4.0803 -14
6500	2.6655 -08	3.3204 -08	4.0791 -14	4.3436 -14	4.9392 -14	5.9879 -14
7000	2.5655 -08	3.1759 -08	5.6887 -14	6.0473 -14	6.8514 -14	8.2604 -14
7500	2.4662 -08	3.0364 -08	7.5428 -14	8.0063 -14	9.0421 -14	1.0850 -13
8000	2.3692 -08	2.9031 -08	9.6021 -14	1.0179 -13	1.1464 -13	1.3698 -13
8500	2.2754 -08	2.7764 -08	1.1824 -13	1.2520 -13	1.4065 -13	1.6745 -13
9000	2.1853 -08	2.6565 -08	1.4165 -13	1.4983 -13	1.6796 -13	1.9930 -13
9500	2.0993 -08	2.5433 -08	1.6584 -13	1.7527 -13	1.9609 -13	2.3199 -13
10000	2.0173 -08	2.4366 -08	1.9045 -13	2.0111 -13	2.2460 -13	2.6502 -13
11000	1.8656 -08	2.2415 -08	2.3966 -13	2.5271 -13	2.8137 -13	3.3047 -13
12000	1.7292 -08	2.0685 -08	2.8722 -13	3.0250 -13	3.3595 -13	3.9308 -13
13000	1.6069 -08	1.9150 -08	3.3180 -13	3.4909 -13	3.8686 -13	4.5117 -13
14000	1.4971 -08	1.7784 -08	3.7258 -13	3.9166 -13	4.3323 -13	5.0384 -13
15000	1.3984 -08	1.6565 -08	4.0919 -13	4.2983 -13	4.7468 -13	5.5071 -13
16000	1.3094 -08	1.5474 -08	4.4155 -13	4.6351 -13	5.1115 -13	5.9177 -13
17000	1.2291 -08	1.4492 -08	4.6974 -13	4.9282 -13	5.4280 -13	6.2723 -13
18000	1.1562 -08	1.3607 -08	4.9398 -13	5.1799 -13	5.6988 -13	6.5743 -13
19000	1.0901 -08	1.2806 -08	5.1456 -13	5.3932 -13	5.9276 -13	6.8280 -13
20000	1.0298 -08	1.2079 -08	5.3179 -13	5.5714 -13	6.1180 -13	7.0379 -13
21000	9.7467 -09	1.1417 -08	5.4599 -13	5.7180 -13	6.2739 -13	7.2084 -13
22000	9.2420 -09	1.0812 -08	5.5747 -13	5.8362 -13	6.3989 -13	7.3439 -13
23000	8.7784 -09	1.0257 -08	5.6653 -13	5.9292 -13	6.4964 -13	7.4483 -13
24000	8.3516 -09	9.7480 -09	5.7344 -13	5.9998 -13	6.5698 -13	7.5254 -13
25000	7.9576 -09	9.2789 -09	5.7847 -13	6.0508 -13	6.6218 -13	7.5785 -13
26000	7.5931 -09	8.8458 -09	5.8184 -13	6.0846 -13	6.6553 -13	7.6107 -13
27000	7.2552 -09	8.4450 -09	5.8375 -13	6.1032 -13	6.6724 -13	7.6248 -13
28000	6.9413 -09	8.0732 -09	5.8440 -13	6.1087 -13	6.6754 -13	7.6230 -13
29000	6.6491 -09	7.7276 -09	5.8394 -13	6.1027 -13	6.6660 -13	7.6075 -13
30000	6.3766 -09	7.4058 -09	5.8253 -13	6.0869 -13	6.6461 -13	7.5803 -13

Table 7. Rate constant for hydrogen molecule in  $v=1$  and  $J=4-9$  states.

T(K)	$v=1, J=4$	$v=1, J=5$	$v=1, J=6$	$v=1, J=7$	$v=1, J=8$	$v=1, J=9$
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	---	---	---	---
600	---	---	---	---	---	---
700	---	---	---	---	---	5.6587-29
800	---	1.4313-29	5.7710-29	2.8276-28	1.6623-27	1.1877-26
900	5.8094-28	1.6839-27	5.9689-27	2.5256-26	1.2613-25	7.5199-25
1000	2.8482-26	7.5711-26	2.4208-25	9.1086-25	3.9923-24	2.0593-23
1100	6.8330-25	1.6921-24	4.9723-24	1.6996-23	6.6949-23	3.0673-22
1200	9.5948-24	2.2396-23	6.1343-23	1.9355-22	6.9748-22	2.8948-21
1300	8.9261-23	1.9819-22	5.1145-22	1.5080-21	5.0401-21	1.9240-20
1400	6.0108-22	1.2785-21	3.1352-21	8.7227-21	2.7329-20	9.7102-20
1500	3.1261-21	6.4066-21	1.5030-20	3.9763-20	1.1779-19	3.9331-19
1600	1.3182-20	2.6150-20	5.9016-20	1.4940-19	4.2143-19	1.3326-18
1700	4.6778-20	9.0165-20	1.9664-19	4.7881-19	1.2934-18	3.8981-18
1800	1.4378-19	2.7014-19	5.7150-19	1.3443-18	3.4943-18	1.0090-17
1900	3.9161-19	7.1912-19	1.4805-18	3.3762-18	8.4792-18	2.3567-17
2000	9.6255-19	1.7315-18	3.4784-18	7.7142-18	1.8783-17	5.0438-17
2100	2.1668-18	3.8257-18	7.5168-18	1.6255-17	3.8484-17	1.0017-16
2200	4.5214-18	7.8488-18	1.5113-17	3.1941-17	7.3717-17	1.8652-16
2300	8.8331-18	1.5098-17	2.8540-17	5.9068-17	1.3318-16	3.2837-16
2400	1.6291-17	2.7451-17	5.1023-17	1.0359-16	2.2863-16	5.5048-16
2500	2.8561-17	4.7503-17	8.6927-17	1.7339-16	3.7524-16	8.8395-16
2600	4.7883-17	7.8681-17	1.4193-16	2.7851-16	5.9189-16	1.3665-15
2700	7.7148-17	1.2536-16	2.2314-16	4.3130-16	9.0130-16	2.0423-15
2800	1.1997-16	1.9293-16	3.3919-16	6.4646-16	1.3300-15	2.9618-15
2900	1.8074-16	2.8785-16	5.0026-16	9.4105-16	1.9081-15	4.1812-15
3000	2.6463-16	4.1765-16	7.1809-16	1.3344-15	2.6692-15	5.7612-15
3100	3.7760-16	5.9092-16	1.0058-15	1.8478-15	3.6495-15	7.7667-15
3200	5.2639-16	8.1726-16	1.3780-15	2.5046-15	4.8879-15	1.0265-14
3300	7.1845-16	1.1071-15	1.8503-15	3.3292-15	6.4249-15	1.3326-14
3400	9.6186-16	1.4719-15	2.4394-15	4.3476-15	8.3023-15	1.7020-14
3500	1.2653-15	1.9234-15	3.1626-15	5.5864-15	1.0562-14	2.1415-14
3600	1.6378-15	2.4741-15	4.0380-15	7.0726-15	1.3247-14	2.6579-14
3700	2.0889-15	3.1368-15	5.0837-15	8.8331-15	1.6398-14	3.2578-14
3800	2.6282-15	3.9246-15	6.3179-15	1.0895-14	2.0056-14	3.9473-14
3900	3.2655-15	4.8503-15	7.7589-15	1.3284-14	2.4258-14	4.7321-14
4000	4.0106-15	5.9269-15	9.4241-15	1.6024-14	2.9042-14	5.6176-14

Table 7. (continued)

T(K)	$v=1, J=4$	$v=1, J=5$	$v=1, J=6$	$v=1, J=7$	$v=1, J=8$	$v=1, J=9$
4100	4.8731-15	7.1669-15	1.1331-14	1.9141-14	3.4440-14	6.6086-14
4200	5.8625-15	8.5825-15	1.3495-14	2.2656-14	4.0484-14	7.7091-14
4300	6.9880-15	1.0185-14	1.5932-14	2.6589-14	4.7201-14	8.9228-14
4400	8.2581-15	1.1986-14	1.8656-14	3.0960-14	5.4616-14	1.0253-13
4500	9.6812-15	1.3996-14	2.1680-14	3.5785-14	6.2750-14	1.1701-13
4600	1.1265-14	1.6223-14	2.5016-14	4.1078-14	7.1619-14	1.3270-13
4700	1.3016-14	1.8676-14	2.8673-14	4.6852-14	8.1238-14	1.4961-13
4800	1.4942-14	2.1364-14	3.2662-14	5.3117-14	9.1617-14	1.6774-13
4900	1.7047-14	2.4292-14	3.6990-14	5.9882-14	1.0276-13	1.8709-13
5000	1.9337-14	2.7466-14	4.1662-14	6.7151-14	1.1468-13	2.0766-13
5500	3.3683-14	4.7156-14	7.0312-14	1.1114-13	1.8573-13	3.2833-13
6000	5.2989-14	7.3295-14	1.0773-13	1.6753-13	2.7495-13	4.7639-13
6500	7.7122-14	1.0559-13	1.5332-13	2.3516-13	3.8008-13	6.4741-13
7000	1.0564-13	1.4337-13	2.0602-13	3.1226-13	4.9809-13	8.3613-13
7500	1.3790-13	1.8573-13	2.6448-13	3.9678-13	6.2572-13	1.0371-12
8000	1.7317-13	2.3168-13	3.2730-13	4.8662-13	7.5975-13	1.2454-12
8500	2.1068-13	2.8021-13	3.9309-13	5.7978-13	8.9724-13	1.4564-12
9000	2.4970-13	3.3036-13	4.6055-13	6.7449-13	1.0356-12	1.6664-12
9500	2.8955-13	3.8128-13	5.2858-13	7.6922-13	1.1728-12	1.8724-12
10000	3.2965-13	4.3224-13	5.9622-13	8.6270-13	1.3070-12	2.0720-12
11000	4.0864-13	5.3191-13	7.2732-13	1.0420-12	1.5614-12	2.4453-12
12000	4.8365-13	6.2570-13	8.4936-13	1.2068-12	1.7918-12	2.7778-12
13000	5.5281-13	7.1146-13	9.5983-13	1.3543-12	1.9952-12	3.0665-12
14000	6.1513-13	7.8814-13	1.0577-12	1.4834-12	2.1708-12	3.3118-12
15000	6.7027-13	8.5546-13	1.1427-12	1.5943-12	2.3197-12	3.5162-12
16000	7.1827-13	9.1362-13	1.2155-12	1.6881-12	2.4437-12	3.6834-12
17000	7.5947-13	9.6313-13	1.2768-12	1.7661-12	2.5452-12	3.8173-12
18000	7.9433-13	1.0047-12	1.3277-12	1.8298-12	2.6265-12	3.9219-12
19000	8.2340-13	1.0389-12	1.3691-12	1.8808-12	2.6900-12	4.0008-12
20000	8.4723-13	1.0667-12	1.4021-12	1.9206-12	2.7381-12	4.0577-12
21000	8.6640-13	1.0887-12	1.4277-12	1.9505-12	2.7726-12	4.0957-12
22000	8.8142-13	1.1056-12	1.4468-12	1.9719-12	2.7956-12	4.1175-12
23000	8.9278-13	1.1181-12	1.4602-12	1.9859-12	2.8086-12	4.1255-12
24000	9.0094-13	1.1266-12	1.4688-12	1.9935-12	2.8131-12	4.1220-12
25000	9.0630-13	1.1318-12	1.4731-12	1.9957-12	2.8104-12	4.1087-12
26000	9.0923-13	1.1340-12	1.4738-12	1.9932-12	2.8016-12	4.0872-12
27000	9.1004-13	1.1337-12	1.4713-12	1.9867-12	2.7876-12	4.0588-12
28000	9.0903-13	1.1312-12	1.4662-12	1.9769-12	2.7692-12	4.0248-12
29000	9.0644-13	1.1268-12	1.4588-12	1.9642-12	2.7473-12	3.9862-12
30000	9.0251-13	1.1209-12	1.4494-12	1.9491-12	2.7223-12	3.9438-12

Table 8. Rate constant for hydrogen molecule in  $v=1$  and  $J=10-15$  states.

T(K)	$v=1, J=10$	$v=1, J=11$	$v=1, J=12$	$v=1, J=13$	$v=1, J=14$	$v=1, J=15$
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	---	---	1.1418-28	6.7321-27
600	---	1.1959-29	2.5823-28	6.5013-27	1.8552-25	6.0008-24
700	6.0711-28	7.6075-27	1.1242-25	1.9017-24	3.5861-23	7.5530-22
800	9.9176-26	9.5130-25	1.0577-23	1.3277-22	1.8352-21	2.8015-20
900	5.1670-24	4.0260-23	3.5876-22	3.5706-21	3.8763-20	4.6067-19
1000	1.2106-22	7.9875-22	5.9625-21	4.9283-20	4.4103-19	4.2898-18
1100	1.5869-21	9.1390-21	5.9017-20	4.1902-19	3.2015-18	2.6431-17
1200	1.3465-20	6.9230-20	3.9619-19	2.4782-18	1.6598-17	1.1953-16
1300	8.1779-20	3.8200-19	1.9737-18	1.1090-17	6.6443-17	4.2624-16
1400	3.8205-19	1.6437-18	7.7800-18	3.9875-17	2.1713-16	1.2615-15
1500	1.4472-18	5.7979-18	2.5435-17	1.2037-16	6.0340-16	3.2169-15
1600	4.6241-18	1.7405-17	7.1442-17	3.1532-16	1.4701-15	7.2699-15
1700	1.2844-17	4.5755-17	1.7711-16	7.3502-16	3.2147-15	1.4876-14
1800	3.1753-17	1.0771-16	3.9573-16	1.5548-15	6.4245-15	2.8026-14
1900	7.1169-17	2.3106-16	8.1020-16	3.0310-15	1.1903-14	4.9257-14
2000	1.4677-16	4.5809-16	1.5402-15	5.5132-15	2.0682-14	8.1615-14
2100	2.8188-16	8.4891-16	2.7476-15	9.4504-15	3.4014-14	1.2858-13
2200	5.0907-16	1.4842-15	4.6404-15	1.5392-14	5.3351-14	1.9393-13
2300	8.7158-16	2.4669-15	7.4731-15	2.3979-14	8.0306-14	2.8168-13
2400	1.4242-15	3.9230-15	1.1545-14	3.5935-14	1.1661-13	3.9586-13
2500	2.2339-15	6.0010-15	1.7196-14	5.2047-14	1.6407-13	5.4043-13
2600	3.3790-15	8.8702-15	2.4800-14	7.3148-14	2.2449-13	7.1918-13
2700	4.9496-15	1.2718-14	3.4757-14	1.0009-13	2.9965-13	9.3558-13
2800	7.0452-15	1.7747-14	4.7483-14	1.3374-13	3.9126-13	1.1927-12
2900	9.7739-15	2.4169-14	6.3404-14	1.7492-13	5.0088-13	1.4933-12
3000	1.3250-14	3.2204-14	8.2943-14	2.2444-13	6.2995-13	1.8394-12
3100	1.7593-14	4.2074-14	1.0651-13	2.8306-13	7.7972-13	2.2329-12
3200	2.2924-14	5.3997-14	1.3451-13	3.5144-13	9.5124-13	2.6749-12
3300	2.9363-14	6.8186-14	1.6730-13	4.3020-13	1.1454-12	3.1660-12
3400	3.7031-14	8.4846-14	2.0522-13	5.1987-13	1.3627-12	3.7066-12
3500	4.6041-14	1.0417-13	2.4858-13	6.2086-13	1.6038-12	4.2964-12
3600	5.6505-14	1.2632-13	2.9764-13	7.3352-13	1.8688-12	4.9349-12
3700	6.8525-14	1.5147-13	3.5262-13	8.5810-13	2.1577-12	5.6210-12
3800	8.2194-14	1.7975-13	4.1370-13	9.9476-13	2.4705-12	6.3534-12
3900	9.7598-14	2.1128-13	4.8103-13	1.1436-12	2.8068-12	7.1307-12
4000	1.1481-13	2.4615-13	5.5469-13	1.3045-12	3.1662-12	7.9509-12

Table 8. (continued)

T(K)	$v=1, J=10$	$v=1, J=11$	$v=1, J=12$	$v=1, J=13$	$v=1, J=14$	$v=1, J=15$
4100	1.3390-13	2.8445-13	6.3475-13	1.4775-12	3.5481-12	8.8120-12
4200	1.5492-13	3.2622-13	7.2121-13	1.6624-12	3.9518-12	9.7120-12
4300	1.7790-13	3.7151-13	8.1405-13	1.8590-12	4.3766-12	1.0648-11
4400	2.0289-13	4.2032-13	9.1322-13	2.0669-12	4.8214-12	1.1619-11
4500	2.2989-13	4.7266-13	1.0186-12	2.2859-12	5.2854-12	1.2621-11
4600	2.5893-13	5.2850-13	1.1302-12	2.5156-12	5.7675-12	1.3652-11
4700	2.9001-13	5.8780-13	1.2476-12	2.7555-12	6.2667-12	1.4710-11
4800	3.2310-13	6.5051-13	1.3709-12	3.0053-12	6.7819-12	1.5792-11
4900	3.5821-13	7.1656-13	1.4999-12	3.2643-12	7.3119-12	1.6895-11
5000	3.9529-13	7.8588-13	1.6342-12	3.5322-12	7.8557-12	1.8017-11
5500	6.0899-13	1.1779-12	2.3787-12	4.9857-12	1.0741-11	2.3835-11
6000	8.6471-13	1.6346-12	3.2212-12	6.5807-12	1.3806-11	2.9804-11
6500	1.1538-12	2.1390-12	4.1290-12	8.2540-12	1.6931-11	3.5710-11
7000	1.4669-12	2.6744-12	5.0717-12	9.9510-12	2.0023-11	4.1393-11
7500	1.7949-12	3.2254-12	6.0229-12	1.1628-11	2.3009-11	4.6748-11
8000	2.1296-12	3.7787-12	6.9616-12	1.3251-11	2.5839-11	5.1708-11
8500	2.4643-12	4.3238-12	7.8715-12	1.4797-11	2.8482-11	5.6238-11
9000	2.7933-12	4.8524-12	8.7406-12	1.6249-11	3.0919-11	6.0327-11
9500	3.1122-12	5.3584-12	9.5610-12	1.7597-11	3.3142-11	6.3978-11
10000	3.4179-12	5.8376-12	1.0327-11	1.8838-11	3.5151-11	6.7206-11
11000	3.9812-12	6.7058-12	1.1689-11	2.0993-11	3.8550-11	7.2489-11
12000	4.4733-12	7.4476-12	1.2823-11	2.2734-11	4.1190-11	7.6387-11
13000	4.8925-12	8.0658-12	1.3743-11	2.4099-11	4.3171-11	7.9126-11
14000	5.2419-12	8.5692-12	1.4470-11	2.5136-11	4.4594-11	8.0915-11
15000	5.5272-12	8.9696-12	1.5029-11	2.5894-11	4.5553-11	8.1935-11
16000	5.7550-12	9.2796-12	1.5442-11	2.6417-11	4.6131-11	8.2343-11
17000	5.9324-12	9.5115-12	1.5733-11	2.6745-11	4.6399-11	8.2265-11
18000	6.0659-12	9.6766-12	1.5921-11	2.6912-11	4.6419-11	8.1807-11
19000	6.1617-12	9.7851-12	1.6022-11	2.6948-11	4.6240-11	8.1053-11
20000	6.2253-12	9.8460-12	1.6052-11	2.6876-11	4.5902-11	8.0072-11
21000	6.2617-12	9.8672-12	1.6024-11	2.6719-11	4.5440-11	7.8920-11
22000	6.2751-12	9.8552-12	1.5948-11	2.6493-11	4.4882-11	7.7640-11
23000	6.2692-12	9.8158-12	1.5832-11	2.6212-11	4.4250-11	7.6268-11
24000	6.2472-12	9.7539-12	1.5686-11	2.5888-11	4.3562-11	7.4832-11
25000	6.2118-12	9.6736-12	1.5514-11	2.5530-11	4.2833-11	7.3354-11
26000	6.1654-12	9.5784-12	1.5322-11	2.5148-11	4.2076-11	7.1853-11
27000	6.1099-12	9.4711-12	1.5115-11	2.4747-11	4.1300-11	7.0343-11
28000	6.0469-12	9.3543-12	1.4896-11	2.4333-11	4.0513-11	6.8834-11
29000	5.9781-12	9.2301-12	1.4668-11	2.3910-11	3.9721-11	6.7335-11
30000	5.9045-12	9.1002-12	1.4434-11	2.3482-11	3.8930-11	6.5854-11

Table 9. Rate constant for hydrogen molecule in  $v=1$  and  $J=16-21$  states.

T(K)	$v=1, J=16$	$v=1, J=17$	$v=1, J=18$	$v=1, J=19$	$v=1, J=20$	$v=1, J=21$
100	---	---	---	---	---	---
200	---	---	---	---	---	1.5954-27
300	---	---	---	---	---	5.9505-21
400	3.9404-29	7.4506-27	1.4779-24	6.3976-27	5.5163-24	5.9505-21
500	4.3193-25	3.1507-23	2.3908-21	1.8208-19	1.2555-17	1.0943-17
600	2.0843-22	8.0571-21	3.2222-19	1.2848-17	4.7109-16	1.8748-14
700	1.6926-20	4.1573-19	1.0523-17	2.6442-16	6.1745-15	1.5361-13
800	4.5200-19	7.9011-18	1.4192-16	2.5231-15	4.2004-14	7.3501-13
900	5.7565-18	7.7243-17	1.0625-15	1.4437-14	1.8474-13	2.4598-12
1000	4.3694-17	4.7453-16	5.2729-15	5.7795-14	5.9915-13	6.4138-12
1100	2.2776-16	2.0805-15	1.9415-14	1.7852-13	1.5579-12	1.3954-11
1200	8.9601-16	7.0860-15	5.7170-14	4.5415-13	3.4338-12	2.6516-11
1300	2.8397-15	1.9879-14	1.4181-13	9.9547-13	6.6666-12	4.5416-11
1400	7.5962-15	4.7900-14	3.0748-13	1.9415-12	1.1718-11	7.1710-11
1500	1.7746-14	1.0222-13	5.9882-13	3.4496-12	1.9028-11	1.0611-10
1600	3.7146-14	1.9766-13	1.0689-12	5.6832-12	2.8973-11	1.4898-10
1700	7.1039-14	3.5250-13	1.7764-12	8.7993-12	4.1848-11	2.0033-10
1800	1.2602-13	5.8767-13	2.7814-12	1.2939-11	5.7850-11	2.5990-10
1900	2.0989-13	9.2584-13	4.1427-12	1.8218-11	7.7079-11	3.2719-10
2000	3.3132-13	1.3902-12	5.9142-12	2.4726-11	9.9545-11	4.0154-10
2100	4.9958-13	2.0035-12	8.1425-12	3.2521-11	1.2517-10	4.8217-10
2200	7.2410-13	2.7869-12	1.0865-11	4.1631-11	1.5383-10	5.6825-10
2300	1.0141-12	3.7594-12	1.4111-11	5.2056-11	1.8532-10	6.5891-10
2400	1.3784-12	4.9371-12	1.7899-11	6.3773-11	2.1941-10	7.5331-10
2500	1.8250-12	6.3328-12	2.2236-11	7.6735-11	2.5585-10	8.5062-10
2600	2.3608-12	7.9559-12	2.7123-11	9.0881-11	2.9436-10	9.5007-10
2700	2.9916-12	9.8127-12	3.2551-11	1.0613-10	3.3466-10	1.0509-09
2800	3.7220-12	1.1906-11	3.8504-11	1.2240-10	3.7648-10	1.1525-09
2900	4.5554-12	1.4235-11	4.4961-11	1.3960-10	4.1954-10	1.2543-09
3000	5.4937-12	1.6796-11	5.1895-11	1.5762-10	4.6358-10	1.3557-09
3100	6.5380-12	1.9585-11	5.9275-11	1.7637-10	5.0835-10	1.4562-09
3200	7.6879-12	2.2592-11	6.7069-11	1.9575-10	5.5362-10	1.5556-09
3300	8.9420-12	2.5810-11	7.5240-11	2.1566-10	5.9917-10	1.6533-09
3400	1.0298-11	2.9225-11	8.3753-11	2.3600-10	6.4481-10	1.7491-09
3500	1.1753-11	3.2827-11	9.2569-11	2.5669-10	6.9036-10	1.8427-09
3600	1.3304-11	3.6601-11	1.0165-10	2.7763-10	7.3565-10	1.9340-09
3700	1.4945-11	4.0534-11	1.1097-10	2.9876-10	7.8055-10	2.0228-09
3800	1.6672-11	4.4612-11	1.2048-10	3.1998-10	8.2492-10	2.1090-09
3900	1.8480-11	4.8820-11	1.3015-10	3.4124-10	8.6866-10	2.1924-09
4000	2.0364-11	5.3144-11	1.3994-10	3.6246-10	9.1166-10	2.2729-09

Table 9. (continued)

T(K)	$v=1, J=16$	$v=1, J=17$	$v=1, J=18$	$v=1, J=19$	$v=1, J=20$	$v=1, J=21$
4100	2.2317-11	5.7571-11	1.4983-10	3.8359-10	9.5385-10	2.3506-09
4200	2.4333-11	6.2085-11	1.5979-10	4.0457-10	9.9514-10	2.4254-09
4300	2.6408-11	6.6674-11	1.6979-10	4.2536-10	1.0355-09	2.4972-09
4400	2.8535-11	7.1324-11	1.7980-10	4.4592-10	1.0748-09	2.5661-09
4500	3.0708-11	7.6023-11	1.8980-10	4.6620-10	1.1132-09	2.6322-09
4600	3.2922-11	8.0759-11	1.9976-10	4.8617-10	1.1504-09	2.6953-09
4700	3.5171-11	8.5520-11	2.0967-10	5.0581-10	1.1865-09	2.7557-09
4800	3.7450-11	9.0297-11	2.1951-10	5.2508-10	1.2216-09	2.8132-09
4900	3.9753-11	9.5079-11	2.2925-10	5.4397-10	1.2555-09	2.8680-09
5000	4.2075-11	9.9856-11	2.3889-10	5.6245-10	1.2883-09	2.9202-09
5500	5.3821-11	1.2339-10	2.8508-10	6.4833-10	1.4353-09	3.1433-09
6000	6.5439-11	1.4577-10	3.2713-10	7.2277-10	1.5555-09	3.3101-09
6500	7.6566-11	1.6644-10	3.6445-10	7.8580-10	1.6512-09	3.4295-09
7000	8.6964-11	1.8514-10	3.9691-10	8.3808-10	1.7253-09	3.5098-09
7500	9.6495-11	2.0174-10	4.2467-10	8.8056-10	1.7808-09	3.5583-09
8000	1.0510-10	2.1626-10	4.4801-10	9.1434-10	1.8206-09	3.5812-09
8500	1.1275-10	2.2879-10	4.6732-10	9.4049-10	1.8472-09	3.5836-09
9000	1.1949-10	2.3946-10	4.8301-10	9.6005-10	1.8628-09	3.5697-09
9500	1.2535-10	2.4842-10	4.9548-10	9.7395-10	1.8693-09	3.5430-09
10000	1.3040-10	2.5584-10	5.0514-10	9.8303-10	1.8684-09	3.5063-09
11000	1.3829-10	2.6665-10	5.1737-10	9.8956-10	1.8492-09	3.4118-09
12000	1.4368-10	2.7308-10	5.2217-10	9.8445-10	1.8139-09	3.2995-09
13000	1.4707-10	2.7611-10	5.2149-10	9.7125-10	1.7684-09	3.1783-09
14000	1.4886-10	2.7655-10	5.1683-10	9.5255-10	1.7167-09	3.0539-09
15000	1.4940-10	2.7504-10	5.0932-10	9.3024-10	1.6618-09	2.9299-09
16000	1.4898-10	2.7209-10	4.9983-10	9.0569-10	1.6054-09	2.8086-09
17000	1.4782-10	2.6808-10	4.8898-10	8.7985-10	1.5490-09	2.6914-09
18000	1.4610-10	2.6331-10	4.7726-10	8.5344-10	1.4934-09	2.5790-09
19000	1.4397-10	2.5801-10	4.6503-10	8.2695-10	1.4392-09	2.4719-09
20000	1.4153-10	2.5236-10	4.5254-10	8.0072-10	1.3868-09	2.3702-09
21000	1.3887-10	2.4649-10	4.4000-10	7.7500-10	1.3363-09	2.2738-09
22000	1.3606-10	2.4052-10	4.2753-10	7.4995-10	1.2879-09	2.1827-09
23000	1.3316-10	2.3450-10	4.1526-10	7.2567-10	1.2417-09	2.0965-09
24000	1.3021-10	2.2851-10	4.0323-10	7.0224-10	1.1975-09	2.0152-09
25000	1.2724-10	2.2259-10	3.9152-10	6.7967-10	1.1555-09	1.9384-09
26000	1.2428-10	2.1676-10	3.8014-10	6.5799-10	1.1154-09	1.8658-09
27000	1.2134-10	2.1106-10	3.6912-10	6.3719-10	1.0773-09	1.7973-09
28000	1.1845-10	2.0550-10	3.5848-10	6.1725-10	1.0410-09	1.7325-09
29000	1.1560-10	2.0008-10	3.4821-10	5.9816-10	1.0065-09	1.6713-09
30000	1.1281-10	1.9483-10	3.3831-10	5.7989-10	9.7369-10	1.6133-09

Table 10. Rate constant for hydrogen molecule in  $v=1$  and  $J=22-27$  states.

T(K)	$v=1, J=22$	$v=1, J=23$	$v=1, J=24$	$v=1, J=25$	$v=1, J=26$	$v=1, J=27$
100	---	---	2.3081-23	3.4335-16	9.3750-12	1.9937-10
200	3.9356-23	2.8315-19	4.2929-16	4.2075-13	5.2145-11	7.4464-10
300	5.5018-18	1.7321-15	1.6143-13	9.1049-12	2.1832-10	1.9308-09
400	1.9754-15	1.3869-13	3.6826-12	6.3167-11	6.7053-10	3.8973-09
500	6.5671-14	1.9324-12	2.5537-11	2.3457-10	1.5335-09	6.5108-09
600	6.6644-13	1.1160-11	9.4830-11	5.9273-10	2.8192-09	9.5182-09
700	3.4394-12	3.8855-11	2.4355-10	1.1708-09	4.4528-09	1.2679-08
800	1.1646-11	9.8477-11	4.9423-10	1.9624-09	6.3255-09	1.5813-08
900	2.9803-11	2.0186-10	8.5516-10	2.9350-09	8.3303-09	1.8806-08
1000	6.2724-11	3.5659-10	1.3219-09	4.0442-09	1.0378-08	2.1588-08
1100	1.1457-10	5.6529-10	1.8814-09	5.2447-09	1.2403-08	2.4129-08
1200	1.8823-10	8.2627-10	2.5162-09	6.4956-09	1.4356-08	2.6416-08
1300	2.8512-10	1.1347-09	3.2074-09	7.7624-09	1.6208-08	2.8455-08
1400	4.0527-10	1.4838-09	3.9369-09	9.0183-09	1.7941-08	3.0257-08
1500	5.4758-10	1.8660-09	4.6882-09	1.0243-08	1.9543-08	3.1837-08
1600	7.1009-10	2.2735-09	5.4475-09	1.1421-08	2.1013-08	3.3214-08
1700	8.9034-10	2.6987-09	6.2031-09	1.2542-08	2.2352-08	3.4405-08
1800	1.0856-09	3.1350-09	6.9457-09	1.3600-08	2.3564-08	3.5428-08
1900	1.2929-09	3.5762-09	7.6682-09	1.4592-08	2.4654-08	3.6300-08
2000	1.5096-09	4.0174-09	8.3651-09	1.5516-08	2.5630-08	3.7036-08
2100	1.7329-09	4.4541-09	9.0325-09	1.6371-08	2.6499-08	3.7651-08
2200	1.9605-09	4.8828-09	9.6678-09	1.7159-08	2.7269-08	3.8158-08
2300	2.1902-09	5.3008-09	1.0269-08	1.7883-08	2.7947-08	3.8568-08
2400	2.4200-09	5.7057-09	1.0836-08	1.8544-08	2.8541-08	3.8892-08
2500	2.6484-09	6.0960-09	1.1368-08	1.9146-08	2.9058-08	3.9138-08
2600	2.8738-09	6.4704-09	1.1865-08	1.9692-08	2.9503-08	3.9317-08
2700	3.0951-09	6.8280-09	1.2328-08	2.0185-08	2.9884-08	3.9435-08
2800	3.3114-09	7.1683-09	1.2758-08	2.0628-08	3.0206-08	3.9499-08
2900	3.5217-09	7.4911-09	1.3156-08	2.1024-08	3.0474-08	3.9514-08
3000	3.7255-09	7.7964-09	1.3524-08	2.1378-08	3.0692-08	3.9487-08
3100	3.9224-09	8.0842-09	1.3862-08	2.1690-08	3.0866-08	3.9423-08
3200	4.1119-09	8.3549-09	1.4171-08	2.1965-08	3.1000-08	3.9325-08
3300	4.2938-09	8.6088-09	1.4454-08	2.2206-08	3.1097-08	3.9197-08
3400	4.4680-09	8.8463-09	1.4712-08	2.2414-08	3.1160-08	3.9043-08
3500	4.6344-09	9.0680-09	1.4946-08	2.2592-08	3.1194-08	3.8866-08
3600	4.7929-09	9.2744-09	1.5158-08	2.2742-08	3.1199-08	3.8668-08
3700	4.9437-09	9.4662-09	1.5348-08	2.2867-08	3.1180-08	3.8453-08
3800	5.0867-09	9.6438-09	1.5519-08	2.2969-08	3.1139-08	3.8222-08
3900	5.2222-09	9.8080-09	1.5670-08	2.3048-08	3.1077-08	3.7977-08
4000	5.3503-09	9.9593-09	1.5804-08	2.3108-08	3.0997-08	3.7721-08

Table 10. (continued)

T(K)	$v=1, J=22$	$v=1, J=23$	$v=1, J=24$	$v=1, J=25$	$v=1, J=26$	$v=1, J=27$
4100	5.4712-09	1.0098-08	1.5922-08	2.3149-08	3.0901-08	3.7454-08
4200	5.5851-09	1.0226-08	1.6025-08	2.3174-08	3.0790-08	3.7179-08
4300	5.6921-09	1.0342-08	1.6113-08	2.3182-08	3.0665-08	3.6896-08
4400	5.7925-09	1.0448-08	1.6187-08	2.3176-08	3.0529-08	3.6606-08
4500	5.8866-09	1.0544-08	1.6249-08	2.3157-08	3.0382-08	3.6311-08
4600	5.9745-09	1.0630-08	1.6300-08	2.3126-08	3.0225-08	3.6012-08
4700	6.0566-09	1.0707-08	1.6339-08	2.3084-08	3.0059-08	3.5709-08
4800	6.1329-09	1.0777-08	1.6368-08	2.3032-08	2.9886-08	3.5403-08
4900	6.2038-09	1.0838-08	1.6388-08	2.2971-08	2.9707-08	3.5095-08
5000	6.2695-09	1.0891-08	1.6399-08	2.2901-08	2.9521-08	3.4786-08
5500	6.5276-09	1.1061-08	1.6343-08	2.2448-08	2.8528-08	3.3233-08
6000	6.6864-09	1.1098-08	1.6143-08	2.1872-08	2.7472-08	3.1704-08
6500	6.7678-09	1.1040-08	1.5848-08	2.1226-08	2.6398-08	3.0226-08
7000	6.7894-09	1.0912-08	1.5489-08	2.0542-08	2.5334-08	2.8815-08
7500	6.7655-09	1.0735-08	1.5090-08	1.9845-08	2.4297-08	2.7478-08
8000	6.7071-09	1.0524-08	1.4668-08	1.9148-08	2.3297-08	2.6218-08
8500	6.6231-09	1.0290-08	1.4236-08	1.8464-08	2.2341-08	2.5033-08
9000	6.5201-09	1.0042-08	1.3801-08	1.7797-08	2.1429-08	2.3920-08
9500	6.4036-09	9.7864-09	1.3370-08	1.7153-08	2.0564-08	2.2877-08
10000	6.2777-09	9.5270-09	1.2947-08	1.6534-08	1.9745-08	2.1898-08
11000	6.0095-09	9.0107-09	1.2134-08	1.5374-08	1.8236-08	2.0121-08
12000	5.7334-09	8.5111-09	1.1375-08	1.4317-08	1.6889-08	1.8555-08
13000	5.4599-09	8.0368-09	1.0672-08	1.3359-08	1.5686-08	1.7171-08
14000	5.1950-09	7.5918-09	1.0027-08	1.2491-08	1.4608-08	1.5943-08
15000	4.9419-09	7.1770-09	9.4340-09	1.1705-08	1.3642-08	1.4850-08
16000	4.7023-09	6.7918-09	8.8909-09	1.0992-08	1.2773-08	1.3872-08
17000	4.4767-09	6.4349-09	8.3931-09	1.0344-08	1.1988-08	1.2994-08
18000	4.2649-09	6.1044-09	7.9364-09	9.7537-09	1.1278-08	1.2202-08
19000	4.0666-09	5.7984-09	7.5168-09	9.2151-09	1.0633-08	1.1487-08
20000	3.8811-09	5.5150-09	7.1308-09	8.7224-09	1.0046-08	1.0837-08
21000	3.7076-09	5.2521-09	6.7751-09	8.2706-09	9.5095-09	1.0245-08
22000	3.5454-09	5.0082-09	6.4467-09	7.8552-09	9.0182-09	9.7046-09
23000	3.3936-09	4.7815-09	6.1429-09	7.4726-09	8.5670-09	9.2094-09
24000	3.2515-09	4.5705-09	5.8614-09	7.1193-09	8.1515-09	8.7545-09
25000	3.1183-09	4.3739-09	5.6001-09	6.7923-09	7.7681-09	8.3353-09
26000	2.9935-09	4.1904-09	5.3571-09	6.4892-09	7.4134-09	7.9483-09
27000	2.8763-09	4.0189-09	5.1307-09	6.2075-09	7.0845-09	7.5900-09
28000	2.7662-09	3.8584-09	4.9194-09	5.9453-09	6.7790-09	7.2577-09
29000	2.6626-09	3.7080-09	4.7220-09	5.7007-09	6.4946-09	6.9487-09
30000	2.5650-09	3.5668-09	4.5371-09	5.4723-09	6.2293-09	6.6609-09

Table 11. Rate constant for hydrogen molecule in  $v=1$  and  $J=28-30$  states and  $v=2$  and  $J=0-2$  state

T(K)	$v=1, J=28$	$v=1, J=29$	$v=1, J=30$	$v=2, J=0$	$v=2, J=1$	$v=2, J=2$
100	1.2848-09	4.3533-09	7.1478-09	---	---	---
200	3.9586-09	1.0433-08	1.4969-08	---	---	---
300	7.7653-09	1.6719-08	2.1481-08	---	---	---
400	1.2229-08	2.2535-08	2.6675-08	---	---	---
500	1.6837-08	2.7595-08	3.0732-08	---	---	---
600	2.1242-08	3.1852-08	3.3867-08	---	---	---
700	2.5267-08	3.5363-08	3.6271-08	1.5013-29	1.9675-29	3.2707-29
800	2.8839-08	3.8222-08	3.8102-08	3.8941-27	4.9570-27	7.8073-27
900	3.1950-08	4.0527-08	3.9484-08	2.9070-25	3.6178-25	5.4636-25
1000	3.4623-08	4.2368-08	4.0513-08	9.0823-24	1.1100-23	1.6209-23
1100	3.6896-08	4.3823-08	4.1263-08	1.5069-22	1.8146-22	2.5779-22
1200	3.8813-08	4.4956-08	4.1793-08	1.5559-21	1.8507-21	2.5695-21
1300	4.0414-08	4.5823-08	4.2145-08	1.1158-20	1.3134-20	1.7886-20
1400	4.1741-08	4.6469-08	4.2355-08	6.0113-20	7.0127-20	9.3919-20
1500	4.2828-08	4.6930-08	4.2451-08	2.5765-19	2.9824-19	3.9371-19
1600	4.3707-08	4.7237-08	4.2454-08	9.1723-19	1.0546-18	1.3747-18
1700	4.4406-08	4.7415-08	4.2381-08	2.8030-18	3.2034-18	4.1294-18
1800	4.4949-08	4.7486-08	4.2245-08	7.5431-18	8.5748-18	1.0945-17
1900	4.5357-08	4.7466-08	4.2059-08	1.8241-17	2.0637-17	2.6107-17
2000	4.5649-08	4.7370-08	4.1830-08	4.0281-17	4.5377-17	5.6949-17
2100	4.5839-08	4.7210-08	4.1567-08	8.2298-17	9.2350-17	1.1507-16
2200	4.5941-08	4.6996-08	4.1275-08	1.5724-16	1.7582-16	2.1763-16
2300	4.5967-08	4.6737-08	4.0960-08	2.8342-16	3.1589-16	3.8867-16
2400	4.5928-08	4.6440-08	4.0625-08	4.8549-16	5.3952-16	6.6018-16
2500	4.5832-08	4.6112-08	4.0275-08	7.9525-16	8.8134-16	1.0730-15
2600	4.5687-08	4.5757-08	3.9911-08	1.2521-15	1.3842-15	1.6774-15
2700	4.5499-08	4.5380-08	3.9538-08	1.9035-15	2.0994-15	2.5330-15
2800	4.5274-08	4.4985-08	3.9156-08	2.8046-15	3.0864-15	3.7089-15
2900	4.5018-08	4.4575-08	3.8768-08	4.0179-15	4.4127-15	5.2829-15
3000	4.4735-08	4.4153-08	3.8376-08	5.6129-15	6.1529-15	7.3404-15
3100	4.4429-08	4.3722-08	3.7980-08	7.6648-15	8.3874-15	9.9735-15
3200	4.4103-08	4.3283-08	3.7582-08	1.0254-14	1.1202-14	1.3279-14
3300	4.3761-08	4.2839-08	3.7182-08	1.3463-14	1.4685-14	1.7359-14
3400	4.3404-08	4.2391-08	3.6783-08	1.7379-14	1.8929-14	2.2314-14
3500	4.3035-08	4.1940-08	3.6384-08	2.2089-14	2.4026-14	2.8250-14
3600	4.2657-08	4.1488-08	3.5985-08	2.7679-14	3.0066-14	3.5266-14
3700	4.2271-08	4.1035-08	3.5589-08	3.4233-14	3.7140-14	4.3464-14
3800	4.1878-08	4.0583-08	3.5195-08	4.1855-14	4.5334-14	5.2938-14
3900	4.1480-08	4.0132-08	3.4803-08	5.0562-14	5.4731-14	6.3779-14
4000	4.1079-08	3.9684-08	3.4414-08	6.0489-14	6.5407-14	7.6071-14

Table 11. (continued)

T(K)	$v=1, J=28$	$v=1, J=29$	$v=1, J=30$	$v=2, J=0$	$v=2, J=1$	$v=2, J=2$
4100	4.0675-08	3.9237-08	3.4029-08	7.1684-14	7.7435-14	8.9891-14
4200	4.0270-08	3.8794-08	3.3647-08	8.4210-14	9.0878-14	1.0531-13
4300	3.9863-08	3.8354-08	3.3268-08	9.8122-14	1.0580-13	1.2239-13
4400	3.9457-08	3.7918-08	3.2894-08	1.1347-13	1.2224-13	1.4118-13
4500	3.9051-08	3.7487-08	3.2523-08	1.3029-13	1.4024-13	1.6173-13
4600	3.8646-08	3.7059-08	3.2157-08	1.4863-13	1.5986-13	1.8407-13
4700	3.8243-08	3.6636-08	3.1795-08	1.6851-13	1.8110-13	2.0823-13
4800	3.7842-08	3.6218-08	3.1438-08	1.8995-13	2.0398-13	2.3423-13
4900	3.7444-08	3.5805-08	3.1085-08	2.1296-13	2.2853-13	2.6208-13
5000	3.7048-08	3.5397-08	3.0737-08	2.3755-13	2.5475-13	2.9178-13
5500	3.5120-08	3.3436-08	2.9063-08	3.8399-13	4.1056-13	4.6761-13
6000	3.3293-08	3.1608-08	2.7505-08	5.6756-13	6.0532-13	6.8622-13
6500	3.1575-08	2.9911-08	2.6057-08	7.8356-13	8.3390-13	9.4161-13
7000	2.9969-08	2.8340-08	2.4714-08	1.0258-12	1.0897-12	1.2262-12
7500	2.8473-08	2.6885-08	2.3470-08	1.2874-12	1.3655-12	1.5321-12
8000	2.7079-08	2.5538-08	2.2316-08	1.5620-12	1.6544-12	1.8515-12
8500	2.5783-08	2.4291-08	2.1246-08	1.8435-12	1.9502-12	2.1775-12
9000	2.4577-08	2.3135-08	2.0252-08	2.1267-12	2.2472-12	2.5041-12
9500	2.3454-08	2.2062-08	1.9328-08	2.4072-12	2.5411-12	2.8264-12
10000	2.2408-08	2.1065-08	1.8469-08	2.6815-12	2.8282-12	3.1406-12
11000	2.0523-08	1.9272-08	1.6920-08	3.2013-12	3.3713-12	3.7330-12
12000	1.8875-08	1.7711-08	1.5568-08	3.6718-12	3.8620-12	4.2661-12
13000	1.7429-08	1.6344-08	1.4381-08	4.0868-12	4.2938-12	4.7336-12
14000	1.6152-08	1.5139-08	1.3333-08	4.4452-12	4.6659-12	5.1349-12
15000	1.5021-08	1.4073-08	1.2404-08	4.7488-12	4.9806-12	5.4731-12
16000	1.4012-08	1.3123-08	1.1576-08	5.0017-12	5.2422-12	5.7529-12
17000	1.3109-08	1.2274-08	1.0834-08	5.2085-12	5.4555-12	5.9800-12
18000	1.2298-08	1.1512-08	1.0167-08	5.3742-12	5.6259-12	6.1604-12
19000	1.1566-08	1.0824-08	9.5646-09	5.5036-12	5.7585-12	6.2998-12
20000	1.0903-08	1.0201-08	9.0188-09	5.6014-12	5.8582-12	6.4035-12
21000	1.0300-08	9.6357-09	8.5224-09	5.6718-12	5.9294-12	6.4763-12
22000	9.7496-09	9.1199-09	8.0695-09	5.7185-12	5.9760-12	6.5227-12
23000	9.2464-09	8.6481-09	7.6549-09	5.7449-12	6.0015-12	6.5465-12
24000	8.7847-09	8.2153-09	7.2744-09	5.7539-12	6.0091-12	6.5510-12
25000	8.3599-09	7.8172-09	6.9241-09	5.7482-12	6.0015-12	6.5391-12
26000	7.9679-09	7.4501-09	6.6009-09	5.7301-12	5.9809-12	6.5135-12
27000	7.6055-09	7.1106-09	6.3018-09	5.7013-12	5.9495-12	6.4763-12
28000	7.2695-09	6.7960-09	6.0246-09	5.6638-12	5.9090-12	6.4295-12
29000	6.9575-09	6.5039-09	5.7670-09	5.6189-12	5.8609-12	6.3746-12
30000	6.6670-09	6.2319-09	5.5271-09	5.5679-12	5.8065-12	6.3131-12

Table 12. Rate constant for hydrogen molecule in v=2 and J=3-8 states.

T(K)	v=2, J=3	v=2, J=4	v=2, J=5	v=2, J=6	v=2, J=7	v=2, J=8
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	---	---	---	---
600	---	---	---	---	2.4468-29	2.0688-28
700	7.0041-29	1.9313-28	6.7234-28	2.8928-27	1.5390-26	9.9777-26
800	1.5418-26	3.8163-26	1.1634-25	4.2861-25	1.9083-24	1.0137-23
900	1.0131-24	2.3055-24	6.3390-24	2.0697-23	8.0227-23	3.6501-22
1000	2.8579-23	6.0809-23	1.5393-22	4.5631-22	1.5832-21	6.3633-21
1100	4.3614-22	8.7831-22	2.0779-21	5.6915-21	1.8036-20	6.5497-20
1200	4.2003-21	8.0793-21	1.8066-20	4.6329-20	1.3612-19	4.5427-19
1300	2.8398-20	5.2543-20	1.1202-19	2.7167-19	7.4878-19	2.3263-18
1400	1.4544-19	2.6029-19	5.3266-19	1.2316-18	3.2134-18	9.3896-18
1500	5.9665-19	1.0374-18	2.0490-18	4.5450-18	1.1308-17	3.1333-17
1600	2.0441-18	3.4655-18	6.6353-18	1.4194-17	3.3878-17	8.9603-17
1700	6.0387-18	1.0012-17	1.8651-17	3.8641-17	8.8903-17	2.2568-16
1800	1.5769-17	2.5630-17	4.6597-17	9.3829-17	2.0895-16	5.1141-16
1900	3.7118-17	5.9269-17	1.0543-16	2.0695-16	4.4761-16	1.0603-15
2000	8.0003-17	1.2572-16	2.1929-16	4.2069-16	8.8628-16	2.0387-15
2100	1.5990-16	2.4768-16	4.2439-16	7.9744-16	1.6405-15	3.6746-15
2200	2.9947-16	4.5779-16	7.7183-16	1.4232-15	2.8652-15	6.2644-15
2300	5.3003-16	8.0056-16	1.3300-15	2.4104-15	4.7577-15	1.0175-14
2400	8.9288-16	1.3338-15	2.1861-15	3.8998-15	7.5595-15	1.5843-14
2500	1.4402-15	2.1298-15	3.4473-15	6.0610-15	1.1555-14	2.3769-14
2600	2.2356-15	3.2752-15	5.2407-15	9.0911-15	1.7067-14	3.4509-14
2700	3.3542-15	4.8714-15	7.7122-15	1.3213-14	2.4454-14	4.8663-14
2800	4.8818-15	7.0331-15	1.1025-14	1.8671-14	3.4101-14	6.6865-14
2900	6.9145-15	9.8872-15	1.5356-14	2.5729-14	4.6415-14	8.9764-14
3000	9.5572-15	1.3571-14	2.0897-14	3.4661-14	6.1813-14	1.1802-13
3100	1.2922-14	1.8228-14	2.7843-14	4.5750-14	8.0717-14	1.5226-13
3200	1.7126-14	2.4010-14	3.6399-14	5.9284-14	1.0354-13	1.9313-13
3300	2.2290-14	3.1070-14	4.6769-14	7.5544-14	1.3070-13	2.4121-13
3400	2.8537-14	3.9562-14	5.9154-14	9.4807-14	1.6256-13	2.9704-13
3500	3.5988-14	4.9637-14	7.3752-14	1.1734-13	1.9951-13	3.6112-13
3600	4.4764-14	6.1442-14	9.0750-14	1.4338-13	2.4185-13	4.3390-13
3700	5.4979-14	7.5119-14	1.1033-13	1.7317-13	2.8991-13	5.1575-13
3800	6.6746-14	9.0799-14	1.3265-13	2.0690-13	3.4393-13	6.0699-13
3900	8.0166-14	1.0861-13	1.5786-13	2.4477-13	4.0413-13	7.0787-13
4000	9.5335-14	1.2865-13	1.8609-13	2.8694-13	4.7071-13	8.1858-13

Table 12. (continued)

T(K)	v=2, J=3	v=2, J=4	v=2, J=5	v=2, J=6	v=2, J=7	v=2, J=8
4100	1.1234-13	1.5104-13	2.1747-13	3.3353-13	5.4380-13	9.3924-13
4200	1.3126-13	1.7584-13	2.5209-13	3.8466-13	6.2351-13	1.0699-12
4300	1.5216-13	2.0315-13	2.9003-13	4.4040-13	7.0990-13	1.2106-12
4400	1.7509-13	2.3302-13	3.3134-13	5.0080-13	8.0300-13	1.3613-12
4500	2.0011-13	2.6549-13	3.7608-13	5.6591-13	9.0280-13	1.5218-12
4600	2.2725-13	3.0060-13	4.2428-13	6.3572-13	1.0093-12	1.6920-12
4700	2.5653-13	3.3838-13	4.7593-13	7.1022-13	1.1223-12	1.8718-12
4800	2.8798-13	3.7882-13	5.3103-13	7.8937-13	1.2418-12	2.0608-12
4900	3.2159-13	4.2192-13	5.8956-13	8.7310-13	1.3677-12	2.2589-12
5000	3.5736-13	4.6768-13	6.5149-13	9.6135-13	1.4997-12	2.4657-12
5500	5.6792-13	7.3499-13	1.0099-12	1.4665-12	2.2463-12	3.6183-12
6000	8.2761-13	1.0611-12	1.4414-12	2.0654-12	3.1156-12	4.9335-12
6500	1.1289-12	1.4360-12	1.9318-12	2.7369-12	4.0754-12	6.3608-12
7000	1.4627-12	1.8480-12	2.4654-12	3.4590-12	5.0938-12	7.8523-12
7500	1.8195-12	2.2853-12	3.0267-12	4.2109-12	6.1415-12	9.3660-12
8000	2.1902-12	2.7368-12	3.6018-12	4.9741-12	7.1937-12	1.0868-11
8500	2.5670-12	3.1930-12	4.1788-12	5.7333-12	8.2300-12	1.2330-11
9000	2.9431-12	3.6459-12	4.7478-12	6.4762-12	9.2349-12	1.3733-11
9500	3.3129-12	4.0891-12	5.3011-12	7.1935-12	1.0197-11	1.5064-11
10000	3.6720-12	4.5176-12	5.8331-12	7.8782-12	1.1108-11	1.6312-11
11000	4.3462-12	5.3167-12	6.8172-12	9.1330-12	1.2758-11	1.8543-11
12000	4.9492-12	6.0257-12	7.6816-12	1.0221-11	1.4169-11	2.0416-11
13000	5.4750-12	6.6391-12	8.4219-12	1.1142-11	1.5344-11	2.1949-11
14000	5.9238-12	7.1586-12	9.0425-12	1.1905-11	1.6302-11	2.3173-11
15000	6.2997-12	7.5901-12	9.5523-12	1.2522-11	1.7064-11	2.4124-11
16000	6.6087-12	7.9415-12	9.9624-12	1.3011-11	1.7654-11	2.4840-11
17000	6.8577-12	8.2215-12	1.0284-11	1.3387-11	1.8096-11	2.5354-11
18000	7.0536-12	8.4389-12	1.0530-11	1.3666-11	1.8411-11	2.5699-11
19000	7.2031-12	8.6019-12	1.0709-11	1.3861-11	1.8618-11	2.5901-11
20000	7.3125-12	8.7180-12	1.0831-11	1.3986-11	1.8735-11	2.5985-11
21000	7.3873-12	8.7939-12	1.0905-11	1.4051-11	1.8776-11	2.5971-11
22000	7.4325-12	8.8355-12	1.0938-11	1.4067-11	1.8754-11	2.5876-11
23000	7.4525-12	8.8482-12	1.0937-11	1.4040-11	1.8680-11	2.5716-11
24000	7.4512-12	8.8364-12	1.0907-11	1.3978-11	1.8564-11	2.5502-11
25000	7.4318-12	8.8040-12	1.0853-11	1.3888-11	1.8412-11	2.5244-11
26000	7.3972-12	8.7544-12	1.0779-11	1.3774-11	1.8231-11	2.4953-11
27000	7.3500-12	8.6906-12	1.0688-11	1.3640-11	1.8028-11	2.4634-11
28000	7.2922-12	8.6149-12	1.0584-11	1.3491-11	1.7807-11	2.4294-11
29000	7.2256-12	8.5296-12	1.0469-11	1.3330-11	1.7571-11	2.3938-11
30000	7.1520-12	8.4365-12	1.0346-11	1.3158-11	1.7324-11	2.3571-11



Table 13. Rate constant for hydrogen molecule in v=2 and J=9-14 states.

T(K)	v=2, J=9	v=2, J=10	v=2, J=11	v=2, J=12	v=2, J=13	v=2, J=14
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	1.9584-29	1.7059-27
500	---	1.1012-29	2.6900-28	7.7643-27	2.6584-25	1.0220-23
600	2.1868-27	2.7479-26	4.1720-25	7.3061-24	1.4790-22	3.2967-21
700	7.8655-25	7.2157-24	7.8002-23	9.5590-22	1.3294-20	2.0079-19
800	6.4125-23	4.6460-22	3.8931-21	3.6501-20	3.8306-19	4.3216-18
900	1.9456-21	1.1732-20	8.0647-20	6.1395-19	5.1756-18	4.6540-17
1000	2.9577-20	1.5398-19	9.0338-19	5.8215-18	4.1186-17	3.0891-16
1100	2.7214-19	1.2563-18	6.4747-18	3.6405-17	2.2315-16	1.4429-15
1200	1.7191-18	7.1793-18	3.3213-17	1.6669-16	9.0661-16	5.1805-15
1300	8.1340-18	3.1208-17	1.3177-16	6.0066-16	2.9527-15	1.5197-14
1400	3.0678-17	1.0945-16	4.2730-16	1.7937-15	8.0852-15	3.8046-14
1500	9.6530-17	3.2334-16	1.1795-15	4.6101-15	1.9275-14	8.3925-14
1600	2.6220-16	8.3116-16	2.8572-15	1.0490-14	4.1069-14	1.6707-13
1700	6.3109-16	1.9055-15	6.2157-15	2.1597-14	7.9781-14	3.0567-13
1800	1.3735-15	3.9714-15	1.2365-14	4.0908-14	1.4352-13	5.2135-13
1900	2.7468-15	7.6403-15	2.2818-14	7.2245-14	2.4203-13	8.3827-13
2000	5.1122-15	1.3733-14	3.9502-14	1.2023-13	3.8637-13	1.2820-12
2100	8.9473-15	2.3288-14	6.4751-14	1.9016-13	5.8855-13	1.8786-12
2200	1.4850-14	3.7559-14	1.0126-13	2.8786-13	8.6100-13	2.6530-12
2300	2.3539-14	5.7993-14	1.5200-13	4.1949-13	1.2161-12	3.6285-12
2400	3.5839-14	8.6202-14	2.2017-13	5.9133-13	1.6659-12	4.8259-12
2500	5.2671-14	1.2392-13	3.0907-13	8.0956-13	2.2215-12	6.2629-12
2600	7.5028-14	1.7295-13	4.2200-13	1.0801-12	2.8927-12	7.9534-12
2700	1.0395-13	2.3514-13	5.6220-13	1.4085-12	3.6883-12	9.9081-12
2800	1.4052-13	3.1231-13	7.3276-13	1.7997-12	4.6151-12	1.2134-11
2900	1.8579-13	4.0623-13	9.3650-13	2.2580-12	5.6786-12	1.4633-11
3000	2.4081-13	5.1856-13	1.1760-12	2.7869-12	6.8826-12	1.7407-11
3100	3.0658-13	6.5083-13	1.4535-12	3.3893-12	8.2291-12	2.0451-11
3200	3.8404-13	8.0443-13	1.7708-12	4.0672-12	9.7189-12	2.3760-11
3300	4.7404-13	9.8054-13	2.1295-12	4.8220-12	1.1351-11	2.7325-11
3400	5.7735-13	1.1802-12	2.5307-12	5.6541-12	1.3124-11	3.1137-11
3500	6.9464-13	1.4041-12	2.9750-12	6.5634-12	1.5033-11	3.5182-11
3600	8.2646-13	1.6531-12	3.4629-12	7.5492-12	1.7075-11	3.9448-11
3700	9.7326-13	1.9274-12	3.9944-12	8.6102-12	1.9245-11	4.3921-11
3800	1.1354-12	2.2272-12	4.5692-12	9.7444-12	2.1536-11	4.8584-11
3900	1.3130-12	2.5527-12	5.1867-12	1.0950-11	2.3943-11	5.3422-11
4000	1.5064-12	2.9037-12	5.8460-12	1.2223-11	2.6458-11	5.8420-11

Table 13. (continued)

T(K)	v=2, J=9	v=2, J=10	v=2, J=11	v=2, J=12	v=2, J=13	v=2, J=14
4100	1.7154-12	3.2798-12	6.5460-12	1.3562-11	2.9073-11	6.3561-11
4200	1.9400-12	3.6808-12	7.2854-12	1.4962-11	3.1783-11	6.8829-11
4300	2.1801-12	4.1059-12	8.0627-12	1.6421-11	3.4577-11	7.4209-11
4400	2.4353-12	4.5545-12	8.8763-12	1.7935-11	3.7450-11	7.9685-11
4500	2.7055-12	5.0258-12	9.7243-12	1.9500-11	4.0393-11	8.5242-11
4600	2.9901-12	5.5189-12	1.0605-11	2.1112-11	4.3398-11	9.0866-11
4700	3.2888-12	6.0329-12	1.1516-11	2.2767-11	4.6458-11	9.6544-11
4800	3.6011-12	6.5668-12	1.2456-11	2.4461-11	4.9567-11	1.0226-10
4900	3.9264-12	7.1195-12	1.3422-11	2.6191-11	5.2715-11	1.0801-10
5000	4.2641-12	7.6899-12	1.4413-11	2.7952-11	5.5897-11	1.1377-10
5500	6.1175-12	1.0768-11	1.9664-11	3.7104-11	7.2091-11	1.4244-10
6000	8.1851-12	1.4119-11	2.5229-11	4.6530-11	8.8260-11	1.7013-10
6500	1.0386-11	1.7610-11	3.0895-11	5.5888-11	1.0388-10	1.9609-10
7000	1.2646-11	2.1130-11	3.6490-11	6.4925-11	1.1858-10	2.1988-10
7500	1.4906-11	2.4590-11	4.1887-11	7.3464-11	1.3217-10	2.4128-10
8000	1.7116-11	2.7923-11	4.6998-11	8.1397-11	1.4451-10	2.6026-10
8500	1.9242-11	3.1083-11	5.1766-11	8.8663-11	1.5558-10	2.7685-10
9000	2.1257-11	3.4038-11	5.6158-11	9.5239-11	1.6539-10	2.9118-10
9500	2.3146-11	3.6773-11	6.0160-11	1.0113-10	1.7400-10	3.0341-10
10000	2.4899-11	3.9279-11	6.3774-11	1.0635-10	1.8146-10	3.1371-10
11000	2.7983-11	4.3607-11	6.9880-11	1.1494-10	1.9329-10	3.2924-10
12000	3.0518-11	4.7075-11	7.4616-11	1.2133-10	2.0158-10	3.3914-10
13000	3.2546-11	4.9770-11	7.8161-11	1.2586-10	2.0699-10	3.4460-10
14000	3.4123-11	5.1797-11	8.0701-11	1.2887-10	2.1009-10	3.4663-10
15000	3.5311-11	5.3257-11	8.2405-11	1.3065-10	2.1137-10	3.4602-10
16000	3.6168-11	5.4242-11	8.3424-11	1.3143-10	2.1122-10	3.4343-10
17000	3.6746-11	5.4835-11	8.3888-11	1.3142-10	2.0997-10	3.3935-10
18000	3.7092-11	5.5107-11	8.3905-11	1.3079-10	2.0788-10	3.3417-10
19000	3.7246-11	5.5116-11	8.3564-11	1.2968-10	2.0515-10	3.2821-10
20000	3.7242-11	5.4914-11	8.2940-11	1.2820-10	2.0195-10	3.2170-10
21000	3.7109-11	5.4542-11	8.2093-11	1.2643-10	1.9841-10	3.1482-10
22000	3.6872-11	5.4035-11	8.1074-11	1.2445-10	1.9463-10	3.0772-10
23000	3.6552-11	5.3421-11	7.9923-11	1.2231-10	1.9068-10	3.0051-10
24000	3.6164-11	5.2724-11	7.8673-11	1.2007-10	1.8663-10	2.9326-10
25000	3.5723-11	5.1964-11	7.7350-11	1.1775-10	1.8254-10	2.8604-10
26000	3.5241-11	5.1155-11	7.5976-11	1.1539-10	1.7844-10	2.7890-10
27000	3.4728-11	5.0313-11	7.4570-11	1.1300-10	1.7435-10	2.7188-10
28000	3.4191-11	4.9446-11	7.3144-11	1.1062-10	1.7031-10	2.6501-10
29000	3.3638-11	4.8564-11	7.1711-11	1.0825-10	1.6633-10	2.5829-10
30000	3.3073-11	4.7674-11	7.0279-11	1.0590-10	1.6242-10	2.5174-10

Table 14. Rate constant for hydrogen molecule in  $v=2$  and  $J=15-20$  states

T(K)	$v=2, J=15$	$v=2, J=16$	$v=2, J=17$	$v=2, J=18$	$v=2, J=19$	$v=2, J=20$
100	---	---	---	---	---	---
200	---	---	---	---	1.6761-26	1.4770-22
300	---	---	---	---	3.1270-20	1.4506-17
400	1.7497-25	1.6454-28	9.1821-26	5.3405-23	4.0694-17	4.3332-15
500	4.4903-22	1.9636-23	2.4694-21	3.1890-19	2.9182-15	1.2853-13
600	8.2297-20	2.1149-20	1.0878-18	5.6978-17	4.9332-14	1.2064-12
700	3.3470-18	2.1736-18	6.1610-17	1.7687-15	3.6607-13	5.8815-12
800	5.3210-17	5.8493-17	1.0834-15	2.0247-14	1.6262-12	1.9069-11
900	4.5273-16	4.5635-15	9.1864-15	1.2444-13	5.1365-12	4.7156-11
1000	2.4888-15	2.0694-14	1.7833-13	5.0574-13	1.2787-11	9.6536-11
1100	9.9634-15	7.0778-14	5.1866-13	3.8027-12	2.6787-11	1.7234-10
1200	3.1458-14	1.9600-13	1.2549-12	8.0288-12	4.9320-11	2.7777-10
1300	8.2775-14	4.6158-13	2.6365-12	1.5032-11	8.2251-11	4.1395-10
1400	1.8879-13	9.5729-13	4.9585-12	2.5613-11	1.2694-10	5.8020-10
1500	3.8415-13	1.7939-12	8.5370-12	4.0483-11	1.8416-10	7.7444-10
1600	7.1256-13	3.0961-12	1.3683-11	6.0209-11	2.5414-10	9.9362-10
1700	1.2249-12	4.9946-12	2.0677-11	8.5181-11	3.3658-10	1.2342-09
1800	1.9767-12	7.6170-12	2.9756-11	1.1561-10	4.3082-10	1.4922-09
1900	3.0246-12	1.1081-11	4.1098-11	1.5153-10	5.3588-10	1.7640-09
2000	4.4240-12	1.5487-11	5.4822-11	1.9283-10	6.5060-10	2.0458-09
2100	6.2262-12	2.0918-11	7.0986-11	2.3926-10	7.7367-10	2.3343-09
2200	8.4761-12	2.7433-11	8.9590-11	2.9050-10	9.0379-10	2.6265-09
2300	1.1211-11	3.5067-11	1.1058-10	3.4614-10	1.0396-09	2.9196-09
2400	1.4460-11	4.3838-11	1.3388-10	4.0571-10	1.1799-09	3.2114-09
2500	1.8244-11	5.3739-11	1.5935-10	4.6874-10	1.3234-09	3.4998-09
2600	2.2572-11	6.4748-11	1.8684-10	5.3472-10	1.4690-09	3.7832-09
2700	2.7450-11	7.6826-11	2.1618-10	6.0318-10	1.6157-09	4.0602-09
2800	3.2871-11	8.9924-11	2.4719-10	6.7363-10	1.7626-09	4.3297-09
2900	3.8824-11	1.0398-10	2.7967-10	7.4562-10	1.9089-09	4.5909-09
3000	4.5293-11	1.1892-10	3.1344-10	8.1871-10	2.0539-09	4.8432-09
3100	5.2254-11	1.3468-10	3.4830-10	8.9253-10	2.1969-09	5.0859-09
3200	5.9682-11	1.5117-10	3.8406-10	9.6668-10	2.3375-09	5.3188-09
3300	6.7546-11	1.6832-10	4.2055-10	1.0409-09	2.4751-09	5.5416-09
3400	7.5815-11	1.8605-10	4.5760-10	1.1147-09	2.6095-09	5.7543-09
3500	8.4456-11	2.0428-10	4.9504-10	1.1881-09	2.7404-09	5.9569-09
3600	9.3433-11	2.2292-10	5.3272-10	1.2606-09	2.8674-09	6.1494-09
3700	1.0271-10	2.4191-10	5.7051-10	1.3322-09	2.9904-09	6.3319-09
3800	1.1226-10	2.6117-10	6.0827-10	1.4026-09	3.1093-09	6.5045-09
3900	1.2204-10	2.8064-10	6.4590-10	1.4716-09	3.2240-09	6.6676-09
4000	1.3201-10	3.0025-10	6.8328-10	1.5392-09	3.3344-09	6.8214-09

Table 14. (continued)

T(K)	$v=2, J=15$	$v=2, J=16$	$v=2, J=17$	$v=2, J=18$	$v=2, J=19$	$v=2, J=20$
4100	1.4216-10	3.1995-10	7.2033-10	1.6052-09	3.4404-09	6.9660-09
4200	1.5243-10	3.3966-10	7.5695-10	1.6696-09	3.5422-09	7.1019-09
4300	1.6282-10	3.5936-10	7.9307-10	1.7322-09	3.6396-09	7.2292-09
4400	1.7327-10	3.7897-10	8.2864-10	1.7931-09	3.7327-09	7.3484-09
4500	1.8378-10	3.9847-10	8.6358-10	1.8521-09	3.8217-09	7.4596-09
4600	1.9431-10	4.1782-10	8.9785-10	1.9092-09	3.9064-09	7.5633-09
4700	2.0484-10	4.3697-10	9.3141-10	1.9644-09	3.9872-09	7.6597-09
4800	2.1535-10	4.5590-10	9.6422-10	2.0178-09	4.0639-09	7.7491-09
4900	2.2582-10	4.7458-10	9.9626-10	2.0692-09	4.1367-09	7.8318-09
5000	2.3623-10	4.9297-10	1.0275-09	2.1187-09	4.2058-09	7.9081-09
5500	2.8681-10	5.8010-10	1.1711-09	2.3387-09	4.4979-09	8.2037-09
6000	3.3390-10	6.5797-10	1.2935-09	2.5151-09	4.7117-09	8.3791-09
6500	3.7659-10	7.2591-10	1.3954-09	2.6527-09	4.8605-09	8.4613-09
7000	4.1449-10	7.8403-10	1.4784-09	2.7568-09	4.9562-09	8.4722-09
7500	4.4757-10	8.3286-10	1.5446-09	2.8324-09	5.0092-09	8.4291-09
8000	4.7601-10	8.7317-10	1.5959-09	2.8841-09	5.0280-09	8.3454-09
8500	5.0009-10	9.0584-10	1.6345-09	2.9160-09	5.0199-09	8.2317-09
9000	5.2020-10	9.3173-10	1.6621-09	2.9316-09	4.9904-09	8.0962-09
9500	5.3671-10	9.5169-10	1.6805-09	2.9338-09	4.9445-09	7.9451-09
10000	5.5001-10	9.6649-10	1.6910-09	2.9252-09	4.8857-09	7.7835-09
11000	5.6842-10	9.8336-10	1.6935-09	2.8833-09	4.7415-09	7.4427-09
12000	5.7804-10	9.8707-10	1.6775-09	2.8187-09	4.5758-09	7.0948-09
13000	5.8100-10	9.8127-10	1.6492-09	2.7402-09	4.4002-09	6.7519-09
14000	5.7900-10	9.6870-10	1.6125-09	2.6538-09	4.2219-09	6.4210-09
15000	5.7334-10	9.5142-10	1.5707-09	2.5636-09	4.0455-09	6.1058-09
16000	5.6504-10	9.3095-10	1.5258-09	2.4724-09	3.8741-09	5.8078-09
17000	5.5485-10	9.0841-10	1.4793-09	2.3818-09	3.7091-09	5.5277-09
18000	5.4337-10	8.8463-10	1.4324-09	2.2933-09	3.5515-09	5.2652-09
19000	5.3104-10	8.6021-10	1.3858-09	2.2074-09	3.4017-09	5.0195-09
20000	5.1818-10	8.3560-10	1.3400-09	2.1247-09	3.2597-09	4.7898-09
21000	5.0506-10	8.1111-10	1.2954-09	2.0455-09	3.1255-09	4.5752-09
22000	4.9186-10	7.8697-10	1.2521-09	1.9697-09	2.9988-09	4.3746-09
23000	4.7871-10	7.6334-10	1.2104-09	1.8975-09	2.8793-09	4.1870-09
24000	4.6573-10	7.4033-10	1.1702-09	1.8288-09	2.7665-09	4.0114-09
25000	4.5299-10	7.1801-10	1.1316-09	1.7634-09	2.6602-09	3.8469-09
26000	4.4053-10	6.9643-10	1.0947-09	1.7013-09	2.5598-09	3.6927-09
27000	4.2840-10	6.7560-10	1.0593-09	1.6423-09	2.4651-09	3.5481-09
28000	4.1663-10	6.5554-10	1.0255-09	1.5862-09	2.3756-09	3.4121-09
29000	4.0522-10	6.3623-10	9.9314-10	1.5329-09	2.2911-09	3.2843-09
30000	3.9418-10	6.1767-10	9.6225-10	1.4823-09	2.2111-09	3.1639-09

Table 15. Rate constant for hydrogen molecule in  $v=2$  and  $J=21$ -26 states.

T(K)	$v=2, J=21$	$v=2, J=22$	$v=2, J=23$	$v=2, J=24$	$v=2, J=25$	$v=2, J=26$
100	1.3446-29	1.3715-21	2.4429-14	6.3420-10	4.4562-09	6.5102-09
200	1.7055-18	1.6313-14	3.3922-11	2.6472-09	1.0319-08	1.2250-08
300	7.7732-15	3.4605-12	4.1478-10	5.9816-09	1.5717-08	1.6440-08
400	5.0071-13	4.8562-11	1.5053-09	9.9582-09	2.0226-08	1.9566-08
500	5.9242-12	2.3137-10	3.3004-09	1.3978-08	2.3869-08	2.1960-08
600	3.0170-11	6.4428-10	5.5800-09	1.7723-08	2.6784-08	2.3837-08
700	9.5134-11	1.3223-09	8.1039-09	2.1064-08	2.9116-08	2.5338-08
800	2.2265-10	2.2453-09	1.0686-08	2.3976-08	3.0985-08	2.6555-08
900	4.2755-10	3.3626-09	1.3202-08	2.6479-08	3.2486-08	2.7553-08
1000	7.1532-10	4.6148-09	1.5579-08	2.8611-08	3.3692-08	2.8376-08
1100	1.0832-09	5.9458-09	1.7777-08	3.0417-08	3.4659-08	2.9056-08
1200	1.5225-09	7.3089-09	1.9780-08	3.1937-08	3.5430-08	2.9619-08
1300	2.0214-09	8.6673-09	2.1586-08	3.3212-08	3.6040-08	3.0082-08
1400	2.5668-09	9.9938-09	2.3200-08	3.4274-08	3.6515-08	3.0460-08
1500	3.1458-09	1.1269-08	2.4634-08	3.5153-08	3.6877-08	3.0765-08
1600	3.7464-09	1.2481-08	2.5901-08	3.5873-08	3.7144-08	3.1006-08
1700	4.3581-09	1.3622-08	2.7013-08	3.6457-08	3.7330-08	3.1190-08
1800	4.9718-09	1.4687-08	2.7985-08	3.6923-08	3.7445-08	3.1325-08
1900	5.5802-09	1.5674-08	2.8830-08	3.7285-08	3.7501-08	3.1416-08
2000	6.1772-09	1.6586-08	2.9560-08	3.7559-08	3.7506-08	3.1467-08
2100	6.7582-09	1.7422-08	3.0187-08	3.7755-08	3.7465-08	3.1485-08
2200	7.3196-09	1.8187-08	3.0721-08	3.7883-08	3.7386-08	3.1471-08
2300	7.8588-09	1.8883-08	3.1171-08	3.7952-08	3.7274-08	3.1430-08
2400	8.3739-09	1.9514-08	3.1546-08	3.7970-08	3.7132-08	3.1364-08
2500	8.8637-09	2.0084-08	3.1854-08	3.7942-08	3.6965-08	3.1276-08
2600	9.3277-09	2.0596-08	3.2101-08	3.7876-08	3.6776-08	3.1169-08
2700	9.7655-09	2.1055-08	3.2294-08	3.7775-08	3.6567-08	3.1044-08
2800	1.0177-08	2.1465-08	3.2439-08	3.7643-08	3.6342-08	3.0903-08
2900	1.0563-08	2.1828-08	3.2540-08	3.7486-08	3.6103-08	3.0749-08
3000	1.0924-08	2.2148-08	3.2602-08	3.7305-08	3.5852-08	3.0582-08
3100	1.1261-08	2.2429-08	3.2629-08	3.7105-08	3.5589-08	3.0405-08
3200	1.1574-08	2.2673-08	3.2625-08	3.6887-08	3.5318-08	3.0218-08
3300	1.1864-08	2.2884-08	3.2592-08	3.6654-08	3.5039-08	3.0022-08
3400	1.2132-08	2.3063-08	3.2535-08	3.6409-08	3.4754-08	2.9819-08
3500	1.2380-08	2.3214-08	3.2455-08	3.6152-08	3.4463-08	2.9610-08
3600	1.2607-08	2.3338-08	3.2356-08	3.5885-08	3.4168-08	2.9395-08
3700	1.2816-08	2.3437-08	3.2238-08	3.5610-08	3.3870-08	2.9175-08
3800	1.3007-08	2.3515-08	3.2105-08	3.5329-08	3.3569-08	2.8951-08
3900	1.3181-08	2.3572-08	3.1957-08	3.5041-08	3.3265-08	2.8724-08
4000	1.3339-08	2.3610-08	3.1797-08	3.4749-08	3.2961-08	2.8493-08

Table 15. (continued)

T(K)	$v=2, J=21$	$v=2, J=22$	$v=2, J=23$	$v=2, J=24$	$v=2, J=25$	$v=2, J=26$
4100	1.3482-08	2.3631-08	3.1626-08	3.4454-08	3.2655-08	2.8261-08
4200	1.3611-08	2.3636-08	3.1445-08	3.4155-08	3.2349-08	2.8026-08
4300	1.3726-08	2.3626-08	3.1255-08	3.3854-08	3.2044-08	2.7791-08
4400	1.3828-08	2.3603-08	3.1058-08	3.3551-08	3.1738-08	2.7554-08
4500	1.3918-08	2.3568-08	3.0854-08	3.3247-08	3.1434-08	2.7316-08
4600	1.3998-08	2.3522-08	3.0644-08	3.2943-08	3.1130-08	2.7078-08
4700	1.4066-08	2.3465-08	3.0430-08	3.2638-08	3.0829-08	2.6841-08
4800	1.4125-08	2.3399-08	3.0211-08	3.2334-08	3.0528-08	2.6603-08
4900	1.4175-08	2.3325-08	2.9988-08	3.2030-08	3.0230-08	2.6366-08
5000	1.4215-08	2.3243-08	2.9763-08	3.1728-08	2.9934-08	2.6129-08
5500	1.4307-08	2.2739-08	2.8607-08	3.0239-08	2.8488-08	2.4963-08
6000	1.4251-08	2.2127-08	2.7437-08	2.8806-08	2.7111-08	2.3836-08
6500	1.4090-08	2.1453-08	2.6283-08	2.7442-08	2.5810-08	2.2758-08
7000	1.3857-08	2.0749-08	2.5163-08	2.6153-08	2.4587-08	2.1734-08
7500	1.3574-08	2.0036-08	2.4089-08	2.4940-08	2.3439-08	2.0766-08
8000	1.3259-08	1.9329-08	2.3065-08	2.3801-08	2.2364-08	1.9853-08
8500	1.2923-08	1.8635-08	2.2093-08	2.2733-08	2.1358-08	1.8994-08
9000	1.2578-08	1.7963-08	2.1173-08	2.1733-08	2.0417-08	1.8186-08
9500	1.2228-08	1.7313-08	2.0305-08	2.0796-08	1.9537-08	1.7427-08
10000	1.1878-08	1.6690-08	1.9485-08	1.9919-08	1.8712-08	1.6714-08
11000	1.1195-08	1.5524-08	1.7984-08	1.8325-08	1.7216-08	1.5412-08
12000	1.0544-08	1.4463-08	1.6649-08	1.6920-08	1.5898-08	1.4260-08
13000	9.9336-09	1.3501-08	1.5459-08	1.5678-08	1.4733-08	1.3236-08
14000	9.3655-09	1.2630-08	1.4397-08	1.4575-08	1.3698-08	1.2324-08
15000	8.8395-09	1.1841-08	1.3446-08	1.3591-08	1.2775-08	1.1507-08
16000	8.3536-09	1.1125-08	1.2590-08	1.2710-08	1.1949-08	1.0774-08
17000	7.9053-09	1.0474-08	1.1819-08	1.1917-08	1.1205-08	1.0114-08
18000	7.4917-09	9.8805-09	1.1121-08	1.1202-08	1.0535-08	9.5164-09
19000	7.1098-09	9.3389-09	1.0487-08	1.0555-08	9.9268-09	8.9742-09
20000	6.7569-09	8.8431-09	9.9102-09	9.9664-09	9.3745-09	8.4807-09
21000	6.4305-09	8.3883-09	9.3832-09	9.4298-09	8.8707-09	8.0299-09
22000	6.1280-09	7.9700-09	8.9004-09	8.9390-09	8.4100-09	7.6171-09
23000	5.8474-09	7.5844-09	8.4570-09	8.4889-09	7.9873-09	7.2379-09
24000	5.5866-09	7.2282-09	8.0486-09	8.0749-09	7.5985-09	6.8888-09
25000	5.3439-09	6.8984-09	7.6717-09	7.6931-09	7.2399-09	6.5666-09
26000	5.1176-09	6.5925-09	7.3230-09	7.3402-09	6.9084-09	6.2684-09
27000	4.9064-09	6.3082-09	6.9996-09	7.0133-09	6.6012-09	5.9919-09
28000	4.7089-09	6.0434-09	6.6991-09	6.7098-09	6.3160-09	5.7350-09
29000	4.5239-09	5.7963-09	6.4192-09	6.4274-09	6.0506-09	5.4957-09
30000	4.3504-09	5.5654-09	6.1582-09	6.1641-09	5.8031-09	5.2725-09

Table 16. Rate constant for hydrogen molecule in  $v=2$  and  $J=27$ -28 states and  $v=3$  and  $J=0$ -3 states

T(K)	$v=2, J=27$	$v=2, J=28$	$v=3, J=0$	$v=3, J=1$	$v=3, J=2$	$v=3, J=3$
100	5.0688-09	2.3575-09	---	---	---	---
200	8.9038-09	4.9037-09	---	---	---	---
300	1.1650-08	6.8528-09	---	---	---	---
400	1.3764-08	8.4752-09	---	---	---	---
500	1.5471-08	9.8969-09	---	---	---	---
600	1.6895-08	1.1176-08	3.5897-28	4.6868-28	8.1392-28	1.8436-27
700	1.8112-08	1.2340-08	1.6985-25	2.1451-25	3.4764-25	7.1081-25
800	1.9168-08	1.3404-08	1.7010-23	2.0955-23	3.2243-23	6.1054-23
900	2.0092-08	1.4378-08	6.0571-22	7.3188-22	1.0816-21	1.9293-21
1000	2.0904-08	1.5267-08	1.0466-20	1.2452-20	1.7817-20	3.0298-20
1100	2.1620-08	1.6076-08	1.0695-19	1.2564-19	1.7508-19	2.8631-19
1200	2.2251-08	1.6811-08	7.3732-19	8.5706-19	1.1684-18	1.8493-18
1300	2.2806-08	1.7476-08	3.7567-18	4.3279-18	5.7910-18	8.9169-18
1400	2.3293-08	1.8075-08	1.5097-17	1.7260-17	2.2729-17	3.4180-17
1500	2.3717-08	1.8612-08	5.0191-17	5.7001-17	7.4031-17	1.0907-16
1600	2.4085-08	1.9093-08	1.4306-16	1.6153-16	2.0726-16	2.9994-16
1700	2.4401-08	1.9520-08	3.5929-16	4.0360-16	5.1237-16	7.2982-16
1800	2.4670-08	1.9897-08	8.1210-16	9.0811-16	1.1419-15	1.6039-15
1900	2.4896-08	2.0229-08	1.6800-15	1.8709-15	2.3328-15	3.2354-15
2000	2.5083-08	2.0519-08	3.2235-15	3.5767-15	4.4257-15	6.0691-15
2100	2.5234-08	2.0769-08	5.7995-15	6.4137-15	7.8812-15	1.0697-14
2200	2.5352-08	2.0984-08	9.8703-15	1.0883-14	1.3289-14	1.7870-14
2300	2.5440-08	2.1166-08	1.6008-14	1.7601-14	2.1370-14	2.8494-14
2400	2.5501-08	2.1317-08	2.4891-14	2.7299-14	3.2970-14	4.3619-14
2500	2.5537-08	2.1440-08	3.7296-14	4.0810-14	4.9049-14	6.4427-14
2600	2.5550-08	2.1538-08	5.4086-14	5.9054-14	7.0660-14	9.2201-14
2700	2.5543-08	2.1613-08	7.6189-14	8.3023-14	9.8929-14	1.2830-13
2800	2.5517-08	2.1665-08	1.0458-13	1.1375-13	1.3503-13	1.7412-13
2900	2.5474-08	2.1699-08	1.4027-13	1.5231-13	1.8015-13	2.3107-13
3000	2.5415-08	2.1714-08	1.8427-13	1.9976-13	2.3548-13	3.0055-13
3100	2.5342-08	2.1713-08	2.3755-13	2.5714-13	3.0217-13	3.8389-13
3200	2.5257-08	2.1696-08	3.0109-13	3.2546-13	3.8133-13	4.8235-13
3300	2.5160-08	2.1667-08	3.7578-13	4.0566-13	4.7399-13	5.9712-13
3400	2.5053-08	2.1624-08	4.6247-13	4.9861-13	5.8110-13	7.2924-13
3500	2.4936-08	2.1571-08	5.6191-13	6.0511-13	7.0349-13	8.7965-13
3600	2.4812-08	2.1507-08	6.7477-13	7.2585-13	8.4191-13	1.0491-12
3700	2.4679-08	2.1433-08	8.0164-13	8.6141-13	9.9696-13	1.2383-12
3800	2.4540-08	2.1352-08	9.4298-13	1.0123-12	1.1692-12	1.4478-12
3900	2.4395-08	2.1262-08	1.0992-12	1.1789-12	1.3589-12	1.6778-12
4000	2.4245-08	2.1166-08	1.2705-12	1.3614-12	1.5664-12	1.9286-12

Table 16. (continued)

T(K)	$v=2, J=27$	$v=2, J=28$	$v=3, J=0$	$v=3, J=1$	$v=3, J=2$	$v=3, J=3$
4100	2.4090-08	2.1063-08	1.4572-12	1.5601-12	1.7918-12	2.2004-12
4200	2.3931-08	2.0955-08	1.6593-12	1.7750-12	2.0352-12	2.4930-12
4300	2.3769-08	2.0842-08	1.8768-12	2.0061-12	2.2964-12	2.8063-12
4400	2.3603-08	2.0724-08	2.1096-12	2.2533-12	2.5754-12	3.1401-12
4500	2.3435-08	2.0602-08	2.3576-12	2.5164-12	2.8719-12	3.4940-12
4600	2.3264-08	2.0477-08	2.6205-12	2.7951-12	3.1855-12	3.8674-12
4700	2.3091-08	2.0349-08	2.8980-12	3.0891-12	3.5158-12	4.2599-12
4800	2.2917-08	2.0217-08	3.1898-12	3.3980-12	3.8624-12	4.6709-12
4900	2.2742-08	2.0084-08	3.4954-12	3.7213-12	4.2246-12	5.0996-12
5000	2.2565-08	1.9948-08	3.8143-12	4.0586-12	4.6020-12	5.5454-12
5500	2.1676-08	1.9248-08	5.5911-12	5.9340-12	6.6929-12	8.0017-12
6000	2.0792-08	1.8530-08	7.6164-12	8.0664-12	9.0578-12	1.0758-11
6500	1.9929-08	1.7815-08	9.8127-12	1.0374-11	1.1605-11	1.3707-11
7000	1.9095-08	1.7114-08	1.2106-11	1.2779-11	1.4249-11	1.6751-11
7500	1.8297-08	1.6435-08	1.4433-11	1.5214-11	1.6918-11	1.9805-11
8000	1.7537-08	1.5782-08	1.6739-11	1.7625-11	1.9551-11	2.2805-11
8500	1.6815-08	1.5157-08	1.8986-11	1.9969-11	2.2103-11	2.5700-11
9000	1.6131-08	1.4562-08	2.1140-11	2.2215-11	2.4542-11	2.8455-11
9500	1.5484-08	1.3996-08	2.3182-11	2.4340-11	2.6844-11	3.1045-11
10000	1.4874-08	1.3460-08	2.5097-11	2.6332-11	2.8995-11	3.3456-11
11000	1.3752-08	1.2470-08	2.8520-11	2.9884-11	3.2819-11	3.7719-11
12000	1.2752-08	1.1581-08	3.1394-11	3.2860-11	3.6006-11	4.1245-11
13000	1.1859-08	1.0784-08	3.3745-11	3.5288-11	3.8594-11	4.4085-11
14000	1.1059-08	1.0068-08	3.5622-11	3.7222-11	4.0643-11	4.6314-11
15000	1.0341-08	9.4233-09	3.7080-11	3.8720-11	4.2219-11	4.8009-11
16000	9.6936-09	8.8410-09	3.8178-11	3.9842-11	4.3389-11	4.9249-11
17000	9.1087-09	8.3136-09	3.8967-11	4.0644-11	4.4214-11	5.0105-11
18000	8.5786-09	7.8347-09	3.9495-11	4.1176-11	4.4749-11	5.0638-11
19000	8.0965-09	7.3986-09	3.9805-11	4.1482-11	4.5042-11	5.0904-11
20000	7.6568-09	7.0004-09	3.9934-11	4.1600-11	4.5135-11	5.0950-11
21000	7.2547-09	6.6357-09	3.9912-11	4.1563-11	4.5063-11	5.0815-11
22000	6.8858-09	6.3009-09	3.9767-11	4.1399-11	4.4856-11	5.0533-11
23000	6.5467-09	5.9928-09	3.9520-11	4.1131-11	4.4539-11	5.0132-11
24000	6.2340-09	5.7085-09	3.9192-11	4.0778-11	4.4133-11	4.9636-11
25000	5.9451-09	5.4456-09	3.8797-11	4.0358-11	4.3656-11	4.9063-11
26000	5.6776-09	5.2020-09	3.8350-11	3.9883-11	4.3123-11	4.8431-11
27000	5.4292-09	4.9758-09	3.7861-11	3.9367-11	4.2546-11	4.7753-11
28000	5.1983-09	4.7653-09	3.7339-11	3.8817-11	4.1936-11	4.7040-11
29000	4.9831-09	4.5691-09	3.6794-11	3.8243-11	4.1300-11	4.6302-11
30000	4.7822-09	4.3858-09	3.6230-11	3.7651-11	4.0647-11	4.5546-11

Table 17. Rate constant for hydrogen molecule in v=3 and J=4-9 states.

T(K)	v=3, J=4	v=3, J=5	v=3, J=6	v=3, J=7	v=3, J=8	v=3, J=9
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	---
500	---	---	4.6760 -29	3.7860 -28	3.9712 -27	5.2579 -26
600	5.4394 -27	2.0839 -26	9.9219 -26	5.8736 -25	4.3315 -24	3.8938 -23
700	1.8313 -24	5.9277 -24	2.3205 -23	1.0985 -22	6.2984 -22	4.2937 -21
800	1.4209 -22	4.0529 -22	1.3699 -21	5.4840 -21	2.6036 -20	1.4223 -19
900	4.1485 -21	1.0724 -20	3.2338 -20	1.1363 -19	4.6583 -19	2.1959 -18
1000	6.1155 -20	1.4613 -19	4.0215 -19	1.2732 -18	4.6412 -18	1.9227 -17
1100	5.4874 -19	1.2294 -18	3.1397 -18	9.1272 -18	3.0226 -17	1.1266 -16
1200	3.3946 -18	7.2078 -18	1.7296 -17	4.6830 -17	1.4315 -16	4.8859 -16
1300	1.5781 -17	3.2019 -17	7.2887 -17	1.8583 -16	5.3088 -16	1.6818 -15
1400	5.8624 -17	1.1440 -16	2.4892 -16	6.0278 -16	1.6249 -15	4.8290 -15
1500	1.8206 -16	3.4350 -16	7.1869 -16	1.6643 -15	4.2664 -15	1.1996 -14
1600	4.8892 -16	8.9559 -16	1.8106 -15	4.0324 -15	9.8918 -15	2.6499 -14
1700	1.1650 -15	2.0791 -15	4.0781 -15	8.7742 -15	2.0704 -14	5.3144 -14
1800	2.5129 -15	4.3819 -15	8.3672 -15	1.7459 -14	3.9801 -14	9.8351 -14
1900	4.9854 -15	8.5149 -15	1.5872 -14	3.2224 -14	7.1226 -14	1.7012 -13
2000	9.2123 -15	1.5443 -14	2.8171 -14	5.5798 -14	1.1995 -13	2.7787 -13
2100	1.6019 -14	2.6404 -14	4.7230 -14	9.1482 -14	1.9178 -13	4.3214 -13
2200	2.6431 -14	4.2903 -14	7.5388 -14	1.4309 -13	2.9319 -13	6.4423 -13
2300	4.1671 -14	6.6698 -14	1.1531 -13	2.1484 -13	4.3113 -13	9.2579 -13
2400	6.3136 -14	9.9763 -14	1.6992 -13	3.1126 -13	6.1278 -13	1.2884 -12
2500	9.2372 -14	1.4424 -13	2.4233 -13	4.3701 -13	8.4535 -13	1.7433 -12
2600	1.3104 -13	2.0240 -13	3.3575 -13	5.9681 -13	1.1359 -12	2.3009 -12
2700	1.8086 -13	2.7654 -13	4.5340 -13	7.9524 -13	1.4909 -12	2.9706 -12
2800	2.4361 -13	3.6900 -13	5.9843 -13	1.0367 -12	1.9166 -12	3.7605 -12
2900	3.2102 -13	4.8203 -13	7.7386 -13	1.3252 -12	2.4184 -12	4.6774 -12
3000	4.1481 -13	6.1780 -13	9.8247 -13	1.6644 -12	3.0007 -12	5.7268 -12
3100	5.2660 -13	7.7832 -13	1.2268 -12	2.0575 -12	3.6675 -12	6.9124 -12
3200	6.5787 -13	9.6540 -13	1.5091 -12	2.5071 -12	4.4217 -12	8.2367 -12
3300	8.1001 -13	1.1807 -12	1.8313 -12	3.0154 -12	5.2654 -12	9.7008 -12
3400	9.8421 -13	1.4255 -12	2.1949 -12	3.5840 -12	6.1997 -12	1.1304 -11
3500	1.1815 -12	1.7011 -12	2.6012 -12	4.2140 -12	7.2250 -12	1.3046 -11
3600	1.4028 -12	2.0083 -12	3.0509 -12	4.9059 -12	8.3411 -12	1.4923 -11
3700	1.6487 -12	2.3478 -12	3.5446 -12	5.6598 -12	9.5469 -12	1.6932 -11
3800	1.9197 -12	2.7200 -12	4.0825 -12	6.4753 -12	1.0841 -11	1.9068 -11
3900	2.2161 -12	3.1250 -12	4.6643 -12	7.3514 -12	1.2220 -11	2.1326 -11
4000	2.5381 -12	3.5628 -12	5.2898 -12	8.2872 -12	1.3683 -11	2.3701 -11

Table 17. (continued)

T(K)	v=3, J=4	v=3, J=5	v=3, J=6	v=3, J=7	v=3, J=8	v=3, J=9
4100	2.8857 -12	4.0331 -12	5.9581 -12	9.2808 -12	1.5225 -11	2.6186 -11
4200	3.2586 -12	4.5356 -12	6.6683 -12	1.0331 -11	1.6843 -11	2.8775 -11
4300	3.6566 -12	5.0694 -12	7.4192 -12	1.1435 -11	1.8534 -11	3.1461 -11
4400	4.0791 -12	5.6340 -12	8.2096 -12	1.2590 -11	2.0294 -11	3.4236 -11
4500	4.5257 -12	6.2284 -12	9.0380 -12	1.3795 -11	2.2117 -11	3.7094 -11
4600	4.9956 -12	6.8515 -12	9.9026 -12	1.5046 -11	2.4001 -11	4.0027 -11
4700	5.4880 -12	7.5021 -12	1.0802 -11	1.6341 -11	2.5939 -11	4.3028 -11
4800	6.0022 -12	8.1792 -12	1.1733 -11	1.7677 -11	2.7929 -11	4.6090 -11
4900	6.5372 -12	8.8813 -12	1.2696 -11	1.9051 -11	2.9965 -11	4.9205 -11
5000	7.0920 -12	9.6071 -12	1.3687 -11	2.0460 -11	3.2042 -11	5.2368 -11
5500	1.0127 -11	1.3542 -11	1.9007 -11	2.7929 -11	4.2908 -11	6.8658 -11
6000	1.3498 -11	1.7856 -11	2.4749 -11	3.5854 -11	5.4207 -11	8.5222 -11
6500	1.7073 -11	2.2379 -11	3.0691 -11	4.3928 -11	6.5520 -11	1.0148 -10
7000	2.0732 -11	2.6963 -11	3.6643 -11	5.1908 -11	7.6529 -11	1.1702 -10
7500	2.4379 -11	3.1491 -11	4.2461 -11	5.9613 -11	8.7006 -11	1.3158 -10
8000	2.7938 -11	3.5874 -11	4.8037 -11	6.6914 -11	9.6805 -11	1.4498 -10
8500	3.1351 -11	4.0046 -11	5.3298 -11	7.3730 -11	1.0584 -10	1.5716 -10
9000	3.4581 -11	4.3965 -11	5.8198 -11	8.0013 -11	1.1407 -10	1.6809 -10
9500	3.7602 -11	4.7606 -11	6.2712 -11	8.5745 -11	1.2148 -10	1.7780 -10
10000	4.0399 -11	5.0955 -11	6.6831 -11	9.0925 -11	1.2810 -10	1.8635 -10
11000	4.5308 -11	5.6775 -11	7.3904 -11	9.9688 -11	1.3910 -10	2.0021 -10
12000	4.9327 -11	6.1476 -11	7.9520 -11	1.0650 -10	1.4741 -10	2.1031 -10
13000	5.2529 -11	6.5165 -11	8.3844 -11	1.1161 -10	1.5344 -10	2.1727 -10
14000	5.5009 -11	6.7972 -11	8.7057 -11	1.1529 -10	1.5757 -10	2.2169 -10
15000	5.6865 -11	7.0026 -11	8.9331 -11	1.1776 -10	1.6015 -10	2.2407 -10
16000	5.8193 -11	7.1446 -11	9.0826 -11	1.1926 -10	1.6147 -10	2.2481 -10
17000	5.9077 -11	7.2339 -11	9.1679 -11	1.1996 -10	1.6178 -10	2.2429 -10
18000	5.9593 -11	7.2798 -11	9.2009 -11	1.2002 -10	1.6130 -10	2.2276 -10
19000	5.9804 -11	7.2902 -11	9.1915 -11	1.1957 -10	1.6019 -10	2.2047 -10
20000	5.9766 -11	7.2717 -11	9.1480 -11	1.1871 -10	1.5859 -10	2.1759 -10
21000	5.9525 -11	7.2299 -11	9.0773 -11	1.1752 -10	1.5661 -10	2.1428 -10
22000	5.9120 -11	7.1694 -11	8.9851 -11	1.1609 -10	1.5434 -10	2.1064 -10
23000	5.8583 -11	7.0941 -11	8.8760 -11	1.1446 -10	1.5186 -10	2.0677 -10
24000	5.7941 -11	7.0072 -11	8.7539 -11	1.1269 -10	1.4922 -10	2.0275 -10
25000	5.7217 -11	6.9112 -11	8.6219 -11	1.1082 -10	1.4648 -10	1.9864 -10
26000	5.6429 -11	6.8084 -11	8.4826 -11	1.0887 -10	1.4366 -10	1.9447 -10
27000	5.5592 -11	6.7005 -11	8.3382 -11	1.0687 -10	1.4081 -10	1.9029 -10
28000	5.4720 -11	6.5890 -11	8.1903 -11	1.0484 -10	1.3794 -10	1.8612 -10
29000	5.3822 -11	6.4751 -11	8.0404 -11	1.0280 -10	1.3508 -10	1.8200 -10
30000	5.2908 -11	6.3598 -11	7.8895 -11	1.0076 -10	1.3224 -10	1.7793 -10

Table 18. Rate constant for hydrogen molecule in v=3 and J=10-15 states.

T(K)	v=3, J=10	v=3, J=11	v=3, J=12	v=3, J=13	v=3, J=14	v=3, J=15
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	7.5895-29	2.8223-27	1.3083-25	4.0110-29	9.0693-27	2.3948-24
500	8.4618-25	1.6150-23	3.6867-22	6.9793-24	4.3626-22	3.0625-20
600	4.1295-22	5.0532-21	7.1934-20	1.1262-18	1.9484-17	8.6396-18
700	3.3806-20	3.0119-19	3.0598-18	3.3754-17	4.0475-16	5.1744-15
800	9.0823-19	6.3787-18	5.0316-17	4.2687-16	3.8893-15	3.7440-14
900	1.1622-17	6.7842-17	4.3957-16	3.0405-15	2.2377-14	1.7278-13
1000	8.8558-17	4.4587-16	2.4683-15	1.4500-14	8.9974-14	5.8241-13
1100	4.6310-16	2.0659-15	1.0055-14	5.1684-14	2.7894-13	1.5631-12
1200	1.8268-15	7.3684-15	3.2216-14	1.4815-13	7.1184-13	3.5378-12
1300	5.8035-15	2.1495-14	8.5829-14	3.5922-13	1.5645-12	7.0249-12
1400	1.5557-14	5.3561-14	1.9787-13	7.6393-13	3.0587-12	1.2590-11
1500	3.6412-14	1.1767-13	4.0640-13	1.4630-12	5.4463-12	2.0791-11
1600	7.6344-14	2.3343-13	7.6005-13	2.5739-12	8.9898-12	3.2131-11
1700	1.4622-13	4.2579-13	1.3161-12	4.2229-12	1.3944-11	4.7025-11
1800	2.5977-13	7.2428-13	2.1377-12	6.5379-12	2.0536-11	6.5778-11
1900	4.3319-13	1.1618-12	3.2903-12	9.6404-12	2.8959-11	8.8578-11
2000	6.8465-13	1.7732-12	4.8383-12	1.3639-11	3.9360-11	1.1550-10
2100	1.0335-12	2.5934-12	6.8423-12	1.8627-11	5.1836-11	1.4651-10
2200	1.4995-12	3.6562-12	9.3562-12	2.4675-11	6.6439-11	1.8150-10
2300	2.1023-12	4.9932-12	1.2426-11	3.1835-11	8.3175-11	2.2027-10
2400	2.8602-12	6.6319-12	1.6087-11	4.0136-11	1.0201-10	2.6257-10
2500	3.7902-12	8.5960-12	2.0367-11	4.9587-11	1.2288-10	3.0811-10
2600	4.9070-12	1.0904-11	2.5280-11	6.0180-11	1.4568-10	3.5657-10
2700	6.2232-12	1.3570-11	3.0835-11	7.1888-11	1.7029-10	4.0761-10
2800	7.7487-12	1.6603-11	3.7029-11	8.4672-11	1.9658-10	4.6088-10
2900	9.4907-12	2.0006-11	4.3850-11	9.8480-11	2.2440-10	5.1606-10
3000	1.1454-11	2.3779-11	5.1283-11	1.1325-10	2.5360-10	5.7280-10
3100	1.3641-11	2.7917-11	5.9302-11	1.2892-10	2.8400-10	6.3079-10
3200	1.6050-11	3.2413-11	6.7880-11	1.4541-10	3.1547-10	6.8971-10
3300	1.8680-11	3.7254-11	7.6984-11	1.6264-10	3.4783-10	7.4929-10
3400	2.1527-11	4.2426-11	8.6578-11	1.8054-10	3.8093-10	8.0927-10
3500	2.4583-11	4.7913-11	9.6625-11	1.9903-10	4.1463-10	8.6939-10
3600	2.7842-11	5.3697-11	1.0708-10	2.1803-10	4.4879-10	9.2944-10
3700	3.1295-11	5.9758-11	1.1792-10	2.3747-10	4.8327-10	9.8921-10
3800	3.4930-11	6.6075-11	1.2908-10	2.5727-10	5.1796-10	1.0485-09
3900	3.8739-11	7.2627-11	1.4054-10	2.7736-10	5.5274-10	1.1072-09
4000	4.2709-11	7.9392-11	1.5225-10	2.9768-10	5.8750-10	1.1652-09

Table 18. (continued)

T(K)	v=3, J=10	v=3, J=11	v=3, J=12	v=3, J=13	v=3, J=14	v=3, J=15
4100	4.6829-11	8.6350-11	1.6418-10	3.1815-10	6.2214-10	1.2222-09
4200	5.1086-11	9.3477-11	1.7628-10	3.3872-10	6.5658-10	1.2783-09
4300	5.5468-11	1.0075-10	1.8853-10	3.5934-10	6.9074-10	1.3333-09
4400	5.9963-11	1.0816-10	2.0089-10	3.7995-10	7.2455-10	1.3871-09
4500	6.4559-11	1.1567-10	2.1332-10	4.0050-10	7.5794-10	1.4397-09
4600	6.9243-11	1.2327-10	2.2580-10	4.2095-10	7.9086-10	1.4910-09
4700	7.4005-11	1.3095-10	2.3830-10	4.4127-10	8.2325-10	1.5410-09
4800	7.8833-11	1.3867-10	2.5079-10	4.6140-10	8.5508-10	1.5896-09
4900	8.3715-11	1.4643-10	2.6324-10	4.8133-10	8.8630-10	1.6368-09
5000	8.8642-11	1.5421-10	2.7565-10	5.0101-10	9.1689-10	1.6826-09
5500	1.1360-10	1.9293-10	3.3615-10	5.9500-10	1.0595-09	1.8903-09
6000	1.3836-10	2.3031-10	3.9281-10	6.8011-10	1.1837-09	2.0631-09
6500	1.6213-10	2.6534-10	4.4447-10	7.5533-10	1.2895-09	2.2035-09
7000	1.8440-10	2.9743-10	4.9060-10	8.2049-10	1.3778-09	2.3149-09
7500	2.0488-10	3.2631-10	5.3108-10	8.7598-10	1.4501-09	2.4009-09
8000	2.2340-10	3.5191-10	5.6608-10	9.2246-10	1.5081-09	2.4651-09
8500	2.3995-10	3.7431-10	5.9592-10	9.6075-10	1.5535-09	2.5108-09
9000	2.5454-10	3.9365-10	6.2099-10	9.9171-10	1.5879-09	2.5409-09
9500	2.6728-10	4.1017-10	6.4175-10	1.0162-09	1.6129-09	2.5578-09
10000	2.7828-10	4.2408-10	6.5863-10	1.0350-09	1.6298-09	2.5640-09
11000	2.9560-10	4.4507-10	6.8246-10	1.0584-09	1.6441-09	2.5508-09
12000	3.0756-10	4.5846-10	6.9556-10	1.0669-09	1.6387-09	2.5131-09
13000	3.1521-10	4.6588-10	7.0048-10	1.0645-09	1.6194-09	2.4593-09
14000	3.1940-10	4.6866-10	6.9924-10	1.0541-09	1.5906-09	2.3954-09
15000	3.2090-10	4.6788-10	6.9344-10	1.0382-09	1.5554-09	2.3256-09
15900	3.2043-10	4.6487-10	6.8533-10	1.0204-09	1.5203-09	2.2600-09
17000	3.1806-10	4.5895-10	6.7274-10	9.9581-10	1.4746-09	2.1786-09
18000	3.1460-10	4.5200-10	6.5952-10	9.7162-10	1.4318-09	2.1048-09
19000	3.1022-10	4.4398-10	6.4516-10	9.4644-10	1.3886-09	2.0323-09
20000	3.0516-10	4.3521-10	6.3009-10	9.2081-10	1.3457-09	1.9617-09
21000	2.9962-10	4.2595-10	6.1462-10	8.9511-10	1.3035-09	1.8933-09
22000	2.9373-10	4.1638-10	5.9899-10	8.6961-10	1.2623-09	1.8275-09
23000	2.8762-10	4.0665-10	5.8338-10	8.4451-10	1.2223-09	1.7642-09
24000	2.8138-10	3.9688-10	5.6791-10	8.1996-10	1.1836-09	1.7036-09
25000	2.7509-10	3.8714-10	5.5268-10	7.9606-10	1.1462-09	1.6457-09
26000	2.6880-10	3.7752-10	5.3777-10	7.7286-10	1.1102-09	1.5904-09
27000	2.6255-10	3.6804-10	5.2323-10	7.5040-10	1.0757-09	1.5376-09
28000	2.5637-10	3.5876-10	5.0908-10	7.2871-10	1.0426-09	1.4872-09
29000	2.5030-10	3.4969-10	4.9535-10	7.0779-10	1.0108-09	1.4392-09
30000	2.4435-10	3.4085-10	4.8205-10	6.8764-10	9.8033-10	1.3934-09

Table 19. Rate constant for hydrogen molecule in  $v=3$  and  $J=16-21$  states.

T(K)	$v=3, J=16$	$v=3, J=17$	$v=3, J=18$	$v=3, J=19$	$v=3, J=20$	$v=3, J=21$
100	---	---	---	3.5812-28	4.1253-21	6.3137-14
200	5.8849-29	3.0363-25	1.6160-21	7.9826-18	2.5335-14	7.6802-11
300	6.9985-22	2.2293-19	7.0947-17	2.0579-14	4.2835-12	7.6519-10
400	2.2968-18	1.8185-16	1.4183-14	1.0006-12	5.3516-11	2.3479-09
500	2.8679-16	9.8545-15	3.3098-13	1.0021-11	2.3773-10	4.5314-09
600	7.0152-15	1.3825-13	2.6502-12	4.5735-11	6.3218-10	6.9573-09
700	6.7771-14	8.9824-13	1.1543-11	1.3351-10	1.2566-09	9.3872-09
800	3.6689-13	3.6130-12	3.4416-11	2.9517-10	2.0849-09	1.1692-08
900	1.3514-12	1.0566-11	7.9773-11	5.4269-10	3.0695-09	1.3813-08
1000	3.8046-12	2.4741-11	1.5514-10	8.7746-10	4.1585-09	1.5730-08
1100	8.8136-12	4.9304-11	2.6568-10	1.2928-09	5.3054-09	1.7444-08
1200	1.7647-11	8.7098-11	4.1374-10	1.7769-09	6.4723-09	1.8964-08
1300	3.1593-11	1.4028-10	5.9909-10	2.3158-09	7.6300-09	2.0306-08
1400	5.1815-11	2.1017-10	8.1943-10	2.8953-09	8.7576-09	2.1486-08
1500	7.9243-11	2.9721-10	1.0711-09	3.5020-09	9.8403-09	2.2520-08
1600	1.1452-10	4.0112-10	1.3495-09	4.1240-09	1.0869-08	2.3423-08
1700	1.5797-10	5.2098-10	1.6498-09	4.7510-09	1.1837-08	2.4209-08
1800	2.0966-10	6.5546-10	1.9672-09	5.3747-09	1.2742-08	2.4890-08
1900	2.6939-10	8.0291-10	2.2970-09	5.9883-09	1.3583-08	2.5479-08
2000	3.3675-10	9.6152-10	2.6350-09	6.5865-09	1.4361-08	2.5983-08
2100	4.1118-10	1.1294-09	2.9772-09	7.1652-09	1.5078-08	2.6414-08
2200	4.9203-10	1.3048-09	3.3203-09	7.7215-09	1.5735-08	2.6777-08
2300	5.7855-10	1.4858-09	3.6616-09	8.2533-09	1.6335-08	2.7082-08
2400	6.6998-10	1.6709-09	3.9985-09	8.7593-09	1.6882-08	2.7332-08
2500	7.6555-10	1.8584-09	4.3290-09	9.2387-09	1.7378-08	2.7535-08
2600	8.6448-10	2.0471-09	4.6515-09	9.6913-09	1.7826-08	2.7695-08
2700	9.6605-10	2.2357-09	4.9648-09	1.0117-08	1.8231-08	2.7817-08
2800	1.0696-09	2.4231-09	5.2678-09	1.0516-08	1.8593-08	2.7904-08
2900	1.1744-09	2.6084-09	5.5597-09	1.0889-08	1.8918-08	2.7960-08
3000	1.2799-09	2.7909-09	5.8401-09	1.1238-08	1.9206-08	2.7988-08
3100	1.3857-09	2.9697-09	6.1085-09	1.1561-08	1.9461-08	2.7991-08
3200	1.4911-09	3.1445-09	6.3648-09	1.1862-08	1.9686-08	2.7971-08
3300	1.5957-09	3.3147-09	6.6089-09	1.2140-08	1.9882-08	2.7932-08
3400	1.6993-09	3.4799-09	6.8408-09	1.2396-08	2.0051-08	2.7874-08
3500	1.8015-09	3.6400-09	7.0607-09	1.2632-08	2.0196-08	2.7800-08
3600	1.9019-09	3.7946-09	7.2687-09	1.2849-08	2.0319-08	2.7711-08
3700	2.0003-09	3.9436-09	7.4650-09	1.3047-08	2.0420-08	2.7610-08
3800	2.0966-09	4.0870-09	7.6501-09	1.3228-08	2.0503-08	2.7496-08
3900	2.1905-09	4.2246-09	7.8241-09	1.3392-08	2.0568-08	2.7372-08
4000	2.2820-09	4.3565-09	7.9874-09	1.3541-08	2.0616-08	2.7239-08

Table 19. (continued)

T(K)	$v=3, J=16$	$v=3, J=17$	$v=3, J=18$	$v=3, J=19$	$v=3, J=20$	$v=3, J=21$
4100	2.3709-09	4.4827-09	8.1404-09	1.3675-08	2.0649-08	2.7097-08
4200	2.4571-09	4.6032-09	8.2834-09	1.3796-08	2.0669-08	2.6948-08
4300	2.5406-09	4.7181-09	8.4169-09	1.3903-08	2.0676-08	2.6793-08
4400	2.6212-09	4.8275-09	8.5412-09	1.3998-08	2.0670-08	2.6632-08
4500	2.6991-09	4.9315-09	8.6567-09	1.4082-08	2.0655-08	2.6465-08
4600	2.7742-09	5.0302-09	8.7638-09	1.4155-08	2.0629-08	2.6295-08
4700	2.8465-09	5.1238-09	8.8628-09	1.4217-08	2.0594-08	2.6120-08
4800	2.9159-09	5.2124-09	8.9541-09	1.4270-08	2.0550-08	2.5942-08
4900	2.9826-09	5.2961-09	9.0380-09	1.4315-08	2.0499-08	2.5761-08
5000	3.0465-09	5.3751-09	9.1150-09	1.4350-08	2.0441-08	2.5578-08
5500	3.3266-09	5.7046-09	9.4059-09	1.4422-08	2.0064-08	2.4638-08
6000	3.5460-09	5.9388-09	9.5669-09	1.4351-08	1.9584-08	2.3684-08
6500	3.7125-09	6.0951-09	9.6283-09	1.4181-08	1.9042-08	2.2740-08
7000	3.8342-09	6.1887-09	9.6143-09	1.3942-08	1.8466-08	2.1820-08
7500	3.9185-09	6.2323-09	9.5437-09	1.3655-08	1.7876-08	2.0934-08
8000	3.9717-09	6.2366-09	9.4310-09	1.3337-08	1.7284-08	2.0085-08
8500	3.9997-09	6.2099-09	9.2877-09	1.3001-08	1.6700-08	1.9276-08
9000	4.0070-09	6.1593-09	9.1224-09	1.2655-08	1.6128-08	1.8508-08
9500	3.9976-09	6.0902-09	8.9418-09	1.2305-08	1.5574-08	1.7780-08
10000	3.9748-09	6.0071-09	8.7511-09	1.1956-08	1.5039-08	1.7090-08
11000	3.8996-09	5.8125-09	8.3543-09	1.1273-08	1.4031-08	1.5821-08
12000	3.7976-09	5.5959-09	7.9538-09	1.0624-08	1.3108-08	1.4686-08
13000	3.6802-09	5.3705-09	7.5621-09	1.0014-08	1.2266-08	1.3670-08
14000	3.5546-09	5.1445-09	7.1859-09	9.4463-09	1.1499-08	1.2759-08
15000	3.4260-09	4.9229-09	6.8289-09	8.9204-09	1.0801-08	1.1939-08
16000	3.2975-09	4.7087-09	6.4924-09	8.4343-09	1.0166-08	1.1199-08
17000	3.1713-09	4.5037-09	6.1767-09	7.9855-09	9.5856-09	1.0530-08
18000	3.0488-09	4.3085-09	5.8813-09	7.5711-09	9.0557-09	9.9230-09
19000	2.9307-09	4.1237-09	5.6053-09	7.1883-09	8.5705-09	9.3703-09
20000	2.8176-09	3.9490-09	5.3475-09	6.8343-09	8.1252-09	8.8658-09
21000	2.7096-09	3.7842-09	5.1069-09	6.5066-09	7.7158-09	8.4039-09
22000	2.6068-09	3.6288-09	4.8821-09	6.2029-09	7.3384-09	7.9800-09
23000	2.5091-09	3.4825-09	4.6720-09	5.9208-09	6.9900-09	7.5899-09
24000	2.4163-09	3.3447-09	4.4755-09	5.6586-09	6.6675-09	7.2301-09
25000	2.3282-09	3.2149-09	4.2916-09	5.4145-09	6.3685-09	6.8974-09
26000	2.2447-09	3.0925-09	4.1192-09	5.1867-09	6.0907-09	6.5892-09
27000	2.1655-09	2.9771-09	3.9575-09	4.9740-09	5.8321-09	6.3029-09
28000	2.0904-09	2.8683-09	3.8056-09	4.7750-09	5.5910-09	6.0365-09
29000	2.0192-09	2.7654-09	3.6628-09	4.5886-09	5.3658-09	5.7882-09
30000	1.9516-09	2.6683-09	3.5283-09	4.4137-09	5.1550-09	5.5563-09

Table 20. Rate constant for hydrogen molecule in v=3 and J=22-27 states.

T(K)	v=3, J=22	v=3, J=23	v=3, J=24	v=3, J=25	v=3, J=26	v=3, J=27
100	5.0627-09	3.6784-09	2.4011-09	1.9463-09	1.6871-09	1.4962-09
200	9.5523-09	7.0169-09	4.9660-09	3.9294-09	3.4060-09	3.0578-09
300	1.2979-08	9.6396-09	7.0878-09	5.6837-09	4.9572-09	4.4564-09
400	1.5688-08	1.1802-08	8.9176-09	7.2655-09	6.3735-09	5.7263-09
500	1.7891-08	1.3637-08	1.0530-08	8.7007-09	7.6685-09	6.8850-09
600	1.9718-08	1.5222-08	1.1965-08	1.0005-08	8.8519-09	7.9442-09
700	2.1256-08	1.6605-08	1.3250-08	1.1190-08	9.9321-09	8.9128-09
800	2.2562-08	1.7820-08	1.4403-08	1.2266-08	1.0917-08	9.7984-09
900	2.3680-08	1.8891-08	1.5437-08	1.3242-08	1.1813-08	1.0607-08
1000	2.4639-08	1.9836-08	1.6365-08	1.4125-08	1.2628-08	1.1346-08
1100	2.5463-08	2.0670-08	1.7196-08	1.4922-08	1.3367-08	1.2018-08
1200	2.6170-08	2.1405-08	1.7940-08	1.5642-08	1.4036-08	1.2629-08
1300	2.6776-08	2.2052-08	1.8604-08	1.6289-08	1.4641-08	1.3184-08
1400	2.7292-08	2.2620-08	1.9196-08	1.6870-08	1.5186-08	1.3687-08
1500	2.7730-08	2.3116-08	1.9721-08	1.7390-08	1.5677-08	1.4140-08
1600	2.8098-08	2.3548-08	2.0186-08	1.7854-08	1.6116-08	1.4549-08
1700	2.8404-08	2.3921-08	2.0595-08	1.8266-08	1.6509-08	1.4915-08
1800	2.8655-08	2.4241-08	2.0953-08	1.8631-08	1.6858-08	1.5243-08
1900	2.8856-08	2.4513-08	2.1265-08	1.8952-08	1.7168-08	1.5535-08
2000	2.9012-08	2.4742-08	2.1535-08	1.9234-08	1.7440-08	1.5793-08
2100	2.9129-08	2.4931-08	2.1766-08	1.9479-08	1.7679-08	1.6021-08
2200	2.9209-08	2.5084-08	2.1962-08	1.9690-08	1.7887-08	1.6221-08
2300	2.9258-08	2.5204-08	2.2125-08	1.9870-08	1.8067-08	1.6394-08
2400	2.9277-08	2.5295-08	2.2259-08	2.0021-08	1.8219-08	1.6543-08
2500	2.9270-08	2.5359-08	2.2366-08	2.0147-08	1.8348-08	1.6670-08
2600	2.9240-08	2.5398-08	2.2448-08	2.0249-08	1.8454-08	1.6776-08
2700	2.9189-08	2.5415-08	2.2507-08	2.0329-08	1.8540-08	1.6863-08
2800	2.9119-08	2.5411-08	2.2546-08	2.0389-08	1.8607-08	1.6933-08
2900	2.9031-08	2.5389-08	2.2566-08	2.0430-08	1.8656-08	1.6986-08
3000	2.8929-08	2.5351-08	2.2569-08	2.0455-08	1.8690-08	1.7025-08
3100	2.8812-08	2.5298-08	2.2556-08	2.0464-08	1.8709-08	1.7050-08
3200	2.8684-08	2.5230-08	2.2529-08	2.0459-08	1.8715-08	1.7063-08
3300	2.8544-08	2.5151-08	2.2489-08	2.0442-08	1.8709-08	1.7064-08
3400	2.8395-08	2.5060-08	2.2438-08	2.0412-08	1.8691-08	1.7055-08
3500	2.8237-08	2.4960-08	2.2375-08	2.0372-08	1.8663-08	1.7036-08
3600	2.8071-08	2.4850-08	2.2303-08	2.0322-08	1.8626-08	1.7008-08
3700	2.7899-08	2.4732-08	2.2222-08	2.0264-08	1.8580-08	1.6972-08
3800	2.7720-08	2.4607-08	2.2133-08	2.0197-08	1.8527-08	1.6929-08
3900	2.7537-08	2.4475-08	2.2037-08	2.0123-08	1.8466-08	1.6879-08
4000	2.7348-08	2.4337-08	2.1934-08	2.0042-08	1.8399-08	1.6823-08

Table 20. (continued)

T(K)	v=3, J=22	v=3, J=23	v=3, J=24	v=3, J=25	v=3, J=26	v=3, J=27
4100	2.7156-08	2.4194-08	2.1825-08	1.9955-08	1.8326-08	1.6761-08
4200	2.6960-08	2.4047-08	2.1712-08	1.9862-08	1.8247-08	1.6694-08
4300	2.6762-08	2.3896-08	2.1593-08	1.9765-08	1.8164-08	1.6622-08
4400	2.6561-08	2.3740-08	2.1470-08	1.9663-08	1.8076-08	1.6546-08
4500	2.6358-08	2.3582-08	2.1344-08	1.9558-08	1.7984-08	1.6466-08
4600	2.6153-08	2.3421-08	2.1214-08	1.9448-08	1.7889-08	1.6383-08
4700	2.5947-08	2.3258-08	2.1081-08	1.9336-08	1.7791-08	1.6297-08
4800	2.5741-08	2.3093-08	2.0946-08	1.9220-08	1.7690-08	1.6208-08
4900	2.5533-08	2.2926-08	2.0808-08	1.9102-08	1.7586-08	1.6116-08
5000	2.5325-08	2.2758-08	2.0668-08	1.8982-08	1.7480-08	1.6022-08
5500	2.4288-08	2.1906-08	1.9950-08	1.8358-08	1.6925-08	1.5528-08
6000	2.3270-08	2.1051-08	1.9218-08	1.7712-08	1.6345-08	1.5008-08
6500	2.2283-08	2.0212-08	1.8488-08	1.7063-08	1.5760-08	1.4480-08
7000	2.1337-08	1.9397-08	1.7774-08	1.6423-08	1.5180-08	1.3955-08
7500	2.0435-08	1.8614-08	1.7082-08	1.5800-08	1.4612-08	1.3440-08
8000	1.9579-08	1.7865-08	1.6416-08	1.5197-08	1.4063-08	1.2940-08
8500	1.8769-08	1.7151-08	1.5779-08	1.4619-08	1.3534-08	1.2459-08
9000	1.8003-08	1.6474-08	1.5171-08	1.4066-08	1.3028-08	1.1996-08
9500	1.7280-08	1.5831-08	1.4593-08	1.3538-08	1.2544-08	1.1554-08
10000	1.6598-08	1.5223-08	1.4044-08	1.3036-08	1.2083-08	1.1132-08
11000	1.5348-08	1.4103-08	1.3029-08	1.2106-08	1.1227-08	1.0349-08
12000	1.4234-08	1.3100-08	1.2117-08	1.1267-08	1.0455-08	9.6401-09
13000	1.3240-08	1.2201-08	1.1297-08	1.0512-08	9.7580-09	9.0002-09
14000	1.2350-08	1.1394-08	1.0558-08	9.8307-09	9.1288-09	8.4219-09
15000	1.1551-08	1.0668-08	9.8924-09	9.2152-09	8.5597-09	7.8986-09
16000	1.0831-08	1.0012-08	9.2900-09	8.6578-09	8.0441-09	7.4241-09
17000	1.0181-08	9.4176-09	8.7437-09	8.1517-09	7.5756-09	6.9928-09
18000	9.5910-09	8.8780-09	8.2469-09	7.6911-09	7.1490-09	6.5999-09
19000	9.0546-09	8.3866-09	7.7938-09	7.2708-09	6.7595-09	6.2410-09
20000	8.5653-09	7.9377-09	7.3796-09	6.8862-09	6.4030-09	5.9125-09
21000	8.1176-09	7.5265-09	6.9999-09	6.5355-09	6.0758-09	5.6109-09
22000	7.7070-09	7.1489-09	6.6509-09	6.2091-09	5.7749-09	5.3334-09
23000	7.3292-09	6.8013-09	6.3293-09	5.9101-09	5.4974-09	5.0776-09
24000	6.9809-09	6.4804-09	6.0324-09	5.6338-09	5.2410-09	4.8411-09
25000	6.6589-09	6.1837-09	5.7576-09	5.3781-09	5.0035-09	4.6220-09
26000	6.3607-09	5.9085-09	5.5027-09	5.1408-09	4.7832-09	4.4187-09
27000	6.0838-09	5.6530-09	5.2658-09	4.9201-09	4.5783-09	4.2296-09
28000	5.8262-09	5.4151-09	5.0452-09	4.7146-09	4.3874-09	4.0534-09
29000	5.5861-09	5.1933-09	4.8394-09	4.5229-09	4.2092-09	3.8890-09
30000	5.3619-09	4.9860-09	4.6471-09	4.3436-09	4.0426-09	3.7352-09



Table 21. Rate constant for hydrogen molecule in v=4 and J=0-5 states.

T(K)	v=4, J=0	v=4, J=1	v=4, J=2	v=4, J=3	v=4, J=4	v=4, J=5
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	---	---	---	---	---	3.3467-29
500	5.3274-27	7.2433-27	1.3088-26	3.2115-26	1.0449-25	4.4921-25
600	5.7472-24	7.4594-24	1.2330-23	2.6421-23	7.1946-23	2.4812-22
700	8.2928-22	1.0412-21	1.6150-21	3.1414-21	7.5323-21	2.2192-20
800	3.4086-20	4.1746-20	6.1734-20	1.1167-19	2.4339-19	6.3724-19
900	6.0723-19	7.2942-19	1.0394-18	1.7769-18	3.5959-18	8.5883-18
1000	6.0295-18	7.1316-18	9.8650-18	1.6120-17	3.0741-17	6.8219-17
1100	3.9160-17	4.5736-17	6.1746-17	9.7236-17	1.7664-16	3.6911-16
1200	1.8506-16	2.1387-16	2.8296-16	4.3208-16	7.5376-16	1.4981-15
1300	6.8506-16	7.8464-16	1.0205-15	1.5182-15	2.5593-15	4.8757-15
1400	2.0936-15	2.3797-15	3.0499-15	4.4372-15	7.2637-15	1.3344-14
1500	5.4902-15	6.1992-15	7.8446-15	1.1194-14	1.7864-14	3.1801-14
1600	1.2716-14	1.4275-14	1.7864-14	2.5063-14	3.9117-14	6.7740-14
1700	2.6590-14	2.9698-14	3.6802-14	5.0870-14	7.7849-14	1.3158-13
1800	5.1075-14	5.6786-14	6.9759-14	9.5152-14	1.4310-13	2.3668-13
1900	9.1340-14	1.0114-13	1.2328-13	1.6617-13	2.4603-13	3.9914-13
2000	1.5374-13	1.6961-13	2.0529-13	2.7377-13	3.9969-13	6.3724-13
2100	2.4568-13	2.7015-13	3.2491-13	4.2912-13	6.1856-13	9.7081-13
2200	3.7542-13	4.1157-13	4.9215-13	6.4432-13	9.1809-13	1.4204-12
2300	5.5182-13	6.0330-13	7.1762-13	9.3200-13	1.3141-12	2.0067-12
2400	7.8406-13	8.5505-13	1.0122-12	1.3049-12	1.8221-12	2.7494-12
2500	1.0813-12	1.1765-12	1.3865-12	1.7755-12	2.4572-12	3.6671-12
2600	1.4525-12	1.5770-12	1.8509-12	2.3554-12	3.2332-12	4.7764-12
2700	1.9062-12	2.0654-12	2.4150-12	3.0555-12	4.1624-12	6.0915-12
2800	2.4500-12	2.6498-12	3.0873-12	3.8852-12	5.2555-12	7.6242-12
2900	3.0908-12	3.3371-12	3.8754-12	4.8527-12	6.5212-12	9.3838-12
3000	3.8345-12	4.1335-12	4.7856-12	5.9645-12	7.9663-12	1.1377-11
3100	4.6860-12	5.0439-12	5.8228-12	7.2257-12	9.5956-12	1.3606-11
3200	5.6489-12	6.0719-12	6.9908-12	8.6396-12	1.1412-11	1.6074-11
3300	6.7260-12	7.2201-12	8.2919-12	1.0208-11	1.3416-11	1.8779-11
3400	7.9188-12	8.4900-12	9.7271-12	1.1932-11	1.5607-11	2.1718-11
3500	9.2278-12	9.8819-12	1.1297-11	1.3810-11	1.7983-11	2.4885-11
3600	1.0653-11	1.1395-11	1.2999-11	1.5840-11	2.0539-11	2.8274-11
3700	1.2192-11	1.3028-11	1.4832-11	1.8019-11	2.3271-11	3.1877-11
3800	1.3843-11	1.4778-11	1.6793-11	2.0342-11	2.6172-11	3.5683-11
3900	1.5604-11	1.6643-11	1.8877-11	2.2805-11	2.9235-11	3.9682-11
4000	1.7471-11	1.8617-11	2.1081-11	2.5401-11	3.2452-11	4.3863-11

Table 21. (continued)

T(K)	v=4, J=0	v=4, J=1	v=4, J=2	v=4, J=3	v=4, J=4	v=4, J=5
4100	1.9440-11	2.0698-11	2.3399-11	2.8125-11	3.5814-11	4.8213-11
4200	2.1507-11	2.2880-11	2.5825-11	3.0968-11	3.9313-11	5.2721-11
4300	2.3666-11	2.5157-11	2.8354-11	3.3924-11	4.2939-11	5.7373-11
4400	2.5912-11	2.7525-11	3.0979-11	3.6985-11	4.6682-11	6.2157-11
4500	2.8240-11	2.9977-11	3.3693-11	4.0144-11	5.0533-11	6.7061-11
4600	3.0645-11	3.2508-11	3.6491-11	4.3392-11	5.4481-11	7.2070-11
4700	3.3120-11	3.5111-11	3.9365-11	4.6722-11	5.8518-11	7.7174-11
4800	3.5661-11	3.7781-11	4.2308-11	5.0126-11	6.2633-11	8.2359-11
4900	3.8261-11	4.0511-11	4.5315-11	5.3595-11	6.6816-11	8.7615-11
5000	4.0914-11	4.3296-11	4.8378-11	5.7123-11	7.1060-11	9.2929-11
5500	5.4794-11	5.7838-11	6.4314-11	7.5384-11	9.2871-11	1.2001-10
6000	6.9232-11	7.2926-11	8.0764-11	9.4086-11	1.1498-10	1.4710-10
6500	8.3694-11	8.8002-11	9.7130-11	1.1257-10	1.3663-10	1.7332-10
7000	9.7773-11	1.0265-10	1.1297-10	1.3034-10	1.5727-10	1.9807-10
7500	1.1118-10	1.1657-10	1.2796-10	1.4707-10	1.7657-10	2.2098-10
8000	1.2372-10	1.2957-10	1.4192-10	1.6256-10	1.9430-10	2.4184-10
8500	1.3529-10	1.4154-10	1.5473-10	1.7671-10	2.1039-10	2.6060-10
9000	1.4583-10	1.5244-10	1.6634-10	1.8947-10	2.2480-10	2.7726-10
9500	1.5534-10	1.6224-10	1.7677-10	2.0087-10	2.3759-10	2.9190-10
10000	1.6384-10	1.7099-10	1.8604-10	2.1096-10	2.4882-10	3.0464-10
11000	1.7796-10	1.8550-10	2.0134-10	2.2746-10	2.6699-10	3.2493-10
12000	1.8865-10	1.9644-10	2.1278-10	2.3966-10	2.8017-10	3.3927-10
13000	1.9642-10	2.0434-10	2.2097-10	2.4823-10	2.8921-10	3.4874-10
14000	2.0176-10	2.0974-10	2.2647-10	2.5385-10	2.9489-10	3.5430-10
15000	2.0511-10	2.1308-10	2.2979-10	2.5707-10	2.9787-10	3.5677-10
16000	2.0685-10	2.1476-10	2.3134-10	2.5837-10	2.9872-10	3.5680-10
17000	2.0730-10	2.1512-10	2.3150-10	2.5816-10	2.9789-10	3.5495-10
18000	2.0672-10	2.1442-10	2.3055-10	2.5676-10	2.9576-10	3.5165-10
19000	2.0534-10	2.1290-10	2.2873-10	2.5443-10	2.9262-10	3.4725-10
20000	2.0332-10	2.1073-10	2.2624-10	2.5140-10	2.8872-10	3.4203-10
21000	2.0081-10	2.0806-10	2.2324-10	2.4782-10	2.8425-10	3.3620-10
22000	1.9794-10	2.0502-10	2.1985-10	2.4384-10	2.7936-10	3.2995-10
23000	1.9478-10	2.0170-10	2.1617-10	2.3957-10	2.7418-10	3.2341-10
24000	1.9143-10	1.9817-10	2.1229-10	2.3510-10	2.6880-10	3.1668-10
25000	1.8793-10	1.9451-10	2.0827-10	2.3049-10	2.6330-10	3.0986-10
26000	1.8435-10	1.9076-10	2.0417-10	2.2581-10	2.5774-10	3.0301-10
27000	1.8071-10	1.8695-10	2.0002-10	2.2109-10	2.5216-10	2.9618-10
28000	1.7705-10	1.8313-10	1.9587-10	2.1638-10	2.4662-10	2.8941-10
29000	1.7339-10	1.7932-10	1.9172-10	2.1170-10	2.4112-10	2.8273-10
30000	1.6976-10	1.7554-10	1.8762-10	2.0707-10	2.3571-10	2.7617-10

Table 22. Rate constant for hydrogen molecule in v=4 and J=11 states.

T(K)	v=4, J=6	v=4, J=7	v=4, J=8	v=4, J=9	v=4, J=10	v=4, J=11
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	---	---	---	---	---
400	2.7193-28	3.0084-27	4.2853-26	8.0431-25	1.4432-28	1.1477-26
500	2.4763-24	1.7530-23	1.5245-22	1.6583-21	1.8989-23	5.3170-22
600	1.0562-21	5.5528-21	3.4755-20	2.6278-19	2.1691-20	3.2482-19
700	7.8546-20	3.3393-19	1.6525-18	9.6361-18	2.3192-18	2.2890-17
800	1.9639-18	7.1202-18	2.9547-17	1.4179-16	7.6542-16	4.7068-16
900	2.3767-17	7.6137-17	2.7552-16	1.1363-15	5.2073-15	4.4893-15
1000	1.7321-16	5.0259-16	1.6301-15	5.9556-15	2.3943-14	1.0282-13
1100	8.7349-16	2.3374-15	6.9316-15	2.2935-14	8.2837-14	3.1766-13
1200	3.3432-15	8.3627-15	2.3017-14	7.0120-14	2.3164-13	8.0841-13
1300	1.0353-14	2.4462-14	6.3212-14	1.7958-13	5.5011-13	1.7728-12
1400	2.7155-14	6.1100-14	1.4958-13	4.0023-13	1.1493-12	3.4593-12
1500	6.2373-14	1.3452-13	3.1425-13	7.9836-13	2.1676-12	6.1500-12
1600	1.2865-13	2.6736-13	5.9950-13	1.4555-12	3.7629-12	1.0138-11
1700	2.4287-13	4.8852-13	1.0565-12	2.4645-12	6.1019-12	1.5708-11
1800	4.2597-13	8.3230-13	1.7431-12	3.9240-12	9.3496-12	2.3114-11
1900	7.0228-13	1.3370-12	2.7208-12	5.9333-12	1.3660-11	3.2570-11
2000	1.0986-12	2.0432-12	4.0520-12	8.5868-12	1.9167-11	4.4238-11
2100	1.6431-12	2.9920-12	5.7964-12	1.1970-11	2.5983-11	5.8229-11
2200	2.3642-12	4.2231-12	8.0095-12	1.6155-11	3.4189-11	7.4599-11
2300	3.2893-12	5.7735-12	1.0740-11	2.1202-11	4.3841-11	9.3355-11
2400	4.4441-12	9.9587-12	1.4027-11	2.7153-11	5.4966-11	1.1446-10
2500	5.8516-12	1.7904-11	3.4035-11	3.4035-11	6.7566-11	1.3783-10
2600	7.5315-12	1.2644-11	2.2391-11	4.1861-11	8.1617-11	1.6337-10
2700	9.5000-12	1.5748-11	2.7502-11	5.0628-11	9.7078-11	1.9094-10
2800	1.1769-11	1.9283-11	3.3241-11	6.0322-11	1.1389-10	2.2039-10
2900	1.4348-11	2.3253-11	3.9605-11	7.0916-11	1.3197-10	2.5155-10
3000	1.7242-11	2.7659-11	4.6581-11	8.2375-11	1.5125-10	2.8425-10
3100	2.0450-11	3.2495-11	5.4153-11	9.4655-11	1.7163-10	3.1832-10
3200	2.3972-11	3.7753-11	6.2297-11	1.0771-10	1.9301-10	3.5356-10
3300	2.7802-11	4.3419-11	7.0985-11	1.2148-10	2.1529-10	3.8982-10
3400	3.1932-11	4.9477-11	8.0188-11	1.3591-10	2.3837-10	4.2692-10
3500	3.6352-11	5.5908-11	8.9869-11	1.5094-10	2.6214-10	4.6469-10
3600	4.1051-11	6.2692-11	9.9995-11	1.6651-10	2.8652-10	5.0298-10
3700	4.6013-11	6.9805-11	1.1053-10	1.8255-10	3.1139-10	5.4165-10
3800	5.1225-11	7.7224-11	1.2143-10	1.9902-10	3.3667-10	5.8054-10
3900	5.6670-11	8.4924-11	1.3266-10	2.1585-10	3.6227-10	6.1955-10
4000	6.2331-11	9.2880-11	1.4418-10	2.3297-10	3.8811-10	6.5855-10

Table 22. (continued)

T(K)	v=4, J=6	v=4, J=7	v=4, J=8	v=4, J=9	v=4, J=10	v=4, J=11
4100	6.8192-11	1.0107-10	1.5595-10	2.5034-10	4.1409-10	6.9742-10
4200	7.4234-11	1.0946-10	1.6795-10	2.6791-10	4.4016-10	7.3608-10
4300	8.0440-11	1.1803-10	1.8012-10	2.8562-10	4.6624-10	7.7444-10
4400	8.6793-11	1.2676-10	1.9244-10	3.0342-10	4.9226-10	8.1240-10
4500	9.3276-11	1.3562-10	2.0488-10	3.2128-10	5.1817-10	8.4991-10
4600	9.9871-11	1.4459-10	2.1741-10	3.3914-10	5.4392-10	8.8690-10
4700	1.0656-10	1.5364-10	2.2999-10	3.5698-10	5.6945-10	9.2331-10
4800	1.1333-10	1.6277-10	2.4259-10	3.7475-10	5.9473-10	9.5909-10
4900	1.2017-10	1.7194-10	2.5520-10	3.9242-10	6.1970-10	9.9421-10
5000	1.2706-10	1.8114-10	2.6779-10	4.0997-10	6.4435-10	1.0286-09
5500	1.6180-10	2.2699-10	3.2967-10	4.9490-10	7.6158-10	1.1891-09
6000	1.9602-10	2.7135-10	3.8832-10	5.7351-10	8.6715-10	1.3293-09
6500	2.2869-10	3.1301-10	4.4239-10	6.4441-10	9.5997-10	1.4489-09
7000	2.5915-10	3.5128-10	4.9119-10	7.0707-10	1.0400-09	1.5489-09
7500	2.8700-10	3.8578-10	5.3446-10	7.6152-10	1.1078-09	1.6309-09
8000	3.1209-10	4.1643-10	5.7226-10	8.0812-10	1.1643-09	1.6970-09
8500	3.3439-10	4.4331-10	6.0486-10	8.4742-10	1.2106-09	1.7488-09
9000	3.5398-10	4.6658-10	6.3258-10	8.8007-10	1.2478-09	1.7884-09
9500	3.7100-10	4.8650-10	6.5585-10	9.0673-10	1.2769-09	1.8173-09
10000	3.8562-10	5.0334-10	6.7509-10	9.2807-10	1.2991-09	1.8371-09
11000	4.0845-10	5.2888-10	7.0311-10	9.5721-10	1.3259-09	1.8546-09
12000	4.2399-10	5.4535-10	7.1970-10	9.7188-10	1.3345-09	1.8497-09
13000	4.3368-10	5.5468-10	7.2746-10	9.7563-10	1.3298-09	1.8291-09
14000	4.3874-10	5.5843-10	7.2849-10	9.7128-10	1.3155-09	1.7975-09
15000	4.4017-10	5.5791-10	7.2446-10	9.6099-10	1.2945-09	1.7587-09
16000	4.3880-10	5.5414-10	7.1666-10	9.4641-10	1.2687-09	1.7152-09
17000	4.3529-10	5.4793-10	7.0610-10	9.2881-10	1.2399-09	1.6688-09
18000	4.3016-10	5.3991-10	6.9357-10	9.0914-10	1.2091-09	1.6210-09
19000	4.2382-10	5.3059-10	6.7966-10	8.8813-10	1.1772-09	1.5727-09
20000	4.1660-10	5.2034-10	6.6484-10	8.6632-10	1.1448-09	1.5246-09
21000	4.0875-10	5.0947-10	6.4945-10	8.4412-10	1.1124-09	1.4773-09
22000	4.0048-10	4.9821-10	6.3377-10	8.2183-10	1.0803-09	1.4310-09
23000	3.9194-10	4.8674-10	6.1799-10	7.9967-10	1.0488-09	1.3860-09
24000	3.8326-10	4.7519-10	6.0227-10	7.7783-10	1.0181-09	1.3424-09
25000	3.7452-10	4.6368-10	5.8673-10	7.5640-10	9.8814-10	1.3004-09
26000	3.6580-10	4.5227-10	5.7144-10	7.3549-10	9.5912-10	1.2599-09
27000	3.5716-10	4.4104-10	5.5648-10	7.1514-10	9.3106-10	1.2209-09
28000	3.4864-10	4.3002-10	5.4188-10	6.9539-10	9.0398-10	1.1836-09
29000	3.4028-10	4.1924-10	5.2767-10	6.7627-10	8.7788-10	1.1477-09
30000	3.3208-10	4.0874-10	5.1387-10	6.5777-10	8.5275-10	1.1133-09

Table 23. Rate constant for hydrogen molecule in v=4 and J=12-17 states.

T(K)	v=4, J=12	v=4, J=13	v=4, J=14	v=4, J=15	v=4, J=16	v=4, J=17
100	---	---	---	---	---	3.0793-26
200	---	---	8.4292-27	1.5701-23	3.3279-20	6.8032-17
300	1.1544-24	1.4251-22	1.9783-20	3.1056-18	5.1581-16	8.0923-14
400	1.7761-20	6.8883-19	2.8875-17	1.3169-15	6.1409-14	2.6758-12
500	5.6008-18	1.0850-16	2.2194-15	4.8246-14	1.0519-12	2.1297-11
600	2.5400-16	3.0990-15	3.9318-14	5.2181-13	6.8634-12	8.3506-11
700	3.8131-15	3.3445-14	3.0186-13	2.8174-12	2.5855-11	2.1898-10
800	2.8727-14	1.9677-13	1.3762-12	9.8689-12	6.9193-11	4.4715-10
900	1.3683-13	7.7333-13	4.4374-12	2.5932-11	1.4756-10	7.7349-10
1000	4.7310-13	2.2932-12	1.1234-11	5.5757-11	2.6863-10	1.1920-09
1100	1.2966-12	5.5434-12	2.3868-11	1.0367-10	4.3605-10	1.6894-09
1200	2.9865-12	1.1501-11	4.4478-11	1.7290-10	6.4970-10	2.2495-09
1300	6.0196-12	2.1221-11	7.4953-11	2.6531-10	9.0653-10	2.8554-09
1400	1.0928-11	3.5719-11	1.1674-10	3.8142-10	1.2016-09	3.4914-09
1500	1.8251-11	5.5871-11	1.7075-10	5.2056-10	1.5287-09	4.1438-09
1600	2.8487-11	8.2354-11	2.3735-10	6.8116-10	1.8816-09	4.8009-09
1700	4.2060-11	1.1561-10	3.1644-10	8.6104-10	2.2539-09	5.4534-09
1800	5.9298-11	1.5585-10	4.0748-10	1.0577-09	2.6397-09	6.0939-09
1900	8.0421-11	2.0308-10	5.0964-10	1.2683-09	3.0335-09	6.7166-09
2000	1.0554-10	2.5708-10	6.2189-10	1.4901-09	3.4308-09	7.3174-09
2100	1.3467-10	3.1753-10	7.4302-10	1.7206-09	3.8275-09	7.8933-09
2200	1.6772-10	3.8396-10	8.7179-10	1.9572-09	4.2203-09	8.4422-09
2300	2.0455-10	4.5583-10	1.0069-09	2.1977-09	4.6062-09	8.9629-09
2400	2.4494-10	5.3254-10	1.1472-09	2.4400-09	4.9831-09	9.4548-09
2500	2.8864-10	6.1347-10	1.2913-09	2.6823-09	5.3493-09	9.9178-09
2600	3.3534-10	6.9799-10	1.4383-09	2.9231-09	5.7033-09	1.0352-08
2700	3.8475-10	7.8548-10	1.5870-09	3.1610-09	6.0441-09	1.0758-08
2800	4.3652-10	8.7534-10	1.7366-09	3.3948-09	6.3710-09	1.1137-08
2900	4.9035-10	9.6700-10	1.8861-09	3.6238-09	6.6836-09	1.1489-08
3000	5.4590-10	1.0599-09	2.0350-09	3.8470-09	6.9815-09	1.1816-08
3100	6.0286-10	1.1536-09	2.1824-09	4.0638-09	7.2647-09	1.2119-08
3200	6.6094-10	1.2477-09	2.3278-09	4.2739-09	7.5333-09	1.2398-08
3300	7.1985-10	1.3416-09	2.4709-09	4.4767-09	7.7874-09	1.2654-08
3400	7.7932-10	1.4351-09	2.6110-09	4.6721-09	8.0272-09	1.2890-08
3500	8.3912-10	1.5278-09	2.7479-09	4.8599-09	8.2530-09	1.3106-08
3600	8.9901-10	1.6194-09	2.8814-09	5.0400-09	8.4653-09	1.3303-08
3700	9.5878-10	1.7098-09	3.0111-09	5.2123-09	8.6645-09	1.3482-08
3800	1.0183-09	1.7986-09	3.1370-09	5.3768-09	8.8509-09	1.3644-08
3900	1.0773-09	1.8856-09	3.2588-09	5.5337-09	9.0251-09	1.3791-08
4000	1.1357-09	1.9708-09	3.3765-09	5.6830-09	9.1875-09	1.3922-08

Table 23. (continued)

T(K)	v=4, J=12	v=4, J=13	v=4, J=14	v=4, J=15	v=4, J=16	v=4, J=17
4100	1.1933-09	2.0540-09	3.4900-09	5.8248-09	9.3386-09	1.4040-08
4200	1.2501-09	2.1350-09	3.5993-09	5.9594-09	9.4789-09	1.4144-08
4300	1.3059-09	2.2139-09	3.7044-09	6.0868-09	9.6088-09	1.4236-08
4400	1.3607-09	2.2904-09	3.8052-09	6.2072-09	9.7289-09	1.4317-08
4500	1.4143-09	2.3647-09	3.9018-09	6.3209-09	9.8395-09	1.4386-08
4600	1.4667-09	2.4366-09	3.9943-09	6.4281-09	9.9412-09	1.4445-08
4700	1.5179-09	2.5061-09	4.0827-09	6.5289-09	1.0034-08	1.4495-08
4800	1.5678-09	2.5732-09	4.1671-09	6.6236-09	1.0119-08	1.4536-08
4900	1.6163-09	2.6379-09	4.2476-09	6.7125-09	1.0197-08	1.4569-08
5000	1.6636-09	2.7003-09	4.3242-09	6.7956-09	1.0266-08	1.4593-08
5500	1.8790-09	2.9771-09	4.6527-09	7.1338-09	1.0519-08	1.4616-08
6000	2.0602-09	3.1993-09	4.8999-09	7.3608-09	1.0638-08	1.4508-08
6500	2.2092-09	3.3729-09	5.0785-09	7.4991-09	1.0657-08	1.4308-08
7000	2.3289-09	3.5046-09	5.2004-09	7.5673-09	1.0601-08	1.4046-08
7500	2.4229-09	3.6005-09	5.2760-09	7.5807-09	1.0490-08	1.3741-08
8000	2.4945-09	3.6666-09	5.3141-09	7.5518-09	1.0338-08	1.3409-08
8500	2.5469-09	3.7077-09	5.3221-09	7.4902-09	1.0157-08	1.3062-08
9000	2.5831-09	3.7283-09	5.3061-09	7.4038-09	9.9571-09	1.2707-08
9500	2.6055-09	3.7321-09	5.2710-09	7.2988-09	9.7433-09	1.2351-08
10000	2.6165-09	3.7222-09	5.2210-09	7.1801-09	9.5214-09	1.1996-08
11000	2.6114-09	3.6712-09	5.0890-09	6.9162-09	9.0674-09	1.1307-08
12000	2.5798-09	3.5913-09	4.9296-09	6.6343-09	8.6160-09	1.0652-08
13000	2.5306-09	3.4936-09	4.7559-09	6.3480-09	8.1790-09	1.0040-08
14000	2.4699-09	3.3856-09	4.5765-09	6.0656-09	7.7623-09	9.4707-09
15000	2.4021-09	3.2726-09	4.3967-09	5.7919-09	7.3690-09	8.9438-09
16000	2.3305-09	3.1580-09	4.2201-09	5.5298-09	6.9998-09	8.4572-09
17000	2.2571-09	3.0441-09	4.0488-09	5.2806-09	6.6545-09	8.0080-09
18000	2.1835-09	2.9325-09	3.8841-09	5.0448-09	6.3323-09	7.5934-09
19000	2.1108-09	2.8241-09	3.7266-09	4.8225-09	6.0319-09	7.2104-09
20000	2.0396-09	2.7197-09	3.5768-09	4.6132-09	5.7518-09	6.8563-09
21000	1.9704-09	2.6194-09	3.4345-09	4.4164-09	5.4908-09	6.5285-09
22000	1.9035-09	2.5235-09	3.2996-09	4.2315-09	5.2472-09	6.2246-09
23000	1.8391-09	2.4320-09	3.1720-09	4.0577-09	5.0199-09	5.9425-09
24000	1.7773-09	2.3448-09	3.0512-09	3.8944-09	4.8074-09	5.6801-09
25000	1.7180-09	2.2618-09	2.9370-09	3.7408-09	4.6087-09	5.4358-09
26000	1.6614-09	2.1829-09	2.8290-09	3.5963-09	4.4226-09	5.2079-09
27000	1.6072-09	2.1078-09	2.7269-09	3.4603-09	4.2481-09	4.9950-09
28000	1.5554-09	2.0365-09	2.6302-09	3.3321-09	4.0843-09	4.7958-09
29000	1.5060-09	1.9687-09	2.5386-09	3.2112-09	3.9304-09	4.6091-09
30000	1.4588-09	1.9042-09	2.4519-09	3.0971-09	3.7856-09	4.4340-09

Table 24. Rate constant for hydrogen molecule in v=4 and J=18-23 states.

T(K)	v=4, J=18	v=4, J=19	v=4, J=20	v=4, J=21	v=4, J=22	v=4, J=23
100	1.5682-19	4.6201-13	2.7809-09	2.1786-09	1.6666-09	1.6307-09
200	1.3229-13	1.5287-10	5.3289-09	4.3230-09	3.5770-09	3.2517-09
300	1.1548-11	1.0126-09	7.4668-09	6.1773-09	5.2408-09	4.6979-09
400	1.0416-10	2.5683-09	9.3220-09	7.8196-09	6.7253-09	6.0116-09
500	3.8207-10	4.4608-09	1.0955-08	9.2900-09	8.0649-09	7.2119-09
600	8.9691-10	6.4239-09	1.2405-08	1.0613-08	9.2798-09	8.3105-09
700	1.6347-09	8.3173-09	1.3698-08	1.1807-08	1.0383-08	9.3160-09
800	2.5461-09	1.0079-08	1.4853-08	1.2886-08	1.1387-08	1.0236-08
900	3.5738-09	1.1686-08	1.5887-08	1.3860-08	1.2298-08	1.1076-08
1000	4.6660-09	1.3136-08	1.6811-08	1.4738-08	1.3125-08	1.1843-08
1100	5.7812-09	1.4437-08	1.7638-08	1.5531-08	1.3875-08	1.2541-08
1200	6.8885-09	1.5599-08	1.8377-08	1.6244-08	1.4554-08	1.3176-08
1300	7.9660-09	1.6634-08	1.9035-08	1.6885-08	1.5167-08	1.3752-08
1400	8.9991-09	1.7554-08	1.9621-08	1.7459-08	1.5720-08	1.4274-08
1500	9.9784-09	1.8370-08	2.0140-08	1.7973-08	1.6218-08	1.4745-08
1600	1.0899-08	1.9093-08	2.0599-08	1.8431-08	1.6664-08	1.5170-08
1700	1.1758-08	1.9731-08	2.1003-08	1.8838-08	1.7063-08	1.5552-08
1800	1.2555-08	2.0294-08	2.1357-08	1.9198-08	1.7418-08	1.5893-08
1900	1.3291-08	2.0787-08	2.1666-08	1.9515-08	1.7733-08	1.6197-08
2000	1.3968-08	2.1219-08	2.1932-08	1.9793-08	1.8011-08	1.6468-08
2100	1.4589-08	2.1595-08	2.2160-08	2.0034-08	1.8255-08	1.6706-08
2200	1.5156-08	2.1921-08	2.2354-08	2.0242-08	1.8468-08	1.6916-08
2300	1.5672-08	2.2201-08	2.2515-08	2.0420-08	1.8652-08	1.7099-08
2400	1.6141-08	2.2440-08	2.2648-08	2.0570-08	1.8810-08	1.7256-08
2500	1.6565-08	2.2641-08	2.2753-08	2.0694-08	1.8943-08	1.7391-08
2600	1.6947-08	2.2808-08	2.2835-08	2.0795-08	1.9054-08	1.7505-08
2700	1.7291-08	2.2945-08	2.2894-08	2.0874-08	1.9144-08	1.7599-08
2800	1.7599-08	2.3053-08	2.2933-08	2.0933-08	1.9215-08	1.7676-08
2900	1.7873-08	2.3136-08	2.2954-08	2.0974-08	1.9268-08	1.7736-08
3000	1.8116-08	2.3196-08	2.2957-08	2.0998-08	1.9306-08	1.7780-08
3100	1.8330-08	2.3235-08	2.2945-08	2.1007-08	1.9329-08	1.7811-08
3200	1.8518-08	2.3255-08	2.2919-08	2.1003-08	1.9338-08	1.7829-08
3300	1.8681-08	2.3257-08	2.2880-08	2.0985-08	1.9335-08	1.7834-08
3400	1.8821-08	2.3244-08	2.2830-08	2.0956-08	1.9320-08	1.7829-08
3500	1.8941-08	2.3217-08	2.2769-08	2.0916-08	1.9295-08	1.7814-08
3600	1.9041-08	2.3176-08	2.2698-08	2.0867-08	1.9261-08	1.7790-08
3700	1.9123-08	2.3124-08	2.2618-08	2.0809-08	1.9218-08	1.7758-08
3800	1.9188-08	2.3061-08	2.2531-08	2.0742-08	1.9167-08	1.7717-08
3900	1.9238-08	2.2989-08	2.2436-08	2.0669-08	1.9108-08	1.7670-08
4000	1.9275-08	2.2908-08	2.2335-08	2.0588-08	1.9043-08	1.7616-08

Table 24. (continued)

T(K)	v=4, J=18	v=4, J=19	v=4, J=20	v=4, J=21	v=4, J=22	v=4, J=23
4100	1.9298-08	2.2818-08	2.2228-08	2.0502-08	1.8972-08	1.7556-08
4200	1.9309-08	2.2722-08	2.2116-08	2.0410-08	1.8895-08	1.7491-08
4300	1.9309-08	2.2619-08	2.1999-08	2.0313-08	1.8814-08	1.7421-08
4400	1.9299-08	2.2511-08	2.1877-08	2.0211-08	1.8728-08	1.7347-08
4500	1.9280-08	2.2397-08	2.1752-08	2.0106-08	1.8637-08	1.7268-08
4600	1.9252-08	2.2279-08	2.1624-08	1.9997-08	1.8543-08	1.7186-08
4700	1.9216-08	2.2156-08	2.1492-08	1.9885-08	1.8446-08	1.7100-08
4800	1.9174-08	2.2030-08	2.1358-08	1.9770-08	1.8346-08	1.7012-08
4900	1.9124-08	2.1900-08	2.1222-08	1.9652-08	1.8243-08	1.6921-08
5000	1.9068-08	2.1767-08	2.1083-08	1.9532-08	1.8137-08	1.6827-08
5500	1.8715-08	2.1073-08	2.0371-08	1.8907-08	1.7583-08	1.6331-08
6000	1.8271-08	2.0348-08	1.9641-08	1.8260-08	1.7002-08	1.5806-08
6500	1.7774-08	1.9615-08	1.8914-08	1.7607-08	1.6413-08	1.5271-08
7000	1.7246-08	1.8891-08	1.8200-08	1.6963-08	1.5827-08	1.4736-08
7500	1.6706-08	1.8183-08	1.7506-08	1.6334-08	1.5252-08	1.4209-08
8000	1.6164-08	1.7498-08	1.6838-08	1.5725-08	1.4694-08	1.3697-08
8500	1.5629-08	1.6839-08	1.6198-08	1.5139-08	1.4155-08	1.3201-08
9000	1.5105-08	1.6209-08	1.5586-08	1.4577-08	1.3638-08	1.2724-08
9500	1.4596-08	1.5607-08	1.5003-08	1.4042-08	1.3144-08	1.2267-08
10000	1.4105-08	1.5033-08	1.4449-08	1.3531-08	1.2671-08	1.1830-08
11000	1.3178-08	1.3970-08	1.3422-08	1.2582-08	1.1792-08	1.1016-08
12000	1.2326-08	1.3011-08	1.2498-08	1.1725-08	1.0997-08	1.0278-08
13000	1.1548-08	1.2145-08	1.1664-08	1.0952-08	1.0277-08	9.6092-09
14000	1.0838-08	1.1364-08	1.0913-08	1.0252-08	9.6254-09	9.0032-09
15000	1.0190-08	1.0658-08	1.0234-08	9.6195-09	9.0350-09	8.4536-09
16000	9.5993-09	1.0018-08	9.6186-09	9.0454-09	8.4989-09	7.9541-09
17000	9.0594-09	9.4365-09	9.0598-09	8.5235-09	8.0111-09	7.4994-09
18000	8.5654-09	8.9069-09	8.5510-09	8.0478-09	7.5662-09	7.0843-09
19000	8.1124-09	8.4233-09	8.0866-09	7.6132-09	7.1594-09	6.7047-09
20000	7.6961-09	7.9805-09	7.6614-09	7.2150-09	6.7865-09	6.3565-09
21000	7.3130-09	7.5742-09	7.2712-09	6.8494-09	6.4440-09	6.0366-09
22000	6.9594-09	7.2004-09	6.9123-09	6.5129-09	6.1285-09	5.7418-09
23000	6.6326-09	6.8556-09	6.5813-09	6.2024-09	5.8374-09	5.4697-09
24000	6.3299-09	6.5370-09	6.2754-09	5.9153-09	5.5680-09	5.2179-09
25000	6.0490-09	6.2419-09	5.9921-09	5.6493-09	5.3184-09	4.9845-09
26000	5.7878-09	5.9679-09	5.7291-09	5.4023-09	5.0866-09	4.7677-09
27000	5.5444-09	5.7131-09	5.4845-09	5.1725-09	4.8708-09	4.5658-09
28000	5.3173-09	5.4757-09	5.2566-09	4.9583-09	4.6696-09	4.3776-09
29000	5.1051-09	5.2541-09	5.0439-09	4.7583-09	4.4817-09	4.2018-09
30000	4.9064-09	5.0469-09	4.8449-09	4.5712-09	4.3059-09	4.0372-09

Table 25. Rate constant for hydrogen molecule in v=4 and J=24-25 states and v=5 and J=0-3 state

T(K)	v=4, J=24	v=4, J=25	v=5, J=0	v=5, J=1	v=5, J=2	v=5, J=3
100	1.4485-09	1.2663-09	---	---	---	---
200	2.8811-09	2.5386-09	---	---	---	---
300	4.1691-09	3.6911-09	---	---	---	---
400	5.3492-09	4.7527-09	4.6789-26	6.5861-26	1.3039-25	3.6282-25
500	6.4349-09	5.7339-09	1.6660-22	2.2000-22	3.8333-22	8.8077-22
600	7.4343-09	6.6407-09	3.8012-20	4.8103-20	7.6976-20	1.5567-19
700	8.3536-09	7.4778-09	1.8088-18	2.2204-18	3.3436-18	6.1726-18
800	9.1983-09	8.2495-09	3.2364-17	3.8833-17	5.5872-17	9.6327-17
900	9.9732-09	8.9597-09	3.0199-16	3.5599-16	4.9435-16	8.0817-16
1000	1.0683-08	9.6121-08	1.7879-15	2.0779-15	2.8049-15	4.3946-15
1100	1.1332-08	1.0210-08	7.6073-15	8.7395-15	1.1527-14	1.7442-14
1200	1.1924-08	1.0758-08	2.5276-14	2.8759-14	3.7206-14	5.4692-14
1300	1.2463-08	1.1257-08	6.9456-14	7.8383-14	9.9763-14	1.4310-13
1400	1.2953-08	1.1713-08	1.6444-13	1.8429-13	2.3129-13	3.2487-13
1500	1.3397-08	1.2127-08	3.4567-13	3.8504-13	4.7743-13	6.5850-13
1600	1.3799-08	1.2502-08	6.5980-13	7.3105-13	8.9691-13	1.2175-12
1700	1.4161-08	1.2841-08	1.1634-12	1.2830-12	1.5594-12	2.0874-12
1800	1.4486-08	1.3147-08	1.9204-12	2.1090-12	2.5423-12	3.3608-12
1900	1.4778-08	1.3421-08	2.9990-12	3.2814-12	3.9261-12	5.1327-12
2000	1.5037-08	1.3667-08	4.4682-12	4.8727-12	5.7913-12	7.4955-12
2100	1.5268-08	1.3886-08	6.3949-12	6.9527-12	8.2136-12	1.0534-11
2200	1.5471-08	1.4079-08	8.8403-12	9.5851-12	1.1261-11	1.4325-11
2300	1.5650-08	1.4250-08	1.1859-11	1.2826-11	1.4993-11	1.8929-11
2400	1.5805-08	1.4400-08	1.5495-11	1.6720-11	1.9456-11	2.4395-11
2500	1.5939-08	1.4529-08	1.9785-11	2.1304-11	2.4686-11	3.0757-11
2600	1.6053-08	1.4640-08	2.4754-11	2.6603-11	3.0706-11	3.8033-11
2700	1.6149-08	1.4735-08	3.0417-11	3.2629-11	3.7526-11	4.6230-11
2800	1.6228-08	1.4813-08	3.6778-11	3.9387-11	4.5146-11	5.5339-11
2900	1.6291-08	1.4878-08	4.3834-11	4.6871-11	5.3557-11	6.5342-11
3000	1.6340-08	1.4928-08	5.1574-11	5.5066-11	6.2739-11	7.6211-11
3100	1.6376-08	1.4967-08	5.9978-11	6.3952-11	7.2666-11	8.7910-11
3200	1.6400-08	1.4994-08	6.9022-11	7.3501-11	8.3303-11	1.0039-10
3300	1.6412-08	1.5010-08	7.8674-11	8.3680-11	9.4613-11	1.1361-10
3400	1.6414-08	1.5017-08	8.8902-11	9.4452-11	1.0655-10	1.2752-10
3500	1.6407-08	1.5015-08	9.9667-11	1.0578-10	1.1907-10	1.4205-10
3600	1.6390-08	1.5004-08	1.1093-10	1.1761-10	1.3213-10	1.5716-10
3700	1.6366-08	1.4986-08	1.2265-10	1.2992-10	1.4568-10	1.7278-10
3800	1.6334-08	1.4961-08	1.3479-10	1.4264-10	1.5966-10	1.8885-10
3900	1.6296-08	1.4930-08	1.4729-10	1.5575-10	1.7403-10	2.0533-10
4000	1.6251-08	1.4893-08	1.6013-10	1.6918-10	1.8874-10	2.2214-10

Table 25. (continued)

T(K)	v=4, J=24	v=4, J=25	v=5, J=0	v=5, J=1	v=5, J=2	v=5, J=3
4100	1.6201-08	1.4850-08	1.7326-10	1.8291-10	2.0374-10	2.3924-10
4200	1.6146-08	1.4803-08	1.8663-10	1.9688-10	2.1899-10	2.5658-10
4300	1.6085-08	1.4751-08	2.0021-10	2.1107-10	2.3443-10	2.7410-10
4400	1.6021-08	1.4694-08	2.1397-10	2.2541-10	2.5004-10	2.9176-10
4500	1.5952-08	1.4634-08	2.2783-10	2.3989-10	2.6576-10	3.0952-10
4600	1.5880-08	1.4571-08	2.4184-10	2.5446-10	2.8156-10	3.2732-10
4700	1.5805-08	1.4505-08	2.5589-10	2.6909-10	2.9740-10	3.4514-10
4800	1.5727-08	1.4435-08	2.6999-10	2.8375-10	3.1325-10	3.6292-10
4900	1.5646-08	1.4364-08	2.8408-10	2.9841-10	3.2908-10	3.8065-10
5000	1.5562-08	1.4289-08	2.9816-10	3.1304-10	3.4486-10	3.9829-10
5500	1.5118-08	1.3891-08	3.6745-10	3.8490-10	4.2210-10	4.8416-10
6000	1.4644-08	1.3464-08	4.3324-10	4.5295-10	4.9483-10	5.6436-10
6500	1.4157-08	1.3023-08	4.9400-10	5.1564-10	5.6151-10	6.3733-10
7000	1.3669-08	1.2580-08	5.4892-10	5.7219-10	6.2137-10	7.0236-10
7500	1.3187-08	1.2141-08	5.9771-10	6.2231-10	6.7419-10	7.5934-10
8000	1.2717-08	1.1712-08	6.4043-10	6.6608-10	7.2012-10	8.0853-10
8500	1.2262-08	1.1296-08	6.7732-10	7.0381-10	7.5951-10	8.5041-10
9000	1.1823-08	1.0894-08	7.0878-10	7.3590-10	7.9284-10	8.8556-10
9500	1.1402-08	1.0509-08	7.3525-10	7.6282-10	8.2064-10	9.1461-10
10000	1.0999-08	1.0139-08	7.5719-10	7.8507-10	8.4347-10	9.3820-10
11000	1.0247-08	9.4494-09	7.8933-10	8.1746-10	8.7629-10	9.7140-10
12000	9.5641-09	8.8219-09	8.0860-10	8.3663-10	8.9515-10	9.8950-10
13000	8.9447-09	8.2524-09	8.1790-10	8.4558-10	9.0327-10	9.9610-10
14000	8.3830-09	7.7356-09	8.1957-10	8.4673-10	9.0327-10	9.9405-10
15000	7.8731-09	7.2662-09	8.1549-10	8.4202-10	8.9718-10	9.8560-10
16000	7.4094-09	6.8392-09	8.0713-10	8.3294-10	8.8659-10	9.7246-10
17000	6.9871-09	6.4501-09	7.9561-10	8.2068-10	8.7274-10	9.5506-10
18000	6.6014-09	6.0947-09	7.8182-10	8.0613-10	8.5657-10	9.3710-10
19000	6.2485-09	5.7694-09	7.6644-10	7.8998-10	8.3881-10	9.1667-10
20000	5.9248-09	5.4710-09	7.4999-10	7.7278-10	8.2000-10	8.9524-10
21000	5.6272-09	5.1965-09	7.3287-10	7.5492-10	8.0058-10	8.7326-10
22000	5.3530-09	4.9436-09	7.1539-10	7.3671-10	7.8085-10	8.5106-10
23000	5.0998-09	4.7100-09	6.9778-10	7.1840-10	7.6107-10	8.2889-10
24000	4.8655-09	4.4938-09	6.8021-10	7.0015-10	7.4140-10	8.0693-10
25000	4.6481-09	4.2933-09	6.6281-10	6.8211-10	7.2200-10	7.8532-10
26000	4.4462-09	4.1069-09	6.4570-10	6.6436-10	7.0295-10	7.6416-10
27000	4.2583-09	3.9334-09	6.2892-10	6.4699-10	6.8432-10	7.4352-10
28000	4.0830-09	3.7716-09	6.1254-10	6.3004-10	6.6617-10	7.2345-10
29000	3.9192-09	3.6205-09	5.9659-10	6.1354-10	6.4853-10	7.0397-10
30000	3.7659-09	3.4790-09	5.8110-10	5.9752-10	6.3142-10	6.8510-10

Table 26. Rate constant for hydrogen molecule in  $v=5$  and  $J=4-9$  states.

T(K)	$v=5, J=4$	$v=5, J=5$	$v=5, J=6$	$v=5, J=7$	$v=5, J=8$	$v=5, J=9$
100	---	---	---	---	---	---
200	---	---	---	---	---	---
300	---	4.0291-29	5.1315-28	9.3472-27	2.3424-25	8.0089-24
400	1.3766-24	7.2924-24	5.0568-23	4.5936-22	5.3113-21	7.7584-20
500	2.6039-21	1.0088-20	4.8587-20	2.9084-19	2.1145-18	1.8546-17
600	3.8970-19	1.2255-18	4.6302-18	2.0994-17	1.1204-16	6.9953-16
700	1.3722-17	3.7179-17	1.1812-16	4.3925-16	1.8801-15	9.2092-15
800	1.9588-16	4.7467-16	1.3243-15	4.2450-15	1.5401-14	6.2892-14
900	1.5335-15	3.4068-15	8.5919-15	2.4539-14	7.8294-14	2.7759-13
1000	7.8891-15	1.6351-14	3.8038-14	9.9066-14	2.8524-13	9.0327-13
1100	2.9925-14	5.8596-14	1.2761-13	3.0821-13	8.1596-13	2.3560-12
1200	9.0356-14	1.6875-13	3.4784-13	7.8899-13	1.9479-12	5.2081-12
1300	2.2898-13	4.1087-13	8.0845-13	1.7390-12	4.0470-12	1.0140-11
1400	5.0582-13	8.7700-13	1.6582-12	3.4084-12	7.5410-12	1.7872-11
1500	1.0013-12	1.6852-12	3.0783-12	6.0831-12	1.2882-11	2.9095-11
1600	1.8133-12	2.9737-12	5.2706-12	1.0063-11	2.0510-11	4.4413-11
1700	3.0525-12	4.8924-12	8.4437-12	1.5639-11	3.0819-11	6.4306-11
1800	4.8355-12	7.5938-12	1.2800-11	2.3078-11	4.4134-11	8.9106-11
1900	7.2783-12	1.1224-11	1.8523-11	3.2602-11	6.0701-11	1.1900-10
2000	1.0491-11	1.5915-11	2.5770-11	4.4385-11	8.0674-11	1.5402-10
2100	1.4571-11	2.1780-11	3.4666-11	5.8548-11	1.0413-10	1.9410-10
2200	1.9602-11	2.8908-11	4.5298-11	7.5156-11	1.3105-10	2.3904-10
2300	2.5650-11	3.7365-11	5.7721-11	9.4226-11	1.6136-10	2.8856-10
2400	3.2761-11	4.7189-11	7.1953-11	1.1572-10	1.9494-10	3.4233-10
2500	4.0964-11	5.8398-11	8.7981-11	1.3958-10	2.3158-10	3.9996-10
2600	5.0271-11	7.0984-11	1.0576-10	1.6569-10	2.7108-10	4.6104-10
2700	6.0675-11	8.4921-11	1.2524-10	1.9393-10	3.1320-10	5.2513-10
2800	7.2156-11	1.0017-10	1.4632-10	2.2414-10	3.5766-10	5.9182-10
2900	8.4682-11	1.1666-10	1.6892-10	2.5615-10	4.0420-10	6.6068-10
3000	9.8209-11	1.3433-10	1.9291-10	2.8979-10	4.5255-10	7.3130-10
3100	1.1268-10	1.5311-10	2.1818-10	3.2489-10	5.0243-10	8.0327-10
3200	1.2805-10	1.7290-10	2.4460-10	3.6125-10	5.5359-10	8.7625-10
3300	1.4423-10	1.9362-10	2.7205-10	3.9871-10	6.0578-10	9.4988-10
3400	1.6117-10	2.1517-10	3.0041-10	4.3708-10	6.5875-10	1.0238-09
3500	1.7880-10	2.3746-10	3.2955-10	4.7619-10	7.1228-10	1.0979-09
3600	1.9704-10	2.6040-10	3.5934-10	5.1589-10	7.6615-10	1.1717-09
3700	2.1582-10	2.8391-10	3.8966-10	5.5602-10	8.2018-10	1.2450-09
3800	2.3507-10	3.0788-10	4.2042-10	5.9645-10	8.7418-10	1.3177-09
3900	2.5473-10	3.3223-10	4.5149-10	6.3702-10	9.2800-10	1.3895-09
4000	2.7472-10	3.5689-10	4.8278-10	6.7763-10	9.8148-10	1.4603-09

Table 26. (continued)

T(K)	$v=5, J=4$	$v=5, J=5$	$v=5, J=6$	$v=5, J=7$	$v=5, J=8$	$v=5, J=9$
4100	2.9498-10	3.8177-10	5.1420-10	7.1816-10	1.0345-09	1.5300-09
4200	3.1545-10	4.0681-10	5.4565-10	7.5851-10	1.0869-09	1.5983-09
4300	3.3608-10	4.3193-10	5.7706-10	7.9857-10	1.1386-09	1.6653-09
4400	3.5680-10	4.5708-10	6.0835-10	8.3827-10	1.1896-09	1.7308-09
4500	3.7758-10	4.8218-10	6.3945-10	8.7753-10	1.2397-09	1.7947-09
4600	3.9835-10	5.0719-10	6.7031-10	9.1628-10	1.2888-09	1.8571-09
4700	4.1907-10	5.3206-10	7.0086-10	9.5446-10	1.3370-09	1.9177-09
4800	4.3971-10	5.5675-10	7.3106-10	9.9202-10	1.3841-09	1.9767-09
4900	4.6023-10	5.8120-10	7.6086-10	1.0289-09	1.4301-09	2.0339-09
5000	4.8058-10	6.0538-10	7.9022-10	1.0651-09	1.4750-09	2.0894-09
5500	5.7900-10	7.2126-10	9.2936-10	1.2344-09	1.6818-09	2.3404-09
6000	6.6992-10	8.2678-10	1.0539-09	1.3828-09	1.8588-09	2.5488-09
6500	7.5180-10	9.2056-10	1.1628-09	1.5100-09	2.0068-09	2.7177-09
7000	8.2407-10	1.0023-09	1.2562-09	1.6170-09	2.1281-09	2.8513-09
7500	8.8679-10	1.0723-09	1.3350-09	1.7052-09	2.2254-09	2.9543-09
8000	9.4040-10	1.1314-09	1.4002-09	1.7767-09	2.3016-09	3.0310-09
8500	9.8556-10	1.1804-09	1.4533-09	1.8332-09	2.3595-09	3.0853-09
9000	1.0230-09	1.2204-09	1.4956-09	1.8768-09	2.4017-09	3.1208-09
9500	1.0536-09	1.2523-09	1.5285-09	1.9091-09	2.4305-09	3.1405-09
10000	1.0780-09	1.2773-09	1.5531-09	1.9317-09	2.4479-09	3.1471-09
11000	1.1112-09	1.3093-09	1.5820-09	1.9534-09	2.4557-09	3.1298-09
12000	1.1278-09	1.3227-09	1.5897-09	1.9511-09	2.4366-09	3.0831-09
13000	1.1317-09	1.3222-09	1.5820-09	1.9318-09	2.3990-09	3.0170-09
14000	1.1264-09	1.3116-09	1.5632-09	1.9006-09	2.3490-09	2.9387-09
15000	1.1143-09	1.2937-09	1.5368-09	1.8614-09	2.2910-09	2.8532-09
16000	1.0972-09	1.2707-09	1.5050-09	1.8169-09	2.2281-09	2.7640-09
17000	1.0766-09	1.2441-09	1.4698-09	1.7692-09	2.1627-09	2.6736-09
18000	1.0537-09	1.2153-09	1.4324-09	1.7198-09	2.0963-09	2.5835-09
19000	1.0293-09	1.1850-09	1.3939-09	1.6697-09	2.0300-09	2.4949-09
20000	1.0040-09	1.1540-09	1.3549-09	1.6196-09	1.9647-09	2.4086-09
21000	9.7819-10	1.1227-09	1.3160-09	1.5702-09	1.9008-09	2.3251-09
22000	9.5232-10	1.0916-09	1.2776-09	1.5218-09	1.8388-09	2.2446-09
23000	9.2663-10	1.0609-09	1.2399-09	1.4746-09	1.7787-09	2.1673-09
24000	9.0129-10	1.0308-09	1.2032-09	1.4289-09	1.7209-09	2.0932-09
25000	8.7645-10	1.0013-09	1.1675-09	1.3847-09	1.6652-09	2.0224-09
26000	8.5221-10	9.7274-10	1.1329-09	1.3421-09	1.6118-09	1.9547-09
27000	8.2862-10	9.4501-10	1.0995-09	1.3010-09	1.5606-09	1.8901-09
28000	8.0573-10	9.1817-10	1.0673-09	1.2616-09	1.5116-09	1.8285-09
29000	7.8357-10	8.9225-10	1.0363-09	1.2238-09	1.4647-09	1.7697-09
30000	7.6214-10	8.6725-10	1.0065-09	1.1875-09	1.4198-09	1.7136-09

Table 27. Rate constant for hydrogen molecule in v=5 and J=10-15 states.

T(K)	v=5, J=10	v=5, J=11	v=5, J=12	v=5, J=13	v=5, J=14	v=5, J=15
100	---	---	---	---	2.7245-29	2.2111-23
200	2.1253-29	8.1145-27	4.0520-24	2.6877-21	1.9562-18	1.6068-15
300	3.5190-22	1.9074-20	1.2281-18	9.3883-17	7.4253-15	6.1573-13
400	1.3638-18	2.7882-17	6.4506-16	1.6776-14	4.3859-13	1.1598-11
500	1.8826-16	2.1460-15	2.6884-14	3.6659-13	4.9438-12	6.6035-11
600	4.9264-15	3.8067-14	3.1698-13	2.8133-12	2.4444-11	2.0753-10
700	4.9963-14	2.9260-13	1.8209-12	1.1900-11	7.5633-11	4.6538-10
800	2.8064-13	1.3356-12	6.6834-12	3.4741-11	1.7483-10	8.4618-10
900	1.0642-12	4.3111-12	1.8215-11	7.9279-11	3.3298-10	1.3389-09
1000	3.0672-12	1.0926-11	4.0333-11	1.5236-10	5.5417-10	1.9229-09
1100	7.2452-12	2.3237-11	7.6823-11	2.5854-10	8.3640-10	2.5747-09
1200	1.4748-11	4.3345-11	1.3075-10	3.9974-10	1.1735-09	3.2717-09
1300	2.6779-11	7.3112-11	2.0413-10	5.7555-10	1.5569-09	3.9942-09
1400	4.4465-11	1.1398-10	2.9786-10	7.8369-10	1.9771-09	4.7256-09
1500	6.8744-11	1.6686-10	4.1182-10	1.0207-09	2.4247-09	5.4529-09
1600	1.0031-10	2.3214-10	5.4506-10	1.2823-09	2.8908-09	6.1663-09
1700	1.3957-10	3.0974-10	6.9603-10	1.5641-09	3.3677-09	6.8583-09
1800	1.8669-10	3.9918-10	8.6274-10	1.8616-09	3.8485-09	7.5236-09
1900	2.4158-10	4.9965-10	1.0430-09	2.1706-09	4.3277-09	8.1587-09
2000	3.0394-10	6.1016-10	1.2346-09	2.4871-09	4.8006-09	8.7614-09
2100	3.7334-10	7.2954-10	1.4352-09	2.8077-09	5.2635-09	9.3303-09
2200	4.4921-10	8.5658-10	1.6426-09	3.1293-09	5.7135-09	9.8650-09
2300	5.3089-10	9.9003-10	1.8549-09	3.4493-09	6.1484-09	1.0366-08
2400	6.1771-10	1.1287-09	2.0701-09	3.7656-09	6.5667-09	1.0833-08
2500	7.0895-10	1.2713-09	2.2867-09	4.0762-09	6.9671-09	1.1268-08
2600	8.0388-10	1.4169-09	2.5032-09	4.3796-09	7.3491-09	1.1671-08
2700	9.0183-10	1.5644-09	2.7183-09	4.6748-09	7.7121-09	1.2044-08
2800	1.0021-09	1.7129-09	2.9308-09	4.9606-09	8.0561-09	1.2389-08
2900	1.1042-09	1.8615-09	3.1399-09	5.2365-09	8.3812-09	1.2706-08
3000	1.2073-09	2.0095-09	3.3448-09	5.5019-09	8.6875-09	1.2997-08
3100	1.3111-09	2.1563-09	3.5448-09	5.7565-09	8.9756-09	1.3263-08
3200	1.4150-09	2.3013-09	3.7393-09	6.0001-09	9.2457-09	1.3506-08
3300	1.5186-09	2.4439-09	3.9281-09	6.2325-09	9.4986-09	1.3727-08
3400	1.6215-09	2.5839-09	4.1108-09	6.4538-09	9.7347-09	1.3928-08
3500	1.7233-09	2.7207-09	4.2870-09	6.6641-09	9.9547-09	1.4109-08
3600	1.8238-09	2.8543-09	4.4568-09	6.8635-09	1.0159-08	1.4272-08
3700	1.9227-09	2.9842-09	4.6199-09	7.0522-09	1.0349-08	1.4418-08
3800	2.0197-09	3.1104-09	4.7764-09	7.2305-09	1.0525-08	1.4548-08
3900	2.1147-09	3.2326-09	4.9262-09	7.3986-09	1.0687-08	1.4663-08
4000	2.2075-09	3.3509-09	5.0693-09	7.5569-09	1.0837-08	1.4764-08

Table 27. (continued)

T(K)	v=5, J=10	v=5, J=11	v=5, J=12	v=5, J=13	v=5, J=14	v=5, J=15
4100	2.2981-09	3.4650-09	5.2059-09	7.7056-09	1.0974-08	1.4853-08
4200	2.3862-09	3.5750-09	5.3360-09	7.8451-09	1.1100-08	1.4929-08
4300	2.4717-09	3.6809-09	5.4598-09	7.9757-09	1.1214-08	1.4993-08
4400	2.5548-09	3.7826-09	5.5773-09	8.0977-09	1.1319-08	1.5047-08
4500	2.6352-09	3.8802-09	5.6888-09	8.2116-09	1.1413-08	1.5091-08
4600	2.7129-09	3.9738-09	5.7943-09	8.3175-09	1.1498-08	1.5126-08
4700	2.7880-09	4.0632-09	5.8941-09	8.4159-09	1.1575-08	1.5152-08
4800	2.8604-09	4.1488-09	5.9884-09	8.5071-09	1.1643-08	1.5170-08
4900	2.9302-09	4.2304-09	6.0772-09	8.5914-09	1.1703-08	1.5181-08
5000	2.9974-09	4.3082-09	6.1608-09	8.6692-09	1.1756-08	1.5184-08
5500	3.2946-09	4.6433-09	6.5070-09	8.9690-09	1.1923-08	1.5113-08
6000	3.5320-09	4.8974-09	6.7490-09	9.1453-09	1.1960-08	1.4928-08
6500	3.7165-09	5.0829-09	6.9067-09	9.2258-09	1.1902-08	1.4666-08
7000	3.8555-09	5.2115-09	6.9969-09	9.2330-09	1.1773-08	1.4351-08
7500	3.9559-09	5.2933-09	7.0336-09	9.1845-09	1.1595-08	1.4004-08
8000	4.0241-09	5.3372-09	7.0282-09	9.0941-09	1.1382-08	1.3637-08
8500	4.0655-09	5.3505-09	6.9900-09	8.9726-09	1.1145-08	1.3260-08
9000	4.0850-09	5.3392-09	6.9265-09	8.8284-09	1.0893-08	1.2880-08
9500	4.0864-09	5.3084-09	6.8436-09	8.6679-09	1.0632-08	1.2503-08
10000	4.0732-09	5.2622-09	6.7461-09	8.4962-09	1.0366-08	1.2131-08
11000	4.0137-09	5.1363-09	6.5215-09	8.1341-09	9.8343-09	1.1414-08
12000	3.9237-09	4.9817-09	6.2748-09	7.7638-09	9.3164-09	1.0739-08
13000	3.8149-09	4.8115-09	6.0198-09	7.3982-09	8.8220-09	1.0112-08
14000	3.6954-09	4.6345-09	5.7651-09	7.0446-09	8.3555-09	9.5307-09
15000	3.5709-09	4.4564-09	5.5161-09	6.7070-09	7.9185-09	8.9949-09
16000	3.4449-09	4.2808-09	5.2759-09	6.3873-09	7.5108-09	8.5012-09
17000	3.3199-09	4.1100-09	5.0462-09	6.0860-09	7.1315-09	8.0465-09
18000	3.1976-09	3.9454-09	4.8278-09	5.8031-09	6.7788-09	7.6274-09
19000	3.0790-09	3.7878-09	4.6210-09	5.5379-09	6.4512-09	7.2408-09
20000	2.9648-09	3.6375-09	4.4256-09	5.2896-09	6.1466-09	6.8838-09
21000	2.8552-09	3.4946-09	4.2414-09	5.0571-09	5.8633-09	6.5535-09
22000	2.7504-09	3.3590-09	4.0678-09	4.8394-09	5.5996-09	6.2475-09
23000	2.6505-09	3.2305-09	3.9043-09	4.6356-09	5.3539-09	5.9636-09
24000	2.5553-09	3.1088-09	3.7502-09	4.4446-09	5.1246-09	5.6997-09
25000	2.4648-09	2.9936-09	3.6051-09	4.2654-09	4.9105-09	5.4541-09
26000	2.3787-09	2.8845-09	3.4684-09	4.0973-09	4.7102-09	5.2251-09
27000	2.2969-09	2.7813-09	3.3394-09	3.9393-09	4.5226-09	5.0112-09
28000	2.2191-09	2.6835-09	3.2177-09	3.7907-09	4.3467-09	4.8111-09
29000	2.1451-09	2.5909-09	3.1028-09	3.6507-09	4.1815-09	4.6237-09
30000	2.0748-09	2.5030-09	2.9941-09	3.5189-09	4.0263-09	4.4478-09

Table 28. Rate constant for hydrogen molecule in v=5 and J=16-21 states.

T(K)	v=5, J=16	v=5, J=17	v=5, J=18	v=5, J=19	v=5, J=20	v=5, J=21
100	1.7254-17	9.6879-12	1.9278-09	1.5251-09	1.5133-09	1.1865-09
200	1.1460-12	5.2441-10	3.8336-09	3.2822-09	3.0319-09	2.6218-09
300	4.3255-11	1.9378-09	5.5045-09	4.8199-09	4.3904-09	3.8897-09
400	2.5823-10	3.7249-09	7.0002-09	6.1977-09	5.6274-09	5.0369-09
500	7.4289-10	5.5329-09	8.3504-09	7.4457-09	6.7600-09	6.0861-09
600	1.4883-09	7.2284-09	9.5740-09	8.5816-09	7.7990-09	7.0493-09
700	2.4287-09	8.7732-09	1.0685-08	9.6172-09	8.7523-09	7.9345-09
800	3.4891-09	1.0165-08	1.1694-08	1.0562-08	9.6263-09	8.7478-09
900	4.6067-09	1.1412-08	1.2610-08	1.1423-08	1.0427-08	9.4944-09
1000	5.7348-09	1.2529-08	1.3441-08	1.2208-08	1.1159-08	1.0179-08
1100	6.8414-09	1.3527-08	1.4194-08	1.2921-08	1.1828-08	1.0806-08
1200	7.9056-09	1.4420-08	1.4875-08	1.3570-08	1.2438-08	1.1379-08
1300	8.9150-09	1.5218-08	1.5491-08	1.4158-08	1.2994-08	1.1902-08
1400	9.8625-09	1.5931-08	1.6046-08	1.4691-08	1.3498-08	1.2379-08
1500	1.0745-08	1.6567-08	1.6546-08	1.5172-08	1.3956-08	1.2812-08
1600	1.1562-08	1.7134-08	1.6994-08	1.5606-08	1.4369-08	1.3205-08
1700	1.2316-08	1.7638-08	1.7395-08	1.5996-08	1.4742-08	1.3560-08
1800	1.3007-08	1.8086-08	1.7753-08	1.6345-08	1.5078-08	1.3881-08
1900	1.3639-08	1.8482-08	1.8071-08	1.6657-08	1.5379-08	1.4169-08
2000	1.4216-08	1.8831-08	1.8351-08	1.6934-08	1.5647-08	1.4427-08
2100	1.4741-08	1.9138-08	1.8598-08	1.7179-08	1.5886-08	1.4657-08
2200	1.5216-08	1.9406-08	1.8814-08	1.7394-08	1.6097-08	1.4862-08
2300	1.5646-08	1.9639-08	1.9001-08	1.7583-08	1.6283-08	1.5042-08
2400	1.6033-08	1.9840-08	1.9161-08	1.7746-08	1.6445-08	1.5201-08
2500	1.6381-08	2.0011-08	1.9297-08	1.7886-08	1.6585-08	1.5339-08
2600	1.6693-08	2.0155-08	1.9410-08	1.8005-08	1.6704-08	1.5457-08
2700	1.6971-08	2.0275-08	1.9503-08	1.8104-08	1.6806-08	1.5559-08
2800	1.7218-08	2.0372-08	1.9577-08	1.8184-08	1.6890-08	1.5644-08
2900	1.7436-08	2.0449-08	1.9633-08	1.8248-08	1.6958-08	1.5714-08
3000	1.7627-08	2.0506-08	1.9674-08	1.8297-08	1.7011-08	1.5770-08
3100	1.7794-08	2.0547-08	1.9699-08	1.8331-08	1.7051-08	1.5813-08
3200	1.7939-08	2.0571-08	1.9711-08	1.8353-08	1.7078-08	1.5844-08
3300	1.8062-08	2.0582-08	1.9711-08	1.8362-08	1.7093-08	1.5865-08
3400	1.8166-08	2.0579-08	1.9699-08	1.8360-08	1.7099-08	1.5875-08
3500	1.8252-08	2.0564-08	1.9676-08	1.8348-08	1.7094-08	1.5876-08
3600	1.8322-08	2.0538-08	1.9645-08	1.8326-08	1.7080-08	1.5868-08
3700	1.8377-08	2.0502-08	1.9604-08	1.8296-08	1.7058-08	1.5853-08
3800	1.8418-08	2.0457-08	1.9555-08	1.8258-08	1.7028-08	1.5830-08
3900	1.8446-08	2.0403-08	1.9499-08	1.8213-08	1.6992-08	1.5800-08
4000	1.8462-08	2.0341-08	1.9436-08	1.8161-08	1.6949-08	1.5764-08

Table 28. (continued)

T(K)	v=5, J=16	v=5, J=17	v=5, J=18	v=5, J=19	v=5, J=20	v=5, J=21
4100	1.8467-08	2.0273-08	1.9367-08	1.8103-08	1.6900-08	1.5723-08
4200	1.8462-08	2.0198-08	1.9292-08	1.8040-08	1.6845-08	1.5676-08
4300	1.8449-08	2.0118-08	1.9212-08	1.7971-08	1.6786-08	1.5625-08
4400	1.8426-08	2.0032-08	1.9128-08	1.7898-08	1.6722-08	1.5569-08
4500	1.8396-08	1.9942-08	1.9039-08	1.7821-08	1.6654-08	1.5509-08
4600	1.8358-08	1.9847-08	1.8947-08	1.7740-08	1.6583-08	1.5446-08
4700	1.8314-08	1.9749-08	1.8851-08	1.7655-08	1.6508-08	1.5379-08
4800	1.8264-08	1.9647-08	1.8752-08	1.7568-08	1.6429-08	1.5309-08
4900	1.8209-08	1.9541-08	1.8650-08	1.7477-08	1.6348-08	1.5237-08
5000	1.8148-08	1.9433-08	1.8546-08	1.7384-08	1.6265-08	1.5162-08
5500	1.7783-08	1.8861-08	1.7996-08	1.6889-08	1.5817-08	1.4757-08
6000	1.7344-08	1.8256-08	1.7418-08	1.6363-08	1.5337-08	1.4319-08
6500	1.6861-08	1.7639-08	1.6829-08	1.5824-08	1.4842-08	1.3865-08
7000	1.6355-08	1.7022-08	1.6242-08	1.5283-08	1.4345-08	1.3407-08
7500	1.5840-08	1.6416-08	1.5665-08	1.4751-08	1.3852-08	1.2953-08
8000	1.5326-08	1.5826-08	1.5104-08	1.4230-08	1.3370-08	1.2507-08
8500	1.4820-08	1.5256-08	1.4561-08	1.3726-08	1.2902-08	1.2074-08
9000	1.4326-08	1.4707-08	1.4039-08	1.3241-08	1.2450-08	1.1655-08
9500	1.3847-08	1.4181-08	1.3539-08	1.2774-08	1.2016-08	1.1252-08
10000	1.3384-08	1.3679-08	1.3061-08	1.2328-08	1.1600-08	1.0865-08
11000	1.2511-08	1.2742-08	1.2169-08	1.1494-08	1.0821-08	1.0140-08
12000	1.1710-08	1.1892-08	1.1360-08	1.0736-08	1.0112-08	0.94791-09
13000	1.0977-08	1.1123-08	1.0627-08	1.0048-08	0.94675-09	8.8777-09
14000	1.0308-08	1.0425-08	0.99620-09	0.94232-09	0.88818-09	8.3307-09
15000	0.96979-09	0.97916-09	0.93585-09	0.88555-09	0.83492-09	7.8329-09
16000	0.91406-09	0.92161-09	0.88097-09	0.83389-09	0.78641-09	7.3793-09
17000	0.86311-09	0.86918-09	0.83097-09	0.78678-09	0.74215-09	6.9652-09
18000	0.81645-09	0.82132-09	0.78531-09	0.74373-09	0.70168-09	6.5865-09
19000	0.77363-09	0.77752-09	0.74352-09	0.70431-09	0.66460-09	6.2393-09
20000	0.73426-09	0.73734-09	0.70517-09	0.66812-09	0.63055-09	5.9204-09
21000	0.69799-09	0.70040-09	0.66991-09	0.63482-09	0.59922-09	5.6268-09
22000	0.66451-09	0.66636-09	0.63741-09	0.60413-09	0.57032-09	5.3560-09
23000	0.63354-09	0.63493-09	0.60740-09	0.57576-09	0.54360-09	5.1056-09
24000	0.60484-09	0.60583-09	0.57961-09	0.54950-09	0.51886-09	4.8736-09
25000	0.57819-09	0.57885-09	0.55383-09	0.52513-09	0.49590-09	4.6583-09
26000	0.55339-09	0.55377-09	0.52988-09	0.50247-09	0.47455-09	4.4580-09
27000	0.53028-09	0.53043-09	0.50757-09	0.48137-09	0.45466-09	4.2715-09
28000	0.50871-09	0.50865-09	0.48676-09	0.46168-09	0.43610-09	4.0973-09
29000	0.48853-09	0.48830-09	0.46731-09	0.44328-09	0.41874-09	3.9345-09
30000	0.46963-09	0.46926-09	0.44911-09	0.42605-09	0.40250-09	3.7821-09



Table 29. Rate constant for hydrogen molecule in v=5 and J=22-23 states and v=6 and J=0-3 state

T(K)	v=5, J=22	v=5, J=23	v=6, J=0	v=6, J=1	v=6, J=2	v=6, J=3
100	1.1341-09	9.7691-10	---	---	---	---
200	2.3999-09	2.1216-09	---	---	---	---
300	3.5325-09	3.1474-09	1.9312-25	2.9964-25	6.9396-25	2.3075-24
400	4.5672-09	4.0863-09	4.6001-21	6.4174-21	1.2132-20	3.0188-20
500	5.5198-09	4.9527-09	1.8870-18	2.4697-18	4.1339-18	8.6442-18
600	6.3986-09	5.7538-09	1.0202-16	1.2798-16	1.9752-16	3.6784-16
700	7.2095-09	6.4946-09	1.7372-15	2.1139-15	3.0792-15	5.2791-15
800	7.9572-09	7.1792-09	1.4389-14	1.7116-14	2.3873-14	3.8468-14
900	8.6458-09	7.8111-09	7.3791-14	8.6241-14	1.1630-13	1.7859-13
1000	9.2791-09	8.3934-09	2.7075-13	3.1199-13	4.0956-13	6.0517-13
1100	9.8605-09	8.9292-09	7.7911-13	8.8750-13	1.1397-12	1.6318-12
1200	1.0393-08	9.4212-09	1.8692-12	2.1089-12	2.6589-12	3.7088-12
1300	1.0881-08	9.8724-09	3.9003-12	4.3649-12	5.4187-12	7.3930-12
1400	1.1326-08	1.0285-08	7.2951-12	8.1075-12	9.9323-12	1.3297-11
1500	1.1732-08	1.0662-08	1.2504-11	1.3813-11	1.6728-11	2.2031-11
1600	1.2101-08	1.1005-08	1.9966-11	2.1941-11	2.6307-11	3.4153-11
1700	1.2435-08	1.1317-08	3.0081-11	3.2904-11	3.9104-11	5.0129-11
1800	1.2738-08	1.1600-08	4.3182-11	4.7039-11	5.5467-11	7.0312-11
1900	1.3011-08	1.1855-08	5.9521-11	6.4600-11	7.5641-11	9.4930-11
2000	1.3255-08	1.2085-08	7.9265-11	8.5745-11	9.9770-11	1.2409-10
2100	1.3475-08	1.2291-08	1.0250-10	1.1055-10	1.2790-10	1.5778-10
2200	1.3670-08	1.2476-08	1.2922-10	1.3899-10	1.5997-10	1.9590-10
2300	1.3843-08	1.2639-08	1.5936-10	1.7099-10	1.9588-10	2.3826-10
2400	1.3996-08	1.2784-08	1.9281-10	2.0640-10	2.3542-10	2.8460-10
2500	1.4129-08	1.2911-08	2.2937-10	2.4503-10	2.7838-10	3.3463-10
2600	1.4245-08	1.3022-08	2.6885-10	2.8665-10	3.2447-10	3.8800-10
2700	1.4344-08	1.3118-08	3.1099-10	3.3100-10	3.7341-10	4.4436-10
2800	1.4428-08	1.3199-08	3.5555-10	3.7781-10	4.2487-10	5.0333-10
2900	1.4498-08	1.3267-08	4.0226-10	4.2679-10	4.7855-10	5.6457-10
3000	1.4554-08	1.3324-08	4.5085-10	4.7765-10	5.3413-10	6.2768-10
3100	1.4599-08	1.3368-08	5.0104-10	5.3012-10	5.9129-10	6.9234-10
3200	1.4633-08	1.3403-08	5.5258-10	5.8392-10	6.4975-10	7.5820-10
3300	1.4656-08	1.3428-08	6.0522-10	6.3879-10	7.0921-10	8.2495-10
3400	1.4670-08	1.3444-08	6.5870-10	6.9447-10	7.6942-10	8.9230-10
3500	1.4675-08	1.3452-08	7.1281-10	7.5074-10	8.3010-10	9.5996-10
3600	1.4672-08	1.3452-08	7.6733-10	8.0737-10	8.9105-10	1.0277-09
3700	1.4661-08	1.3445-08	8.2207-10	8.6415-10	9.5204-10	1.0953-09
3800	1.4643-08	1.3432-08	8.7683-10	9.2091-10	1.0129-09	1.1625-09
3900	1.4619-08	1.3413-08	9.3146-10	9.7747-10	1.0734-09	1.2291-09
4000	1.4589-08	1.3388-08	9.8580-10	1.0337-09	1.1334-09	1.2951-09

Table 29. (continued)

T(K)	v=5, J=22	v=5, J=23	v=6, J=0	v=6, J=1	v=6, J=2	v=6, J=3
4100	1.4554-08	1.3358-08	1.0397-09	1.0894-09	1.1928-09	1.3601-09
4200	1.4514-08	1.3324-08	1.0931-09	1.1445-09	1.2514-09	1.4242-09
4300	1.4469-08	1.3285-08	1.1458-09	1.1989-09	1.3092-09	1.4872-09
4400	1.4420-08	1.3242-08	1.1978-09	1.2524-09	1.3659-09	1.5490-09
4500	1.4368-08	1.3196-08	1.2489-09	1.3051-09	1.4217-09	1.6095-09
4600	1.4311-08	1.3146-08	1.2991-09	1.3568-09	1.4763-09	1.6686-09
4700	1.4252-08	1.3093-08	1.3484-09	1.4074-09	1.5297-09	1.7263-09
4800	1.4189-08	1.3038-08	1.3966-09	1.4569-09	1.5820-09	1.7826-09
4900	1.4124-08	1.2980-08	1.4437-09	1.5053-09	1.6329-09	1.8374-09
5000	1.4057-08	1.2919-08	1.4898-09	1.5526-09	1.6825-09	1.8907-09
5500	1.3691-08	1.2590-08	1.7025-09	1.7703-09	1.9104-09	2.1338-09
6000	1.3293-08	1.2230-08	1.8853-09	1.9568-09	2.1042-09	2.3385-09
6500	1.2878-08	1.1853-08	2.0389-09	2.1129-09	2.2653-09	2.5070-09
7000	1.2458-08	1.1471-08	2.1654-09	2.2410-09	2.3966-09	2.6427-09
7500	1.2040-08	1.1089-08	2.2675-09	2.3440-09	2.5012-09	2.7495-09
8000	1.1630-08	1.0714-08	2.3480-09	2.4248-09	2.5825-09	2.8311-09
8500	1.1230-08	1.0348-08	2.4098-09	2.4864-09	2.6436-09	2.8911-09
9000	1.0843-08	9.9936-09	2.4554-09	2.5314-09	2.6875-09	2.9329-09
9500	1.0470-08	9.6517-09	2.4872-09	2.5624-09	2.7167-09	2.9591-09
10000	1.0112-08	9.3232-09	2.5072-09	2.5814-09	2.7336-09	2.9724-09
11000	9.4411-09	8.7067-09	2.5191-09	2.5909-09	2.7379-09	2.9684-09
12000	8.8283-09	8.1433-09	2.5029-09	2.5718-09	2.7131-09	2.9343-09
13000	8.2702-09	7.6298-09	2.4671-09	2.5331-09	2.6684-09	2.8800-09
14000	7.7622-09	7.1622-09	2.4182-09	2.4812-09	2.6106-09	2.8125-09
15000	7.2997-09	6.7363-09	2.3606-09	2.4208-09	2.5443-09	2.7369-09
16000	6.8780-09	6.3478-09	2.2978-09	2.3552-09	2.4730-09	2.6567-09
17000	6.4929-09	5.9930-09	2.2319-09	2.2867-09	2.3991-09	2.5743-09
18000	6.1406-09	5.6682-09	2.1649-09	2.2172-09	2.3244-09	2.4915-09
19000	5.8175-09	5.3704-09	2.0977-09	2.1476-09	2.2500-09	2.4096-09
20000	5.5207-09	5.0967-09	2.0313-09	2.0790-09	2.1769-09	2.3293-09
21000	5.2473-09	4.8446-09	1.9663-09	2.0119-09	2.1054-09	2.2512-09
22000	4.9951-09	4.6120-09	1.9030-09	1.9466-09	2.0361-09	2.1756-09
23000	4.7619-09	4.3968-09	1.8416-09	1.8834-09	1.9692-09	2.1027-09
24000	4.5459-09	4.1975-09	1.7824-09	1.8225-09	1.9047-09	2.0327-09
25000	4.3453-09	4.0124-09	1.7254-09	1.7639-09	1.8428-09	1.9656-09
26000	4.1587-09	3.8402-09	1.6707-09	1.7076-09	1.7834-09	1.9013-09
27000	3.9848-09	3.6798-09	1.6182-09	1.6536-09	1.7265-09	1.8398-09
28000	3.8225-09	3.5300-09	1.5678-09	1.6020-09	1.6720-09	1.7810-09
29000	3.6708-09	3.3900-09	1.5196-09	1.5525-09	1.6199-09	1.7248-09
30000	3.5287-09	3.2588-09	1.4734-09	1.5051-09	1.5701-09	1.6712-09

Table 30. Rate constant for hydrogen molecule in v=6 and J=4-9 states.

T(K)	v=6, J=4	v=6, J=5	v=6, J=6	v=6, J=7	v=6, J=8	v=6, J=9
100	---	---	---	---	---	---
200	---	---	8.5299-29	4.3459-27	3.3008-25	3.9050-23
300	1.1840-23	8.6448-23	8.8911-22	1.2410-20	2.2552-19	5.4742-18
400	1.0424-19	4.6974-19	2.7358-18	2.0002-17	1.7790-16	1.9578-15
500	2.3538-17	7.9423-17	3.2902-16	1.6330-15	9.4656-15	6.4845-14
600	8.5500-16	2.3793-15	7.8567-15	3.0134-14	1.3136-13	6.5642-13
700	1.0960-14	2.6580-14	7.4663-14	2.3830-13	8.4781-13	3.3834-12
800	7.3382-14	1.6054-13	3.9952-13	1.1113-12	3.3961-12	1.1453-11
900	3.1899-13	6.4420-13	1.4592-12	3.6480-12	9.9073-12	2.9323-11
1000	1.0256-12	1.9428-12	4.0822-12	9.3719-12	2.3166-11	6.1778-11
1100	2.6492-12	4.7629-12	9.4122-12	2.0156-11	4.6137-11	1.1301-10
1200	5.8096-12	1.0000-11	1.8778-11	3.7953-11	8.1498-11	1.8601-10
1300	1.1236-11	1.8642-11	3.3529-11	6.4536-11	1.3131-10	2.8236-10
1400	1.9692-11	3.1661-11	5.4880-11	1.0131-10	1.9685-10	4.0228-10
1500	3.1905-11	4.9917-11	8.3806-11	1.4922-10	2.7862-10	5.4487-10
1600	4.8501-11	7.4099-11	1.2098-10	2.0873-10	3.7641-10	7.0840-10
1700	6.9972-11	1.0468-10	1.6677-10	2.7985-10	4.8946-10	8.9057-10
1800	9.6654-11	1.4194-10	2.2124-10	3.6222-10	6.1657-10	1.0888-09
1900	1.2872-10	1.8591-10	2.8420-10	4.5517-10	7.5626-10	1.3003-09
2000	1.6620-10	2.3648-10	3.5524-10	5.5782-10	9.0689-10	1.5224-09
2100	2.0899-10	2.9338-10	4.3380-10	6.6914-10	1.0667-09	1.7524-09
2200	2.5688-10	3.5621-10	5.1920-10	7.8802-10	1.2341-09	1.9881-09
2300	3.0956-10	4.2449-10	6.1068-10	9.1331-10	1.4074-09	2.2271-09
2400	3.6668-10	4.9769-10	7.0747-10	1.0439-09	1.5849-09	2.4675-09
2500	4.2780-10	5.7523-10	8.0875-10	1.1786-09	1.7653-09	2.7077-09
2600	4.9251-10	6.5652-10	9.1374-10	1.3165-09	1.9474-09	2.9460-09
2700	5.6034-10	7.4097-10	1.0217-09	1.4566-09	2.1298-09	3.1813-09
2800	6.3084-10	8.2802-10	1.1318-09	1.5980-09	2.3115-09	3.4125-09
2900	7.0357-10	9.1712-10	1.2435-09	1.7398-09	2.4918-09	3.6386-09
3000	7.7809-10	1.0077-09	1.3562-09	1.8814-09	2.6697-09	3.8590-09
3100	8.5399-10	1.0994-09	1.4692-09	2.0221-09	2.8447-09	4.0731-09
3200	9.3090-10	1.1917-09	1.5820-09	2.1614-09	3.0162-09	4.2804-09
3300	1.0084-09	1.2842-09	1.6943-09	2.2988-09	3.1836-09	4.4806-09
3400	1.0863-09	1.3765-09	1.8056-09	2.4339-09	3.3467-09	4.6735-09
3500	1.1642-09	1.4682-09	1.9155-09	2.5662-09	3.5051-09	4.8589-09
3600	1.2418-09	1.5592-09	2.0237-09	2.6956-09	3.6586-09	5.0368-09
3700	1.3189-09	1.6491-09	2.1300-09	2.8217-09	3.8070-09	5.2070-09
3800	1.3953-09	1.7377-09	2.2342-09	2.9444-09	3.9502-09	5.3696-09
3900	1.4707-09	1.8249-09	2.3360-09	3.0636-09	4.0881-09	5.5247-09
4000	1.5451-09	1.9104-09	2.4353-09	3.1790-09	4.2207-09	5.6724-09

Table 30. (continued)

T(K)	v=6, J=4	v=6, J=5	v=6, J=6	v=6, J=7	v=6, J=8	v=6, J=9
4100	1.6182-09	1.9940-09	2.5320-09	3.2907-09	4.3480-09	5.8128-09
4200	1.6900-09	2.0758-09	2.6259-09	3.3985-09	4.4699-09	5.9461-09
4300	1.7602-09	2.1555-09	2.7171-09	3.5024-09	4.5866-09	6.0724-09
4400	1.8290-09	2.2331-09	2.8053-09	3.6025-09	4.6981-09	6.1919-09
4500	1.8960-09	2.3086-09	2.8907-09	3.6987-09	4.8045-09	6.3048-09
4600	1.9614-09	2.3818-09	2.9732-09	3.7910-09	4.9058-09	6.4113-09
4700	2.0250-09	2.4528-09	3.0528-09	3.8795-09	5.0023-09	6.5117-09
4800	2.0868-09	2.5215-09	3.1294-09	3.9643-09	5.0939-09	6.6061-09
4900	2.1468-09	2.5879-09	3.2031-09	4.0454-09	5.1809-09	6.6947-09
5000	2.2050-09	2.6521-09	3.2740-09	4.1228-09	5.2634-09	6.7778-09
5500	2.4681-09	2.9392-09	3.5867-09	4.4584-09	5.6122-09	7.1170-09
6000	2.6865-09	3.1730-09	3.8348-09	4.7160-09	5.8676-09	7.3473-09
6500	2.8635-09	3.3586-09	4.0264-09	4.9070-09	6.0456-09	7.4901-09
7000	3.0037-09	3.5021-09	4.1695-09	5.0424-09	6.1607-09	7.5638-09
7500	3.1118-09	3.6095-09	4.2718-09	5.1318-09	6.2248-09	7.5832-09
8000	3.1923-09	3.6862-09	4.3400-09	5.1835-09	6.2482-09	7.5603-09
8500	3.2494-09	3.7374-09	4.3801-09	5.2048-09	6.2393-09	7.5047-09
9000	3.2867-09	3.7671-09	4.3970-09	5.2014-09	6.2049-09	7.4240-09
9500	3.3076-09	3.7792-09	4.3952-09	5.1783-09	6.1505-09	7.3245-09
10000	3.3148-09	3.7768-09	4.3781-09	5.1395-09	6.0806-09	7.2109-09
11000	3.2970-09	3.7384-09	4.3094-09	5.0274-09	5.9082-09	6.9560-09
12000	3.2483-09	3.6684-09	4.2091-09	4.8851-09	5.7092-09	6.6816-09
13000	3.1792-09	3.5783-09	4.0896-09	4.7259-09	5.4972-09	6.4013-09
14000	3.0973-09	3.4761-09	3.9595-09	4.5585-09	5.2814-09	6.1237-09
15000	3.0078-09	3.3671-09	3.8243-09	4.3888-09	5.0673-09	5.8537-09
16000	2.9143-09	3.2554-09	3.6881-09	4.2206-09	4.8584-09	5.5944-09
17000	2.8195-09	3.1434-09	3.5532-09	4.0563-09	4.6569-09	5.3472-09
18000	2.7250-09	3.0328-09	3.4215-09	3.8974-09	4.4640-09	5.1129-09
19000	2.6320-09	2.9249-09	3.2939-09	3.7447-09	4.2803-09	4.8915-09
20000	2.5414-09	2.8203-09	3.1711-09	3.5988-09	4.1058-09	4.6827-09
21000	2.4536-09	2.7195-09	3.0535-09	3.4598-09	3.9405-09	4.4860-09
22000	2.3690-09	2.6228-09	2.9411-09	3.3277-09	3.7842-09	4.3010-09
23000	2.2877-09	2.5302-09	2.8339-09	3.2022-09	3.6364-09	4.1269-09
24000	2.2098-09	2.4418-09	2.7319-09	3.0832-09	3.4968-09	3.9630-09
25000	2.1353-09	2.3574-09	2.6348-09	2.9705-09	3.3649-09	3.8088-09
26000	2.0641-09	2.2770-09	2.5426-09	2.8636-09	3.2403-09	3.6635-09
27000	1.9961-09	2.2004-09	2.4550-09	2.7623-09	3.1226-09	3.5266-09
28000	1.9313-09	2.1274-09	2.3717-09	2.6663-09	3.0112-09	3.3975-09
29000	1.8694-09	2.0579-09	2.2926-09	2.5752-09	2.9059-09	3.2756-09
30000	1.8103-09	1.9918-09	2.2173-09	2.4888-09	2.8062-09	3.1605-09

Table 31. Rate constant for hydrogen molecule in v=6 and J=10-15 states.

T(K)	v=6, J=10	v=6, J=11	v=6, J=12	v=6, J=13	v=6, J=14	v=6, J=15
100	---	1.3861-29	1.1367-24	1.1202-19	1.4142-14	6.0797-10
200	6.2370-21	1.3323-18	3.5220-16	9.4912-14	2.4946-11	2.4885-09
300	1.6021-16	5.5798-15	2.1883-13	8.3299-12	2.8566-10	4.2423-09
400	2.4576-14	3.4644-13	5.2488-12	7.5575-11	9.4983-10	5.7709-09
500	4.9045-13	4.0259-12	3.4550-11	2.7884-10	1.9386-09	7.1202-09
600	3.5450-12	2.0321-11	1.1961-10	6.5840-10	3.1073-09	8.3261-09
700	1.4375-11	6.3833-11	2.8744-10	1.2068-09	4.3424-09	9.4118-09
800	4.0671-11	1.4927-10	5.5049-10	1.8901-09	5.5722-09	1.0393-08
900	9.0609-11	2.8694-10	9.0692-10	2.6672-09	6.7559-09	1.1283-08
1000	1.7087-10	4.8118-10	1.3454-09	3.5002-09	7.8720-09	1.2090-08
1100	2.8556-10	7.3088-10	1.8498-09	4.3581-09	8.9110-09	1.2821-08
1200	4.3605-10	1.0311-09	2.4032-09	5.2173-09	9.8701-09	1.3485-08
1300	6.2133-10	1.3744-09	2.9893-09	6.0607-09	1.0750-08	1.4086-08
1400	8.3866-10	1.7527-09	3.5940-09	6.8764-09	1.1555-08	1.4630-08
1500	1.0842-09	2.1574-09	4.2056-09	7.6564-09	1.2287-08	1.5121-08
1600	1.3534-09	2.5808-09	4.8144-09	8.3959-09	1.2953-08	1.5564-08
1700	1.6417-09	3.0156-09	5.4130-09	9.0922-09	1.3557-08	1.5962-08
1800	1.9446-09	3.4558-09	5.9957-09	9.7443-09	1.4103-08	1.6319-08
1900	2.2578-09	3.8959-09	6.5583-09	1.0352-08	1.4596-08	1.6638-08
2000	2.5774-09	4.3318-09	7.0979-09	1.0916-08	1.5039-08	1.6922-08
2100	2.9001-09	4.7598-09	7.6126-09	1.1439-08	1.5438-08	1.7174-08
2200	3.2229-09	5.1772-09	8.1010-09	1.1920-08	1.5796-08	1.7397-08
2300	3.5432-09	5.5819-09	8.5627-09	1.2363-08	1.6115-08	1.7592-08
2400	3.8590-09	5.9722-09	8.9976-09	1.2770-08	1.6399-08	1.7761-08
2500	4.1686-09	6.3471-09	9.4058-09	1.3142-08	1.6651-08	1.7908-08
2600	4.4704-09	6.7056-09	9.7879-09	1.3482-08	1.6873-08	1.8032-08
2700	4.7635-09	7.0474-09	1.0145-08	1.3791-08	1.7069-08	1.8137-08
2800	5.0469-09	7.3722-09	1.0477-08	1.4072-08	1.7239-08	1.8224-08
2900	5.3201-09	7.6800-09	1.0785-08	1.4325-08	1.7386-08	1.8294-08
3000	5.5826-09	7.9709-09	1.1071-08	1.4554-08	1.7512-08	1.8348-08
3100	5.8340-09	8.2453-09	1.1335-08	1.4760-08	1.7618-08	1.8388-08
3200	6.0743-09	8.5034-09	1.1579-08	1.4944-08	1.7706-08	1.8415-08
3300	6.3035-09	8.7457-09	1.1803-08	1.5108-08	1.7778-08	1.8429-08
3400	6.5214-09	8.9728-09	1.2009-08	1.5253-08	1.7835-08	1.8432-08
3500	6.7283-09	9.1850-09	1.2197-08	1.5380-08	1.7878-08	1.8425-08
3600	6.9244-09	9.3831-09	1.2368-08	1.5491-08	1.7908-08	1.8409-08
3700	7.1098-09	9.5675-09	1.2525-08	1.5587-08	1.7926-08	1.8384-08
3800	7.2849-09	9.7389-09	1.2666-08	1.5669-08	1.7933-08	1.8350-08
3900	7.4499-09	9.8977-09	1.2794-08	1.5738-08	1.7930-08	1.8310-08
4000	7.6050-09	1.0045-08	1.2908-08	1.5795-08	1.7918-08	1.8262-08

Table 31. (continued)

T(K)	v=6, J=10	v=6, J=11	v=6, J=12	v=6, J=13	v=6, J=14	v=6, J=15
4100	7.7508-09	1.0180-08	1.3010-08	1.5840-08	1.7897-08	1.8209-08
4200	7.8874-09	1.0305-08	1.3101-08	1.5875-08	1.7869-08	1.8150-08
4300	8.0152-09	1.0420-08	1.3181-08	1.5900-08	1.7834-08	1.8085-08
4400	8.1346-09	1.0524-08	1.3251-08	1.5917-08	1.7792-08	1.8016-08
4500	8.2459-09	1.0620-08	1.3312-08	1.5925-08	1.7744-08	1.7943-08
4600	8.3495-09	1.0707-08	1.3363-08	1.5925-08	1.7690-08	1.7865-08
4700	8.4456-09	1.0785-08	1.3407-08	1.5918-08	1.7632-08	1.7784-08
4800	8.5346-09	1.0856-08	1.3442-08	1.5905-08	1.7568-08	1.7700-08
4900	8.6168-09	1.0919-08	1.3470-08	1.5885-08	1.7501-08	1.7613-08
5000	8.6925-09	1.0975-08	1.3492-08	1.5859-08	1.7430-08	1.7523-08
5500	8.9841-09	1.1163-08	1.3510-08	1.5661-08	1.7027-08	1.7043-08
6000	9.1543-09	1.1226-08	1.3413-08	1.5374-08	1.6571-08	1.6528-08
6500	9.2306-09	1.1195-08	1.3235-08	1.5028-08	1.6084-08	1.5999-08
7000	9.2350-09	1.1097-08	1.3001-08	1.4647-08	1.5584-08	1.5466-08
7500	9.1848-09	1.0949-08	1.2729-08	1.4245-08	1.5081-08	1.4939-08
8000	9.0935-09	1.0765-08	1.2433-08	1.3833-08	1.4583-08	1.4424-08
8500	8.9717-09	1.0556-08	1.2122-08	1.3420-08	1.4096-08	1.3923-08
9000	8.8277-09	1.0331-08	1.1803-08	1.3010-08	1.3622-08	1.3440-08
9500	8.6676-09	1.0096-08	1.1482-08	1.2607-08	1.3163-08	1.2975-08
10000	8.4967-09	9.8549-09	1.1163-08	1.2215-08	1.2722-08	1.2529-08
11000	8.1363-09	9.3685-09	1.0539-08	1.1465-08	1.1892-08	1.1695-08
12000	7.7679-09	8.8909-09	9.9455-09	1.0768-08	1.1131-08	1.0935-08
13000	7.4041-09	8.4321-09	9.3879-09	1.0124-08	1.0436-08	1.0243-08
14000	7.0523-09	7.9972-09	8.8682-09	9.5317-09	9.8025-09	9.6140-09
15000	6.7162-09	7.5882-09	8.3858-09	8.9875-09	9.2246-09	9.0416-09
16000	6.3978-09	7.2055-09	7.9392-09	8.4879-09	8.6969-09	8.5199-09
17000	6.0977-09	6.8483-09	7.5261-09	8.0288-09	8.2144-09	8.0436-09
18000	5.8157-09	6.5155-09	7.1439-09	7.6067-09	7.7724-09	7.6079-09
19000	5.5513-09	6.2056-09	6.7903-09	7.2180-09	7.3668-09	7.2084-09
20000	5.3036-09	5.9170-09	6.4627-09	6.8596-09	6.9938-09	6.8414-09
21000	5.0716-09	5.6482-09	6.1590-09	6.5284-09	6.6501-09	6.5034-09
22000	4.8544-09	5.3976-09	5.8770-09	6.2219-09	6.3327-09	6.1916-09
23000	4.6509-09	5.1638-09	5.6148-09	5.9378-09	6.0390-09	5.9032-09
24000	4.4601-09	4.9453-09	5.3707-09	5.6739-09	5.7667-09	5.6360-09
25000	4.2811-09	4.7411-09	5.1430-09	5.4284-09	5.5138-09	5.3879-09
26000	4.1130-09	4.5498-09	4.9305-09	5.1997-09	5.2785-09	5.1571-09
27000	3.9551-09	4.3705-09	4.7317-09	4.9861-09	5.0591-09	4.9420-09
28000	3.8065-09	4.2023-09	4.5455-09	4.7865-09	4.8542-09	4.7413-09
29000	3.6665-09	4.0442-09	4.3709-09	4.5995-09	4.6625-09	4.5535-09
30000	3.5346-09	3.8954-09	4.2069-09	4.4242-09	4.4830-09	4.3777-09

Table 32. Rate constant for hydrogen molecule in v=6 and J= [6-21] states.

T(K)	v=6, J=16	v=6, J=17	v=6, J=18	v=6, J=19	v=6, J=20	v=6, J=21
100	1.4069-09	1.3439-09	1.2448-09	1.1447-09	1.0455-09	9.4387-10
200	3.0196-09	2.7861-09	2.5427-09	2.3219-09	2.1135-09	1.9082-09
300	4.4356-09	4.0710-09	3.7132-09	3.3894-09	3.0851-09	2.7885-09
400	5.7093-09	5.2387-09	4.7860-09	4.3734-09	3.9843-09	3.6048-09
500	6.8676-09	6.3082-09	5.7742-09	5.2838-09	4.8189-09	4.3639-09
600	7.9257-09	7.2904-09	6.6859-09	6.1266-09	5.5936-09	5.0698-09
700	8.8938-09	8.1931-09	7.5268-09	6.9063-09	6.3119-09	5.7255-09
800	9.7799-09	9.0225-09	8.3019-09	7.6268-09	6.9771-09	6.3337-09
900	1.0591-08	9.7838-09	9.0154-09	8.2917-09	7.5922-09	6.8971-09
1000	1.1332-08	1.0482-08	9.6715-09	8.9045-09	8.1602-09	7.4180-09
1100	1.2008-08	1.1121-08	1.0274-08	9.4683-09	8.6838-09	7.8990-09
1200	1.2625-08	1.1706-08	1.0826-08	9.9863-09	9.1656-09	8.3423-09
1300	1.3187-08	1.2240-08	1.1332-08	1.0461-08	9.6082-09	8.7500-09
1400	1.3697-08	1.2726-08	1.1793-08	1.0896-08	1.0014-08	9.1244-09
1500	1.4160-08	1.3168-08	1.2214-08	1.1293-08	1.0385-08	9.4676-09
1600	1.4579-08	1.3570-08	1.2597-08	1.1655-08	1.0725-08	9.7813-09
1700	1.4958-08	1.3933-08	1.2945-08	1.1985-08	1.1034-08	1.0068-08
1800	1.5298-08	1.4262-08	1.3259-08	1.2284-08	1.1314-08	1.0328-08
1900	1.5604-08	1.4557-08	1.3543-08	1.2554-08	1.1569-08	1.0565-08
2000	1.5877-08	1.4822-08	1.3799-08	1.2798-08	1.1799-08	1.0779-08
2100	1.6121-08	1.5059-08	1.4028-08	1.3017-08	1.2006-08	1.0972-08
2200	1.6336-08	1.5270-08	1.4232-08	1.3213-08	1.2192-08	1.1145-08
2300	1.6526-08	1.5456-08	1.4414-08	1.3388-08	1.2358-08	1.1300-08
2400	1.6693-08	1.5620-08	1.4574-08	1.3542-08	1.2505-08	1.1439-08
2500	1.6837-08	1.5763-08	1.4715-08	1.3679-08	1.2636-08	1.1561-08
2600	1.6961-08	1.5887-08	1.4838-08	1.3798-08	1.2750-08	1.1669-08
2700	1.7066-08	1.5993-08	1.4943-08	1.3902-08	1.2849-08	1.1763-08
2800	1.7154-08	1.6083-08	1.5033-08	1.3990-08	1.2935-08	1.1844-08
2900	1.7226-08	1.6157-08	1.5109-08	1.4065-08	1.3008-08	1.1914-08
3000	1.7283-08	1.6217-08	1.5171-08	1.4127-08	1.3069-08	1.1972-08
3100	1.7326-08	1.6264-08	1.5220-08	1.4178-08	1.3119-08	1.2021-08
3200	1.7357-08	1.6299-08	1.5258-08	1.4217-08	1.3159-08	1.2059-08
3300	1.7376-08	1.6323-08	1.5286-08	1.4247-08	1.3189-08	1.2089-08
3400	1.7385-08	1.6336-08	1.5303-08	1.4267-08	1.3211-08	1.2111-08
3500	1.7383-08	1.6340-08	1.5311-08	1.4278-08	1.3224-08	1.2126-08
3600	1.7373-08	1.6335-08	1.5311-08	1.4281-08	1.3230-08	1.2133-08
3700	1.7354-08	1.6322-08	1.5303-08	1.4277-08	1.3228-08	1.2134-08
3800	1.7327-08	1.6302-08	1.5288-08	1.4266-08	1.3221-08	1.2128-08
3900	1.7293-08	1.6274-08	1.5266-08	1.4249-08	1.3207-08	1.2118-08
4000	1.7253-08	1.6241-08	1.5238-08	1.4226-08	1.3188-08	1.2102-08

Table 32. (continued)

T(K)	v=6, J=16	v=6, J=17	v=6, J=18	v=6, J=19	v=6, J=20	v=6, J=21
4100	1.7206-08	1.6201-08	1.5205-08	1.4197-08	1.3164-08	1.2081-08
4200	1.7154-08	1.6156-08	1.5166-08	1.4164-08	1.3135-08	1.2056-08
4300	1.7097-08	1.6106-08	1.5122-08	1.4126-08	1.3101-08	1.2027-08
4400	1.7036-08	1.6052-08	1.5075-08	1.4084-08	1.3064-08	1.1994-08
4500	1.6970-08	1.5993-08	1.5023-08	1.4037-08	1.3023-08	1.1958-08
4600	1.6900-08	1.5931-08	1.4967-08	1.3988-08	1.2979-08	1.1918-08
4700	1.6827-08	1.5865-08	1.4908-08	1.3935-08	1.2931-08	1.1876-08
4800	1.6750-08	1.5796-08	1.4846-08	1.3879-08	1.2881-08	1.1831-08
4900	1.6671-08	1.5724-08	1.4781-08	1.3820-08	1.2828-08	1.1784-08
5000	1.6589-08	1.5650-08	1.4713-08	1.3759-08	1.2773-08	1.1734-08
5500	1.6148-08	1.5246-08	1.4345-08	1.3423-08	1.2468-08	1.1458-08
6000	1.5672-08	1.4808-08	1.3942-08	1.3053-08	1.2129-08	1.1151-08
6500	1.5179-08	1.4351-08	1.3520-08	1.2664-08	1.1772-08	1.0826-08
7000	1.4682-08	1.3889-08	1.3091-08	1.2267-08	1.1407-08	1.0493-08
7500	1.4189-08	1.3429-08	1.2662-08	1.1870-08	1.1041-08	1.0158-08
8000	1.3705-08	1.2976-08	1.2241-08	1.1478-08	1.0680-08	9.8273-09
8500	1.3235-08	1.2536-08	1.1829-08	1.1096-08	1.0326-08	9.5032-09
9000	1.2780-08	1.2109-08	1.1430-08	1.0724-08	9.9817-09	9.1879-09
9500	1.2342-08	1.1698-08	1.1045-08	1.0365-08	9.6491-09	8.8829-09
10000	1.1921-08	1.1302-08	1.0674-08	1.0019-08	9.3286-09	8.5888-09
11000	1.1133-08	1.0560-08	9.9776-09	9.3685-09	8.7255-09	8.0350-09
12000	1.0414-08	9.8819-09	9.3401-09	8.7726-09	8.1723-09	7.5267-09
13000	9.7588-09	9.2635-09	8.7583-09	8.2282-09	7.6666-09	7.0619-09
14000	9.1625-09	8.7000-09	8.2278-09	7.7314-09	7.2049-09	6.6373-09
15000	8.6193-09	8.1865-09	7.7439-09	7.2781-09	6.7833-09	6.2495-09
16000	8.1240-09	7.7178-09	7.3021-09	6.8639-09	6.3981-09	5.8950-09
17000	7.6715-09	7.2895-09	6.8980-09	6.4850-09	6.0455-09	5.5705-09
18000	7.2574-09	6.8972-09	6.5279-09	6.1378-09	5.7223-09	5.2730-09
19000	6.8775-09	6.5372-09	6.1881-09	5.8190-09	5.4255-09	4.9997-09
20000	6.5284-09	6.2063-09	5.8756-09	5.5256-09	5.1524-09	4.7482-09
21000	6.2068-09	5.9013-09	5.5875-09	5.2552-09	4.9005-09	4.5163-09
22000	5.9099-09	5.6198-09	5.3215-09	5.0054-09	4.6679-09	4.3020-09
23000	5.6354-09	5.3593-09	5.0753-09	4.7742-09	4.4525-09	4.1036-09
24000	5.3809-09	5.1178-09	4.8470-09	4.5598-09	4.2527-09	3.9196-09
25000	5.1445-09	4.8934-09	4.6349-09	4.3605-09	4.0670-09	3.7485-09
26000	4.9246-09	4.6847-09	4.4375-09	4.1750-09	3.8942-09	3.5893-09
27000	4.7197-09	4.4901-09	4.2535-09	4.0021-09	3.7330-09	3.4408-09
28000	4.5283-09	4.3083-09	4.0816-09	3.8405-09	3.5824-09	3.3021-09
29000	4.3493-09	4.1383-09	3.9208-09	3.6894-09	3.4415-09	3.1722-09
30000	4.1817-09	3.9790-09	3.7701-09	3.5477-09	3.3095-09	3.0506-09

Table 33. Rate constant for hydrogen molecule in  $v=6$  and  $J=22$  states and  $v=7$  and  $J=0-4$  states.

T(K)	$v=6, J=22$	$v=7, J=0$	$v=7, J=1$	$v=7, J=2$	$v=7, J=3$	$v=7, J=4$
100	7.6531-10	---	---	---	---	---
200	1.6463-09	1.9765-25	3.5373-25	1.0692-24	5.7615-24	5.2065-23
300	2.4460-09	1.5779-19	2.3276-19	4.8738-19	1.4999-18	6.5075-18
400	3.1843-09	1.3461-16	1.8029-16	3.1427-16	7.3113-16	2.1989-15
500	3.8698-09	7.5083-15	9.4916-15	1.4823-14	2.9163-14	7.0426-14
600	4.5072-09	1.0755-13	1.3083-13	1.8991-13	3.3419-13	6.9738-13
700	5.0996-09	7.1018-13	8.4049-13	1.1581-12	1.8822-12	3.5394-12
800	5.6496-09	2.8942-12	3.3557-12	4.4469-12	6.8097-12	1.1846-11
900	6.1595-09	8.5584-12	9.7660-12	1.2556-11	1.8360-11	3.0068-11
1000	6.6316-09	2.0231-11	2.2794-11	2.8608-11	4.0320-11	6.2925-11
1100	7.0679-09	4.0657-11	4.5336-11	5.5789-11	7.6302-11	1.1449-10
1200	7.4704-09	7.2366-11	8.0001-11	9.6850-11	1.2919-10	1.8764-10
1300	7.8412-09	1.1735-10	1.2879-10	1.5378-10	2.0087-10	2.8381-10
1400	8.1820-09	1.7692-10	1.9296-10	2.2770-10	2.9212-10	4.0314-10
1500	8.4947-09	2.5165-10	2.7300-10	3.1888-10	4.0277-10	5.4469-10
1600	8.7810-09	3.4146-10	3.6870-10	4.2685-10	5.3190-10	7.0667-10
1700	9.0425-09	4.4574-10	4.7932-10	5.5059-10	6.7796-10	8.8682-10
1800	9.2808-09	5.6346-10	6.0370-10	6.8868-10	8.3908-10	1.0825-09
1900	9.4974-09	6.9331-10	7.4040-10	8.3942-10	1.0131-09	1.2911-09
2000	9.6937-09	8.3380-10	8.8783-10	1.0010-09	1.1980-09	1.5100-09
2100	9.8710-09	9.8336-10	1.0443-09	1.1716-09	1.3915-09	1.7365-09
2200	1.0031-08	1.1404-09	1.2082-09	1.3493-09	1.5915-09	1.9683-09
2300	1.0174-08	1.3034-09	1.3779-09	1.5325-09	1.7962-09	2.2033-09
2400	1.0301-08	1.4709-09	1.5519-09	1.7194-09	2.0039-09	2.4396-09
2500	1.0415-08	1.6415-09	1.7287-09	1.9088-09	2.2128-09	2.6756-09
2600	1.0514-08	1.8140-09	1.9072-09	2.0991-09	2.4217-09	2.9097-09
2700	1.0602-08	1.9873-09	2.0861-09	2.2893-09	2.6293-09	3.1407-09
2800	1.0678-08	2.1604-09	2.2645-09	2.4783-09	2.8346-09	3.3677-09
2900	1.0743-08	2.3323-09	2.4415-09	2.6652-09	3.0367-09	3.5898-09
3000	1.0798-08	2.5024-09	2.6163-09	2.8493-09	3.2348-09	3.8062-09
3100	1.0844-08	2.6700-09	2.7882-09	3.0299-09	3.4284-09	4.0164-09
3200	1.0881-08	2.8345-09	2.9568-09	3.2065-09	3.6168-09	4.2200-09
3300	1.0910-08	2.9955-09	3.1215-09	3.3786-09	3.7998-09	4.4166-09
3400	1.0931-08	3.1525-09	3.2821-09	3.5460-09	3.9770-09	4.6061-09
3500	1.0946-08	3.3053-09	3.4381-09	3.7082-09	4.1482-09	4.7882-09
3600	1.0954-08	3.4536-09	3.5893-09	3.8651-09	4.3133-09	4.9629-09
3700	1.0957-08	3.5973-09	3.7356-09	4.0166-09	4.4720-09	5.1302-09
3800	1.0954-08	3.7362-09	3.8769-09	4.1625-09	4.6244-09	5.2901-09
3900	1.0945-08	3.8702-09	4.0130-09	4.3029-09	4.7705-09	5.4427-09
4000	1.0932-08	3.9992-09	4.1440-09	4.4376-09	4.9103-09	5.5880-09

Table 33. (continued)

T(K)	$v=6, J=22$	$v=7, J=0$	$v=7, J=1$	$v=7, J=2$	$v=7, J=3$	$v=7, J=4$
4100	1.0915-08	4.1232-09	4.2698-09	4.5668-09	5.0438-09	5.7262-09
4200	1.0894-08	4.2423-09	4.3904-09	4.6903-09	5.1712-09	5.8574-09
4300	1.0868-08	4.3565-09	4.5059-09	4.8084-09	5.2925-09	5.9818-09
4400	1.0840-08	4.4657-09	4.6163-09	4.9211-09	5.4079-09	6.0995-09
4500	1.0808-08	4.5701-09	4.7218-09	5.0284-09	5.5175-09	6.2109-09
4600	1.0774-08	4.6698-09	4.8223-09	5.1306-09	5.6214-09	6.3160-09
4700	1.0736-08	4.7648-09	4.9181-09	5.2277-09	5.7199-09	6.4150-09
4800	1.0697-08	4.8553-09	5.0091-09	5.3198-09	5.8130-09	6.5082-09
4900	1.0655-08	4.9413-09	5.0956-09	5.4072-09	5.9009-09	6.5958-09
5000	1.0611-08	5.0230-09	5.1777-09	5.4898-09	5.9838-09	6.6779-09
5500	1.0365-08	5.3708-09	5.5257-09	5.8381-09	6.3292-09	7.0141-09
6000	1.0090-08	5.6288-09	5.7821-09	6.0911-09	6.5741-09	7.2436-09
6500	9.7984-09	5.8119-09	5.9624-09	6.2655-09	6.7371-09	7.3873-09
7000	9.4988-09	5.9335-09	6.0805-09	6.3761-09	6.8342-09	7.4630-09
7500	9.1976-09	6.0053-09	6.1481-09	6.4354-09	6.8788-09	7.4852-09
8000	8.8994-09	6.0370-09	6.1754-09	6.4538-09	6.8820-09	7.4656-09
8500	8.6069-09	6.0366-09	6.1705-09	6.4397-09	6.8526-09	7.4137-09
9000	8.3223-09	6.0107-09	6.1400-09	6.4001-09	6.7979-09	7.3369-09
9500	8.0468-09	5.9648-09	6.0895-09	6.3406-09	6.7236-09	7.2413-09
10000	7.7810-09	5.9031-09	6.0235-09	6.2657-09	6.6343-09	7.1316-09
11000	7.2803-09	5.7464-09	5.8583-09	6.0837-09	6.4253-09	6.8843-09
12000	6.8205-09	5.5616-09	5.6658-09	5.8756-09	6.1924-09	6.6169-09
13000	6.3997-09	5.3626-09	5.4596-09	5.6552-09	5.9497-09	6.3431-09
14000	6.0153-09	5.1583-09	5.2489-09	5.4315-09	5.7057-09	6.0712-09
15000	5.6642-09	4.9545-09	5.0392-09	5.2100-09	5.4660-09	5.8065-09
16000	5.3431-09	4.7549-09	4.8342-09	4.9944-09	5.2339-09	5.5518-09
17000	5.0492-09	4.5617-09	4.6362-09	4.7866-09	5.0111-09	5.3088-09
18000	4.7796-09	4.3761-09	4.4462-09	4.5878-09	4.7988-09	5.0781-09
19000	4.5320-09	4.1990-09	4.2650-09	4.3986-09	4.5973-09	4.8600-09
20000	4.3041-09	4.0304-09	4.0928-09	4.2190-09	4.4065-09	4.6541-09
21000	4.0940-09	3.8705-09	3.9295-09	4.0490-09	4.2262-09	4.4601-09
22000	3.8998-09	3.7190-09	3.7749-09	3.8882-09	4.0561-09	4.2774-09
23000	3.7199-09	3.5756-09	3.6287-09	3.7363-09	3.8956-09	4.1053-09
24000	3.5532-09	3.4399-09	3.4904-09	3.5928-09	3.7442-09	3.9434-09
25000	3.3981-09	3.3116-09	3.3598-09	3.4573-09	3.6014-09	3.7908-09
26000	3.2538-09	3.1903-09	3.2362-09	3.3293-09	3.4666-09	3.6471-09
27000	3.1192-09	3.0755-09	3.1194-09	3.2083-09	3.3394-09	3.5115-09
28000	2.9934-09	2.9669-09	3.0088-09	3.0939-09	3.2192-09	3.3837-09
29000	2.8758-09	2.8641-09	2.9042-09	2.9857-09	3.1056-09	3.2629-09
30000	2.7655-09	2.7666-09	2.8051-09	2.8832-09	2.9981-09	3.1488-09

Table 34. Rate constant for hydrogen molecule in  $v=7$  and  $J=5-10$  states.

T(K)	$v=7, J=5$	$v=7, J=6$	$v=7, J=7$	$v=7, J=8$	$v=7, J=9$	$v=7, J=10$
100	---	---	---	7.6980-27	3.8658-23	3.4037-19
200	7.3970-22	1.6294-20	5.5519-19	2.8848-17	1.8803-15	1.5288-13
300	3.8060-17	2.9606-16	3.0501-15	4.1092-14	6.3228-13	1.0887-11
400	8.2583-15	3.8231-14	2.1695-13	1.4912-12	1.1182-11	8.9133-11
500	2.0287-13	6.8858-13	2.7357-12	1.2577-11	6.1403-11	3.0962-10
600	1.6840-12	4.6508-12	1.4583-11	5.1340-11	1.8862-10	7.0299-10
700	7.5377-12	1.7975-11	4.7635-11	1.3873-10	4.1658-10	1.2540-09
800	2.2966-11	4.9079-11	1.1471-10	2.9004-10	7.4948-10	1.9256-09
900	5.4195-11	1.0639-10	2.2563-10	5.1142-10	1.1770-09	2.6773-09
1000	1.0701-10	1.9632-10	3.8539-10	8.0087-10	1.6812-09	3.4736-09
1100	1.8570-10	3.2241-10	5.9431-10	1.1508-09	2.2423-09	4.2864-09
1200	2.9260-10	4.8529-10	8.4909-10	1.5509-09	2.8412-09	5.0949-09
1300	4.2814-10	6.8324-10	1.1441-09	1.9896-09	3.4616-09	5.8843-09
1400	5.9118-10	9.1292-10	1.4726-09	2.4560-09	4.0897-09	6.6447-09
1500	7.7946-10	1.1700-09	1.8274-09	2.9401-09	4.7148-09	7.3697-09
1600	9.8995-10	1.4497-09	2.2017-09	3.4332-09	5.3286-09	8.0554-09
1700	1.2193-09	1.7471-09	2.5889-09	3.9280-09	5.9249-09	8.6999-09
1800	1.4639-09	2.0578-09	2.9836-09	4.4187-09	6.4995-09	9.3026-09
1900	1.7203-09	2.3773-09	3.3808-09	4.9005-09	7.0492-09	9.8640-09
2000	1.9854-09	2.7018-09	3.7764-09	5.3699-09	7.5721-09	1.0385-08
2100	2.2561-09	3.0281-09	4.1670-09	5.8239-09	8.0671-09	1.0867-08
2200	2.5298-09	3.3533-09	4.5499-09	6.2608-09	8.5337-09	1.1311-08
2300	2.8042-09	3.6750-09	4.9229-09	6.6790-09	8.9721-09	1.1721-08
2400	3.0771-09	3.9912-09	5.2844-09	7.0777-09	9.3826-09	1.2096-08
2500	3.3470-09	4.3002-09	5.6331-09	7.4564-09	9.7659-09	1.2440-08
2600	3.6124-09	4.6009-09	5.9680-09	7.8149-09	1.0123-08	1.2754-08
2700	3.8721-09	4.8921-09	6.2886-09	8.1533-09	1.0454-08	1.3040-08
2800	4.1252-09	5.1732-09	6.5946-09	8.4719-09	1.0762-08	1.3300-08
2900	4.3709-09	5.4435-09	6.8857-09	8.7711-09	1.1046-08	1.3535-08
3000	4.6085-09	5.7028-09	7.1620-09	9.0515-09	1.1308-08	1.3748-08
3100	4.8378-09	5.9508-09	7.4236-09	9.3135-09	1.1549-08	1.3939-08
3200	5.0584-09	6.1875-09	7.6707-09	9.5580-09	1.1770-08	1.4110-08
3300	5.2700-09	6.4128-09	7.9036-09	9.7856-09	1.1973-08	1.4263-08
3400	5.4727-09	6.6268-09	8.1228-09	9.9970-09	1.2158-08	1.4398-08
3500	5.6662-09	6.8297-09	8.3285-09	1.0193-08	1.2326-08	1.4517-08
3600	5.8508-09	7.0216-09	8.5213-09	1.0374-08	1.2479-08	1.4622-08
3700	6.0265-09	7.2030-09	8.7016-09	1.0541-08	1.2616-08	1.4712-08
3800	6.1934-09	7.3740-09	8.8700-09	1.0695-08	1.2740-08	1.4790-08
3900	6.3517-09	7.5349-09	9.0268-09	1.0836-08	1.2852-08	1.4855-08
4000	6.5016-09	7.6861-09	9.1726-09	1.0965-08	1.2950-08	1.4909-08

Table 34. (continued)

T(K)	$v=7, J=5$	$v=7, J=6$	$v=7, J=7$	$v=7, J=8$	$v=7, J=9$	$v=7, J=10$
4100	6.6434-09	7.8280-09	9.3079-09	1.1083-08	1.3038-08	1.4953-08
4200	6.7771-09	7.9608-09	9.4331-09	1.1190-08	1.3115-08	1.4988-08
4300	6.9031-09	8.0849-09	9.5488-09	1.1287-08	1.3181-08	1.5013-08
4400	7.0217-09	8.2007-09	9.6553-09	1.1375-08	1.3239-08	1.5030-08
4500	7.1331-09	8.3085-09	9.7532-09	1.1453-08	1.3287-08	1.5039-08
4600	7.2376-09	8.4086-09	9.8427-09	1.1523-08	1.3328-08	1.5041-08
4700	7.3354-09	8.5014-09	9.9245-09	1.1585-08	1.3360-08	1.5036-08
4800	7.4267-09	8.5872-09	9.9988-09	1.1639-08	1.3386-08	1.5025-08
4900	7.5119-09	8.6664-09	1.0066-08	1.1686-08	1.3404-08	1.5008-08
5000	7.5912-09	8.7392-09	1.0127-08	1.1726-08	1.3417-08	1.4986-08
5500	7.9075-09	9.0177-09	1.0341-08	1.1841-08	1.3398-08	1.4810-08
6000	8.1104-09	9.1774-09	1.0434-08	1.1838-08	1.3274-08	1.4550-08
6500	8.2240-09	9.2455-09	1.0436-08	1.1750-08	1.3077-08	1.4234-08
7000	8.2679-09	9.2436-09	1.0371-08	1.1601-08	1.2830-08	1.3883-08
7500	8.2577-09	9.1886-09	1.0256-08	1.1409-08	1.2549-08	1.3513-08
8000	8.2062-09	9.0937-09	1.0104-08	1.1186-08	1.2248-08	1.3132-08
8500	8.1231-09	8.9692-09	9.9265-09	1.0944-08	1.1934-08	1.2748-08
9000	8.0163-09	8.8232-09	9.7310-09	1.0689-08	1.1615-08	1.2367-08
9500	7.8920-09	8.6618-09	9.5236-09	1.0427-08	1.1295-08	1.1992-08
10000	7.7550-09	8.4900-09	9.3089-09	1.0163-08	1.0977-08	1.1626-08
11000	7.4573-09	8.1288-09	8.8710-09	9.6364-09	1.0360-08	1.0925-08
12000	7.1449-09	7.7605-09	8.4362-09	9.1268-09	9.7736-09	1.0271-08
13000	6.8310-09	7.3973-09	8.0153-09	8.6419-09	9.2243-09	9.6655-09
14000	6.5234-09	7.0462-09	7.6138-09	8.1854-09	8.7131-09	9.1076-09
15000	6.2267-09	6.7110-09	7.2345-09	7.7583-09	8.2391-09	8.5943-09
16000	5.9435-09	6.3936-09	6.8781-09	7.3602-09	7.8005-09	8.1222-09
17000	5.6749-09	6.0944-09	6.5444-09	6.9900-09	7.3950-09	7.6879-09
18000	5.4211-09	5.8133-09	6.2326-09	6.6459-09	7.0200-09	7.2881-09
19000	5.1821-09	5.5497-09	5.9415-09	6.3262-09	6.6731-09	6.9195-09
20000	4.9574-09	5.3027-09	5.6699-09	6.0291-09	6.3518-09	6.5792-09
21000	4.7462-09	5.0715-09	5.4164-09	5.7527-09	6.0539-09	6.2645-09
22000	4.5478-09	4.8548-09	5.1797-09	5.4953-09	5.7773-09	5.9730-09
23000	4.3615-09	4.6519-09	4.9585-09	5.2555-09	5.5201-09	5.7026-09
24000	4.1864-09	4.4616-09	4.7516-09	5.0317-09	5.2806-09	5.4513-09
25000	4.0218-09	4.2830-09	4.5578-09	4.8226-09	5.0573-09	5.2173-09
26000	3.8670-09	4.1153-09	4.3762-09	4.6269-09	4.8488-09	4.9991-09
27000	3.7212-09	3.9577-09	4.2058-09	4.4437-09	4.6537-09	4.7953-09
28000	3.5838-09	3.8094-09	4.0457-09	4.2718-09	4.4710-09	4.6047-09
29000	3.4543-09	3.6697-09	3.8951-09	4.1103-09	4.2997-09	4.4261-09
30000	3.3319-09	3.5380-09	3.7533-09	3.9585-09	4.1387-09	4.2585-09

Table 35. Rate constant for hydrogen molecule in  $v=7$  and  $J=11-16$  states.

T(K)	$v=7, J=11$	$v=7, J=12$	$v=7, J=13$	$v=7, J=14$	$v=7, J=15$	$v=7, J=16$
100	4.2462-15	4.3584-11	1.3751-09	1.1463-09	1.0409-09	9.1235-10
200	1.3337-11	8.2502-10	2.7873-09	2.4971-09	2.3089-09	2.0919-09
300	1.8481-10	2.2076-09	4.0527-09	3.6995-09	3.4345-09	3.1419-09
400	6.7529-10	3.6672-09	5.2062-09	4.7921-09	4.4573-09	4.0973-09
500	1.4576-09	5.0376-09	6.2644-09	5.7939-09	5.3962-09	4.9758-09
600	2.4244-09	6.2857-09	7.2372-09	6.7156-09	6.2614-09	5.7866-09
700	3.4779-09	7.4138-09	8.1320-09	7.5646-09	7.0596-09	6.5358-09
800	4.5508-09	8.4326-09	8.9548-09	8.3464-09	7.7959-09	7.2280-09
900	5.6015-09	9.3535-09	9.7108-09	9.0659-09	8.4746-09	7.8672-09
1000	6.6062-09	1.0187-08	1.0405-08	9.7274-09	9.0996-09	8.4567-09
1100	7.5523-09	1.0941-08	1.1041-08	1.0335-08	9.6745-09	8.9998-09
1200	8.4344-09	1.1625-08	1.1623-08	1.0892-08	1.0203-08	9.4995-09
1300	9.2511-09	1.2245-08	1.2155-08	1.1402-08	1.0687-08	9.9585-09
1400	1.0003-08	1.2806-08	1.2641-08	1.1868-08	1.1130-08	1.0379-08
1500	1.0694-08	1.3313-08	1.3083-08	1.2294-08	1.1536-08	1.0765-08
1600	1.1326-08	1.3772-08	1.3485-08	1.2681-08	1.1905-08	1.1117-08
1700	1.1903-08	1.4187-08	1.3849-08	1.3033-08	1.2242-08	1.1438-08
1800	1.2428-08	1.4560-08	1.4179-08	1.3353-08	1.2547-08	1.1730-08
1900	1.2905-08	1.4896-08	1.4477-08	1.3641-08	1.2824-08	1.1995-08
2000	1.3338-08	1.5197-08	1.4744-08	1.3901-08	1.3074-08	1.2234-08
2100	1.3730-08	1.5466-08	1.4984-08	1.4135-08	1.3299-08	1.2451-08
2200	1.4084-08	1.5705-08	1.5197-08	1.4344-08	1.3500-08	1.2645-08
2300	1.4403-08	1.5918-08	1.5387-08	1.4530-08	1.3680-08	1.2819-08
2400	1.4689-08	1.6105-08	1.5555-08	1.4695-08	1.3840-08	1.2974-08
2500	1.4945-08	1.6270-08	1.5702-08	1.4840-08	1.3982-08	1.3111-08
2600	1.5174-08	1.6413-08	1.5829-08	1.4967-08	1.4106-08	1.3232-08
2700	1.5377-08	1.6536-08	1.5939-08	1.5077-08	1.4213-08	1.3337-08
2800	1.5556-08	1.6641-08	1.6033-08	1.5171-08	1.4306-08	1.3429-08
2900	1.5714-08	1.6730-08	1.6112-08	1.5251-08	1.4385-08	1.3507-08
3000	1.5852-08	1.6803-08	1.6176-08	1.5317-08	1.4451-08	1.3572-08
3100	1.5971-08	1.6862-08	1.6227-08	1.5370-08	1.4505-08	1.3627-08
3200	1.6072-08	1.6907-08	1.6266-08	1.5412-08	1.4548-08	1.3671-08
3300	1.6158-08	1.6940-08	1.6294-08	1.5443-08	1.4581-08	1.3705-08
3400	1.6230-08	1.6962-08	1.6312-08	1.5464-08	1.4604-08	1.3730-08
3500	1.6288-08	1.6974-08	1.6320-08	1.5476-08	1.4618-08	1.3746-08
3600	1.6333-08	1.6976-08	1.6320-08	1.5480-08	1.4624-08	1.3755-08
3700	1.6367-08	1.6969-08	1.6311-08	1.5475-08	1.4623-08	1.3757-08
3800	1.6390-08	1.6954-08	1.6294-08	1.5463-08	1.4614-08	1.3751-08
3900	1.6404-08	1.6932-08	1.6271-08	1.5445-08	1.4599-08	1.3740-08
4000	1.6408-08	1.6902-08	1.6241-08	1.5420-08	1.4578-08	1.3723-08

Table 35. (continued)

T(K)	$v=7, J=11$	$v=7, J=12$	$v=7, J=13$	$v=7, J=14$	$v=7, J=15$	$v=7, J=16$
4100	1.6404-08	1.6866-08	1.6206-08	1.5389-08	1.4552-08	1.3700-08
4200	1.6392-08	1.6825-08	1.6165-08	1.5353-08	1.4520-08	1.3673-08
4300	1.6374-08	1.6778-08	1.6118-08	1.5313-08	1.4484-08	1.3641-08
4400	1.6348-08	1.6726-08	1.6068-08	1.5267-08	1.4443-08	1.3605-08
4500	1.6317-08	1.6670-08	1.6013-08	1.5218-08	1.4398-08	1.3565-08
4600	1.6280-08	1.6609-08	1.5954-08	1.5165-08	1.4350-08	1.3521-08
4700	1.6238-08	1.6545-08	1.5892-08	1.5108-08	1.4298-08	1.3474-08
4800	1.6191-08	1.6477-08	1.5826-08	1.5048-08	1.4244-08	1.3425-08
4900	1.6140-08	1.6406-08	1.5758-08	1.4986-08	1.4186-08	1.3372-08
5000	1.6085-08	1.6332-08	1.5687-08	1.4920-08	1.4126-08	1.3317-08
5500	1.5761-08	1.5928-08	1.5298-08	1.4561-08	1.3793-08	1.3011-08
6000	1.5379-08	1.5484-08	1.4872-08	1.4164-08	1.3424-08	1.2669-08
6500	1.4962-08	1.5019-08	1.4427-08	1.3747-08	1.3034-08	1.2307-08
7000	1.4526-08	1.4546-08	1.3974-08	1.3322-08	1.2635-08	1.1935-08
7500	1.4083-08	1.4074-08	1.3522-08	1.2896-08	1.2235-08	1.1561-08
8000	1.3641-08	1.3609-08	1.3076-08	1.2475-08	1.1840-08	1.1190-08
8500	1.3205-08	1.3155-08	1.2641-08	1.2064-08	1.1452-08	1.0827-08
9000	1.2778-08	1.2714-08	1.2219-08	1.1664-08	1.1075-08	1.0473-08
9500	1.2364-08	1.2289-08	1.1811-08	1.1278-08	1.0711-08	1.0130-08
10000	1.1963-08	1.1879-08	1.1418-08	1.0906-08	1.0359-08	9.7995-09
11000	1.1205-08	1.1109-08	1.0680-08	1.0205-08	9.6965-09	9.1758-09
12000	1.0507-08	1.0404-08	1.0004-08	9.5618-09	9.0881-09	8.6025-09
13000	9.8666-09	9.7599-09	9.3859-09	8.9739-09	8.5313-09	8.0774-09
14000	9.2803-09	9.1723-09	8.8219-09	8.4368-09	8.0224-09	7.5971-09
15000	8.7438-09	8.6359-09	8.3070-09	7.9462-09	7.5572-09	7.1579-09
16000	8.2526-09	8.1459-09	7.8366-09	7.4977-09	7.1318-09	6.7559-09
17000	7.8024-09	7.6976-09	7.4060-09	7.0870-09	6.7420-09	6.3877-09
18000	7.3892-09	7.2867-09	7.0113-09	6.7103-09	6.3845-09	6.0497-09
19000	7.0093-09	6.9094-09	6.6488-09	6.3643-09	6.0559-09	5.7389-09
20000	6.6593-09	6.5622-09	6.3151-09	6.0457-09	5.7533-09	5.4527-09
21000	6.3364-09	6.2420-09	6.0074-09	5.7518-09	5.4742-09	5.1886-09
22000	6.0378-09	5.9462-09	5.7231-09	5.4801-09	5.2161-09	4.9444-09
23000	5.7611-09	5.6724-09	5.4599-09	5.2286-09	4.9770-09	4.7181-09
24000	5.5043-09	5.4184-09	5.2157-09	4.9952-09	4.7552-09	4.5081-09
25000	5.2656-09	5.1823-09	4.9887-09	4.7782-09	4.5489-09	4.3129-09
26000	5.0432-09	4.9625-09	4.7774-09	4.5761-09	4.3568-09	4.1310-09
27000	4.8357-09	4.7576-09	4.5802-09	4.3876-09	4.1776-09	3.9612-09
28000	4.6418-09	4.5661-09	4.3961-09	4.2115-09	4.0100-09	3.8026-09
29000	4.4602-09	4.3869-09	4.2237-09	4.0466-09	3.8532-09	3.6540-09
30000	4.2900-09	4.2189-09	4.0621-09	3.8920-09	3.7062-09	3.5148-09

Table 36. Rate constant for hydrogen molecule in  $v=7$  and  $J=17$ -20 states and  $v=8$  and  $J=0$ -1 state

T(K)	$v=7, J=17$	$v=7, J=18$	$v=7, J=19$	$v=7, J=20$	$v=8, J=0$	$v=8, J=1$
100	8.4198-10	9.2118-10	8.3434-10	6.3554-10	1.8123-27	5.0575-27
200	1.9284-09	1.8569-09	1.6846-09	1.4265-09	1.3629-17	2.2576-17
300	2.8973-09	2.7111-09	2.4622-09	2.1402-09	2.4493-14	3.4111-14
400	3.7809-09	3.5040-09	3.1841-09	2.7970-09	9.9850-13	1.2755-12
500	4.5951-09	4.2420-09	3.8565-09	3.4063-09	9.0310-12	1.0955-11
600	5.3479-09	4.9288-09	4.4828-09	3.9730-09	3.8626-11	4.5279-11
700	6.0449-09	5.5673-09	5.0658-09	4.5000-09	1.0792-10	1.2347-10
800	6.6898-09	6.1602-09	5.6076-09	4.9900-09	2.3135-10	2.5993-10
900	7.2863-09	6.7099-09	6.1106-09	5.4449-09	4.1600-10	4.6089-10
1000	7.8373-09	7.2189-09	6.5768-09	5.8669-09	6.6173-10	7.2504-10
1100	8.3456-09	7.6895-09	7.0082-09	6.2575-09	9.6321-10	1.0459-09
1200	8.8140-09	8.1237-09	7.4068-09	6.6187-09	1.3121-09	1.4141-09
1300	9.2448-09	8.5238-09	7.7744-09	6.9521-09	1.6987-09	1.8193-09
1400	9.6404-09	8.8918-09	8.1128-09	7.2593-09	2.1135-09	2.2515-09
1500	1.0003-08	9.2297-09	8.4238-09	7.5418-09	2.5474-09	2.7014-09
1600	1.0335-08	9.5392-09	8.7090-09	7.8012-09	2.9926-09	3.1609-09
1700	1.0638-08	9.8223-09	8.9701-09	8.0388-09	3.4422-09	3.6231-09
1800	1.0914-08	1.0080-08	9.2085-09	8.2559-09	3.8907-09	4.0826-09
1900	1.1165-08	1.0315-08	9.4256-09	8.4539-09	4.3334-09	4.5349-09
2000	1.1392-08	1.0529-08	9.6228-09	8.6339-09	4.7669-09	4.9763-09
2100	1.1597-08	1.0722-08	9.8015-09	8.7972-09	5.1882-09	5.4044-09
2200	1.1782-08	1.0896-08	9.9628-09	8.9448-09	5.5954-09	5.8170-09
2300	1.1948-08	1.1052-08	1.0108-08	9.0776-09	5.9868-09	6.2128-09
2400	1.2095-08	1.1192-08	1.0238-08	9.1968-09	6.3615-09	6.5909-09
2500	1.2227-08	1.1316-08	1.0354-08	9.3032-09	6.7189-09	6.9508-09
2600	1.2343-08	1.1426-08	1.0456-08	9.3976-09	7.0585-09	7.2922-09
2700	1.2444-08	1.1523-08	1.0547-08	9.4809-09	7.3802-09	7.6151-09
2800	1.2533-08	1.1607-08	1.0625-08	9.5538-09	7.6843-09	7.9197-09
2900	1.2608-08	1.1679-08	1.0694-08	9.6171-09	7.9710-09	8.2063-09
3000	1.2673-08	1.1741-08	1.0752-08	9.6713-09	8.2405-09	8.4754-09
3100	1.2726-08	1.1793-08	1.0801-08	9.7172-09	8.4935-09	8.7276-09
3200	1.2770-08	1.1836-08	1.0841-08	9.7552-09	8.7303-09	8.9633-09
3300	1.2804-08	1.1870-08	1.0874-08	9.7860-09	8.9517-09	9.1832-09
3400	1.2830-08	1.1895-08	1.0899-08	9.8100-09	9.1581-09	9.3879-09
3500	1.2848-08	1.1914-08	1.0917-08	9.8277-09	9.3503-09	9.5781-09
3600	1.2858-08	1.1925-08	1.0929-08	9.8396-09	9.5287-09	9.7545-09
3700	1.2861-08	1.1930-08	1.0935-08	9.8461-09	9.6941-09	9.9177-09
3800	1.2859-08	1.1929-08	1.0935-08	9.8475-09	9.8471-09	1.0068-08
3900	1.2850-08	1.1923-08	1.0930-08	9.8443-09	9.9882-09	1.0207-08
4000	1.2836-08	1.1911-08	1.0920-08	9.8367-09	1.0118-08	1.0334-08

Table 36. (continued)

T(K)	$v=7, J=17$	$v=7, J=18$	$v=7, J=19$	$v=7, J=20$	$v=8, J=0$	$v=8, J=1$
4100	1.2816-08	1.1895-08	1.0906-08	9.8251-09	1.0237-08	1.0451-08
4200	1.2792-08	1.1874-08	1.0888-08	9.8098-09	1.0346-08	1.0557-08
4300	1.2764-08	1.1849-08	1.0867-08	9.7911-09	1.0446-08	1.0654-08
4400	1.2732-08	1.1821-08	1.0841-08	9.7692-09	1.0536-08	1.0742-08
4500	1.2696-08	1.1789-08	1.0813-08	9.7443-09	1.0618-08	1.0821-08
4600	1.2657-08	1.1753-08	1.0781-08	9.7168-09	1.0692-08	1.0892-08
4700	1.2614-08	1.1715-08	1.0747-08	9.6867-09	1.0758-08	1.0955-08
4800	1.2569-08	1.1674-08	1.0710-08	9.6543-09	1.0816-08	1.1011-08
4900	1.2521-08	1.1631-08	1.0671-08	9.6198-09	1.0868-08	1.1060-08
5000	1.2471-08	1.1585-08	1.0630-08	9.5833-09	1.0914-08	1.1103-08
5500	1.2190-08	1.1329-08	1.0398-08	9.3770-09	1.1056-08	1.1232-08
6000	1.1874-08	1.1039-08	1.0135-08	9.1418-09	1.1085-08	1.1248-08
6500	1.1539-08	1.0730-08	9.8528-09	8.8896-09	1.1029-08	1.1181-08
7000	1.1193-08	1.0412-08	9.5619-09	8.6286-09	1.0913-08	1.1054-08
7500	1.0845-08	1.0090-08	9.2681-09	8.3647-09	1.0752-08	1.0884-08
8000	1.0500-08	9.7710-09	8.9761-09	8.1022-09	1.0560-08	1.0684-08
8500	1.0161-08	9.4572-09	8.6889-09	7.8438-09	1.0347-08	1.0463-08
9000	9.8307-09	9.1513-09	8.4086-09	7.5915-09	1.0120-08	1.0229-08
9500	9.5106-09	8.8544-09	8.1366-09	7.3465-09	9.8847-09	9.9867-09
10000	9.2015-09	8.5677-09	7.8737-09	7.1096-09	9.6450-09	9.7410-09
11000	8.6181-09	8.0262-09	7.3770-09	6.6619-09	9.1643-09	9.2499-09
12000	8.0813-09	7.5277-09	6.9195-09	6.2493-09	8.6948-09	8.7717-09
13000	7.5893-09	7.0704-09	6.4998-09	5.8706-09	8.2454-09	8.3148-09
14000	7.1392-09	6.6519-09	6.1154-09	5.5238-09	7.8202-09	7.8833-09
15000	6.7273-09	6.2688-09	5.7636-09	5.2062-09	7.4209-09	7.4785-09
16000	6.3503-09	5.9181-09	5.4413-09	4.9153-09	7.0476-09	7.1004-09
17000	6.0048-09	5.5965-09	5.1459-09	4.6485-09	6.6994-09	6.7481-09
18000	5.6875-09	5.3012-09	4.8746-09	4.4035-09	6.3750-09	6.4201-09
19000	5.3958-09	5.0296-09	4.6250-09	4.1782-09	6.0731-09	6.1150-09
20000	5.1271-09	4.7794-09	4.3950-09	3.9705-09	5.7919-09	5.8309-09
21000	4.8791-09	4.5484-09	4.1827-09	3.7787-09	5.5300-09	5.5664-09
22000	4.6497-09	4.3348-09	3.9863-09	3.6013-09	5.2858-09	5.3199-09
23000	4.4372-09	4.1368-09	3.8043-09	3.4369-09	5.0579-09	5.0900-09
24000	4.2399-09	3.9530-09	3.6354-09	3.2843-09	4.8450-09	4.8752-09
25000	4.0564-09	3.7821-09	3.4782-09	3.1424-09	4.6458-09	4.6743-09
26000	3.8855-09	3.6228-09	3.3318-09	3.0101-09	4.4593-09	4.4863-09
27000	3.7260-09	3.4742-09	3.1951-09	2.8866-09	4.2845-09	4.3100-09
28000	3.5769-09	3.3353-09	3.0674-09	2.7712-09	4.1203-09	4.1446-09
29000	3.4373-09	3.2052-09	2.9477-09	2.6631-09	3.9660-09	3.9891-09
30000	3.3064-09	3.0832-09	2.8356-09	2.5618-09	3.8208-09	3.8428-09



Table 37. Rate constant for hydrogen molecule in v=8 and J=2-7 states.

T(K)	v=8, J=2	v=8, J=3	v=8, J=4	v=8, J=5	v=8, J=6	v=8, J=7
100	3.5072-26	7.5409-25	3.5423-23	4.4720-21	1.1718-18	6.1006-16
200	5.8464-17	2.6304-16	1.7249-15	1.8087-14	2.6331-13	5.1060-12
300	6.3664-14	1.7031-13	5.8071-13	2.6674-12	1.4922-11	9.7718-11
400	2.0221-12	4.1752-12	1.0282-11	3.1340-11	1.0918-10	4.1863-10
500	1.5756-11	2.7872-11	5.6528-11	1.3497-10	3.5499-10	9.9250-10
600	6.1044-11	9.7473-11	1.7384-10	3.5320-10	7.7200-10	1.7553-09
700	1.5899-10	2.3607-10	3.8437-10	6.9664-10	1.3364-09	2.6291-09
800	3.2348-10	4.5499-10	6.9228-10	1.1527-09	2.0078-09	3.5513-09
900	5.5864-10	7.5360-10	1.0883-09	1.6975-09	2.7459-09	4.4788-09
1000	8.6061-10	1.1231-09	1.5561-09	2.3051-09	3.5174-09	5.3843-09
1100	1.2205-09	1.5505-09	2.0774-09	2.9515-09	4.2969-09	6.2513-09
1200	1.6272-09	2.0217-09	2.6348-09	3.6169-09	5.0661-09	7.0708-09
1300	2.0690-09	2.5231-09	3.2130-09	4.2855-09	5.8126-09	7.8385-09
1400	2.5350-09	3.0428-09	3.7993-09	4.9455-09	6.5281-09	8.5529-09
1500	3.0155-09	3.5706-09	4.3838-09	5.5884-09	7.2076-09	9.2145-09
1600	3.5021-09	4.0983-09	4.9586-09	6.2081-09	7.8483-09	9.8249-09
1700	3.9882-09	4.6192-09	5.5179-09	6.8005-09	8.4491-09	1.0386-08
1800	4.4682-09	5.1282-09	6.0576-09	7.3632-09	9.0099-09	1.0902-08
1900	4.9378-09	5.6218-09	6.5748-09	7.8947-09	9.5314-09	1.1373-08
2000	5.3938-09	6.0969-09	7.0676-09	8.3946-09	1.0015-08	1.1804-08
2100	5.8339-09	6.5519-09	7.5349-09	8.8629-09	1.0462-08	1.2196-08
2200	6.2562-09	6.9854-09	7.9762-09	9.3001-09	1.0874-08	1.2554-08
2300	6.6596-09	7.3968-09	8.3915-09	9.7073-09	1.1252-08	1.2878-08
2400	7.0435-09	7.7858-09	8.7810-09	1.0085-08	1.1600-08	1.3171-08
2500	7.4075-09	8.1524-09	9.1454-09	1.0435-08	1.1918-08	1.3436-08
2600	7.7515-09	8.4970-09	9.4854-09	1.0759-08	1.2209-08	1.3674-08
2700	8.0759-09	8.8200-09	9.8018-09	1.1057-08	1.2474-08	1.3888-08
2800	8.3808-09	9.1221-09	1.0096-08	1.1331-08	1.2714-08	1.4080-08
2900	8.6669-09	9.4039-09	1.0368-08	1.1583-08	1.2932-08	1.4250-08
3000	8.9346-09	9.6663-09	1.0619-08	1.1814-08	1.3129-08	1.4401-08
3100	9.1846-09	9.9100-09	1.0852-08	1.2024-08	1.3306-08	1.4534-08
3200	9.4176-09	1.0136-08	1.1065-08	1.2215-08	1.3465-08	1.4650-08
3300	9.6343-09	1.0345-08	1.1261-08	1.2389-08	1.3606-08	1.4751-08
3400	9.8354-09	1.0538-08	1.1441-08	1.2546-08	1.3732-08	1.4837-08
3500	1.0022-08	1.0715-08	1.1604-08	1.2687-08	1.3842-08	1.4910-08
3600	1.0194-08	1.0878-08	1.1753-08	1.2814-08	1.3939-08	1.4970-08
3700	1.0352-08	1.1027-08	1.1889-08	1.2928-08	1.4023-08	1.5020-08
3800	1.0498-08	1.1164-08	1.2011-08	1.3028-08	1.4095-08	1.5058-08
3900	1.0632-08	1.1288-08	1.2121-08	1.3117-08	1.4156-08	1.5087-08
4000	1.0754-08	1.1400-08	1.2219-08	1.3194-08	1.4207-08	1.5107-08

Table 37. (continued)

T(K)	v=8, J=2	v=8, J=3	v=8, J=4	v=8, J=5	v=8, J=6	v=8, J=7
4100	1.0865-08	1.1502-08	1.2306-08	1.3261-08	1.4248-08	1.5119-08
4200	1.0966-08	1.1593-08	1.2384-08	1.3318-08	1.4280-08	1.5122-08
4300	1.1058-08	1.1675-08	1.2452-08	1.3366-08	1.4303-08	1.5119-08
4400	1.1140-08	1.1747-08	1.2510-08	1.3406-08	1.4319-08	1.5109-08
4500	1.1214-08	1.1811-08	1.2561-08	1.3437-08	1.4328-08	1.5093-08
4600	1.1279-08	1.1867-08	1.2604-08	1.3461-08	1.4330-08	1.5071-08
4700	1.1337-08	1.1915-08	1.2639-08	1.3479-08	1.4326-08	1.5044-08
4800	1.1388-08	1.1956-08	1.2667-08	1.3489-08	1.4316-08	1.5011-08
4900	1.1432-08	1.1991-08	1.2689-08	1.3494-08	1.4300-08	1.4975-08
5000	1.1469-08	1.2019-08	1.2705-08	1.3494-08	1.4280-08	1.4934-08
5500	1.1573-08	1.2079-08	1.2707-08	1.3418-08	1.4116-08	1.4680-08
6000	1.1565-08	1.2032-08	1.2608-08	1.3251-08	1.3874-08	1.4363-08
6500	1.1477-08	1.1907-08	1.2436-08	1.3021-08	1.3579-08	1.4006-08
7000	1.1330-08	1.1727-08	1.2215-08	1.2749-08	1.3251-08	1.3626-08
7500	1.1141-08	1.1510-08	1.1961-08	1.2449-08	1.2904-08	1.3234-08
8000	1.0924-08	1.1267-08	1.1685-08	1.2133-08	1.2546-08	1.2840-08
8500	1.0688-08	1.1007-08	1.1396-08	1.1809-08	1.2186-08	1.2447-08
9000	1.0441-08	1.0738-08	1.1100-08	1.1482-08	1.1827-08	1.2061-08
9500	1.0186-08	1.0464-08	1.0803-08	1.1157-08	1.1474-08	1.1684-08
10000	9.9290-09	1.0190-08	1.0507-08	1.0836-08	1.1129-08	1.1318-08
11000	9.4181-09	9.6486-09	9.9290-09	1.0216-08	1.0466-08	1.0622-08
12000	8.9231-09	9.1286-09	9.3783-09	9.6303-09	9.8479-09	9.9764-09
13000	8.4519-09	8.6364-09	8.8604-09	9.0839-09	9.2743-09	9.3820-09
14000	8.0082-09	8.1748-09	8.3771-09	8.5768-09	8.7449-09	8.8359-09
15000	7.5929-09	7.7442-09	7.9280-09	8.1076-09	8.2571-09	8.3346-09
16000	7.2056-09	7.3438-09	7.5116-09	7.6742-09	7.8080-09	7.8744-09
17000	6.8452-09	6.9720-09	7.1260-09	7.2739-09	7.3944-09	7.4517-09
18000	6.5101-09	6.6269-09	6.7689-09	6.9041-09	7.0132-09	7.0629-09
19000	6.1987-09	6.3067-09	6.4380-09	6.5622-09	6.6616-09	6.7049-09
20000	5.9091-09	6.0093-09	6.1313-09	6.2458-09	6.3366-09	6.3745-09
21000	5.6396-09	5.7330-09	5.8465-09	5.9525-09	6.0359-09	6.0692-09
22000	5.3886-09	5.4758-09	5.5819-09	5.6804-09	5.7572-09	5.7866-09
23000	5.1545-09	5.2362-09	5.3357-09	5.4274-09	5.4985-09	5.5245-09
24000	4.9361-09	5.0128-09	5.1062-09	5.1919-09	5.2578-09	5.2809-09
25000	4.7319-09	4.8041-09	4.8921-09	4.9724-09	5.0337-09	5.0542-09
26000	4.5408-09	4.6089-09	4.6920-09	4.7674-09	4.8246-09	4.8429-09
27000	4.3617-09	4.4261-09	4.5047-09	4.5756-09	4.6292-09	4.6455-09
28000	4.1937-09	4.2547-09	4.3292-09	4.3961-09	4.4463-09	4.4609-09
29000	4.0359-09	4.0938-09	4.1644-09	4.2277-09	4.2749-09	4.2880-09
30000	3.8874-09	3.9425-09	4.0096-09	4.0695-09	4.1140-09	4.1258-09

Table 38. Rate constant for hydrogen molecule in v=8 and J=8-13 states.

T(K)	v=8, J=8	v=8, J=9	v=8, J=10	v=8, J=11	v=8, J=12	v=8, J=13
100	4.9461-13	3.1537-10	1.2682-09	1.1809-09	1.1068-09	9.5061-10
200	1.1146-10	1.6669-09	2.5109-09	2.3607-09	2.2137-09	2.0193-09
300	6.5483-10	3.0641-09	3.6344-09	3.4277-09	3.2175-09	2.9802-09
400	1.5778-09	4.3169-09	4.6679-09	4.4096-09	4.1442-09	3.8619-09
500	2.6753-09	5.4368-09	5.6223-09	5.3174-09	5.0030-09	4.6770-09
600	3.8107-09	6.4461-09	6.5044-09	6.1575-09	5.7994-09	5.4322-09
700	4.9149-09	7.3618-09	7.3194-09	6.9348-09	6.5376-09	6.1322-09
800	5.9568-09	8.1958-09	8.0719-09	7.6534-09	7.2211-09	6.7807-09
900	6.9246-09	8.9572-09	8.7661-09	8.3172-09	7.8533-09	7.3809-09
1000	7.8161-09	9.6531-09	9.4057-09	8.9295-09	8.4373-09	7.9359-09
1100	8.6332-09	1.0289-08	9.9941-09	9.4936-09	8.9761-09	8.4483-09
1200	9.3799-09	1.0871-08	1.0535-08	1.0013-08	9.4724-09	8.9208-09
1300	1.0061-08	1.1402-08	1.1031-08	1.0489-08	9.9289-09	9.3558-09
1400	1.0681-08	1.1887-08	1.1485-08	1.0927-08	1.0348-08	9.7556-09
1500	1.1246-08	1.2329-08	1.1901-08	1.1327-08	1.0732-08	1.0123-08
1600	1.1758-08	1.2731-08	1.2280-08	1.1693-08	1.1084-08	1.0459-08
1700	1.2224-08	1.3096-08	1.2625-08	1.2026-08	1.1405-08	1.0766-08
1800	1.2645-08	1.3427-08	1.2939-08	1.2330-08	1.1697-08	1.1046-08
1900	1.3027-08	1.3727-08	1.3223-08	1.2605-08	1.1963-08	1.1301-08
2000	1.3371-08	1.3997-08	1.3480-08	1.2854-08	1.2204-08	1.1532-08
2100	1.3681-08	1.4240-08	1.3712-08	1.3079-08	1.2422-08	1.1742-08
2200	1.3961-08	1.4458-08	1.3920-08	1.3281-08	1.2618-08	1.1931-08
2300	1.4211-08	1.4652-08	1.4105-08	1.3462-08	1.2794-08	1.2100-08
2400	1.4434-08	1.4824-08	1.4271-08	1.3624-08	1.2951-08	1.2252-08
2500	1.4633-08	1.4977-08	1.4417-08	1.3767-08	1.3091-08	1.2387-08
2600	1.4810-08	1.5110-08	1.4545-08	1.3893-08	1.3214-08	1.2507-08
2700	1.4965-08	1.5226-08	1.4657-08	1.4003-08	1.3322-08	1.2612-08
2800	1.5101-08	1.5327-08	1.4753-08	1.4099-08	1.3416-08	1.2704-08
2900	1.5220-08	1.5412-08	1.4836-08	1.4180-08	1.3497-08	1.2784-08
3000	1.5321-08	1.5483-08	1.4905-08	1.4249-08	1.3566-08	1.2851-08
3100	1.5408-08	1.5541-08	1.4962-08	1.4307-08	1.3623-08	1.2908-08
3200	1.5480-08	1.5588-08	1.5008-08	1.4353-08	1.3670-08	1.2955-08
3300	1.5540-08	1.5623-08	1.5043-08	1.4389-08	1.3707-08	1.2992-08
3400	1.5587-08	1.5649-08	1.5068-08	1.4416-08	1.3735-08	1.3021-08
3500	1.5623-08	1.5664-08	1.5084-08	1.4434-08	1.3755-08	1.3042-08
3600	1.5649-08	1.5672-08	1.5092-08	1.4444-08	1.3766-08	1.3055-08
3700	1.5665-08	1.5671-08	1.5092-08	1.4446-08	1.3771-08	1.3061-08
3800	1.5673-08	1.5662-08	1.5085-08	1.4441-08	1.3769-08	1.3061-08
3900	1.5673-08	1.5647-08	1.5071-08	1.4430-08	1.3760-08	1.3054-08
4000	1.5665-08	1.5623-08	1.5051-08	1.4413-08	1.3746-08	1.3042-08

Table 38. (continued)

T(K)	v=8, J=8	v=8, J=9	v=8, J=10	v=8, J=11	v=8, J=12	v=8, J=13
4100	1.5650-08	1.5597-08	1.5025-08	1.4390-08	1.3726-08	1.3025-08
4200	1.5628-08	1.5564-08	1.4994-08	1.4363-08	1.3701-08	1.3004-08
4300	1.5601-08	1.5526-08	1.4958-08	1.4330-08	1.3672-08	1.2978-08
4400	1.5569-08	1.5483-08	1.4918-08	1.4293-08	1.3639-08	1.2947-08
4500	1.5531-08	1.5436-08	1.4873-08	1.4252-08	1.3601-08	1.2913-08
4600	1.5489-08	1.5385-08	1.4825-08	1.4208-08	1.3560-08	1.2876-08
4700	1.5442-08	1.5330-08	1.4774-08	1.4160-08	1.3516-08	1.2835-08
4800	1.5392-08	1.5272-08	1.4719-08	1.4109-08	1.3469-08	1.2791-08
4900	1.5338-08	1.5211-08	1.4661-08	1.4055-08	1.3419-08	1.2745-08
5000	1.5281-08	1.5147-08	1.4600-08	1.3998-08	1.3366-08	1.2696-08
5500	1.4955-08	1.4795-08	1.4265-08	1.3683-08	1.3071-08	1.2421-08
6000	1.4580-08	1.4403-08	1.3890-08	1.3329-08	1.2739-08	1.2110-08
6500	1.4178-08	1.3989-08	1.3494-08	1.2953-08	1.2384-08	1.1776-08
7000	1.3762-08	1.3565-08	1.3088-08	1.2567-08	1.2019-08	1.1432-08
7500	1.3340-08	1.3139-08	1.2680-08	1.2179-08	1.1651-08	1.1085-08
8000	1.2921-08	1.2718-08	1.2276-08	1.1794-08	1.1285-08	1.0739-08
8500	1.2509-08	1.2305-08	1.1880-08	1.1416-08	1.0925-08	1.0399-08
9000	1.2106-08	1.1904-08	1.1494-08	1.1047-08	1.0575-08	1.0067-08
9500	1.1715-08	1.1515-08	1.1120-08	1.0690-08	1.0234-08	9.7447-09
10000	1.1337-08	1.1140-08	1.0759-08	1.0344-08	9.9055-09	9.4330-09
11000	1.0624-08	1.0433-08	1.0079-08	9.6928-09	9.2843-09	8.8436-09
12000	9.9661-09	9.7830-09	9.4528-09	9.0931-09	8.7119-09	8.3002-09
13000	9.3628-09	9.1877-09	8.8792-09	8.5431-09	8.1867-09	7.8012-09
14000	8.8104-09	8.6433-09	8.3543-09	8.0395-09	7.7055-09	7.3438-09
15000	8.3046-09	8.1453-09	7.8741-09	7.5786-09	7.2649-09	6.9248-09
16000	7.8414-09	7.6895-09	7.4344-09	7.1564-09	6.8611-09	6.5408-09
17000	7.4166-09	7.2718-09	7.0313-09	6.7692-09	6.4908-09	6.1884-09
18000	7.0265-09	6.8884-09	6.6612-09	6.4137-09	6.1505-09	5.8645-09
19000	6.6677-09	6.5358-09	6.3209-09	6.0866-09	5.8374-09	5.5665-09
20000	6.3369-09	6.2110-09	6.0072-09	5.7851-09	5.5488-09	5.2917-09
21000	6.0315-09	5.9112-09	5.7177-09	5.5067-09	5.2822-09	5.0378-09
22000	5.7490-09	5.6339-09	5.4498-09	5.2491-09	5.0355-09	4.8028-09
23000	5.4872-09	5.3770-09	5.2016-09	5.0104-09	4.8068-09	4.5850-09
24000	5.2441-09	5.1384-09	4.9711-09	4.7887-09	4.5945-09	4.3827-09
25000	5.0180-09	4.9166-09	4.7568-09	4.5825-09	4.3969-09	4.1944-09
26000	4.8073-09	4.7099-09	4.5570-09	4.3903-09	4.2127-09	4.0189-09
27000	4.6106-09	4.5170-09	4.3706-09	4.2109-09	4.0407-09	3.8550-09
28000	4.4266-09	4.3366-09	4.1963-09	4.0432-09	3.8800-09	3.7018-09
29000	4.2544-09	4.1678-09	4.0330-09	3.8861-09	3.7294-09	3.5582-09
30000	4.0929-09	4.0094-09	3.8799-09	3.7387-09	3.5881-09	3.4235-09

Table 39. Rate constant for hydrogen molecule in v=8 and J=14-18 states and v=9 and J=0 states.

T(K)	v=8, J=14	v=8, J=15	v=8, J=16	v=8, J=17	v=8, J=18	v=9, J=0
100	9.3829-10	8.4915-10	6.8747-10	7.2225-10	5.3716-10	8.5114-14
200	1.9046-09	1.7541-09	1.5453-09	1.4672-09	1.2365-09	4.7895-11
300	2.7860-09	2.5777-09	2.3187-09	2.1504-09	1.8660-09	3.7894-10
400	3.6027-09	3.3396-09	3.0298-09	2.7860-09	2.4447-09	1.0549-09
500	4.3621-09	4.0478-09	3.6889-09	3.3791-09	2.9815-09	1.9452-09
600	5.0683-09	4.7067-09	4.3016-09	3.9326-09	3.4810-09	2.9248-09
700	5.7247-09	5.3194-09	4.8712-09	4.4487-09	3.9461-09	3.9158-09
800	6.3341-09	5.8887-09	5.4006-09	4.9294-09	4.3789-09	4.8766-09
900	6.8992-09	6.4171-09	5.8921-09	5.3765-09	4.7814-09	5.7863-09
1000	7.4225-09	6.9068-09	6.3480-09	5.7917-09	5.1552-09	6.6363-09
1100	7.9064-09	7.3600-09	6.7702-09	6.1767-09	5.5020-09	7.4239-09
1200	8.3532-09	7.7789-09	7.1606-09	6.5331-09	5.8231-09	8.1500-09
1300	8.7652-09	8.1654-09	7.5212-09	6.8627-09	6.1201-09	8.8172-09
1400	9.1443-09	8.5214-09	7.8537-09	7.1667-09	6.3942-09	9.4287-09
1500	9.4926-09	8.8489-09	8.1596-09	7.4469-09	6.6469-09	9.9881-09
1600	9.8121-09	9.1494-09	8.4408-09	7.7044-09	6.8794-09	1.0499-08
1700	1.0104-08	9.4248-09	8.6985-09	7.9408-09	7.0929-09	1.0965-08
1800	1.0372-08	9.6765-09	8.9344-09	8.1573-09	7.2885-09	1.1390-08
1900	1.0615-08	9.9060-09	9.1497-09	8.3550-09	7.4673-09	1.1775-08
2000	1.0836-08	1.0115-08	9.3459-09	8.5353-09	7.6304-09	1.2126-08
2100	1.1036-08	1.0304-08	9.5240-09	8.6991-09	7.7787-09	1.2443-08
2200	1.1217-08	1.0476-08	9.6853-09	8.8476-09	7.9132-09	1.2730-08
2300	1.1380-08	1.0630-08	9.8308-09	8.9817-09	8.0348-09	1.2989-08
2400	1.1527-08	1.0769-08	9.9616-09	9.1024-09	8.1444-09	1.3222-08
2500	1.1657-08	1.0893-08	1.0079-08	9.2105-09	8.2426-09	1.3431-08
2600	1.1773-08	1.1003-08	1.0183-08	9.3068-09	8.3302-09	1.3618-08
2700	1.1875-08	1.1100-08	1.0275-08	9.3922-09	8.4079-09	1.3785-08
2800	1.1964-08	1.1185-08	1.0356-08	9.4674-09	8.4765-09	1.3932-08
2900	1.2041-08	1.1259-08	1.0427-08	9.5330-09	8.5364-09	1.4062-08
3000	1.2107-08	1.1323-08	1.0488-08	9.5897-09	8.5883-09	1.4175-08
3100	1.2163-08	1.1377-08	1.0540-08	9.6381-09	8.6328-09	1.4273-08
3200	1.2210-08	1.1422-08	1.0584-08	9.6788-09	8.6702-09	1.4358-08
3300	1.2247-08	1.1459-08	1.0619-08	9.7123-09	8.7012-09	1.4429-08
3400	1.2277-08	1.1488-08	1.0648-08	9.7390-09	8.7261-09	1.4489-08
3500	1.2298-08	1.1509-08	1.0669-08	9.7595-09	8.7453-09	1.4537-08
3600	1.2313-08	1.1524-08	1.0684-08	9.7742-09	8.7593-09	1.4575-08
3700	1.2320-08	1.1533-08	1.0694-08	9.7835-09	8.7684-09	1.4604-08
3800	1.2322-08	1.1535-08	1.0698-08	9.7878-09	8.7730-09	1.4624-08
3900	1.2318-08	1.1533-08	1.0697-08	9.7874-09	8.7733-09	1.4635-08
4000	1.2308-08	1.1525-08	1.0691-08	9.7827-09	8.7697-09	1.4640-08

Table 39. (continued)

T(K)	v=8, J=14	v=8, J=15	v=8, J=16	v=8, J=17	v=8, J=18	v=9, J=0
4100	1.2294-08	1.1513-08	1.0680-08	9.7739-09	8.7625-09	1.4637-08
4200	1.2275-08	1.1496-08	1.0666-08	9.7614-09	8.7519-09	1.4627-08
4300	1.2252-08	1.1475-08	1.0648-08	9.7454-09	8.7382-09	1.4612-08
4400	1.2225-08	1.1451-08	1.0627-08	9.7263-09	8.7215-09	1.4591-08
4500	1.2194-08	1.1423-08	1.0602-08	9.7041-09	8.7022-09	1.4565-08
4600	1.2160-08	1.1392-08	1.0574-08	9.6792-09	8.6804-09	1.4535-08
4700	1.2123-08	1.1358-08	1.0543-08	9.6518-09	8.6562-09	1.4500-08
4800	1.2083-08	1.1322-08	1.0510-08	9.6220-09	8.6299-09	1.4460-08
4900	1.2040-08	1.1283-08	1.0475-08	9.5900-09	8.6017-09	1.4418-08
5000	1.1995-08	1.1241-08	1.0437-08	9.5560-09	8.5716-09	1.4372-08
5500	1.1741-08	1.1006-08	1.0223-08	9.3615-09	8.3989-09	1.4099-08
6000	1.1450-08	1.0737-08	9.9761-09	9.1369-09	8.1988-09	1.3774-08
6500	1.1139-08	1.0448-08	9.7096-09	8.8941-09	7.9820-09	1.3418-08
7000	1.0817-08	1.0147-08	9.4326-09	8.6414-09	7.7562-09	1.3044-08
7500	1.0490-08	9.8433-09	9.1516-09	8.3849-09	7.5266-09	1.2663-08
8000	1.0166-08	9.5400-09	8.8712-09	8.1286-09	7.2972-09	1.2280-08
8500	9.8457-09	9.2411-09	8.5945-09	7.8757-09	7.0706-09	1.1902-08
9000	9.5330-09	8.9487-09	8.3237-09	7.6281-09	6.8487-09	1.1531-08
9500	9.2293-09	8.6646-09	8.0604-09	7.3872-09	6.6327-09	1.1169-08
10000	8.9354-09	8.3895-09	7.8054-09	7.1538-09	6.4235-09	1.0818-08
11000	8.3792-09	7.8688-09	7.3222-09	6.7116-09	6.0268-09	1.0153-08
12000	7.8660-09	7.3879-09	6.8758-09	6.3028-09	5.6600-09	9.5376-09
13000	7.3945-09	6.9459-09	6.4653-09	5.9268-09	5.3226-09	8.9709-09
14000	6.9621-09	6.5405-09	6.0885-09	5.5817-09	5.0127-09	8.4505-09
15000	6.5658-09	6.1687-09	5.7430-09	5.2651-09	4.7285-09	7.9729-09
16000	6.2024-09	5.8278-09	5.4260-09	4.9747-09	4.4677-09	7.5345-09
17000	5.8688-09	5.5148-09	5.1349-09	4.7079-09	4.2282-09	7.1318-09
18000	5.5623-09	5.2270-09	4.8673-09	4.4626-09	4.0079-09	6.7614-09
19000	5.2800-09	4.9621-09	4.6208-09	4.2367-09	3.8051-09	6.4202-09
20000	5.0197-09	4.7177-09	4.3935-09	4.0283-09	3.6179-09	6.1053-09
21000	4.7792-09	4.4919-09	4.1833-09	3.8357-09	3.4449-09	5.8142-09
22000	4.5566-09	4.2828-09	3.9888-09	3.6573-09	3.2847-09	5.5447-09
23000	4.3502-09	4.0889-09	3.8084-09	3.4919-09	3.1362-09	5.2947-09
24000	4.1584-09	3.9088-09	3.6407-09	3.3382-09	2.9981-09	5.0623-09
25000	3.9800-09	3.7412-09	3.4847-09	3.1952-09	2.8696-09	4.8460-09
26000	3.8136-09	3.5849-09	3.3392-09	3.0618-09	2.7498-09	4.6442-09
27000	3.6583-09	3.4390-09	3.2033-09	2.9372-09	2.6379-09	4.4538-09
28000	3.5130-09	3.3025-09	3.0762-09	2.8207-09	2.5333-09	4.2795-09
29000	3.3768-09	3.1746-09	2.9572-09	2.7115-09	2.4352-09	4.1143-09
30000	3.2491-09	3.0546-09	2.8455-09	2.6091-09	2.3432-09	3.9593-09

Table 40. Rate constant for hydrogen molecule in v=9 and J=1-6 states.

T(K)	v=9, J=1	v=9, J=2	v=9, J=3	v=9, J=4	v=9, J=5	v=9, J=6
100	1.9651-13	1.0234-12	1.1243-11	2.0885-10	9.6823-10	1.0772-09
200	6.9984-11	1.4648-10	4.1553-10	1.3539-09	2.2103-09	2.2235-09
300	4.7724-10	7.4419-10	1.3722-09	2.6375-09	3.3109-09	3.2588-09
400	1.2364-09	1.6735-09	2.5168-09	3.8107-09	4.3090-09	4.2098-09
500	2.1870-09	2.7290-09	3.6573-09	4.8644-09	5.2247-09	5.0885-09
600	3.2018-09	3.7937-09	4.7293-09	5.8154-09	6.0688-09	5.9021-09
700	4.2091-09	4.8142-09	5.7166-09	6.6786-09	6.8481-09	6.6554-09
800	5.1732-09	5.7694-09	6.6192-09	7.4655-09	7.5678-09	7.3527-09
900	6.0783-09	6.6529-09	7.4425-09	8.1845-09	8.2322-09	7.9974-09
1000	6.9187-09	7.4649-09	8.1929-09	8.8424-09	8.8450-09	8.5930-09
1100	7.6941-09	8.2088-09	8.8769-09	9.4450-09	9.4098-09	9.1426-09
1200	8.4066-09	8.8890-09	9.5003-09	9.9967-09	9.9296-09	9.6489-09
1300	9.0596-09	9.5101-09	1.0069-08	1.0502-08	1.0407-08	1.0115-08
1400	9.6570-09	1.0077-08	1.0586-08	1.0964-08	1.0846-08	1.0543-08
1500	1.0203-08	1.0593-08	1.1058-08	1.1386-08	1.1248-08	1.0935-08
1600	1.0700-08	1.1063-08	1.1487-08	1.1771-08	1.1615-08	1.1294-08
1700	1.1154-08	1.1491-08	1.1877-08	1.2121-08	1.1951-08	1.1623-08
1800	1.1566-08	1.1879-08	1.2231-08	1.2440-08	1.2256-08	1.1922-08
1900	1.1941-08	1.2231-08	1.2552-08	1.2730-08	1.2534-08	1.2194-08
2000	1.2281-08	1.2550-08	1.2843-08	1.2992-08	1.2786-08	1.2441-08
2100	1.2588-08	1.2839-08	1.3105-08	1.3228-08	1.3013-08	1.2665-08
2200	1.2866-08	1.3099-08	1.3341-08	1.3441-08	1.3218-08	1.2866-08
2300	1.3116-08	1.3333-08	1.3553-08	1.3632-08	1.3402-08	1.3047-08
2400	1.3341-08	1.3542-08	1.3742-08	1.3802-08	1.3567-08	1.3209-08
2500	1.3543-08	1.3729-08	1.3910-08	1.3954-08	1.3713-08	1.3353-08
2600	1.3723-08	1.3896-08	1.4060-08	1.4087-08	1.3842-08	1.3481-08
2700	1.3883-08	1.4043-08	1.4191-08	1.4205-08	1.3955-08	1.3593-08
2800	1.4024-08	1.4173-08	1.4306-08	1.4307-08	1.4054-08	1.3691-08
2900	1.4148-08	1.4286-08	1.4406-08	1.4394-08	1.4139-08	1.3775-08
3000	1.4256-08	1.4385-08	1.4492-08	1.4469-08	1.4211-08	1.3847-08
3100	1.4349-08	1.4469-08	1.4564-08	1.4531-08	1.4272-08	1.3907-08
3200	1.4429-08	1.4540-08	1.4624-08	1.4583-08	1.4321-08	1.3957-08
3300	1.4496-08	1.4599-08	1.4673-08	1.4623-08	1.4360-08	1.3997-08
3400	1.4551-08	1.4646-08	1.4712-08	1.4654-08	1.4390-08	1.4027-08
3500	1.4596-08	1.4684-08	1.4741-08	1.4676-08	1.4411-08	1.4049-08
3600	1.4630-08	1.4712-08	1.4761-08	1.4689-08	1.4424-08	1.4063-08
3700	1.4655-08	1.4731-08	1.4772-08	1.4695-08	1.4428-08	1.4069-08
3800	1.4672-08	1.4742-08	1.4776-08	1.4693-08	1.4429-08	1.4069-08
3900	1.4681-08	1.4745-08	1.4773-08	1.4685-08	1.4419-08	1.4062-08
4000	1.4682-08	1.4741-08	1.4763-08	1.4670-08	1.4405-08	1.4049-08

Table 40. (continued)

T(K)	v=9, J=1	v=9, J=2	v=9, J=3	v=9, J=4	v=9, J=5	v=9, J=6
4100	1.4676-08	1.4730-08	1.4747-08	1.4650-08	1.4385-08	1.4031-08
4200	1.4665-08	1.4714-08	1.4725-08	1.4625-08	1.4360-08	1.4008-08
4300	1.4647-08	1.4692-08	1.4698-08	1.4594-08	1.4330-08	1.3980-08
4400	1.4624-08	1.4665-08	1.4667-08	1.4559-08	1.4296-08	1.3947-08
4500	1.4596-08	1.4633-08	1.4630-08	1.4520-08	1.4258-08	1.3911-08
4600	1.4563-08	1.4597-08	1.4590-08	1.4477-08	1.4216-08	1.3871-08
4700	1.4526-08	1.4557-08	1.4546-08	1.4431-08	1.4170-08	1.3827-08
4800	1.4485-08	1.4513-08	1.4499-08	1.4381-08	1.4121-08	1.3780-08
4900	1.4441-08	1.4465-08	1.4448-08	1.4328-08	1.4070-08	1.3731-08
5000	1.4393-08	1.4415-08	1.4394-08	1.4272-08	1.4015-08	1.3679-08
5500	1.4113-08	1.4123-08	1.4090-08	1.3961-08	1.3711-08	1.3385-08
6000	1.3783-08	1.3784-08	1.3742-08	1.3609-08	1.3366-08	1.3052-08
6500	1.3423-08	1.3417-08	1.3368-08	1.3234-08	1.2999-08	1.2695-08
7000	1.3046-08	1.3035-08	1.2981-08	1.2846-08	1.2619-08	1.2327-08
7500	1.2662-08	1.2647-08	1.2590-08	1.2456-08	1.2237-08	1.1955-08
8000	1.2278-08	1.2259-08	1.2201-08	1.2068-08	1.1856-08	1.1585-08
8500	1.1898-08	1.1877-08	1.1817-08	1.1686-08	1.1482-08	1.1221-08
9000	1.1525-08	1.1503-08	1.1442-08	1.1314-08	1.1117-08	1.0866-08
9500	1.1163-08	1.1139-08	1.1078-08	1.0952-08	1.0762-08	1.0520-08
10000	1.0811-08	1.0787-08	1.0725-08	1.0603-08	1.0420-08	1.0186-08
11000	1.0145-08	1.0119-08	1.0059-08	9.9418-09	9.7713-09	9.5542-09
12000	9.5285-09	9.5024-09	9.4438-09	9.3327-09	9.1735-09	8.9711-09
13000	8.9615-09	8.9355-09	8.8788-09	8.7733-09	8.6245-09	8.4352-09
14000	8.4409-09	8.4153-09	8.3607-09	8.2607-09	8.1212-09	7.9439-09
15000	7.9633-09	7.9382-09	7.8858-09	7.7909-09	7.6599-09	7.4934-09
16000	7.5251-09	7.5006-09	7.4503-09	7.3603-09	7.2369-09	7.0803-09
17000	7.1225-09	7.0988-09	7.0506-09	6.9650-09	6.8487-09	6.7010-09
18000	6.7523-09	6.7294-09	6.6832-09	6.6018-09	6.4919-09	6.3524-09
19000	6.4113-09	6.3891-09	6.3449-09	6.2674-09	6.1634-09	6.0313-09
20000	6.0967-09	6.0752-09	6.0328-09	5.9590-09	5.8604-09	5.7351-09
21000	5.8058-09	5.7852-09	5.7445-09	5.6741-09	5.5804-09	5.4614-09
22000	5.5366-09	5.5166-09	5.4776-09	5.4103-09	5.3212-09	5.2080-09
23000	5.2868-09	5.2675-09	5.2301-09	5.1657-09	5.0808-09	4.9730-09
24000	5.0546-09	5.0361-09	5.0001-09	4.9385-09	4.8575-09	4.7546-09
25000	4.8385-09	4.8206-09	4.7860-09	4.7270-09	4.6496-09	4.5513-09
26000	4.6370-09	4.6197-09	4.5865-09	4.5299-09	4.4558-09	4.3617-09
27000	4.4488-09	4.4321-09	4.4001-09	4.3457-09	4.2748-09	4.1847-09
28000	4.2728-09	4.2566-09	4.2257-09	4.1735-09	4.1055-09	4.0191-09
29000	4.1078-09	4.0922-09	4.0624-09	4.0121-09	3.9468-09	3.8639-09
30000	3.9529-09	3.9378-09	3.9091-09	3.8607-09	3.7980-09	3.7183-09

Table 41. Rate constant for hydrogen molecule in  $v=9$  and  $J=7-12$  states.

T(K)	$v=9, J=7$	$v=9, J=8$	$v=9, J=9$	$v=9, J=10$	$v=9, J=11$	$v=9, J=12$
100	1.0456-09	9.5222-10	9.1907-10	9.5425-10	8.6276-10	8.0877-10
200	2.1421-09	2.0268-09	1.9329-09	1.8923-09	1.7523-09	1.6407-09
300	3.1367-09	2.9932-09	2.8506-09	2.7485-09	2.5652-09	2.4020-09
400	4.0530-09	3.8798-09	3.6960-09	3.5435-09	3.3199-09	3.1101-09
500	4.9014-09	4.6993-09	4.4793-09	4.2837-09	4.0228-09	3.7707-09
600	5.6880-09	5.4587-09	5.2066-09	4.9728-09	4.6777-09	4.3869-09
700	6.4173-09	6.1628-09	5.8817-09	5.6139-09	5.2873-09	4.9611-09
800	7.0929-09	6.8152-09	6.5082-09	6.2097-09	5.8543-09	5.4956-09
900	7.7184-09	7.4194-09	7.0889-09	6.7627-09	6.3809-09	5.9926-09
1000	8.2966-09	7.9783-09	7.6266-09	7.2752-09	6.8695-09	6.4541-09
1100	8.8305-09	8.4947-09	8.1239-09	7.7497-09	7.3222-09	6.8819-09
1200	9.3228-09	8.9711-09	8.5831-09	8.1884-09	7.7409-09	7.2780-09
1300	9.7761-09	9.4100-09	9.0066-09	8.5932-09	8.1277-09	7.6442-09
1400	1.0193-08	9.8138-09	9.3965-09	8.9662-09	8.4845-09	7.9822-09
1500	1.0575-08	1.0185-08	9.7549-09	9.3094-09	8.8130-09	8.2936-09
1600	1.0926-08	1.0525-08	1.0084-08	9.6246-09	9.1149-09	8.5801-09
1700	1.1246-08	1.0836-08	1.0385-08	9.9135-09	9.3918-09	8.8431-09
1800	1.1539-08	1.1120-08	1.0660-08	1.0178-08	9.6454-09	9.0841-09
1900	1.1805-08	1.1379-08	1.0911-08	1.0419-08	9.8771-09	9.3044-09
2000	1.2047-08	1.1614-08	1.1140-08	1.0638-08	1.0088-08	9.5053-09
2100	1.2266-08	1.1827-08	1.1347-08	1.0838-08	1.0280-08	9.6882-09
2200	1.2463-08	1.2020-08	1.1534-08	1.1018-08	1.0454-08	9.8540-09
2300	1.2641-08	1.2193-08	1.1703-08	1.1181-08	1.0611-08	1.0004-08
2400	1.2800-08	1.2349-08	1.1855-08	1.1327-08	1.0752-08	1.0139-08
2500	1.2942-08	1.2488-08	1.1991-08	1.1458-08	1.0879-08	1.0260-08
2600	1.3068-08	1.2611-08	1.2111-08	1.1575-08	1.0992-08	1.0369-08
2700	1.3179-08	1.2719-08	1.2218-08	1.1678-08	1.1092-08	1.0465-08
2800	1.3276-08	1.2815-08	1.2311-08	1.1769-08	1.1181-08	1.0549-08
2900	1.3359-08	1.2897-08	1.2393-08	1.1848-08	1.1258-08	1.0624-08
3000	1.3431-08	1.2968-08	1.2462-08	1.1916-08	1.1324-08	1.0688-08
3100	1.3491-08	1.3028-08	1.2522-08	1.1974-08	1.1381-08	1.0743-08
3200	1.3541-08	1.3077-08	1.2571-08	1.2023-08	1.1429-08	1.0790-08
3300	1.3582-08	1.3118-08	1.2612-08	1.2062-08	1.1469-08	1.0829-08
3400	1.3613-08	1.3149-08	1.2644-08	1.2094-08	1.1501-08	1.0860-08
3500	1.3635-08	1.3172-08	1.2668-08	1.2118-08	1.1525-08	1.0884-08
3600	1.3650-08	1.3188-08	1.2684-08	1.2135-08	1.1543-08	1.0902-08
3700	1.3658-08	1.3197-08	1.2694-08	1.2145-08	1.1554-08	1.0914-08
3800	1.3659-08	1.3199-08	1.2698-08	1.2150-08	1.1559-08	1.0920-08
3900	1.3654-08	1.3195-08	1.2695-08	1.2148-08	1.1559-08	1.0921-08
4000	1.3642-08	1.3185-08	1.2687-08	1.2142-08	1.1554-08	1.0917-08

Table 41. (continued)

T(K)	$v=9, J=7$	$v=9, J=8$	$v=9, J=9$	$v=9, J=10$	$v=9, J=11$	$v=9, J=12$
4100	1.3626-08	1.3170-08	1.2674-08	1.2130-08	1.1545-08	1.0909-08
4200	1.3604-08	1.3151-08	1.2656-08	1.2114-08	1.1530-08	1.0896-08
4300	1.3578-08	1.3126-08	1.2634-08	1.2094-08	1.1512-08	1.0880-08
4400	1.3548-08	1.3098-08	1.2608-08	1.2069-08	1.1490-08	1.0860-08
4500	1.3514-08	1.3066-08	1.2578-08	1.2042-08	1.1465-08	1.0837-08
4600	1.3476-08	1.3030-08	1.2545-08	1.2010-08	1.1436-08	1.0811-08
4700	1.3435-08	1.2991-08	1.2508-08	1.1976-08	1.1405-08	1.0781-08
4800	1.3390-08	1.2949-08	1.2469-08	1.1939-08	1.1370-08	1.0750-08
4900	1.3343-08	1.2904-08	1.2427-08	1.1899-08	1.1333-08	1.0715-08
5000	1.3293-08	1.2857-08	1.2382-08	1.1857-08	1.1294-08	1.0679-08
5500	1.3011-08	1.2588-08	1.2127-08	1.1616-08	1.1068-08	1.0469-08
6000	1.2691-08	1.2281-08	1.1835-08	1.1339-08	1.0807-08	1.0224-08
6500	1.2347-08	1.1951-08	1.1520-08	1.1039-08	1.0524-08	9.9590-09
7000	1.1992-08	1.1609-08	1.1193-08	1.0728-08	1.0230-08	9.6820-09
7500	1.1632-08	1.1263-08	1.0861-08	1.0411-08	9.9303-09	9.4001-09
8000	1.1274-08	1.0918-08	1.0530-08	1.0096-08	9.6309-09	9.1180-09
8500	1.0922-08	1.0578-08	1.0204-08	9.7838-09	9.3351-09	8.8391-09
9000	1.0577-08	1.0245-08	9.8846-09	9.4787-09	9.0452-09	8.5656-09
9500	1.0242-08	9.9216-09	9.5739-09	9.1816-09	8.7629-09	8.2992-09
10000	9.9177-09	9.6086-09	9.2729-09	8.8939-09	8.4893-09	8.0408-09
11000	9.3041-09	9.0158-09	8.7027-09	8.3483-09	7.9702-09	7.5505-09
12000	8.7377-09	8.4682-09	8.1756-09	7.8438-09	7.4899-09	7.0964-09
13000	8.2170-09	7.9647-09	7.6906-09	7.3794-09	7.0475-09	6.6781-09
14000	7.7393-09	7.5025-09	7.2454-09	6.9529-09	6.6410-09	6.2935-09
15000	7.3013-09	7.0786-09	6.8368-09	6.5614-09	6.2678-09	5.9404-09
16000	6.8994-09	6.6896-09	6.4618-09	6.2020-09	5.9251-09	5.6160-09
17000	6.5304-09	6.3324-09	6.1173-09	5.8717-09	5.6101-09	5.3178-09
18000	6.1911-09	6.0038-09	5.8003-09	5.5679-09	5.3202-09	5.0433-09
19000	5.8786-09	5.7011-09	5.5083-09	5.2879-09	5.0530-09	4.7903-09
20000	5.5903-09	5.4218-09	5.2388-09	5.0295-09	4.8063-09	4.5567-09
21000	5.3238-09	5.1637-09	4.9897-09	4.7905-09	4.5782-09	4.3406-09
22000	5.0771-09	4.9246-09	4.7589-09	4.5692-09	4.3669-09	4.1405-09
23000	4.8482-09	4.7028-09	4.5448-09	4.3638-09	4.1708-09	3.9547-09
24000	4.6355-09	4.4967-09	4.3458-09	4.1729-09	3.9885-09	3.7819-09
25000	4.4375-09	4.3048-09	4.1606-09	3.9951-09	3.8188-09	3.6211-09
26000	4.2529-09	4.1258-09	3.9877-09	3.8293-09	3.6604-09	3.4710-09
27000	4.0804-09	3.9586-09	3.8263-09	3.6743-09	3.5124-09	3.3308-09
28000	3.9190-09	3.8022-09	3.6752-09	3.5294-09	3.3739-09	3.1995-09
29000	3.7678-09	3.6556-09	3.5337-09	3.3935-09	3.2442-09	3.0765-09
30000	3.6259-09	3.5181-09	3.4008-09	3.2660-09	3.1223-09	2.9610-09

Table 42. Rate constant for hydrogen molecule in  $v=9$  and  $J=13$ -16 states and  $v=10$  and  $J=0$ -1 stat

T(K)	$v=9, J=13$	$v=9, J=14$	$v=9, J=15$	$v=9, J=16$	$v=10, J=0$	$v=10, J=1$
100	6.7627-10	6.6247-10	6.2484-10	5.5609-10	8.8282-10	7.8973-10
200	1.4791-09	1.3812-09	1.2684-09	1.1245-09	1.8848-09	1.8144-09
300	2.2048-09	2.0391-09	1.8599-09	1.6474-09	2.7884-09	2.7302-09
400	2.8738-09	2.6503-09	2.4116-09	2.1359-09	3.6192-09	3.5666-09
500	3.4953-09	3.2204-09	2.9275-09	2.5933-09	4.3887-09	4.3385-09
600	4.0738-09	3.7525-09	3.4099-09	3.0213-09	5.1032-09	5.0537-09
700	4.6124-09	4.2488-09	3.8604-09	3.4213-09	5.7669-09	5.7172-09
800	5.1137-09	4.7114-09	4.2807-09	3.7948-09	6.3831-09	6.3327-09
900	5.5797-09	5.1420-09	4.6723-09	4.1430-09	6.9547-09	6.9035-09
1000	6.0125-09	5.5423-09	5.0367-09	4.4672-09	7.4844-09	7.4323-09
1100	6.4139-09	5.9140-09	5.3751-09	4.7686-09	7.9748-09	7.9217-09
1200	6.7857-09	6.2585-09	5.6891-09	5.0482-09	8.4280-09	8.3740-09
1300	7.1296-09	6.5773-09	5.9799-09	5.3074-09	8.8465-09	8.7915-09
1400	7.4471-09	6.8720-09	6.2489-09	5.5472-09	9.2322-09	9.1764-09
1500	7.7398-09	7.1439-09	6.4971-09	5.7686-09	9.5872-09	9.5306-09
1600	8.0092-09	7.3943-09	6.7259-09	5.9728-09	9.9133-09	9.8560-09
1700	8.2567-09	7.6245-09	6.9363-09	6.1607-09	1.0212-08	1.0154-08
1800	8.4835-09	7.8357-09	7.1294-09	6.3332-09	1.0486-08	1.0428-08
1900	8.6911-09	8.0290-09	7.3064-09	6.4913-09	1.0736-08	1.0677-08
2000	8.8806-09	8.2056-09	7.4681-09	6.6359-09	1.0964-08	1.0905-08
2100	9.0530-09	8.3665-09	7.6155-09	6.7678-09	1.1171-08	1.1111-08
2200	9.2096-09	8.5127-09	7.7495-09	6.8877-09	1.1358-08	1.1298-08
2300	9.3513-09	8.6451-09	7.8710-09	6.9965-09	1.1528-08	1.1468-08
2400	9.4791-09	8.7646-09	7.9806-09	7.0947-09	1.1680-08	1.1620-08
2500	9.5938-09	8.8720-09	8.0793-09	7.1832-09	1.1817-08	1.1756-08
2600	9.6964-09	8.9682-09	8.1677-09	7.2624-09	1.1938-08	1.1878-08
2700	9.7876-09	9.0538-09	8.2464-09	7.3331-09	1.2046-08	1.1986-08
2800	9.8681-09	9.1295-09	8.3162-09	7.3957-09	1.2141-08	1.2081-08
2900	9.9388-09	9.1960-09	8.3775-09	7.4509-09	1.2224-08	1.2164-08
3000	1.0000-08	9.2539-09	8.4309-09	7.4990-09	1.2296-08	1.2236-08
3100	1.0053-08	9.3038-09	8.4770-09	7.5406-09	1.2358-08	1.2297-08
3200	1.0098-08	9.3461-09	8.5163-09	7.5760-09	1.2409-08	1.2349-08
3300	1.0135-08	9.3815-09	8.5492-09	7.6057-09	1.2452-08	1.2392-08
3400	1.0165-08	9.4104-09	8.5761-09	7.6301-09	1.2486-08	1.2426-08
3500	1.0189-08	9.4332-09	8.5974-09	7.6496-09	1.2512-08	1.2453-08
3600	1.0206-08	9.4503-09	8.6136-09	7.6644-09	1.2531-08	1.2472-08
3700	1.0218-08	9.4622-09	8.6249-09	7.6749-09	1.2543-08	1.2484-08
3800	1.0225-08	9.4692-09	8.6318-09	7.6813-09	1.2549-08	1.2490-08
3900	1.0227-08	9.4716-09	8.6345-09	7.6841-09	1.2549-08	1.2491-08
4000	1.0224-08	9.4697-09	8.6332-09	7.6833-09	1.2544-08	1.2486-08

Table 42. (continued)

T(K)	$v=9, J=13$	$v=9, J=14$	$v=9, J=15$	$v=9, J=16$	$v=10, J=0$	$v=10, J=1$
4100	1.0217-08	9.4639-09	8.6284-09	7.6793-09	1.2533-08	1.2475-08
4200	1.0206-08	9.4544-09	8.6202-09	7.6723-09	1.2518-08	1.2460-08
4300	1.0191-08	9.4415-09	8.6088-09	7.6625-09	1.2498-08	1.2441-08
4400	1.0173-08	9.4255-09	8.5946-09	7.6501-09	1.2475-08	1.2418-08
4500	1.0152-08	9.4065-09	8.5776-09	7.6353-09	1.2447-08	1.2391-08
4600	1.0128-08	9.3848-09	8.5582-09	7.6183-09	1.2416-08	1.2360-08
4700	1.0101-08	9.3606-09	8.5364-09	7.5991-09	1.2382-08	1.2326-08
4800	1.0072-08	9.3340-09	8.5126-09	7.5781-09	1.2345-08	1.2290-08
4900	1.0041-08	9.3053-09	8.4867-09	7.5553-09	1.2305-08	1.2250-08
5000	1.0007-08	9.2746-09	8.4590-09	7.5308-09	1.2263-08	1.2208-08
5500	9.8121-09	9.0963-09	8.2976-09	7.3881-09	1.2020-08	1.1967-08
6000	9.5850-09	8.8876-09	8.1083-09	7.2202-09	1.1738-08	1.1687-08
6500	9.3379-09	8.6599-09	7.9015-09	7.0365-09	1.1434-08	1.1384-08
7000	9.0796-09	8.4216-09	7.6847-09	6.8439-09	1.1116-08	1.1069-08
7500	8.8164-09	8.1785-09	7.4635-09	6.6473-09	1.0793-08	1.0747-08
8000	8.5528-09	7.9349-09	7.2417-09	6.4499-09	1.0470-08	1.0426-08
8500	8.2920-09	7.6937-09	7.0220-09	6.2545-09	1.0151-08	1.0108-08
9000	8.0362-09	7.4570-09	6.8063-09	6.0625-09	9.8376-09	9.7969-09
9500	7.7869-09	7.2263-09	6.5960-09	5.8753-09	9.5328-09	9.4936-09
10000	7.5451-09	7.0023-09	6.3918-09	5.6935-09	9.2372-09	9.1995-09
11000	7.0858-09	6.5769-09	6.0038-09	5.3481-09	8.6763-09	8.6412-09
12000	6.6604-09	6.1827-09	5.6442-09	5.0278-09	8.1570-09	8.1242-09
13000	6.2683-09	5.8192-09	5.3126-09	4.7324-09	7.6784-09	7.6477-09
14000	5.9079-09	5.4849-09	5.0075-09	4.4607-09	7.2384-09	7.2097-09
15000	5.5767-09	5.1778-09	4.7272-09	4.2110-09	6.8343-09	6.8073-09
16000	5.2725-09	4.8955-09	4.4696-09	3.9815-09	6.4630-09	6.4376-09
17000	4.9928-09	4.6360-09	4.2327-09	3.7704-09	6.1215-09	6.0976-09
18000	4.7353-09	4.3971-09	4.0146-09	3.5761-09	5.8071-09	5.7845-09
19000	4.4979-09	4.1768-09	3.8135-09	3.3969-09	5.5173-09	5.4958-09
20000	4.2787-09	3.9733-09	3.6278-09	3.2314-09	5.2496-09	5.2292-09
21000	4.0759-09	3.7851-09	3.4560-09	3.0783-09	5.0019-09	4.9826-09
22000	3.8880-09	3.6107-09	3.2967-09	2.9365-09	4.7724-09	4.7540-09
23000	3.7137-09	3.4489-09	3.1490-09	2.8048-09	4.5593-09	4.5417-09
24000	3.5515-09	3.2983-09	3.0115-09	2.6824-09	4.3611-09	4.3444-09
25000	3.4005-09	3.1581-09	2.8835-09	2.5683-09	4.1765-09	4.1605-09
26000	3.2597-09	3.0274-09	2.7641-09	2.4619-09	4.0042-09	3.9889-09
27000	3.1280-09	2.9051-09	2.6525-09	2.3625-09	3.8432-09	3.8285-09
28000	3.0048-09	2.7907-09	2.5480-09	2.2694-09	3.6924-09	3.6784-09
29000	2.8893-09	2.6835-09	2.4501-09	2.1822-09	3.5511-09	3.5376-09
30000	2.7809-09	2.5828-09	2.3582-09	2.1003-09	3.4184-09	3.4054-09

Table 43. Rate constant for hydrogen molecule in  $v=10$  and  $J=2-7$  states.

T(K)	$v=10, J=2$	$v=10, J=3$	$v=10, J=4$	$v=10, J=5$	$v=10, J=6$	$v=10, J=7$
100	9.1802-10	9.0803-10	8.5733-10	8.7778-10	8.5309-10	7.5549-10
200	1.8882-09	1.8556-09	1.7963-09	1.7729-09	1.7182-09	1.6112-09
300	2.7685-09	2.7185-09	2.6472-09	2.5904-09	2.5087-09	2.3853-09
400	3.5812-09	3.5169-09	3.4323-09	3.3490-09	3.2429-09	3.0994-09
500	4.3355-09	4.2589-09	4.1611-09	4.0556-09	3.9271-09	3.7629-09
600	5.0368-09	4.9493-09	4.8388-09	4.7141-09	4.5650-09	4.3804-09
700	5.6877-09	5.5915-09	5.4692-09	5.3272-09	5.1593-09	4.9554-09
800	6.2944-09	6.1885-09	6.0551-09	5.8977-09	5.7126-09	5.4905-09
900	6.8566-09	6.7428-09	6.5992-09	6.4279-09	6.2269-09	5.9880-09
1000	7.3778-09	7.2569-09	7.1039-09	6.9201-09	6.7046-09	6.4500-09
1100	7.8604-09	7.7331-09	7.5714-09	7.3763-09	7.1475-09	6.8786-09
1200	8.3067-09	8.1736-09	8.0041-09	7.7987-09	7.5578-09	7.2755-09
1300	8.7188-09	8.5805-09	8.4038-09	8.1891-09	7.9371-09	7.6427-09
1400	9.0987-09	8.9558-09	8.7725-09	8.5494-09	8.2874-09	7.9819-09
1500	9.4485-09	9.3014-09	9.1121-09	8.8814-09	8.6103-09	8.2947-09
1600	9.7700-09	9.6190-09	9.4244-09	9.1869-09	8.9075-09	8.5826-09
1700	1.0065-08	9.9105-09	9.7111-09	9.4674-09	9.1805-09	8.8473-09
1800	1.0335-08	1.0177-08	9.9737-09	9.7244-09	9.4308-09	9.0900-09
1900	1.0581-08	1.0421-08	1.0214-08	9.9595-09	9.6598-09	9.3122-09
2000	1.0806-08	1.0644-08	1.0433-08	1.0174-08	9.8688-09	9.5151-09
2100	1.1010-08	1.0846-08	1.0632-08	1.0369-08	1.0059-08	9.6999-09
2200	1.1195-08	1.1029-08	1.0812-08	1.0546-08	1.0232-08	9.8678-09
2300	1.1363-08	1.1195-08	1.0976-08	1.0707-08	1.0388-08	1.0020-08
2400	1.1513-08	1.1344-08	1.1123-08	1.0851-08	1.0529-08	1.0157-08
2500	1.1648-08	1.1478-08	1.1255-08	1.0981-08	1.0656-08	1.0281-08
2600	1.1768-08	1.1597-08	1.1372-08	1.1097-08	1.0770-08	1.0391-08
2700	1.1875-08	1.1703-08	1.1477-08	1.1200-08	1.0870-08	1.0489-08
2800	1.1969-08	1.1797-08	1.1569-08	1.1291-08	1.0959-08	1.0576-08
2900	1.2051-08	1.1878-08	1.1650-08	1.1370-08	1.1038-08	1.0653-08
3000	1.2122-08	1.1949-08	1.1720-08	1.1440-08	1.1106-08	1.0719-08
3100	1.2183-08	1.2010-08	1.1781-08	1.1499-08	1.1164-08	1.0777-08
3200	1.2234-08	1.2061-08	1.1831-08	1.1549-08	1.1214-08	1.0825-08
3300	1.2277-08	1.2103-08	1.1874-08	1.1591-08	1.1255-08	1.0866-08
3400	1.2311-08	1.2138-08	1.1908-08	1.1625-08	1.1289-08	1.0900-08
3500	1.2337-08	1.2164-08	1.1934-08	1.1652-08	1.1315-08	1.0926-08
3600	1.2356-08	1.2183-08	1.1954-08	1.1671-08	1.1335-08	1.0946-08
3700	1.2368-08	1.2196-08	1.1967-08	1.1685-08	1.1348-08	1.0959-08
3800	1.2374-08	1.2203-08	1.1973-08	1.1692-08	1.1356-08	1.0968-08
3900	1.2374-08	1.2203-08	1.1975-08	1.1694-08	1.1359-08	1.0971-08
4000	1.2369-08	1.2199-08	1.1971-08	1.1691-08	1.1356-08	1.0969-08

Table 43. (continued)

T(K)	$v=10, J=2$	$v=10, J=3$	$v=10, J=4$	$v=10, J=5$	$v=10, J=6$	$v=10, J=7$
4100	1.2359-08	1.2189-08	1.1962-08	1.1682-08	1.1348-08	1.0962-08
4200	1.2344-08	1.2175-08	1.1948-08	1.1670-08	1.1337-08	1.0951-08
4300	1.2325-08	1.2157-08	1.1931-08	1.1653-08	1.1321-08	1.0937-08
4400	1.2302-08	1.2134-08	1.1909-08	1.1633-08	1.1302-08	1.0919-08
4500	1.2275-08	1.2108-08	1.1884-08	1.1609-08	1.1279-08	1.0897-08
4600	1.2245-08	1.2079-08	1.1856-08	1.1581-08	1.1252-08	1.0872-08
4700	1.2212-08	1.2046-08	1.1824-08	1.1551-08	1.1223-08	1.0845-08
4800	1.2175-08	1.2011-08	1.1789-08	1.1518-08	1.1191-08	1.0814-08
4900	1.2136-08	1.1973-08	1.1752-08	1.1482-08	1.1157-08	1.0781-08
5000	1.2095-08	1.1932-08	1.1713-08	1.1443-08	1.1120-08	1.0746-08
5500	1.1856-08	1.1698-08	1.1484-08	1.1222-08	1.0907-08	1.0542-08
6000	1.1579-08	1.1426-08	1.1219-08	1.0964-08	1.0658-08	1.0303-08
6500	1.1279-08	1.1131-08	1.0930-08	1.0684-08	1.0387-08	1.0042-08
7000	1.0966-08	1.0823-08	1.0629-08	1.0390-08	1.0103-08	9.7691-09
7500	1.0648-08	1.0510-08	1.0322-08	1.0092-08	9.8130-09	9.4901-09
8000	1.0330-08	1.0197-08	1.0015-08	9.7923-09	9.5227-09	9.2104-09
8500	1.0015-08	9.8868-09	9.7115-09	9.4960-09	9.2354-09	8.9332-09
9000	9.7068-09	9.5829-09	9.4136-09	9.2054-09	8.9534-09	8.6611-09
9500	9.4064-09	9.2868-09	9.1232-09	8.9220-09	8.6783-09	8.3957-09
10000	9.1151-09	8.9996-09	8.8415-09	8.6470-09	8.4113-09	8.1380-09
11000	8.5621-09	8.4543-09	8.3065-09	8.1246-09	7.9041-09	7.6481-09
12000	8.0499-09	7.9492-09	7.8108-09	7.6405-09	7.4337-09	7.1937-09
13000	7.5780-09	7.4836-09	7.3538-09	7.1940-09	6.9999-09	6.7745-09
14000	7.1440-09	7.0554-09	6.9334-09	6.7833-09	6.6006-09	6.3886-09
15000	6.7454-09	6.6620-09	6.5472-09	6.4057-09	6.2337-09	6.0338-09
16000	6.3791-09	6.3005-09	6.1921-09	6.0587-09	5.8963-09	5.7075-09
17000	6.0422-09	5.9680-09	5.8656-09	5.7395-09	5.5858-09	5.4073-09
18000	5.7321-09	5.6619-09	5.5649-09	5.4454-09	5.2999-09	5.1307-09
19000	5.4461-09	5.3795-09	5.2875-09	5.1743-09	5.0361-09	4.8756-09
20000	5.1819-09	5.1187-09	5.0313-09	4.9237-09	4.7925-09	4.6398-09
21000	4.9375-09	4.8774-09	4.7943-09	4.6919-09	4.5669-09	4.4216-09
22000	4.7110-09	4.6538-09	4.5746-09	4.4770-09	4.3579-09	4.2193-09
23000	4.5007-09	4.4461-09	4.3705-09	4.2774-09	4.1637-09	4.0315-09
24000	4.3051-09	4.2530-09	4.1808-09	4.0918-09	3.9831-09	3.8567-09
25000	4.1229-09	4.0731-09	4.0040-09	3.9189-09	3.8149-09	3.6938-09
26000	3.9529-09	3.9052-09	3.8390-09	3.7574-09	3.6578-09	3.5418-09
27000	3.7940-09	3.7483-09	3.6848-09	3.6066-09	3.5110-09	3.3997-09
28000	3.6452-09	3.6013-09	3.5404-09	3.4653-09	3.3735-09	3.2667-09
29000	3.5058-09	3.4636-09	3.4050-09	3.3328-09	3.2446-09	3.1419-09
30000	3.3748-09	3.3342-09	3.2779-09	3.2085-09	3.1236-09	3.0247-09

Table 44. Rate constant for hydrogen molecule in  $v=10$  and  $J=8-13$  states.

T(K)	$v=10, J=8$	$v=10, J=9$	$v=10, J=10$	$v=10, J=11$	$v=10, J=12$	$v=10, J=13$
100	6.9165-10	7.0034-10	6.2586-10	6.5709-10	5.8770-10	5.3966-10
200	1.5146-09	1.4605-09	1.3615-09	1.3107-09	1.1908-09	1.0832-09
300	2.2584-09	2.1558-09	2.0257-09	1.9120-09	1.7453-09	1.5831-09
400	2.9440-09	2.8012-09	2.6385-09	2.4740-09	2.2634-09	2.0503-09
500	3.5807-09	3.4030-09	3.2081-09	2.9999-09	2.7483-09	2.4879-09
600	4.1735-09	3.9645-09	3.7390-09	3.4919-09	3.2021-09	2.8975-09
700	4.7256-09	4.4884-09	4.2338-09	3.9518-09	3.6265-09	3.2807-09
800	5.2395-09	4.9766-09	4.6949-09	4.3810-09	4.0227-09	3.6388-09
900	5.7175-09	5.4312-09	5.1242-09	4.7812-09	4.3923-09	3.9728-09
1000	6.1615-09	5.8538-09	5.5234-09	5.1538-09	4.7366-09	4.2841-09
1100	6.5736-09	6.2464-09	5.8942-09	5.5001-09	5.0568-09	4.5737-09
1200	6.9556-09	6.6104-09	6.2381-09	5.8217-09	5.3542-09	4.8428-09
1300	7.3090-09	6.9476-09	6.5567-09	6.1197-09	5.6300-09	5.0924-09
1400	7.6356-09	7.2593-09	6.8514-09	6.3956-09	5.8854-09	5.3237-09
1500	7.9370-09	7.5471-09	7.1235-09	6.6505-09	6.1215-09	5.5375-09
1600	8.2146-09	7.8123-09	7.3743-09	6.8857-09	6.3394-09	5.7349-09
1700	8.4698-09	8.0563-09	7.6052-09	7.1022-09	6.5401-09	5.9168-09
1800	8.7040-09	8.2804-09	7.8172-09	7.3012-09	6.7247-09	6.0841-09
1900	8.9185-09	8.4857-09	8.0116-09	7.4837-09	6.8941-09	6.2376-09
2000	9.1146-09	8.6735-09	8.1894-09	7.6508-09	7.0491-09	6.3783-09
2100	9.2933-09	8.8447-09	8.3516-09	7.8033-09	7.1908-09	6.5068-09
2200	9.4557-09	9.0005-09	8.4993-09	7.9422-09	7.3199-09	6.6239-09
2300	9.6029-09	9.1418-09	8.6332-09	8.0683-09	7.4371-09	6.7303-09
2400	9.7359-09	9.2695-09	8.7544-09	8.1824-09	7.5433-09	6.8267-09
2500	9.8556-09	9.3845-09	8.8635-09	8.2852-09	7.6391-09	6.9137-09
2600	9.9628-09	9.4877-09	8.9614-09	8.3776-09	7.7251-09	6.9919-09
2700	1.0058-08	9.5797-09	9.0488-09	8.4601-09	7.8021-09	7.0619-09
2800	1.0143-08	9.6613-09	9.1264-09	8.5334-09	7.8706-09	7.1241-09
2900	1.0218-08	9.7332-09	9.1947-09	8.5981-09	7.9310-09	7.1791-09
3000	1.0282-08	9.7960-09	9.2545-09	8.6548-09	7.9841-09	7.2274-09
3100	1.0339-08	9.8503-09	9.3063-09	8.7039-09	8.0301-09	7.2693-09
3200	1.0386-08	9.8968-09	9.3506-09	8.7460-09	8.0697-09	7.3054-09
3300	1.0427-08	9.9358-09	9.3879-09	8.7816-09	8.1031-09	7.3359-09
3400	1.0459-08	9.9680-09	9.4187-09	8.8110-09	8.1309-09	7.3613-09
3500	1.0486-08	9.9937-09	9.4434-09	8.8347-09	8.1534-09	7.3819-09
3600	1.0506-08	1.0013-08	9.4624-09	8.8531-09	8.1710-09	7.3980-09
3700	1.0520-08	1.0028-08	9.4762-09	8.8666-09	8.1839-09	7.4099-09
3800	1.0528-08	1.0036-08	9.4850-09	8.8753-09	8.1926-09	7.4179-09
3900	1.0532-08	1.0041-08	9.4892-09	8.8798-09	8.1972-09	7.4223-09
4000	1.0531-08	1.0040-08	9.4891-09	8.8803-09	8.1981-09	7.4233-09

Table 44. (continued)

T(K)	$v=10, J=8$	$v=10, J=9$	$v=10, J=10$	$v=10, J=11$	$v=10, J=12$	$v=10, J=13$
4100	1.0525-08	1.0036-08	9.4851-09	8.8770-09	8.1955-09	7.4211-09
4200	1.0516-08	1.0027-08	9.4774-09	8.8702-09	8.1897-09	7.4160-09
4300	1.0502-08	1.0015-08	9.4662-09	8.8602-09	8.1809-09	7.4082-09
4400	1.0485-08	9.9993-09	9.4518-09	8.8472-09	8.1693-09	7.3978-09
4500	1.0465-08	9.9807-09	9.4345-09	8.8314-09	8.1551-09	7.3851-09
4600	1.0442-08	9.9591-09	9.4143-09	8.8129-09	8.1385-09	7.3702-09
4700	1.0416-08	9.9349-09	9.3917-09	8.7921-09	8.1196-09	7.3532-09
4800	1.0388-08	9.9081-09	9.3667-09	8.7691-09	8.0987-09	7.3344-09
4900	1.0357-08	9.8791-09	9.3394-09	8.7440-09	8.0758-09	7.3138-09
5000	1.0324-08	9.8479-09	9.3102-09	8.7169-09	8.0512-09	7.2916-09
5500	1.0130-08	9.6652-09	9.1386-09	8.5578-09	7.9057-09	7.1603-09
6000	9.9023-09	9.4497-09	8.9357-09	8.3691-09	7.7325-09	7.0038-09
6500	9.6532-09	9.2134-09	8.7131-09	8.1617-09	7.5418-09	6.8314-09
7000	9.3919-09	8.9652-09	8.4791-09	7.9434-09	7.3409-09	6.6497-09
7500	9.1250-09	8.7114-09	8.2396-09	7.7199-09	7.1351-09	6.4633-09
8000	8.8571-09	8.4566-09	7.9991-09	7.4952-09	6.9279-09	6.2758-09
8500	8.5915-09	8.2038-09	7.7604-09	7.2721-09	6.7222-09	6.0896-09
9000	8.3306-09	7.9554-09	7.5258-09	7.0528-09	6.5199-09	5.9064-09
9500	8.0760-09	7.7129-09	7.2967-09	6.8385-09	6.3221-09	5.7273-09
10000	7.8288-09	7.4772-09	7.0741-09	6.6302-09	6.1299-09	5.5532-09
11000	7.3585-09	7.0290-09	6.6504-09	6.2338-09	5.7638-09	5.2216-09
12000	6.9222-09	6.6128-09	6.2570-09	5.8655-09	5.4237-09	4.9134-09
13000	6.5194-09	6.2286-09	5.8937-09	5.5253-09	5.1093-09	4.6287-09
14000	6.1485-09	5.8747-09	5.5591-09	5.2119-09	4.8197-09	4.3663-09
15000	5.8075-09	5.5492-09	5.2513-09	4.9235-09	4.5532-09	4.1248-09
16000	5.4938-09	5.2498-09	4.9681-09	4.6581-09	4.3079-09	3.9025-09
17000	5.2052-09	4.9742-09	4.7074-09	4.4138-09	4.0821-09	3.6979-09
18000	4.9392-09	4.7202-09	4.4671-09	4.1886-09	3.8739-09	3.5093-09
19000	4.6938-09	4.4858-09	4.2454-09	3.9808-09	3.6817-09	3.3351-09
20000	4.4670-09	4.2692-09	4.0404-09	3.7887-09	3.5041-09	3.1742-09
21000	4.2571-09	4.0687-09	3.8507-09	3.6109-09	3.3397-09	3.0252-09
22000	4.0624-09	3.8828-09	3.6748-09	3.4460-09	3.1872-09	2.8870-09
23000	3.8817-09	3.7101-09	3.5114-09	3.2928-09	3.0455-09	2.7587-09
24000	3.7135-09	3.5494-09	3.3594-09	3.1503-09	2.9137-09	2.6392-09
25000	3.5568-09	3.3997-09	3.2177-09	3.0174-09	2.7908-09	2.5279-09
26000	3.4105-09	3.2599-09	3.0854-09	2.8934-09	2.6761-09	2.4240-09
27000	3.2737-09	3.1293-09	2.9617-09	2.7774-09	2.5689-09	2.3268-09
28000	3.1456-09	3.0069-09	2.8459-09	2.6688-09	2.4684-09	2.2358-09
29000	3.0255-09	2.8921-09	2.7373-09	2.5670-09	2.3743-09	2.1504-09
30000	2.9128-09	2.7843-09	2.6353-09	2.4714-09	2.2858-09	2.0703-09



Table 45. Rate constant for hydrogen molecule in  $v=10$  and  $J=14$  states and  $v=11$  and  $J=0-4$  states.

T(K)	$v=10, J=14$	$v=11, J=0$	$v=11, J=1$	$v=11, J=2$	$v=11, J=3$	$v=11, J=4$
100	4.6291-10	7.2118-10	7.0824-10	7.0879-10	6.6795-10	6.7734-10
200	9.4054-10	1.4671-09	1.4590-09	1.4421-09	1.3935-09	1.3758-09
300	1.3802-09	2.1512-09	2.1441-09	2.1147-09	2.0576-09	2.0169-09
400	1.7908-09	2.7886-09	2.7800-09	2.7408-09	2.6748-09	2.6151-09
500	2.1752-09	3.3841-09	3.3729-09	3.3257-09	3.2507-09	3.1747-09
600	2.5351-09	3.9406-09	3.9265-09	3.8722-09	3.7887-09	3.6981-09
700	2.8718-09	4.4604-09	4.4432-09	4.3827-09	4.2910-09	4.1873-09
800	3.1866-09	4.9454-09	4.9251-09	4.8589-09	4.7597-09	4.6440-09
900	3.4803-09	5.3974-09	5.3741-09	5.3028-09	5.1966-09	5.0698-09
1000	3.7541-09	5.8181-09	5.7920-09	5.7161-09	5.6032-09	5.4665-09
1100	4.0089-09	6.2092-09	6.1803-09	6.1002-09	5.9814-09	5.8354-09
1200	4.2457-09	6.5722-09	6.5408-09	6.4569-09	6.3324-09	6.1780-09
1300	4.4655-09	6.9087-09	6.8749-09	6.7876-09	6.6579-09	6.4958-09
1400	4.6691-09	7.2202-09	7.1841-09	7.0936-09	6.9593-09	6.7900-09
1500	4.8575-09	7.5081-09	7.4699-09	7.3765-09	7.2379-09	7.0622-09
1600	5.0314-09	7.7737-09	7.7335-09	7.6376-09	7.4950-09	7.3133-09
1700	5.1917-09	8.0183-09	7.9763-09	7.8780-09	7.7319-09	7.5448-09
1800	5.3392-09	8.2431-09	8.1995-09	8.0991-09	7.9497-09	7.7577-09
1900	5.4747-09	8.4494-09	8.4042-09	8.3020-09	8.1497-09	7.9532-09
2000	5.5987-09	8.6383-09	8.5916-09	8.4877-09	8.3328-09	8.1322-09
2100	5.7122-09	8.8108-09	8.7628-09	8.6574-09	8.5001-09	8.2959-09
2200	5.8155-09	8.9680-09	8.9187-09	8.8120-09	8.6525-09	8.4450-09
2300	5.9095-09	9.1108-09	9.0604-09	8.9524-09	8.7911-09	8.5806-09
2400	5.9947-09	9.2400-09	9.1886-09	9.0796-09	8.9166-09	8.7035-09
2500	6.0716-09	9.3566-09	9.3043-09	9.1944-09	9.0299-09	8.8145-09
2600	6.1407-09	9.4614-09	9.4082-09	9.2976-09	9.1318-09	8.9142-09
2700	6.2026-09	9.5551-09	9.5011-09	9.3898-09	9.2229-09	9.0035-09
2800	6.2576-09	9.6385-09	9.5837-09	9.4719-09	9.3040-09	9.0831-09
2900	6.3064-09	9.7121-09	9.6567-09	9.5444-09	9.3758-09	9.1534-09
3000	6.3491-09	9.7767-09	9.7207-09	9.6081-09	9.4388-09	9.2152-09
3100	6.3863-09	9.8328-09	9.7763-09	9.6634-09	9.4935-09	9.2690-09
3200	6.4183-09	9.8810-09	9.8240-09	9.7109-09	9.5406-09	9.3153-09
3300	6.4455-09	9.9218-09	9.8644-09	9.7511-09	9.5806-09	9.3546-09
3400	6.4681-09	9.9557-09	9.8979-09	9.7846-09	9.6139-09	9.3874-09
3500	6.4864-09	9.9831-09	9.9251-09	9.8118-09	9.6409-09	9.4141-09
3600	6.5008-09	1.0005-08	9.9462-09	9.8330-09	9.6622-09	9.4351-09
3700	6.5116-09	1.0020-08	9.9619-09	9.8487-09	9.6780-09	9.4507-09
3800	6.5188-09	1.0031-08	9.9723-09	9.8593-09	9.6887-09	9.4615-09
3900	6.5229-09	1.0037-08	9.9779-09	9.8651-09	9.6947-09	9.4676-09
4000	6.5240-09	1.0038-08	9.9790-09	9.8664-09	9.6963-09	9.4694-09

Table 45. (continued)

T(K)	$v=10, J=14$	$v=11, J=0$	$v=11, J=1$	$v=11, J=2$	$v=11, J=3$	$v=11, J=4$
4100	6.5223-09	1.0035-08	9.9759-09	9.8636-09	9.6938-09	9.4672-09
4200	6.5180-09	1.0028-08	9.9688-09	9.8569-09	9.6876-09	9.4613-09
4300	6.5113-09	1.0017-08	9.9582-09	9.8466-09	9.6777-09	9.4519-09
4400	6.5024-09	1.0003-08	9.9442-09	9.8330-09	9.6646-09	9.4392-09
4500	6.4913-09	9.9863-09	9.9270-09	9.8162-09	9.6484-09	9.4236-09
4600	6.4784-09	9.9662-09	9.9070-09	9.7966-09	9.6293-09	9.4052-09
4700	6.4636-09	9.9434-09	9.8842-09	9.7743-09	9.6076-09	9.3842-09
4800	6.4472-09	9.9180-09	9.8589-09	9.7495-09	9.5835-09	9.3608-09
4900	6.4292-09	9.8903-09	9.8313-09	9.7224-09	9.5570-09	9.3352-09
5000	6.4098-09	9.8605-09	9.8016-09	9.6931-09	9.5285-09	9.3075-09
5500	6.2949-09	9.6841-09	9.6260-09	9.5202-09	9.3595-09	9.1432-09
6000	6.1577-09	9.4741-09	9.4170-09	9.3142-09	9.1578-09	8.9467-09
6500	6.0064-09	9.2428-09	9.1869-09	9.0872-09	8.9352-09	8.7299-09
7000	5.8468-09	8.9990-09	8.9443-09	8.8477-09	8.7004-09	8.5009-09
7500	5.6831-09	8.7490-09	8.6957-09	8.6022-09	8.4595-09	8.2659-09
8000	5.5184-09	8.4974-09	8.4456-09	8.3551-09	8.2169-09	8.0292-09
8500	5.3547-09	8.2475-09	8.1971-09	8.1096-09	7.9758-09	7.7940-09
9000	5.1936-09	8.0016-09	7.9526-09	7.8680-09	7.7385-09	7.5624-09
9500	5.0362-09	7.7612-09	7.7136-09	7.6318-09	7.5065-09	7.3358-09
10000	4.8831-09	7.5274-09	7.4812-09	7.4021-09	7.2807-09	7.1155-09
11000	4.5915-09	7.0821-09	7.0385-09	6.9643-09	6.8506-09	6.6954-09
12000	4.3205-09	6.6680-09	6.6269-09	6.5573-09	6.4505-09	6.3047-09
13000	4.0700-09	6.2851-09	6.2463-09	6.1809-09	6.0805-09	5.9432-09
14000	3.8392-09	5.9321-09	5.8954-09	5.8339-09	5.7393-09	5.6099-09
15000	3.6268-09	5.6070-09	5.5723-09	5.5143-09	5.4250-09	5.3028-09
16000	3.4313-09	5.3077-09	5.2747-09	5.2199-09	5.1356-09	5.0200-09
17000	3.2513-09	5.0319-09	5.0006-09	4.9487-09	4.8689-09	4.7594-09
18000	3.0854-09	4.7775-09	4.7478-09	4.6986-09	4.6229-09	4.5189-09
19000	2.9323-09	4.5426-09	4.5143-09	4.4676-09	4.3957-09	4.2969-09
20000	2.7907-09	4.3253-09	4.2983-09	4.2539-09	4.1855-09	4.0915-09
21000	2.6596-09	4.1240-09	4.0983-09	4.0560-09	3.9908-09	3.9012-09
22000	2.5381-09	3.9372-09	3.9127-09	3.8723-09	3.8101-09	3.7246-09
23000	2.4252-09	3.7636-09	3.7401-09	3.7016-09	3.6422-09	3.5604-09
24000	2.3201-09	3.6020-09	3.5795-09	3.5427-09	3.4858-09	3.4076-09
25000	2.2222-09	3.4513-09	3.4298-09	3.3945-09	3.3400-09	3.2651-09
26000	2.1308-09	3.3106-09	3.2899-09	3.2560-09	3.2038-09	3.1320-09
27000	2.0454-09	3.1789-09	3.1590-09	3.1266-09	3.0764-09	3.0074-09
28000	1.9653-09	3.0556-09	3.0364-09	3.0052-09	2.9571-09	2.8908-09
29000	1.8903-09	2.9398-09	2.9214-09	2.8914-09	2.8451-09	2.7813-09
30000	1.8198-09	2.8311-09	2.8134-09	2.7845-09	2.7399-09	2.6784-09

Table 46. Rate constant for hydrogen molecule in  $v=11$  and  $J=5-10$  states.

T(K)	$v=11, J=5$	$v=11, J=6$	$v=11, J=7$	$v=11, J=8$	$v=11, J=9$	$v=11, J=10$
100	6.7448-10	5.6120-10	4.9962-10	4.8551-10	5.0626-10	3.9825-10
200	1.3500-09	1.2338-09	1.1526-09	1.0937-09	1.0533-09	9.2034-10
300	1.9697-09	1.8442-09	1.7413-09	1.6447-09	1.5552-09	1.3922-09
400	2.5480-09	2.4087-09	2.2832-09	2.1535-09	2.0227-09	1.8272-09
500	3.0889-09	2.9345-09	2.7867-09	2.6271-09	2.4598-09	2.2318-09
600	3.5950-09	3.4251-09	3.2561-09	3.0691-09	2.8688-09	2.6094-09
700	4.0681-09	3.8832-09	3.6939-09	3.4818-09	3.2514-09	2.9620-09
800	4.5099-09	4.3106-09	4.1024-09	3.8670-09	3.6090-09	3.2913-09
900	4.9218-09	4.7091-09	4.4831-09	4.2263-09	3.9428-09	3.5985-09
1000	5.3056-09	5.0802-09	4.8377-09	4.5610-09	4.2540-09	3.8848-09
1100	5.6626-09	5.4254-09	5.1675-09	4.8725-09	4.5438-09	4.1514-09
1200	5.9942-09	5.7461-09	5.4739-09	5.1620-09	4.8132-09	4.3993-09
1300	6.3018-09	6.0436-09	5.7582-09	5.4308-09	5.0634-09	4.6295-09
1400	6.5867-09	6.3192-09	6.0216-09	5.6798-09	5.2954-09	4.8429-09
1500	6.8501-09	6.5741-09	6.2653-09	5.9103-09	5.5102-09	5.0405-09
1600	7.0933-09	6.8095-09	6.4903-09	6.1232-09	5.7086-09	5.2232-09
1700	7.3175-09	7.0265-09	6.6979-09	6.3197-09	5.8918-09	5.3917-09
1800	7.5237-09	7.2262-09	6.8889-09	6.5005-09	6.0604-09	5.5470-09
1900	7.7130-09	7.4096-09	7.0644-09	6.6667-09	6.2154-09	5.6898-09
2000	7.8865-09	7.5777-09	7.2252-09	6.8191-09	6.3576-09	5.8207-09
2100	8.0450-09	7.7314-09	7.3724-09	6.9586-09	6.4878-09	5.9406-09
2200	8.1896-09	7.8716-09	7.5066-09	7.0858-09	6.6066-09	6.0501-09
2300	8.3210-09	7.9992-09	7.6287-09	7.2017-09	6.7147-09	6.1498-09
2400	8.4401-09	8.1148-09	7.7395-09	7.3068-09	6.8129-09	6.2404-09
2500	8.5476-09	8.2193-09	7.8396-09	7.4018-09	6.9017-09	6.3223-09
2600	8.6443-09	8.3133-09	7.9298-09	7.4874-09	6.9817-09	6.3961-09
2700	8.7309-09	8.3976-09	8.0106-09	7.5642-09	7.0535-09	6.4624-09
2800	8.8080-09	8.4727-09	8.0827-09	7.6327-09	7.1176-09	6.5216-09
2900	8.8763-09	8.5392-09	8.1465-09	7.6935-09	7.1744-09	6.5742-09
3000	8.9362-09	8.5977-09	8.2028-09	7.7470-09	7.2245-09	6.6205-09
3100	8.9884-09	8.6487-09	8.2518-09	7.7938-09	7.2683-09	6.6610-09
3200	9.0333-09	8.6927-09	8.2941-09	7.8342-09	7.3061-09	6.6961-09
3300	9.0715-09	8.7301-09	8.3302-09	7.8687-09	7.3385-09	6.7261-09
3400	9.1033-09	8.7615-09	8.3605-09	7.8976-09	7.3656-09	6.7514-09
3500	9.1293-09	8.7871-09	8.3852-09	7.9214-09	7.3879-09	6.7722-09
3600	9.1497-09	8.8074-09	8.4049-09	7.9403-09	7.4057-09	6.7888-09
3700	9.1649-09	8.8226-09	8.4198-09	7.9547-09	7.4193-09	6.8016-09
3800	9.1754-09	8.8333-09	8.4303-09	7.9649-09	7.4290-09	6.8108-09
3900	9.1814-09	8.8396-09	8.4366-09	7.9712-09	7.4350-09	6.8166-09
4000	9.1832-09	8.8419-09	8.4390-09	7.9738-09	7.4376-09	6.8192-09

Table 46. (continued)

T(K)	$v=11, J=5$	$v=11, J=6$	$v=11, J=7$	$v=11, J=8$	$v=11, J=9$	$v=11, J=10$
4100	9.1811-09	8.8404-09	8.4379-09	7.9730-09	7.4370-09	6.8189-09
4200	9.1754-09	8.8354-09	8.4334-09	7.9690-09	7.4334-09	6.8159-09
4300	9.1664-09	8.8272-09	8.4257-09	7.9621-09	7.4271-09	6.8103-09
4400	9.1542-09	8.8159-09	8.4152-09	7.9524-09	7.4182-09	6.8023-09
4500	9.1391-09	8.8018-09	8.4020-09	7.9401-09	7.4069-09	6.7922-09
4600	9.1213-09	8.7851-09	8.3862-09	7.9255-09	7.3933-09	6.7800-09
4700	9.1010-09	8.7659-09	8.3682-09	7.9086-09	7.3777-09	6.7658-09
4800	9.0783-09	8.7445-09	8.3479-09	7.8897-09	7.3602-09	6.7500-09
4900	9.0535-09	8.7210-09	8.3257-09	7.8689-09	7.3409-09	6.7324-09
5000	9.0267-09	8.6955-09	8.3015-09	7.8463-09	7.3199-09	6.7134-09
5500	8.8677-09	8.5439-09	8.1576-09	7.7112-09	7.1943-09	6.5989-09
6000	8.6774-09	8.3619-09	7.9846-09	7.5485-09	7.0429-09	6.4606-09
6500	8.4673-09	8.1605-09	7.7929-09	7.3679-09	6.8747-09	6.3068-09
7000	8.2454-09	7.9477-09	7.5901-09	7.1768-09	6.6966-09	6.1438-09
7500	8.0177-09	7.7289-09	7.3817-09	6.9801-09	6.5134-09	5.9760-09
8000	7.7883-09	7.5085-09	7.1715-09	6.7818-09	6.3284-09	5.8066-09
8500	7.5602-09	7.2892-09	6.9624-09	6.5844-09	6.1444-09	5.6379-09
9000	7.3356-09	7.0732-09	6.7564-09	6.3898-09	5.9629-09	5.4716-09
9500	7.1160-09	6.8619-09	6.5547-09	6.1993-09	5.7853-09	5.3088-09
10000	6.9023-09	6.6562-09	6.3585-09	6.0139-09	5.6123-09	5.1502-09
11000	6.4950-09	6.2640-09	5.9841-09	5.6602-09	5.2824-09	4.8475-09
12000	6.1161-09	5.8990-09	5.6357-09	5.3309-09	4.9751-09	4.5656-09
13000	5.7655-09	5.5613-09	5.3132-09	5.0260-09	4.6906-09	4.3046-09
14000	5.4422-09	5.2497-09	5.0156-09	4.7446-09	4.4280-09	4.0636-09
15000	5.1443-09	4.9626-09	4.7414-09	4.4853-09	4.1860-09	3.8416-09
16000	4.8700-09	4.6981-09	4.4888-09	4.2464-09	3.9630-09	3.6369-09
17000	4.6172-09	4.4544-09	4.2560-09	4.0262-09	3.7575-09	3.4483-09
18000	4.3839-09	4.2295-09	4.0412-09	3.8230-09	3.5678-09	3.2742-09
19000	4.1685-09	4.0218-09	3.8427-09	3.6353-09	3.3926-09	3.1134-09
20000	3.9693-09	3.8296-09	3.6591-09	3.4616-09	3.2305-09	2.9646-09
21000	3.7846-09	3.6515-09	3.4890-09	3.3007-09	3.0803-09	2.8267-09
22000	3.6133-09	3.4863-09	3.3311-09	3.1513-09	2.9408-09	2.6987-09
23000	3.4541-09	3.3327-09	3.1843-09	3.0124-09	2.8112-09	2.5797-09
24000	3.3058-09	3.1896-09	3.0477-09	2.8832-09	2.6905-09	2.4689-09
25000	3.1675-09	3.0563-09	2.9202-09	2.7626-09	2.5780-09	2.3656-09
26000	3.0384-09	2.9317-09	2.8012-09	2.6500-09	2.4729-09	2.2691-09
27000	2.9176-09	2.8151-09	2.6898-09	2.5446-09	2.3745-09	2.1789-09
28000	2.8044-09	2.7059-09	2.5854-09	2.4459-09	2.2823-09	2.0943-09
29000	2.6982-09	2.6034-09	2.4875-09	2.3532-09	2.1959-09	2.0149-09
30000	2.5984-09	2.5071-09	2.3955-09	2.2662-09	2.1146-09	1.9403-09

Table 47. Rate constant for hydrogen molecule in  $v=11$  and  $J=11-12$  states and  $v=12$  and  $J=0-3$  sta

T(K)	$v=11, J=11$	$v=11, J=12$	$v=12, J=0$	$v=12, J=1$	$v=12, J=2$	$v=12, J=3$
100	4.2006-10	3.2021-10	5.1003-10	5.3615-10	5.2319-10	4.7860-10
200	8.6354-10	7.1671-10	1.0702-09	1.0796-09	1.0576-09	1.0098-09
300	1.2718-09	1.0755-09	1.5820-09	1.5798-09	1.5495-09	1.4960-09
400	1.6528-09	1.4069-09	2.0576-09	2.0476-09	2.0096-09	1.9482-09
500	2.0096-09	1.7158-09	2.5021-09	2.4861-09	2.4410-09	2.3710-09
600	2.3438-09	2.0043-09	2.9180-09	2.8972-09	2.8455-09	2.7667-09
700	2.6567-09	2.2741-09	3.3071-09	3.2821-09	3.2243-09	3.1370-09
800	2.9494-09	2.5261-09	3.6709-09	3.6423-09	3.5787-09	3.4833-09
900	3.2227-09	2.7614-09	4.0107-09	3.9789-09	3.9100-09	3.8069-09
1000	3.4777-09	2.9808-09	4.3278-09	4.2931-09	4.2191-09	4.1088-09
1100	3.7153-09	3.1852-09	4.6232-09	4.5859-09	4.5073-09	4.3902-09
1200	3.9364-09	3.3753-09	4.8981-09	4.8584-09	4.7756-09	4.6521-09
1300	4.1417-09	3.5519-09	5.1535-09	5.1117-09	5.0250-09	4.8956-09
1400	4.3322-09	3.7157-09	5.3906-09	5.3468-09	5.2564-09	5.1215-09
1500	4.5087-09	3.8674-09	5.6102-09	5.5646-09	5.4709-09	5.3309-09
1600	4.6718-09	4.0077-09	5.8134-09	5.7661-09	5.6694-09	5.5246-09
1700	4.8224-09	4.1372-09	6.0010-09	5.9522-09	5.8527-09	5.7036-09
1800	4.9611-09	4.2565-09	6.1740-09	6.1238-09	6.0217-09	5.8686-09
1900	5.0887-09	4.3662-09	6.3331-09	6.2817-09	6.1772-09	6.0205-09
2000	5.2057-09	4.4669-09	6.4793-09	6.4267-09	6.3201-09	6.1599-09
2100	5.3129-09	4.5591-09	6.6132-09	6.5596-09	6.4510-09	6.2878-09
2200	5.4108-09	4.6433-09	6.7355-09	6.6810-09	6.5706-09	6.4046-09
2300	5.5000-09	4.7200-09	6.8471-09	6.7918-09	6.6797-09	6.5112-09
2400	5.5810-09	4.7897-09	6.9485-09	6.8924-09	6.7789-09	6.6081-09
2500	5.6543-09	4.8528-09	7.0403-09	6.9836-09	6.8688-09	6.6959-09
2600	5.7204-09	4.9096-09	7.1232-09	7.0658-09	6.9499-09	6.7751-09
2700	5.7797-09	4.9607-09	7.1977-09	7.1398-09	7.0229-09	6.8464-09
2800	5.8327-09	5.0062-09	7.2643-09	7.2060-09	7.0881-09	6.9102-09
2900	5.8797-09	5.0467-09	7.3236-09	7.2648-09	7.1462-09	6.9669-09
3000	5.9212-09	5.0824-09	7.3759-09	7.3168-09	7.1975-09	7.0171-09
3100	5.9575-09	5.1137-09	7.4218-09	7.3624-09	7.2425-09	7.0611-09
3200	5.9889-09	5.1408-09	7.4617-09	7.4020-09	7.2816-09	7.0994-09
3300	6.0158-09	5.1639-09	7.4959-09	7.4360-09	7.3151-09	7.1322-09
3400	6.0385-09	5.1834-09	7.5248-09	7.4647-09	7.3435-09	7.1601-09
3500	6.0571-09	5.1995-09	7.5488-09	7.4885-09	7.3671-09	7.1832-09
3600	6.0721-09	5.2124-09	7.5681-09	7.5078-09	7.3862-09	7.2019-09
3700	6.0835-09	5.2223-09	7.5831-09	7.5227-09	7.4010-09	7.2164-09
3800	6.0918-09	5.2294-09	7.5941-09	7.5337-09	7.4119-09	7.2272-09
3900	6.0970-09	5.2339-09	7.6014-09	7.5409-09	7.4191-09	7.2343-09
4000	6.0994-09	5.2360-09	7.6051-09	7.5447-09	7.4229-09	7.2381-09

Table 47. (continued)

T(K)	$v=11, J=11$	$v=11, J=12$	$v=12, J=0$	$v=12, J=1$	$v=12, J=2$	$v=12, J=3$
4100	6.0992-09	5.2358-09	7.6055-09	7.5452-09	7.4235-09	7.2388-09
4200	6.0965-09	5.2336-09	7.6029-09	7.5426-09	7.4211-09	7.2365-09
4300	6.0915-09	5.2293-09	7.5975-09	7.5373-09	7.4159-09	7.2316-09
4400	6.0844-09	5.2233-09	7.5894-09	7.5293-09	7.4082-09	7.2241-09
4500	6.0754-09	5.2155-09	7.5788-09	7.5189-09	7.3980-09	7.2143-09
4600	6.0645-09	5.2062-09	7.5660-09	7.5062-09	7.3856-09	7.2022-09
4700	6.0519-09	5.1954-09	7.5510-09	7.4913-09	7.3711-09	7.1882-09
4800	6.0377-09	5.1832-09	7.5341-09	7.4746-09	7.3547-09	7.1722-09
4900	6.0221-09	5.1698-09	7.5153-09	7.4559-09	7.3364-09	7.1545-09
5000	6.0050-09	5.1552-09	7.4948-09	7.4356-09	7.3165-09	7.1352-09
5500	5.9028-09	5.0674-09	7.3707-09	7.3128-09	7.1959-09	7.0179-09
6000	5.7791-09	4.9612-09	7.2199-09	7.1632-09	7.0490-09	6.8749-09
6500	5.6416-09	4.8431-09	7.0515-09	6.9963-09	6.8850-09	6.7151-09
7000	5.4958-09	4.7179-09	6.8727-09	6.8189-09	6.7107-09	6.5452-09
7500	5.3457-09	4.5889-09	6.6882-09	6.6360-09	6.5308-09	6.3699-09
8000	5.1941-09	4.4587-09	6.5017-09	6.4510-09	6.3489-09	6.1926-09
8500	5.0432-09	4.3291-09	6.3158-09	6.2667-09	6.1675-09	6.0158-09
9000	4.8944-09	4.2012-09	6.1323-09	6.0846-09	5.9885-09	5.8412-09
9500	4.7486-09	4.0760-09	5.9525-09	5.9062-09	5.8130-09	5.6701-09
10000	4.6067-09	3.9541-09	5.7772-09	5.7324-09	5.6419-09	5.5033-09
11000	4.3359-09	3.7214-09	5.4424-09	5.4002-09	5.3151-09	5.1846-09
12000	4.0836-09	3.5047-09	5.1300-09	5.0903-09	5.0102-09	4.8872-09
13000	3.8500-09	3.3040-09	4.8405-09	4.8031-09	4.7275-09	4.6115-09
14000	3.6344-09	3.1189-09	4.5730-09	4.5376-09	4.4662-09	4.3566-09
15000	3.4357-09	2.9482-09	4.3261-09	4.2927-09	4.2251-09	4.1215-09
16000	3.2526-09	2.7909-09	4.0984-09	4.0667-09	4.0028-09	3.9045-09
17000	3.0837-09	2.6459-09	3.8883-09	3.8582-09	3.7976-09	3.7043-09
18000	2.9280-09	2.5121-09	3.6942-09	3.6637-09	3.6080-09	3.5194-09
19000	2.7841-09	2.3885-09	3.5148-09	3.4876-09	3.4327-09	3.3484-09
20000	2.6509-09	2.2742-09	3.3486-09	3.3227-09	3.2704-09	3.1901-09
21000	2.5275-09	2.1683-09	3.1945-09	3.1698-09	3.1199-09	3.0432-09
22000	2.4130-09	2.0700-09	3.0513-09	3.0278-09	2.9801-09	2.9069-09
23000	2.3066-09	1.9786-09	2.9182-09	2.8956-09	2.8500-09	2.7800-09
24000	2.2075-09	1.8935-09	2.7941-09	2.7725-09	2.7289-09	2.6617-09
25000	2.1151-09	1.8142-09	2.6783-09	2.6576-09	2.6158-09	2.5514-09
26000	2.0287-09	1.7401-09	2.5701-09	2.5502-09	2.5101-09	2.4483-09
27000	1.9480-09	1.6707-09	2.4688-09	2.4497-09	2.4111-09	2.3517-09
28000	1.8723-09	1.6058-09	2.3738-09	2.3555-09	2.3183-09	2.2612-09
29000	1.8013-09	1.5448-09	2.2847-09	2.2670-09	2.2312-09	2.1763-09
30000	1.7346-09	1.4876-09	2.2008-09	2.1838-09	2.1494-09	2.0964-09

Table 48. Rate constant for hydrogen molecule in  $v=12$  and  $J=4-9$  states.

T(K)	$v=12, J=4$	$v=12, J=5$	$v=12, J=6$	$v=12, J=7$	$v=12, J=8$	$v=12, J=9$
100	4.6914 -10	4.6347 -10	4.1819 -10	3.7257 -10	3.4308 -10	3.1160 -10
200	9.8252 -10	9.4396 -10	8.7839 -10	8.0104 -10	7.2643 -10	6.4137 -10
300	1.4516 -09	1.3867 -09	1.2994 -09	1.1922 -09	1.0780 -09	9.4527 -10
400	1.8877 -09	1.8003 -09	1.6910 -09	1.5557 -09	1.4055 -09	1.2292 -09
500	2.2953 -09	2.1880 -09	2.0572 -09	1.8953 -09	1.7119 -09	1.4953 -09
600	2.6768 -09	2.5513 -09	2.4001 -09	2.2133 -09	1.9989 -09	1.7449 -09
700	3.0339 -09	2.8917 -09	2.7210 -09	2.5109 -09	2.2678 -09	1.9787 -09
800	3.3678 -09	3.2102 -09	3.0213 -09	2.7893 -09	2.5194 -09	2.1977 -09
900	3.6798 -09	3.5080 -09	3.3019 -09	3.0496 -09	2.7546 -09	2.4025 -09
1000	3.9709 -09	3.7859 -09	3.5639 -09	3.2925 -09	2.9742 -09	2.5937 -09
1100	4.2422 -09	4.0451 -09	3.8081 -09	3.5190 -09	3.1790 -09	2.7721 -09
1200	4.4948 -09	4.2863 -09	4.0355 -09	3.7299 -09	3.3698 -09	2.9383 -09
1300	4.7296 -09	4.5107 -09	4.2469 -09	3.9261 -09	3.5472 -09	3.0929 -09
1400	4.9475 -09	4.7189 -09	4.4431 -09	4.1082 -09	3.7120 -09	3.2364 -09
1500	5.1494 -09	4.9120 -09	4.6251 -09	4.2770 -09	3.8647 -09	3.3695 -09
1600	5.3362 -09	5.0907 -09	4.7935 -09	4.4333 -09	4.0062 -09	3.4928 -09
1700	5.5088 -09	5.2557 -09	4.9491 -09	4.5777 -09	4.1369 -09	3.6067 -09
1800	5.6680 -09	5.4080 -09	5.0926 -09	4.7109 -09	4.2575 -09	3.7118 -09
1900	5.8144 -09	5.5481 -09	5.2247 -09	4.8336 -09	4.3685 -09	3.8086 -09
2000	5.9490 -09	5.6769 -09	5.3461 -09	4.9463 -09	4.4706 -09	3.8975 -09
2100	6.0723 -09	5.7949 -09	5.4573 -09	5.0497 -09	4.5642 -09	3.9791 -09
2200	6.1850 -09	5.9028 -09	5.5591 -09	5.1442 -09	4.6498 -09	4.0538 -09
2300	6.2878 -09	6.0012 -09	5.6519 -09	5.2304 -09	4.7279 -09	4.1219 -09
2400	6.3812 -09	6.0908 -09	5.7363 -09	5.3089 -09	4.7990 -09	4.1838 -09
2500	6.4659 -09	6.1719 -09	5.8129 -09	5.3801 -09	4.8635 -09	4.2400 -09
2600	6.5423 -09	6.2452 -09	5.8820 -09	5.4444 -09	4.9218 -09	4.2908 -09
2700	6.6111 -09	6.3111 -09	5.9442 -09	5.5022 -09	4.9742 -09	4.3365 -09
2800	6.6726 -09	6.3701 -09	5.9999 -09	5.5540 -09	5.0212 -09	4.3775 -09
2900	6.7274 -09	6.4226 -09	6.0495 -09	5.6002 -09	5.0631 -09	4.4140 -09
3000	6.7758 -09	6.4691 -09	6.0933 -09	5.6410 -09	5.1001 -09	4.4463 -09
3100	6.8182 -09	6.5099 -09	6.1318 -09	5.6769 -09	5.1327 -09	4.4747 -09
3200	6.8551 -09	6.5454 -09	6.1653 -09	5.7082 -09	5.1610 -09	4.4994 -09
3300	6.8868 -09	6.5758 -09	6.1942 -09	5.7350 -09	5.1855 -09	4.5207 -09
3400	6.9136 -09	6.6017 -09	6.2186 -09	5.7579 -09	5.2062 -09	4.5387 -09
3500	6.9359 -09	6.6232 -09	6.2389 -09	5.7769 -09	5.2235 -09	4.5538 -09
3600	6.9539 -09	6.6406 -09	6.2554 -09	5.7923 -09	5.2376 -09	4.5661 -09
3700	6.9680 -09	6.6542 -09	6.2683 -09	5.8045 -09	5.2486 -09	4.5757 -09
3800	6.9784 -09	6.6643 -09	6.2779 -09	5.8135 -09	5.2569 -09	4.5829 -09
3900	6.9852 -09	6.6710 -09	6.2843 -09	5.8196 -09	5.2625 -09	4.5878 -09
4000	6.9889 -09	6.6747 -09	6.2878 -09	5.8230 -09	5.2656 -09	4.5905 -09

Table 48. (continued)

T(K)	$v=12, J=4$	$v=12, J=5$	$v=12, J=6$	$v=12, J=7$	$v=12, J=8$	$v=12, J=9$
4100	6.9895 -09	6.6755 -09	6.2886 -09	5.8239 -09	5.2665 -09	4.5913 -09
4200	6.9874 -09	6.6736 -09	6.2869 -09	5.8225 -09	5.2653 -09	4.5902 -09
4300	6.9826 -09	6.6692 -09	6.2828 -09	5.8188 -09	5.2620 -09	4.5874 -09
4400	6.9753 -09	6.6624 -09	6.2765 -09	5.8131 -09	5.2569 -09	4.5829 -09
4500	6.9658 -09	6.6535 -09	6.2681 -09	5.8055 -09	5.2501 -09	4.5769 -09
4600	6.9542 -09	6.6425 -09	6.2579 -09	5.7961 -09	5.2417 -09	4.5696 -09
4700	6.9406 -09	6.6297 -09	6.2458 -09	5.7850 -09	5.2317 -09	4.5609 -09
4800	6.9252 -09	6.6151 -09	6.2321 -09	5.7725 -09	5.2204 -09	4.5510 -09
4900	6.9081 -09	6.5989 -09	6.2169 -09	5.7585 -09	5.2078 -09	4.5400 -09
5000	6.8894 -09	6.5811 -09	6.2003 -09	5.7431 -09	5.1940 -09	4.5279 -09
5500	6.7762 -09	6.4735 -09	6.0990 -09	5.6498 -09	5.1098 -09	4.4545 -09
6000	6.6381 -09	6.3420 -09	5.9753 -09	5.5355 -09	5.0065 -09	4.3644 -09
6500	6.4838 -09	6.1950 -09	5.8369 -09	5.4076 -09	4.8909 -09	4.2635 -09
7000	6.3198 -09	6.0385 -09	5.6896 -09	5.2714 -09	4.7678 -09	4.1561 -09
7500	6.1505 -09	5.8770 -09	5.5375 -09	5.1306 -09	4.6405 -09	4.0450 -09
8000	5.9793 -09	5.7137 -09	5.3836 -09	4.9881 -09	4.5117 -09	3.9326 -09
8500	5.8086 -09	5.5507 -09	5.2301 -09	4.8460 -09	4.3831 -09	3.8204 -09
9000	5.6400 -09	5.3897 -09	5.0784 -09	4.7055 -09	4.2560 -09	3.7096 -09
9500	5.4747 -09	5.2319 -09	4.9297 -09	4.5678 -09	4.1314 -09	3.6009 -09
10000	5.3136 -09	5.0780 -09	4.7848 -09	4.4335 -09	4.0099 -09	3.4948 -09
11000	5.0058 -09	4.7840 -09	4.5077 -09	4.1768 -09	3.7776 -09	3.2922 -09
12000	4.7186 -09	4.5096 -09	4.2491 -09	3.9372 -09	3.5608 -09	3.1031 -09
13000	4.4523 -09	4.2551 -09	4.0092 -09	3.7149 -09	3.3597 -09	2.9276 -09
14000	4.2062 -09	4.0199 -09	3.7876 -09	3.5095 -09	3.1738 -09	2.7655 -09
15000	3.9791 -09	3.8029 -09	3.5830 -09	3.3199 -09	3.0023 -09	2.6158 -09
16000	3.7696 -09	3.6026 -09	3.3943 -09	3.1449 -09	2.8440 -09	2.4778 -09
17000	3.5763 -09	3.4178 -09	3.2201 -09	2.9835 -09	2.6979 -09	2.3504 -09
18000	3.3977 -09	3.2471 -09	3.0592 -09	2.8344 -09	2.5629 -09	2.2327 -09
19000	3.2325 -09	3.0893 -09	2.9104 -09	2.6965 -09	2.4382 -09	2.1239 -09
20000	3.0796 -09	2.9431 -09	2.7726 -09	2.5688 -09	2.3226 -09	2.0232 -09
21000	2.9378 -09	2.8076 -09	2.6449 -09	2.4504 -09	2.2155 -09	1.9297 -09
22000	2.8061 -09	2.6817 -09	2.5262 -09	2.3404 -09	2.1160 -09	1.8430 -09
23000	2.6836 -09	2.5645 -09	2.4158 -09	2.2381 -09	2.0234 -09	1.7623 -09
24000	2.5694 -09	2.4554 -09	2.3130 -09	2.1427 -09	1.9372 -09	1.6871 -09
25000	2.4629 -09	2.3536 -09	2.2170 -09	2.0538 -09	1.8567 -09	1.6170 -09
26000	2.3633 -09	2.2584 -09	2.1273 -09	1.9706 -09	1.7815 -09	1.5514 -09
27000	2.2701 -09	2.1693 -09	2.0433 -09	1.8928 -09	1.7111 -09	1.4900 -09
28000	2.1827 -09	2.0857 -09	1.9646 -09	1.8198 -09	1.6451 -09	1.4325 -09
29000	2.1006 -09	2.0073 -09	1.8907 -09	1.7514 -09	1.5831 -09	1.3785 -09
30000	2.0235 -09	1.9336 -09	1.8212 -09	1.6870 -09	1.5249 -09	1.3278 -09

Table 49. Rate constant for hydrogen molecule in  $v=12$  and  $J=10$  states and  $v=13$  and  $J=0-4$  states.

T(K)	$v=12, J=10$	$v=13, J=0$	$v=13, J=1$	$v=13, J=2$	$v=13, J=3$	$v=13, J=4$
100	2.5670-10	3.3281-10	3.4942-10	3.2159-10	3.1253-10	3.0436-10
200	5.2405-10	6.9929-10	7.0358-10	6.6939-10	6.4266-10	6.0916-10
300	7.7077-10	1.0349-09	1.0302-09	9.8931-10	9.4698-10	8.9105-10
400	1.0015-09	1.3474-09	1.3360-09	1.2879-09	1.2314-09	1.1556-09
500	1.2180-09	1.6399-09	1.6230-09	1.5677-09	1.4982-09	1.4041-09
600	1.4211-09	1.9142-09	1.8924-09	1.8301-09	1.7485-09	1.6376-09
700	1.6115-09	2.1712-09	2.1451-09	2.0762-09	1.9833-09	1.8567-09
800	1.7897-09	2.4119-09	2.3819-09	2.3067-09	2.2032-09	2.0621-09
900	1.9565-09	2.6372-09	2.6035-09	2.5224-09	2.4091-09	2.2544-09
1000	2.1122-09	2.8477-09	2.8107-09	2.7241-09	2.6015-09	2.4342-09
1100	2.2575-09	3.0442-09	3.0041-09	2.9123-09	2.7812-09	2.6020-09
1200	2.3929-09	3.2273-09	3.1844-09	3.0878-09	2.9487-09	2.7585-09
1300	2.5187-09	3.3978-09	3.3523-09	3.2512-09	3.1046-09	2.9043-09
1400	2.6357-09	3.5563-09	3.5084-09	3.4031-09	3.2496-09	3.0397-09
1500	2.7441-09	3.7034-09	3.6532-09	3.5441-09	3.3842-09	3.1655-09
1600	2.8445-09	3.8397-09	3.7875-09	3.6747-09	3.5089-09	3.2820-09
1700	2.9373-09	3.9658-09	3.9116-09	3.7956-09	3.6242-09	3.3899-09
1800	3.0229-09	4.0822-09	4.0263-09	3.9072-09	3.7308-09	3.4895-09
1900	3.1018-09	4.1896-09	4.1320-09	4.0102-09	3.8290-09	3.5813-09
2000	3.1743-09	4.2883-09	4.2293-09	4.1048-09	3.9194-09	3.6658-09
2100	3.2407-09	4.3790-09	4.3185-09	4.1918-09	4.0024-09	3.7434-09
2200	3.3015-09	4.4620-09	4.4003-09	4.2714-09	4.0784-09	3.8144-09
2300	3.3570-09	4.5378-09	4.4750-09	4.3442-09	4.1479-09	3.8793-09
2400	3.4075-09	4.6069-09	4.5431-09	4.4104-09	4.2111-09	3.9385-09
2500	3.4533-09	4.6697-09	4.6049-09	4.4707-09	4.2686-09	3.9922-09
2600	3.4947-09	4.7265-09	4.6608-09	4.5252-09	4.3207-09	4.0409-09
2700	3.5319-09	4.7777-09	4.7112-09	4.5743-09	4.3676-09	4.0848-09
2800	3.5653-09	4.8237-09	4.7565-09	4.6184-09	4.4097-09	4.1241-09
2900	3.5950-09	4.8647-09	4.7969-09	4.6578-09	4.4473-09	4.1593-09
3000	3.6213-09	4.9012-09	4.8328-09	4.6928-09	4.4807-09	4.1906-09
3100	3.6444-09	4.9333-09	4.8644-09	4.7237-09	4.5102-09	4.2181-09
3200	3.6645-09	4.9613-09	4.8920-09	4.7507-09	4.5359-09	4.2422-09
3300	3.6819-09	4.9856-09	4.9159-09	4.7740-09	4.5582-09	4.2630-09
3400	3.6966-09	5.0063-09	4.9363-09	4.7939-09	4.5772-09	4.2808-09
3500	3.7088-09	5.0237-09	4.9535-09	4.8107-09	4.5932-09	4.2958-09
3600	3.7188-09	5.0381-09	4.9675-09	4.8245-09	4.6064-09	4.3080-09
3700	3.7267-09	5.0495-09	4.9787-09	4.8355-09	4.6169-09	4.3179-09
3800	3.7325-09	5.0581-09	4.9873-09	4.8438-09	4.6249-09	4.3254-09
3900	3.7365-09	5.0643-09	4.9933-09	4.8498-09	4.6306-09	4.3307-09
4000	3.7387-09	5.0681-09	4.9970-09	4.8535-09	4.6341-09	4.3340-09

Table 49. (continued)

T(K)	$v=12, J=10$	$v=13, J=0$	$v=13, J=1$	$v=13, J=2$	$v=13, J=3$	$v=13, J=4$
4100	3.7393-09	5.0697-09	4.9985-09	4.8551-09	4.6356-09	4.3354-09
4200	3.7384-09	5.0692-09	4.9980-09	4.8547-09	4.6352-09	4.3350-09
4300	3.7361-09	5.0667-09	4.9956-09	4.8524-09	4.6331-09	4.3330-09
4400	3.7324-09	5.0625-09	4.9915-09	4.8484-09	4.6293-09	4.3294-09
4500	3.7275-09	5.0567-09	4.9857-09	4.8429-09	4.6240-09	4.3245-09
4600	3.7215-09	5.0492-09	4.9783-09	4.8358-09	4.6172-09	4.3181-09
4700	3.7144-09	5.0403-09	4.9695-09	4.8273-09	4.6091-09	4.3106-09
4800	3.7064-09	5.0301-09	4.9594-09	4.8176-09	4.5998-09	4.3019-09
4900	3.6974-09	5.0186-09	4.9481-09	4.8066-09	4.5894-09	4.2921-09
5000	3.6875-09	5.0060-09	4.9356-09	4.7945-09	4.5778-09	4.2813-09
5500	3.6276-09	4.9280-09	4.8586-09	4.7200-09	4.5067-09	4.2147-09
6000	3.5541-09	4.8314-09	4.7634-09	4.6277-09	4.4185-09	4.1322-09
6500	3.4718-09	4.7227-09	4.6561-09	4.5237-09	4.3192-09	4.0392-09
7000	3.3842-09	4.6064-09	4.5414-09	4.4124-09	4.2129-09	3.9398-09
7500	3.2936-09	4.4860-09	4.4227-09	4.2971-09	4.1027-09	3.8368-09
8000	3.2019-09	4.3638-09	4.3022-09	4.1801-09	3.9910-09	3.7322-09
8500	3.1104-09	4.2417-09	4.1817-09	4.0631-09	3.8793-09	3.6277-09
9000	3.0201-09	4.1209-09	4.0626-09	3.9474-09	3.7688-09	3.5243-09
9500	2.9314-09	4.0023-09	3.9456-09	3.8338-09	3.6602-09	3.4227-09
10000	2.8450-09	3.8864-09	3.8314-09	3.7228-09	3.5543-09	3.3235-09
11000	2.6798-09	3.6647-09	3.6127-09	3.5104-09	3.3514-09	3.1337-09
12000	2.5256-09	3.4574-09	3.4083-09	3.3117-09	3.1616-09	2.9561-09
13000	2.3827-09	3.2648-09	3.2184-09	3.1272-09	2.9854-09	2.7912-09
14000	2.2505-09	3.0865-09	3.0426-09	2.9564-09	2.8222-09	2.6386-09
15000	2.1286-09	2.9217-09	2.8801-09	2.7985-09	2.6715-09	2.4975-09
16000	2.0161-09	2.7696-09	2.7301-09	2.6527-09	2.5322-09	2.3673-09
17000	1.9123-09	2.6290-09	2.5915-09	2.5180-09	2.4036-09	2.2469-09
18000	1.8164-09	2.4990-09	2.4633-09	2.3935-09	2.2846-09	2.1356-09
19000	1.7278-09	2.3787-09	2.3447-09	2.2782-09	2.1745-09	2.0326-09
20000	1.6457-09	2.2671-09	2.2348-09	2.1714-09	2.0725-09	1.9372-09
21000	1.5697-09	2.1637-09	2.1327-09	2.0722-09	1.9778-09	1.8486-09
22000	1.4990-09	2.0675-09	2.0379-09	1.9800-09	1.8898-09	1.7663-09
23000	1.4333-09	1.9779-09	1.9496-09	1.8942-09	1.8079-09	1.6897-09
24000	1.3721-09	1.8944-09	1.8673-09	1.8142-09	1.7315-09	1.6183-09
25000	1.3150-09	1.8164-09	1.7904-09	1.7395-09	1.6602-09	1.5516-09
26000	1.2616-09	1.7435-09	1.7185-09	1.6697-09	1.5935-09	1.4892-09
27000	1.2116-09	1.6752-09	1.6512-09	1.6043-09	1.5310-09	1.4308-09
28000	1.1648-09	1.6112-09	1.5881-09	1.5429-09	1.4724-09	1.3760-09
29000	1.1209-09	1.5510-09	1.5288-09	1.4853-09	1.4174-09	1.3245-09
30000	1.0796-09	1.4944-09	1.4730-09	1.4311-09	1.3656-09	1.2761-09

Table 50. Rate constant for hydrogen molecule in v=13 and J=5-7 states and v=14 and J=0-2 states

T(K)	v=13, J=5	v=13, J=6	v=13, J=7	v=14, J=0	v=14, J=1	v=14, J=2
100	2.6408-10	2.2337-10	1.6971-10	1.3382-10	1.3600-10	1.3272-10
200	5.4464-10	4.7142-10	3.7357-10	2.9953-10	2.9141-10	2.7005-10
300	8.0344-10	6.9893-10	5.5941-10	4.4966-10	4.3336-10	3.9685-10
400	1.0454-09	9.1094-10	7.3193-10	5.8863-10	5.6542-10	5.1559-10
500	1.2724-09	1.1095-09	8.9317-10	7.1839-10	6.8903-10	6.2710-10
600	1.4853-09	1.2957-09	1.0442-09	8.3988-10	8.0495-10	7.3185-10
700	1.6851-09	1.4702-09	1.1857-09	9.5371-10	9.1366-10	8.3019-10
800	1.8723-09	1.6336-09	1.3182-09	1.0603-09	1.0155-09	9.2242-10
900	2.0475-09	1.7866-09	1.4421-09	1.1602-09	1.1109-09	1.0088-09
1000	2.2113-09	1.9296-09	1.5579-09	1.2535-09	1.2002-09	1.0897-09
1100	2.3642-09	2.0631-09	1.6661-09	1.3407-09	1.2836-09	1.1652-09
1200	2.5068-09	2.1875-09	1.7668-09	1.4220-09	1.3613-09	1.2357-09
1300	2.6395-09	2.3034-09	1.8607-09	1.4977-09	1.4338-09	1.3013-09
1400	2.7629-09	2.4111-09	1.9479-09	1.5682-09	1.5012-09	1.3624-09
1500	2.8775-09	2.5111-09	2.0288-09	1.6336-09	1.5638-09	1.4192-09
1600	2.9836-09	2.6037-09	2.1038-09	1.6943-09	1.6219-09	1.4718-09
1700	3.0819-09	2.6894-09	2.1732-09	1.7505-09	1.6757-09	1.5206-09
1800	3.1726-09	2.7686-09	2.2373-09	1.8025-09	1.7254-09	1.5656-09
1900	3.2563-09	2.8416-09	2.2964-09	1.8504-09	1.7712-09	1.6072-09
2000	3.3332-09	2.9087-09	2.3507-09	1.8945-09	1.8134-09	1.6455-09
2100	3.4039-09	2.9704-09	2.4007-09	1.9350-09	1.8522-09	1.6807-09
2200	3.4686-09	3.0269-09	2.4464-09	1.9722-09	1.8878-09	1.7129-09
2300	3.5278-09	3.0785-09	2.4882-09	2.0062-09	1.9204-09	1.7424-09
2400	3.5817-09	3.1255-09	2.5262-09	2.0372-09	1.9500-09	1.7693-09
2500	3.6307-09	3.1682-09	2.5608-09	2.0654-09	1.9770-09	1.7938-09
2600	3.6750-09	3.2069-09	2.5921-09	2.0910-09	2.0015-09	1.8160-09
2700	3.7150-09	3.2418-09	2.6204-09	2.1141-09	2.0236-09	1.8360-09
2800	3.7509-09	3.2731-09	2.6457-09	2.1349-09	2.0435-09	1.8540-09
2900	3.7830-09	3.3011-09	2.6684-09	2.1535-09	2.0613-09	1.8701-09
3000	3.8114-09	3.3259-09	2.6885-09	2.1700-09	2.0771-09	1.8845-09
3100	3.8366-09	3.3478-09	2.7062-09	2.1846-09	2.0911-09	1.8972-09
3200	3.8585-09	3.3669-09	2.7217-09	2.1974-09	2.1034-09	1.9083-09
3300	3.8775-09	3.3835-09	2.7351-09	2.2086-09	2.1140-09	1.9179-09
3400	3.8938-09	3.3977-09	2.7466-09	2.2181-09	2.1232-09	1.9262-09
3500	3.9074-09	3.4096-09	2.7562-09	2.2262-09	2.1309-09	1.9332-09
3600	3.9187-09	3.4194-09	2.7642-09	2.2329-09	2.1373-09	1.9390-09
3700	3.9276-09	3.4272-09	2.7705-09	2.2383-09	2.1435-09	1.9437-09
3800	3.9345-09	3.4332-09	2.7753-09	2.2425-09	2.1465-09	1.9473-09
3900	3.9394-09	3.4374-09	2.7788-09	2.2456-09	2.1494-09	1.9500-09
4000	3.9424-09	3.4400-09	2.7809-09	2.2476-09	2.1513-09	1.9517-09

Table 50. (continued)

T(K)	v=13, J=5	v=13, J=6	v=13, J=7	v=14, J=0	v=14, J=1	v=14, J=2
4100	3.9437-09	3.4412-09	2.7818-09	2.2486-09	2.1523-09	1.9526-09
4200	3.9434-09	3.4409-09	2.7816-09	2.2487-09	2.1524-09	1.9527-09
4300	3.9416-09	3.4393-09	2.7803-09	2.2479-09	2.1517-09	1.9520-09
4400	3.9384-09	3.4365-09	2.7780-09	2.2464-09	2.1502-09	1.9506-09
4500	3.9339-09	3.4325-09	2.7748-09	2.2441-09	2.1480-09	1.9486-09
4600	3.9282-09	3.4275-09	2.7708-09	2.2410-09	2.1451-09	1.9460-09
4700	3.9213-09	3.4215-09	2.7659-09	2.2374-09	2.1416-09	1.9428-09
4800	3.9134-09	3.4146-09	2.7603-09	2.2331-09	2.1375-09	1.9391-09
4900	3.9045-09	3.4068-09	2.7541-09	2.2283-09	2.1329-09	1.9349-09
5000	3.8947-09	3.3983-09	2.7471-09	2.2229-09	2.1278-09	1.9302-09
5500	3.8342-09	3.3454-09	2.7043-09	2.1896-09	2.0958-09	1.9012-09
6000	3.7592-09	3.2798-09	2.6513-09	2.1478-09	2.0558-09	1.8649-09
6500	3.6747-09	3.2060-09	2.5915-09	2.1005-09	2.0105-09	1.8238-09
7000	3.5842-09	3.1269-09	2.5275-09	2.0497-09	1.9619-09	1.7796-09
7500	3.4904-09	3.0450-09	2.4613-09	1.9970-09	1.9114-09	1.7338-09
8000	3.3953-09	2.9619-09	2.3940-09	1.9433-09	1.8601-09	1.6872-09
8500	3.3002-09	2.8788-09	2.3268-09	1.8896-09	1.8086-09	1.6405-09
9000	3.2061-09	2.7966-09	2.2602-09	1.8364-09	1.7577-09	1.5943-09
9500	3.1136-09	2.7159-09	2.1949-09	1.7841-09	1.7076-09	1.5488-09
10000	3.0234-09	2.6371-09	2.1311-09	1.7330-09	1.6587-09	1.5044-09
11000	2.8505-09	2.4861-09	2.0090-09	1.6350-09	1.5649-09	1.4193-09
12000	2.6890-09	2.3450-09	1.8948-09	1.5433-09	1.4771-09	1.3396-09
13000	2.5388-09	2.2140-09	1.7888-09	1.4580-09	1.3954-09	1.2654-09
14000	2.3999-09	2.0927-09	1.6906-09	1.3789-09	1.3197-09	1.1967-09
15000	2.2715-09	1.9806-09	1.6000-09	1.3058-09	1.2497-09	1.1332-09
16000	2.1529-09	1.8771-09	1.5163-09	1.2382-09	1.1850-09	1.0745-09
17000	2.0434-09	1.7815-09	1.4389-09	1.1757-09	1.1251-09	1.0202-09
18000	1.9421-09	1.6931-09	1.3674-09	1.1179-09	1.0698-09	9.6999-10
19000	1.8484-09	1.6113-09	1.3013-09	1.0643-09	1.0185-09	9.2348-10
20000	1.7615-09	1.5355-09	1.2400-09	1.0146-09	9.7100-10	8.8036-10
21000	1.6809-09	1.4652-09	1.1832-09	9.6854-10	9.2686-10	8.4032-10
22000	1.6060-09	1.3998-09	1.1303-09	9.2566-10	8.8582-10	8.0309-10
23000	1.5363-09	1.3390-09	1.0811-09	8.8573-10	8.4760-10	7.6842-10
24000	1.4713-09	1.2823-09	1.0353-09	8.4849-10	8.1195-10	7.3609-10
25000	1.4106-09	1.2293-09	9.9251-10	8.1370-10	7.7865-10	7.0589-10
26000	1.3539-09	1.1798-09	9.5250-10	7.8115-10	7.4750-10	6.7763-10
27000	1.3007-09	1.1335-09	9.1504-10	7.5066-10	7.1832-10	6.5117-10
28000	1.2509-09	1.0900-09	8.7991-10	7.2206-10	6.9094-10	6.2634-10
29000	1.2041-09	1.0492-09	8.4692-10	6.9518-10	6.6522-10	6.0301-10
30000	1.1601-09	1.0108-09	8.1590-10	6.6990-10	6.4102-10	5.8106-10

Table 51. Rate constant for hydrogen molecule in  $v=14$  and  $J=3$  states.

T(K)	$v=14, J=3$	T(K)	$v=14, J=3$
100	9.8568 -11	4100	1.6287 -09
200	2.1704 -10	4200	1.6288 -09
300	3.2507 -10	4300	1.6283 -09
400	4.2542 -10	4400	1.6271 -09
500	5.1927 -10	4500	1.6255 -09
600	6.0723 -10	4600	1.6233 -09
700	6.8970 -10	4700	1.6206 -09
800	7.6697 -10	4800	1.6175 -09
900	8.3931 -10	4900	1.6140 -09
1000	9.0697 -10	5000	1.6102 -09
1100	9.7018 -10	5500	1.5860 -09
1200	1.0291 -09	6000	1.5557 -09
1300	1.0841 -09	6500	1.5214 -09
1400	1.1352 -09	7000	1.4845 -09
1500	1.1826 -09	7500	1.4463 -09
1600	1.2266 -09	8000	1.4074 -09
1700	1.2674 -09	8500	1.3684 -09
1800	1.3050 -09	9000	1.3298 -09
1900	1.3398 -09	9500	1.2919 -09
2000	1.3718 -09	10000	1.2548 -09
2100	1.4012 -09	11000	1.1838 -09
2200	1.4282 -09	12000	1.1172 -09
2300	1.4528 -09	13000	1.0554 -09
2400	1.4753 -09	14000	9.9804 -10
2500	1.4958 -09	15000	9.4503 -10
2600	1.5144 -09	16000	8.9602 -10
2700	1.5311 -09	17000	8.5072 -10
2800	1.5462 -09	18000	8.0882 -10
2900	1.5597 -09	19000	7.7001 -10
3000	1.5717 -09	20000	7.3403 -10
3100	1.5823 -09	21000	7.0062 -10
3200	1.5916 -09	22000	6.6956 -10
3300	1.5997 -09	23000	6.4064 -10
3400	1.6066 -09	24000	6.1366 -10
3500	1.6125 -09	25000	5.8847 -10
3600	1.6173 -09	26000	5.6490 -10
3700	1.6213 -09	27000	5.4282 -10
3800	1.6243 -09	28000	5.2211 -10
3900	1.6265 -09	29000	5.0265 -10
4000	1.6280 -09	30000	4.8435 -10

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