Co אין די פון ts o ע t שי Isotopic a עם C אין ארך די Studies of t שי T אין ארך די Deco אין Deco אין ארך די Nit rate

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Т ГГ м (AN, м Г g Г 176	трГтр), Гд ч Э400°С	u	μα μα (^Δ . 1) -							
$NH_4NO_3 \rightarrow N_2O + 2 H_2O$			(1)							
Гю u юГиГ , Rю ю юд u д u T u 1 ¹⁴ NH4 ¹⁵ NO3	⁺ 5.Τ π Γ π ,1 Γ ῶ Γ ¹⁵ Ν ¹	(1) F N-15 O-1 u fn ¹⁴ NO ¹⁴ N ¹⁵ N	18 Г u u 1,1 ,1 ,6 9. ¹⁵ NH4 ¹⁴ NO3 0 m							
Г.Т 10 10 10 10 10 10 10 10 10 10 10 10 10 1	г им 220	N_2O H_2O °C±20°C, u	N-15 O-18,							
N-15 O-18 m 1 . T r $(_{\infty}),$ $(45/44)_{\infty}/(45/44)_{1} = 1.007 \pm$ T m g $(_{\infty}),$ m f m u N-15 u u $^{15}NH_{4}^{+}$ m m m f u g_{u} u f m f m f m f m f _ m f m f _ m f _ m f	$u \qquad (45)$ $u \qquad (45)$ $u \qquad N-15$ $u \qquad N-15$ $u \qquad 1^{15} NO_3^{-1}$ m $f \qquad m \qquad f$ $f \qquad m \qquad f$ $(= \infty) \qquad (H_2)$	$\begin{array}{c} \mathrm{NH_4NO_3}\\ \mathrm{MH_4NO_3}\\ \mathrm{MH_4NO_3}$	g u $rQ u r^{2}M_{2}O r^{2} r^{2}M_{2}O r^{2} r^{2}M_{2}O r^{2} r^{2}M_{2}OM_{2}^{16}O) N_{2}Or^{2}$							
$ (N_2^{18}O/N_2^{16}O)/(H_2^{18}O/H_2^{16}O) = (212.6\pm0.2\times10^{5})/(208.0\pm0.3\times10^{5}) = 1.022 = (212.5\pm0.5\times10^{5})/(207.6\pm0.2\times10^{5}) = 1.024 $										

 $= 1.023 \pm 0.003$ (m Jū)

T ຟີ g	u ([¶] . 2	Г Гта 3):		O-18 10	N ₂ O ГนГ	H2 tri	0 10110	uto		-
NH ₄ N ¹⁶ O ₂	$_3 \rightarrow \mathrm{NH}_2\mathrm{N}$	${\rm H}^{16}{\rm O}_2 + {\rm H_2}^1$	^{.6} O							(2)
NH ₂ N ¹⁶ O ₂	$_2 \rightarrow N_2^{16}C$	$H_{2}^{16}O$								(3)
N ti r	φ (. T	ស រី រើរ	u g m ^g) u,	បវេរ		tri	to Γ	uto	m-
ГиГ (N ⁻¹⁶ О ¹⁸ О/ ¹⁶ О	m (1/ 2)]	u * ¹⁸ O 2 3%	, N₂O	ן H ₂ C	g	≙ u	u g	g u	Ր u	-
Т Г	u A u	m (4):	u (. NI	$\frac{11}{2}$ 5 H_4NO_3		uto	u		u)
NH4 ⁺ NO ₃	(ı) ⇔ NH3	g) + HNO	3 g)							(4)
P u 225 2 (A . 6, 7, 2	Ги HNC 75°C (498 3) 3,5 :	лг г О ₃ г 3 548 К),	рПтри тр , AN	u J to	tø		(^ .: g	AN 5) m	ר י	u Ma
$NH_4^+NO_3^-$	$+ H_2O \rightarrow$	NH4OH +	- HNO ₃							(5)
2 HONO ₂	$\xrightarrow{r} N$	$O_2^+ + NO_3^-$	+ H ₂ O							(6)
$NH_3 + NC$	$O_2^+ \rightarrow NH_2$	$_{2}NO_{2} + H^{+}$								(7)
NH2NO2 -	$\rightarrow N_2O + 2$	НОН								(3)
A m 290°C	оГ g	to	AN Гю	ugg m (A .	8 10)	4 :	l	5		
HONO ₂ –	– <mark>r̃</mark> →H($D^{\cdot} + NO_2$								(8)
$HO^{\cdot} + NH$	$H_3 \longrightarrow N_2$	$H_2^{+} + HOH$								(9)
$NH_2^{+} + N$	$O_2 \longrightarrow N$	$H_2NO_2 \rightarrow$	$N_2O + H_2$	0						(10)
Τ tri α	AN 1.2	т , Г Ш и	3,4 NO ₃ m m	to g	N M ND ₄ N M Г	₩Н ₃ . Т Ю ₃	H ₂ (m 340°C (8)): ⊃):	/D	-

$${}^{15}\mathrm{NH_4}{}^{14}\mathrm{N}{}^{16}\mathrm{O}_3 \xrightarrow{\mathrm{N}_{-15}}{r} {}^{15}\mathrm{NH_4} {}^{14}\mathrm{N}{}^{16}\mathrm{O} \xrightarrow{\neq} \mathrm{H_2}{}^{16}\mathrm{O} + \\ : \\ {}^{16}\mathrm{O} \\ + {}^{15}\mathrm{NH_2}{}^{14}\mathrm{N}{}^{16}\mathrm{O}_2 \longrightarrow \mathrm{H_2}{}^{16}\mathrm{O} + {}^{15}\mathrm{N}{}^{14}\mathrm{N}{}^{16}\mathrm{O}$$
(14)

$${}^{14}\mathrm{NH_4}{}^{15}\mathrm{N}{}^{16}\mathrm{O}_3 \xrightarrow{\mathrm{A_{-15}}}{r} {}^{14}\mathrm{NH_4} {}^{15}\mathrm{N}{}^{16}\mathrm{O} \xrightarrow{\neq} \mathrm{H_2}{}^{16}\mathrm{O} + \\ \vdots \\ {}^{16}\mathrm{O} \\ + {}^{14}\mathrm{NH_2}{}^{15}\mathrm{N}{}^{16}\mathrm{O}_2 \longrightarrow \mathrm{H_2}{}^{16}\mathrm{O} + {}^{14}\mathrm{N}{}^{15}\mathrm{N}{}^{16}\mathrm{O}$$
(15)

A to $\mathbf{II}(1\%)$ g N_2O m ${}^{15}N^{14}N^{16}O + {}^{14}N^{15}N^{16}O / {}^{14}N_2{}^{16}O = ({}^{A}-15){}^{14}NH_4{}^{15}N^{16}O_3 + {}^{16}N_4{}^{16}O_3 + {}^{$ + ($^{\rm N}$ -15) 15 NH₄ 14 N¹⁶O₃ / (-14) 14 NH₄ 14 N¹⁶O₃ (16) $, (^{N}-15) = (-14),$ S , gГ g uþ gu: ${}^{15}N^{14}N^{16}O + {}^{14}N^{15}N^{16}O \ / \ {}^{14}N_2{}^{16}O \ = \ (\ {}^{A}\text{--}15)/(\ \text{--}14) + 1 \qquad {}^{14}NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}15)/(\ {}^{A}\text{--}15)/(\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16NH_4{}^{15}N^{16}O_3 \ / \ (\ {}^{A}\text{--}16) + 1 \qquad {}^{A}\text{--}16) + 1 \qquad$ ¹⁴NH₄¹⁴N¹⁶O₃ (17)A mr m AN: ${}^{14}\mathrm{NH_4}{}^{15}\mathrm{N}{}^{16}\mathrm{O}_3 \ \ + \ \ {}^{15}\mathrm{NH_4}{}^{14}\mathrm{N}{}^{16}\mathrm{O}_3 \ \ / \ \ {}^{14}\mathrm{N}{}_2{}^{16}\mathrm{O} \ \ = \ \ R^{\mathrm{N}} \ \ {}^{45}({}^{15}\mathrm{N}) + R^{\mathrm{A}} \ \ {}^{45}({}^{15}\mathrm{N}) \ \ = \ \ {}^{16}\mathrm{N}{}_2{}^{16}\mathrm{O}_3 \ \ \ {}^{16}\mathrm{N}{}_2{}^{16}\mathrm{N}{}_2{}^{16}\mathrm{O}_3 \ \ \ {}^{16}\mathrm{N}{}_2{}^{16}\mathrm{$ $= R^{to 45}(=\infty)$ (18) $R^{N-45} = ~~^{15}NH_4 ~^{14}N^{16}O_3 ~/~^{14}NH_4 ~^{14}N^{16}O_3 ~~=~~^{15}N^{14}N^{16}O ~/~^{14}N_2 ~^{16}O ~~_{=\infty}$ $R^{A\ 45} = \ \ ^{14}NH_4 \ ^{15}NO_3 \ / \ \ ^{14}NH_4 \ ^{14}NO_3 \quad \ \cong \ \ \ ^{14}N^{15}N^{16}O \ / \ \ ^{14}N_2 \ ^{16}O \quad \ = _{\infty}$ г и N-15 AN: Ι $R^{m45}(,1\%) = (^{A}-15)/(-14) + 1 = 1/2 R^{m45}_{=\infty}$ (19) $(^{A}-15)/(-14)+1) = 2 R_{(1\%)}^{m45}/R_{=\infty}^{m45}$ (20)Τu $(-14)/(^{A}-15) = 1/2 R_{(1\%)}^{m45}/R_{=\infty}^{m45} 1$ (21)Ŭ g <u>∿</u>u $(R_{=\infty}^{m45}/R_{(1\%)}^{m45})$ (21)te IT m 1.007 1 $(-14)/(^{A}-15),$ N-15 m 1.008 1.015±0.001. Т រ រោ KIE um g g m Ē m g g. u g g m g u I.E. I AN u N-14 N-15 m u Jũ u N-15 KIE 1.015. T Ē ց ս սՐ ult¹⁵N KIE т ¹⁵№ ¹⁶О ſ uu.T mg **g Г** ¹⁵N ¹⁶O $, (\mathrm{H}^{16}\mathrm{O}...^{15}\mathrm{NO}_2)^{\neq},$ g ſ T.S.(≠) m Г ГдГ N-15 , u m . T g g g u u u тg g – g **•**.4). N-15 AN(g

Г А N-15 HNO_3 (g u) lĨ u N-15 u _ **⊈**u NH₂NO₂ Г ľū Г u u $(\mathbf{A}, 7, 3)$.T u, ¹⁵N KIE N-15 N_2O u Ē ¹⁵N ¹⁶O uГ u u <u></u>¶_u г um $^{15}\mathrm{N}$ to g u ⁴ . 4). u g T ¹⁵N ⊆¶_u Г NH₃ $NH_4^+NO_3^$ g 10 , , m NO ١T Г NO₂ 11 , , NO HNO₃ 12-Г g **Г** (**⁹**. 22 24): 15 NH_{3(g)} + 14 NH₄NO_{3(f)} \Leftrightarrow 15 NH₄NO₃ + 14 NH_{3(g)} (22) $\alpha = K = 1.034 - 25^{\circ}C 10$, $^{15}NO + ^{14}NO_2 \Leftrightarrow ^{14}NO + ^{15}NO_2$ (23) $K = 1.0417 \quad 25^{\circ}C$ (**I** ul.); 1.0146 $200^{\circ}C$; 1.0075 $400^{\circ}C$; 1.0044 600°C 11 , , . $^{15}NO + H^{14}NO_3 \Leftrightarrow H^{15}NO_3 + {}^{14}NO$ (24) $K = 1.045 \pm 0.01;$ **μ**:1.055 25°C (NO 10 M. HNO₃) m 12 . Т NH₄NO₃(m Г) HNO₃(g) П (m ΠГΓ), Гg u H¹⁴NO₃/H¹⁵NO₃ Гm . T Г m ſ Гu NO_3^- Ш 13-g.T g H¹⁵NO₃ 14– ſ . I m u g 16 มี มโ ſ 0 uГ m Г ſ u 1ว โมโ g ſ u u տ Ր սՐ . g Q Т **Г ս**Г 11 . T ſ, m ıΓ ſ n ſ u Г ท Г นโ $(^{14}N)/$ (^{15}N) £ m g u 1.014±0.001, mm Гm 15, սГ Г m ſ Ē ſ g þ .

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