

Appendix D

Health Risk Assessment

PRIORITIZATION FOR

CHARLES VAN DER KOOI Project # 1053434 Region (C) Facility (7013)

DEVICE NUMBER 1
DEVICE NAME Milk Parlor

CAS NUMBER	POLLUTANT NAME	LBS/YEAR	LBS/HOUR	Emissions and Potency Method			Dispersion Adjustment Method		
				Prioritization Scores			Prioritization Scores		
				Cancer	CHRONIC	ACUTE	Cancer	CHRONIC	ACUTE
1210	Xylenes (mixed)	1.06E+01	1.21E-03		5.21E-07	1.65E-07		2.87E-07	9.10E-08
9960	SULFATES	3.37E+01	3.87E-03		4.63E-05	9.68E-05		2.55E-05	5.32E-05
50000	Formaldehyde	2.35E+00	2.68E-04	4.80E-05	2.69E-05	8.57E-06	2.61E-05	1.48E-05	4.71E-06
56235	Carbon tetrachloride	3.47E-01	3.96E-05	4.95E-05	2.98E-07	6.25E-08	2.69E-05	1.64E-07	3.44E-08
67630	Isopropyl alcohol	9.56E+00	1.09E-03		4.69E-08	1.02E-06		2.58E-08	5.63E-07
67663	Chloroform	7.73E-01	8.82E-05	1.39E-05	8.84E-08	1.76E-06	7.57E-06	4.86E-08	9.70E-07
71432	Benzene	1.88E+00	2.15E-04	1.86E-04	1.08E-06	4.96E-07	1.01E-04	5.93E-07	2.73E-07
74873	Methyl chloride {Chloromethane}	4.69E+00	5.35E-04						
75003	Ethyl chloride {Chlorethane}	1.41E+00	1.61E-04		1.62E-09			8.90E-10	
75070	Acetaldehyde	1.42E+01	1.63E-03	1.31E-04	5.44E-05		7.11E-05	2.99E-05	
75150	Carbon disulfide	1.47E+01	1.68E-03		0.00E+00	8.13E-07		0.00E+00	4.47E-07
75694	Trichlorofluoromethane {Freon 11}	6.36E-04	7.26E-08		3.12E-11			1.72E-11	
78933	Methyl ethyl ketone {2-Butanone}	8.63E+01	9.85E-03		2.96E-06	2.27E-06		1.63E-06	1.25E-06
79005	1,1,2-Trichloroethane	1.34E+00	1.53E-04	7.28E-05			3.96E-05		
79345	1,1,1,2-Tetrachloroethane	5.16E-02	5.89E-06	1.02E-05			5.53E-06		
91203	Naphthalene	6.87E+00	7.85E-04	7.95E-04	2.62E-05		4.32E-04	1.44E-05	
95501	1,2-Dichlorobenzene	3.24E+00	3.70E-04						
96128	1,2-Dibromo-3-chloropropane	2.92E-01	3.33E-05	1.98E-03	5.01E-05		1.08E-03	2.76E-05	
96184	1,2,3-Trichloropropane	1.63E+00	1.86E-04						
98828	Cumene	3.32E-01	3.79E-05						
100414	Ethyl benzene	2.05E+00	2.34E-04	1.74E-05	3.52E-08		9.48E-06	1.94E-08	
100425	Styrene	2.12E+00	2.42E-04		8.10E-08	3.46E-08		4.45E-08	1.90E-08
100447	Benzyl chloride	1.71E+00	1.95E-04	2.84E-04	4.88E-06	2.44E-06	1.55E-04	2.69E-06	1.34E-06
106467	p-Dichlorobenzene	3.07E+00	3.50E-04	1.15E-04	1.32E-07		6.24E-05	7.24E-08	
106934	Ethylene dibromide {EDB}	1.81E+00	2.07E-04	4.37E-04	7.77E-05		2.37E-04	4.27E-05	
107062	Ethylene dichloride {EDC}	3.49E-01	3.98E-05	2.49E-05	2.99E-08		1.35E-05	1.65E-08	

**PRIORITIZATION
FOR**

**CHARLES VAN DER KOOI
Project # 1053434
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107131	Acrylonitrile	1.43E+00	1.64E-04	1.41E-03	9.85E-06		7.69E-04	5.42E-06	
108054	Vinyl acetate	1.16E+01	1.33E-03		2.00E-06			1.10E-06	
108101	Methyl isobutyl ketone {Hexone}	4.19E+00	4.78E-04						
108883	Toluene	6.34E+00	7.24E-04		7.26E-07	5.87E-08		3.99E-07	3.23E-08
108907	Chlorobenzene	1.61E+00	1.84E-04		5.52E-08			3.04E-08	
110543	Hexane	4.80E+00	5.48E-04		2.36E-08			1.30E-08	
110827	Cyclohexane	4.04E+01	4.61E-03						
120821	1,2,4-Trichlorobenzene	4.61E+00	5.26E-04						
123728	Butyraldehyde	6.73E-01	7.68E-05						
123911	1,4-Dioxane	8.33E+00	9.51E-04	2.18E-04	9.54E-08	9.51E-07	1.19E-04	5.25E-08	5.23E-07
127184	Perchloroethylene {Tetrachloroethene}	3.85E+00	4.39E-04	7.72E-05	3.77E-06	6.59E-08	4.19E-05	2.08E-06	3.62E-08
541731	1,3-Dichlorobenzene	2.90E+00	3.31E-04						
764410	1,4-Dichloro-2-butene	5.27E+00	6.02E-04						
4170303	Crotonaldehyde	8.36E-01	9.54E-05						
7429905	Aluminum	2.81E+01	1.12E-02						
7439921	Lead	4.05E-02	1.61E-05	1.65E-06			8.99E-07		
7439965	Manganese	7.41E-01	2.94E-04		1.27E-04			7.00E-05	
7440020	Nickel	3.19E-02	1.27E-05	2.82E-05	2.19E-05	6.34E-06	1.53E-05	1.21E-05	3.49E-06
7440224	Silver	1.60E-02	6.34E-06						
7440382	Arsenic	6.14E-03	2.44E-06	6.89E-05	7.03E-06	3.85E-05	3.75E-05	3.87E-06	2.12E-05
7440393	Barium	5.71E-01	2.27E-04						
7440439	Cadmium	1.11E-02	4.39E-06	1.58E-04	1.90E-05		8.58E-05	1.04E-05	
7440484	Cobalt	3.69E-03	1.46E-06						
7440508	Copper	1.04E-01	4.15E-05		1.49E-06	1.24E-06		8.22E-07	6.84E-07
7440622	Vanadium (fume or dust)	1.40E-01	5.56E-05			5.56E-06			3.06E-06
7440666	Zinc	2.89E-01	1.15E-04		2.83E-07			1.56E-07	
7631869	Silica, crystalline	8.67E+01	3.44E-02		9.92E-04			5.46E-04	
7664417	Ammonia	5.52E+00	2.19E-03		9.48E-07	2.06E-06		5.21E-07	1.13E-06
7726956	Bromine	4.79E-02	1.90E-05		9.68E-07			5.32E-07	
7782492	Selenium	7.37E-03	2.93E-06		1.27E-08			6.96E-09	

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7782505	Chlorine	7.88E+00	3.13E-03		1.35E-03	4.47E-05		7.44E-04	2.46E-05
18540299	Chromium, hexavalent (& compounds)	4.91E-03	1.95E-06	2.51E-03	8.44E-07		1.36E-03	4.64E-07	
TOTALS FOR DEVICE 1				8.64E-03	2.83E-03	2.14E-04	4.70E-03	1.56E-03	1.18E-04

DEVICE NUMBER 2
DEVICE NAME Cow Housing

**Emissions and Potency
Method**

**Dispersion Adjustment
Method**

Prioritization Scores

Prioritization Scores

CAS NUMBER	POLLUTANT NAME	LBS/YEAR	LBS/HOUR	Emissions and Potency Method			Dispersion Adjustment Method		
				Cancer	CHRONIC	ACUTE	Cancer	CHRONIC	ACUTE
1210	Xylenes (mixed)	1.22E+02	1.40E-02		6.00E-06	1.90E-06		3.30E-06	1.05E-06
9960	SULFATES	3.88E+02	4.45E-02		5.33E-04	1.11E-03		2.93E-04	6.12E-04
50000	Formaldehyde	2.70E+01	3.09E-03	5.52E-04	3.10E-04	9.85E-05	3.00E-04	1.70E-04	5.42E-05
56235	Carbon tetrachloride	3.99E+00	4.55E-04	5.70E-04	3.42E-06	7.19E-07	3.10E-04	1.88E-06	3.95E-07
67630	Isopropyl alcohol	1.10E+02	1.26E-02		5.40E-07	1.18E-05		2.97E-07	6.47E-06
67663	Chloroform	8.88E+00	1.01E-03	1.60E-04	1.02E-06	2.03E-05	8.70E-05	5.59E-07	1.12E-05
71432	Benzene	2.17E+01	2.47E-03	2.14E-03	1.24E-05	5.71E-06	1.16E-03	6.82E-06	3.14E-06
74873	Methyl chloride {Chloromethane}	5.39E+01	6.15E-03						
75003	Ethyl chloride {Chlorethane}	1.63E+01	1.86E-03		1.86E-08			1.02E-08	
75070	Acetaldehyde	1.64E+02	1.87E-02	1.50E-03	6.25E-04		8.18E-04	3.44E-04	
75150	Carbon disulfide	1.69E+02	1.93E-02		0.00E+00	9.35E-06		0.00E+00	5.14E-06
75694	Trichlorofluoromethane {Freon 11}	7.31E-03	8.35E-07		3.59E-10			1.97E-10	
78933	Methyl ethyl ketone {2-Butanone}	9.93E+02	1.13E-01		3.41E-05	2.61E-05		1.87E-05	1.44E-05
79005	1,1,2-Trichloroethane	1.54E+01	1.76E-03	8.37E-04			4.55E-04		
79345	1,1,2,2-Tetrachloroethane	5.94E-01	6.78E-05	1.17E-04			6.36E-05		
91203	Naphthalene	7.91E+01	9.02E-03	9.14E-03	3.02E-04		4.97E-03	1.66E-04	
95501	1,2-Dichlorobenzene	3.73E+01	4.25E-03						
96128	1,2-Dibromo-3-chloropropane	3.36E+00	3.83E-04	2.28E-02	5.76E-04		1.24E-02	3.17E-04	
96184	1,2,3-Trichloropropane	1.88E+01	2.14E-03						
98828	Cumene	3.82E+00	4.36E-04						
100414	Ethyl benzene	2.36E+01	2.69E-03	2.01E-04	4.05E-07		1.09E-04	2.23E-07	
100425	Styrene	2.44E+01	2.79E-03		9.31E-07	3.98E-07		5.12E-07	2.19E-07

**PRIORITIZATION
FOR**

**CHARLES VAN DER KOOI
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100447	Benzyl chloride	1.96E+01	2.24E-03	3.27E-03	5.62E-05	2.80E-05	1.78E-03	3.09E-05	1.54E-05
106467	p-Dichlorobenzene	3.53E+01	4.03E-03	1.32E-03	1.51E-06		7.17E-04	8.33E-07	
106934	Ethylene dibromide {EDB}	2.08E+01	2.38E-03	5.02E-03	8.93E-04		2.73E-03	4.91E-04	
107062	Ethylene dichloride {EDC}	4.01E+00	4.58E-04	2.86E-04	3.44E-07		1.56E-04	1.89E-07	
107131	Acrylonitrile	1.65E+01	1.88E-03	1.63E-02	1.13E-04		8.84E-03	6.23E-05	
108054	Vinyl acetate	1.34E+02	1.53E-02		2.30E-05			1.26E-05	
108101	Methyl isobutyl ketone {Hexone}	4.82E+01	5.50E-03						
108883	Toluene	7.30E+01	8.33E-03		8.35E-06	6.75E-07		4.59E-06	3.71E-07
108907	Chlorobenzene	1.85E+01	2.11E-03		6.35E-07			3.49E-07	
110543	Hexane	5.52E+01	6.30E-03		2.71E-07			1.49E-07	
110827	Cyclohexane	4.64E+02	5.30E-02						
120821	1,2,4-Trichlorobenzene	5.30E+01	6.05E-03						
123728	Butyraldehyde	7.74E+00	8.83E-04						
123911	1,4-Dioxane	9.58E+01	1.09E-02	2.51E-03	1.10E-06	1.09E-05	1.36E-03	6.03E-07	6.02E-06
127184	Perchloroethylene {Tetrachloroethene}	4.42E+01	5.05E-03	8.87E-04	4.34E-05	7.58E-07	4.82E-04	2.39E-05	4.17E-07
541731	1,3-Dichlorobenzene	3.33E+01	3.80E-03						
764410	1,4-Dichloro-2-butene	6.07E+01	6.92E-03						
4170303	Crotonaldehyde	9.61E+00	1.10E-03						
7429905	Aluminum	3.23E+02	1.28E-01						
7439921	Lead	4.66E-01	1.85E-04	1.90E-05			1.03E-05		
7439965	Manganese	8.52E+00	3.38E-03		1.46E-03			8.05E-04	
7440020	Nickel	3.67E-01	1.46E-04	3.25E-04	2.52E-04	7.30E-05	1.76E-04	1.39E-04	4.01E-05
7440224	Silver	1.84E-01	7.30E-05						
7440382	Arsenic	7.06E-02	2.81E-05	7.93E-04	8.09E-05	4.43E-04	4.31E-04	4.45E-05	2.44E-04
7440393	Barium	6.57E+00	2.61E-03						
7440439	Cadmium	1.27E-01	5.05E-05	1.82E-03	2.18E-04		9.87E-04	1.20E-04	
7440484	Cobalt	4.24E-02	1.68E-05						
7440508	Copper	1.20E+00	4.77E-04		1.72E-05	1.43E-05		9.45E-06	7.87E-06
7440622	Vanadium (fume or dust)	1.61E+00	6.40E-04			6.40E-05			3.52E-05
7440666	Zinc	3.32E+00	1.32E-03		3.26E-06			1.79E-06	

**PRIORITIZATION
FOR**

**CHARLES VAN DER KOOI
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7631869	Silica, crystalline	9.97E+02	3.96E-01		1.14E-02		6.28E-03			
7664417	Ammonia	6.35E+01	2.52E-02		1.09E-05	2.36E-05	5.99E-06	1.30E-05		
7726956	Bromine	5.51E-01	2.19E-04		1.11E-05		6.12E-06			
7782492	Selenium	8.48E-02	3.37E-05		1.46E-07		8.01E-08			
7782505	Chlorine	9.06E+01	3.60E-02		1.56E-02	5.14E-04	8.55E-03	2.83E-04		
18540299	Chromium, hexavalent (& compounds)	5.65E-02	2.24E-05	2.88E-02	9.70E-06		1.57E-02	5.34E-06		
TOTALS FOR DEVICE 2					9.94E-02	3.26E-02	2.46E-03	5.40E-02	1.79E-02	1.35E-03

DEVICE NUMBER 3

DEVICE NAME Lagoon West

**Emissions and Potency
Method**

**Dispersion Adjustment
Method**

Prioritization Scores

Prioritization Scores

CAS NUMBER	POLLUTANT NAME	LBS/YEAR	LBS/HOUR	Emissions and Potency Method			Dispersion Adjustment Method		
				Cancer	CHRONIC	ACUTE	Cancer	CHRONIC	ACUTE
1210	Xylenes (mixed)	3.66E+01	4.17E-03		1.79E-06	5.69E-07		9.86E-07	3.13E-07
56235	Carbon tetrachloride	6.65E+01	7.58E-03	9.49E-03	5.71E-05	1.20E-05	5.16E-03	3.14E-05	6.59E-06
67663	Chloroform	3.32E+01	3.80E-03	5.99E-04	3.80E-06	7.59E-05	3.25E-04	2.09E-06	4.17E-05
71432	Benzene	3.32E+01	3.80E-03	3.28E-03	1.90E-05	8.76E-06	1.78E-03	1.05E-05	4.82E-06
71556	Methyl chloroform {1,1,1-TCA}	1.33E+02	1.52E-02		4.56E-06	6.69E-07		2.51E-06	3.68E-07
75252	Bromoform	1.48E+03	1.68E-01						
75694	Trichlorofluoromethane {Freon 11}	7.31E+01	8.35E-03		3.59E-06			1.97E-06	
76131	Chlorinated fluorocarbon {CFC-113}	6.65E+01	7.58E-03		3.26E-06			1.79E-06	
78933	Methyl ethyl ketone {2-Butanone}	8.11E+02	9.26E-02		2.78E-05	2.14E-05		1.53E-05	1.17E-05
79016	Trichloroethylene	3.32E+01	3.80E-03	2.26E-04	1.90E-06		1.23E-04	1.05E-06	
95501	1,2-Dichlorobenzene	4.70E+03	5.36E-01						
95636	1,2,4-Trimethylbenzene	3.32E+01	3.80E-03						
100425	Styrene	4.65E+01	5.31E-03		1.78E-06	7.59E-07		9.76E-07	4.17E-07
106467	p-Dichlorobenzene	8.31E+01	9.49E-03	3.11E-03	3.57E-06		1.69E-03	1.96E-06	
106990	1,3-Butadiene	3.32E+01	3.80E-03	1.92E-02	5.71E-05		1.04E-02	3.14E-05	
108054	Vinyl acetate	3.32E+02	3.79E-02		5.71E-05			3.14E-05	
108101	Methyl isobutyl ketone {Hexone}	1.89E+02	2.16E-02						
108883	Toluene	3.99E+02	4.55E-02		4.56E-05	3.69E-06		2.51E-05	2.03E-06

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110827	Cyclohexane	3.32E+01	3.80E-03							
115071	Propylene	4.32E+02	4.93E-02		4.94E-06			2.72E-06		
541731	1,3-Dichlorobenzene	8.31E+01	9.49E-03							
7783064	Hydrogen sulfide	9.18E+02	1.05E-01		3.15E-03	7.50E-03		1.73E-03	4.13E-03	
TOTALS FOR DEVICE 3					3.59E-02	3.45E-03	7.62E-03	1.95E-02	1.89E-03	4.19E-03

DEVICE NUMBER 4
DEVICE NAME Lagoon East

CAS NUMBER	POLLUTANT NAME	LBS/YEAR	LBS/HOUR	Emissions and Potency Method			Dispersion Adjustment Method		
				Prioritization Scores			Prioritization Scores		
				Cancer	CHRONIC	ACUTE	Cancer	CHRONIC	ACUTE
1210	Xylenes (mixed)	3.66E+01	4.17E-03		1.79E-06	5.69E-07		9.86E-07	3.13E-07
56235	Carbon tetrachloride	6.65E+01	7.58E-03	9.49E-03	5.71E-05	1.20E-05	5.16E-03	3.14E-05	6.59E-06
67663	Chloroform	3.32E+01	3.80E-03	5.99E-04	3.80E-06	7.59E-05	3.25E-04	2.09E-06	4.17E-05
71432	Benzene	3.32E+01	3.80E-03	3.28E-03	1.90E-05	8.76E-06	1.78E-03	1.05E-05	4.82E-06
71556	Methyl chloroform {1,1,1-TCA}	1.33E+02	1.52E-02		4.56E-06	6.69E-07		2.51E-06	3.68E-07
75252	Bromoform	1.48E+03	1.68E-01						
75694	Trichlorofluoromethane {Freon 11}	7.31E+01	8.35E-03		3.59E-06			1.97E-06	
76131	Chlorinated fluorocarbon {CFC-113}	6.65E+01	7.58E-03		3.26E-06			1.79E-06	
78933	Methyl ethyl ketone {2-Butanone}	8.11E+02	9.26E-02		2.78E-05	2.14E-05		1.53E-05	1.17E-05
79016	Trichloroethylene	3.32E+01	3.80E-03	2.26E-04	1.90E-06		1.23E-04	1.05E-06	
95501	1,2-Dichlorobenzene	4.70E+03	5.36E-01						
95636	1,2,4-Trimethylbenzene	3.32E+01	3.80E-03						
100425	Styrene	4.65E+01	5.31E-03		1.78E-06	7.59E-07		9.76E-07	4.17E-07
106467	p-Dichlorobenzene	8.31E+01	9.49E-03	3.11E-03	3.57E-06		1.69E-03	1.96E-06	
106990	1,3-Butadiene	3.32E+01	3.80E-03	1.92E-02	5.71E-05		1.04E-02	3.14E-05	
108054	Vinyl acetate	3.32E+02	3.79E-02		5.71E-05			3.14E-05	
108101	Methyl isobutyl ketone {Hexone}	1.89E+02	2.16E-02						
108883	Toluene	3.99E+02	4.55E-02		4.56E-05	3.69E-06		2.51E-05	2.03E-06
110827	Cyclohexane	3.32E+01	3.80E-03						
115071	Propylene	4.32E+02	4.93E-02		4.94E-06			2.72E-06	

PRIORITIZATION
FOR

CHARLES VAN DER KOOI
Project # 1053434
Region (C) Facility (7013)

541731	1,3-Dichlorobenzene	8.31E+01	9.49E-03						
7783064	Hydrogen sulfide	9.18E+02	1.05E-01		3.15E-03	7.50E-03		1.73E-03	4.13E-03
TOTALS FOR DEVICE 4				3.59E-02	3.45E-03	7.62E-03	1.95E-02	1.89E-03	4.19E-03

PRIORITIZATION FOR

CHARLES VAN DER KOOI Project # 1053434 Region (C) Facility (7013)

Emissions and Potency Method

Prioritization Scores

Cancer	CHRONIC	ACUTE
1.80E-01	4.23E-02	1.79E-02

TS = Total Score

t = Specific Toxic Substance

EYR = Emissions Lbs / Year

EHR = Emissions Lbs / Hour

NF = Normalization Factor (Cancer = 1700, Acute = 1500, Chronic = 150)

URF = Unit Risk Factor

AREL = Acute Reference Exposure Level

CREL = Chronic Reference Exposure Level

RP = Receptor Proximity Adjustment Factor

R = Receptor Distance

RP

0m < R < 100m	1.0
100m < R < 250m	0.25
250m < R < 500m	0.04
500m < R < 1000m	0.011
1000m < R < 1500m	0.003
1500m < R < 2000m	0.002
R > 2000m	0.001

Cancer Score:

$$TS(t) = EYR(t) * URF(t) * RP * 1700$$

Acute Score:

$$TS(t) = [EHR(t) / AREL(t)] * RP * 1500$$

Chronic Score:

$$TS(t) = \{ ([EYR(t) / \text{Hours Of Operation}] / CREL(t)) * RP * 150 \}$$

Dispersion Adjustment Method

Prioritization Scores

Cancer	CHRONIC	ACUTE
9.77E-02	2.33E-02	9.86E-03

TS = Total Score

t = Specific Toxic Substance

EYR = Emissions Lbs / Year

EHR = Emissions Lbs / Hour

NF = Normalization Factor (Cancer = 28, Acute = 25, Chronic = 2.5)

URF = Unit Risk Factor

AREL = Acute Reference Exposure Level

CREL = Chronic Reference Exposure Level

SHA = Stack Height Adjustment (< 20m = 60, < 45m = 9, >= 45m = 1)

RP = Receptor Proximity Adjustment Factor

R = Receptor Distance

H = Stack Height

For Stack - 0m <= H < 20m		For Stack - 20m <= H < 45m		For Stack - >= H < 45m	
RP		RP		RP	
0m < R < 100m	1.0	0m < R < 100m	1.0	0m < R < 100m	1.0
100m < R < 250m	0.25	100m < R < 250m	0.85	100m < R < 250m	1.0
250m < R < 500m	0.04	250m < R < 500m	0.22	250m < R < 500m	0.90
500m < R < 1000m	0.011	500m < R < 1000m	0.064	500m < R < 1000m	0.40
1000m < R < 1500m	0.003	1000m < R < 1500m	0.018	1000m < R < 1500m	0.13
1500m < R < 2000m	0.002	1500m < R < 2000m	0.009	1500m < R < 2000m	0.066
R > 2000m	0.001	R > 2000m	0.006	R > 2000m	0.042

Cancer Score:

$$TS(t) = EYR(t) * URF(t) * RP * SHA * 28$$

Acute Score:

$$TS(t) = [EHR(t) / AREL(t)] * RP * SHA * 25$$

Chronic Score:

$$TS(t) = \{ ([EYR(t) / \text{Hours Of Operation}] / CREL(t)) * RP * SHA * 2.5 \}$$