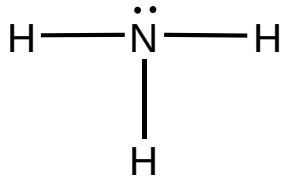
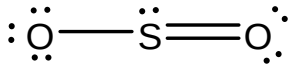
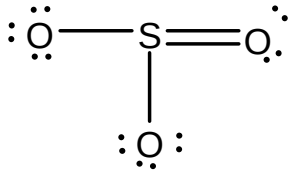
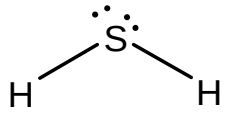
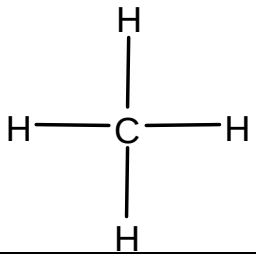
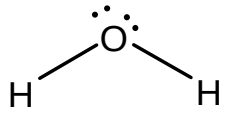
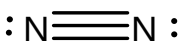
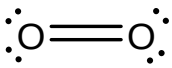
Chemistry 2.4 **Worksheet 5** Name _____

Question One- Complete the table below

Name (and formula)	Lewis Diagram	Bonds contain
Ammonia (NH_3)		3 × N-H
Sulfur dioxide (SO_2)		1 × S-O 1 × S=O
Sulfur trioxide (SO_3)		2 × S-O 1 × S=O
Hydrogen sulfide (H_2S)		2 × S-H
Methane (CH_4)		4 × C-H
Water (H_2O)		2 × O-H
Nitrogen gas (N_2)		1 × NΞN
Oxygen gas (O_2)		1 × O=O

Question Two- Haber process is the industrial process for ammonia production

$$N_2 + 3H_2 \rightleftharpoons 2\,NH_3 \qquad \Delta H = -93\ kJmol^{-1}$$

$N \equiv N$ 945 $kJmol^{-1}$ H-H 436 $kJmol^{-1}$

a) Using the information above, calculate the bond enthalpy of N-H

Bond energy reactant = N-N + 3 × H-H = 945 + 3 × 436 = 2253 $kJmol^{-1}$
Bond energy product = 6 × N-H
2253 – 6 × N-H = -93 $kJmol^{-1}$
6 × N-H = 2346 $kJmol^{-1}$
N-H = 391 $kJmol^{-1}$

The bond enthalpy of N-H is <u>391 $kJmol^{-1}$</u>

b) Calculate how much energy will released when 500 kg of nitrogen gas is fully turned to ammonia

The molar mass for N_2 is 28 $gmol^{-1}$
Amount of nitrogen = 500000 g ÷ 28 $gmol^{-1}$ = 17857.14… mol of N_2
N_2 : reaction = 1 : 1
Amount of reaction = 17857.14… mol
93 $kJmol^{-1}$ × 17857.14… mol = 1660714.29… kJ
or
1.66×10^6 kJ

<u>1.66×10^6 kJ</u> of energy is released when 500 kg of nitrogen gas is fully turned to ammonia.