Question 39 **(16 marks)**

Pentlandite, $Fe_9Ni_9S_8$, is a common nickel sulfide ore that can be used to obtain the materials required to produce sulfuric acid. This metal sulfide ore is combusted in air to form sulfur dioxide according to the following equation.

$$Fe_9Ni_9S_8 + 17\ O_2 \rightarrow 9\ NiO + 9\ FeO + 8\ SO_2$$

(a) What is the volume of sulfur dioxide produced if 2.2 tonne of pentlandite is combusted in air? The process has a yield of 72.0%, and takes place at 300.0 °C and 165.0 kPa. Express your answer to the appropriate number of significant figures.

Molar mass of $Fe_9Ni_9S_8$ = 1287.42 g mol^{-1}. (7 marks)

This sulfur dioxide is then passed over four beds of a vanadium pentoxide or platinum catalyst at 450 °C to produce sulfur trioxide.

$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g) \qquad \Delta H = -197.78\ kJ$$

(b) State **two** justifications for the use of catalysts in this process. (2 marks)

One: _____

_____

Two: _____

_____

(c) State the effect of raising the pressure of the system on both the rate and yield. (2 marks)

Effect on rate: _____

_____

Effect on yield: _____

_____

(d) Use the Collision Theory to explain the effect of raising the total pressure on the yield.

(5 marks)