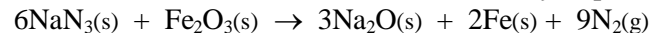


VERSION ORANGE

Question#1: Most air bags in automobiles are inflated with nitrogen produced by the rapid reaction of sodium azide with iron(III) oxide, which is initiated by a spark:



How many moles of sodium azide are required to inflate an air bag with nitrogen to a volume of 35.0 L at a temperature of 25.0°C and a pressure of 765 torr? **(5 marks)**

$$V(\text{N}_2) = 35.0 \text{ L} \quad T = 25.0^\circ\text{C} = \mathbf{298.15 \text{ K}} \quad \mathbf{1 \text{ pt for T conversion}}$$

$$P = 765 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = \mathbf{1.01 \text{ atm}} \quad \mathbf{OR} \quad P = 765 \text{ torr} \times \frac{101.3 \text{ kPa}}{760 \text{ torr}} = \mathbf{102.0 \text{ kPa}}$$

1 pt for P conversion

$$n = \frac{PV}{RT} = \frac{(1.01 \text{ atm})(35.0 \text{ L})}{(0.0821 \text{ atm}\cdot\text{L}\cdot\text{mol}^{-1}\cdot\text{K}^{-1})(298.15 \text{ K})} = \mathbf{1.44_4 \text{ mol N}_2}$$

1pt

$$\text{OR } n = \frac{PV}{RT} = \frac{(102.0 \text{ kPa})(35.0 \text{ L})}{(8.314 \text{ kPa}\cdot\text{L}\cdot\text{mol}^{-1}\cdot\text{K}^{-1})(298.15 \text{ K})} = 1.44_0 \text{ mol N}_2$$

1 mark for proper substitution

$$\# \text{ moles NaN}_3 = 1.44 \text{ moles N}_2 \times \frac{6 \text{ mol NaN}_3}{9 \text{ mol N}_2} = \mathbf{0.960 \text{ moles NaN}_3}$$

1 pt for final answer or or proper ratio.

BONUS QUESTION: How would the amount of NaN₃ needed to inflate an air bag to a volume of 35.0 L depend on altitude? For example, if one were driving in the “mile-high” city of Denver would more, less, or the same amount of NaN₃ be required? (2 marks)

As altitude increases, atmospheric pressure decreases. **1 mark**

∴ one would require less moles of NaN₃ to achieve 35.0 L **1 mark.**

Question#2: Complete the table. For “Is it polar?”, circle “yes” or “no”. **(3 marks)**

Molecule	Draw the Lewis structure	Sketch the geometry & name it.	Is it polar?
XeF_5^+ $V = 8 + (5 \times 7) - 1$ $= 42 \text{ e}^-$		 <i>Square pyramidal</i>	<input checked="" type="radio"/> Yes <input type="radio"/> No

1 mark for Lewis diagram
(correct # e⁻s/bonds)

1 mark for shape/name
(based on Lewis structure)

1 mark for polarity
(must match shape)

