Checking a Model Bicarbonate Refill

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A classroom simulation tests bicarbonate cartridges used to remove hydrogen ions from a model acidic solution. Every run starts with 0.030 mol H^+. The model collects all the carbon dioxide produced, and the reaction stops when either reactant is used up.

$H^+(aq) + HCO_3^-(aq) \rightarrow CO_2(g) + H_2O(l)$

Cartridge	**Initial bicarbonate (mol)**
P	0.020
Q	0.030
R	0.040

1 For cartridge P, identify the limiting reactant. Explain using the initial amounts and the coefficients. [1]

Answer and work

2 Which cartridge uses up both reactants in the same run?

(1) P only

(2) Q only

(3) R only

(4) Q and R

A repeat run starts with the same 0.030 mol H^+, but the cartridge label is missing. The simulation collects only 0.020 mol CO_2 when the reaction stops.

3 Calculate the hydrogen ion amount still present in the repeat run. Show how the gas amount enters the calculation. [1]

Answer and work

4 Suppose a later check shows the gas trap missed some carbon dioxide in the repeat run. Would using only the trapped gas make the calculated leftover H^+ amount too high or too low? Explain. [1]

Answer and work