

Acid Reactivity With Sodium Carbonate

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Response: Compounds **(c)** and **(d)** liberate CO_2 gas when treated with aqueous Na_2CO_3 .

Reaction Principle For an organic compound to react with aqueous sodium carbonate (Na_2CO_3) and liberate carbon dioxide (CO_2), it must be a stronger acid than carbonic acid (H_2CO_3 , $pK_a \approx 6.37$).

Compound Breakdown

- **(a) m-Cresol** ($pK_a \approx 10.1$): Phenols generally have pK_a values around 10, making them weaker acids than carbonic acid. Therefore, it does not react with Na_2CO_3 to yield CO_2 .
- **(b) Phenol** ($pK_a \approx 9.95$): Like m-cresol, phenol is weaker than carbonic acid and will not liberate CO_2 .
- **(c) Phenylacetic acid** ($pK_a \approx 4.31$): Carboxylic acids are significantly stronger acids than carbonic acid ($pK_a < 5$). Phenylacetic acid reacts readily to release CO_2 gas:



- **(d) m-Nitrobenzoic acid** ($pK_a \approx 3.45$): This carboxylic acid is strengthened further by the electron-withdrawing $-\text{NO}_2$ group, making it strong enough to decompose Na_2CO_3 and liberate CO_2 .
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