

# Vehicle Exhaust Environmental Impacts Explained

<https://gemini.google.com/app/be91182772f83f8d>

Response: Based on environmental chemistry principles, the correct option is **(1) exhaust gas released from fossil fuel burning vehicles**.

## Detailed Explanation

Exhaust gas from fossil fuel-burning vehicles contains a combination of gases, primary among them being **carbon dioxide (CO<sub>2</sub>)**, **nitrogen oxides (NO<sub>x</sub>, mainly NO and NO<sub>2</sub>)**, and **volatile organic compounds (VOCs)** or unburnt hydrocarbons.

Here is how these components contribute to all three environmental issues:

### 1. Global Warming:

- Vehicles emit large amounts of CO<sub>2</sub> (a major greenhouse gas) along with trace amounts of N<sub>2</sub>O, which trap heat in the atmosphere.

### 2. Acid Rain:

- High combustion temperatures inside vehicle engines cause atmospheric N<sub>2</sub> and O<sub>2</sub> to react, forming NO<sub>x</sub>.
- These nitrogen oxides dissolve in atmospheric moisture to form nitric acid (HNO<sub>3</sub>), contributing significantly to acid rain.

### 3. Photochemical Smog:

- Vehicle exhaust is the primary source of both NO<sub>x</sub> and **unburnt hydrocarbons (VOCs)**.
- Under sunlight, NO<sub>x</sub> and VOCs undergo photochemical reactions to produce secondary pollutants such as ozone (O<sub>3</sub>) and peroxyacetyl nitrate (PAN), which are the main components of photochemical smog.

## Why Other Options Are Incorrect

- **(2) Exhaust gas from coal power plants:** Produces SO<sub>2</sub> and CO<sub>2</sub> (leading to acid rain and global warming), but emits significantly fewer volatile hydrocarbons necessary to trigger classical vehicle-driven **photochemical smog**.
- **(3) Refrigerant gases:** CFCs/HFCs contribute mainly to ozone layer depletion and global warming, not acid rain or photochemical smog.

- **(4) Municipal solid waste emissions:** Primarily release methane ( $\text{CH}_4$ ) and  $\text{CO}_2$  (global warming), but do not directly cause photochemical smog or major acid rain.
- **(5) Biofuel burning vehicle emissions:** Biofuels are generally considered carbon-neutral regarding net global warming emissions over their lifecycle compared to fossil fuels.

**Correct Answer: (1)**

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Response: The **incorrect** statement is **(4) Among Group I elements, lithium has the weakest metallic bonding.**

### Detailed Analysis of Each Statement

- **(1) Among the Group I elements from Li – Cs, lithium has the most negative value for electron gain energy:**

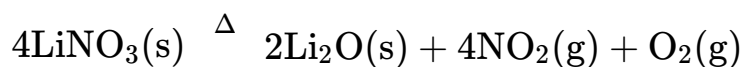
**Correct.** Electron gain enthalpy ( $\Delta_{eg}H$ ) becomes less negative as you go down Group 1 due to increasing atomic radius and shielding effect. Lithium, being the smallest atom in Group 1, has the most negative (most exothermic) electron gain enthalpy.

- **(2) Lithium forms two products when heated in air:**

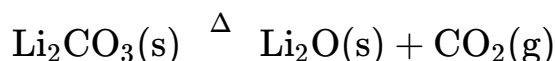
**Correct.** Unlike other Group 1 metals which mainly react with oxygen, lithium reacts with both oxygen ( $\text{O}_2$ ) and nitrogen ( $\text{N}_2$ ) in the air to form **lithium oxide** ( $\text{Li}_2\text{O}$ ) and **lithium nitride** ( $\text{Li}_3\text{N}$ ).

- **(3) Considering the gases evolved, upon heating  $\text{LiNO}_3(\text{s})$  produces two gases whereas  $\text{Li}_2\text{CO}_3(\text{s})$  gives only one gas:**

**Correct.** Due to the high charge density of the small  $\text{Li}^+$  ion, lithium nitrate thermally decomposes similarly to Group 2 nitrates, giving **two gases** ( $\text{NO}_2$  and  $\text{O}_2$ ):



In contrast, lithium carbonate decomposes to yield **only one gas** ( $\text{CO}_2$ ):



- **(4) Among Group I elements, lithium has the weakest metallic bonding:**

**Incorrect.** Metallic bonding strength increases with **smaller ionic radii** and **higher charge density**. Because  $\text{Li}^+$  has the smallest ionic radius in Group 1, its delocalized electrons are held most tightly to the nuclei. Thus, lithium actually has the **strongest** metallic bonding in Group 1 (which gives it the highest melting point and hardness among alkali metals).

- **(5) Lithium gives a red coloured flame in the flame test:**

**Correct.** Lithium salts impart a characteristic crimson/carmine red color to a non-luminous flame.

**Correct Answer: (4)**

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