Incandescent Light Bulbs

Question:
An incandescent light bulb contains some gas along with the filament. How would removing this gas affect the bulb’s energy efficiency?
- Make it more efficient
- Make it less efficient
- No change

Thermal Radiation
- All materials contain electric charges
- Thermal energy makes these charges accelerate
- Accelerating charges emit electromagnetic waves
- All materials emit electromagnetic waves

Black Body Spectrum
- The spectrum and intensity of electromagnetic waves from a black body depend only on its temperature

Incandescent Bulb
- Features:
  - Tungsten filament produces light
  - Electrical connections deliver power to filament
  - Glass envelope protects filament
  - Nitrogen/Argon/Krypton gas fill prolongs life

Operation Issues (Part 1)
- Filament temperature
  - Determines color temperature and efficiency
  - Higher temperature yields higher efficiency
  - Higher temperature shortens filament life
- Filament heating
  - Electrical heating
  - Requires thin wire at higher voltages
Operation Issues (Part 2)

- Filament reactivity
  - Tungsten is reactive
  - Tungsten needs protection from oxygen in air
- Filament sublimation
  - At high temperatures, tungsten atoms sublime
- Non-reactive gas added to limit sublimation
  - Gas bounces tungsten atoms back onto filament
  - Gas leads to convective heat loss

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Halogen Bulb

- Features:
  - Bromine/Iodine/Oxygen gas added to bulb
  - Small, high temperature glass envelope on bulb
- Yields a filament recycling process

Three-Way Bulb

- Two separate filaments
  - One low-power filament
  - One high-power filament
- Three light levels
  - Low-power filament only
  - High-power filament only
  - Both filaments together

Specialized bulbs

- Clear vs. Soft white bulbs
- Long life (high voltage) bulbs
- Rough service bulbs
- Energy-saver bulbs
- Krypton bulbs
- Heat bulbs
- Photoflood bulbs