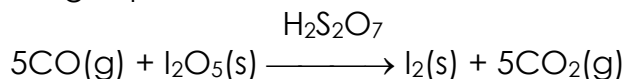


## Quiz (Environmental Protection)

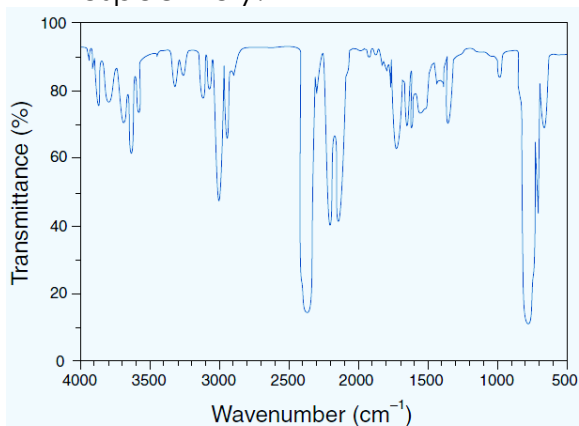
1. Iodine pentoxide ( $I_2O_5$ ) is a white solid commonly used in carbon monoxide colorimetric tubes. In the presence of oleum ( $H_2S_2O_7$ ), iodine pentoxide oxidizes carbon monoxide to carbon dioxide at room temperature according to the following equation:



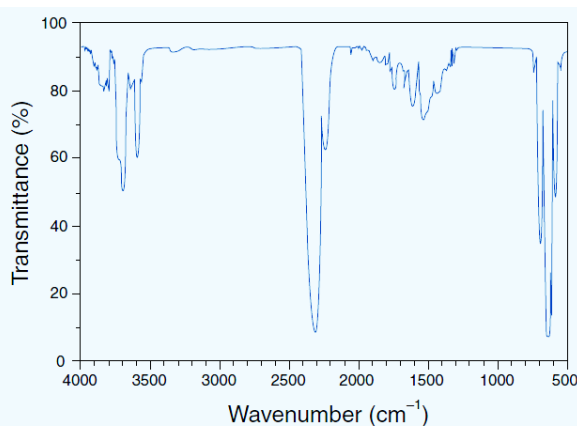
Manufacturers put the iodine pentoxide on the silica gel in a glass tubing. The air sample is drawn through the glass tubing for analysis.

- (a) State the colour change in the glass tubing when carbon monoxide enters the glass tubing.
- (b) Explain why the concentration of carbon monoxide in an air sample can be determined by the above method.
2. Car exhaust is one of the sources of air pollution in Hong Kong. To encourage the use of environmentally friendly petrol, the HKSAR Government has launched a tax reduction program for private cars with low levels of emission. Drivers can pay a lower tax when they buy a newly registered private car with low emissions.

The following diagrams show the infrared spectra for exhaust gas from a petrol car and a hybrid car (using both petrol and electricity as energy sources) respectively.



Infrared spectrum of exhaust gas from a petrol car



Infrared spectrum of exhaust gas from a hybrid car

- (a) Explain why carbon dioxide and water are present in the exhaust gas.
- (b) Assign the absorptions at around  $3000\text{ cm}^{-1}$  and  $2100\text{ cm}^{-1}$  in the infrared spectrum of the petrol car.
- (c) By analysing the spectra, explain why a hybrid car causes less pollution to the environment.

**Suggested Answer**

1. (a) The white solid in the glass tubing changes to brown in colour.  
  
(b) Based on the above equation, the amount of iodine produced increases as the concentration of carbon monoxide increases. As a result, the longer the brown stain in the glass tubing, the higher is the concentration of carbon monoxide. If calibration of the brown stain is done, the concentration of carbon monoxide in an air sample can be determined.
2. (a) The complete combustion of petrol produces carbon dioxide and water.  
  
(b) The absorption peak at around  $3000\text{ cm}^{-1}$  is observed because of the C—H bond in unburnt hydrocarbons from the petrol.  
The absorption peak at around  $2100\text{ cm}^{-1}$  is observed because of the C≡O bond in carbon monoxide formed in the incomplete combustion of petrol.  
  
(c) From the IR spectrum of exhaust gas from a hybrid car, there is absence of absorption peaks at around  $3000\text{ cm}^{-1}$  and  $2100\text{ cm}^{-1}$ .  
This indicates that unburnt hydrocarbons and carbon monoxide are absent in the exhaust. Thus, hybrid car causes less pollution to the environment.