Ideal Gas Law and Stoichiometry Name Answer Key

Use the following reaction to answer the next few questions:

$$2\ C_8H_{18(l)} + 25\ O_{2(g)} \longrightarrow 16\ CO_{2(g)} + 18\ H_2O_{(g)}$$

The above reaction is the reaction between gasoline (octane) and oxygen that occurs inside automobile engines.

1) If 4.00 moles of gasoline are burned, what volume of oxygen is needed if the pressure is 0.953 atm, and the temperature is 35.0°C?

(i) $4.00\ mol\ gasol \times \frac{25\ mol\ O_2}{2\ mol\ gasol} = 50\ mol\ O_2$ sig figs 1330 L O_2

(ii) $\frac{PV}{P} = \frac{nRT}{P} = \frac{(50\ mol\ O_2)(8.314\ kPa\,L/mol\,K)(35.0°C + 273)}{(0.953\ atm \times \frac{101.3\ kPa}{1\ atm})} = 1326\ L\ O_2$

2) How many grams of water would be produced if 20.0 liters of oxygen were burned at a temperature of -10.0°C and a pressure of 1.3 atm?

(i) $\frac{PV}{RT} = \frac{nRT}{RT} = \frac{(1.3\ atm \times \frac{101.3\ kPa}{1\ atm})(20.0\ L)}{(8.314\ \frac{kPa\,L}{mol\,K})(-10.0°C + 273)} = 1.2\ mol\ O_2$

(ii) $1.2\ mol\ O_2 \times \frac{2\ mol\ H_2O}{0.5\ mol\ O_2} \times \frac{18\ g}{1\ mol} =$ 16 g H_2O

3) If you burned one gallon of gas (C_8H_{18}) (approximately 4000 grams), how many liters of carbon dioxide would be produced at a temperature of 21.0°C and a pressure of 1.00 atm?

$4000\ g\ C_8H_{18} \times \frac{1\ mol}{114\ g} \times \frac{16\ mol\ CO_2}{2\ mol\ C_8H_{18}} = 281\ mol\ CO_2$

$\frac{PV}{P} = \frac{nRT}{P} = \frac{(281\ mol)(8.314\ kPa\,L/mol\,K)(21.0°C + 273)}{(101.3\ kPa)} = 6780\ L$ ← rounding; lec of diff rounding

4) How many liters of oxygen would be needed to produced 45.0 liters of carbon dioxide if the temperature and pressure for both are 0.00°C and 5.02 atm?

$45.0\ L\ CO_2 \times \frac{25\ L\ O_2}{1\ mol\ CO_2} =$ 70.3 L O_2

Answers: 1) 1330 L	2) 16 g	3) 6760 L	4) 70.3 L