LONG ANSWER

f) $(2265\ kJ)(.4355) = 986.4\ kJ = 986{,}400\ J$ (efficiency)

$986{,}400\ J = mc\Delta T = (3558\ g)\left(\frac{4.184\ J}{g\ ^\circ C}\right)(T_f - 25)$

$T_f = 91.3^\circ C$

Propane, C_3H_8, is used in plumber's torches and for cooking on gas BBQ grills. The equation is

$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O \quad \Delta H_{rxn} = -2221\ kJ$

(H_f: ? 0 3(394) 4(−286))

	ΔH_f		ΔH_f
H_2O	-286 kJ	CO_2	-394 kJ

$\Delta H_{rxn} = -2221\ kJ = \Sigma H_f(\text{products}) - \Sigma H_f(\text{reactants})$

$-2221 = ((3)(-394) + (4)(-286)) - (1H_f + 0)$

a) What is the ΔH_f value for C_3H_8?

Solve for H_f → $H_f = -105\ kJ$

b) Write the equation for the formation of C_3H_8.

$3C(s) + 4H_2(g) \rightarrow C_3H_8 \quad \Delta H_f = -105\ kJ$

c) Is the reaction in part (b) above, exothermic or endothermic? Explain your reasoning.

exothermic b/c $\Delta H < 0$

d) Calculate the volume of air at STP that is needed to burn completely 45.0 grams of propane. Assume that air is 21.0 percent O_2 by volume.

e) If 45.0 grams of C_3H_8 were combusted, how much heat energy was produced?

from (d) $n = 1.02\ mol\ C_3H_8$ $\left(2221\ \frac{kJ}{mol}\right)(1.02\ mol) = 2265\ kJ$ released

f) Assuming an 43.55% efficiency in the transfer of heat from the reaction in part (e), what would the final temperature be of 3558 grams of water in a pot on the grill at 25.0°C were heated with the 45.0 grams of propane from part (e)?

see above

d) $\frac{45.0\ g}{MM} = \text{moles } C_3H_8$ $\frac{45.0\ g}{44.10\ g/mol} = 1.02\ mol\ C_3H_8$

2 ways to solve for liters $O_2(g)$

1) stoichiometry and $PV = nRT$

from above $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

	C_3H_8	$5O_2$	$3CO_2$	$4H_2O$
mol:mol	1	5	3	4
actual mol	1.02	? = 5.10		

@ STP 273K, 1atm

$PV = nRT$

$(1atm)(V) = (5.10)(.0821)(273)$

$V = 114.3\ L\ O_2(g)$

this is volume of O_2 (NOT AIR!)

2) or @ STP

$\frac{22.4\ L}{1\ mol} = \frac{V}{5.10\ mol}$ $V = 114.2\ L\ O_2(g)$

then for volume of air $\frac{21}{100} = \frac{114.3}{x}$ $x = 544.3\ L$ air