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### Application Questions Chapter 5

1. Prepare a table identifying several energy transitions that take place during the typical operation of an automobile. 10pts

<b>Energy Transition</b>	<b>Type of operation</b>
Fuel into rotational energy and heat	Starter motor
Chemical energy to electrical energy	Automobile battery to the starter motor.
Mechanical energy to kinetic energy	Acceleration
Kinetic energy to heat	Applying breaks
Electrical energy to chemical energy	Charging the battery of the automobile
Electrical energy into to, light energy, sound energy and radio waves	Lamps and electronic devices

2. Which is the least expensive source of energy in kilojoules per dollar: a box of breakfast cereal that weighs 32 ounces and costs \$4.23, or a liter of isooctane (density, 0.6919 g/mL) that costs \$0.45? Compare the nutritional value of the cereal with the heat produced by combustion of the isooctane under standard conditions. A 1.0-ounce serving of the cereal provides 130 Calories. 10pts

**Cereal:** First, convert the unit from calories per ounce to kilojoules per ounce as required:

$$130 \text{ cal/ounce} \times 10^{-3} \text{ kcal/cal} \times 4.184 \text{ kJ/kcal} = 0.544 \text{ kJ/ounce}$$

Then, calculate the total amount of energy in the 32-ounce cereal

$$0.544 \text{ kJ/ounce} \times 32.0 \text{ ounce} = 17.408 \text{ kJ}$$

$$17.408 \text{ kJ} / \$4.23 = 4.12 \text{ kJ}/\$$$

**Isooctane:**  $1 \text{ L} \times 10^3 \text{ mL/L} \times 0.6919 \text{ g/ml} = 691.9 \text{ g}$

$691.9 \text{ g} / 114.2285 \text{ g}\cdot\text{mol}^{-1}$  (molar mass of isooctane obtained from NIST) = 6.057 mol (keep only four effective number)

Then, calculate the total amount of energy we can obtain from combusting 6.057 mol of isooctane.

$$-5461.3 \text{ kJ/mol} \times 6.057 \text{ mol} = -3.307 \times 10^4 \text{ kJ}$$

$$Q = 3.307 \times 10^4 \text{ kJ}$$

$$3.307 \times 10^4 \text{ kJ} / \$0.45 = 7.349 \times 10^4 \text{ kJ}/\$$$

Now to compare the two,

$$7.349 \times 10^4 \text{ kJ}/\$ \square\square 4.12 \text{ kJ}/\$$$

In summary, we can obtain a great lot more kilojoules of energy from burning isooctane than eating cereal by buying one dollar of them. However, because the human's digestion system cannot process isooctane it is still better to choose a cereal.