

***Energy and the Environment 3rd edition Ristinen
Solutions Manual***

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Chapter 2: Fossil Fuels

Odd-numbered problems

•Problem 2.5 : Global oil per person

From Table 2.9, remaining oil in U.S. = $220 \times 10^9 \text{ bbl}$

In U.S., per person: $\frac{220 \times 10^9}{300 \times 10^6} = 733 \text{ bbl/person}$

Page 35, Edwards global oil estimate = $1792 \times 10^9 \text{ bbl}$

Globally, per person: $\frac{1792 \times 10^9}{7 \times 10^9} = 256 \text{ bbl/person}$, or about 1/3 the U.S. amount.

•Problem 2.7: Cost of home heating

See Example 2.1: $\frac{10^6 \text{ Btu}}{0.6} \times \frac{\$14.39}{10^6 \text{ Btu}} = \$23.98 \text{ per day}$

•Problem 2.11: Tons of oil shale per day

For one barrel of oil: $42 \text{ gal} \times 7 \frac{\text{lbs}}{\text{gal}} = 294 \text{ lb}$

$25,000 \text{ ft} \times 294 \text{ lb} = 7.35 \times 10^6 \text{ ft} \cdot \text{lb}$

$1.36 \frac{\text{j}}{\text{ft} \cdot \text{lb}} \times 7.35 \times 10^6 \text{ ft} \cdot \text{lb} = 10 \times 10^6 \text{ j}$

$\frac{10 \times 10^6 \text{ j}}{6.12 \times 10^9 \text{ j/bbl}} = 0.0016 \text{ bbl oil equivalent heat energy}$

∴ Heat energy content is much greater than potential energy.

Multiple choice problems

•Problem 2.1: Bacterial colony in a jar

Answer: g)

$1 \Leftarrow 1/2 \Leftarrow 1/4 \Leftarrow 1/8 \Leftarrow 1/16$

12:00 11:59 11:58 11:57 11:56

•Problem 2.3: Energy consumption per year

Answer: b)

Total energy: $100 \text{ QBtu} = 100 \times 10^{15} \text{ Btu}$

$$\frac{100 \times 10^{15} \text{ Btu/yr}}{300 \times 10^6 \text{ people}} \times \frac{1 \text{ bbl}}{5.8 \times 10^6 \text{ Btu}} = 57.5 \frac{\text{bbl}}{\text{person} \cdot \text{yr}}$$

•Problem 2.5: Petroleum Q_∞

Answer: d)

Page 33: $Q_\infty(\text{oil}) \approx 420 \times 10^9 \text{ bbl}$ **•Problem 2.7: Water required for oil shale**

Answer: c)

See page 51

•Problem 2.9: Energy content ratio of U.S. fossil fuels

Answer: a)

See Table 2.9: *oil gas coal*

1 1.78 5.58

•Problem 2.11: Coal - oil shale comparison

Answer: a)

See page 51

•Problem 2.13: Oil imports

Answer: c)

See page 33, 34. Imports = 1/2 of consumption: $\frac{6 \times 10^9 \text{ bbls}}{2} = 3 \times 10^9$

•Problem 2.15: U.S. petroleum use

Answer: d)

See page 33

•Problem 2.17: Remaining recoverable petroleum

Answer: c)

$$\frac{220 \times 10^9 bbl}{6.1 \times 10^9 bbl/yr} = 36 \text{ yrs, assuming no imports}$$