



Energy Equations

Materials Needed

- Masking tape
- Ring toss set (or other tossing game)
- Math problems and answer key
- Pencils or markers
- Scrap paper or markerboards
- Erasers
- Calculators (optional)

Energy Equations Team Play

Each team tries to solve five energy math problems. To receive a math problem, the team must first successfully complete a tossing game.

Get Ready

1. We have provided 16 sample energy math problems. The earlier problems may be easier for younger students. The latter problems may be more difficult and better suited for older students. Look at all of the problems and carefully select a set of problems to use for the game. You may also make up your own problems, if necessary or desired.
2. If possible, laminate the math problems that you have chosen. Players may write answers and solve on scrap paper. Markerboards also work well for this activity.
3. Have pencils and scrap paper or markerboards, markers, and erasers available for each team's calculations and answers. Decide if you will allow students to use calculators. Modify the instructions to reflect your decision.

Get Set

To play *Energy Equations*, each team must play a tossing game, such as tossing a clothespin into a bucket, tossing a ring over a bottle, or tossing a foam ball into a basket; any tossing skill will do. Mark a tossing line on the floor with masking tape. After each successful toss, the team receives a math problem. Members of the team should start work immediately as the tosses continue. There is no limit to the number of tosses the team can have. Keep playing until the team receives five math problems.

Go!

Give these instructions to the carnival team:

1. I have five energy math problems for your team to solve. Each problem you answer correctly will win your team one energy buck. To receive a math problem, a member of your team must first toss (explain the tossing game you have chosen). Five successful tosses will get you the five math problems. You can have as many tosses as you need to receive all five problems.
2. As soon as you make your first successful toss, I will give you an energy math problem and members of your team can start working immediately.
3. You may use these pencils and paper or markerboard with markers to work out the problems. Please be sure to check each other's math! Once you are sure that you have the correct answer, give the paper to me. You will win one energy buck for each correct answer.
4. This is where you must stand when you toss the object. Are there any questions? Who will make the first toss? Who will be the spokesperson for your team?

Energy Equations Individual Play

The player tries to solve an energy math problem after five attempts at a tossing game. The number of successful tosses determines the number of energy bucks earned if the math problem is correctly solved.

Get Ready

1. We have provided 16 sample energy math problems. The earlier problems may be easier for younger students. The latter problems may be more difficult and better suited for older students. Look at all of the problems and carefully select a set of problems to use for the game. You may also make up your own problems, if necessary or desired.
2. If possible, laminate the math problems that you have chosen. The players can write their answers on scrap paper or markerboards. If your players are of different ages, it is suggested that you color-code the problems according to level of difficulty.
3. Have pencils and scrap paper or markerboards with markers and erasers available for the players' calculations and answers. Decide if you will allow players to use calculators. Modify the instructions to reflect your decision.
4. Collect each player's *Energy Equations* coupon.

Get Set

To play *Energy Equations*, each player first must play a tossing game, such as tossing a clothespin into a bucket, tossing a ring over a bottle, or tossing a foam ball into a basket; any tossing skill will do. Mark a tossing line on the floor with masking tape. After five tosses with at least one successful toss, the player receives a math problem. After solving the math problem correctly, the player earns the number of energy bucks equal to the number of successful tosses. A few practice tosses are recommended for each player. Three to five individuals can play at the same time if you have several sets of problems.

Go!

Give these instructions to the individual player(s):

1. I have one energy math problem for you to solve. However, before I give you the problem, you must toss (explain the tossing game you have chosen). After you have made five tosses, with at least one successful toss, I will give you an energy problem. If you correctly solve the math problem, you will earn energy bucks equal to the number of successful tosses you made. If you have five successful tosses and a correctly solved math problem, you will earn five energy bucks.
2. When you are sure you have the correct answer, give the answer to me.
3. This is where you should stand when you toss the object. Are there any questions?



Answers to Energy Equations

1. $\frac{\$6.50}{\$0.40/\text{lb.}} = 16.25 \times 32\text{can/lb.} = 520 \text{ cans}$

2. 1998, accept 1997-1999

3. 4,020 billion kilowatt-hours

4. 6 domestic + 4 foreign = 10 total usage
4 foreign/10 total = $0.4 \times 100 = 40\%$

5. 100 miles/ 5 miles per gallon = 20 gallons of fuel;
20 gallons x \$2.50/gallon = \$50.00

6. $\frac{1}{2} = \frac{5}{10}$ $\frac{1}{5} = \frac{2}{10}$
 $\frac{5}{10} + \frac{2}{10} = \frac{7}{10}$
 $\frac{10}{10} - \frac{7}{10} = \frac{3}{10}$

7. Year 6

8. $\frac{2}{3} \times 1,266 \text{ therms} = 844 \text{ therms}$

9. Total production = 4,020 billion kWh
Uranium = 805 billion kWh
 $\frac{805}{4,020} = 0.2002 = 20.0\%$, round
= 20%

10. 16 cups to a gallon

$(\frac{1}{16}) \times (91,500) = 5,718.75 = 5,719 \text{ Btu}$

11. United States = 15.6 MBD

Canada = 5.0 MBD

Brazil = 3.4 MBD

Total = 24.0 MBD

12. Total of fossil fuels:

14.1% (coal) + 28.7% (natural gas) +
37.0% (petroleum) = 79.8%

$98 \text{ quads} \times 0.798 = 78.2 = 78.2 \text{ quads}$

13. $A = P (1.0 + R)^T$

A = Final Amount

P = Principle

R = Rate of Increase

T = Number of Years

$A = 37 (1.0 + .02)^{10}$

$A = 37 (1.02)^{10}$

$A = 37 (1.219) = 45.1$

$A = 45.1 \text{ quads}$

14. $A = 1.4B$ $C = 360 \text{ gallons}$ $C = 1.2B$

360 gallons

$B = 1.2$

$B = 300 \text{ gallons}$

$A = 1.4 (300 \text{ gallons}) = 420 \text{ gallons}$

15. $24 \text{ kWh} \times 3.5 \text{ miles/kWh} = 84 \text{ miles}$

16. 6,000 gallons

Question 1

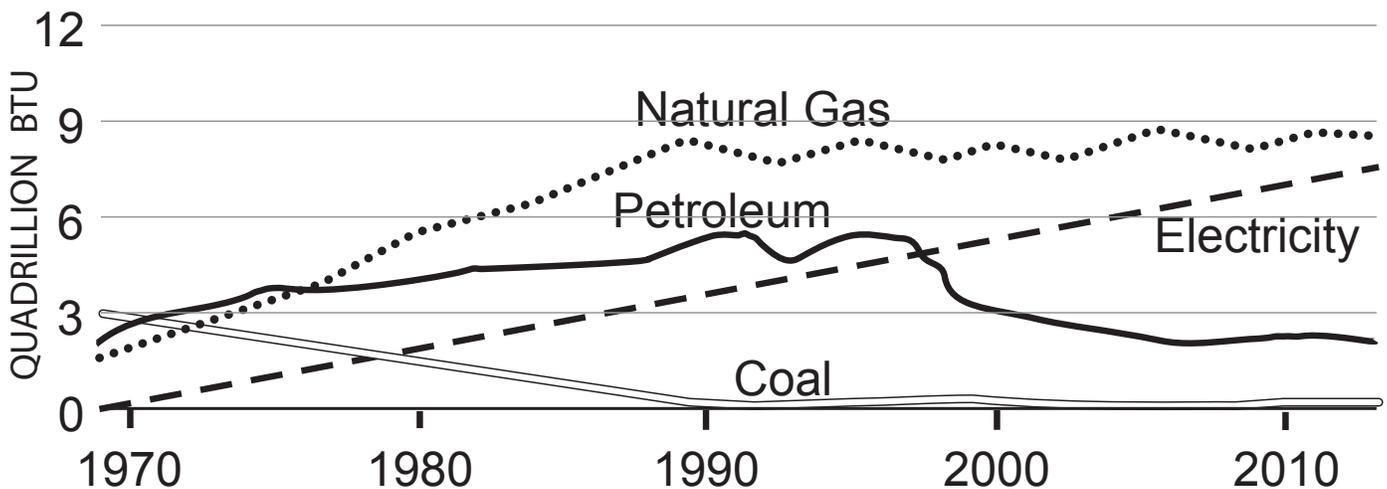


$$\times 32 = 1 \text{ lb.} = \$1.30$$

If an aluminum recycling center is paying \$1.30 per lb. for aluminum (32 cans per lb.), how many cans were cashed in at a recycling center if a person received \$6.50?

Question 2

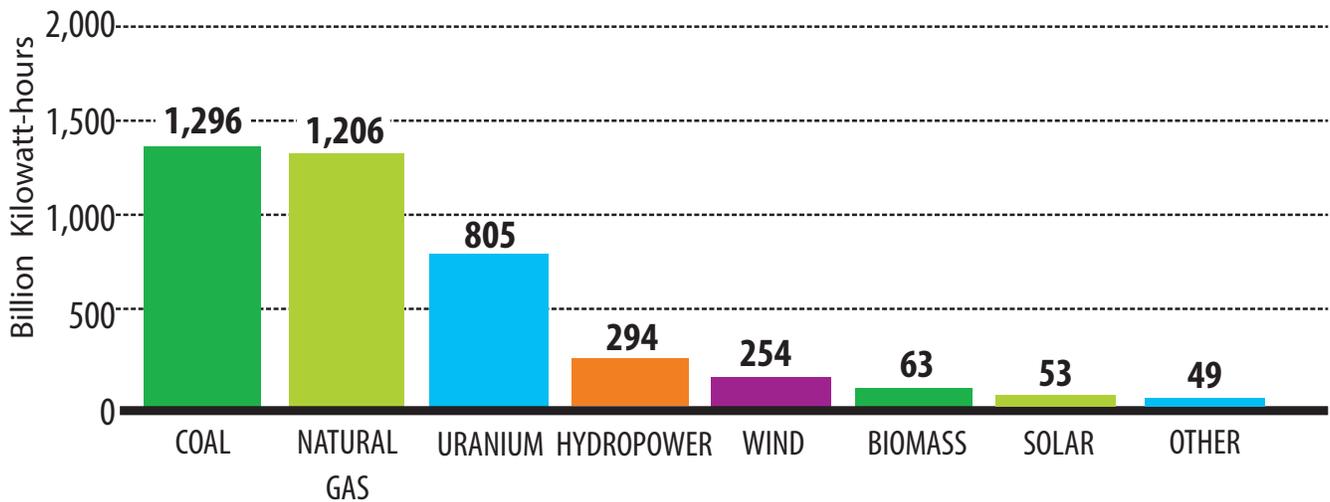
Residential and Commercial Sectors



In approximately what year did the use of electricity match the use of petroleum in the residential and commercial sectors?

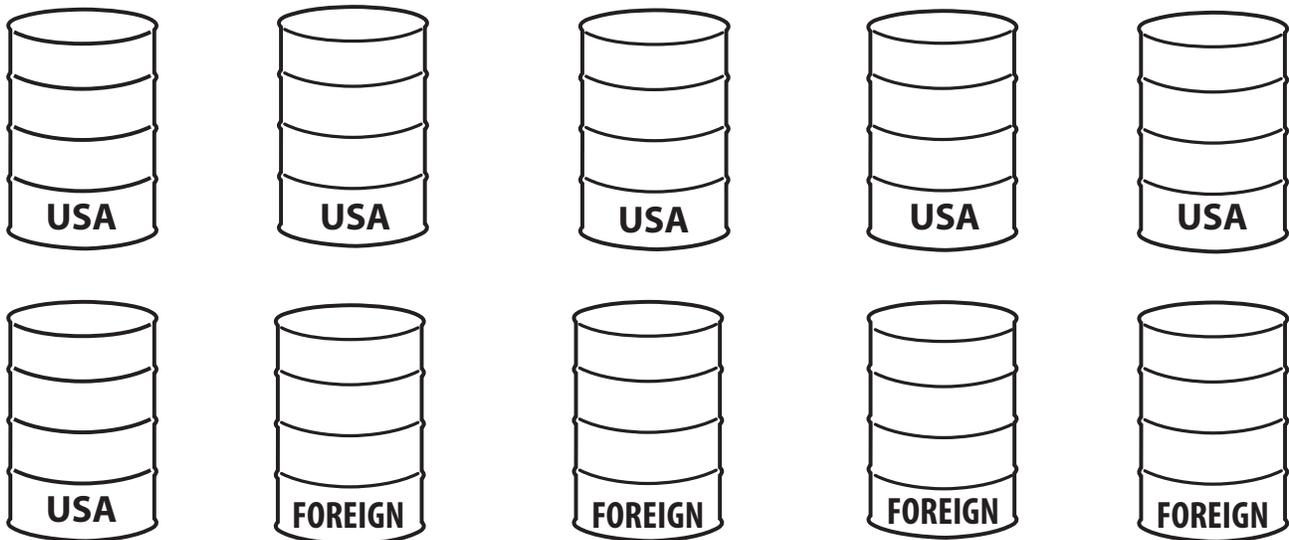
Question 3

Electricity Generation, 2017



How many billion kilowatt-hours of electricity were generated in the United States in 2017?

Question 4



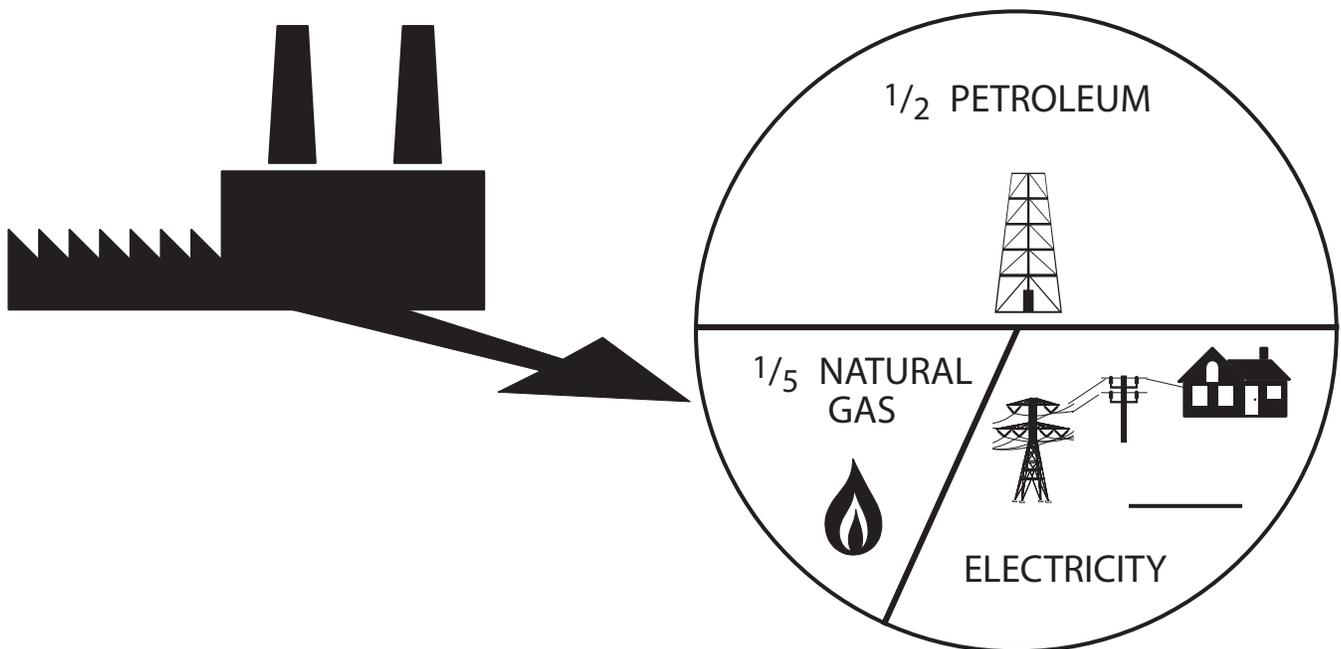
The ten barrels represent all of the petroleum consumed in the U.S. in 2017. What percentage of that petroleum had to be imported from other nations?

Question 5



A semi-truck gets 5 miles per gallon. If the diesel fuel it uses costs \$2.50 per gallon, what would it cost for the truck to bring bread to your school from the factory 100 miles away?

Question 6



What fraction of this factory's energy is supplied by electricity?

Question 7

Let's go shopping for a new refrigerator! We want to buy a refrigerator that will save us money and energy over the life of the appliance, not just with the purchase price. We can calculate how much it will cost each year for five years.

MODEL 1	EXPENSES	COST TO DATE	MODEL 2 - ENERGY STAR® MODEL	EXPENSES	COST TO DATE
Purchase Price	\$720	\$720	Purchase Price	\$799	\$799
Year One	\$64	$\$720 + \$64 = \$784$	Year One	\$49	$\$799 + \$49 = \$848$
Year Two	\$64	$\$784 + \$64 = \$848$	Year Two	\$49	$\$848 + \$49 = \$897$
Year Three	\$64	$\$848 + \$64 = \$912$	Year Three	\$49	$\$897 + \$49 = \$946$
Year Four	\$64	$\$912 + \$64 = \$976$	Year Four	\$49	$\$946 + \$49 = \$995$
Year Five	\$64	$\$976 + \$64 = \$1,040$	Year Five	\$49	$\$995 + \$49 = \$1,044$
Year Six	\$64	$\$1,040 + \$64 = \$1,104$	Year Six	\$49	$\$1,044 + \$49 = \$1,093$

In the example above, in what year would you start to see a payback on the ENERGY STAR® appliance?

Question 8

1974



1,266 THERMS

Today

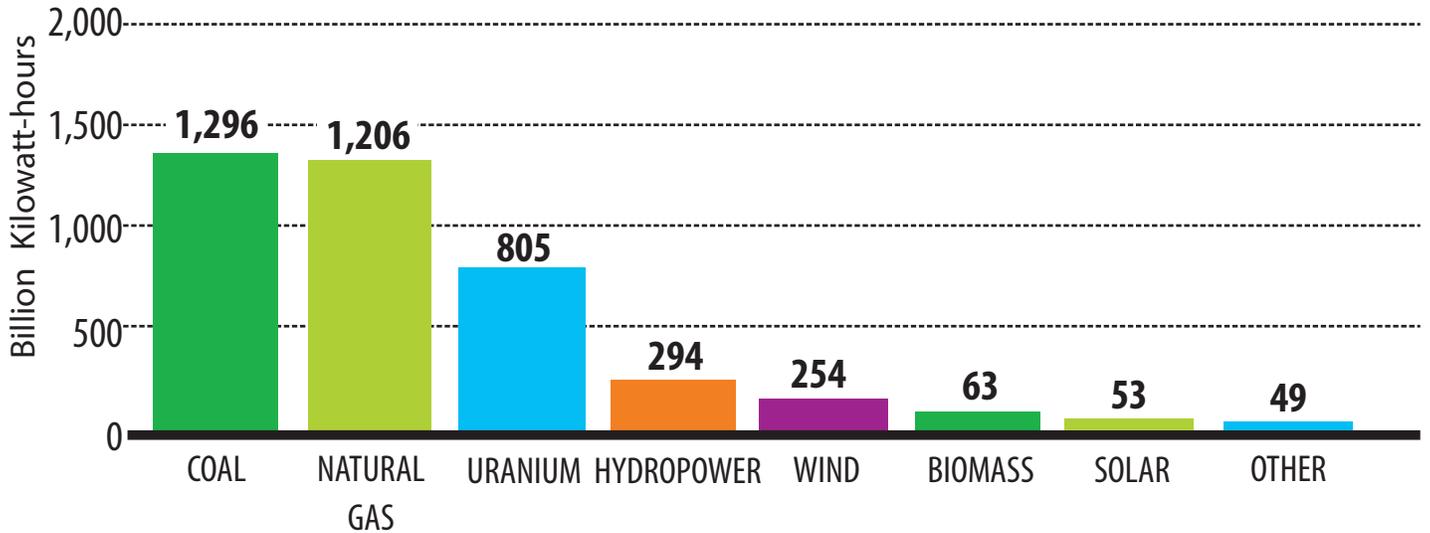


_____ THERMS

In 1974, the average home consumed 1,266 therms of natural gas. If a home today uses one-third less natural gas than the home of 1974, how many therms of natural gas does a home consume today?

Question 9

Electricity Generation, 2017



How many billion kilowatt-hours of electricity were generated in the United States in 2017?

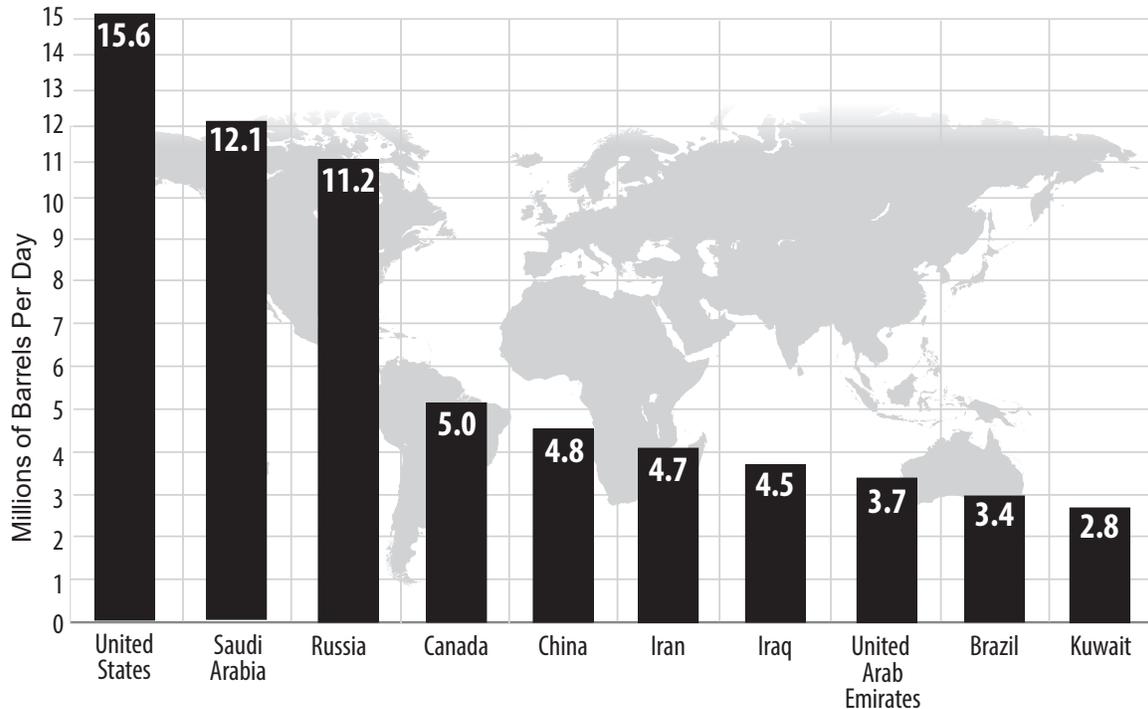
Question 10



One gallon of propane provides 91,500 Btus of energy. How many Btus will one cup of propane provide (to the nearest Btu)?

Question 11

2017 Top Oil Producing Countries



Of the top oil producing countries, how many millions of barrels per day (mbd) did countries in the Western Hemisphere produce in 2017?

Question 12

U.S. Energy Consumption by Source, 2017

NONRENEWABLE

 **PETROLEUM** 37.0% *
Uses: transportation, manufacturing - includes propane

 **NATURAL GAS** 28.7% *
Uses: heating, manufacturing, electricity - includes propane

 **COAL** 14.1%
Uses: electricity, manufacturing

 **URANIUM** 8.6%
Uses: electricity

 **PROPANE** *Propane consumption is included in petroleum and natural gas totals.
Uses: heating, manufacturing

RENEWABLE

 **BIOMASS** 5.2%
Uses: heating, electricity, transportation

 **HYDROPOWER** 2.8%
Uses: electricity

 **WIND** 2.4%
Uses: electricity

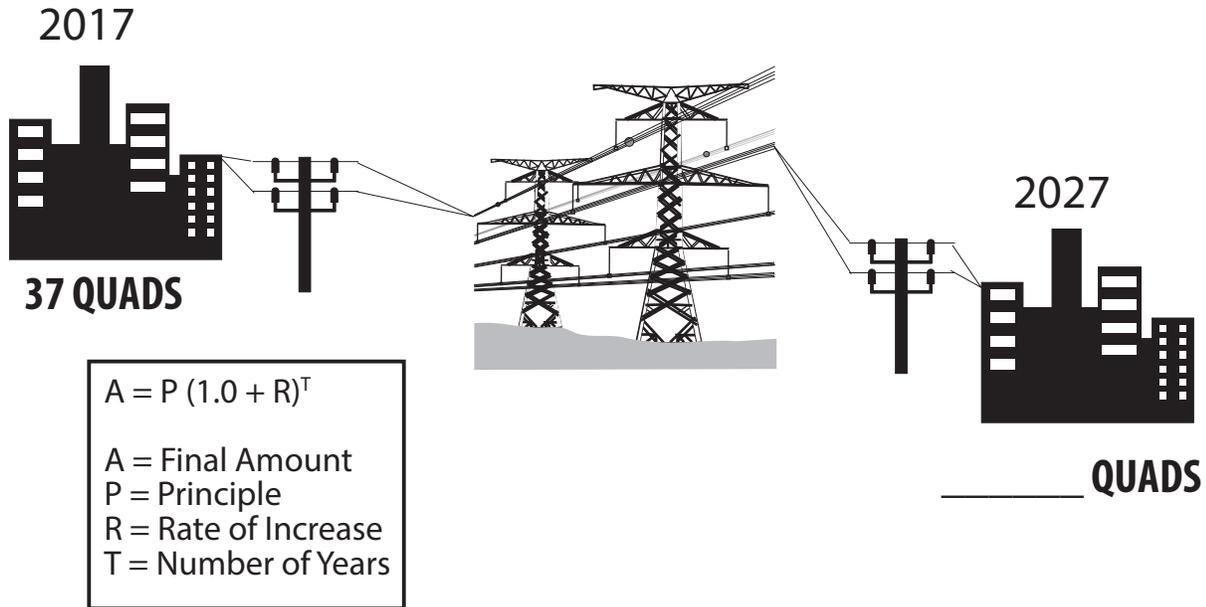
 **SOLAR** 0.8%
Uses: heating, electricity

 **GEOTHERMAL** 0.2%
Uses: heating, electricity

**Total does not add up to 100% due to independent rounding.
Data: Energy Information Administration

If the nation consumed 98 quads of energy in 2017, how many quads were provided by fossil fuels, to the nearest tenth of a quad?

Question 13



In 2017, the nation consumed about 37 quads of energy to generate its electricity. If demand increases by two percent a year, how many quads of energy (to the nearest tenth of a quad) will be consumed to generate the nation's electricity in 2027?

Question 14



A



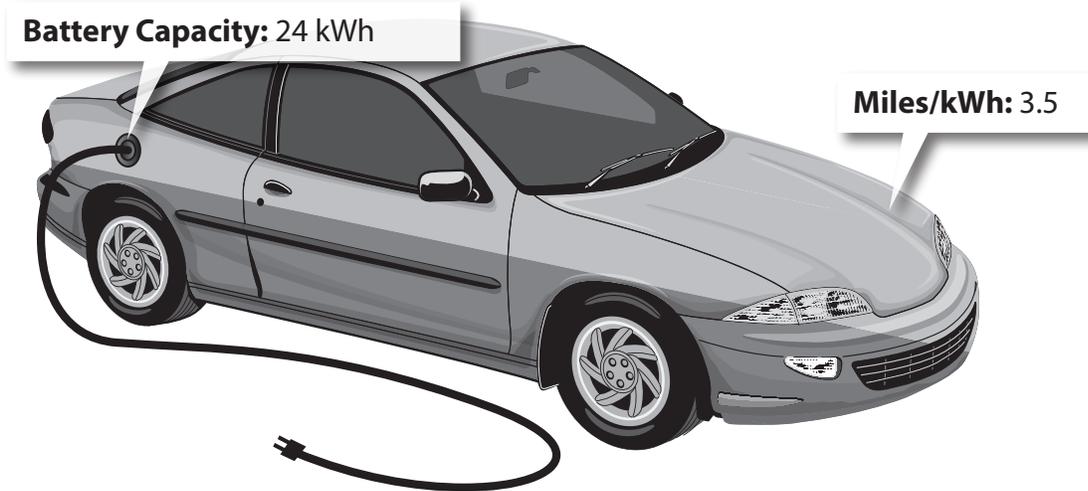
B



C

House A consumes 40% more heating fuel than House B. House C consumes 360 gallons of heating fuel a year, 20% more than House B. How many gallons of heating fuel does House A consume in one year?

Question 15



An all electric automobile's battery can hold 24 kWh of energy. How many total miles can this vehicle travel if it can travel 3.5 miles on one kWh of electricity?

Question 16



An average family washes 400 loads of laundry a year. An old washing machine uses 40 gallons of water per load. If an ENERGY STAR® washer uses 25 gallons per load, how much water will be saved in one year by switching?