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Energy Sources & Energy Challenges: Worksheet

1) A hot shower

a) We are using a shower that sprays 5 gallons/minute, and she spends 5 minutes in the shower. How much water will we use?

Volume of water =_____ x _____ = _____

b) How many pounds of water is this? We need to convert volume to mass, using density.

$$\text{density} = \frac{\square}{\square}$$

density of water = 8lb/gallon

mass of water = _____ x _____ = _____

c) How much does the temperature of the water increase?

tap water = 60°F

hot shower = 110°F

temperature change = _____ - _____ = _____

d) Where does the energy come from?

_____

_____

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e) What units do we use to measure energy?

(Note: lb is the symbol for pound)

BTU = British Thermal Unit

1 BTU = energy it takes to heat 1 lb of water by 1°F

Another way to say it: 1 BTU per lb per °F

"per" is like saying "divided by".

Write an equation that "says" 1 BTU per lb per °F

f) Mathematical Analogy from everyday life

-it costs $7 per person per movie. Write an equation that "says" $7 per person per movie.

-What if you had 3 persons and everyone wanted to see 2 movies? How much would it cost (use whatever method you want)?

Write an equation to find the cost

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g) Energy Example – how many BTU's does it take to heat 10 lbs of water by 5°F?

_____ x _____ x _____ = _____

h) What about the our shower?

_____ lbs water heated by _____ °F

How many BTU's?

_____ x _____ x _____ = _____

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2) Now we are going to make a people-power generator to make energy. We are also going to learn how power is different than energy.

a) How much work (energy) does it take to lift a 5 lb sack of potatoes by 5 ft? work = force x distance

_____ x _____ = _____

b) _ _ _ _ing the sack STORES energy. _ _ _ _ _ ing the sack releases energy. One cycle of our power plant releases

_____ ft·lb of energy.

c) how do we compare mechanical energy to heat?

1 BTU ≈ 800 ft·lb

d) How many cycles of your people-power generator do you need to get 1 BTU of energy?

(800 ft·lb) /(_____ ft·lb/cycle) = _____ cycles

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e) How fast can you generate your energy?

Energy / Time = POWER

What is your generator's power in ft·lb/sec?

$$\frac{\_\_\_\_cycles}{min} \times \frac{1min}{60\ sec} \times \frac{\_\_\_\_ft \cdot lb}{cycle} = \_\_\_\_ {}^{ft \cdot lb}/_{sec}$$

f) What is your generator's power in units of horsepower?

$$\_\_\_\_\_ft \cdot lb/sec \times \frac{1hp}{550ft \cdot lb/sec} = \_\_\_\_\_hp$$

or

1 *peoplepower* = _____ *hp*

or

1 *peoplepower* = _____ *BTU/min*

g) So how long would your people-power generator have to run for each 5 minute shower that we take?

$$\frac{\_\_\_\_\_BTU}{\_\_\_\_BTU/min} = \_\_\_\_\_min$$

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