

Answer Key Pd 1

Thermal Energy

AT Energy (19)

Read all Directions prior to everything else: This test will be VERY different from every test you have had this year. As you take this test, PLEASE do not make strange sounds, (This means you, Answer) etc, as some will not read these directions. You should find these questions much easier than what is typical for a test. Know that the preparation for the test IS the learning experience, not the test itself. Knowing that a test may be tough only encourages you to ensure a better understanding of the material. Each question is worth 5 points. There will be a total of 50 points. Oh...and the last part....there will not be a "DAY 2" test! It's been a great year, Thank you.

- 1) Steel, as used in railroad tracks, has a coefficient of linear expansion $12 \times 10^{-12}/\text{C}^\circ$. Determine the change in length of a railroad track between York and Harrisburg, a distance of 30 miles from 32°F to a hot day of 95°F . You may express your answer in miles, meters, or feet. (1 mi=1609m=5280ft).

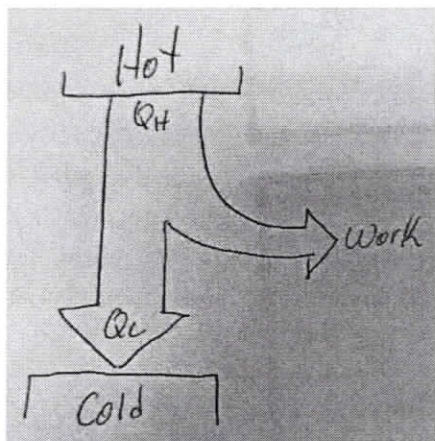
$$32^\circ\text{F} = 0^\circ\text{C}$$
$$95^\circ\text{F} = 35^\circ\text{C}$$

$$\Delta L = L_0 \alpha \Delta T$$
$$\Delta L = (30 \text{ mi}) (12 \times 10^{-12} / \text{C}^\circ) (35^\circ\text{C})$$

$$\Delta L = 1.26 \times 10^{-2} \text{ mi}$$
$$29 \text{ m}$$
$$66.5 \text{ ft}$$
$$1.26 \times 10^{-8} \text{ mi}$$
$$2 \times 10^{-5} \text{ m}$$
$$6.6 \times 10^{-5} \text{ ft}$$
$$7.92 \times 10^{-4} \text{ in}$$

Answer Key Pd 1

- 2) A heat engine with an efficiency of 40% does 800J of work each cycle. How much heat is rejected to the surroundings?



$$\text{Therm Eff} = \frac{W}{Q_H} = \frac{Q_H - Q_C}{Q_H}$$

$$.4 = \frac{800\text{J}}{Q_H}$$

$$Q_H = 2,000\text{J}$$

$$2,000\text{J} - 800\text{J} = \textcircled{1200\text{J}}$$

Answer Key Pd 1

- 3) An air conditioner with a COP of 1.75 is used to remove 300,000 J of heat in 10 minutes. Determine the power required (in watts)

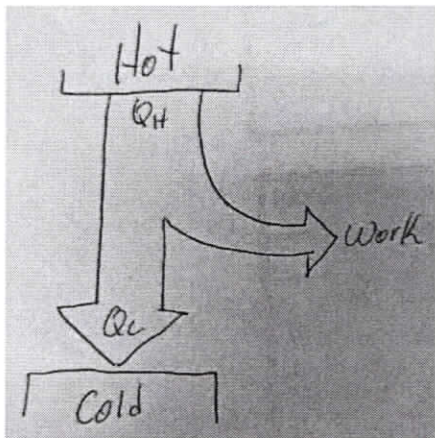
$$\text{COP} = \frac{Q_c}{W}$$

$$1.75 = \frac{300,000 \text{ J}}{\text{Work}}$$

$$W_{\text{work}} = \frac{171428 \text{ J}}{10 \text{ min}} = \frac{171428 \text{ J}}{600 \text{ s}} = 285 \text{ W}$$

Answer Key Pd 1

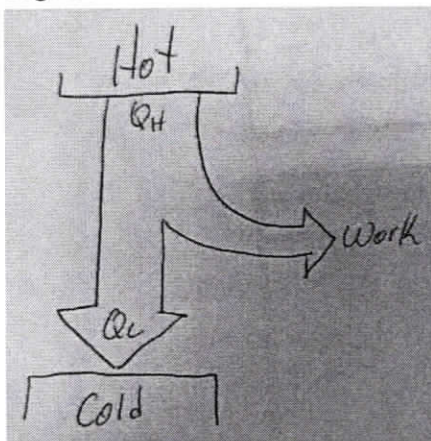
- 4) A heat engine does uses 800J of heat to do 150J of work. How much thermal energy is exhausted?



$$800\text{J} - 150\text{J} = 650\text{J}$$

Answer Key Pd 1

- 5) A heat engine uses 800J of heat to do 150J of work. What is the thermal efficiency of the engine?



$$E_{th} = \frac{W}{Q_H} = \frac{150\text{J}}{800\text{J}}$$

$$18.75\%$$

Answer Key Pd 1

- 6) Determine the energy that is required to melt a 1 kg block of ice. The latent heat of ice is $3.33 \times 10^5 \text{ J/kg}$

$$3.33 \times 10^5 \text{ J}$$

- 7) Complete the statement: Heat always flows:..... *Hot To Cold*