

X3.10b

Physics 107 (Kaldon)

WMU - Fall 1999

Exam 3 - 100,000 points

107

Name _____

Book Title _____

Section: **10a** **10b** **10c** **10d** **10e** **10f**
A to C D to F G to K L to N O to R S to Z
11/09/1999-Rev.2-11/12/03 R3

State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Short Answers Should Be Short! – Feel Free to Ask Any Questions

“Fact or Fiction” (50,000 points) Multiple-Guess-Pick-The-Best-Answer-Fill-In-The-Bubbles

1.) An engine has operating temperatures of 248°F (120.°C) and 550.°F (288°C). (a) The best efficiency this heat engine could have would be:

A = 29.9% B = 41.7% C = 45.1% D = 58.3% E = 70.1%
F = None of these

A B C D E F

(b) 1234 J of heat energy is extracted from the hot reservoir at 28.6% actual efficiency. The waste heat rejected to the cold reservoir is:

A = 352.9 J B = 881.1 J C = 1234 J D = 35,290 J E = 88,110 J
F = None of these

A B C D E F

(c) A full 15.0 m tall water tower springs a leak halfway down. How fast does the water come out?

A = 294 m/s B = 147 m/s C = 79.6 m/s D = 17.1 m/s E = 12.1 m/s
F = None of these

A B C D E F

(d) A 3” diameter pipe narrows to 1” diameter. Water flowing in the narrow pipe is ___ as fast as the wide pipe.

A = 1/3rd B = 1/9th C = just D = 3 times E = 9 times
F = None of these

A B C D E F

In parts (e)-(h), select which of the laws and definitions of Thermodynamics is best used to solve or describe the problem. (e) The very best a heat engine can be.

A = Thermo 1st law B = Thermo 2nd law C = Entropy
D = Actual Efficiency E = Carnot Efficiency F = None of these

A B C D E F

(f) The ratio of useful work to total energy in a heat engine.

A = Thermo 1st law B = Thermo 2nd law C = Entropy
D = Actual Efficiency E = Carnot Efficiency F = None of these

A B C D E F

(g) The **ratio** of useful work extracted from a heat engine to waste heat rejected.

A = Thermo 1st law B = Thermo 2nd law C = Entropy
D = Actual Efficiency E = Carnot Efficiency F = None of these

A B C D E F

(h) The fact that real heat engines need periodic maintenance.

A = Thermo 1st law B = Thermo 2nd law C = Entropy
D = Actual Efficiency E = Carnot Efficiency F = None of these

A B C D E F

In parts (i)-(j), select the answer that best fills in the blank.

(i) A block of ice is melted. The volume of the liquid water is _____ the volume of the ice.

A = more than B = less than C = the same as
D = None of these

A B C D

(j) A block of steel is melted. The volume of the liquid steel is _____ the volume of the **solid steel**.

A = more than B = less than C = the same as
D = None of these

A B C D**“A Penny for Your Thoughts?” (50,000 points)**

2.) A 1964 Lincoln penny is actually made of copper, unlike today’s zinc pennies which are just coated with a copper wash to look like copper. Copper has $\rho = 8920 \text{ kg/m}^3$, $\alpha = 17 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$ and $C = 387 \text{ J/kg}\cdot^\circ\text{C}$. The penny is **18.00 mm (0.01800 m)** in diameter and **1.00 mm (0.00100 m)** thick, with a volume of $2.545 \times 10^{-7} \text{ m}^3$, starting at room temperature of 20°C (68°F). (a) What is the mass of this copper penny?

(b) Water has $\rho = 1000 \text{ kg/m}^3$ and mercury has $\rho = 13,600 \text{ kg/m}^3$. Which, if any, of these two liquids might a copper penny float in? *Briefly* state why.

(c) The melting point of copper is 1083°C. The two latent heats are $L_f = 134,000 \text{ J/kg}$ and $L_v = 5,060,000 \text{ J/kg}$. How much energy does it take to completely melt a room temperature copper penny?

Find (d) the diameter and (e) the volume of the solid penny at 1083°C just before it melts.