“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

(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

(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

(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

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

(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

(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

(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

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

(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

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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 \( \rho = 8920 \, \text{kg/m}^3 \), \( \alpha = 17 \times 10^{-6} \, \text{°C}^{-1} \) and \( C = 387 \, \text{J/kg·°C} \). 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?

   \( A = 1.46 \times 10^{-3} \, \text{kg} \)

   \( B = 3.25 \times 10^{-3} \, \text{kg} \)

   \( C = 4.69 \times 10^{-3} \, \text{kg} \)

   \( D = 5.96 \times 10^{-3} \, \text{kg} \)

   \( E = 7.19 \times 10^{-3} \, \text{kg} \)

   \( F = \text{None of these} \)

(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.

   \( A = \text{water} \)

   \( B = \text{mercury} \)

   \( C = \text{neither} \)

   \( D = \text{both} \)

   \( E = \text{None of these} \)

(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?

   \( A = 340 \, \text{J} \)

   \( B = 3400 \, \text{J} \)

   \( C = 34,000 \, \text{J} \)

   \( D = 340,000 \, \text{J} \)

   \( E = 3400,000 \, \text{J} \)

   \( F = \text{None of these} \)

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