

Assignment11:

Optional review online MC Assignment. Answer the questions below using online assessment tool.

Thermal Physics: Heat Engines, Carnot Engine, Coefficient of Performance, Entropy,
Second Law of Thermodynamics, Heat Transport, Processes, Thermal Expansion of Solids, Fluids

Assigned: Nov 27

Due: December 7 (Wednesday) 22:00

1. A heat pump has a coefficient of performance of 4. If the heat pump absorbs 20 cal of heat from the cold outdoors in each cycle, the heat expelled (in cal) to the warm indoors is
a. 34 b. 27 c. 36 d. 40 e. 80
2. A refrigerator has a coefficient of performance of 4. If the refrigerator absorbs 30 cal of heat from the cold reservoir in each cycle, the heat expelled (in cal) into the heat reservoir is
a. 40.5 b. 37.5 c. 36.5 d. 34.5 e. 22.5
3. An 800-MW electric power plant has an efficiency of 30%. It loses its waste heat in large cooling towers. Approximately how much waste heat (in MJ) is discharged to the atmosphere per second?
a. 1200 b. 1900 c. 800 d. 560 e. 240
4. Find the change in entropy (in J/K) when 5.00 moles of an ideal gas undergo a free expansion from an initial volume of 20 cm^3 to a final volume of 100 cm^3 .
a. 71 b. 52 c. 67 d. 191 e. 208
5. Ten kilograms of water at 0°C is mixed with 10 kg of water at 100°C . The change in entropy (in cal/K) of the system is
a. 1000 b. 480 c. -720 d. 240 e. -168
6. An ideal heat engine can have an efficiency of 1 if the temperature of the low temperature reservoir is
a. 0 K. b. 0°C . c. 0°F . d. 0°R .
e. the same as the temperature of the heat source.
7. The average kinetic energy of a nitrogen molecule at room temperature (20°C) is
a. $2 \times 10^{-21} \text{ J}$. b. $4 \times 10^{-21} \text{ J}$. c. $6 \times 10^{-21} \text{ J}$. d. $8 \times 10^{-21} \text{ J}$. e. $1 \times 10^{-20} \text{ J}$.
8. The average translational speed of a nitrogen molecule at room temperature (20°C) is approximately (in m/s)
a. 100 b. 500 c. 300 d. 700 e. 200

9. A cup of coffee is enclosed on all sides in an insulated cup 1/2 cm thick in the shape of a cube 10 cm on a side. The temperature of the coffee is 95°C , and the temperature of the surroundings is 21°C . Find the rate of heat loss (in J/s) due to conduction if the thermal conductivity of the cup is $2 \times 10^{-4} \text{ cal/s} \cdot \text{cm} \cdot ^{\circ}\text{C}$.
- a. 62 b. 74 c. 230 d. 160 e. 12
10. A 100-kg student eats a 200-Calorie doughnut. To "burn it off", he decides to climb the steps of a tall building. How high (in m) would he have to climb to expend an equivalent amount of work? (1 food Calorie = 10^3 calories.)
- a. 273 b. 623 c. 418 d. 854 e. 8400
11. What is the change in area (in cm^2) of a 60.0 cm by 150 cm automobile windshield when the temperature changes from 0°C to 36.0°C . The coefficient of linear expansion of glass is $9 \times 10^{-6} / ^{\circ}\text{C}$.
- a. 1.62 b. 2.92 c. 3.24 d. 4.86 e. 5.83
12. In a wind tunnel the pressure on the top surface of a model airplane wing is $8.8 \times 10^4 \text{ N/m}^2$ and the pressure on the bottom surface is $9.0 \times 10^4 \text{ N/m}^2$. If the area of the top and bottom surfaces of each wing is 2.0 m^2 , what is the total lift on the model airplane?
- a. $2.0 \times 10^3 \text{ N}$ b. $8.0 \times 10^3 \text{ N}$ c. $1.6 \times 10^4 \text{ N}$
d. $3.6 \times 10^4 \text{ N}$ e. $1.0 \times 10^3 \text{ N}$
13. Air within the funnel of a large tornado may have a pressure of only 0.2 ATM. What is the approximate outward force on a (5 m \times 10 m) wall if a tornado suddenly envelops the house? (1 ATM = 10^5 N/m^2 .)
- a. $4 \times 10^3 \text{ N}$ b. $4 \times 10^4 \text{ N}$ c. $4 \times 10^5 \text{ N}$ d. $4 \times 10^6 \text{ N}$ e. $7 \times 10^5 \text{ N}$
14. A thin rectangular piece of wood floats in water. You slowly pour oil with a density equal to that of the wood on the surface of the water until the height of the oil above the water is twice the height of the piece of wood. Which statement is correct?
- a. The wood floats on top of the oil, so it sticks up in the air.
b. The wood does not change its position
c. The wood sinks below the surface of the water.
d. The wood is half in the water and half in the oil.
e. The wood floats in the oil just above the water.