Name: ____

Please mark your answer both in the scantron and here, in the Exam, as well.

1. Helium condenses into the liquid phase at approximately 4 K. What temperature, in degrees Fahrenheit, does this correspond to?

a. –182
b. –269
c. –118
d. –452 <=
e. –484

2. A building made with a steel structure is 650 m high on a winter day when the temperature is 0°F. How much taller (in cm) is the building when it is 100°F? (The linear expansion coefficient of steel is $11 \times 10^{-6}(°C)^{-1}$.)

a. 71
b. 36
c. 40 <=
d. 46
e. 65

3. A helium-filled balloon has a volume of 1 m^3. As it rises in the earth's atmosphere, its volume expands. What will its new volume be (in m^3) if its original temperature and pressure are 20°C and 1 atm, and its final temperature and pressure are –40°C and 0.1 atm?

a. 4
b. 6
c. 8 <=
d. 10
e. 1.5

4. How much heat (in kilocalories) is needed to convert 1.00 kg of ice at 0°C into steam at 100°C?

a. 23.9
b. 79.6
c. 564
d. 643
e. 720 <=

5. Angela claims that she wears a cylindrical-shaped hollow gold bracelet because it expands less than a solid one with a change in temperature. Clarissa claims that a cylindrical-shaped solid gold bracelet expands less than a hollow one. Which one, if either, is correct?

a. Angela, because the bracelet expands outward on its outer surface and inward on its inner surface.
b. Clarissa, because the bracelet expands outward on its outer surface and inward on its inner surface.
c. Angela, because the inner circumference does not change, but the outer circumference expands.
d. Clarissa, because the inner circumference does not change, but the outer circumference expands.
e. Neither, because both the inner and outer circumferences increase in lengthXX

6. The work done in the expansion from an initial to a final state

a. is the area under the curve of a PV diagram. <=
b. depends only on the end point.
c. is independent of the path.
d. is the slope of a PV curve.
e. equals $P(V_F - V_i)$.

7. Determine the work done by 5 moles of an ideal gas that is kept at 100°C in an expansion from 1 liter to 5 liters.

a. 2.5×10^4 J <=
b. 1.1×10^4 J
c. 6.7×10^3 J
d. 2.9×10^3 J
e. 8.4×10^3 J

8. Five moles of an ideal gas expands isothermally at 100°C to five times its initial volume. Find the heat flow into the system.

a. 2.5×10^4 J <=
b. 1.1×10^4 J
c. 6.7×10^3 J
d. 2.9×10^3 J
e. 7.0×10^2 J

9. Find the specific heat (in cal/mole K) of a gas kept at constant volume when it takes 1.0×10^4 J of heat to raise the temperature of 5.0 moles of the gas 200 K above the initial temperature.

a. 7.5
b. 5.0
c. 2.4 <=
d. 10
e. 20

10. An ideal gas is allowed to expand adiabatically until its volume increases by 50%. By approximately what factor is the pressure reduced? (γ= 5/3.)

a. 1.5
b. 2.0 <=
c. 2.5
d. 3.0
e. 3.5

11. The average molecular translational kinetic energy of a molecule in an ideal gas is

a. $\frac{3}{2}k_{\mathrm{B}}T.$ <=
b. $\frac{3}{2}RT.$
c. $\frac{5}{2}k_{\mathrm{B}}T.$
d. $\frac{5}{2}RT.$
e. $\frac{n+3}{2}k_{\mathrm{B}}T$, where n = number of internal degrees of freedom.

12. One mole of hydrogen, one mole of nitrogen and two moles of oxygen are held in a 22.4×10^3 cm^3 enclosed vessel at 0° C. The pressure in the vessel, in N/m^2, is

a. 109.
b. 304.
c. 4×10^5. <=
d. 1.09×10^5.
e. 3.26×10^5.

13. A gasoline engine absorbs 2500 J of heat and performs 1000 J of mechanical work in each cycle. The efficiency of the engine is

a. 80%
b. 40% <=
c. 60%
d. 20%
e. 50%

14. 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

15. A new electric power plant has an efficiency of 42%. For every 100 barrels of oil needed to run the turbine, how many are essentially lost as waste heat (in barrels of oil) to the environment?

a. 21
b. 42
c. 58 <=
d. 10
e. 79

16. One kilogram of chilled water (0°C) is placed in a freezer which is kept at 0°F ($-18°C$). Approximately how much electric energy (in kilocalories) is needed just to freeze the water if the room temperature is maintained at 75°F (24°C)? ($L_{ice} = 333$ J/g $\quad c_{ice} = 209$ J/g °C .)

a. 11
b. 15
c. 16
d. 13 <=
e. 33

17. Exactly 500 grams of ice are melted at a temperature of 32°F. ($L_{ice} = 333$ J/g) The change in entropy (in J/K) is

a. 321
b. 146
c. 512
d. 610 <=
e. 5230

18. An engine is designed to obtain energy from the temperature gradient of the ocean. What is the thermodynamic efficiency of such an engine if the temperature of the surface of the water is 59°F (15°C) and the temperature well below the surface is 41°F (5°C)?

a. 3.5% <=
b. 67%
c. 31%
d. 17%
e. 96%

19. When water of mass m and specific heat c is heated from absolute temperature T_1 to absolute temperature T_2, its change in entropy is

a. $cm \ln(T_2/T_1)$ <=
b. $cm\,(T_2/T_1)$
c. $cm\,(T_2 - T_1)/T_1$
d. $cm\,(T_2 - T_1)/T_2$
e. $cm\,(T_2 - T_1)/(T_2 + T_1)$

20. 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