PHY 220 Classical Physics II Chapter 17–20 Test A Fall 2015

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The melting point of aluminum is 660°C, the latent heat of fusion is 4.00×10^5 J/kg, and its specific heat is 900 J/(kg•K). How much heat must be added to 500 g of aluminum at 27°C to completely melt it? 1) _____

A) 273 kJ B) 485 kJ C) 14 kJ D) 395 kJ E) 147 kJ

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

2) If a thermometer measures the temperature of two objects as being equal, you can conclude that the objects will be in thermal equilibrium if they are brought into thermal contact. 2) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) What is the outside temperature if 4000 kcal of heat is lost through a 4.0 m^2 pane of 0.30 cm thick glass ($k = 2.0 \times 10^{-4}$ kcal/s•m•°C) in one hour from a house kept at 20°C? 3) _____

A) 18°C B) 0°C C) 24°C D) 4°C E) 6°C

4) A heat pump has a coefficient of performance that is 60% of the Carnot heat pump coefficient of performance. The heat pump is used to heat a home to 24.0°C during the winter with the low temperature reservoir at the outdoor temperature. At which outdoor temperature would it be more efficient to add the energy directly to the interior of the home than use it to run the heat pump? 4) _____

A) −83.4°C B) −154°C C) −4.00°C D) −25.2°C E) −40.0°C

5) An ideal gas starts in state A at temperature T. The gas expands to new volume V by an adiabatic process and its final temperature is T'. What is the relationship between T and T'? 5) _____

A) $T < T'$
B) $T > T'$
C) $T = T'$
D) The answer depends on the heat capacity of the ideal gas.
E) The answer depends on the number of moles of gas and the pressure.

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

6) When comparing two gases at the same temperature, the molecules of the gas with the smaller molecular weight have the higher rms speed. 6) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

7) An athlete doing push−ups performs 650 kJ of work and loses 425 kJ of heat. What is the change in the internal energy of the athlete? 7) _____

A) 975 kJ B) 225 kJ C) −975 kJ D) 276 kJ E) −225 kJ

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

8) The triple point of water occurs only at a unique temperature and pressure. 8) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

9) Nitrogen boils at −196°C. What is the corresponding temperature in the Fahrenheit scale? 9) _____
A) −290°F B) −346°F C) −315°F D) −196°F E) −321°F

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

10) Entropy is a state function. 10) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

11) How many water molecules are there in 36 g of water? Express your answer as a multiple of Avogadro's number N_A. (The molecular structure of a water molecule is H_2O.) 11) _____
A) $6N_A$
B) $2N_A$
C) $18N_A$
D) $36N_A$
E) none of the above

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

12) A heat engine has an efficiency of 35.0% and receives 150 J of heat per cycle. 12) _____
(a) How much work does it perform in each cycle?
(b) How much heat does it exhaust in each cycle?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

13) In an isothermal process, there is no change in 13) _____
A) temperature.
B) pressure.
C) volume.
D) heat.
E) internal energy.

14) A heat engine operating at maximum efficiency has an efficiency of 35.0%. The temperature of the hot reservoir is 700 K. What is the temperature of the cold reservoir? 14) _____
A) 245 K B) 200 K C) 600 K D) 455 K E) 350 K

15) For chlorine gas, the van der Waals constants are: a = 0.658 J•m^3/mol^2, and b = 5.62 × 10^{-5} m^3/mol. A 3.0–L tank contains 10.0 moles of chlorine gas at a temperature of 625 K. What is the pressure in the container? 15) _____
A) 15.0 MPa B) 17.3 MPa C) 13.5 MPa D) 18.2 MPa E) 11.0 MPa

16) Carbon dioxide solidifies at 195 K. Express this temperature in degrees Fahrenheit. 16) _____
A) −78°F B) −163°F C) −40°F D) −351°F E) −109°F

17) If the theoretical efficiency of a Carnot engine is to be 100%, the heat sink must be 17) _____
A) at 100°C.
B) at 1000°C.
C) infinitely hot.
D) at absolute zero.
E) at 0°C.

18) During an isothermal process, 5.0 J of heat is removed from an ideal gas. What is the work done in the process? 18) _____
A) zero
B) 5.0 J
C) −5.0 J
D) 2.0 J
E) none of the above

19) A piece of wood 350 mm × 350 mm and 15 mm thick conducts heat through its thickness under steady state conditions. The rate of heat flow is measured to be 14.0 watts when the temperature difference is 28 C°. Determine the coefficient of thermal conductivity for this wood 19) _____
A) 270 J/(m•s•C°)
B) 9.2×10^{-4} J/(m•s•C°)
C) 16 J/(m•s•C°)
D) 0.061 J/(m•s•C°)
E) 33 J/(m•s•C°)

20) For a fixed amount of gas, if the absolute temperature of the gas is doubled, what happens to the pressure of the gas? 20) _____
A) The pressure of the gas becomes four times the original pressure.
B) The pressure of the gas becomes double the original pressure.
C) The pressure of the gas becomes triple the original pressure.
D) The pressure of the gas becomes one half the original pressure.
E) The answer cannot be determined without volume information.

21) A liquid boils when its vapor pressure 21) _____
A) equals the equilibrium vapor pressure.
B) is between the equilibrium vapor pressure and the external pressure.
C) exceeds the external pressure.
D) equals the external pressure.
E) None of the other choices is correct.

22) Calculate the total entropy change that occurs when 2.00 kg of lead at 40.0°C are placed in a very large quantity of water at 10.0°C. The specific heat of lead is 0.031 cal/(g•K). 22) _____
A) 6.6 J/K B) 100 J/K C) 190 J/K D) 1.4 J/K E) 6.2 J/K

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

23) No device is possible whose sole effect is to transform a given amount of heat completely into work. 23) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

24) When a solid melts 24) _____
A) heat energy enters the substance.
B) heat energy leaves the substance.
C) the temperature of the substance increases.
D) the temperature of the substance decreases.

25) A bimetallic strip is made out of two strips of metal bonded together. Each strip is 20.0 cm long and 1.00 mm thick. One strip has a coefficient of thermal expansion 4.00×10^{-6}/K and the other has a coefficient of thermal expansion 3.00×10^{-6}/K. At 20.0°C the strip is straight. What is the inner radius of curvature of the composite strip at 200°C? 25) _____
A) 2.22 m B) 15.2 cm C) 34.8 cm D) 1.27 m E) 5.56 m

26) It is a well-known fact that water has a higher specific heat capacity than iron. Now, consider equal masses of water and iron that are initially in thermal equilibrium. The same amount of heat, 30 calories, is added to each. Which statement is true? 26) _____
A) They are no longer in thermal equilibrium; the iron is warmer.
B) They remain in thermal equilibrium.
C) They are no longer in thermal equilibrium; the water is warmer.
D) It is impossible to say without knowing the exact mass involved.
E) It is impossible to say without knowing the exact specific heat capacities.