Physics 105 Sample exam on thermo, waves, acoustics

0. Did you put your CID number on the cover? _____ You won’t easily get your exam back without it.

1. A 70 g piece of copper at 100 °C is dropped into 100 g of water at 20 °C. The temperature of the system after reaching equilibrium is _____ °C. The specific heat of copper is 0.092 cal/g/°C
   a. 20 to 24
   b. 24 to 28
   c. 28 to 32
   d. 32 to 36
   e. 36 to 40
   f. more than 40

2. How much ice at 0 °C must be added to 100 g of water at 50 °C, so the final temperature is 10 °C? ____ g
   a. 0 to 10
   b. 10 to 20
   c. 20 to 30
   d. 30 to 40
   e. 40 to 50
   f. more than 50

3. A glowing hot bar emits 5500 W of radiation power, has an area of 60 cm², and an emissivity of 0.70. The temperature of the bar is ______ K.
   a. 0 to 1000
   b. 1000 to 1500
   c. 1500 to 2000
   d. 2000 to 2500
   e. 2500 to 3000
   f. more than 3000

4. You stir a fire with an iron rod. The rod conducts 10 W of heat flow into your hand. If you now stir with a rod that has twice the diameter, and twice the length, the rod will conduct _____ W into you hand. Assume the hand and fire don’t change their temperatures.
   a. 2.5
   b. 5.0
   c. 10
   d. 20
   e. 40
   f. more than 40

5. If you roughen a surface it will make it a _______ of radiation
   a) better absorber and poorer emitter
   b) better absorber and better emitter
   c) poorer absorber and poorer emitter
   d) poorer absorber and better emitter
   e) none of above; it makes no difference

6. Air (γ = 1.4) originally at 293 K expands adiabatically to twice its original volume. It's final temperature is____ K.
   a. 0 to 100
   b. 100 to 200
   c. 200 to 300
   d. 300 to 400
   e. 400 to 500
   f. more than 500

7. The unique thing about an adiabatic process is that____
   a) heat is zero
   b) internal energy change is zero
   c) work is zero
   d) two of the above are zero
8. In physics terms, the hotter an object is, the more ______ the system contains.
   a) work
   b) internal energy
   c) heat

9. A system of volume 3 m$^3$ contracts to 1 m$^3$ at constant pressure of 500 Pa while the internal energy grew by 800 J. The heat flow was ______ J, ____ the system.
   a) 0 to 300, out of
   b) 300 to 500, out of
   c) more than 500, out of
   d) 0 to 300, into
   e) 300 to 500, into
   f) more than 500, into

10. The work done by an ideal gas during the process shown is _________ x10$^6$ J.
    a. 0 to 2
    b. 2 to 4
    c. 4 to 6
    d. 6 to 8
    e. 8 to 10
    f. more than 10

11. (continued) The work itself (not the whole process) ______
    a) gave the system energy
    b) cost the system energy
    c) did not represent an exchange of energy

12. (continued) The internal energy change of the system was ______
    a) positive
    b) negative
    c) zero
    d) can’t be determined without knowing Q

13. The unique thing about an isothermal process for an ideal gas is that _____
    a) heat is zero
    b) internal energy change is zero
    c) work is zero
    d) two of the above are zero
    e) none of the above are zero

14. Starting at standard conditions, 2 moles of an ideal gas expands isothermally to 3 times its original volume. The change in entropy is ______ J/K.
    a. 0 to 10
    b. 10 to 12
    c. 12 to 14
    d. 14 to 16
    e. more than 16

15. The maximum efficiency of a heat engine operating between the temperature limits of 20 C and 500 °C is_____%
    a. 0 to 20
    b. 20 to 40
    c. 40 to 60
    d. 60 to 80
    e. 80 to 100
16. The reason no engine can approach 100% efficiency has mostly to do with
   a) limits from energy conservation
   b) limits from entropy
   c) limits from technology
   d) none; there is no inherent limit on the efficiency

17. A refrigerator takes heat from cool water inside and puts the heat into a warm room. The entropy of the water _____
   a) increases
   b) decreases
   c) stays the same

18. (continued) and the entropy of the universe _____
   a) increases
   b) decreases
   c) stays the same

19. The position of a simple harmonic oscillating spring (spring constant of 150 N/m) attached to a mass of 5 kg is represented by the following equation: 
   \[ x = 0.06 \cos(5.477 t) \]. The frequency of the oscillation is _____ Hz.
   a. 0 to 0.2
   b. 0.2 to 0.4
   c. 0.4 to 0.6
   d. 0.6 to 0.8
   e. 0.8 to 1
   f. more than 1

20. The maximum speed of the mass on the spring is _____ m/s.
   a. 0 to 0.2
   b. 0.2 to 0.4
   c. 0.4 to 0.6
   d. 0.6 to 0.8
   e. 0.8 to 1
   f. more than 1

21. (continued) At a time of 3 sec, the acceleration of the mass is ______ .
   a) positive
   b) negative
   c) zero

22. A 6.0 g guitar string is 90 cm long. The tension required to produce a wavespeed of 35 m/s in this string is _____ N.
   a. 0 to 2
   b. 2 to 4
   c. 4 to 6
   d. 6 to 8
   e. 8 to 10
   f. more than 10

23. (continued) The waves on this guitar string are _____
   a. transverse
   b. longitudinal
   c. a combination of the above
24. A spherical air bubble originating from a scuba diver at a depth of 18.0 m has a diameter of 1.0 cm. The bubble's diameter when it reaches the surface will be ___ cm. (Assume constant temperature.)
   a. 0 to 1
   b. 1 to 1.2
   c. 1.2 to 1.5
   d. 1.5 to 1.8
   e. 1.8 to 2.0
   f. more than 2.0

25. Two ideal gases, X and Y, are mixed in a single container. The molecular mass of X is 9 times that of Y. The ratio of root-mean-square velocities of the two gases is \( \frac{v_X}{v_Y} = \) ________
   a. 9/1
   b. 3/1
   c. 1/3
   d. 1/9

26. Two one-liter containers each contain 10 moles of a gas. The temperature is the same in both containers. Container A holds helium (molecular mass = 4 g/mole), and container B holds oxygen (molecular mass = 16 g/mole). Which container has the higher pressure and by what factor?
   a. Container A has 4 times the pressure of container B.
   b. Container A has 2 times the pressure of container B.
   c. Container B has 4 times the pressure of container A.
   d. Container B has 2 times the pressure of container A.
   e. Both containers have the same pressure.

27. 15 g of SO\(_2\) (M = 64.1 g/mol) is at 300 K and 1 atm will occupy ____ liters. (Assume it acts like an ideal gas)
   a. 0 to 2
   b. 2 to 4
   c. 4 to 6
   d. 6 to 8
   e. 8 to 10
   f. more than 10