Phys 220, Fall 2013
Exam 4
Version A

Name: _____ Lab Group: _____

Problems 1-3: A 2.0 kg book is resting on a table. The table top is 1.5 meters above the floor.

1. What is the potential energy of the book with respect to the table?
    a. 0 J
    b. 3 J
    c. 20 J
    d. 29 J

2. The book is nudged off the table. What is the kinetic energy of the book just before it hits the floor?
    a. 0 J
    b. 3 J
    c. 20 J
    d. 29 J

3. What is the speed of the book just before it hits the floor?
    a. 0 m/s
    b. 1.7 m/s
    c. 4.4 m/s
    d. 5.4 m/s

4. How much work is done by gravity on the book if it is lifted off of the floor and put on a shelf 2.0 m above the floor?
    a. 0 J
    b. 29 J
    c. - 29 J
    d. 39 J
    e. - 39 J

5. A boy throws his sister's doll off a cliff high above the ravine below. The doll is thrown at an angle of 60 degrees and reaches a maximum height of 25 meters above the ravine before landing in the bottom. What is the doll's speed just before it hits the bottom of the ravine? (ignore air resistance)
    a. 11 m/s
    b. 16 m/s
    c. 22 m/s
    d. 49 m/s

6. What is in the bubbles of boiling water?
    a. Hydrogen Gas and Oxygen Gas
    b. Air
    c. Water vapor
    d. Empty Space

7. What makes a bigger explosion
    a. Pure oxygen
    b. Pure hydrogen
    c. Hydrogen and oxygen
    d. b and c
    e. a, b and c

8. In perfectly inelastic collisions
    a. only momentum is conserved.
    b. only mechanical energy is conserved.
    c. both momentum and mechanical energy are conserved.

9. When you lose 15 lbs, how did the largest fraction of the weight leave your body?
    a. Water (sweat, urine)
    b. Solid waste
    c. Energy
    d. Respiration – water vapor
    e. Respiration – carbon dioxide

10. A nail sits out in the elements and rusts. Rusting is oxidation of iron where iron and oxygen combine to form iron oxide (rust). After rusting, the nail
    a. Weighs the same
    b. Weighs less than before
    c. Weighs more than before

11. What causes the atmosphere to be denser at lower altitudes?
    a. There is more pressure
    b. There are more molecules
    c. The air is hotter
    d. gravity

12. Convert 200 °F to Celsius
    a. 93 °C
    b. 149 °C
    c. 182 °C
    d. 392 °C

13. Is 600 °F colder, warmer or equal to 600 K?
    a. colder
    b. warmer
    c. equal

14. When the temperature of an ideal gas is increased, which of the following also increases? (1) The thermal energy of the gas; (2) the average kinetic energy of the gas; (3) the average potential energy of the gas; (4) the speed of the molecules in the gas.
    a. 1, 2, and 3
    b. 1 and 2
    c. 3 and 4
    d. 1, 2 and 4
    e. All of 1–4

15. A helium balloon contains one mole of Helium (6.647×10^{-27}kg). You take it outside on a very cold day, -15^{o}C. What is the thermal energy of the gas in the balloon?
    a. 3.1×10^{-22} J
    b. 5.3×10^{-21} J
    c. 186 J
    d. 3200 J

16. What is the rms speed of a helium molecule (6.647×10^{-27}kg) at -15^{o}C?
    a. 306 m/s
    b. 1350 m/s
    c. 1270 m/s
    d. 3200 m/s

17. An aluminum ring is tight around a solid iron rod. If we wish to loosen the ring to remove it from the rod, we should
    a. Increase the temperature of the ring and rod
    b. Decrease the temperature of the ring and rod
    c. Neither will work.

18. A glass of ice water has been sitting on a table for an hour and still has a little bit of ice in it. What is the temperature of the water?
    a. < 0 ^{o}C
    b. 0 ^{o}C
    c. 100 ^{o}C
    d. > 0 ^{o}C
    e. b or d.

19. The reason suction cups stick to a wall is because
    a. The molecules of the suction cup and the wall form a weak bond.
    b. There is a vacuum formed behind the cup when you press it that sucks it to the wall.
    c. There is a force outside the suction cup pushing it against the wall.

20. You purchase a coffee on a blustery winters' day. The barista puts a nice snug lid on the coffee made out of thin plastic with two little holes in the top, one to sip from and one for air. Which form of heat transfer does this lid insulate against?
    a. Conduction
    b. Convection
    c. Radiation
    d. Evaporation
    e. It is a poor insulator.

21. Which of the following changes would allow your refrigerator to use less energy to run? (1) Increasing the temperature inside the refrigerator; (2) increasing the temperature of the kitchen; (3) decreasing the temperature inside the refrigerator; (4) decreasing the temperature of the kitchen.
    a. All of the above
    b. 1 only
    c. 1 and 4
    d. 2 and 3

For the following problems, ***show all work for credit.***

22. Joe (70kg) rides his 5.0 kg sled at a constant velocity 40 meters down a slight incline covered in snow. If he changes his elevation by 15 meters during this ride,
    a. Find the average force of friction acting on the sled.
    b. How much snow is melted by the sled if it is at 0 ^{o}C?

23. A 5.00 kg block of ice is at -65 ^{o}C. It is put in thermal contact with 1.00 kg of water at 50.0^{o}C. What is the final temperature of the system? What is the final mass of ice? What is the final mass of water? c_{water} = 4186 J/kg^{o}C, c_{ice} =2090 J/kg^{o}C, c_{steam} = 2010 J/kg^{o}C, L_f =3.33 x 10^{5}J/Kg, L_v = 2.26 x 10^{6}J/kg

24. A 2,000 kg Mercury Monterey and a 2,300 kg Chrysler Imperial collide head on during a demolition derby. The Monterey was initially moving at 3 m/s and the Imperial at 10 m/s. The two cars lock bumpers after the collision. How much energy was converted to thermal energy?

$W = F\,\Delta x = \Delta E$ $K = \frac{1}{2}\, m\, v^2$ $U_g = mgh$ $U_s = \frac{1}{2}\, k\, x^2$

$g = 9.8\ \text{m/s}^2$ $K_r = \frac{1}{2}\, I\, \omega^2$ $P = W/\Delta t = F\, v$

$T_C = T - 273.15\,^oC$ $T_F = (9\,^oF/5\,^oC)\, T_C + 32\,^oF$

$K_{avg} = 3/2\ k_B T$ $E_{th} = 3/2\ N k_B T$ $v_{rms} = \sqrt{\frac{3k_B T}{m}}$ $k_B = 1.38 \times 10^{-23}\ J/K$

$\Delta L = \alpha L_i \Delta T$ $\Delta V = \beta V_i \Delta T$

$Q = Mc\Delta T$ $Q = +/- ML_f$ $Q = +/- ML_v$

$\vec{p} = m\vec{v}$ $\vec{F}\,\Delta t = \Delta\,\vec{p}$ $\vec{p}_i = \vec{p_f}$ $\Sigma\vec{F} = m\vec{a}$

$v_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$ $a_x = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{\Delta t}$

$x_f = x_i + v_{xi}\Delta t + \frac{1}{2}\, a_x (\Delta t)^2$ $v_{xf} = v_{xi} + a_x \Delta t$ $v_{xf}^2 = v_{xi}^2 + 2a_x\,(\Delta x)$

$\sin\theta$ = opp/hyp $\cos\theta$ = adj/hyp $\tan\theta$ = opp/adj

$a^2 + b^2 = c^2$

1 mole = 6.022×10^{23} molecules

TABLE 12.4 Specific heats of solids and liquids

Substance	c (J/kg • K)
Solids	
Lead	128
Gold	129
Copper	385
Iron	449
Aluminum	900
Water ice	2090
Mammalian body	3400
Liquids	
Mercury	140
Ethyl alcohol	2400
Water	4190

TABLE 12.3 Coefficients of linear and volume thermal expansion at 20°C

Substance	Linear α (K^{-1})	Volume β (K^{-1})
Aluminum	23×10^{-6}	69×10^{-6}
Glass	9×10^{-6}	27×10^{-6}
Iron or steel	12×10^{-6}	36×10^{-6}
Concrete	12×10^{-6}	36×10^{-6}
Ethyl alcohol		1100×10^{-6}
Water		210×10^{-6}
Air (and other gases)		3400×10^{-6}