

Physics 103 Exam 3

Name _____ ID# _____

Section # _____ TA Name _____

Fill in the information on the scantron sheet. Use your student ID # and not your social security #. Fill the letters given for the first 5 questions on the scantron sheet. These letters determine which version of the test you took and are IMPORTANT to get right.

1. A
2. D
3. C
4. E
5. B
6. In an elastic solid there is a direct proportionality between strain and:
 - a. elastic modulus
 - b. cross-sectional area
 - c. temperature
 - d. density
 - e. stress
7. The quantity "strain" expressed in terms of the fundamental quantities (mass, length, time) is equivalent to:
 - a. MLT^{-1}
 - b. $ML^{-1}T^{-2}$
 - c. $M^2L^{-1}T^{-3}$
 - d. a dimensionless quantity
 - e. L^3
8. By what factor is the total pressure greater at a depth of 850 m of water than at the surface where the pressure is one atmosphere?
 - a. 100
 - b. 74
 - c. 84
 - d. 190
 - e. 19

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9. A fountain sends water to a height of 100 meters. What must be the pressure (above atmospheric) of the underground water system?
- 1 ATM
 - 7.2 ATM
 - 4.2 ATM
 - 10.7 ATM
 - 9.7 ATM
10. Which best expresses the value for the coefficient of volume expansion, β for given material as a function of its corresponding coefficient of linear expansion, α ?
- $\beta = \alpha^3$
 - $\beta = 3\alpha$
 - $\beta = 2\alpha$
 - $\beta = \alpha$
 - $\beta = \alpha^2$
11. If the temperature of an ideal gas contained in a box is increased:
- the average velocity of the molecules in the box will be increased.
 - the distance between molecules in the box will be increased.
 - the average speed of the molecules in the box will be increased.
 - the average time between collisions will be increased.
 - the number of molecules in the box will be increased.
12. A 10 g piece of aluminum (which has a specific heat of 0.215 cal/gm-°C) is warmed so that its temperature increases by 5°C. How much heat was transferred into it?
- 11 cal
 - 34 cal
 - 22 cal
 - 54 cal
 - 48 cal
13. Heat flow occurs between two bodies in thermal contact when they differ in what property?
- mass
 - density
 - specific heat
 - heat capacity
 - temperature

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14. Which one of the following processes occur only in a fluid?
- evaporation
 - conduction
 - radiation
 - convection
 - compression
15. A window pane is half a centimeter thick and has an area of 1 m^2 . The temperature difference between the inside and outside surfaces of the pane is 15°C . What is the rate of heat flow through this window? (Thermal conductivity for glass is $0.8 \text{ J/s}\cdot\text{m}\cdot^\circ\text{C}$.)
- 4,800 J/s
 - 48,000 J/s
 - 2,400 J/s
 - 1,000 J/s
 - 500 J/s
16. A swimming pool heater has to be able to raise the temperature of the 40,000 gallons of water in the pool by 10°C . How many kilowatt-hours of energy are required? (One gallon of water has a mass of approximately 3.8 kg and the specific heat of water is $4186 \text{ J/kg}\cdot^\circ\text{C}$.)
- 180 kWh
 - 1955 kWh
 - 1770 kWh
 - 330 kWh
 - 216 kWh
17. Iced tea is made by adding ice to 1.8 kg of hot tea, initially at 80°C . How many kg of ice, initially at 0°C , are required to bring the mixture to 10°C ? ($L_f = 80 \text{ kcal/kg}$)
- 1.5 kg
 - 1.8 kg
 - 1.6 kg
 - 1.4 kg
 - 1.2 kg

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18. A 5 gram lead bullet traveling in 20°C air at 300 m/s strikes a flat steel plate and stops. What is the final temperature of the lead bullet? (Assume all heat is retained by the bullet). The melting point of lead is 327°C. The specific heat of lead is 0.122 J/g/°C and the heat of fusion of lead is 24.7 J/g.
- 300°C
 - 227°C
 - 260°C
 - 293°C
 - 327°C
19. The tungsten filament of a lightbulb has an operating temperature of about 1800°C. If the emitting area of the filament is 1 cm², and its emissivity is 0.68, what is the power output of the lightbulb? ($\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$)
- 150 W
 - 100 W
 - 70 W
 - 60 W
 - 40 W
20. In an isothermal process for an ideal gas system (where the internal energy doesn't change), which of the following choices best corresponds to the value of the work done by the system?
- half the heat intake
 - its heat intake
 - twice its heat intake
 - the negative of its heat intake
 - twice the negative of its heat intake
21. A heat engine exhausts 3000 J of heat while performing 1500 J of useful work. What is the efficiency of the engine?
- 67%
 - 15%
 - 33%
 - 50%
 - 60%

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22. A 5 mole ideal gas system undergoes an adiabatic expansion, while cooling from 80°C to 50°C . How much work is done by the system during this expansion? ($R = 8.31 \text{ J/mol-K}$)
- +41 J
 - 1250 J
 - 41 J
 - zero
 - +1250 J
23. One kilogram of water at the 1 ATM boiling point (100°C) is heated until all the water vaporizes. What is its change in entropy? (For water, $L_{\text{vap}} = 2.26 \times 10^6 \text{ J/kg}$)
- 2260 J/K
 - 12118 J/K
 - 6059 J/K
 - 3030 J/K
 - 1223 J/K
24. When gasoline is burned, it gives off 46,000 J/gram of heat energy. If an automobile uses 13.0 kg of gasoline per hour with an efficiency of 21%, what is the average horsepower output of the engine? (1 HP = 746 W)
- 223 HP
 - 46.76 HP
 - 108.7 HP
 - 67.2 HP
 - 33.6 HP
25. A bottle with a fixed volume of 2 m^3 contains an ideal gas at a pressure of 1 ATM at a temperature of 300°C . The bottle is placed against a metal block that is maintained at 900°C , and the gas comes to thermal equilibrium with the block. What is the pressure of the gas after equilibrium is reached?
- 5 ATM
 - 1 ATM
 - 2 ATM
 - 3 ATM
 - 4 ATM