EXAM 1 PHYS 103 FALL 2011 **A**

NAME: ____SECTION__________

As a student at NJIT I ___________________________________, will conduct myself in a professional manner and will comply with the provisions of the NJIT Academic Honor Code. I also understand that I must subscribe to the following pledge on major work submitted for credit as described in the NJIT Academic Honor Code:
On my honor, I pledge that I have not violated the provisions of the NJIT Academic Honor Code.

The exam is closed book and closed notes. Choose the answer that is <u>closest to the given answer.</u> In order to receive credit, please show your work for each multiple choice question.

1. A copper wire of length 2.0 m, cross sectional area 7.1×10^{-6} m^2 and Young's modulus 11×10^{10} N/m^2 has a 200-kg load hung on it. What is its increase in length? (g = 9.8 m/s^2)

a. 0.50 mm
b. 1.0 mm
c. 2.5 mm
d. 5.0 mm
e. 20 mm

2. How large a force is necessary to stretch a 2.0-mm-diameter steel wire ($Y = 2.0 \times 10^{11}$ N/m^2) by 1.0%?

a. 3.1×10^3 N
b. 6.3×10^3 N
c. 9.4×10^3 N
d. 1.3×10^4 N
e. 3.1×10^7 N

3. A 15 000-N car on a hydraulic lift rests on a cylinder with a piston of radius 0.20 m. If a connecting cylinder with a piston of 0.040-m radius is driven by compressed air, what force must be applied to this smaller piston in order to lift the car?

a. 600 N
b. 1 500 N
c. 3 000 N
d. 15 000 N
e. 25 000 N

4. A piece of aluminum has density 2.70 g/cm^3 and mass 775 g. The aluminum is submerged in a container of oil of density 0.650 g/cm^3. A spring balance is attached with string to the piece of aluminum. What reading will the balance register in grams (g) for the submerged metal?

a. 960 g
b. 775 g
c. 588 g
d. 190 g
e. 28 g

5. A cube of wood of density 0.78 g/cm^3 is 10 cm on a side. When placed in water, what height of the block will float above the surface? (water density = 1.00 g/cm^3)

a. 7.8 cm
b. 5.0 cm
c. 2.2 cm
d. 6.4 cm
e. 0.5 cm

6. A large stone is resting on the bottom of the swimming pool. The normal force of the bottom of the pool on the stone is equal to the:

a. weight of the stone.
b. weight of the water displaced.
c. sum of the weight of the stone and the weight of the displaced water.
d. difference between the weight of the stone and the weight of the displaced water.
e. none of the above

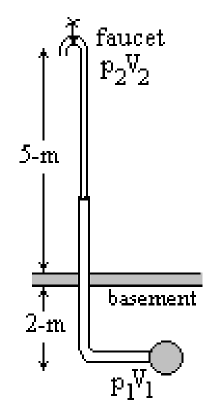
7. The flow rate of a liquid through a 2.0-cm-radius pipe is 0.008 0 m^3/s. The average fluid speed in the pipe is:

a. 0.64 m/s.
b. 2.0 m/s.
c. 0.040 m/s.
d. 6.4 m/s.
e. 12 m/s

8. If wind (density of air =1.29 kg/m^3) blows at 30 m/s parallel to a flat roof having an area of 475 m^2, what is the force exerted on the roof?

a. 2.76x10^5 N, up
b. 8.75x10^5 N, down
c. 4.26x10^6 N, up
d. 6.16x10^6 N, down
e. 1.23x10^7 N, up

9. A water line enters a house 2 m below the ground. A smaller diameter pipe carries water to a faucet 5 m above the ground, on the second floor. Water flows at 2.2 m/s in the main line and at 6.4 m/s on the second floor. If the pressure in the main line is 2.65x10^5 Pa, then the pressure on the second floor is:



a. 2.5x10^2 Pa
b. 3.4x10^3 Pa,
c. 1.4x10^4 Pa
d. 1.8x10^5 Pa
e. 8.4x10^5 Pa

10. 88°F is how many degrees Celsius?

a. 31
b. 49
c. 56
d. 158
e. 176

11. A steel plate has a hole drilled through it. The plate is put into a furnace and heated. What happens to the size of the inside diameter of a hole as its temperature increases?

a. increases
b. decreases
c. remains constant
d. becomes elliptical
e. none of the above

12. As a copper wire is heated, its length increases by 0.100%. What is the change of the temperature of the wire? (α_{Cu} = 16.6×10^{-6}/C°)

a. 120.4°C
b. 60.2°C
c. 30.1°C
d. 6.0°C
e. 134.8^0C

13. A rectangular steel plate with dimensions of 30 cm × 25 cm is heated from 20°C to 220°C. What is its change in area? (Coefficient of linear expansion for steel is 11×10^{-6}/C°.)

a. 0.82 cm^2
b. 1.65 cm^2
c. 3.3 cm^2
d. 6.6 cm^2
e. 0.48 cm^2

14. Suppose the ends of a 20-m-long steel beam are rigidly clamped at 0°C to prevent expansion. The rail has a cross-sectional area of 30 cm^2. What force does the beam exert when it is heated to 40°C? ($\alpha_{steel} = 1.1 \times 10^{-5}$/C°, $Y_{steel} = 2.0 \times 10^{11}$ N/m^2).

a. 2.6×10^5 N
b. 5.6×10^4 N
c. 1.3×10^3 N
d. 6.5×10^2 N
e. 6.5×10^7 N
.

15. Two moles of nitrogen gas are contained in an enclosed cylinder with a movable piston. If the molecular mass of nitrogen is 28, how many grams of nitrogen are present?

a. 0.14
b. 56
c. 42
d. 112
e. 89

16. Two moles of nitrogen gas are contained in an enclosed cylinder with a movable piston. If the gas temperature is 298 K, and the pressure is 1.01×10^6 N/m^2, what is the volume? (R = 8.31 J/mol·K)

a. 9.80×10^{-3} m^3
b. 4.90×10^{-3} m^3
c. 17.3×10^{-3} m^3
d. 8.31×10^{-3} m^3
e. 0.38×10^{-3} m^3

17 How many moles of air must escape from a 10-m × 8.0-m × 5.0-m room when the temperature is raised from 0°C to 20°C? Assume the pressure remains unchanged at one atmosphere while the room is heated.

a. 1.3×10^3 moles
b. 1.2×10^3 moles
c. 7.5×10^2 moles
d. 3.7×10^2 moles
e. 3.7×10^5 moles

$\rho_w = 1000\ kg/m^3$ $p = \frac{F}{A}$ $\sigma = \frac{F}{A}$ $\sigma = Y\frac{L - L_0}{L}$ $p_h = \rho gh$;

1 atm = $1.013\ x10^5$ Pa, $F_B = \rho gV$ $A_1v_1 = A_2v_2$ Av -volume flow rate,

Mass flow rate = $Av\rho$

$p_1 + 1/2\rho v_1^2 + \rho gh_1 = p_2 + 1/2\rho v_2^2 + \rho gh_2$ flow in horizontal pipe: $p_1 + 1/2\rho v_1^2 = p_2 + 1/2\rho v_2^2$

$T(^0C) = \frac{5}{9}\ [T(^0F) - 32]$; $T(^0F) = \frac{9}{5}\ T(^0C) + 32$; $T(K) = [T(^0C) + 273]$

$L - L_0 = \alpha\ L_0\ (T-T_0)$; $A - A_0 = 2\alpha\ L_0\ (T-T_0)$; $V - V_0 = \beta\ V_0\ (T-T_0)$ $V - V_0 = 3\alpha\ V_0\ (T-T_0$

$\sigma = Y\alpha\ (T-T_0)$ $\rho = \frac{m}{V}$; $A_{circle} = \pi r^2$ 1 m = 100 cm $V_{cube} = a^3$ $V_{sphere} = \frac{4}{3}\pi R^3$

$V_{cyl} = \pi r^2 L$ 1m = 100 cm 1 kg = 1000 g