$\rho_w = 1000\ kg/m^3$ $p = F/A;$ $p_h = \rho gh;$ $1\ atm = 1.013 \times 10^5\ Pa,$

$F_B = \rho gV$

$A_1v_1 = A_2v_2$ 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: $p_1 + 1/2\rho v_1^2 = p_2 + 1/2\rho v_2^2$

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

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

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

Heat: $Q = mc(T - T_0),$ $Q = mL_F,$ L - latent heat heat lost = heat gained

$c_{water} = 4186 \frac{J}{kg.^0C};$ $L_F = 3.35 \times 10^5 \frac{J}{kg};$ $c_{ice} = 2100 \frac{J}{kg.^0C}$

$Q = kA\frac{T_1 - T_2}{L}t$ $\frac{Q}{t} = e\sigma A(T^4 - T_0^4)$ $\sigma = 5.67 \times 10^{-8}\ W/m^2K^4$

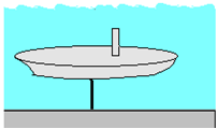
$V_{cyl} = \pi r^2 L$ $1m = 100\ cm$ $1\ kg = 1000\ g$

EXAM 2 PHYS 103 VERSION A
FALL 07

1. Crew members attempt to escape from a damaged submarine 80 m below the surface. What force must they apply to a pop-out hatch of radius of 18 cm to push it out? Assume the density of ocean water 1025 kg/m^3.

A) 92 kN
B) 124 kN
C) 165 kN
D) 186 kN
E) 252 kN

2. A cylindrical submarine with mass 20 x 10^5 kg , radius of 2.75 m and length of 100 m is anchored to the bottom of a channel as shown schematically in the figure. What is the tension in the cable assuming the submarine is totally submerged?



A) 3.7x10^6 N
B) 4.8x10^7 N
C) 7.6x10^6 N
D) 24x10^4 N
E) can't tell

3. A water hose of radius of 1.2 cm is used to fill a bucket of volume of 0.075 m^3. If it takes 2.2 min to fill the bucket, what is the speed at which the water leaves the hose?

A) 0.5 m/s
B) 1.3 m/s
C) 3.0 m/s
D) 4.9 m/s
E) 8.8 m/s

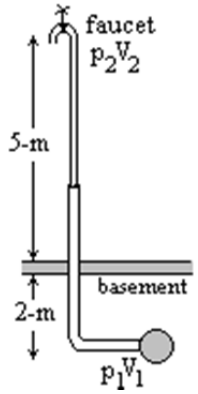
4. An air condition system uses a cylindrical air duct to replenish the air in a room of volume 280 m^3 every 8 min. The air flows in the duct at 5 m/s. What is the cross-section area of the air duct?

A) 0.09 m^2
B) 0.12 m^2
C) 0.24 m^2
D) 0.38 m^2
E) 0.62 m^2

5. 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

6. 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 2.65×10^5 Pa, then the pressure on the second floor is:



A) 2.5×10^2 Pa
B) 3.4×10^3 Pa,
C) 1.4×10^4 Pa
D) 1.8×10^5 Pa
E) 8.4×10^5 Pa

7. A pair of eyeglass frames is made of epoxy plastic. At 20^0C, the frames have circular lens holes 3.12 cm in radius. To what temperature must the fames be heated or cooled in order to insert lenses 3.13 cm in radius? ($\alpha_{epoxy} = 1.6 \times 10^{-4}/^0$C).

A) 5^0C
B) 10^0C
C) 20^0C
D) 40^0C
E) 50^0C

8. When a bimetallic strip is heated, the strip will bend toward the side

A) with larger coefficient of linear expansion.
B) with the smaller coefficient of linear expansion.
C) with the higher temperature.
D) with the lower temperature.
E) can't tell.

10. How much ice at 0°C is needed to cool 200 g of water from 32^0C to 12^0C? (The heat of fusion of ice is 3.33×10^5J/kg).

A) 5 g
B) 12 g
C) 25 g
D) 37 g
E) 43 g

11. An 500 g aluminum electric tea kettle has a 500-W heating coil. How long will it take to heat up 1 kg of water from 18°C to 98°C in this kettle? The specific heat of aluminum is 900 J/kg·°C and the specific heat of water is 4186 J/kg·°C

A) 2 minutes
B) 7 minutes
C) 12 minutes
D) 22 minutes
E) 29 minutes

12. The *R* value of fiberglass batting, 3.5 inches thick, is 11 ft^2 °F h/BTU. What is the thermal conductivity (in BTU/ft · °F · s)?

A) 7.4×10^{-6}
B) 2.7×10^{-2}
C) 8.9×10^{-5}
D) 1.4×10^{-4}
E) 3.6×10^{-3}

13. A super-insulated house is at a temperature of 20°C. The temperature outside is 0°C. The surface area of the house is 200 m^2,
and the emissivity is 1. Approximately how much energy is radiated (in W) per second?

A) 20 000 W
B) 2000 W
C) 200 W
D) 2 W
E) 0.2 W

14. A thermopane window consists of two glass panes, each 0.6 cm thick, with a 1-cm-thick sealed layer of air in between. If inside the room temperature is 23 ^{0}C and the outside temperature is 0^0 C, determine the rate of energy transfer through 1m^2 of the window. (k=0.84 J/smK k_{air} = 0.0234 J/smK)

A) 62 W
B) 58 W
C) 55 W
D) 65 W
E) 52 W

15. A solid concrete wall 4 m by 2.4 m and 30 cm thick, with a thermal conductivity of 1.3 J/s·m·K, separates a basement at 18^0C from the ground outside at 6^0C. How much heat flows through the wall in one hour?
A) 5 kJ
B) 80 kJ
C) 280 kJ
D) 1.8 MJ
E) 2.5 MJ

16. Which of the following statements pertaining to a vacuum flask (thermos) is NOT CORRECT?
A) silvering reduces radiation loss
B) vacuum reduces conduction loss
C) vacuum reduces convection loss
D) vacuum reduces radiation loss
E) glass walls reduce conduction loss