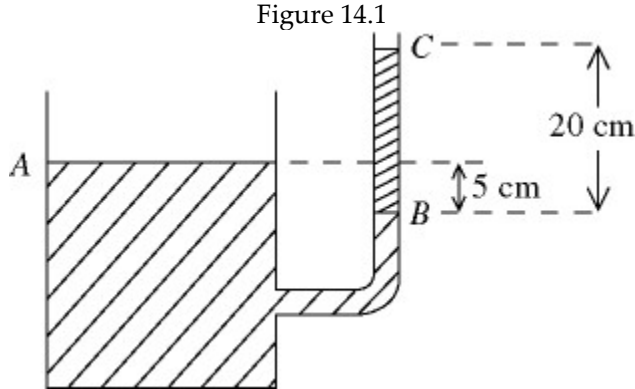


# PreExam-I

Please try to solve these problems. I will solve them in the class before Exam-I.

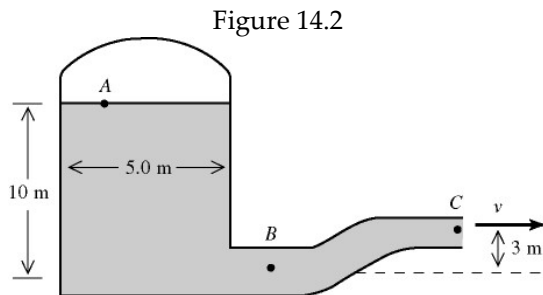


- 1) A container has a vertical tube, whose inner radius is 27.00 mm, connected to it at its side. An unknown liquid reaches level A in the container and level B in the tube—level A being 5.0 cm higher than level B. The liquid supports a 20.0-cm high column of oil, between levels B and C, whose density is  $830 \text{ kg/m}^3$ . In Fig. 14.1, the gauge pressure at level B is closest to:
- A) 2400 Pa
  - B) 1200 Pa
  - C) 810 Pa
  - D) 2000 Pa
  - E) 1600 Pa

1) \_\_\_\_\_

- 2) A 3.4-kg solid sphere, made of metal whose density is  $4600 \text{ kg/m}^3$ , is suspended by a cord. The density of water is  $1000 \text{ kg/m}^3$ . When the sphere is immersed in water, the tension in the cord is closest to:
- A) 26 N
  - B) 33 N
  - C) 30 N
  - D) 41 N
  - E) 37 N

2) \_\_\_\_\_

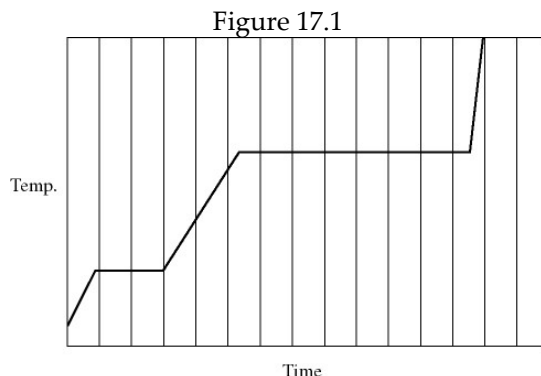


- 3) A pressurized cylindrical tank, 5.0 m in diameter, contains water that emerges from the pipe at point C, with a velocity of  $50 \text{ m/s}$ . Point A is 10 m above point B and point C is 3 m above point B. The area of the pipe at point B is  $0.07 \text{ m}^2$  and the pipe narrows to an area of  $0.04 \text{ m}^2$  at point C. Assume the water is an ideal fluid in laminar flow. The density of water is  $1000 \text{ kg/m}^3$ . In Fig. 14.2, the mass flow rate in the pipe is closest to:
- A) 1600 Kg/s

3) \_\_\_\_\_

- B) 2000 Kg/s
- C) 1200 Kg/s
- D) 1800 Kg/s
- E) 1400 Kg/s

- 4) An aluminum rod is 40.0 cm long and a steel rod is 30.0 cm long when both rods are at a temperature of  $15^{\circ}\text{C}$ . Both rods have the same diameter. The rods are joined end-to-end to form a rod 60.0 cm long. The coefficients of linear expansion of aluminum and steel are  $2.4 \times 10^{-5} \text{ K}^{-1}$  and  $1.2 \times 10^{-5} \text{ K}^{-1}$ , respectively. The temperature is raised to  $110^{\circ}\text{C}$ . The increase in the length of the joined rod, in mm, is closest to:
- A) 1.3      B) 1.4      C) 1.0      D) 1.1      E) 0.88



- 5) In Fig. 17.1, heat is added to a pure substance in a closed container at a constant rate. A graph of the temperature of the substance as a function of time is shown here. If  $L_f = \text{latent heat of fusion}$  and  $L_v = \text{latent heat of vaporization}$ , what is the value of the ratio  $L_v/L_f$  for this substance?
- A) 3.5      B) 7.2      C) 4.5      D) 5.0      E) 1.5

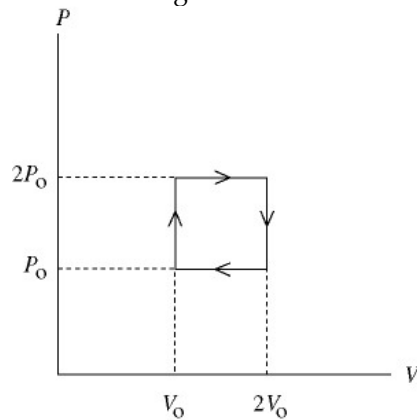
- 6) A concrete wall of a cold storage room measures 3.0 m high, 5.0 m wide, and 20 cm thick. The room temperature is maintained at  $-10^{\circ}\text{C}$  and the outside temperature is  $20^{\circ}\text{C}$ . The inside wall is to be covered by a layer of wood in order to reduce the heat current through the wall by 90 percent. The thermal conductivities of concrete and wood are 0.8 and  $0.04 \text{ W/m} \cdot \text{K}$ , respectively.
- The temperature difference across the layer of wood, in  $^{\circ}\text{C}$ , is closest to:
- A) 25      B) 28      C) 27      D) 24      E) 26

- 7) A sphere, 0.30 m in radius, has a surface emissivity of 0.48 and is at a temperature of 600 K. The sphere is surrounded by a concentric spherical shell whose inner surface has a radius of 0.90 m and an emissivity of 1.00. The temperature of the shell is 400 K. The net heat current radiated, including direction, in the space between the sphere and the shell, in kW, is closest to:
- A) 10.8, inward
- B) 4.0, outward

- C) 8.3, outward
- D) 6.5, inward
- E) 18.8, outward

- 8) A sealed  $21\text{-m}^3$  tank is filled with 5000 moles of oxygen gas (diatomic) at an initial temperature of  $270\text{ K}$ . The gas is heated to a final temperature of  $390\text{ K}$ . The atomic mass of oxygen is  $16.0\text{ g/mol}$ . The mass density of the oxygen gas, in SI units, is closest to: 8) \_\_\_\_\_
- A) 9.5      B) 3.8      C) 15      D) 7.6      E) 5.7
- 9) A  $5.1\text{ L}$  volume of neon gas (monatomic) is at a pressure of  $4.7$  atmospheres and a temperature of  $390\text{ K}$ . The atomic mass of neon is  $20.2\text{ g/mol}$ . In this situation, the temperature of the gas is increased to  $490$  and the volume is increased to  $7.1\text{ L}$ . The final pressure of the gas, in atmospheres, is closest to: 9) \_\_\_\_\_
- A) 3.8      B) 5.5      C) 4.7      D) 5.1      E) 4.2
- 10) A  $5.0\text{-liter}$  gas tank holds  $1.4$  moles of helium (monatomic) and  $0.7$  moles of oxygen (diatomic), at a temperature of  $260\text{ K}$ . The atomic masses of helium and oxygen are  $4.0\text{ g/mol}$  and  $16.0\text{ g/mol}$ , respectively. The total random translational kinetic energy of the gas in the tank, in kJ, is closest to: 10) \_\_\_\_\_
- A) 61      B) 76      C) 68      D) 91      E) 83
- 11) If it takes  $25.0\text{ J}$  to increase the temperature of  $n$  moles of ideal He at fixed volume from  $15.0^\circ\text{C}$  to  $85.0^\circ\text{C}$ , the heat required to increase the temperature of  $n$  moles of ideal  $\text{H}_2$  at fixed volume by the same amount is closest to: 11) \_\_\_\_\_
- A)  $15.0\text{ J}$       B)  $19.4\text{ J}$       C)  $69.4\text{ J}$       D)  $41.7\text{ J}$       E)  $25.0\text{ J}$
- 12) If we double the root-mean-square speed of the molecules of a gas, then 12) \_\_\_\_\_
- A) its temperature must increase by a factor of 4.
  - B) its temperature must increase by a factor of 2.
  - C) its pressure must increase by a factor of 4.
  - D) its pressure must increase by a factor of 2.
  - E) its temperature must increase by a factor of  $\sqrt{2}$ .
- 13) A compression, at a constant pressure of  $40\text{ kPa}$ , is performed on  $7.0$  moles of an ideal monatomic gas ( $C_V = 3/2 R$ ). The compression reduces the volume of the gas from  $0.25\text{ m}^3$  to  $0.12\text{ m}^3$ . The change in the internal energy of the gas, in kJ, is closest to: 13) \_\_\_\_\_
- A) -13      B) -7.8      C) 7.8      D) 13      E) zero

Figure 19.2



- 14) In Fig. 19.2, an ideal gas is carried around the cyclic process. How much work is done in one cycle if  $P_0 = 7 \text{ atm.}$  and  $V_0 = 6.00 \text{ liters}$ ? 14) \_\_\_\_\_
- A) 1700 J  
 B) 4240 J  
 C) 7980 J  
 D) 17,000 J  
 E) 8480 J
- 15) Twenty moles of a monatomic ideal gas ( $\gamma = 5/3$ ) undergo an adiabatic process. The initial pressure is  $400 \text{ kPa}$  and the initial temperature is  $450 \text{ K}$ . The final temperature of the gas is  $320 \text{ K}$ . The final volume of the gas, in SI units, is closest to: 15) \_\_\_\_\_
- A) 0.27      B) 0.19      C) 0.35      D) 0.23      E) 0.31
- 16) A real (non-Carnot) heat engine, operating between heat reservoirs at temperatures of  $740 \text{ K}$  and  $270 \text{ K}$ , performs  $2.7 \text{ kJ}$  of net work and rejects  $8.2 \text{ kJ}$  of heat in a single cycle. The thermal efficiency of this heat engine is closest to: 16) \_\_\_\_\_
- A) 0.27      B) 0.30      C) 0.22      D) 0.20      E) 0.25
- 17) A Carnot engine is operated as an air conditioner to cool a house in the summer. The air conditioner removes  $20 \text{ kJ}$  of heat per second from the house, and maintains the inside temperature at  $293 \text{ K}$ , while the outside temperature is  $366 \text{ K}$ . The power required for the air conditioner under these operating conditions, in SI units, is closest to: 17) \_\_\_\_\_
- A) 6000      B) 7000      C) 9000      D) 8000      E) 5000