Practice Exam[1] for Chapters 1 – 3

1. Which of the following would be identified as a control volume?

   A) The air in a tire as a car is driven from Michigan to Arizona
   B) Filling a tire with air at a service station
   C) Expansion of gases in a cylinder
   D) Compression of air in a cylinder

2. Which of the following could be a quasi-equilibrium process?

   A) Mixing a fluid in a rigid volume
   B) Combustion of the air-fuel mixture in a cylinder
   C) Expansion of gases in a piston-cylinder arrangement
   D) Heating air in a cylinder with a resistance heater

3. The mass in a volume of 10 cubic meters with v = 20 m^3/kg is nearest:

   A) 2 kg **B)** 1 kg **C)** 0.5 kg **D)** 0.25 kg

4. If the elevation is 3000 m, the pressure at a point where the gage pressure is 200 mm of mercury is nearest (ρ_{Hg} = 13.6 ρ_{water}):

   A) 97 kPa **B)** 109 kPa **C)** 127 kPa **D)** 141 kPa

5. The volume occupied by 10 kg of water at 170°C and 800 kPa is nearest:

   A) 13.1 L **B)** 12.6 L **C)** 11.9 L **D)** 11.4 L

6. Two kg of steam is contained in a piston-cylinder arrangement. The 20-mm-dia, 48-kg piston is allowed to rise with no friction until the temperature reaches 250°C. The final volume is nearest:

   A) 0.422 m^3 **B)** 0.388 m^3 **C)** 0.302 m^3 **D)** 0.284 m^3

7. The gage pressure in an automobile tire is 240 kPa when the tire temperature is –30°C. The automobile is driven to a warmer climate and the tire temperature increases to 65°C. The gage pressure in the tire assuming the elevation does not change is nearest:

   A) 480 kPa **B)** 370 kPa **C)** 320 kPa **D)** 280 kPa

8. Ten kilograms of air at 800 kPa are heated at constant pressure from 170°C to 400°C. The heat required is nearest:

   A) 2300 kJ B) 2100 kJ C) 1900 kJ D) 1700 kJ

9. A mass of 0.025 kg of steam at a quality of 10 percent and a pressure of 200 kPa is heated in a rigid container until the temperature reaches 300°C. The pressure at state 2 is nearest:

   A) 2.25 MPa B) 2.5 MPa C) 2.75 MPa D) 3.0 MPa

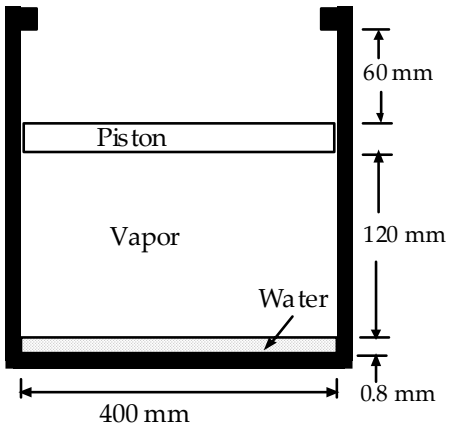
10. Two kilograms of air is expanded in a piston-cylinder arrangement at a constant pressure of 600 kPa from a volume of 0.1 m^3 to a volume of 0.3 m^3. Then the temperature is then held constant during an expansion to 0.5 m^3. The total work done by the air is nearest:

    A) 119 kJ B) 132 kJ C) 151 kJ D) 189 kJ

[1] [1] [1] Suggested grades: A: 15 - 20, B: 12- 14, C: 9 – 11, D: 6 - 8, F: 0 - 5

Questions 11–14

The frictionless piston shown in its initial position provides a pressure of 600 kPa in the cylinder. Energy is added until the temperature reaches 250°C.



11. The initial quality is nearest:

A) 39.8% B) 34.4% C) 30.1% D) 22.2%

12. The quality when the piston just hits the stops is nearest:

A) 64.0% B) 59.9% C) 51.5% D) 45.2%

13. The final pressure is nearest:

A) 920 kPa B) 980 kPa C) 1020 kPa D) 1220 kPa

14. The work done by the vapor on the piston is nearest:

A) 65 J B) 55 J C) 45 J D) 35 J

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15. Energy is added to 5 kg of air with a paddle wheel until ΔT = 100°C. Find the magnitude of the paddle wheel work if the rigid container is insulated.

A) 424 kJ B) 392 kJ C) 358 kJ D) 306 kJ

16. Helium is contained in a 2-m^3 rigid volume at 50°C and 200 kPa. Calculate the heat transfer needed to increase the pressure to 400 kPa.

A) 1390 kJ B) 1230 kJ C) 1100 kJ D) 978 kJ

17. Air is compressed using an adiabatic quasi-equilibrium process from 100 kPa and 20°C to 800 kPa. The temperature T_2 is nearest:

A) 260°C B) 280°C C) 300°C D) 320°C

18. The initial temperature and pressure of 8000 cm^3 of air are 300°C and 800 kPa, respectively. The necessary heat transfer, if the volume does not change and the final pressure is 200 kPa, is nearest:

A) –12 kJ B) –22 kJ C) –32 kJ D) –42 kJ

19. Heat is added to an initial 0.15-m^3 volume of steam with a quality of 0.5. Estimate the final temperature if 800 kJ of heat is added while the pressure remains constant at 400 kPa.

A) 180°C B) 220°C C) 260°C D) 300°C

20. Nitrogen at 100°C and 600 kPa expands in such a way that it can be approximated by a polytropic process with n = 1.2. The work if the final pressure is 100 kPa is nearest:

A) 128 kJ/kg B) 143 kJ/kg C) 171 kJ/kg D) 194 kJ/kg

$$\rho = \frac{m}{V} \qquad v = \frac{V}{m} \qquad F = ma$$

$$P = \frac{F_n}{A} \qquad P_{\text{absolute}} = P_{\text{gage}} + P_{\text{atmospheric}}$$

$$x = \frac{m_g}{m} \qquad v = v_f + x(v_g - v_f) \qquad Pv = RT$$

$$h = u + Pv \qquad u_2 - u_1 = C_v(T_2 - T_1) \qquad h_2 - h_1 = C_p(T_2 - T_1)$$

$$C_p = C_v + R \qquad k = \frac{C_p}{C_v} \qquad Z = \frac{Pv}{RT}$$

$$W_{1\text{-}2} = \frac{1}{2}K(x_2^2 - x_1^2) \qquad \dot{W} = \omega T \qquad \dot{W} = Vi = \frac{V^2}{R}$$

$$q - w = \Delta u \qquad Q = m(h_2 - h_1) \quad \text{if} \quad P = \text{const}$$

$$Q = W = mRT \ln \frac{V_2}{V_1} \qquad \frac{T_2}{T_1} = \left(\frac{v_1}{v_2}\right)^{k-1} = \left(\frac{P_2}{P_1}\right)^{(k-1)/k}$$

$$w = \frac{P_2 v_2 - P_1 v_1}{1 - n} \quad \text{for a polytropic process}$$