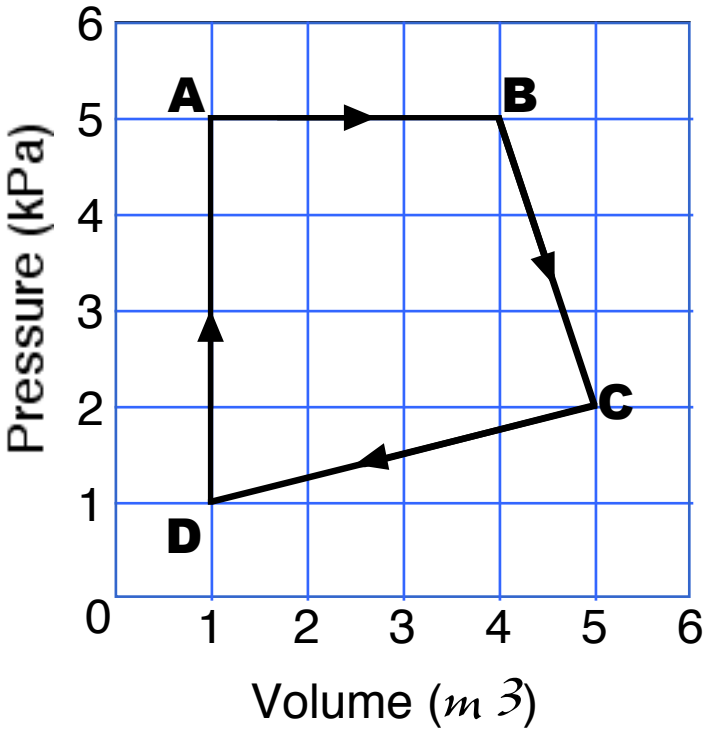
Thermodynamics

To the right is a P-V diagram that shows multiple step thermodynamic cycle.



1. What is the name of the thermal dynamic process as the gas goes from point "**A**" to point **B**"?

2. What is the name of the thermal dynamic process as the gas goes from point "**D**" to point "**A**"?

3. How much work is done as a gas undergoes a change along the curve from point "**B**" to "**C**?"

4. How much work is done as a gas undergoes a change along the curve from point "**C**" to "**D**?"

5. How much *NET* work is done on or by the gas as it undergoes a change along the curve from point "**A**" to "**B**" to "**C**" to "**D**" and back to "**A**?"

6. If the PV diagram above is for 2 moles of a gas then what is the gas's temperature at point "**A**?"

7. If the PV diagram above is for 2 moles of a gas then what is the gas's temperature at point "**D**?"

8. If the PV diagram above is for 2 moles of a gas then what is the change in internal energy of the gas during the process from "**D**" to "**A**?"

9. How much thermal energy is added to the gas as it undergoes a change from point "**D**" to "**A**?"

10. How much work is done either on or by the system during the process from "**D**" to "**A**?"

11. How much work is done either on or by the surroundings from the process from "**B**" to "**C**?"

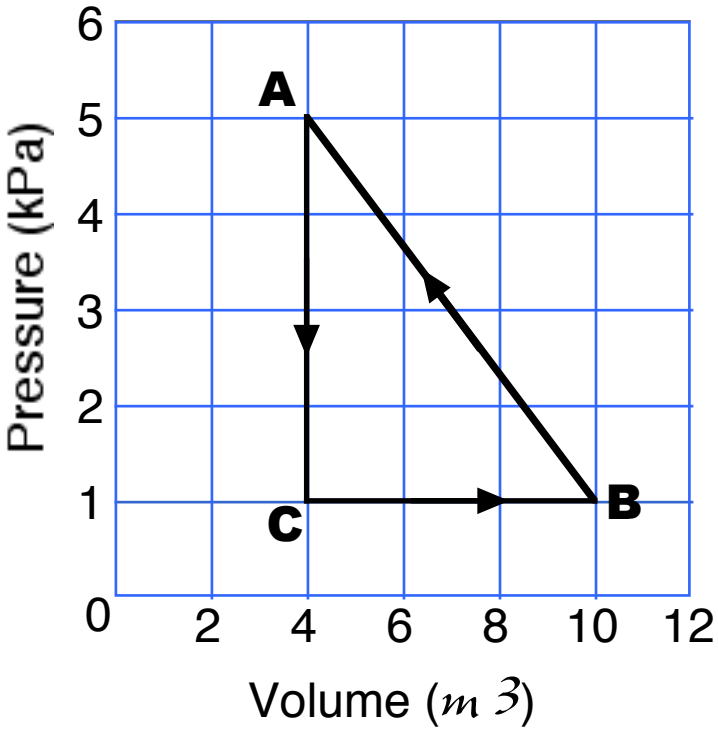
12. How much work is done either on or by the <u>surroundings</u> during the cycle from **A** to **B** to **C** to **D**?

13. If 15 kJ of thermal energy is entered into the system shown from the P-V diagram, then what is the change in internal energy?

Thermodynamics

Show your work on a separate piece of paper.

To the right is a P-V diagram that shows a thermal dynamic cycle.



14. What is the name of the thermal dynamic process as the gas goes from point "**B**" to point "**C**"?

15. What is the name of the thermal dynamic process as the gas goes from point "**C**" to point "**A**"?

16. How much *NET* work is done as a goes undergoes a change along the curve from point "**A**" to "**B**" to "**C**" to "**A**" again?

17. If 20 kJ of thermal energy is entered into the system shown from the P-V diagram, then what is the change in internal energy of the cycle?

18. If this process occurs to a system containing 4 moles of gas then what is the temperature at location "**B**?"

19. If this process occurs to a system containing 4 moles of gas then what is the change in internal energy during the process from "**A**" to "**C**?"

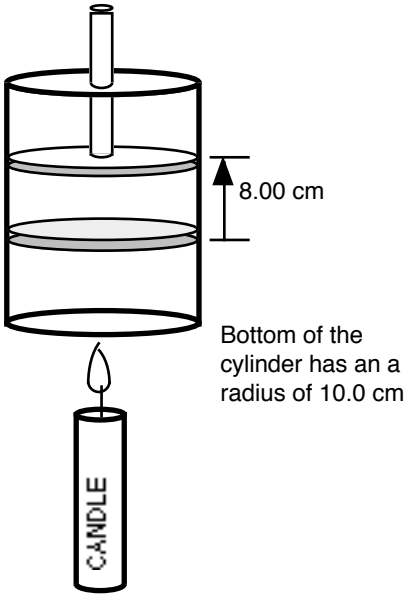
20. How much work is done by the system during the process from "**C**" to "**B**?"

21. How much work is done by the surroundings during the process from "**B**" to "**A**?"

22. How much thermal energy is added or removed to/from the system from "**C**" to "**B,**" if this process occurs to a system containing 4 moles of gas?

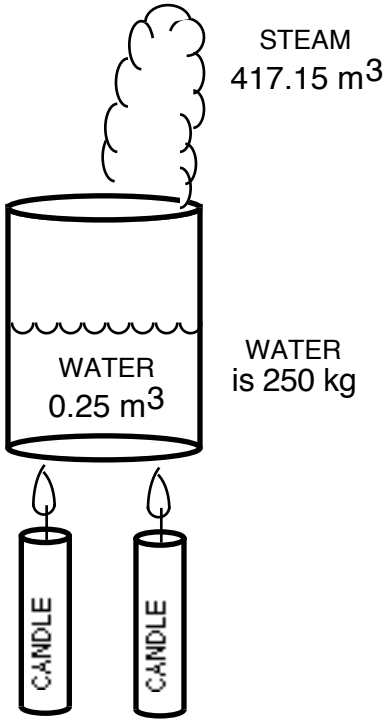
Thermodynamics

Show your work on a separate piece of paper.



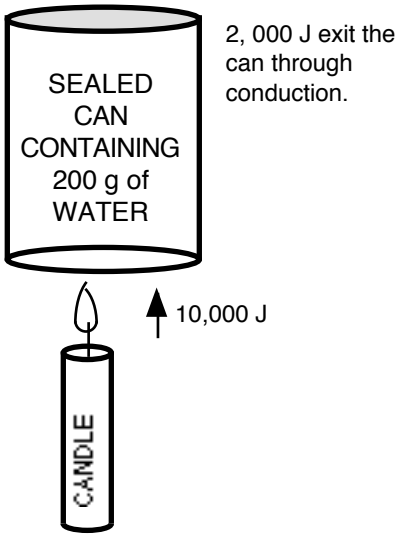
23. A cylinder has a piston sticking out of its top. The piston is a lid that is allowed to slide up and down.

(A) What kind of thermodynamic process is this?
(B) How much work is done in sliding the piston up?
(C) How much thermal energy does the candle give the can?



24. A container is holding water as shown. All the water is converted to steam. The temperature does not change. This process occurs at a constant 101325 Pa of pressure.

(A) What kind of thermodynamic process(es) is this?
(B) How much thermal energy, Q, is added to the water?
(C) How much work is done by expanding the water into steam?
(D) What is the change in internal energy of the system.



25. A sealed can contains 200 grams of water at 34°C. A candle injects 10,000 J into the can. The can looses 2,000 J through conduction.

(A) What kind of thermal dynamic process is this?
(B) What is the change in internal energy?
(C) What is the change in temperature of the water? C=4.186 J/g

Latent Heat of Fusion and Vaporization

26. How much heat is requires to melt 3.0 kg of ice at 0° C?

27. Ice at 32° C is placed in a Styrofoam cup containing 0.32 kg of water at 27° C. After the ice and water have reached equilibrium, *some ice still remains*. Determine the mass of ice that has melted if no heat loss occurs to the cup or the environment.

28. A 7.00 kg glass bowl [C = 840 J/(kg•C°)] contains 16.0 kg of punch at 25.0° C. 2.5 kg of ice [C = 2000 J/(kg•C°)] is added to the punch. the ice has an initial temperature of -20° C. The punch may be treated as if it is water [C =4186 J/(kg•C°)]. what is the temperature of the punch, ice and bowl is no heat is lost to the environment?

Conduction

29. A portable ice chest has walls 0.020 m thick. the area of the walls is 0.66 m2. For a picnic the chest is loaded with 3.0 kg of ice at 0° C. the temperature at the outside surface of the chest is 35° C. Find the time required to melt the ice when the chest is made of (a) Styrofoam (b) wood.

Stefan-Boltzmann

30. The emissitivity of a person is about 0.900. How much power is radiated by a person whose body temperature is 37° C while sitting in a room whose temperature is 20° C? Assume the area of a person is 1.5 m2.

31. Betelgeuse is a distance super giant star in the belt of the Orion constellation. Betelgeuse has a surface temperature of about 2900 K and emits a radiant power of about 4 X 1030 W. the temperature is about one-half the power and about 10,000 times greater than that of our own sun. Assuming the star is a perfect emitter (emissitivity = 1) and spherical, find its radius.

A fire is started in a wood stove. The room reaches a constant temperature of 29° C while the stove reaches a temperature of 198° C. The stove's surface area is 3.5 m2. The emissitivity of the stove is 0.900.

32. How much power is radiated by the stove?
33. How much power is radiated by the room on the stove?
34. What is the net radiated power of the stove?

35. A container maintains a constant pressure of 76700 Pa while changing to a volume of 38 liters. If -66030 J of work was done by the gas, what was the starting volume?

36. 24.4 moles of an ideal gas is held at a temperature of 70°C while expanding from 139 liters to 799 liters. How much work is done by the gas?

37. A container maintains a constant pressure of 39300 Pa and volume of 104 liters while 432.3 of heat is added. How much work is done by the gas?

38. 23.4 moles of an ideal gas is held at a temperature of 55°C while changing to a volume of 175 liters. If 57560 J of work was done by the gas, what was the starting volume?

39. A container maintains a constant pressure of 63600 Pa and volume of 47 liters while 26330 of heat is added. How much work is done by the gas?

40. 27 moles of an ideal gas is held at a temperature of 372°C while expanding from 6 liters to 58 liters. How much work is done by the gas?

41. A container maintains a constant pressure of 20900 Pa while expanding from 83 liters to 911 liters. How much work is done by the gas?

42. 16.2 moles of an ideal gas is held at a temperature of 287°C while changing to a volume of 95 liters. If 797.9 J of work was done by the gas, what was the starting volume?

43. A container maintains a constant pressure of 70700 Pa while changing to a volume of 25 liters. If -59100 J of work was done by the gas, what was the starting volume?

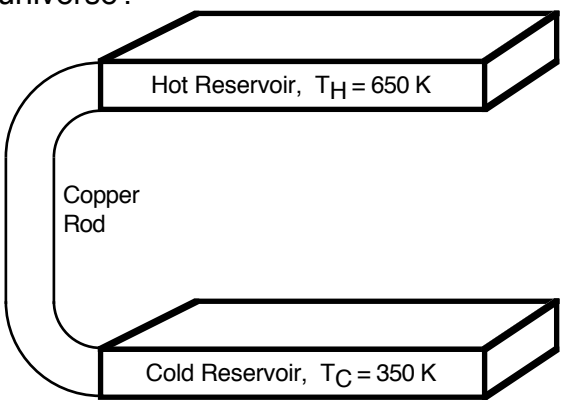
44. 21.4 moles of an ideal gas is held at a temperature of 5°C while expanding from 0.026 m3 to 0.631 m3. How much work is done by the gas?

45. A container maintains a constant pressure of 72000 Pa and volume of 64 liters while 51620 of heat is added. How much work is done by the gas?

46. 10.2 moles of an ideal gas is held at a temperature of 124°C while expanding from 147 liters to 424 liters. How much work is done by the gas?

These are the answer to the problems above in no particular order (the units are missing on purpose.)
899, no work is done, 17300, 1.577×10^5 , no work is done, 35650, 94, no work is done, 861, 1.216×10^5, 3.283×10^5 , 71

47. 1200 J of heat spontaneously flows from a hot reservoir at 650 K to a cold reservoir at 350 K. What is the change to the entropy of the universe?



48. 4 kilograms of carbon dioxide sublimes from solid "dry ice" to a gas at a pressure of 1.00 atm and a temperature of 194.7 K. the latent heat of sublimation for carbon dioxide is 5.77×10^5 J/kg. Find the change in entropy of the carbon dioxide.

49. The spring on a screen door with a force constant of 200 N/m is stretched 30 cm on a day where the temperature is 25 °C. What is the change in entropy of the universe if 25% of the stored energy is lost when the spring is stretched?

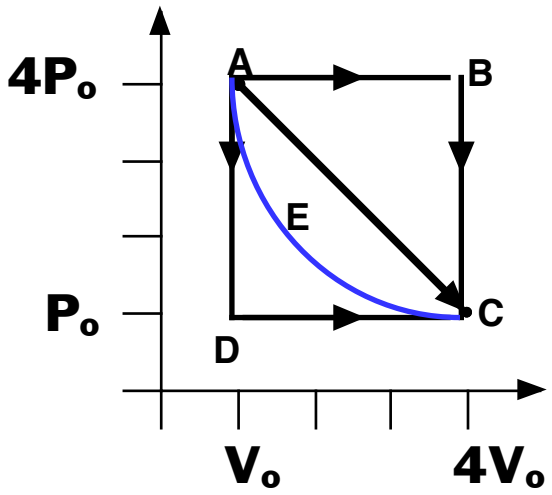
Thermodynamics

Show your work on a separate piece of paper.

50. Which process(es) shows a ΔQ equal to 5/2nRΔT?

51. Which process(es) show a W=0?

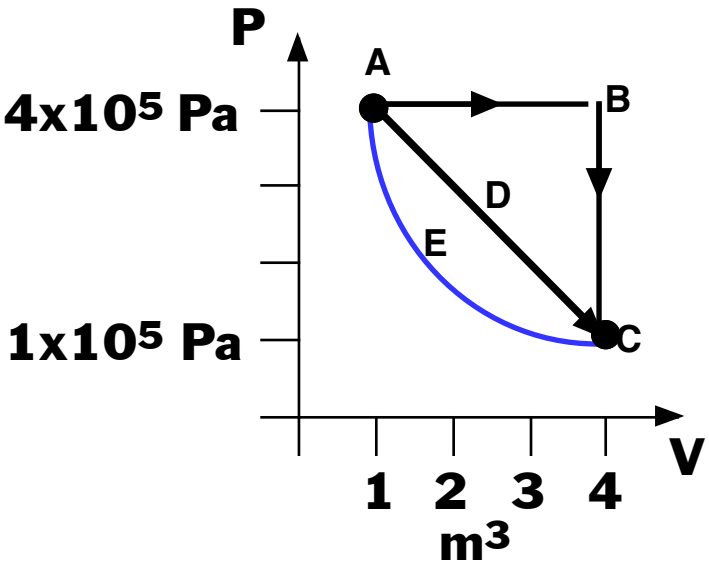
52. Which process shows a decrease in temperature?



53. For the graph to the right, assuming no molecules are allowed to escape, show that states A and C are at the same temperature.?

54. How much work is done along the path from A to B?

55. How much thermal energy is added from state A to B if this represents 3 moles of an ideal gas?



56. How much work is done from states B to C?

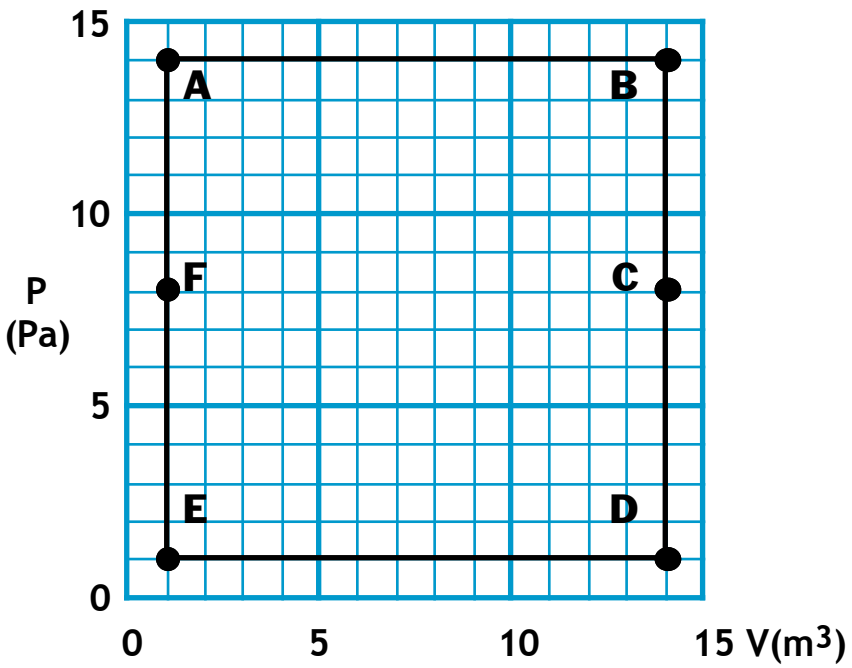
57. Is positive work done **on** the surroundings or **by** the surroundings as the system under goes a change along A → D → C?

Thermodynamics

Show your work on a separate piece of paper.

58. Assuming the molecules cannot escape the system, rank each point's internal energy from highest to lowest.

59. Rank the six points according to their temperatures from highest to lowest.



60. There are two possible paths between state F and C. They are F→A→B→C or F→E→D→C. Consider the process of, F→A, B→C, F→E, D→C: Which process shows the greatest amount of heat flowing into the system and least amount of heat flowing into the system?

61. How much thermal energy flows from the system from D→E?

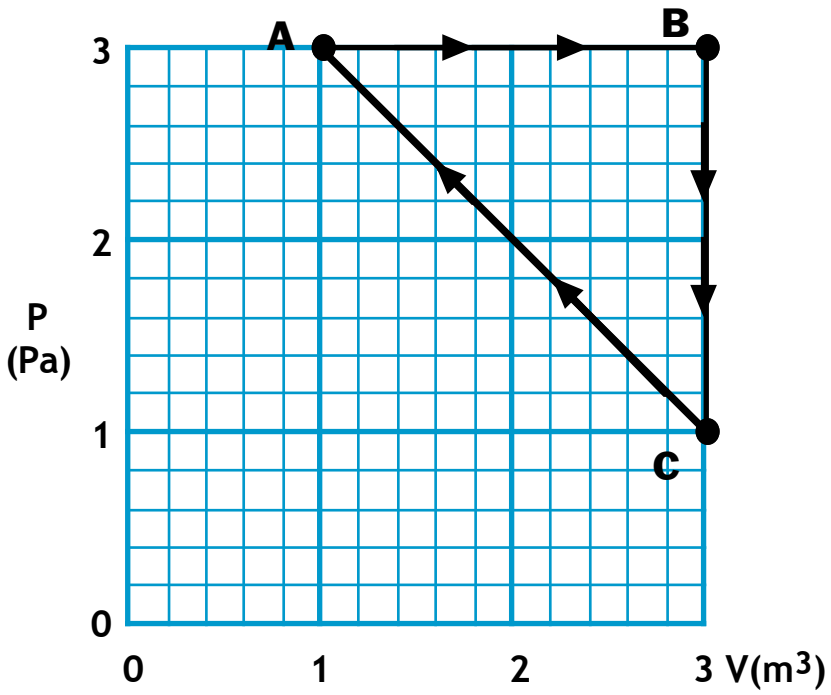
---

62. How much work is done by the surroundings from C→A?

63. How much work is done by the gas in the system from A→B?

64. How much work is done by the surroundings in the cycle A→B→C?

65. Does thermal energy flow into or out of the system during the cycle, A→B→C?



66. In the process from A→B, how much thermal energy flows from the environment?