

VERY IMPORTANT PROBLEMS 01 (VIP 01 - THERMODYNAMICS)

INSTRUCTION: Solve or familiarize the answers of the following very probable problems.

1. Determine the specific weight of air at 760 mmHg absolute and 22°C.
A. 1.024 kg/m³ C. 1.197 kg/m³
B. 1.316 kg/m³ D. 1.266 kg/m³
Answer: C
2. Find the enthalpy of Helium if its internal energy is 200 kJ/kg.
A. 144 kJ/kg C. 333.42 kJ/kg
B. 223.42 kJ/kg D. 166 kJ/kg
Answer: C
3. Compute the mass of a 2 m³ propane at 280 kPa and 40°C.
A. 6.47 kg C. 10.20 kg
B. 5.1 kg D. 9.47 kg
Answer: D
4. Find the pressure at the 100 fathom depth of water in kpag.
A. 1,793.96 kpag C. 1,983.96 kpag
B. 1,893.96 kpag D. 1,693.96 kpag
Answer: A
5. Find the depth in furlong of the ocean (SG = 1.03) if the pressure at the sea bed is 2,032.56 kpag.
A. 1 C. 3
B. 2 D. 4
Answer: A
6. A 1 m x 1.5 m cylindrical tank is full of oil with SG = 0.92. Find the force acting at the bottom of the tank in dynes.
A. 106.33 x 10⁷ dynes C. 106.33 x 10⁴ dynes
B. 106.33 x 10⁵ dynes D. 106.33 x 10⁶ dynes
Answer: D
7. Find the mass of ten quartz of water.
A. 10.46 kg C. 11.46 kg
B. 9.46 kg D. 8.46 kg
Answer: B
8. Find the mass of carbon dioxide having a pressure of 20 psia at 200°F with 10 ft³ volume.
A. 1.04 lbs C. 1.24 lbs
B. 1.14 lbs D. 1.34 lbs
Answer: C
9. What is the approximate value of temperature of water having enthalpy of 208 Btu/lb?
A. 138.67°C C. 258.67°C
B. 115.55°C D. 68.67°C
Answer: B
10. Carnot cycle A, B, and C are connected in series so that the heat rejected from A will be the heat added to B and heat rejected from B will be added to C, each cycle operates between 30°C to 400°C. If heat added to A is 1000 kW, find the work output of C.
A. 111.44 kW C. 247.53 kW
B. 549.78 kW D. 141.69 kW
Answer: A
11. Two kilogram of air in a rigid tank changes its temperature from 32°C to 150°C. Find the work done during the process.
A. 236 C. 195
B. 170 D. 0
Answer: D
12. Determine the atmospheric pressure at a location where barometric reading is 740 mm Hg and gravitational acceleration is $g = 9.7 \text{ m/s}^2$. Assume the temperature of mercury to be 10°C, at which the density is 13,670 kg/m³.
A. 99.45 kPa C. 95.44 kPa
B. 97.41 kPa D. 98.66 kPa
Answer: B
13. An ideal gas at 0.80 atmospheres and 87°C 0.450 liter. How many moles are in the sample? ($R = 0.0821 \text{ liter-atm/mole-K}$)
A. 0.0002 mole C. 0.0122 mole
B. 0.0378 mole D. 0.0091 mole
Answer: C
14. A certain gas at 101.325 kPa and 10°C whose volume is 2.83 m³ are compressed into a storage vessel at 0.31 m³ capacity. Before admission, the storage vessel contained the gas at a pressure and temperature of 137.8 kPa and 26°C, after admission the pressure has increased to 1171.6 kPa. What should be the final temperature of the gas in the vessel in Kelvin?
A. 296.0 C. 180.0
B. 319.8 D. 314.2
15. Answer: D
A perfect gas has a value of $R = 58.8 \text{ ft-lb/lb-}^\circ\text{R}$ and $k = 1.26$. If 20 Btu are added to 10 lbs of the gas at constant volume when initial temperature is 90°F, find the final temperature.
A. 97°F C. 154°F
B. 104°F D. 185°F
Answer: A
16. Ammonia weighing 22 kgs is confined inside a cylinder equipped with a piston has an initial pressure of 413 kPa at 38°C. If 3200 kJ of heat is added to the ammonia until its final pressure and temperature are 413 kPa at 100°C, respectively, what is the amount of work done by the fluid in kJ?
A. 667 C. 420
B. 304 D. 502
Answer: A
17. A tank contains 90 ft³ of air at a pressure of 350 psig. If the air is cooled until its pressure and temperature decreases to 200 psig and 70°F, respectively, what is the decrease in internal energy?
A. 6232.09 Btu C. 5552 Btu
B. -5552 Btu D. -6232.09 Btu
Answer: D
18. A large mining company was provided with a 3 m³ of compressed air tank. Air pressure in the tank drops from 700 kPa to 150 kPa while the temperature remains constant at 28°C. What percentage has the mass of air in the tank been reduced?
A. 74.00 C. 78.56
B. 72.45 D. 78.57
Answer: D
19. A 4 m³/hr pump delivers water to a pressure tank. At the start, the gage reads 138 kPa until it reads 276 kPa and then the pump was shut off. The volume of the tank is 180 liters. At 276 kPa the water occupied 2/3 of the tank volume. Determine the volume of water that can be taken out until the gage reads 138 kPa.
A. 31.20 liters C. 16.67 liters
B. 34.59 liters D. 29.50 liters
Answer: B
20. Atmospheric pressure boils at 212°F. At the vacuum pressure at 24 in Hg, the temperature is 142°F. Find the boiling temperature when the pressure is increased by 40 psia from atmospheric.
A. 449.42°F C. 479.13°F
B. 526.34°F D. 263.45°F
Answer: A
21. Find the work posses for a Helium gas at 20 deg C.
A. 609 kJ/kg C. 229 kJ/kg
B. 168 kJ/kg D. 339 kJ/kg
Answer: A
22. What is the hydraulic gradient of a 1 mile, 17 inches inside diameter pipe when 3300 gal/min of water flow with $f = 0.03$.
A. 0.00714 C. 0.00234
B. 0.00614 D. 0.00187
Answer: A
23. Convert 750°R to °K.
A. 390.33 °K C. 410.33 °K
B. 395.33 °K D. 416.33 °K
Answer: D
24. Air is compressed adiabatically from 30°C to 100°C. If mass of air being compressed is 5 kg. Find the change in entropy.
A. 1.039 kJ/°K C. 0
B. 0.746 kJ/°K D. 1.245 kJ/kg
Answer: C
25. A steam condenser receives 10 kg/s of steam with an enthalpy of 2770 kJ/kg. Steam condenses into a liquid and leaves with an enthalpy of 160 kJ/kg. Cooling water passes through the condenser with temperature increases from 13°C to 24°C. Calculate the water flow rate in kg/s.
A. 583 C. 523
B. 567 D. 528
Answer: B
26. If the initial volume of an ideal gas is compressed to one-half its original volume and to twice its temperature, the pressure:
A. Doubles C. Quadruples
B. Remains constant D. Halves
Answer: C

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27. If the gage pressure of a medium is 30 kPa (vacuum) and the atmospheric pressure is 101.3 kPa, the absolute pressure will be:
 A. 131.3 kPa
 B. 71.3 kPa
 C. -71.3 kPa
 D. -131.3 kPa
 Answer: B
 28. If a particle has a velocity of 4 meters per second and a kinetic energy of 144 Joules, then the mass, in kilograms of this particle must be:
 A. 44
 B. 18
 C. 16
 D. 24
 Answer: B
 29. A condenser vacuum gauge reads 715 mm Hg when the barometer stands at 757 mm Hg. State the absolute pressure in the condenser in kN/m² or kPa.
 A. 5.6 kPa
 B. 6.5 kPa
 C. 5.9 kPa
 D. 5.2 kPa
 Answer: A
 30. Determine the force in Newton in a piston of 465 mm² area with a pressure of 0.172 MPa.
 A. 65 N
 B. 80 N
 C. 72 N
 D. 111 N
 Answer: B
 31. One piston of a hydraulic press has an area of 1 cm². The other piston has an area of 25 cm². If a force of 150 N is applied on the smaller piston, what will be the total force on the larger piston is both piston surfaces are the same level?
 A. 6 N
 B. 3750 N
 C. 175 N
 D. 4250 N
 Answer: B
 32. If the pressure of a confined gas at a constant temperature is tripled, what will happen to the volume?
 A. The volume will be tripled
 B. The volume will remain unchanged
 C. The volume will be reduced to one-third of its original value
 D. The volume is constant
 Answer: C
 33. The work done on air is 10.86 kJ/kg, determine the compressor power if it is receiving 272 kg/min of air.
 A. 36.72 hp
 B. 2954 hp
 C. 49.23 hp
 D. 66 hp
 Answer: D
 34. A water tank of 18 ft wide, 14 ft long and 4 ft high, calculate the pressure at the bottom of the tank.
 A. 1.733 psi
 B. 2.337 psi
 C. 1.999 psi
 D. 3.773 psi
 Answer: A
 35. The pressure of 750 mm Hg in kN/m².
 A. 90
 B. 103
 C. 100
 D. 110
 Answer: C
 36. A double purpose tank 18 ft wide, 24 ft long and 4 ft depth is filled with water. What is the weight of water in the tank in long tons?
 A. 49 tons
 B. 54 tons
 C. 48 tons
 D. 50 tons
 Answer: A
 37. Oil flow through a 16 tubes on a single cooler with a velocity of 2 m/s. The internal diameter of the tube is 30mm and oil density is 0.85 g/ml. Find the volume flow in liters per sec.
 A. 22.62
 B. 62.22
 C. 32.22
 D. 42.62
 Answer: A
 38. A substance temperature was 620 deg R. What is the temperature in deg C?
 A. 50.7
 B. 71.11
 C. 45.54
 D. 94.44
 Answer: B
 39. Unknown volume of container gas of 1 atmosphere is allowed to expand to another container of 10 m³ volume at 500 mm Hg at constant temperature. Find the unknown volume.
 A. 6.58 m³
 B. 5.67 m³
 C. 6.75 m³
 D. 7.65 m³
 Answer: A
 40. An iron block weights 7 newtons and has a volume of 200 cubic centimeters. What is the density of the block?
 A. 3465 kg/m³
 B. 3565 kg/m³
 C. 1255 kg/m³
 D. 2550 kg/m³
 Answer: B
 41. An iron block weights 5 Newton and has volume of 200 cm³. What is the density of the block?
 A. 2458 kg/m³
 B. 2584 kg/m³
 C. 2485 kg/m³
 D. 2549 kg/m³
 Answer: D
 42. If air is at a pressure of 22.22 psia and at temperature of 800°R, what is the specific volume?
 A. 11.3 ft³/lbm
 B. 13.3 ft³/lbm
 C. 33.1 ft³/lbm
 D. 31.3 ft³/lbm
 Answer: B
 43. The specific gravity of mercury is 13.55. What is the specific weight of mercury?
 A. 123.9 kN/m³
 B. 132.9 kN/m³
 C. 139.2 kN/m³
 D. 193.2 kN/m³
 Answer: B
 44. The equivalent weight of mass 10 kg at a location where the acceleration of gravity is 9.77 m/sec².
 A. 97.7 N
 B. 77.9 N
 C. 79.7 N
 D. 977 N
 Answer: A
 45. A transportation company specializes in the shipment of pressurized gaseous materials. An order is received from 100 liters of a particular gas at STP (32°F and 1 atm). What minimum volume tank is necessary to transport the gas at 80 °F and maximum pressure of 8 atm?
 A. 16 liters
 B. 10 liters
 C. 14liters
 D. 12 liters
 Answer: C
 46. 100 g of water are mixed with 150 g of alcohol (density = 790 kg/m³). What is the specific volume of the resulting mixtures, assuming that the fluids mixed completely?
 A. 0.82 x 10⁻³ cu.m/kg
 B. 0.63 x 10⁻³ cu.m/kg
 C. 0.88 x 10⁻³ cu.m/kg
 D. 1.16x10⁻³ cu.m/kg
 Answer: D
 47. How much does 30 lb_m weigh on the moon? (g_{moon} = 5.47 ft/s²).
 A. 2.0 lbr
 B. 3.4 lbr
 C. 3.2 lbr
 D. 5.096 lbr
 Answer: D
 48. A 10 kg block is raised vertically 3 meters. What is the change in potential energy?
 A. 320 J
 B. 294 J
 C. 350 kg-m²/s²
 D. 350 N-m
 Answer: B
 49. How many cubic meters is 100 gallons of liquid?
 A. 3.7850 cu.m
 B. 0.3785 cu.m
 C. 0.1638 cu.m
 D. 1.638 cu.m
 Answer: B
 50. Steam turbine is receiving 1014 lb_m/hr of steam, determine the horsepower output of the turbine if the work done by steam is 251 Btu/lb_m.
 A. 100 Hp
 B. 200 Hp
 C. 462.7 Hp
 D. 6002.7 Hp
 Answer: A
 51. What is the resulting pressure when one pound of air at 15 psia and 200°F is heated at constant volume to 800°F?
 A. 52.1 psia
 B. 28.6 psia
 C. 15 psia
 D. 36.4 psia
 Answer: B
 52. A bicycle tire has a volume of 600 cm³. It is inflated with carbon dioxide to pressure of 551.43 kPa at 20 °C. How many grams of CO₂ are contained in the tire? R_{CO2} = 0.18896 kJ/kg.K
 A. 5.98 g
 B. 4.63g
 C. 6.43 g
 D. 3.83 g
 Answer: A
 53. The absolute pressure at the bottom of a vertical column of water is 15.5 psia. What is the height of this column?
 A. 22 in.
 B. 12 in
 C. 9.2 in
 D. 9.8
 Answer: A
 54. A water temperature rise of 18 °F in the water cooled condenser is equivalent in °C to:
 A. 7.78°C
 B. 263.56°K
 C. 10°C
 D. -9.44°C
 Answer: C
 55. An oil storage tank contains oil with specific gravity of 0.88 and depth of 20 meters. What is the hydrostatic pressure at the bottom of the tank in kg/cm²?
 A. 1.67
 B. 1.56
 C. 1.76
 D. 1.87
 Answer: C

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56. A vertical column of water will be supported to what height by standard atmospheric pressure?
A. 34 ft
B. 24 ft
C. 36 ft
D. 26 ft
Answer: A
57. The specific weight of liquid is 60 lb/ft³ what is the equivalent to kN/m³?
A. 9.334
B. 9.643
C. 9.249
D. 9.420
Answer: D
58. A cylinder weighs 150 lb. Its cross-sectional area is 40 square inches. When the cylinder stands vertically on one end, what pressure does the cylinder exert on the floor?
A. 14.1 kPa
B. 0.258 bar
C. 58.2 kPa
D. 0.141 bar
Answer: B
59. What is the absolute pressure exerted on the surface of a submarine cruising 300 ft below the free surface of the sea? Assume specific gravity of sea water is 1.03.
A. 133.9 psia
B. 100.7 psia
C. 148.6 psia
D. 103.7 psia
Answer: C
60. Air enters a nozzle steadily at 2.21 kg/m³ and 30 m/s. What is the mass flow rate through the nozzle if the inlet area of the nozzle is 80 cm²?
A. 0.35 kg/s
B. 5.3 kg/s
C. 3.5 kg/s
D. 0.53 kg/s
Answer: D
61. The work required to accelerate an 800-kg car from rest to 100 km/h on a level road:
A. 308.6 kJ
B. 608.3 kJ
C. 806.3 kJ
D. 386 kJ
Answer: A
62. Assuming that there are no heat effects and no friction effects, find the speed of a 3220-lbm body after it falls 778 ft from rest.
A. 422 ft/sec
B. 224 ft/sec
C. 424 ft/sec
D. 424 ft/sec
Answer: B
63. What is the flow rate through a pipe 4 inches in diameter carrying water at a velocity of 11 ft/sec?
A. 430.84 gpm
B. 340.28 gpm
C. 7.18 gpm
D. 39.16 gpm
Answer: A
64. If the specific weight of a liquid is 58.5 lb_f/ft³ per cubic foot, what is the specific volume of the liquid, cm³/g?
A. 0.5321 cm³/g
B. 0.9504 cm³/g
C. 0.6748 cm³/g
D. 1.0675 cm³/g
Answer: D
65. What is the resulting pressure when one pound of air at 0.3 psig and 200 °F is heated at constant volume to 800 °F?
A. 0.572 psig
B. 7.857 psia
C. 28.6 psia
D. 1.2 psig
Answer: C
66. A mixture of 0.4 lb_m of helium and 0.2 lb_m of oxygen is compressed polytropically from 14.7 psia and 60°F to 60 psia according to $n = 1.4$. Determine the final temperature, T₂.
A. 727.7°R
B. 777.2°R
C. 722.7°R
D. 277.7°R
Answer: B
67. During the working stroke of an engine the heat transferred out of the system was 150 kJ/kg of working substances. The internal energy also decreased by 400 kJ/kg of working substance. Determine the work done.
A. 250 kJ/kg
B. 600 kJ/kg
C. 550 kJ/kg
D. 350 kJ/kg
Answer: A
68. Find the density of oil with a specific gravity of 1.6 in g/cm³.
A. 15.68 g/cm³
B. 0.8 g/cm³
C. 99.84 g/cm³
D. 1.6 g/cm³
Answer: D
69. What is the absolute pressure if the gauge pressure is reading 9 bar and the atmospheric pressure is 0.9 bar?
A. 6.3 bar
B. 9.9 bar
C. 7.8 bar
D. 8.1 bar
Answer: B
70. The tank of an air compressor has a volume of 3 ft³ and is filled with air at a temperature of 40 °F. If a gage on the tank reads 150 psig, what is the mass of the air in the tank?
A. 1.78 lbs
B. 2.67 lbs is the answer
C. 2.00 lbs
D. 1.98 lbs
Answer: A
71. What is the mass of acetylene gas, V=0.94 cu.ft., R=59.35 ft.lb/lb °R, T = 90 °F, P= 200 psia
A. 0.816 lb
B. 0.829 lb
C. 0.841 lb
D. 0.852 lb
Answer: B
72. A refrigerating system operates on the reversed Carnot Cycle. The higher temperature of the refrigerant in the system is 120 °F and the lower is 10 °F. The capacity is 20 tons. Neglect losses. Determine the coefficient of performance.
A. 2.732
B. 7.372
C. 5.373
D. 4.273
Answer: D
73. Aluminum has a specific heat of 0.902 J/g x °C. How much heat is lost when a piece of aluminum with a mass of 23.984 g cools from a temperature of 415.0 °C to a temperature of 22.0 °C?
A. 8500 J
B. 80000 J
C. 6000 J
D. 7500 J
Answer: A
74. If the temperature of an air parcel is -20.5 °C, and its density is 0.690 kg/m³, what is the pressure of the air parcel?
A. 40 kPa
B. 60 kPa
C. 50 kPa
D. 70 kPa
Answer: C
75. A 35.0 mL sample of gas is enclosed in a flask at 22 degrees Celsius. If the flask was placed in an ice bath at 0 degrees Celsius, what would the new gas volume be if the pressure is held constant?
A. 34.1 mL
B. 32.39 mL
C. 32.1 mL
D. 33.1 mL
Answer: B
76. The thermal efficiency of a Carnot cycle operating between 170°C and 620°C is closest to:
A. 44%
B. 63%
C. 50%
D. 73%
Answer: C
77. A pressure gage registers 50 psig in a region where the barometer reads 14.8 psia. Find the absolute pressure in kPa.
A. 666.66 kPa
B. 446.66 kPa
C. 556.66 kPa
D. 336.66 kPa
Answer: B
78. Determine the pressure exerted on a diver at 30 m below the free surface of the sea. Assume a barometric pressure of 101 kPa and the specific gravity of sea water is 1.03.
A. 404 kPa
B. 420 kPa
C. 410 kPa
D. 430 kPa
Answer: A
79. An air compressor has an inlet enthalpy of 35 Btu/lb and an exit enthalpy of 70 Btu/lb. The mass flow rate of air is 3 lb/s. If the heat loss is 466.62 Btu/min, find the work input to the compressor.
A. 139.59 hp
B. 159.59 hp
C. 149.59 hp
D. 169.59 hp
Answer: B
80. An automobile tire is inflated to 35 psig at 54 °F. After being driven, the temperature rises to 80 °F. Determine the final gage pressure assuming that the tire is inflexible.
A. 36.51 psig
B. 38.51 psig
C. 37.51 psig
D. 39.51 psig
Answer: C
81. A condenser vacuum gauge reads 600 mm Hg when the barometer reads 760 mm Hg. What is the absolute condenser pressure in bar?
A. 0.0213
B. 0.213
C. 0.061
D. 0.610
Answer: B
82. Water flows in a pipe at the rate of 10 kg/s. If the velocity of flow is 10 m/s, find the pipe diameter.
A. 30.23 mm
B. 38.39 mm
C. 35.68 mm
D. 42.39 mm
Answer: C
83. What is the resulting pressure when one kilogram of air at 104 kPa and 98 °C is heated at constant volume to 450 °C?
A. 202.67 kPa
B. 186.53 kPa
C. 194.67 kPa
D. 198.65 kPa
Answer: A

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84. Determine the degrees of superheat of steam at 101.325 kPa and 170 °C.
 A. 50 °C
 B. 60 °C
 C. 70 °C
 D. 80 °C
 Answer: C
85. Calculate the approximate enthalpy of water at 90 °C.
 A. 366.83 kJ/kg
 B. 386.83 kJ/kg
 C. 376.83 kJ/kg
 D. 396.83 kJ/kg
 Answer: C
86. A Carnot cycle operates between 30 °C and 350 °C. Find the cycle efficiency.
 A. 51.36%
 B. 45.37%
 C. 63.45%
 D. 76.45%
 Answer: A
87. A Carnot cycle has a maximum temperature of 550 °F and minimum temperature of 100 °F. If the heat added is 4200 Btu/min, find the horsepower output of the engine.
 A. 34.53
 B. 44.13
 C. 40.56
 D. 65.40
 Answer: B
88. A Carnot cycle has a sink temperature of 100 °F and a cycle efficiency of 70%. Find the temperature of the heat source.
 A. 1306.70 °F
 B. 1506.70 °F
 C. 1406.70 °F
 D. 1606.70 °F
 Answer: C
89. Fifty kilograms of cooling water per second enter the condenser at 25 °C and leaves at 50 °C. Find the heat carried away by water.
 A. 1234.45 kW
 B. 2340.53 kW
 C. 5233.75 kW
 D. 3140.25 kW
 Answer: C
90. Determine the quality of steam in a vessel containing 2 kg of saturated vapor and 8 kg of saturated liquid.
 A. 100%
 B. 80%
 C. 20%
 D. 60%
 Answer: C
91. One kilogram of air is compressed adiabatically and in a steady-flow manner. The compression efficiency is 80% and the work done on the air is 265 kJ/kg. Compute the heat.
 A. 212 kJ/kg
 B. 0 kJ/kg
 C. 100 kJ/kg
 D. 331.25 kJ/kg
 Answer: B
92. Three-hundred kilojoules of heat flow by conduction from the outside to the inside of a cold storage in one hour. If the temperature and all other conditions are the same, what is the heat flowing through the cold storage room in two hours?
 A. 600 kJ
 B. 300 kJ
 C. 900 kJ
 D. 1,200 kJ
 Answer: A
93. Determine the specific weight of air at 760 mmHg absolute and 22 °C?
 A. 1.014 kg/m³
 B. 1.197 kg/m³
 C. 1.316 kg/m³
 D. 1.266 kg/m³
 Answer: B
94. Two Carnot heat engine operate in series between a source at 527°C and sink at 17°C. The first engine rejects 400 KJ to the second engine. If both engines have the same efficiency. Calculate the source temperature for the second.
 A. 272°C
 B. 94.65°C
 C. 208.66°C
 D. 510°C
 Answer: C
95. A steam turbine receives a steam flow of 1.35 kg/s and delivers 500 KW. The heat loss from the casing is negligible. Find the change of specific enthalpy across the turbine when the velocities at the entrance and exit and the difference in elevation at the entrance and exit are negligible.
 A. -370.37 KJ/kg
 B. -372.37 KJ/kg
 C. -371.37 KJ/kg
 D. -373.37 KJ/kg
 Answer: A
96. A Carnot cycle engine has a sink temperature of 45°C. Its thermal efficiency is 48.20%. The heat rejected is 742 KJ/min. Determine the power output in KW.
 A. 23.87 KW
 B. 11.51 KW
 C. 12.37 KW
 D. 18.33 KW
 Answer: B
97. A pressure gage registers 50 psig in a region where the barometer reads 14.8 psia. Find the absolute pressure in kPa.
 A. 666.66 kPa
 C. 446.66 kPa
- B. 556.66 kPa
 D. 336.66 kPa
 Answer: C
98. Consider 1 kg of air at 32°C that expanded by a reversible polytropic process with $n = 1.25$ until the pressure is halved. Determine the heat transfer. Specific heat at constant volume for air is 0.1786 kJ/kg.K.
 A. 17.02 kJ heat rejected
 B. 17.02 kJ heat added
 C. 7.05 kJ heat rejected
 D. 7.05 kJ heat added
 Answer: B
99. Fifty kilograms of cooling water per second enter the condenser at 25°C and leaves at 50°C. Find the heat carried away by water.
 A. 1234.45 kW
 B. 5233.75 kW
 C. 2340.53 kW
 D. 3140.25 kW
 Answer: B
100. A heat engine has a thermal efficiency of 50%. How much power does the engine produce when heat is transferred at a rate of 10⁹ kJ/hr?
 A. 50 MW
 B. 75 MW
 C. 139 MW
 D. 147 MW
 Answer: C
101. One kilogram of air is compressed adiabatically and in a steady-flow manner. The compression efficiency is 80% and the work done on the air is 265 kJ/kg. Compute the heat.
 A. 212 kJ/kg
 B. 100 kJ/kg
 C. 0 kJ/kg
 D. 331.25 kJ/kg
 Answer: C
102. Three hundred kilojoules of heat flow by conduction from the outside to the inside of a cold storage in one hour. If the temperature and all other conditions are the same, what is the heat flowing through the cold storage room in two hours?
 A. 600 kJ
 B. 900 kJ
 C. 300 kJ
 D. 1,200 kJ
 Answer: A
103. The gain of entropy during isothermal nonflow process of 5 lb of air at 60°F is 0.462 Btu/R. Find the V_1/V_2 .
 A. 3.85
 B. 0.296
 C. 1.0
 D. 0.259
 Answer: D
104. Air at 300°K and 200 kpa is heated at constant pressure to 600°K. Determine the change of internal energy.
 A. 245.58 KJ/kg
 B. 235.58 KJ/kg
 C. 225.58 KJ/kg
 D. 215.58 KJ/kg
 Answer: D
105. An insulated rigid tank initially contains 1.5 lb of helium at 80°F and 50 psia. A paddle wheel with power rating of 0.02 hp is operated within the tank for 30 min. Determine the final temperature.
 A. 159.22°F
 B. 235.58°F
 C. 179.22°F
 D. 189.22°F
 Answer: C
106. A heat source at 800 deg K losses 2000 of heat to a sink at 500 deg K. Determine the entropy generated during this process.
 A. 1.5 KJ/K
 B. 2.5 KJ/K
 C. -2.5 KJ/K
 D. 4 KJ/K
 Answer: A
107. Helium gases is compressed in an adiabatic compressor from an initial state of 14 psia and 50 deg F to a final temperature of 320 deg F in a reversible manner. Determine the exit pressure of Helium.
 A. 38.5 psia
 B. 40.5 psia
 C. 42.5 psia
 D. 44.5 psia
 Answer: B
108. A 50 kg block of iron casting at 500K is thrown into a large lake that is at a temperature of 258 deg K. The iron block eventually reaches thermal equilibrium with the lake water. Assuming average specific heat of 0.45 KJ/kg-K for the iron, determine the entropy generated during this process.
 A. -12.65 KJ/K
 B. 16.97 KJ/K
 C. 4.32 KJ/K
 D. 6.32 KJ/K
 Answer: A
109. A heat engine receives heat from a source at 1200 deg K at a rate of 500 KJ/s and rejects the waste heat to a medium at 300 deg K. The power output of the heat

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- engine is 180 KW. Determine the irreversibility rate for this process.
A.190 KW C.200 KW
B.195 KW D.205 KW
Answer: B
110. A dealer advertises that he has just received a shipment of electric resistance heaters for residential buildings that have an efficiency of 100 percent. Assuming an indoor temperature of 21 deg C and outdoor temperature of 10 deg C, determine the second law efficiency of these heaters.
A.8.74% C.3.74%
B.6.74% D.4.74%
Answer: C
111. A rigid tank contains 2 kmol of N_2 and 6 kmol of CO_2 gases at 300 Deg K and 115 Mpa. Find the tank volume using ideal gas equation.
A.7.33 m^3 C.3.33 m^3
B.5.33 m^3 D.1.33 m^3
Answer: D
112. A spherical balloon with a diameter of 6 m is filled with helium at 20 deg C and 200 kpa. Determine the mole number.
A.9.28 Kmol C.11.28 Kmol
B.10.28 Kmol D.13.28 Kmol
Answer: A
113. The air in an automobile tire with a volume of 0.53 ft^3 is at 90 deg F and 20 psig. Determine the amount of air that must be added to raise the pressure to the recommended value of 30 psig. Assume the atmospheric pressure to be 14.7 psia and the temperature and the volume to remain constant.
A.0.026 lb C.0.066 lb
B.0.046 lb D.0.086 lb
Answer: A
114. A rigid tank contains 20 lbm of air at 20 psia and 70 deg F. More air is added to the tank until the pressure and temperature rise to 35 psia and 90 deg F, respectively. Determine the amount of air added to the tank.
A.11.73 lb C.15.73 lb
B.13.73 lb D.17.73 lb
Answer: B
115. A rigid tank contains 5 kg of an ideal gas at 4 atm and 40 deg C. Now a valve is opened, and half of mass of the gas is allowed to escape. If the final pressure in the tank is 1.5 atm, the final temperature in the tank is:
A.-38 deg C C.40 deg C
B.-30 deg C D.53 deg C
Answer: A
116. The pressure of an automobile tire is measured to be 200 kpa(gage) before the trip and 220 kpa(gage) after the trip at a location where the atmospheric pressure is 90 kpa. If the temperature of the air in the tire before the trip is 25 deg C, the air temperature after the trip is:
A.45.6 deg C C.27.5 deg C
B.54.8 deg C D.26.7 deg C
Answer: A
117. Water is boiling at 1 atm pressure in a stainless pan on an electric range. It is observed that 2 kg of liquid water evaporates in 30 min. The rate of heat transfer to the water is:
A.2.97 KW C.2.51 KW
B.0.47 KW D.3.12 KW
Answer: C
118. An elastic sphere containing gas at 120 kPa has a diameter of 1.0 m. Heating the sphere causes it to expand to a diameter of 1.3 m. During the process the pressure is proportional to the sphere diameter. Calculate the work done by the gas in KJ.
A.41.8 C.87.5
B.50.6 D.35.4
Answer: C
119. An ideal gas with molecular weight of 7.1 kg/kg mol is compressed from 600 kPa and 280 deg K to a final specific volume of 0.5 m^3/kg . Calculate the work of compression in KJ/kg?
A.32.8 C.35.6
B.33.3 D.28.7
Answer: B
120. A one cubic container contains a mixture of gases composed of 0.02 kg-mol of oxygen and 0.04 kg-mol of helium at a pressure of 220 kPa. What is the temperature of this ideal gas mixture in degrees Kelvin?
A.441 C.400
B.450 D.350
Answer: A
121. A 12 DC electrical motor draws a current of 15 amps. How much work in KJ does this motor produce over a 10-minute period of operation?
A.108.0 C.216.0
B.318.2 D.129.6
Answer: A
122. An insulated box containing helium gas falls from a balloon 4.5 km above the earth's surface. Calculate the temperature rise in deg C of the helium when box hits the ground.
A.15.2 C.25.3
B.14.1 D.12.6
Answer: B
123. Consider two Carnot heat engines operating in series. The first engine receives heat from the reservoir at 2400 deg K and rejects the waste heat to another reservoir at temperature T. The second engine receives heat by the first one, convert some of it to work, and rejects the rest to a reservoir at 300 deg K. If thermal efficiencies of both engines are the same, determine the temperature T.
A.849 deg K C.763 deg K
B.578 deg K D.978 deg K
Answer: A
124. A Carnot cycle operates between the temperature limits of 300 deg K and 1500 deg K, and produces 600 KW of net power. The rate of entropy change of the working fluid during the heat addition process is:
A.0 C.0.5 KW/K
B.0.4 KW/K D.2.0 KW/K
Answer: C
125. Helium gas in an ideal Otto cycle is compressed from 20 deg C and 2 L to 0.25 L and its temperature increases by an additional 800 deg C during the heat addition process. The temperature of helium before the expansion process is:
A.1700C C.1240C
B.1440C D.880C
Answer: A
126. A heat engine receives heat from a source at 1200 deg K at a rate of 500 KJ/s and rejects the waste heat to a sink at 300 deg K. If the power output of the engine is 200 KW, the second law efficiency of this heat engine is:
A.35% C.53%
B.75% D.40%
Answer: C
127. A water reservoir contains 100,000 kg of water at an average elevation of 60 m. The maximum amount of electric power that can be generated from this water is:
A.8 KWh C.1630 KWh
B.16 KWh D.58,800 KWh
Answer: B
128. A house is maintained at 22 deg C in winter by electric resistance heaters. If the outdoor temperature is 5 deg C, the second law efficiency of the resistance heaters is:
A.0% C.34%
B.77% D.5.8%
Answer: D
129. Determine the temperature for which a thermometer with degrees Fahrenheit is numerically twice the reading of the temperature in degrees Celsius.
A. -24.6 C. 160
B. 320 D. -12.3
Answer: B
130. During takeoff in a spaceship, an astronaut is subjected to acceleration equal to 5 times the pull of the earth's standard gravity. If the astronaut is 180 lb_m and the takeoff is vertical, what force does he exert on the seat?
A. 4810.9 N C. 8829 N
B. 4414.5 N D. 9620 N
Answer: A

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131. A pressure cooker operates by cooking food at a higher pressure and temperature than is possible at atmospheric conditions. Steam is contained in the sealed pot, with vent hole in the middle of the cover, allowing steam to escape. The pressure is regulated by covering the vent hole with a small weight, which is displaced slightly by escaping steam. Atmospheric pressure is 100 kPa, the vent hole area is 7-mm², and the pressure inside should be 250 kPa. What is the mass of the weight?
A. 0.107 kg
B. 1.05 kg
C. 1.75 kg
D. 0.1783 kg
Answer: A
132. A barometer can be used to measure an airplane's altitude by comparing the barometric pressure at a given flying altitude to that on the ground. Determine an airplane's altitude if the pilot measures the barometric pressure at 700 mm-Hg, the ground reports it at 758 mm-Hg, and the average air density is 1.19 kg/m³. $g = 9.8 \text{ m/s}^2$.
A. 987 m
B. 633 m
C. 788 m
D. 663 m
Answer: D
133. A mixture of 0.4 lb_m of helium and 0.2 lb_m of oxygen is compressed polytropically from 14.7 psia and 60°F to 60 psia according to $n = 1.4$. Determine the polytropic work.
A. 139 Btu
B. 239 Btu
C. 339 Btu
D. 539 Btu
Answer: A
134. A turbine receives 150 lb_m/sec of air at 63 psia and 2450°R and expands it polytropically to 14.7 psia. The exponent n is equal to 1.45 for the process. Determine the power.
A. 52,343.16 BTU/sec
B. 53,343.16 kW
C. 53,343.16 HP
D. 53,343.16 ft-lb/sec
Answer: A
135. An adiabatic tank containing air is used to power an air turbine during times of peak power demand. The tank has a volume of 500 m³ and contains air at 1000 kPa and 500°K. Determine the mass remaining when the pressure reaches 100 kPa.
A. 276.37 kg
B. 672.73 kg
C. 772.73 kg
D. 227.73 kg
Answer: B
136. An adiabatic tank containing air is used to power an air turbine during times of peak power demand. The tank has a volume of 500 m³ and contains air at 1000 kPa and 500°K. The temperature at this instant.
A. -14.03°C
B. 14.03°K
C. 14.03°F
D. 14.03°R
Answer: A
137. How many hours would it take to boil down 1.2 kg of water in a kettle if a constant supply of heat at 1.25 kW is supplied to the kettle?
A. 36 hrs
B. 52 hrs
C. 18 hrs
D. 0.6 hrs
Answer: D
138. During an experiment on Charles Law, the volume of gas trapped in the apparatus was 10000 mm³ when the temperature was 18°C. The temperature of the gas was then raised to 85°C. Determine the new volume of gas trapped in the apparatus if the pressure exerted on the gas remained constant.
A. 12302.41 mm³
B. 70833.33 mm³
C. 8128.49 mm³
D. 2117.64 mm³
Answer: A
139. At a pressure of 60°F, A motorbike tire is inflated to 33psig. As it is driven along the C-5 road, the temperature rise to 76°F. Assuming the volume remains constant. Determine the final gauge pressure.
A. 34.47 psig
B. 35.00 psig
C. 49.17 psig
D. 34.30 psig
Answer: A
140. Steam enters a turbine stage with an enthalpy of 3700 KJ/kg and a velocity of 80 m/s and leaves with an enthalpy of 2864 KJ/kg with a velocity of 128m/s. If the rate of a steam flow through the turbine is 0.44 kg/s, what is the work done in KW?
A. 365 kW
B. 366.0 kW
C. 365.64 kW
D. 366.50 kW
Answer: C
141. A Carnot cycle uses nitrogen ($k = 1.399$) as the working substance. The heat supplied is 54 kJ and the adiabatic expansion ratio is 10. Determine the heat rejected.
A. 10 kJ
B. 21.6 kJ
C. 32.4 kJ
D. 54 kJ
Answer: B
142. A tank contains 20 kg of air at 200 kPa (gauge) and 23°C. During heating process the temperature of air rises. For safety purposes a technician installed a relief-type valve so that pressure of air inside the tank never exceed 260 kPa (gauge). At what air temperature the relief valve will start releasing air?
A. 112°C
B. 82°C
C. 92°C
D. 102°C
Answer: B
143. During a reversible process there are abstracted 317 kJ/s from 1.134 kg/s of a certain gas while the temperature remains constant at 26.7°C. For this gas $c_p = 2.232$ and $c_v = 1.713 \text{ kJ/kg.K}$. The initial pressure is 586 kPa. Determine the final volume flow rate.
A. 0.301 m³/s
B. 0.5 m³/s
C. 0.03 m³/s
D. 0.05 m³/s
Answer: D
144. In a process carried out on a closed system, the work transferred into the system was 4200KJ and the increase in the total energy of the system was 3500KJ. Determine the heat transferred.
A. -700KJ
B. -7700KJ
C. 7700KJ
D. 700KJ
Answer: A
145. Determine the atmospheric pressure at a location where the barometric reading is 740mm hg and the gravitational acceleration is $g = 9.81 \text{ m/s}^2$. Assume the temperature of mercury to be 10°C, at which its density is 13,570 kg/m³.
A. 99.7 KPa
B. 101.325 KPa
C. 98.5 KPa
D. 97.5 KPa
Answer: C
146. A fluid in a cylinder is at a pressure of 700KN/m². It is expanded at a constant pressure from a volume of 0.28m³ to a volume of 1.68m³. Determine the work done.
A. 960 KJ
B. 955 KJ
C. 1000 KJ
D. 980 KJ
Answer: D
147. An iron block weights 7 Newtons and has a volume of 200 cubic centimeters. What is the density of the block?
A. 3465 kg/m³
B. 3565 kg/m³
C. 1255 kg/m³
D. 2550 kg/m³
Answer: B
148. If the density of the gas is 0.003 slugs per cubic foot, what is the specific weight of the gas?
A. 9.04 N/m³
B. 15.2 N/m³
C. 76.3 N/m³
D. 98.2 N/m³
Answer: B
149. The specific gravity of mercury relative to water is 13.55. What is the specific weight of mercury? (The specific weight of water is 62.4 lb_f/ft³ per cubic foot.)
A. 82.2 kN/m³
B. 102.3 kN/m³
C. 132.9 kN/m³
D. 150.9 kN/m³
Answer: C
150. If the specific weight of a liquid is 58.5 lb_f/ft³ per cubic foot, what is the specific volume of the liquid?
A. 0.5321 cm³/g
B. 0.6748 cm³/g
C. 0.9504 cm³/g
D. 1.0675 cm³/g
Answer: D
151. Which of the following are not units of pressure?
A. Pa
B. bars
C. kg/m.s² → is the ansu
D. kg/m²
Answer: D
152. A cylinder weights 150 lb_f. Its cross-sectional area is 40 square inches. When the cylinder stands vertically on one end, what pressure does the cylinder exert on the floor?
A. 14.1 kPa
B. 25.8 kPa
C. 63.2 kPa
D. 89.7 kPa
Answer: B
153. What pressure is a column of water 100 centimeters high equivalent to?
A. 9810 dyne/cm²
C. 0.1 bars

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- B.9810 N/m² D. 0.1 atm
 Answer: B
154. One hundred milliliters of water in a plastic bag of negligible mass is to be catapulted upwards with an initial acceleration of 20.0 m/s². What force is necessary to do this? Assume that gravity is 9.81 m/s² and the density of water is 1 g/cm³.
 A.2.00 N C. 15.0 N
 B.2.98 N D. 2.00 Kn
 Answer: B
155. Air has a specific heat of 1 kJ/kg.K. If 2 BTU of energy is added to 100 g of air, what is the change in air temperature?
 A.10.0 °C C. 44.1 °C
 B.21.1 °C D. 88.2 °C
 Answer: B
156. Air has specific heat (c_p) of 1 kJ/kg.K. If 100 g of air are heated with 1500 W heater, which of the following occurs?
 I. The air heats up at a rate of 15 K/s.
 II. The air reaches a final temperature of 15000 K.
 III. The air undergoes a nonisentropic process.
 A.I only C. I, II, and III
 B.I and II D. I and III
 Answer: D
157. In a constant temperature, closed system process, 100 BTU of heat is transferred to the working fluid at 100 °F. What is the change in entropy of the working fluid?
 A.0.18 kJ/K C. 0.34 kJ/K
 B.0.25 kJ/K D. 0.57 kJ.k
 Answer: C
158. If a 1/3 horsepower pump runs for 20 minutes, what is the energy used?
 A.0.06 ergs C. 0.30 MJ
 B.0.25 kW D. 0.11 kW.h
 Answer: C
159. A machine is capable of accelerating a 1 kg mass at 1 m/s² for 1 minute. The machine runs at 60 rpm. What is the power output of the machine?
 A.1 erg C. 1 J
 B.1 cal D. 1 W
 Answer: D
160. A power of 6 kW is supplied to the motor of a crane. The motor has an efficiency of 90%. With what constant speed does the crane lift an 800 lb weight?
 A.0.09 cm/s C. 0.98 cm/s
 B.0.32 cm/s D. 1.52 cm/s
 Answer: D
161. An engine has an efficiency of 26%. It uses 2 gallons of gasoline per hour. Gasoline has a heating value of 20,500 BTU/lb_m and a specific gravity of 0.8. What is the power output of the engine?
 A.0.33 kW C. 26.0 kW
 B.20.8 kW D. 41.7 kW
 Answer: B
162. In a Carnot cycle engine, the volume after adiabatic compression is 8.5% of that before the compression. The sink temperature is 30°C. Determine: thermal efficiency.
 A. 60.71% C. 61.6%
 B. 62.7% D. 63.7%
 Answer: B
163. Water is being in a closed pan on top of a range while being stirred by a paddle wheel. During the process, 30 KJ of heat is transferred to the water, and 5 KJ of heat is lost to the surrounding air. The paddle-wheel work amounts to 500 N-m. Determine the final energy of the system if its initial energy is 10 KJ.
 A.35.5 KJ C.25.5 KJ
 B.45.5 KJ D.14.5 KJ
 Answer: A
164. Consider 1 kg of air at 32°C that expanded by a reversible polytropic process with $n = 1.25$ until the pressure is halved. Determine the heat transfer. Specific heat at constant volume for air is 0.1786 kJ/kg.K.
 A. 17.02 kJ heat rejected C. 17.02 kJ heat added
 B. 7.05 kJ heat rejected D. 7.05 kJ heat added
 Answer: C
165. A Carnot cycle is represented by a rectangle in a T-s diagram that operates between temperature limits of 300 °K and 650 °K. Inscribed within a rectangle is a ellipse of maximum major and minor axes, represents a cycle and

- operating at the same temperature limits. Considering that the major axis of the ellipse is two times that of its minor axis. Determine the thermal efficiency of the cycle represented by an ellipse.
 a) 44.88 % c) 48.48 %
 b) 43.66 % d) 46.36 %
 Answer: A
166. If an airplane is flying at an altitude of 5 800 ft, what is the approximate atmospheric pressure at the said altitude?
 a) 12.34 psi c) 14.7 psi
 b) 13.24 psi d) 14.32 psi
 Answer: A
167. Air at 1 MPaa and 310 °C is expanded to 250 kPaa in accordance with the relation $pV^{1.25} = C$. Determine the work done.
 a) + 162.11 kJ/kg c) - 162.11 kJ/kg
 b) + 126.11 kJ/kg d) - 126.11 kJ/kg
 Answer: A
168. A container filled with helium is dropped 3000 m above the ground, find the change of temperature?
 a) 12.43 °C c) 9.43 °C
 b) 15.43 °C d) 8.43 °C
 Answer: C
169. A 3153-lb car is accelerated from 32 fps to 55 fps in 10 seconds. Determine the work done, in Btu.
 a) 125.92 c) 192.52
 b) 152.92 d) 129.52
 Answer: A
170. A 2-kg steam at 2.5 MPaa and 260 °C undergoes a constant pressure until the quality becomes 70 %. Determine the heat rejected, in Btu. At 2.5 MPaa and 260°C: $h = 2907.4$ kJ/kg; and at 2.5 MPaa and 70 % quality: $h_f = 962.11$ kJ/kg and $h_g = 2803.1$ kJ/kg.
 a) 1244.7 Btu c) 1424.7 Btu
 b) 1442.7 Btu d) 1274.4 Btu
 Answer: A
171. Helium is used in a Carnot engine where the volumes beginning with the constant temperature heat addition are $V_1 = 0.3565$ m³, $V_2 = 0.5130$ m³, $V_3 = 8.0$ m³, and $V_4 = 5.57$ m³. Determine the thermal efficiency if $k = 1.666$.
 a) 83.95 % c) 89.35 %
 b) 85.93 % d) 85.39 %
 Answer: A
172. The temperature inside a furnace is 320 °C and temperature of the outside is - 10 °C. What is the temperature difference in °R.
 a) 495 c) 945
 b) 594 d) 596
 Answer: B
173. A boiler installed where the atmospheric pressure is 752 mm Hg has a pressure of 12 kg/cm². Find the absolute pressure, in MPa.
 a) 1277.05 kPaa c) 1727.05 kPaa
 b) 1772.05 kPaa d) 1572.07 kPaa
 Answer: A

NOTE: STUDY PROBLEMS AND ELEMENTS IN PIPE AVAILABLE IN THE OFFICE.

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