VERY IMPORTANT PROBLEMS 03 (VIP 03 - REF/AIRCON)

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

1. The refrigerant volume flow rate at the entrance of compressor were obtained from a test on a twin cylinder, single acting 15 cm x 20 cm, 320 rpm compressor ammonia refrigerating a plant to be 33 L/s. Determine the volumetric efficiency of the compressor.
   A. 77.65% C. 97.6 TR
   B. 87.6% D. 65.65%
   Answer: B
2. Compute the humidity ratio of air at 70% relative humidity and 25°C when the barometric pressure is 101.325 kPa from steam tables. $P_{sat\ at\ 34°C}$ = 3.169 Kpa
   A. 0.014 kg water vapor/kg dry air
   B. 0.14 kg water vapor/kg dry air
   C. 1.4 kg water vapor/kg dry air
   D. 0.0014 kg water vapor/kg dry air
   Answer: A
3. Compute the air flow in ft^3/min of mechanical ventilation required to exhaust an accumulation of refrigerant due to leaks of the system capable of revolving air from the machinery room for a mass of 4 kg refrigerant.
   A. 200 C. 220
   B. 210 D. 230
   Answer: A
4. Compute the free-aperture cross-section in m^2 for the ventilation of a machinery room if the mass of refrigerant is 9 kg.
   A. 0.314 C. 0.514
   B. 0.414 D. 0.614
   Answer: B
5. Wet material containing 220% moisture (dry basis) is to be dried at the rate of 1.5 kg/s in a continuous dryer to give a product containing 10%(dry basis). Find the moisture removed, kg/hr.
   A. 3543.75 kg/hr C. 3563.75 kg/hr
   B. 3513.75 kg/hr D. 3563.75 kg/hr
   Answer: A
6. Copra enters a dryer containing 70% moisture and leaves at 7% moisture. Find the moisture removed on each pound of solid in final product.
   A. 6.258 lb C. 4.258 lb
   B. 1.258 lb D. 2.258 lb
   Answer: D
7. A refrigeration system consumed 28,800 kw-hr per month of energy. There are 20% of energy is lost due to cooling system of compressor and motor efficiency is 90%. If COP of the system is 6, find the tons of refrigeration of the system.
   A. 43.15 TR C. 49.15 TR
   B. 46.15 TR D. 41.15 TR
   Answer: C
8. A 23 tons refrigeration system has a heat rejected of 100 kW. Find the energy efficiency ratio of the system.
   A. 13.42 C. 15.42
   B. 14.42 D. 16.42
   Answer: B
9. If the energy efficiency ratio of the refrigeration system is 12.6, what is the COP of the system?
   A. 3.69 C. 5.92
   B. 4.23 D. 6.83
   Answer: A
10. A refrigeration plant is rated at 15 tons capacity. How many pounds of air per hour will it cool from 70 to 90°F at constant pressure.
    A. 50,000 lb/hr C. 52,000 lb/hr
    B. 37,500 lb/hr D. 45,000 lb/hr
    Answer: B
11. A basic refrigeration cycle requires 25 kW when operating at a condenser temperature of 70 °C and a COP of 3.50. Determine the sink temperature.
    A. -8.22 °C C. -10.22 °C
    B. -12.22 °C D. -6.22 °C
    Answer: D
12. An ice plant produces 15 cm x 5 cm x 100 cm ice block using brine at -12°C. What is the approximate freezing time per block?
    A. 11.5 hrs. C. 13.3 hrs.
    B. 15.5 hrs. D. 17.5 hrs.
    Answer: C
13. A cold storage plant has an average wall gain load of 11 KW and air change head of 5 KW. The plant is used to cool 18.6 MT of product (c = 3.85 KJ/kg °C) from 30°C to 40°C in 24 hrs. If the plant operates 18hrs.per day, what is the ref. capacity?
    A. 10.1 TR C. 11.5 TR
    B. 12.6 TR D. 13.5 TR
    Answer: D
14. Re-circulated air of 10 kg/s with 53 KJ/ kg dry air enthalpy and outside air of 4 kg/s with 90 KJ/kg dry air enthalpy enters the conditioning unit. Determine the air conditioning capacity of air conditioning apparatus if supply enthalpy to conditioned space is 42 dry air.
    A. 154 KW C. 204 KW
    B. 302 KW D. 4. 484 KW
    Answer: B
15. 30 kg/s of dry air enters an adiabatic drying chamber at 88°C and with a humidity ratio of 0.16 kg/kg d.a. The exhaust air leaves the drying chamber at 40°C. What is the rate of water removal in the drying chamber?
    At 40°C, Psat. = 7.375 kPa; at 88°C, hg = 2656.9 KJ/kg
    A. 0.24 kg/s C. 0.38 kg/s
    B. 0.46 kg/s D. 0.58 kg/s
    Answer: D
16. Compute the specific volume of an air-vapor mixture in cubic meters pre kilogram of dry air when the following conditions prevail : t = 40°C, w = 0.015 kg/kg, and P_t = 100 kPa.
    A. 0.99 m^3/kg C. 0.79 m^3/kg
    B. 0.89 m^3/kg D. 0.69 m^3/kg
    Answer: A
17. Compute the humidity ratio of air considering the density at 27°C and 98 kPa is 1.32 kg/m^3.
    A. 0.34 kg_{vapor} / kg_{air} C. 0.35 kg_{vapor}/kg_{air}
    B. 0.43 kg_{vapor} / kg_{air} D. 0.53 kg_{vapor}/kg_{air}
    Answer: C
18. If the actual COP is 5.0, the indicated hp/ton of refrigeration is.
    A. 4.71 HP/TR C. 0.889 HP/TR
    B. 24.26 HP/TR D. 0.94 HP/TR
    Answer: D
19. An evaporator has a temperature of 3°C with the entrance enthalpy of 352.75 KJ/kg. At 3°C hf = 319.56 KJ/kg and hg = 642.45 KJ/kg. Find the equality after the expansion.
    A. 16.27% C. 21.48%
    B. 15.67% D. 10.28%
    Answer: D
20. A refrigerant compressor has a theoretical piston displacement of 8.04 m^3/s. The refrigerant enters the compressor with a density of 16 kg/m^3. The enthalpy of the refrigerant increases by 110 KJ/kg across the evaporator. What is the refrigerating capacity of the system?
    A. 10 TR C. 15 TR
    B. 20 TR D. 25 TR
    Answer: B
21. An ice plant produces 20 tons of ice per day at – 16°C from water at 25°C. If miscellaneous losses are 12% of the freezing and chilling load. Calculate the refrigerating capacity of the plant in TR.
    A. 21.35 TR C. 43.12 TR
    B. 31.5 TR D. 36.3 TR
    Answer: B
22. A Carnot refrigeration system operates at T_{max} / T_{min} = 1:5. Find the KW per ton of refrigeration.
    A.1.91 C.1.76
    B.2.15 D.1.55
    Answer: C
23. A water cooler uses 50 lb/hr of melting ice to cool running water from 80°F to 42°F. Based on the inside coil area, U_1 = 110 Btu/hr-ft^2-F. Find the gpm of water cooled.
    A.0.10 GPM C.0.38 GPM
    B.0.21 GPM D.0.45 GPM
    Answer: C
24. An auditorium seating 1500 people is to be maintained at 80°F dry bulb and 65°F wet bulb temperature when outdoor air is at 91°F dry bulb and 75° F wet bulb. Solar heat load is 110,000 Btu/hr and supply air is at 60°F, determine the amount of supply air.
    A.93,229.17 lb/hr C.73,229.17 lb/hr
    B.83,229.17 lb/hr D.63,229.17 lb/hr
    Answer: A

25. At 35% solution leaves the absorber and 30% solution enters the absorber. The heat removed from the absorber by cooling water is 547.6 Btu and ammonia is superheated by 10^0. Find the pound per pound of ammonia gas from the evaporating coils.
A.11 C.13
D.14 D.12
Answer: C

26. Consider a refrigeration whose 40 watts light bulb remains on continuously as a result of a malfunction of the switch. If the refrigerator has a COP of 1.3 and the cost of electricity is 8 cents per kw-hr, determine the increase in the energy consumption of the refrigerator and its cost per year if the switch is not fixed.
A.P49.59 C.P45.59
B.P47.59 D.P43.59
Answer: A

27. A 75 hp motor that has an efficiency of 91% is worn out and is replaced by a high-efficiency motor that has an efficiency of 95.4%. Determine the reduction in heat gain of the room due to higher efficiency under full-load conditions.
A.2.24 KW C.2.64 KW
B.2.44 KW D.2.84 KW
Answer: B

28. A household refrigerator that has a power input of 450 watts and a COP of 2.5 is to cool five large watermelons, 10 kg each, to 8 deg C. If the watermelons are initially at 20 deg C, determine how long will take for the refrigerator to cool them. The watermelons can be treated as water whose specific heat is 4.2 KJ/kg-^{0}K.
A.2220 seconds C.2240 seconds
B.2230 seconds D.2250 seconds
Answer: C

29. When a man returns to his wall-sealed house on a summer day, he finds that the house is at 32 deg C. He returns on the air conditioner which cools the entire house to 20 deg C in 15 minutes. If COP is 2.5, determine the power drawn by the airconditioner. Assume the entire mass within the house is 800 kg of air for which c_v = 0.72 KJ/kg-K$_1c_p$ = 1.0 KJ/kg-K
A.1.072 KW C.3.072 KW
B.2.072 KW D.4.072 KW
Answer: C

30. A supply of 50 kg chicken at 6 deg C contained in a box is to be frozen to -18 deg C in a freezer. Determine the amount of heat that needs to be removed. The latent heat of the chicken is 247 KJ/kg, and its specific heat is 3.32 KJ/kg-C above freezing and 1.77 KJ/kg-C below freezing. The container box is 1.5 kg, and the specific heat of the box material is 1.4 KJ/kg-C. Also the freezing temperature of chicken is -2.8 deg C.
A.15,206.4 KJ C.15,156 KJ
B.50.4 KJ D.1,863KJ
Answer: A

31. A classroom that normally contains 40 people is to be air-conditioned with window air-conditioning units of 5 KW cooling capacity. A person at rest may be assumed to dissipate heat at a rate of about 360 KJ/hr. These are 10 light bulbs in the room, each with a rating of 100 watts. The rate of heat transfer to the classroom through the temperature of 21 deg C, determine the number of window air-conditioning units required.
A.1 unit C.3 units
B.2 units D.4 units
Answer: B

32. In order to cool 1 ton (1000 kg) of water at 20 deg C in an insulated tank, a person pours 80 kg of ice at -5 deg C into the water. Determine the final equilibrium temperature in the tank. The melting temperature and the heat of fusion of ice at atmospheric pressure are 0 deg C and 333.7 KJ/kg, respectively.
A.12.43 deg C C.16.43 deg C
B.14.43 deg C D.18.43 deg C
Answer: A

33. A thermoelectric refrigerator that resembles a small ice chest is powered by a car battery, and has a COP of 0.10. If the refrigerator cools a 0.350 L canned drink from 20 deg C to 40 deg C I 30 min, determine the average electric power consumed by the thermoelectric refrigerator.
A.130 W C.120 W
B.110 W D.140 W
Answer: A

34. A Carnot refrigerator operates in a room in which the temperature is 25°C and consumes 2 kW of power when operating. If the food compartment of the refrigerator is to be maintained at 3°C, determine the rate of heat removal from the food compartment.
A. 1504.8 kJ/min C. 12.86kJ/min
B. 1625 kJ/min D. 9.57 kJ/min
Answer: A

35. A household refrigerator with EER 8.0 removes heat from the refrigerated space at a rate of 90 kJ/min. Determine the rate of heat transfer to the kitchen air.
A. 101.25 kJ/min C. 63.05 kJ/min
B. 128.46 kJ/min D. 80 kJ/min
Answer: B

36. An air-conditioning system is used to maintain a house at 75°F when the temperature outside is 95°F. The house is gaining heat through the walls and windows at a rate of 1250 Btu/min, and the heat generation rate within the house from people, lights, and appliances amounts to 350 Btu/min. Determine the minimum power input required for this air-conditioning system.
A. 10.06 hp C. 1.36 hp
B. 1.41 hp D. 7.94 hp
Answer: B

37. A refrigeration system is to cool bread loaves with an average mass of 450 g from 22°C to −10°C at a rate of 500 loaves per hour by refrigerated air. Taking the average specific and latent heats of bread to be 2.93 kJ/kg.°C and 109.3 kJ/kg, respectively, determine the product load.
A. 541.7 kJ/min C. 351.6 kJ/min
B. 761.5 kJ/min D. 409.9 kJ/min
Answer: B

38. A house that was heated by electric resistance heaters consumed 1200 kWh of electric energy in a winter month. If this house were heated instead by a heat pump that has an average performance factor, PF of 2.4, determine how much money the homeowner would be saved that month. Assume a price of 0.085$/kWh for electricity.
A. $42.5 C. $59.50
B. $102 D. $97.75
Answer: C

39. An ammonia simple saturation cycle operates with a suction pressure of 291.6 kPa and a condenser pressure of 1204 kPa develops 15 tons of refrigeration. Determine the theoretical horsepower of the compressor.The following enthalpies have been found: condenser entrance = 1653 kJ/kg, exit = 346.6 kJ/kg; compressor entrance = 1450.2 kJ/kg, exit = 1653 kJ/kg.
A. 7.23 hp C. 13 hp
B. 15 hp D. 8.23 hp
Answer: C

40. An ammonia ice plant operates between a condenser temperature of 35°C and evaporator of −15°C. It produces 10 metric tons of ice per day from water at 30°C to ice at −5°C. Assuming simple saturation cycle, determine the horsepower of the motor if the adiabatic efficiency of the compressor η_k = 0.85 and mechanical efficiency η_m = 0.95. The specific heat of ice is 2.094 kJ/kg.°C and the latent heat is 335 kJ/kg.
From the table for ammonia the following enthalpies are: condenser entrance = 1703 kJ/kg, exit = 366.1 kJ/kg; compressor entrance = 1443.9 kJ/kg, exit = 1703 kJ/kg
A. 17.68 hp C. 18.61 hp
B. 15.5 hp D. 21.9 hp
Answer: D

41. A Freon 22 air conditioning under standard operating conditions of 35°C condensing and 5°C evaporating temperatures. The volume flow rate entering the compressor is 23.72 L/s Determine the refrigerating capacity if the refrigerating effect is 164 kJ/kg. From the table for R22 the specific volume at the compressor entrance is 40.36 L/kg.
A. 339.3 TR C. 79.3 TR
B. 96.4 TR D. 27.4 TR
Answer: D

42. The refrigerant volume flow rate at the entrance of compressor were obtained from a test on a twin cylinder, single acting 15 cm x 20 cm, 320 rpm compressor

ammonia refrigerating plant to be 33 L/s. Determine the volumetric efficiency of the compressor.
A. 77.65% C. 87.6%
B. 97.6 TR D. 65.65%
Answer: C

43. A vapor compression refrigeration system is designed to have a 80 tons refrigerating of refrigeration. Its actual COP is 4 and 30 percent of the power supplied to the compressor is lost in the form of friction and cylinder losses. Determine condenser cooling water required for a temperature rise of 10°C.
A. 5.63 kg/s C. 7.82 kg/s
B. 4.47 kg/s D. 9.0 kg/s
Answer: C

44. A twin cylinder ammonia compressor with volume displacement of 14,726 cm^3 operates at 300 rpm. Condenser and evaporator pressure are 1200 kPa and 227 kPa respectively. Specific volume of refrigerant at the entrance of compressor is 528.26 L/kg. Compression process is polytropic with n = 1.20 and clearance factor of compressor is 2 percent. Determine horsepower required.
A. 60 hp C. 70 hp
B. 80 hp D. 90 hp
Answer: B

45. A reversed Carnot cycle has a refrigerating COP of 2.5. Determine the ratio T_H/T_L?
A. 1.4 C. 1.5
B. 1.25 D. 1.2
Answer: A

46. Three thousand cubic feet per minute of air are circulated over an air-cooled condenser. If the load on the condenser is 64,800 Btu/hr, compute the temperature rise of the air passing over the condenser. Specific volume of standard air (13.34 ft^3/lb).
A. 10°F C. 15°F
B. 20°F D. 25°F
Answer: B

47. Saturated vapor ammonia at −16°C (h_7 = 1442.60 kJ/kg) leaves the evaporator and enters the compressor at −6°C (h_1 = 1465 kJ/kg). The refrigerant leaves the condenser as saturated liquid at 40°C (h4 = 390.6 kJ/kg) and enter the expansion valve at 35°C (h_5 = 366.1 kJ/kg). Heat rejected from the condenser amount to 50 kW. The work to compressor is 208 kJ/kg, while the heat loss from compressor is 33 kJ/kg. If 95 kJ/kg of heat are lost in the piping between the compressor discharge and condenser inlet, determine the refrigerating capacity of the system.
A. 49.5 TR C. 46.61 TR
B. 12.88 TR D. 13.24 TR
Answer: D

48. In an actual refrigeration cycle using R12 as working fluid, the refrigerant flow rate is 0.05 kg/s. Vapor enters the expansion valve at 1.15 MPa, 40°C (h = 238.5 kJ/kg) and leaves the evaporator at 175 kPa, −15°C (h = 345 kJ/kg). The electric input to motor driving the compressor is measured and found 3.0 kW. Motor efficiency at this load is 92 percent and mechanical efficiency 82%. Determine the actual coefficient of performance for this cycle.
A. 1.58 C. 2.36
B. 1.78 D. 1.34
Answer: C

49. In an ammonia refrigeration system the temperature in the evaporator is −12°C and the ammonia at the evaporator entry is 0.1511 dry while at exit is 0.95 dry. If the rate of ammonia circulation is 5.64 kg/min, determine the refrigerating capacity of the system. Enthalpy of saturated liquid and vapor at −12°C is 144.929 kJ/kg and 1447.74 kJ/kg respectively.
A. 17.82 C. 34.82 TR
B. 27.82 TR D. 4.82 TR
Answer: B

50. A two stage cascade vapor compression refrigeration system uses ammonia in the low-temperature loop and R-12 in the high-temperature loop. The ammonia provides 15 tons cooling. If the high-loop temperature requires 10.12 kW compressor power and low-loop 15.93 kW, determine the COP of the system.
A. 2.027 C. 5.22 TR
B. 3.314 TR D. 9.1 TR
Answer: A

51. When a man returns to his well-sealed house on a summer day, he finds that the house is at 32°C. He turns on the air conditioner, which cools the entire house to 20°C in 15 min. If COP of the air-conditioner system is 2.5, determine the power drawn by the air conditioners. Assume the entire mass within the house is equivalent to 800 kg of air for which c = 0.72 kJ/kg.°C.
A. 7.68 kW C. 3.07 kW
B. 19.2 kW D. 12.03 kW
Answer: C

52. It is desired to double the COP of a reversed Carnot engine for cooling from 5.0 by raising the temperature of heat addition while keeping the temperature of heat rejection constant. By what percentage must the temperature of heat addition be raised?
A. 10.1% C 9.1%
B. 8.1% D. 7.1%
Answer: C

53. A single acting compressor has a volumetric efficiency of 87%, operates at 500 rpm. It takes in ammonia at 277 kPa and discharges it at 1204 kPa. The ammonia handled is 4.13 m^3/min measured at the discharge condition. If the compression is polytropic with n = 1.20, determine the piston displacement per stroke.
A. 0.0095 m^3 C. 19.7 m^3
B. 16.59 m^3 D. 0.03814 m^3
Answer: D

54. An ammonia water-cooled compressor receives the refrigerant at specific volume 62 L/kg. It has a piston displacement rate of 5 m^3/min. If a squirrel cage motor running at 1200 rpm drives the compressor and average piston speed is 490 m/min, calculate size of cylinder bore.
A. 20.4 cm C. 26.0 cm
B. 16.13 cm D. 13.6 cm
Answer: B

55. A room contains air at 20° Celsius and 96 kPa at a relative humidity of 75%. Determine the enthalpy of moist air where: (Psat @ 20° Celsius = 2.339 kPa)(hg @ 20° Celsius = 2538.1 KJ/kgda)
A. 45.919 KJ/kgda C. 49.515 KJ/kgda
B. 45.515 KJ/kgda D. 41.815 KJ/kgda
Answer: C

56. Determine the mass of water vapor contained in a 150 m^3 room at 100 kPa, 23°C and 40% relative humidity. From Steam Tables: Psat @ 23°C = 2.810 KPa.
A. 1.6342 kg C. 1.9342 kg
B. 1.2342 kg D. 2.2342 kg
Answer: B

57. Specific volume is the number of cubic meters of mixture per kilogram of dry air. If dry air has these following properties: Ra = 287 J / kg K T = 303 K Pa = 99.604 kPa. Solve for specific volume.
A. 0.873 m^3/kg C. 0.853 m^3/kg
B. 0.953 m^3/kg D. 0.783 m^3/kg
Answer: A

58. Compute the humidity ratio of air at 70% relative humidity and 25°C when the barometric pressure is 101.325 kpa. From steam tables: Psat at 34 °C = 3.169 kPa
A. 0.014 kg water vapor/kg dry air
B. 0.14 kg water vapor/kg dry air
C. 1.4 kg water vapor/kg dry air
D. 0.0014 kg water vapor/kg dry air
Answer: A

59. An inventor claims to have developed a refrigeration unit which maintains the refrigerated space at 20 °F within a room where the temperature is 80 °F. He claims a coefficient of performance of at least 7.50. How do you evaluate his claim?
A. No data available to evaluate the claim
B. Possible
C. Impossible
D. More observation are required
Answer: B

60. A 200 mm x 300 mm ammonia water cooled compressor at 1200 rpm receives refrigerant at 200 kPa, -10 °C, h = 1442 kJ/kg, 619.9 L/kg specific volume and is compressed to a final pressure and h= 1759 kJ/kg, k of ammonia is 1.12. For a mass of 1 kg/s of ammonia. Calculate the work of the compressor in horsepower.
A. 317 C. 425
B. 713 D. 524
Answer: C

61. A manufacturer of Carnot refrigerators has the choice of varying either the evaporator temperature, T_1= 250 K or the condenser temperature T_2 = 500 K by plus or minus 25 K; no restrictions are placed on the operating temperatures. In the best interest of economy, what would you recommend to this manufacturer?
A. Fix the temperature of condenser and increase the temperature of the evaporator by 25 K.
B. Fix the temperature of condenser and decrease the temperature of the evaporator by 25 K.
C. Fix the temperature of evaporator and increase the temperature of the condenser by 25 K.
D. Fix the temperature of evaporator and decrease the temperature of the condenser by 25 K.
Answer: A

62. A creamery must cool 40,000liters of milk received each day from initial temperature of 20 °C to final temperature of 2 °C in 10 hours. If refrigeration losses amount to 30% of the cooling load, what must be the capacity of the refrigerating machine if the specific heat of milk is 0.93 Btu/lb-R and SG = 1.15.
A. 33 TR
B. 43 TR
C. 38 TR
D. 48 TR
Answer: A

63. A refrigeration system produces 250 Btu/lb of cooling. In order to have a rating of one ton of refrigeration, what mass of refrigerant shall be used in the refrigeration system?
A. 1152 lb/day
B. 180 lb/hr
C. 1920 lb/day
D. 360 lb/hr
Answer: A

64. Express ten tons of refrigeration in CHU/hr.
A. 840
B. 2257
C. 970.3
D. 66, 666.67
Answer: D

65. A standard vapor compression refrigeration system requires a compressor work of 5 kW. The condenser releases 15 kJ/s of heat. Determine the amount of air to be conditioned if the decrease in enthalpy at the air conditioning unit is 50 kJ/kg.
A. 0.40
B. 0.60
C. 0.20
D. 0.80
Answer: C

66. The refrigerant load of vapor compression refrigeration system is 50 kJ/kg. The COP is 6. The enthalpy of the refrigerant leaving the compressor is 85 kJ/kg. Determine the enthalpy entering the compressor.
A. 72 kJ/kg
B. 83 kJ/kg
C. 77kJ/kg
D. 88 kJ/kg
Answer: C

67. A 3-hp refrigerator of heat pump operates between 0 °F and 100 °F. The maximum theoretical heat that can be transferred from the hot reservoir is nearest to
A. 76,000 Btu/hr
B. 23,000 Btu/hr
C. 13,000 Btu/hr
D. 43,000 Btu/hr
Answer: D

68. What is the enthalpy of a refrigerant entering the compressor in kJ/kg if the COP of the refrigeration system is 4.80 and the compressor work is 207.30 kJ/kg? The enthalpy at the entrance of the evaporator is 58.20 kJ/kg.
A. 1035.24 kJ/kg
B. 1520.42 kJ/kg
C. 1043. 25 kJ/kg
D. 1053.24 kJ/kg
Answer: D

69. A refrigeration system operates on an ideal vapor compression using R-12 with a saturated temperature -1.1 °C (h_g=351.003 kJ/kg) and a liquid R-12 temperature at 30 °C (h_f=288.54 kJ/kg). What is the mass flow rate of the refrigerant if the refrigerating capacity is 1.776 TR in kg/s?
A. 0.40 kg/s
B. 0.20 kg/s
C. 0.30 kg/s
D. 0.10 kg/s
Answer: D

70. Ten gallons per minute of cooling water undergo an 8 °C temperature rise during passage through a shell and tube condenser. If the refrigerant flow rate is 3 kg/min and the tons of refrigeration is 5.15, what is the work of isentropic compression in kJ/kg?
A. 40
B. 70
C. 60
D. 80
Answer: C

71. A businessman after feasibility study found out that the ice consumption of his locality to be 48,000 kg of ice per day. He wants to manufacture ice at -10 °C from water available at 25 °C. The estimated COP of the refrigeration system is 3.20. Determine the capacity of the compressor in hp.
A. 207
B. 107
C. 80
D. 190
Answer: B

72. A household with a COP of 1.8 remove heat from a refrigerant space at rate of 0.90 KJ/min. Determine the rate of heat transfer to the kitchen air.
A. 40KJ/min
B. 90KJ/min
C. 50KJ/min
D. 140 KJ/min
Answer: D

73. The rate of heat transfer to the surroundings from a person at rest is about 400 KJ/hr. Suppose that the ventilation system fails in an auditorium containing 120 people and assuming that the energy goes into the air of volume 1500 m^3 initially at 300 deg K and 101 kPa, calculate the rate in deg C/min of air temperature change.
A.0.81
B.0.53
C.0.63
D.1.0
Answer: C

74. What is the clearance volumetric efficiency of an ammonia compressor designed with 4 % clearance and operating between condenser temperature of 30 °C (p_{sat} = 1.1672 MPaa) and evaporator temperature of 4 °C (p_{sat} = 497.48 kPaa)?
a) 93.61 %
b) 96.31 %
c) 93.68 %
d) 96.83 %
Answer: B

75. A 10 kg/s of air enters the theater at 16 °C. The theater is to be maintained at 27 °C DB and 20 °C WB. If the sensible heat ratio is 0.71, what is the latent heat load of the theater?
a) 45.21 kW
b) 110.682 kW
c) 54.21 kW
d) 42.51 kW
Answer: A

76. The approach and efficiency of cooling tower are 10 °C and 65 %, respectively. If the temperature of water leaving the tower is 27 °C, determine the temperature of water entering the tower.
a) 54.57 °C
b) 45.57 °C
c) 55.47 °C
d) 54.75 °C
Answer: B

77. An air-vapor mixture has a dry bulb temperature of 30 °C and a humidity ratio of 0.015 kg/kg d.a., calculate the enthalpy of the moist air.
a) 68.527 kJ/kg d.a
b) 65.827 kJ/kg d.a.
c) 86.527 kJ/kg d.a
d) 67.528 kJ/kg d.a
Answer: A

78. A Carnot refrigerator is to remove heat from a cooled space at a rate of 18 000 kJ/hr to maintain the temperature at – 8 °C. If the air surrounding the refrigerator is 25 °C, determine the minimum power required for the refrigerator.
a) 0.723 kW
b) 0.623 kW
c) 0.523 kW
d) 0.423 kW
Answer: B

79. A 5 m x 4 m x 4 m room has an air temperature of 32 °C (p_{sat} = 4.559 kPaa, h_g = 2559.9 kJ/kg) and the pressure is 101 kPaa. The mass of water vapor in air is 2.5 kg with R_v = 0.45 kJ/kg-°K. What is the relative humidity of the air?
a) 94.08 %
b) 84.08 %
c) 74.08 %
d) 64.08 %
Answer: A

80. Fish weighing 11 000 kg with a temperature of 20 °C is brought to a cold storage and which shall be cooled to – 10 °C in 11 hours. Find the required plant refrigerating capacity in TR if the specific heat of fish is 0.7 kCal/kg-°C above freezing and 0.30 kCal/kg-°C below freezing point that is – 3 °C. The latent heat of freezing is 55.5 kCal/kg.
a) 25.26
b) 15.26
c) 14.38
d) 24.38
Answer: D

81. A refrigeration system operates on the reversed Carnot cycle. The minimum and maximum temperatures are – 25 C and 72 C, respectively. If the heat rejected at the condenser is 6000 kJ/min, find the tons of refrigeration required.
a) 20.44 TR
b) 42.20 TR
c) 24.40 TR
d) 44.20 TR
Answer: A

NOTE: STUDY THE SOLVED PROBLEMS IN REFRIGERATION AND AIRCONDITIONING IN PRIMES INDUSTRIAL PLANT ENGG REVIEWER. STUDY ALSO PRIMES POCKET ELEMENTS IN POWER AND IDUSTRIAL PLANT ENGG.

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