This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Basic Concepts".

1. One kg of diatomic Oxygen is present in a 500 L tank. Find the specific volume on both mass and mole basis.
a) 0.6 m3/kg , 0.260 m3/mole
b) 0.5 m3/kg , 0.0160 m3/mole
c) 0.56 m3/kg , 0.0215 m3/mole
d) 0.7 m3/kg , 0.0325 m3/mole
View AnswerAnswer: b
Explanation: The specific volume on mass basis= 0.5/1 = 0.5 m3/kg
specific volume on mole basis= 0.5/(1/0.032) = 0.0160 m3/mole.

2. A piston/cylinder with a cross-sectional area of 0.01 m^2 is resting on the stops. With an outside pressure of 100 kPa, what should the water pressure to lift the piston?
a) 178kPa
b) 188kPa
c) 198kPa
d) 208kPa
View AnswerAnswer: c
Explanation: Pw = Po + mg/A = 100000 + (100*9.8/0.01) = 198kPa.

3. A large exhaust fan in a lab room keeps the pressure inside at 10 cm water relative vacuum to the hallway? What is the net force acting on the door measuring 1.9 m by 1.1 m?
a) 2020 N
b) 2030 N
c) 2040 N
d) 2050 N
View AnswerAnswer: d
Explanation: Net force acting on the door = Gauge pressure*area
= 0.1cm water*1.9*1.1 = 2050 N.

4. A 5 m long vertical tu having cross sectional area 200 cm^2 is placed in a water. It is filled with 15°C water, with the bottom closed and the top open to 100 kPa atmosphere. How much water is present in tu?
a) 99.9 kg
b) 109.9 kg
c) 89.9 kg
d) 79.9 kg
View AnswerAnswer: a
Explanation: $m = \rho V = V/v = AH/v$
$= 200 \times 10^{-4} \times 5/0.001001 = 99.9$ kg.

5. A 5 m long vertical tu having cross sectional area 200 cm2 is placed in a water. It is filled with 15°C water, with the bottom closed and the top open to 100 kPa atmosphere. What is the pressure at the bottom of tu ?

a) 119 kPa
b) 129 kPa
c) 139 kPa
d) 149 kPa
View AnswerAnswer: d
Explanation: $\Delta P = \rho\ gH = gH/v = 9.80665 \times 5/0.001001$
$= 48.98$ kPa
$P(total) = P(top) + \Delta P = 149$ kPa.

6. Find the pressure of water at 200°C and having specific volume of 1.5 m3/kg.
a) 0.9578 m3/kg
b) 0.8578 m3/kg
c) 0.7578 m3/kg
d) 0.6578 m3/kg
View AnswerAnswer: a
Explanation: The state is superheated vapour bebetween 100 and 150 kPa.
$v = 1.3136 + (0.8689 – 1.3136)(140 – 100)/(150 – 100)$
$= 1.3136 + (– 0.4447) \times 0.8 = 0.9578$ m3/kg.
7. Find the pressure of water at 200°C and having specific volume of 1.5 m^3/kg.
a) 141.6 kPa
b) 111.6 kPa
c) 121.6 kPa
d) 161.6 kPa
View AnswerAnswer: d
Explanation: v > vg so that it is superheated vapour.
bebetween 100 kPa and 200 kPa,
$P = 100 + (200 – 100)(1.5 – 2.17226)/(1.08034 – 2.17226)$
$= 161.6$ kPa.
8. A 5m^3 container is filled with 840 kg of granite (density is 2400 kg/m^3) and the rest of the volume is air (density is 1.15 kg/m^3). Find the mass of air present in the container.
a) 9.3475 kg
b) 8.3475 kg
c) 6.3475 kg
d) 5.3475 kg
View AnswerAnswer: d
Explanation: Mass of the air (mair) = ρairVair = ρair (Vtotal – Vgranite)
= ρair (Vtotal – (m/ρ)granite) = 1.15*(5 – 840/2400) = 5.3475 kg.
9. A 100 m tall building receives superheated steam at 200 kPa at ground and leaves saturated vapour from the top at 125 kPa by losing 110 kJ/kg of heat. What should the minimum inlet temperature at the ground of the building so that no steam will condense inside the pipe at steady state?
a) 363.54°C
b) 263.54°C
c) 163.54°C

d) none of the mentioned
View AnswerAnswer: c
Explanation: FLOT for steam flow results: q + h(ground) = h(top) + gZtop.
h(top) = kPa = 2685.35 kJ/kg
H(ground) = 2685.35 + (9.80665*100)/1000 – (-110) = 2796.33 kJ/kg
Minimum temperature at the ground of the building T(ground) = 163.54°C.

10. The pressure gauge on an air tank shows 60 kPa when the diver is 8 m down in the ocean. At what depth will the gauge pressure zero?
a) 34.118 m
b) 24.118 m
c) 14.118 m
d) none of the mentioned
View AnswerAnswer: b
Explanation: Pressure at 10 m depth = Patm + ρgh = 101.325 + 1000*9.80665*8/1000 = 179.778 kPa
Absolute pressure of the air in the tank = 179.778 + 60 = 239.778 kPa
Depth at which gauge pressure is zero (H) = (239.778 – 101.325)*1000/(1000*9.80665) = 14.118 m.
11. A piston-cylinder device initially contains air at 150 kPa and 27°C. At this state, the volume is 400 litre. The mass of the piston is such that a 350 kPa pressure is required to move it. The air is now heated until its volume has doubled. Determine the final temperature.
a) 1400 K
b) 400 K
c) 500 K
d) 1500 K
View AnswerAnswer: a
Explanation: Final temperature (T3)= 1400 K.-> P1V1/T1=P3V3/T3.
12. A piston-cylinder device initially contains air at 150 kPa and 27°C. At this state, the volume is 400 litre. The mass of the piston is such that a 350 kPa pressure is required to move it. The air is now heated until its volume has doubled. Determine work done by the air.
a) 120 kJ
b) 130 kJ
c) 100 kJ
d) 140 kJ
View AnswerAnswer: d
Explanation: Work done = P3(V3- V1) = 140 kJ.
13. Find the change in u for carbon dioxide bebetween 600 K and 1200 K for a constant Cv0 value.

a) 291.8 kJ/kg
b) 391.8 kJ/kg
c) 491.8 kJ/kg
d) 591.8 kJ/kg
View AnswerAnswer: b
Explanation: $\Delta u = C_{v0}\,\Delta T = 0.653 \times (1200-600) = 391.8$ kJ/kg.

14. Calculate the change in enthalpy of carbon dioxide from 30 to 1500°C at 100 kPa at constant specific heat.
a) 2237.7 kJ/kg
b) 1637.7 kJ/kg
c) 1237.7 kJ/kg
d) 2337.7 kJ/kg
View AnswerAnswer: c
Explanation: $\Delta h = C_p\Delta T = 0.842\ (1500 - 30) = 1237.7$ kJ/kg.
15. A sealed rigid vessel has volume of 1 m^3 and contains 2 kg of water at 100°C. The vessel is now heated. If a safety pressure valve is installed, at what pressure should the valve set to have a maximum temperature of 200°C ?
a) 431.3 kPa
b) 531.3 kPa
c) 631.3 kPa
d) 731.3 kPa
View AnswerAnswer: a
Explanation: Initial specific volume (v_1) = 1 m^3/2 kg = 0.5 m^3/kg
Interpolating, pressure for the same specific volume at 200°C
= 400 + {(0.53422-0.5)/(0.53422-0.42492)}*(500-400) = 431.3 kPa.
16. A system undergoing change in state from A to B along path 'X' receives 100 J heat and does 40 J work. It returns to state A from B along path 'Y' with work input of 30 J. Calculate the heat transfer involved along the path 'Y'.
a) – 60 J
b) 60 J
c) – 90 J
d) 90 J
View AnswerAnswer: c
Explanation: ΔUX = AQB – AWB = 100 – 40 = 60 J
Heat transfer involved along the 'Y' (BQA) = ΔUY + BWA = – ΔUX + BWA
= – 60 – 30 = – 90 J.

» Next - Thermodynamics Questions and Answers – Temperature BasicsThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Temperature Basics".
1. When a body A is in thermal equilibrium with a body B, and also separately with a

body C, then B and C will in thermal equilibrium with each other.
a) True
b) False
View AnswerAnswer: a
Explanation: Zeroth law of thermodynamics.

2. Which of the following were used as fixed points fore 1954?
a) The ice point
b) The steam point
c) All of the mentioned
d) None of the mentioned
View AnswerAnswer: c
Explanation: Both of these were used.
3. What is the standard fixed point of thermometry?
a) The ice point
b) The steam point
c) The triple point of water
d) None of the mentioned
View AnswerAnswer: c
Explanation: After 1954, only one fixed point has en used.
4. All gases and vapours approach ideal gas haviour at?
a) High pressure and high density
b) Low pressure and low density
c) High pressure and low density
d) Low pressure and high density
View AnswerAnswer: b
Explanation: Comes from ideal gas equation of state.

5. The value of ratio of the steam point temperature to the ice point temperature is?
a) 1.466
b) 1.266
c) 1.166
d) 1.366
View AnswerAnswer: d
Explanation: This value is a universal constant.
6. Celsius temperature of the triple point of water is (in degree Celsius)?
a) -0.00
b) 0.00
c) 0.01

d) None of the mentioned
View AnswerAnswer: c
Explanation: Zero point of degree Celsius is shifted.
7. Which of the following is chosen as the standard thermometric substance?
a) Gas
b) Liquid
c) Solid
d) All of the mentioned
View AnswerAnswer: a
Explanation: Smallest variation is observed among different gas thermometers.

8. A real gas haves as an ideal gas when?
a) Temperature approaches zero
b) Pressure approaches zero
c) Both temperature and pressure approaches zero
d) None of the mentioned
View AnswerAnswer: b
Explanation: It is a property of gas.
9. The temperature interval from the oxygen point to the gold point is divided into how many parts?
a) 2
b) 3
c) 4
d) 1
View AnswerAnswer: b
Explanation: Taken as international temperature scale.
10. Optical method is adopted for measuring temperatures higher than the gold point?
a) True
b) False
View AnswerAnswer: a
Explanation: Temperature is determined with the help of Planck’s law of thermal radiation.

« Prev - Thermodynamics Questions and Answers – Basic Concepts» Next - Thermodynamics Questions and Answers – Work TransferThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Work Transfer”.
1. The magnitude of mechanical work is the

a) product of the force and distance travelled perpendicular to the force
b) product of the force and distance travelled parallel to the force
c) sum of the force and distance travelled perpendicular to the force
d) sum of the force and distance travelled parallel to the force
View AnswerAnswer: b
Explanation: The work is done by a force as it acts upon a body moving in the direction of the force.

2. Work done by a system is taken to
a) positive
b) negative
c) zero
d) varies according to situation
View AnswerAnswer: a
Explanation: In thermodynamics, work done by a system is take to positive.
3. Work done on a system is taken to
a) positive
b) negative
c) zero
d) varies according to situation
View AnswerAnswer: b
Explanation: In thermodynamics, work done on a system is take to negative.
4. Work is a
a) point function
b) path function
c) depends on the state
d) none of the mentioned
View AnswerAnswer: b
Explanation: Amount of work done depends on the path the system follows.

5. Thermodynamic properties are
a) point function
b) path function
c) depends on the state
d) none of the mentioned
View AnswerAnswer: a
Explanation: For a given state there is a definite value for each property.
6. The differentials of point functions are
a) perfect differentials
b) exact differentials

c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Change in thermodynamic property is independent of path and depends only on initial and final states of the system.
7. In the equation dV=(1/p)dW, (1/p) is known as
a) volume factor
b) pressure factor
c) differential factor
d) integration factor
View AnswerAnswer: d
Explanation: Used to convert inexact differential dW into exact differential dV.

8. Cyclic integral of a property is always
a) zero
b) one
c) infinite value
d) none of the mentioned
View AnswerAnswer: a
Explanation: The initial and final states of the system for a cyclic process are the same.
9. Constant pressure process is also known as
a) isopiestic process
b) isobaric process
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Isobaric and isopiestic means pressure ing constant.
10. Work done in a quasi-static process
a) depends on the path followed
b) independent of the path followed
c) depends only on the initial and final states
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is cause work done is a path function.

« Prev - Thermodynamics Questions and Answers – Temperature Basics» Next -

Thermodynamics Questions and Answers – Displacement Work and Indicator DiagramThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Displacement Work and Indicator Diagram”.
1. Macroscopic properties p and V are significant only for
a) equilibrium states
b) non-equilibrium states
c) depends on the state
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is true for at any intermediate point in the travel of piston.

2. In a cylinder, infinitesimal amount of work done by the gas on piston is given by
a) F*dl
b) p*a*dl
c) p*dV
d) all of the mentioned
View AnswerAnswer: d
Explanation: F=p*a and work equals force multiplied by displacement.
3. For a constant pressure process, work done is
a) zero
b) p*(V2-V1)
c) p1*V1*ln(V2/V1)
d) none of the mentioned
View AnswerAnswer: b
Explanation: Work done in a process is given by the area under p-dV graph.
4. For a constant volume process, work done is
a) zero
b) p*(V2-V1)
c) p1*V1*ln(V2/V1)
d) none of the mentioned
View AnswerAnswer: a
Explanation: Work done in a process is zero since volume remains constant.
5. For a process in which pV=C, work done is
a) zero
b) p*(V2-V1)
c) p1*V1*ln(V2/V1)
d) none of the mentioned
View AnswerAnswer: c
Explanation: Work done is given by integral of (p*dV) from V1 to V2.

6. The area of the indicator diagram represents the magnitude of the
a) net heat transfer by the system
b) net work done on the system
c) net work done by the system
d) none of the mentioned
View AnswerAnswer: c
Explanation: It is the work done in one engine cycle.
7. For Pm=(Ad/Ld)*K, which of the following is true?
a) Pm=mean effective pressure
b) Ad and Ld are area of diagram and length of diagram respectively
c) K id the indicator spring constant
d) all of the mentioned
View AnswerAnswer: d
Explanation: This formula comes from the indicator diagram.
8. For a two-stroke engine, work done in one minute is given by
a) PmALN
b) PmALN/2
c) 2PmALN
d) none of the mentioned
View AnswerAnswer: a
Explanation: In a two-stroke cycle, the engine cycle is completed in two strokes of the piston.
9. The power available at crankshaft is always _____ indicated power.
a) more
b) less
c) equal
d) none of the mentioned
View AnswerAnswer: b
Explanation: Due to friction.

10. Mechanical efficiency of engine is given by
a) IP/BP
b) 1/(BP*IP)
c) (BP*IP)
d) BP/IP
View AnswerAnswer: d
Explanation: Brake power is less than indicated power and mechanical efficiency is given by BP/IP.
11. An engine is said to double-acting, if the working fluid is made to work on both sides of the piston.
a) true
b) false
View AnswerAnswer: a

Explanation: Such an engine develops twice the amount of work developed in a single-acting engine.
f 1000+ Multiple Choice Questions and Answers.

« Prev - Thermodynamics Questions and Answers – Work Transfer» Next - Thermodynamics Questions and Answers – Other types of Work Transfer-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Other types of Work Transfer-1".

1. The current flow, I, in amperes, is given by $I=(dC)/(d\tau)$
a) dC is the charge crossing a boundary
b) time taken is $d\tau$
c) c is the charge in coulombs and t is time in seconds
d) all of the mentioned
View AnswerAnswer: d
Explanation: This current flow is responsible for the work transfer.

2. Shaft uses which kind of motion to do work?
a) vertical motion
b) horizontal motion
c) rotational motion
d) none of the mentioned
View AnswerAnswer: c
Explanation: When a shaft is rotated by a motor, there is work transfer into the system.

3. Shaft work is given by
a) $T*\omega$
b) $T*d\theta$
c) $T*\tau$
d) none of the mentioned
View AnswerAnswer: a
Explanation: Shaft power is the rate if doing shaft work.

4.The flow work is significant only in
a) flow process
b) open system
c) both of the mentioned
c) none of the mentioned
View AnswerAnswer: c
Explanation: Condition for the flow work.

5. Flow work is analogous to

a) shaft work
b) electrical work
c) stirring work
d) displacement work
View AnswerAnswer: d
Explanation: Flow work is the displacement work done at the moving system boundary.

6. The infinitesimal amount of work done on changing the length of a wire with tension T from L to L+dL is
a) -FdL
b) FdL
c) -2FdL
d) 2FdL
View AnswerAnswer: a
Explanation: It is the work done in stretching a wire.
7. Work done in stretching a wire is given by
a) -∫FdL
b) -∫EεALdε
c) -AEL∫εdε
d) all of the mentioned
View AnswerAnswer: d
Explanation: Above formulae arrive when we limit the problem within the elastic limit.
8. The surface tension acts to make the surface area of the liquid
a) maximum
b) minimum
c) zero
d) none of the mentioned
View AnswerAnswer: b
Explanation: Characteristic of surface tension.
9. The work done per unit volume on a magnetic material is dW=-Hdl where H is
a) field strength
b) magnetization field
c) induced current
d) none of the mentioned
View AnswerAnswer: a
Explanation: H is the field strength of the magnetic field.

10. The work is equal to the integral of the product of an intensive property.

a) true
b) false
View AnswerAnswer: a
Explanation: Along with it, change in work is related to the extensive property.

11. A 1200 hp engine has a drive shaft rotating at 2000 RPM. Find the torque on the shaft?
a) 2214 Nm
b) 3214 Nm
c) 4214 Nm
d) 5214 Nm
View AnswerAnswer: c
Explanation: Power, rate of work = T ω and 1 hp = 0.7355 kW = 735.5 W
ω = RPM × (2π)/(60 s) = 209.44 rad/s
T = power/ω = (1200 hp × 735.5 W/hp)/ 209.44 rad/s
= 4214 Ws = 4214 Nm.

12. A 1200 hp engine drives a car with a speed of 100 km/h. Find the force bebetween the tires and the road?
a) 11.8 kN
b) 21.8 kN
c) 31.8 kN
d) 41.8 kN
View AnswerAnswer: c
Explanation: Power = F V and 1 hp = 0.7355 kW = 735.5 W
velocity in m/s: V = 100 × 1000 / 3600 = 27.78 m/s
F = (1200 × 735.5)/(27.78) = 31 771 N
= 31.8 kN.

13. A work of 2.5 kJ is delivered on a rod from a piston/cylinder where the air pressure is 500 kPa. What should the diameter of cylinder to restrict the rod motion to maximum 0.5 m?
a) 0.013 m
b) 0.113 m
c) 0.213 m
d) 0.313 m
View AnswerAnswer: b
Explanation: W = ⌠P dV = ⌠PA dx = PA Δx = P(π/4)(D^2)Δx
Putting the values in above equation we get
D = 0.113 m.

14. A force of 1.2 kN moves a car with 60 km/h up a hill. Find the power?
a) 20 kW
b) 30 kW
c) 40 kW
d) 50 kW
View AnswerAnswer: a

Explanation: Power = F V = 1.2 kN × 60 (km/h)
= (1.2 × 10^3 × 60)*(1000/3600)
= 20 000 W = 20 kW.

15. When a battery(12 V) is charged with 6 amp for 3 hours how much energy is delivered?
a) 477.6 kJ
b) 577.6 kJ
c) 677.6 kJ
d) 777.6 kJ
View AnswerAnswer: d
Explanation: W = ⌠(power)dt = V i Δt
= 12 V × 6 Amp × 3 × 3600 s
= 777 600 J = 777.6 kJ.

« Prev - Thermodynamics Questions and Answers – Displacement Work and Indicator Diagram» Next - Thermodynamics Questions and Answers – Other types of Work Transfer-2This set of Thermodynamics Interview Questions and Answers focuses on “Other types of Work Transfer-2”.

1. Find the rate of conduction heat transfer through a 1.5 cm thick board(k = 0.16 W/m K), with a temperature difference of 20°C bebetween the two sides.
a) 113 W/m2
b) 413 W/m2
c) 313 W/m2
d) 213 W/m2
View AnswerAnswer: c
Explanation: The rate of conduction heat transfer = k(ΔT/Δx)
= (0.16 *20)/0.015 = 213 W/m2.

2. A window having area of 2m^2 has a surface temperature of 15°C and the air is blowing at 2°C across it with convection heat transfer coefficient of h = 125 W/m2K. Find the total heat transfer loss?
a) 3250 W
b) 2250 W
c) 4250 W
d) 5250 W
View AnswerAnswer: a
Explanation: Total heat transfer loss = h A ΔT
= 125*2*(15-2) = 3250 W.

3. A radiant heating lamp has a temperature of 1000 K with ε = 0.8. What should the surface area to provide 250 W of radiation heat transfer?
a) 0.0035 m2
b) 0.0055 m2
c) 0.0075 m2

d) 0.0095 m2
View AnswerAnswer: b
Explanation: Radiation heat transfer = $\varepsilon\sigma A(T4)$
$A = 250/[0.8 \times 5.67 \times 10-8\times 10004]$
$= 0.0055$ m2.

4. A piston of mass 2 kg is lowered by 0.5 m. Find the work involved in the process.
a) 7.805 J
b) 8.805 J
c) 9.805 J
d) 10.805 J
View AnswerAnswer: c
Explanation: F = ma = 2 kg × 9.80665 m/s2 = 19.61 N
$W = \int F\,dx = F \int dx = F\,\Delta x$ = 19.61 N × 0.5 m = 9.805 J.

5. An escalator raises a 100 kg bucket of water 10 m in 60 seconds. Determine the amount of work done during the process.
a) 9807 J
b) 9307 J
c) 9507 J
d) 9107 J
View AnswerAnswer: a
Explanation: F = mg
$W = \int F\,dx = F \int dx = F\,\Delta x$ = 100 kg × 9.80665 m/s2 × 10 m
= 9807 J.

6. A hydraulic cylinder has a piston(cross sectional area 25cm2) and a fluid pressure of 2 MPa. If piston moves by 0.25m, how much work is done?
a) 0.25 kJ
b) 1.25 kJ
c) 2.25 kJ
d) 3.25 kJ
View AnswerAnswer: b
Explanation: $W = \int F\,dx = \int PA\,dx = PA\,\Delta x$
= 2000 kPa × 25 × 10(-4) m2 × 0.25 m = 1.25 kJ.

7. In a thermally insulated kitchen, a refrigerator with 2 kW motor for running the compressor provides 6000 kJ of cooling to the refrigerated space during 30 min operation. If the condenser coil placed hind the refrigerator rejects 8000 kJ of heat to the kitchen during the same period, calculate the change in internal energy of the kitchen.
a) 3600 kJ
b) 2400 kJ
c) 4800 kJ
d) none of the mentioned
View AnswerAnswer: a
Explanation: QKitchen = 0 (Insulated!),
W(Electrical) = – P*$\Delta\tau$ = – 2 kW*30*60 sec = – 3600 kJ
(It is negative cause work is done on to the system)

Change in internal energy of the kitchen ($\Delta U_{Kitchen}$) = $Q_{Kitchen} - W_{Electrical}$
= 0 – (–3600) = 3600 kJ.

8. An escalator raises a 100 kg bucket of sand 10 m in a minute. Determine the rate of work done during the process.
a) 143 W
b) 153 W
c) 163 W
d) 173 W
View AnswerAnswer: c
Explanation: The work is force with a displacement and force is F = mg, which is constant

$W = \int F\, dx = F \int dx = F\, \Delta x = 100\ kg \times 9.80665\ m/s^2 \times 10\ m = 9807\ J$

The rate of work is work per unit time = $W/\Delta t = 9807\ J / 60\ s$
= 163 W.

9. A crane lifts a bucket of cement with a mass of 450 kg vertically up with a constant velocity of 2 m/s. Find the rate of work.
a) 8.83 kW
b) 8.33 kW
c) 8.53 kW
d) 8.63 kW
View AnswerAnswer: a
Explanation: Rate of doing work = FV = mg × V = 450 kg × 9.807 ms^{-2} × 2 ms^{-1} = 8826 J/s = 8.83 kW.

10. A battery is well insulated while ing charged by 12.3 V at a current of 6 A. Take the battery as a control mass and find the instantaneous rate of work.
a) 63.8 W
b) 73.8 W
c) 83.8 W
d) 93.8 W
View AnswerAnswer: b
Explanation: Battery thermally insulated ⇒ Q = 0
For constant voltage E and current i, Power = E i = 12.3 × 6 = 73.8 W.

11. A current of 10 amp runs through a resistor with resistance of 15 ohms. Find the rate of work that heats the resistor up.
a) 1200 W
b) 1300 W
c) 1400 W
d) 1500 W
View AnswerAnswer: d
Explanation: Power = E i = R i^2 = 15 × 10 × 10 = 1500 W.

12. A pressure of 650 kPa pushes a piston of radius 0.125 m with V = 5 m/s. What is the transmitted power?
a) 139.5 kW
b) 149.5 kW
c) 159.5 kW
d) 169.5 kW
View AnswerAnswer: c
Explanation: $A = \pi/4(D)2 = 0.049087$ m2;
Volume flow rate = AV = 0049087 m^2 × 5 m/s = 0.2454 m3/s
Power = F V = P(Volume flow rate) = 650 kPa × 0.2454 m3/s = 159.5 kW.
13. Air at a constant pressure in a piston-cylinder is at 300 K, 300 kPa and V=0.1 m^3. It is heated to 600 K in 30 seconds in a process with constant piston velocity. Find the power delivered to the piston.
a) 1 kW
b) 2 kW
c) 3 kW
d) 4 kW
View AnswerAnswer: a
Explanation: Process: P = constant : dW = P dV
$V2 = V1\times (T2/T1) = 0.1 \times (600/300) = 0.2$
Rate = $P (\Delta V / \Delta t) = 300 \times (0.2-0.1)/30 = 1$ kW.

14. A torque of 650 Nm rotates a shaft of radius 0.125 m with $\omega = 50$ rad/s. What is the transmitted power?
a) 22.5 kW
b) 32.5 kW
c) 42.5 kW
d) 52.5 kW
View AnswerAnswer: b
Explanation: $V = \omega r = 50 \times 0.125 = 6.25$ m/s
Power = $T\omega = 650 \times 50$ Nm/s = 32 500 W = 32.5 kW.
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« Prev - Thermodynamics Questions and Answers – Other types of Work Transfer-1»
Next - Thermodynamics Questions and Answers – Conduction, Convection and RadiationThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Conduction, Convection and Radiation”.
1. The sun shines on a 150 m2 road surface so it is at 45°C. low the 5cm thick asphalt(average conductivity of 0.06 W/m K), is a layer of rubbles at 15°C. Find the rate of heat transfer to the rubbles.
a) 5300 W
b) 5400 W

c) 5500 W
d) 5600 W
View AnswerAnswer: b
Explanation: There is conduction through the asphalt layer.
heat transfer rate = $k A \Delta T/\Delta x = 0.06 \times 150 \times (45-15)/0.05$
$= 5400$ W.

2. A pot of steel(conductivity 50 W/m K), with a 5 mm thick bottom is filled with liquid water at 15°C. The pot has a radius of 10 cm and is now placed on a stove that delivers 250 W as heat transfer. Find the temperature on the outer pot bottom surface assuming the inner surface to at 15°C.
a) 15.8°C
b) 16.8°C
c) 18.8°C
d) 19.8°C
View AnswerAnswer: a
Explanation: Steady conduction, $Q = k A \Delta T/\Delta x \Rightarrow \Delta T = Q \Delta x / kA$
$\Delta T = 250 \times 0.005/(50 \times \pi/4 \times 0.22) = 0.796$
$T = 15 + 0.796 = 15.8$°C.
3. A water-heater is covered with insulation boards over a total surface area of 3 m2. The inside board surface is at 75°C and the outside ing at 20°C and the conductivity of material ing 0.08 W/m K. Find the thickness of board to limit the heat transfer loss to 200 W ?
a) 0.036 m
b) 0.046 m
c) 0.056 m
d) 0.066 m
View AnswerAnswer: d
Explanation: Steady state conduction through board.
$Q = k A \Delta T/\Delta x \Rightarrow \Delta T = Q \Delta x / kA$
$\Delta x = 0.08 \times 3 \times (75 - 20)/200 = 0.066$ m.
4. On a winter day with atmospheric air at –15°C, the outside front wind-shield of a car has surface temperature of +2°C, maintained by blowing hot air on the inside surface. If the wind-shield is 0.5 m2 and the outside convection coefficient is 250 W/Km2, find the rate of energy loss through front wind-shield.
a) 125 W
b) 1125 W
c) 2125 W
d) 3125 W
View AnswerAnswer: c
Explanation: Q (conv) = $h A \Delta T = 250 \times 0.5 \times [2 - (-15)]$
$= 250 \times 0.5 \times 17 = 2125$ W.
5. A large heat exchanger transfers a total of 100 MW. Assume the wall separating steam and seawater is 4 mm of steel, conductivity 15 W/m K and that a maximum of 5°C

difference bebetween the two fluids is allowed. Find the required minimum area for the heat transfer.
a) 180 m2
b) 280 m2
c) 380 m2
d) 480 m2
View AnswerAnswer: d
Explanation: Steady conduction

$$Q = k\ A\ \Delta T/\Delta x \Rightarrow A = Q\ \Delta x\ /\ k\Delta T$$

$$A = 100 \times 10^6 \times 0.004\ /\ (15 \times 5) = 480\ m2.$$

6. The black grille on the back of a refrigerator has a surface temperature of 35°C with a surface area of 1 m2. Heat transfer to the room air at 20°C takes place with convective heat transfer coefficient of 15 W/Km^2. How much energy is removed during 15 minutes of operation?
a) 202.5 kJ
b) 212.5 kJ
c) 222.5 kJ
d) 232.5 kJ
View AnswerAnswer: a
Explanation: $Q = hA\ \Delta T\ \Delta t$, $Q = 15 \times 1 \times (35-20)\times15\times60 = 202500\ J = 202.5\ kJ$.
7. A small light bulb (25 W) inside a refrigerator is kept on and 50 W of energy from the outside seeps into the refrigerated space. How much of temperature difference to the ambient(at 20°C) must the refrigerator have in its heat exchanger having an area of 1 m2 and heat transfer coefficient of 15 W/Km2 to reject the leak of energy.
a) 0°C
b) 5°C
c) 10°C
d) 15°C
View AnswerAnswer: b
Explanation: Total energy that goes out = 50+25 = 75 W

$$75 = hA\Delta T = 15 \times 1 \times \Delta T \text{ hence } \Delta T = 5°C.$$

8. As the car slows down, the brake shoe and steel drum continuously absorbs 25 W. Assume a total outside surface area of 0.1 m2 with a convective heat transfer coefficient of 10 W/Km2 to the air at 20°C. How hot does the outside brake and drum surface come when steady conditions are reached?
a) 25°C
b) 35°C
c) 45°C
d) 55°C
View AnswerAnswer: c
Explanation: $\Delta T = heat\ /\ hA$ hence $\Delta T = [\ T(BRAKE) - 20\ ] = 25/(10 \times 0.1) = 25°C$

$$T(BRAKE) = 20 + 25 = 45°C.$$

9. A burning wood in the fireplace has a surface temperature of 450°C. Assume the emissivity to 1 and find the radiant emission of energy per unit area.

a) 15.5 kW/m2
b) 16.5 kW/m2
c) 17.5 kW/m2
d) 18.5 kW/m2
View AnswerAnswer: a
Explanation: $Q / A = 1 \times \sigma T^4$

$= 5.67 \times 10^{-8} \times (273.15 + 450)^4$

$= 15505$ W/m2 = 15.5 kW/m2.

10. A radiant heat lamp is a rod, 0.5 m long, 0.5 cm in diameter, through which 400 W of electric energy is deposited. Assume the surface emissivity to 0.9 and neglecting incoming radiation, find the rod surface temperature?
a) 700K
b) 800K
c) 900K
d) 1000K
View AnswerAnswer: d
Explanation: Outgoing power equals electric power

T^4= electric energy / $\varepsilon\sigma A$

$= 400 / (0.9 \times 5.67 \times 10^{-8} \times 0.5 \times \pi \times 0.005)$

$= 9.9803 \times 10^{11}$ K4 ⇒ T = 1000K.

11. A water-heater is covered up with insulation boards over a total surface area of 3 m2. The inside board surface is at 75°C and the outside surface is at 20°C and the board material has a conductivity of 0.08 W/m K. How thick a board should it to limit the heat transfer loss to 200 W ?
a) 0.066 m
b) 0.166 m
c) 0.266 m
d) 0.366 m
View AnswerAnswer: a
Explanation: Steady state conduction through a single layer board.

$\Delta x = kA(\Delta T)/Q$

$\Delta x = (0.08*3)*(75-20)/200 = 0.066$ m.

12. Find the rate of conduction heat transfer through a 1.5 cm thick hardwood board, k = 0.16 W/m K, with a temperature difference bebetween the two sides of 20°C.
a) 113 W/m2
b) 213 W/m2
c) 230 W/m2
d) 312 W/m2
View AnswerAnswer: b
Explanation: . $q = .Q/A = k\, \Delta T/\Delta x = 0.16$ Wm /K × 20K/0.015 m = 213 W/m2.
13. A 2 m2 window has a surface temperature of 15°C and the outside wind is blowing air at 2°C across it with a convection heat transfer coefficient of h = 125 W/m2K.

What is the total heat transfer loss?
a) 2350 W
b) 1250 W
c) 2250 W
d) 3250 W
View AnswerAnswer: d
Explanation: .Q = h A ΔT = 125 W/m2K × 2 m2 × (15 – 2) K = 3250 W.

14. A radiant heating lamp has a surface temperature of 1000 K with ε = 0.8. How large a surface area is needed to provide 250 W of radiation heat transfer?
a) 0.0035 m2
b) 0.0045 m2
c) 0.0055 m2
d) 0.0065 m2
View AnswerAnswer: c
Explanation: .Q = εσAT^4
A = .Q/(εσT4) = 250/(0.8 × 5.67 × 10-8 × 10004)
= 0.0055 m2.

« Prev - Thermodynamics Questions and Answers – Other types of Work Transfer-2»
Next - Thermodynamics Questions and Answers – Heat TransferThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Heat Transfer".
1. The transfer of heat bebetween two bodies in direct contact is called
a) radiation
b) convection
c) conduction
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the definition of conduction.

2. Heat flow into a system is taken to ____, and heat flow out of the system is taken as ____
a) positive, positive
b) negative, negative
c) negative, positive
d) positive, negative

View AnswerAnswer: d
Explanation: The direction of heat transfer is taken from the high temperature system to the low temperature system.
3. In the equation, dQ=TdX
a) dQ is an inexact differential
b) dX is an exact differential
c) X is an extensive property
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is cause heat transfer is a path function.
4. The transfer of heat bebetween a wall and a fluid system in motion is called
a) radiation
b) convection
c) conduction
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is the definition of convection.

5. For solids and liquids, specific heat
a) depends on the process
b) is independent of the process
c) may or may not depend on the process
d) none of the mentioned
View AnswerAnswer: b
Explanation: It is the property of specific heat.
6. The specific heat of the substance is defined as the amount of heat required to raise a unit mass of the substance through a unit rise in temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: $c=Q/(m*\Delta t)$.
7. Heat and work are
a) path functions
b) inexact differentials
c) depend upon the path followed
d) all of the mentioned
View AnswerAnswer: d
Explanation: It is an important point to rememr regarding heat and work transfer.

8. Latent heat is taken at

a) constant temperature
b) constant pressure
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The latent heat is heat transfer required to cause a phase change in a unit mass of substance at a constant pressure and temperature.
9. Which of the following is true?
a) latent heat of fusion is not much affected by pressure
b) latent heat of vaporization is highly sensitive to pressure
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: It is a general fact about latent heat.
10. Heat transfer and work transfer are
a) boundary phenomena
b) energy interactions
c) energy in the transit
d) all of the mentioned
View AnswerAnswer: d
Explanation: It is an important point to rememr regarding heat and work transfer.

« Prev - Thermodynamics Questions and Answers – Conduction, Convection and Radiation» Next - Thermodynamics Questions and Answers – First Law for a Closed SystemThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “First Law for a Closed System”.
1. Energy has different forms which include
a) heat
b) work
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Basic fact about energy.

2. Work input is directly proportional to heat and the constant of proportionality is called
a) joule’s equivalent

b) mechanical equivalent of heat
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: True for a closed system undergoing a cycle.
3. The value of constant of proportionality, J, has the value
a) 1
b) 0
c) -1
d) infinity
View AnswerAnswer: a
Explanation: In the S.I. system, both heat and work are measured in the derived unit of energy, the Joule.
4. It was Joule who first established that heat is a form of energy, and thus laid the foundation of the first law of thermodynamics.
a) true
b) false
View AnswerAnswer: a
Explanation: Prior to Joule, heat was considered to an invisible fluid flowing from a body of higher calorie to a body of lower calorie.

5. Which of the following represents the energy in storage?
a) heat
b) work
c) internal energy
d) none of the mentioned
View AnswerAnswer: c
Explanation: Energy in storage is internal energy or the energy of the system.
6. By first law of thermodynamics,
a) $Q=\Delta E-W$
b) $Q=\Delta E+W$
c) $Q=-\Delta E-W$
d) $Q=-\Delta E+W$
View AnswerAnswer: b
Explanation: Q-W is the net energy stored in system and is called internal energy of system.
7. The expression $(\Sigma W)_{cycle}=(\Sigma Q)_{cycle}$ applies only to systems undergoing cycles.
a) true
b) false
View AnswerAnswer: a
Explanation: The above expression holds for a closed cycle.

8. Which of the following is the first law for a closed system undergoing a cycle?
a) $\oint dW=\oint dQ$
b) $J\oint dW=\oint dQ$
c) $\oint dW=J\oint dQ$
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the expression for first law of thermodynamics where $\oint$ denotes the cyclic integral for the closed path.
9. Which of the following an considered as the definition of energy?
a) $Q=\Delta E+W$
b) $Q-W=\Delta E$
c) first law of thermodynamics
d) all of the mentioned
View AnswerAnswer: d
Explanation: The first law is a particular formulation of the principle of the conservation of energy.
10. The first law of thermodynamics gives only the change on energy ΔE for the process.
a) true
b) false
View AnswerAnswer: a
Explanation: An absolute value of energy E, is not given by the first law.

« Prev - Thermodynamics Questions and Answers – Heat Transfer» Next - Thermodynamics Questions and Answers – EnergyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Energy”.
1. Energy is a
a) point function
b) property of the system
c) extensive property
d) all of the mentioned
View AnswerAnswer: d
Explanation: Energy has a definite value for every state of the system.

2. The specific energy, e=E/m is an extensive property.
a) true
b) false
View AnswerAnswer: b
Explanation: The specific energy is an intensive property.
3. (m*V*V)/2 gives the
a) macroscopic kinetic energy
b) microscopic kinetic energy
c) macroscopic potential energy
d) microscopic potential energy
View AnswerAnswer: a
Explanation: The formula gives the macroscopic kinetic energy of the fluid element by virtue of its motion.
4. (m*g*z) gives the
a) macroscopic kinetic energy
b) microscopic kinetic energy
c) macroscopic potential energy
d) microscopic potential energy
View AnswerAnswer: c
Explanation: The above formula gives the macroscopic potential energy of the fluid element by virtue of its position.

5. Which of the following types of energy can present in molecules?
a) translational and rotational kinetic energy
b) electronic energy and vibrational energy
c) chemical energy and nuclear energy
d) all of the mentioned
View AnswerAnswer: d
Explanation: The molecules may subjected to rotation as well as vibration due to a collision.
6. The total internal energy of the system is given by
a) U=N/ε
b) U=Nε
c) U=ε/N
d) none of the mentioned
View AnswerAnswer: b
Explanation: U=Nε where N is the total numr of molecules in the system and ε represents the energy of one molecule.
7. In an ideal gas there are no intermolecular forces of attraction and repulsion, and the internal energy is a function of temperature only.
a) true
b) false
View AnswerAnswer: a
Explanation: For an ideal gas U depends only on T.

8. Which of the following is true in regard to the energy of an isolated system?
a) $dQ \neq 0$
b) $dW \neq 0$
c) E=constant
d) all of the mentioned
View AnswerAnswer: c
Explanation: For an isolated system, $dQ=dW=0$ and hence, $dE=0$ by first law.
9. A perpetual motion machine of first kind
a) is a fictitious machine
b) can supply mechanical work without dissipating energy
c) violates first law
d) all of the mentioned
View AnswerAnswer: d
Explanation: There cannot any machine which would continuously supply mechanical energy without other form of energy ing dissipated.
10. The limitation of the first law is
a) does not indicate the possibility of a spontaneous process proceeding in a definite direction
b) it assigns a quality to different forms of energy
c) indicates the direction of any spontaneous process
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the main limitation of first law and the second law overcomes it.

« Prev - Thermodynamics Questions and Answers – First Law for a Closed System» Next - Thermodynamics Questions and Answers – EnthalpyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Enthalpy”.
1. The enthalpy of a substance(denoted by h), is defined as
a) $h=u-pv$
b) $h=u+pv$
c) $h=-u+pv$
d) $h=-u-pv$
View AnswerAnswer: b
Explanation: This is a basic definition for enthalpy.

2. In a constant volume process, internal energy change is equal to
a) heat transferred
b) work done
c) zero
d) none of the mentioned
View AnswerAnswer: a
Explanation: In a constant volume process, there is no work other than the pdV work.
3. For an ideal gas, enthalpy comes
a) h=u-RT
b) h=-u-RT
c) h=u+RT
d) h=-u+RT
View AnswerAnswer: c
Explanation: For an ideal gas, pv=RT.
4. Enthalpy is an intensive property of a system.
a) true
b) false
View AnswerAnswer: a
Explanation: Enthalpy is an intensive property measured mostly in kJ/kg.

5. Heat transferred at constant pressure _____ the enthalpy of a system.
a) decreases
b) increases
c) first decreases then increases
d) first increases then decreases
View AnswerAnswer: b
Explanation: At constant pressure, (dQ)=dh where h=u+pv is the specific enthalpy of the system.
6. The enthalpy of an ideal gas depends only on the temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause the internal energy of an ideal gas depends only on the temperature.
7. Total enthalpy of a system H is given by
a) H=h/m
b) H=m/h
c) H=mh
d) none of the mentioned
View AnswerAnswer: c
Explanation: Total enthalpy equals (mass*enthalpy) of substance.

8. The enthalpy and internal energy are the function of temperature for
a) all gases
b) steam
c) water
d) ideal gas
View AnswerAnswer: d
Explanation: The enthalpy of an ideal gas depends only on the temperature cause the internal energy of an ideal gas depends only on the temperature.
9. Change in enthalpy of a system is due to heat supplied at
a) constant volume
b) constant pressure
c) both at constant volume and pressure
d) none of the mentioned
View AnswerAnswer: b
Explanation: Change in enthalpy occurs when heat is given to a system at constant pressure.
10. At constant pressure
a) pdv=d(pv)
b) dQ=du+d(pv)
c) dQ=d(u+pv)
d) all of the mentioned
View AnswerAnswer: d
Explanation: For a constant pressure process, dQ=du+pdv.

« Prev - Thermodynamics Questions and Answers – Energy» Next - Thermodynamics Questions and Answers – Specific Heat at Constant Volume and Pressure and Control VolumeThis set of Thermodynamics Questions and Answers for freshers focuses on "Specific Heat at Constant Volume and Pressure and Control Volume".
1. The specific heat of a substance at constant volume is defined as the rate of change of ___ with respect to ___
a) specific internal energy, temperature
b) work, pressure
c) specific internal energy, pressure
d) heat, temperature
View AnswerAnswer: a
Explanation: cv=∂u/∂T at constant volume.

2. Heat transferred at constant _____ increases the _____ of a system.
a) pressure, increases
b) volume, increases
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: At constant pressure, $(dQ)=dh$ and at constant volume, $Q=\Delta u$.
3. Specific heat of a substance at constant volume is a property of the system.
a) true
b) false
View AnswerAnswer: a
Explanation: Since T,v and u are the properties of the system, specific heat at a constant volume is a property of the system.
4. The specific heat of a substance at constant pressure is defined as the rate of change of ___ with respect to ___
a) work, pressure
b) enthalpy, temperature
c) enthalpy, pressure
d) heat, temperature
View AnswerAnswer: b
Explanation: $cp=\partial h/\partial T$ at constant pressure.

5. The heat capacity at constant pressure Cp
a) m/cp
b) cp/m
c) mcp
d) none of the mentioned
View AnswerAnswer: c
Explanation: Cp=(mass*specific heat at constant pressure).
6. Specific heat of a substance at constant pressure is a property of the system.
a) true
b) false
View AnswerAnswer: a
Explanation: cp is a property of a substance just like cv.
7. When there is mass transfer across the system boundary, the system is called
a) isolated system
b) closed system
c) open system
d) none of the mentioned

View AnswerAnswer: c
Explanation: Basic definition of an open system.

8. If a certain mass of steam is considered as the thermodynamic system, then the energy equation comes
a) $Q=\Delta KE + \Delta PE - \Delta U + W$
b) $Q=\Delta KE + \Delta PE - \Delta U - W$
c) $Q=-\Delta KE - \Delta PE + \Delta U + W$
d) $Q=\Delta KE + \Delta PE + \Delta U + W$
View AnswerAnswer: d
Explanation: $Q=\Delta E + W$ and $E=KE + PE + U$.
9. The surface of the control volume is known as the control surface.
a) true
b) false
View AnswerAnswer: a
Explanation: This is same as the system boundary of the open system.
10. Steady flow means that the rates of flow of mass and energy across the control surface
a) varies
b) remains constant
c) depends on the control surface
d) none of the mentioned
View AnswerAnswer: b
Explanation: In a steady flow rate of flow remains constant.

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« Prev - Thermodynamics Questions and Answers – Enthalpy» Next - Thermodynamics Questions and Answers – Mass Balance and Energy Balance in a Simple Steady Flow ProcessThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Mass Balance and Energy Balance in a Simple Steady Flow Process”.
1. Equation of continuity comes from
a) conservation of energy
b) conservation of mass
c) conservation of work
d) conservation of heat
View AnswerAnswer: b

Explanation: w1=w2 i.e., we get (AV/v)1=(AV/v)2 and this is called equation of continuity(where w1 & w2 are mass flow rates).

2. In a flow process, the work transfer may of which type?
a) external work
b) flow work
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Flow work is the displacement work and external work mostly comprises of shaft work.
3. The total rate of flow of all energy streams entering the control volume must equal to that of leaving the control volume.
a) true
b) false
View AnswerAnswer: a
Explanation: Given statement is true by the conservation of energy.
4. Which of the following represents the steady flow energy equation?
a) Q+Wx=(h2-h1)-(V2-V1)(V2+V1)/2+g(Z2-Z1)
b) Q+Wx=(h2-h1)+(V2-V1)(V2+V1)/2+g(Z2-Z1)
c) Q-Wx=(h2-h1)-(V2-V1)(V2+V1)/2+g(Z2-Z1)
d) Q-Wx=(h2-h1)+(V2-V1)(V2+V1)/2+g(Z2-Z1)
View AnswerAnswer: d
Explanation: This equation is the general form of SFEE and it involves conservation of mass and energy.

5. When more than one fluid stream is in a control volume, which of the following is more convenient?
a) energy flow per unit time
b) energy flow per unit mass
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: It makes calculations less difficult.
6. In the differential form, the SFEE comes
a) dQ+dW=dh+VdV+gdZ
b) dQ-dW=dh+VdV+gdZ
c) dQ+dW=dh-VdV-gdZ
d) dQ-dW=dh-VdV+gdZ
View AnswerAnswer: b

Explanation: This equation is the differential form of SFEE.
7. The steady flow energy equation is applied to which of the following processes?
a) pipe line flows
b) heat transfer processes
c) combustion processes
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the applications of SFEE.

8. When more than one fluid stream enters or leaves the control volume, which type of balance is taken?
a) mass balance
b) energy balance
c) mass balance and energy balance
d) none of the mentioned
View AnswerAnswer: c
Explanation: Both energy and mass balance are considered here.
9. What are the different kinds of external work?
a) shear work
b) electrical work
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Given two kinds of external work are important.
10. The flow work is the displacement work done by the fluid and is given by
a) -pvdm
b) pvdm
c) pvdm or -pvdm depending on whether it is inlet or exit
d) none of the mentioned
View AnswerAnswer: c
Explanation: At inlet, flow work=-pvdm and at exit, flow work=pvdm.

« Prev - Thermodynamics Questions and Answers – Specific Heat at Constant Volume and Pressure and Control Volume» Next - Thermodynamics Questions and Answers – Examples of Steady Flow ProcessesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Examples of Steady Flow Processes”.
1. What does a nozzle do?

a) decreases the velocity of a fluid at the cost of its pressure gain
b) increases the velocity of a fluid at the cost of its pressure drop
c) increases the velocity of a fluid and also its pressure
d) none of the mentioned.
View AnswerAnswer: b
Explanation: A nozzle increases KE of fluid and reduces its pressure.

2. What does a diffuser do?
a) increases the pressure of the fluid at the expense of its KE
b) decreases the pressure of the fluid and also increases its KE
c) increases the pressure of the fluid and also its KE
d) decreases the pressure of the fluid and also its KE
View AnswerAnswer: a
Explanation: A diffuser increases the pressure at the expense of its KE.
3. For an insulated nozzle, SFEE of the control surface gives (considering change in PE is zero and inlet velocity is small compared to exit velocity)
a) V2=sqrt(4*Δh)
b) V2=sqrt(Δh)
c) V2=sqrt(Δh/2)
d) V2=sqrt(2*Δh)
View AnswerAnswer: d
Explanation: dQ/dm=0, dW/dm=0, Δh=h1-h2.
4. Fluid flow through which of the following throttles the flow?
a) partially opened valve
b) orifice
c) porous plug
d) all of the mentioned
View AnswerAnswer: d
Explanation: In all of the given cases, there is an appreciable drop in pressure and hence the flow is throttled.
5. In a throttling device, what do we get as SFEE when changes in PE and KE are taken zero?
a) dQ/dm≠0
b) dW/dm≠0
c) h1=h2
d) none of the mentioned
View AnswerAnswer: c
Explanation: Enthalpy of the fluid fore throttling is equal to the enthalpy of the fluid after throttling.

6. Turbines and engines ____ positive power output, and compressors and pumps ____ power input.
a) require, give
b) give, require
c) give, give
d) require, require
View AnswerAnswer: b
Explanation: This is the basic information about turbines, engines, compressors and pumps.
7. For a turbine, it is seen that work is done by the fluid at the expense of its enthalpy.
a) true
b) false
View AnswerAnswer: a
Explanation: For a turbine, W/m=h1-h2.
8. For an adiabatic compressor or pump,
a) the enthalpy of fluid remains constant with the amount of work input
b) the enthalpy of fluid decreases by the amount of work input
c) the enthalpy of fluid increases by the amount of work input
d) none of the mentioned
View AnswerAnswer: c
Explanation: For an adiabatic pump or compressor, W/m=h2-h1.
9. A heat exchanger is a device in which heat is transferred from one fluid to another.
a) true
b) false
View AnswerAnswer: a
Explanation: Basic fact about heat exchanger.

10. For an inviscid frictionless fluid flowing through a pipe, Euler equation is given by
a) Vdp+VdV+gdZ=0
b) Vdp-VdV+gdZ=0
c) Vdp-VdV-gdZ=0
d) none of the mentioned
View AnswerAnswer: a
Explanation: Euler equation is derived from steady flow energy equation.
11. The rnoulli equation is restricted to _____ fluids but the SFEE is valid for _____ fluids as well.
a) viscous compressible, frictionless incompressible
b) frictionless incompressible, viscous compressible
c) viscous incompressible, frictionless compressible
d) none of the mentioned
View AnswerAnswer: b

Explanation: This statement tells us that the rnoulli equation is a limiting case of SFEE.

« Prev - Thermodynamics Questions and Answers – Mass Balance and Energy Balance in a Simple Steady Flow Process» Next - Thermodynamics Questions and Answers – Variable Flow ProcessesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Variable Flow Processes”.

1. Variable flow processes include
a) filling up a gas cylinder
b) evacuating a gas cylinder
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are variable flow processes which can analysed by the control volume technique.

2. The rate at which the mass of fluid within the control volume is accumulated is equal to the net rate of mass flow across the control surface.
a) true
b) false
View AnswerAnswer: a
Explanation: (dm/dt)=w1-w2, where m is the mass of fluid within the control volume at any instant.
3. Rate of energy increase within the control volume is given by
a) rate of energy inflow + rate of energy outflow
b) rate of energy inflow – rate of energy outflow
c) rate of energy inflow = rate of energy outflow
d) none of the mentioned
View AnswerAnswer: b
Explanation: The rate of accumulation of energy within the control volume is equal to the net energy flow across the control surface.
4. Which of the following is true for steady flow?
a)(dE/dt)=0
b)(dE/dt)>0
c)(dE/dt)<0
d) none of the mentioned
View AnswerAnswer: a
Explanation: Rate of change of energy of fluid with respect to time within the control volume is constant.
5. Variable flow processes can analysed by
a) system technique
b) constant volume technique
c) both of the mentioned

d) none of the mentioned
View AnswerAnswer: c
Explanation: These two are the main techniques used for analysing variable flow process.

6. Using system technique, energy balance for the process comes out to
a) m2u2+m1u1+(m2-m1)(((V^2)/2)+(h/2))
b) m2u2-m1u1+(m2-m1)(((V^2)/2)+(h/2))
c) m2u2+m1u1-(m2-m1)(((V^2)/2)+(h/2))
d) m2u2-m1u1-(m2-m1)(((V^2)/2)+(h/2))
View AnswerAnswer: d
Explanation: This comes from the first law by neglecting PE, KE and E is the energy of the gas.
7. Both the techniques for analysing variable flow processes gives same result.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause these techniques have same initial assumptions and hence give same result.
8. In ____ filling a bottle with air at 300K, the gas temperature rises to 420K due to flow work ing converted to ____ increase.
a) adiabatically, heat
b) adiabatically, internal energy
c) constant pressure, heat
d) none of the mentioned
View AnswerAnswer: b
Explanation: In the energy equation, m1=0, Q=0, h>>(V^2)/2, we will get we will get that flow work is converted to increase in molecular internal energy.
9. Which of the following is true for a discharging tank?
a) the process is adiabatic
b) the process is quasi-static
c) dQ=0
d) all of the mentioned
View AnswerAnswer: d
Explanation: Applying first law to the control volume and dW=0, dm=0 and KE and PE of the fluid are assumed to small.

10. For charging a tank,
a) enthalpy is converted to work done
b) work done is converted to enthalpy

c) enthalpy is converted to internal energy
d) internal energy is converted to work done
View AnswerAnswer: c
Explanation: Tank is initially taken to empty and $\Delta U=(m2u2-m1u1)=(mh)$ at constant state of the fluid in the pipeline.
11. For a variable flow process
a) P.E. terms are neglected
b) K.E. of the fluid is assumed to small
c) the process is not steady
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some of the basic assumptions for a variable flow process.

« Prev - Thermodynamics Questions and Answers – Examples of Steady Flow Processes» Next - Thermodynamics Questions and Answers – Polytropic Process-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Polytropic Process-1”.
1. A polytropic process(n = – 1) starts with P = 0, V = 0 and ends with P= 600 kPa, V = 0.01 m3. Find the boundary work done.
a) 1 kJ
b) 2 kJ
c) 3 kJ
d) 4 kJ
View AnswerAnswer: c
Explanation: $W = \int PdV$
$= (1/2)(P1 + P2)(V2 – V1)$
$= (1/2)(P2 + 0)(V2 – 0)$
$= (1/2)(600*0.1)$
$= 3$ kJ.

2. The piston/cylinder contains carbon dioxide at 300 kPa, with volume of 0.2 m3 and at 100°C. Mass is added at such that the gas compresses with PV^(1.2) = constant to a final temperature of 200°C. Determine the work done during the process.
a) -80.4 kJ
b) -40.4 kJ
c) -60.4 kJ
d) -50.4 kJ
View AnswerAnswer: a
Explanation: Work done = (P2V2 – P1V1)/(1-n) and mR = (P1V1)/T1 = 0.1608 kJ/K
Work done = 0.1608(473.2 – 373.2)/(1 – 1.2) = -80.4 kJ.
3. Neon at 400 kPa, 20°C is brought to 100°C in a polytropic process with n = 1.4. Find the work done.

a) -52.39 kJ/kg
b) -62.39 kJ/kg
c) -72.39 kJ/kg
d) -82.39 kJ/kg
View AnswerAnswer: d
Explanation: For Neon, $k = \gamma = 1.667$ so $n < k$, $Cv = 0.618$, $R = 0.412$

$1w2 = [R/(1-n)](T2 - T1) = -82.39$ kJ/kg.

4. A mass of 1kg of air contained in a cylinder at 1000 K, 1.5 MPa, expands in a reversible adiabatic process to 100 kPa. Calculate the work done during the process using Constant specific heat.
a) 286.5 kJ
b) 386.5 kJ
c) 486.5 kJ
d) 586.5 kJ
View AnswerAnswer: b
Explanation: Process: $1Q2 = 0$, $1S2$ gen $= 0 \Rightarrow s2 = s1$

$T2 = T1(P2/P1)^{[(k-1)/k]} = 1000(0.1/1.5)0.286 = 460.9$ K

$1W2 = -(U2 - U1) = mCv(T1 - T2)$

$= 1 \times 0.717(1000 - 460.9) = 386.5$ kJ.

5. A cylinder/piston contains 1kg methane gas at 100 kPa, 20°C. The gas is compressed reversibly to a pressure of 800 kPa. Calculate the work required if the process is isothermal.
a) -216.0 kJ
b) -316.0 kJ
c) -416.0 kJ
d) -516.0 kJ
View AnswerAnswer: b
Explanation: Process: T = constant. For ideal gas then $u2 = u1$ $1W2 = 1Q2$ and $\int dQ/T = 1Q2/T$

$1W2 = 1Q2 = mT(s2 - s1) = -mRT \ln(P2/P1)$

$= -0.51835 \times 293.2 \ln(800/100) = -316.0$ kJ.

6. A cylinder/piston contains 1kg methane gas at 100 kPa, 20°C. The gas is compressed reversibly to a pressure of 800 kPa. Calculate the work required if the process is polytropic, with exponent n = 1.15.
a) -314.5 kJ
b) -414.5 kJ
c) -514.5 kJ
d) -614.5 kJ
View AnswerAnswer: a
Explanation: Process: $Pv^{(n)}$ = constant with n = 1.15 ;

$T2 = T1(P2/P1)^{[(n-1)/n]} = 293.2(800/100)^{0.130} = 384.2$ K

$1W2 = \int mP\, dv = m(P2v2 - P1v1)/(1 - n) = mR (T2 - T1)/(1 - n)$

$= 1*0.51835(384.2 - 293.2)/(1 - 1.15) = -314.5$ kJ.

7. Helium in a piston/cylinder at 20°C, 100 kPa is brought to 400 K in a reversible

polytropic process with exponent $n = 1.25$. Helium can assumed to an ideal gas with constant specific heat. Find the specific work.

a) -587.7 kJ/kg
b) -687.7 kJ/kg
c) -787.7 kJ/kg
d) -887.7 kJ/kg

View AnswerAnswer: d

Explanation: Process: $Pv^{n} = C$ & $Pv = RT \Rightarrow Tv^{(n-1)} = C$

$C_v = 3.116$ kJ/kg K, $R = 2.0771$ kJ/kg K

$v_2 / v_1 = (T_1 / T_2)^{[1/(n-1)]} = 0.2885$

$P_2 / P_1 = (v_1 / v_2)^{n} = 4.73 \Rightarrow P_2 = 473$ kPa

$W = (P_2 v_2 - P_1 v_1)/(1-n) = R(T_2-T_1)/(1-n) = -887.7$ kJ/kg.

8. Consider air in a cylinder volume of 0.2 L at 7 MPa, 1800K. It now expands in a reversible polytropic process with exponent, $n = 1.5$, through a volume ratio of 8:1. Calculate the work for the process.

a) 1.61 kJ
b) 1.71 kJ
c) 1.81 kJ
d) 1.91 kJ

View AnswerAnswer: c

Explanation: Process: $PV^{(1.50)} = \text{constant}$, $V_2/V_1 = 8$

State 1: $P_1 = 7$ MPa, $T_1 = 1800$ K, $V_1 = 0.2$ L, $m_1=P_1V_1/RT_1 = 2.71\times10^{-3}$ kg

State 2: $T_2 = T_1 (V_1/V_2)^{(n-1)} = 1800(1/8)^{(0.5)} = 636.4$ K

${}_1W_2 = \int PdV = mR(T_2 - T_1)/(1 - n)$

$= 2.71\times10^{(-3)} \times 0.287(636.4 - 1800)/(1-1.5) = 1.81$ kJ.

9. A cylinder/piston contains carbon dioxide at 300°C, 1 MPa with a volume of 200L. The total external force acting on the piston is proportional to V^3. This system is allowed to cool to room temperature, 20°C. Find the work.

a) -24.4 kJ
b) -34.4 kJ
c) -44.4 kJ
d) -54.4 kJ

View AnswerAnswer: a

Explanation: $PV^{(-3)} = \text{constant}$

State 1: $m = P_1V_1/RT_1 = (1000 \times 0.2)/(0.18892 \times 573.2) = 1.847$ kg

$P_2 = P_1(T_2/T_1)^{[n/(n-1)]} = 1000(293.2/573.2)^{(3/4)} = 604.8$ kPa

$V_2 = V_1(T_1/T_2)^{[1/(n-1)]} = 0.16914$ m^3

Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = [604.8 \times 0.16914 - 1000 \times 0.2] / [1-(-3)]$

$= -24.4$ kJ.

10. A cylinder/piston contains 100L of air at 25°C, 110 kPa. The air is compressed in a reversible polytropic process to a final state of 200°C, 800 kPa. Assume the heat transfer is with the ambient at 25°C. Find the work done by the air.
a) -11.28 kJ
b) -21.28 kJ
c) -31.28 kJ
d) -41.28 kJ
View AnswerAnswer: b
Explanation: m = P1V1 /(RT1) = 110 × 0.1/(0.287 × 298.15) = 0.1286 kg
T2/T1 = (P2/P1)^[(n-1)/n] => 473.15/298.15 = (800/110)^[(n-1)/n]
⇒ (n-1)/n = 0.2328 hence n = 1.3034
V2 = V1(P1/P2)^(1/n) = 0.1(110/800)^(0.7672) = 0.02182 m^3
Work = ∫PdV = (P2V2 – P1V1)/(1-n) = (800 × 0.02182 – 110 × 0.1)/(1 – 1.3034)
= -21.28 kJ.
11. A mass of 2 kg ethane gas at 100°C, 500 kPa, undergoes a reversible polytropic expansion with n = 1.3, to a final temperature of 20°C. Find the work done.
a) 43.7 kJ/kg
b) 53.7 kJ/kg
c) 63.7 kJ/kg
d) 73.7 kJ/kg
View AnswerAnswer: d
Explanation: P2 = P1(T2/T1)^[n/(n-1)] = 500(293.2/373.2)^(4.333) = 175.8 kPa
Work = ∫PdV = (P2V2 – P1V1)/(1-n) = R(T2-T1)/(1-n)
= 0.2765(293.2-373.2)/(1-1.30) = 73.7 kJ/kg.
12. A piston/cylinder contains air at 100 kPa, 300 K. A reversible polytropic process with n = 1.3 brings the air to 500 K. Any heat transfer if it comes in is from a 325°C reservoir and if it goes out it is to the ambient at 300 K. Find the specific work.
a) -171.3 kJ/kg
b) -181.3 kJ/kg
c) -191.3 kJ/kg
d) -201.3 kJ/kg
View AnswerAnswer: c
Explanation: Process : Pv^(n) = C
Work = ∫PdV = (P2V2 – P1V1)/(1-n) = R(T2-T1)/(1-n)
= 0.287 (500 – 300)/(1 – 1.3) = -191.3 kJ/kg.
13. A cylinder/piston contains saturated vapour R-22 at 10°C; the volume is 10 L. The R-22 is compressed to 60°C, 2 MPa in a reversible polytropic process. If all the heat transfer during the process is with the ambient at 10°C, calculate the work done.
a) −6.26 kJ
b) −7.26 kJ
c) −8.26 kJ
d) −9.26 kJ
View AnswerAnswer: b
Explanation: State 1: P1 = 0.681 MPa, v1 = 0.03471; m = V1/v1 = 0.01/0.03471 = 0.288 kg

State 2: v_2 = 0.01214 m^3/kg; P2/P1 = 2.0/0.681 = (0.03471/0.01214)^(n)
=> n = 1.0255
Work = ∫PdV = m(P2v2 – P1v1)/(1-n)
= 0.288(2000 × 0.01214 – 681 × 0.03471)/(1 – 1.0255) = –7.26 kJ.

« Prev - Thermodynamics Questions and Answers – Variable Flow Processes» Next - Thermodynamics Questions and Answers – Polytropic Process-2This set of Thermodynamics Inteview Questions and Answers for freshers focuses on “Polytropic Process-2”.

1. A cylinder/piston contains air at 100 kPa and 20°C with a V=0.3 m^3. The air is compressed to 800 kPa in a reversible polytropic process with n = 1.2, after which it is expanded back to 100 kPa in a reversible adiabatic process. Find the net work.
a) -174.6 kJ/kg
b) -154.6 kJ/kg
c) -124.6 kJ/kg
d) -194.6 kJ/kg
View AnswerAnswer: a
Explanation: m = P1V1/RT1 = (100 × 0.3)/(0.287 × 293.2) = 0.3565 kg
T2/T1 = (P2/P1)^[(n-1)/n] = 293.2(800/100)^(0.167) = 414.9 K
W = (P2 v2 – P1 v1)/(1-n) = R(T2-T1)/(1-n)
= 0.287(414.9-293.2)/(1-1.20) = -174.6 kJ/kg.

2. A piston-cylinder contains carbon dioxide at 2MPa with V=50 L. The device has a mass of 4 kg. Everything is initially at 200°C. By heat transfer the whole system cools to 25°C, at which point the gas pressure is 1.5 MPa. Find the work done.
a) -10.0 kJ
b) -12.0 kJ
c) -14.0 kJ
d) -16.0 kJ
View AnswerAnswer: c
Explanation: CO2: m = P1V1/RT1 = 2000 × 0.05/(0.18892 × 473.2) = 1.1186 kg
V2 = V1(P1/P2)(T2/T1) = 0.05(2/1.5)(298.2/473.2) = 0.042 m^3
Work = ∫PdV = (P1 + P2)(V2 – V1)/2 = (2000 + 1500)(0.042 –

0.050)/2
= -14.0 kJ.

3. A gas initially at 500°C, 1 MPa is contained in a piston-cylinder arrangement with an initial volume of 0.1 m^3. It is then slowly expanded according to the relation PV = constant until a final pressure of 100 kPa is attained. Determine the work for this process.

a) 200.3 kJ
b) 210.3 kJ
c) 220.3 kJ
d) 230.3 kJ

View AnswerAnswer: d

Explanation: Process: PV = C ⇒ V2 = P1V1/P2 = 1000 × 0.1/100 = 1 m^3
1W2 = ∫ P dV = ∫ CV^(-1)dV = C ln(V2/V1)
1W2 = P1V1 ln(V2/V1) = 1000 × 0.1 ln (1/0.1) = 230.3 kJ.

4. Helium gas expands from 350 K, 125 kPa and 0.25 m^3 to 100 kPa in a polytropic process with n = 1.667. How much work does it give out?

a) 3.09 kJ
b) 4.09 kJ
c) 5.09 kJ
d) 6.09 kJ

View AnswerAnswer: b

Explanation: Process: PV^n = constant = P1(V1)^n = P2(V2)^n
V2 = V1 (P1/P2)^(1/n) = 0.25 × (125/100)^(0.6) = 0.2852 m^3
Work = (P2V2 – P1V1)/(1-n) = (100× 0.2852 – 125× 0.25)/(1 – 1.667)
= 4.09 kJ.

5. Air goes through a polytropic process from 325 K, 125 kPa to 500 K, 300 kPa. Find the specific work in the process.

a) -51.8 kJ/kg
b) -61.8 kJ/kg
c) -71.8 kJ/kg
d) -81.8 kJ/kg

View AnswerAnswer: a

Explanation: Process: Pv^(n) = Const = P1(v1)^n = P2(v2)^n
Ideal gas Pv = RT hence v1 = RT/P = 0.287 × 325/125 = 0.7462 m^3/kg
v1 = RT/P = 0.287 × 500/300 = 0.47833 m^3/kg
n = ln(P2/P1) / ln(v1/v2) = ln 2.4 / ln 1.56 = 1.969
Work = (P2v2 – P1v1)/(1-n) = R(T2-T1)/(1-n) = 0.287(500 – 325)/(1-1.969)
= -51.8 kJ/kg.

6. A piston-cylinder contains 0.1 kg air at 400 K, 100 kPa which goes through a polytropic compression process (n = 1.3) to a pressure of 300 kPa. How much work has en done by air in the process?

a) -277 kJ

b) -377 kJ
c) -477 kJ
d) -577 kJ
View AnswerAnswer: c
Explanation: Process: $Pv^{n} = Const$;
$T_2 = T_1 (P_2 V_2 / P_1V_1) = T_1 (P_2 / P_1)(P_1 / P_2)^{(1/n)}$
$= 400 \times (300/100)^{(1 - 1/1.3)} = 515.4$ K
Work $= (P_2V_2 - P_1V_1)/(1-n) = mR(T_2-T_1)/(1-n)$
$= (0.2 \times 0.287)(515.4-400)/(1 - 1.3) = -477$ kJ.
7. A balloon haves according to the equation $P = (C_2)V^{(1/3)}$, $C_2 = 100$ kPa/m. The balloon is blown up with air from a volume of 1 m^3 to a volume of 3 m^3. Find the work done by the air assuming it is at 25°C.
a) 219.5 kJ
b) 229.5 kJ
c) 239.5 kJ
d) 249.5 kJ
View AnswerAnswer: d
Explanation: The process is polytropic with exponent n = -1/3.
$P_1 = (C_2)V^{(1/3)} = 100 \times 1^{(1/3)} = 100$ kPa
$P_1 = (C_2)V^{(1/3)} = 100 \times 3^{(1/3)} = 144.22$ kPa
Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = (144.22 \times 3 - 100 \times 1)/(1 - (-1/3))$
$= 249.5$ kJ.
8. A balloon haves such that pressure inside it is proportional to the diameter squared. It contains 2kg of ammonia at 0°C, 60% quality. They are now heated so that the final pressure is 600 kPa. Find the work done in the process.
a) 117.5 kJ
b) 127.5 kJ
c) 137.5 kJ
d) 147.5 kJ
View AnswerAnswer: a
Explanation: Process : $P \propto D^2$, with $V \propto D^3$ this implies $P \propto D^2 \propto V^{(2/3)}$
so $PV^{(-2/3)} =$ constant, hence $n = -2/3$
$V_1 = mv_1 = 2(0.001566 + 0.6 \times 0.28783) = 0.3485$ m^3
$V_2 = V_1 \cdot (P_2/P_1)^{(3/2)} = 0.3485(600/429.3)^{(3/2)} = 0.5758$ m^3
Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = (600 \times 0.5758 - 429.3 \times 0.3485)/[1 - (-2/3)]$
$= 117.5$ kJ.
9. Consider a piston-cylinder with 0.5 kg of R-134a as saturated vapour at -10°C. It is compressed to a pressure of 500 kPa in a polytropic process with n = 1.5. Determine the work done during the process.
a) -6.07 kJ
b) -7.07 kJ
c) -8.07 kJ
d) -9.07 kJ
View AnswerAnswer: b
Explanation: $Pv^{(1.5)} =$ constant until P = 500 kPa
1: $v_1 = 0.09921$ m3/kg, $P = P_{sat} = 201.7$ kPa
2: $v_2 = v_1(P_1/P_2)^{(1/1.5)} = 0.09921 \times (201.7/500)^{(2/3)} =$

0.05416
hence it is superheated vapour at T2 = 79°C
Work = ⌠PdV = m(P2 v2 – P1 v1)/(1-1.5) = 2*(500 × 0.05416 – 201.7 × 0.09921)/(-0.5)
= -7.07 kJ.

10. R-12 in a piston-cylinder arrangement is initially at 50°C, x = 1. It is then expanded in a process so that P = Cv^(–1) to a pressure of 100 kPa. Find the work.
a) 23.2 kJ/kg
b) 33.2 kJ/kg
c) 43.2 kJ/kg
d) 53.2 kJ/kg
View AnswerAnswer: c
Explanation: State 1: 50°C, x=1, P1 = 1219.3 kPa, v1 = 0.01417 m^3/kg
Process: P = Cv^(-1) ⇒ Work = ∫ P dv = C ln(v2/v1)
State 2: 100 kPa thus v2 = (v1)(P1)/P2 = 0.1728 m^3/kg hence T = – 13.2°C
Work = P1v1[ln(v2/v1)] = 1219.3 × 0.01417 × ln(0.1728/0.01417)
= 43.2 kJ/kg.
11. A piston-cylinder contains water at 3 MPa, 500°C. It is cooled in a polytropic process to 1 MPa, 200°C. Find the specific work in the process.
a) 155.2 kJ
b) 165.2 kJ
c) 175.2 kJ
d) 185.2 kJ
View AnswerAnswer: a
Explanation: Pv^(n) = C thus (P1/P2) = (v2/v1)^n
n= ln(P1/P2) / ln(v2/v1) = 1.0986/0.57246 = 1.919
Work = ⌠PdV = (P2 v2 – P1 v1)/(1-n) = (1000 × 0.20596 – 3000 × 0.11619)/(1 – 1.919)
= 155.2 kJ.
12. A piston/cylinder contains carbon dioxide at 300 kPa, 100°C with a volume of 0.2 m^3. Weights are added at such a rate that the gas compresses according to the relation PV^1.2 = constant to a final temperature of 200°C. Determine the work done during the process.
a) 70.4 kJ
b) -70.4 kJ
c) 80.4 kJ
d) -80.4 kJ
View AnswerAnswer: d
Explanation: For the Polytropic process PV^n = constant
1W2 = ∫PdV = (P2V2 – P1V1)/(1 – n)

Assuming ideal gas, PV = mRT
But mR = P1V1/T1 = 300 × 0.2/373.15 = 0.1608 kJ/K
1W2 = 0.1608(473.15 – 373.15)/(1 – 1.2) = -80.4 kJ.
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« Prev - Thermodynamics Questions and Answers – Polytropic Process-1» Next - Thermodynamics Questions and Answers – Second Law of ThermodynamicsThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Second Law of Thermodynamics”.

1. Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the net power output for this heat engine.
a) 30 MW
b) 40 MW
c) 50 MW
d) 60 MW
View AnswerAnswer: a
Explanation: Net power output = 80 – 50 MW = 30 MW.

2. Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the thermal efficiency for this heat engine.
a) 47.5 %
b) 27.5 %
c) 37.5 %
d) none of the mentioned
View AnswerAnswer: c
Explanation: The thermal efficiency of heat engine = net work output / heat input
= 30/80 = 0.375 = 37.5 %.
3. A car engine with a power output of 50 kW has a thermal efficiency of 24 percent.

Determine the fuel consumption rate of this car if the fuel has a heating value of 44,000 kJ/kg .
a) 0.00273 kg/s
b) 0.00373 kg/s
c) 0.00473 kg/s
d) 0.00573 kg/s
View AnswerAnswer: c
Explanation: Q = 50/0.24 = 208.3 kW,
hence fuel consumption rate = 208.3 kW / 44000 kJ/kg = 0.00473 kg/s.
4. The food compartment of a refrigerator is maintained at 4°C by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2kW, determine the coefficient of performance of the refrigerator.

a) 4
b) 3
c) 2
d) 1
View AnswerAnswer: b
Explanation: COP = (360/2)(1/60) = 3.
5. The food compartment of a refrigerator is maintained at 4°C by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2kW, determine the rate of heat rejection to the room that houses the refrigerator.
a) 450 kJ/min
b) 460 kJ/min
c) 470 kJ/min
d) 480 kJ/min
View AnswerAnswer: d
Explanation: Q = 360 + (2)(60/1) = 480 kJ/min.

6. A heat pump is used to meet the heating requirements of a house and maintain it at 20°C. On a day when the outdoor air temperature drops to 2°C, the house is estimated to lose heat at a rate of 80,000 kJ/h. If the heat pump under these conditions has a COP of 2.5, determine the power consumed by the heat pump.
a) 32000 kJ/h
b) 33000 kJ/h
c) 34000 kJ/h
d) 35000 kJ/h
View AnswerAnswer: a
Explanation: W = Q/COP = 80000 kJ/h / 2.5 = 32000 kJ/h.
7. A heat pump is used to meet the heating requirements of a house and maintain it at 20°C. On a day when the outdoor air temperature drops to 2°C, the house is estimated to lose heat at a rate of 80,000 kJ/h. If the heat pump under these conditions has a COP of 2.5, determine the rate at which heat is absord from the cold outdoor air.
a) 32000 kJ/h
b) 48000 kJ/h

c) 54000 kJ/h
d) 72000 kJ/h
View AnswerAnswer: b
Explanation: The rate at which heat is absord = 80000 – 32000 = 48000 kJ/h.
8. An air-conditioner provides 1 kg/s of air at 15°C cooled from outside atmospheric air at 35°C. Estimate the amount of power needed to operate the air-conditioner.
a) 1.09 kW
b) 1.19 kW
c) 1.29 kW
d) 1.39 kW
View AnswerAnswer: d
Explanation: Q = m*cp*(temperature change) = 20.08 kW
COP = (15+273)/(35-15) = 14.4
hence power needed = 20/14.4 = 1.39 kW.
9. A cyclic machine, as shown low, receives 325 kJ from a 1000 K energy reservoir. It rejects 125 kJ to a 400 K energy reservoir and the cycle produces 200kJ of work as output. Is this cycle reversible, irreversible, or impossible?
a) reversible
b) irreversible
c) impossible
d) none of the mentioned
View AnswerAnswer: c
Explanation: The Carnot efficiency = 1 – (400/1000) = 0.6 and real efficiency = (300/325) = 0.615 which is greater than the Carnot efficiency hence cycle is impossible.

10. In a cryogenic experiment you need to keep a container at -125°C although it gains 100 W due to heat transfer. What is the smallest motor you would need for a heat pump absorbing heat from the container and rejecting heat to the room at 20°C?
a) 97.84 kW
b) 98.84 kW
c) 99.84 kW
d) 95.84 kW
View AnswerAnswer: a
Explanation: COP = 1.022 and thus power required = 100/1.022 = 97.84 kW.
11. A car engine operates with a thermal efficiency of 35%. Assume the air-conditioner has a coefficient of performance of 3 working as a refrigerator cooling the inside using engine shaft work to drive it. How much fuel energy should spend extra to remove 1 kJ from the inside?
a) 0.752 kJ
b) 0.952 kJ
c) 0.852 kJ
d) none of the mentioned

View AnswerAnswer: b
Explanation: W = thermal efficiency * Q(fuel) thus Q(fuel) = 1/(0.35*3) = 0.952 kJ.

« Prev - Thermodynamics Questions and Answers – Polytropic Process-2» Next - Thermodynamics Questions and Answers – Cyclic Heat EngineThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Cyclic Heat Engine”.

1. The first law of thermodynamics doesn’t tell us whether a thermodynamic process is feasible or not.
a) true
b) false
View AnswerAnswer: a
Explanation: The second law of thermodynamics provides criterion as to the probability of a process.

2. According to Joule’s experiments,
a) heat can completely converted into work
b) work can completely converted into heat
c) both heat and work are completely interchangeable
d) all of the mentioned
View AnswerAnswer: b
Explanation: Work transfer -> internal energy increase -> heat transfer.
3. Which of the following is true?
a) work is a high grade energy
b) heat is a low grade energy
c) complete conversion of low grade energy into high grade energy in a cycle is impossible
d) all of the mentioned
View AnswerAnswer: d
Explanation: These facts are in accordance with Joule’s work and underlies the work of Carnot.
4. In a cyclic heat engine there is
a) net heat transfer to the system and net work transfer from the system
b) net heat transfer from the system and net work transfer to the system
c) depends on the conditions of cycle
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the basic concept of cycle heat engine.
5. Boiler, turbine, condenser and pump together constitute a heat engine.
a) true
b) false
View AnswerAnswer: a
Explanation: It is an example for a cyclic heat engine.

6. In a heat engine cycle, which of the following process occurs?
a) heat is transferred from furnace to boiler
b) work is produced in turbine rotor
c) steam is condensed in condenser
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the basic processes occurring in a heat engine cycle comprising of furnace, boiler condenser and a turbine.
7. The function of a heat engine cycle is to _____ continuously at the expense of _____ to the system.
a) heat input, produce work
b) produce work, heat input
c) can both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: Net work and heat input are of primary interest in a cycle.
8. Efficiency of a heat engine is defined as
a) total heat output / net work input
b) total heat input / net work output
c) net work output / total heat input
d) net work input / total heat output
View AnswerAnswer: c
Explanation: Basic definition of efficiency.
9. A thermal energy reservoir is a large body of
a) small heat capacity
b) large heat capacity
c) infinite heat capacity
d) none of the mentioned
View AnswerAnswer: c
Explanation: Basic fact about TER.

10. Processes inside a thermal energy reservoir are quasi-static.
a) true
b) false
View AnswerAnswer: a
Explanation: The changes taking place in TER are very slow and minute.
11. A TER which transfers heat to system is called ____ and one which receives heat is called ____
a) source, sink
b) sink, source

c) sink, sink
d) source, source
View AnswerAnswer: a
Explanation: A source transfers heat while a sink receives heat.
12. Which if the following statements are true for a mechanical energy reservoir(MER)?
a) it is a large body enclosed by an adiabatic impermeable wall
b) stores work as KE or PE
c) all processes within an MER are quasi-static
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some important features of an MER.

« Prev - Thermodynamics Questions and Answers – Second Law of Thermodynamics» Next - Thermodynamics Questions and Answers – Kelvin-Planck Statement and Clausius' Statement of Second LawThis set of Thermodynamics Questions and Answers for experienced focuses on "Kelvin-Planck Statement and Clausius' Statement of Second Law".
1. According to Kelvin-Planck statement, it is ____ for a heat engine to produce net work in a complete cycle if it exchanges heat only with bodies at ____
a) impossible, single fixed temperature
b) possible, changing temperature
c) impossible, changing temperature
d) possible, single fixed temperature
View AnswerAnswer: a
Explanation: This is the basic definition of Kelvin-Planck statement.

2. If heat rejected from the system Q2 is zero, then
a) net work=Q1 and efficiency=1.00
b) heat is exchanged only with one reservoir
c) it violates the Kelvin-Planck statement

d) all of the mentioned
View AnswerAnswer: d
Explanation: Such a heat engine is called a perpetual motion machine of the second kind(PMM2).
3. A PMM2 is possible.
a) true
b) false
View AnswerAnswer: b
Explanation: A PMM2 is impossible cause it violates the Kelvin-Planck statement.
4. A heat engine has to exchange heat with ___ energy reservoir at ___ different temperatures to produce net work in a complete cycle.
a) one, one
b) one, two
c) two, two
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is required to produce power.

5. The second law is not a deduction of the first law.
a) true
b) false
View AnswerAnswer: a
Explanation: The first law is a separate law of nature.
6. The continual operation of a machine that creates its own energy and thus violates the first law is called
a) PMM2
b) PMM1
c) PMM0
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is a basic fact about PMM1.
7. Which of the following is true?
a) heat always from a high temperature body to a low temperature body
b) heat always from a low temperature body to a high temperature body
c) heat can flow from both low to high and high to low temperature body
d) none of the mentioned
View AnswerAnswer: a
Explanation: The reverse process never occurs spontaneously.

8. According to Clausius statement

a) it is impossible to construct a device than can transfer heat from a cooler body to a hotter body without any effect
b) it is impossible to construct a device than can transfer heat from a hotter body to a cooler body without any effect
c) it is possible to construct a device than can transfer heat from a cooler body to a hotter body without any effect
d) none of the mentioned
View AnswerAnswer: a
Explanation: To transfer heat from a cooler body to a hotter body, some work must expended.
9. If the second law were not true
a) a ship could driven by extracting heat from the ocean
b) run a power plant by extracting heat from the air
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Both of the above possibilities do not violate the first law but do violate the second law.
10. The operation of a machine that utilizes the internal energy of only one TER, thus violating second law is called
a) PMM0
b) PMM1
c) PMM2
d) none of the mentioned
View AnswerAnswer: b
Explanation: PMM2 violates the second law.

« Prev - Thermodynamics Questions and Answers – Cyclic Heat Engine» Next - Thermodynamics Questions and Answers – Refrigerator and Heat PumpThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Refrigerator and Heat Pump”.
1. Which device maintains a body at a temperature lower than the temperature of the surroundings?
a) PMM1
b) PMM2
c) refrigerator
d) heat pump
View AnswerAnswer: c
Explanation: This is the main function of a refrigerator.

2. What does a refrigerant do?
a) absorbs the heat leakage into body from surroundings
b) evaporates in the evaporator
c) absorbs latent heat of vaporization form the body which is cooled
d) all of the mentioned
View AnswerAnswer: d
Explanation: Refrigerant is required for the proper functioning of a refrigerator.
3. Coefficient of performance(COP) is defined as
a) heat leakage/work input
b) work input/heat leakage
c) latent heat of condensation/work input
d) work input/latent heat of condensation
View AnswerAnswer: a
Explanation: Coefficient of performance is the performance parameter used in a refrigerator cycle.
4. Which device maintains a body at a temperature higher than the temperature of the surroundings?
a) PMM1
b) PMM2
c) refrigerator
d) heat pump
View AnswerAnswer: d
Explanation: This is the main function of a heat pump.

5. In a heat pump, there is heat leakage from the body to the surroundings.
a) true
b) false
View AnswerAnswer: a
Explanation: This is just opposite to a refrigerator.
6. What is the relation bebetween COP of heat pump and refrigerator?
a) COP of pump=COP of refrigerator – 1
b) COP of pump=COP of refrigerator + 1
c) COP of pump=COP of refrigerator – 2
d) COP of pump=COP of refrigerator + 2
View AnswerAnswer: b
Explanation: This relation comes from the COP of pump and refrigerator.
7. Heat leakage from a heat pump to surroundings is always greater than work done on pump.
a) true
b) false
View AnswerAnswer: a

Explanation: (Heat leakage from a heat pump to surroundings)=(COP of refrigerator + 1)*(work done on pump).

8. Which of the following statements are true?
a) a heat pump provides a thermodynamic advantage over direct heating
b) COP for both refrigerator and pump cannot infinity
c) work input for both refrigerator and pump is greater than zero
d) all of the mentioned
View AnswerAnswer: d
Explanation: W is the electrical energy used to drive the pump or refrigerator which cannot zero.
9. Kelvin-Planck’s and Clausius’ statements are
a) not connected to each other
b) virtually two parallel statements of second law
c) violation of one doesn’t violate the other
d) none of the mentioned
View AnswerAnswer: b
Explanation: Kelvin-Planck’s and Clausius’ statements are equivalent in all aspects.
10. If one of the Kelvin-Planck’s or Clausius’ statement is violated, then other is also violated.
a) true
b) false
View AnswerAnswer: a
Explanation: This shows the equivalence of Kelvin-Planck’s and Clausius’ statements.

« Prev - Thermodynamics Questions and Answers – Kelvin-Planck Statement and Clausius’ Statement of Second Law» Next - Thermodynamics Questions and Answers – Reversibility, Irreversibilty and causes of IrreversibiltyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Reversibility, Irreversibilty and causes of Irreversibilty”.
1. A reversible process is performed in such a way that
a) at the conclusion of process, both system and surroundings can restored to their initial states without producing any change
b) it should not leave any trace to show that the process had ever occurred
c) it is carried out infinitely slowly
d) all of the mentioned
View AnswerAnswer: d

Explanation: These are some basic concepts of a reversible process.

2. A reversible process coincides with a quasi-static process.
a) true
b) false
View AnswerAnswer: a
Explanation: A reversible process is carried out very slowly and every state it passes through is an equilibrium state.
3. Irreversibility of a process may due to
a) lack of equilibrium during the process
b) involvement of dissipative effects
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two are the major causes of irreversibility.
4. A heat transfer process approaches reversibility as the temperature difference bebetween two bodies approaches
a) infinity
b) zero
c) -1
d) 1
View AnswerAnswer: b
Explanation: For heat transfer to reversible, heat must transferred through an infinitesimal temperature difference.
5. All actual heat transfer processes are
a) irreversible
b) take place through a finite temperature difference
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: An infinitesimal temperature difference is not easy to attain.

6. Free expansion is irreversible.
a) true
b) false
View AnswerAnswer: a
Explanation: It can demonstrated by the second law.
7. Which of the following can a cause of irreversibility?
a) friction, viscosity
b) inelasticity

c) electrical resistance, magnetic hysteresis
d) all of the mentioned
View AnswerAnswer: d
Explanation: These effects are known as dissipative effects.
8. The continual motion of a movable device in the complete absence of friction is known as
a) PMM2
b) PMM3
c) PMM1
d) PMM0
View AnswerAnswer: b
Explanation: This is not possible since lubrication cannot completely eliminated.
9. The friction present in moving devices makes a process reversible.
a) true
b) false
View AnswerAnswer: b
Explanation: Friction lakes the process irreversible.

10. Which of the following is irreversible?
a) stirring work
b) friction work in moving devices
c) current flowing through a wire
d) all of the mentioned
View AnswerAnswer: d
Explanation: All these processes includes a particular cause of irreversibility.
11. A process will reversible if it has
a) no dissipative effects
b) dissipative effects
c) depends on the given conditions
d) none of the mentioned
View AnswerAnswer: a
Explanation: Without any dissipative effects, a process can perform in a reversible manner.
12. Irreversibility can distinguished in how many types?
a) 0
b) 1
c) 2
d) 3
View AnswerAnswer: c
Explanation: Tow types of irreversibility are internal and external irreversibility.
13. Internal irreversibility is caused by
a) internal dissipative effects
b) friction, turbulence
c) electrical resistance, magnetic hysteresis

d) all of the mentioned
View AnswerAnswer: d
Explanation: Internal dissipative effects are the major cause of internal irreversibility.

14. The external irreversibility occurs at the system boundary.
a) true
b) false
View AnswerAnswer: a
Explanation: This mainly includes heat interaction with the surroundings due to a finite temperature gradient.
15. Which of the following is true?
a) mechanical irreversibility is due to finite pressure gradient
b) thermal irreversibility is due to finite temperature gradient
c) chemical irreversibility is due to finite concentration gradient
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some other distinctions of irreversibility.

« Prev - Thermodynamics Questions and Answers – Refrigerator and Heat Pump» Next - Thermodynamics Questions and Answers – Carnot Theorem, Carnot Cycle and Reversed Heat EngineThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Carnot Theorem, Carnot Cycle and Reversed Heat Engine”.
1. Carnot cycle is a reversible cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: A reversible cycle is an ideal hypothetical cycle in which all processes are reversible.

2. A reversible cycle has following processes.
a) 4 isothermal processes
b) 4 adiabatic processes
c) 2 isothermal and 2 adiabatic processes
d) none of the mentioned
View AnswerAnswer: c
Explanation: Two reversible isotherms and two reversible adiabatics constitute a

Carnot cycle.
3. The correct sequence of the processes taking place in a carnot cycle is
a) adiabatic -> adiabatic -> isothermal -> isothermal
b) adiabatic -> isothermal -> adiabatic -> isothermal
c) isothermal -> isothermal -> adiabatic -> adiabatic
d) isothermal -> adiabatic -> isothermal -> adiabatic
View AnswerAnswer: d
Explanation: Carnot cycle consists if these four processes in succession.
4. The reversed heat engine takes heat from a ___ temperature body, then discharges it to a ___ temperature body and ___ an inward flow of network.
a) high, low, receives
b) low, high, receives
c) high, low, gives
d) low, high, gives
View AnswerAnswer: b
Explanation: In reversed heat engine, the magnitude of energy transfers remains same and only directions change.

5. Example of reversed heat engine is
a) heat pump
b) refrigerator
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Heat pump and refrigerator are the types of reversed heat engine.
6. According to Carnot’s theorem, all heat engines operating bebetween a given constant temperature source and sink, none has a higher efficiency than a reversible engine.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the statement of Carnot’s theorem .
7. The efficiency of all reversible heat engines operating bebetween the same heat reservoirs is
a) same
b) independent of the nature of working substance
c) independent of the amount of working substance
d) all of the mentioned
View AnswerAnswer: d
Explanation: This statement is a corollary of Carnot’s theorem.

8. Efficiency of a reversible heat engine is given by
a) 1-(T1/T2)
b) 1-(T2/T1)
c) (T1/T2)-1
d) (T2/T1)-1
View AnswerAnswer: b
Explanation: Efficiency=1-(Q2/Q1) and T2,T1 are temperatures at which heat is rejected and received.
9. For a reversible refrigerator, Coefficient of Performance is given by
a) T2/(T1-T2)
b) T1/(T1-T2)
c) T2/(T2-T1)
d) T1/(T2-T1)
View AnswerAnswer: a
Explanation: For a reversible refrigerator, (Q1/Q2)=(T1/T2).
10. For a reversible heat pump, COP is given by
a) T2/(T1-T2)
b) T1/(T1-T2)
c) T2/(T2-T1)
d) T1/(T2-T1)
View AnswerAnswer: b
Explanation: For a reversible heat pump we have, (Q1/Q2)=(T1/T2).

« Prev - Thermodynamics Questions and Answers – Reversibility, Irreversibilty and causes of Irreversibilty» Next - Thermodynamics Questions and Answers – Absolute Thermodynamic Temperature ScaleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Absolute Thermodynamic Temperature Scale”.
1. It is necessary to have a temperature difference to obtain work of any cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: It comes from the second law of thermodynamics.

2. The absolute thermodynamic temperature scale is also known as
a) celsius scale
b) kelvin scale

c) fahrenheit scale
d) none of the mentioned
View AnswerAnswer: b
Explanation: It was proposed by Kelvin.
3. In defining the temperature scale, the standard reference point is taken as
a) zero kelvin
b) boiling point of water
c) triple point of water
d) none of the mentioned
View AnswerAnswer: c
Explanation: Triple point of water is taken as the standard reference point.
4. When the heat transferred isothermally bebetween the given _____ decreases, the temperature ____
a) isotherms, increases
b) isotherms, decreases
c) adiabatics, increases
d) adiabatics, decreases
View AnswerAnswer: d
Explanation: This comes from the equation, T=(273.16)(Q/Q1).

5. If a system undergoes a reversible isothermal process without transfer of heat, the temperature at which this process takes place is called
a) absolute zero
b) triple point of water
c) boiling point of water
d) none of the mentioned
View AnswerAnswer: a
Explanation: The smallest possible value of Q which is the amount of heat supply is zero and the corresponding temperature is zero.
6. At absolute zero, an isotherm and an adiabatic are identical.
a) true
b) false
View AnswerAnswer: a
Explanation: At absolute zero, there is no heat transfer.
7. A definite zero point ___ on the absolute temperature scale but this point ___ reached ___ violation of the second law.
a) doesnot, can, without
b) exists, cannot, without
c) exists, can, with
d) none of the mentioned
View AnswerAnswer: b
Explanation: When the heat rejected approaches zero, the temperature of heat rejection approaches zero as a limit.

8. Which law is stated here, “It is impossible to reduce any system to the absolute zero of temperature in a finite numr of operations.
a) first law of thermodynamics
b) second law of thermodynamics
c) third law of thermodynamics
d) none of the mentioned
View AnswerAnswer: c
Explanation: Any attainable value of absolute temperature is always greater than zero.
9. The statement of third law is also called the Fowler-Guggenheim statement of the third law.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a fact about third law of thermodynamics.
10. The Kelvin temperature is numerically equal to the _____ and may measured by means of a _____
a) gas temperature, liquid thermometer
b) ideal gas temperature, gas thermometer
c) ideal gas temperature, liquid thermometer
d) none of the mentioned
View AnswerAnswer: b
Explanation: θ=T=273.16K .

« Prev - Thermodynamics Questions and Answers – Carnot Theorem, Carnot Cycle and Reversed Heat Engine» Next - Thermodynamics Questions and Answers – Clausius’ Theorem and the Inequality of ClausiusThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Clausius’ Theorem and the Inequality of Clausius”.
1. Any reversible path can substituted by a reversible zigzag path bebetween the same states.
a) true
b) false
View AnswerAnswer: a
Explanation: It should consist of a reversible adiabatic, followed by a reversible isotherm and then by a reversible adiabatic.

2. According to the Clausius' theorem, the cyclic integral of ____ for a reversible cycle is zero.
a) dW/dT
b) dH/dT
c) dQ/dT
d) dE/dT
View AnswerAnswer: c
Explanation: Q is the total heat supplied or heat rejected in the complete cycle.
3. Two reversible adiabatic paths can intersect each other.
a) true
b) false
View AnswerAnswer: b
Explanation: If we assume they intersect, then the Kelvin-Planck statement of the second law will violated.
4. The efficiency of a general cycle will _____ the efficiency of a reversible cycle.
a) equal to
b) less than
c) equal to or greater than
d) equal to or less than
View AnswerAnswer: d
Explanation: The efficiency of a reversible cycle is maximum.
5. The cyclic integral of entropy is____
a) one
b) zero
c) infinity
d) cannot determined
View AnswerAnswer: b
Explanation: The cyclic integral of any property is zero and entropy is a property.

6. Which of the following is known as the inequality of Clausius?
a) cyclic integral of dQ/T<=0
b) cyclic integral of dQ/T>=0
c) cyclic integral of dW/T<=0
d) cyclic integral of dW/T>=0
View AnswerAnswer: a
Explanation: It provides the criterion for the reversibility of a cycle.
7. If the cyclic integral of dQ/T is zero then the cycle is
a) irreversible but not possible
b) irreversible but possible
c) impossible
d) reversible

View AnswerAnswer: d
Explanation: This comes from the inequality of Clausius.
8. If the cyclic integral of dQ/T is less than zero then the cycle is
a) irreversible but not possible
b) irreversible and possible
c) impossible
d) reversible
View AnswerAnswer: b
Explanation: This comes from the inequality of Clausius.
9. If the cyclic integral of dQ/T is greater than zero then the cycle is
a) irreversible but not possible
b) irreversible but possible
c) impossible
d) reversible
View AnswerAnswer: c
Explanation: This comes from the inequality of Clausius.

10. If dQ is the heat supplied at T and dQ2 is the heat rejected at T2, then efficiency is given by
a) 1-(dQ2/dQ)
b) 1-(dQ/dQ2)
c) (dQ/dQ2)-1
d) (dQ2/dQ)-1
View AnswerAnswer: a
Explanation: Efficiency is given by = 1-(heat reached/heat supplied).
11. A heat engine receives 6 kW from a source at 250°C and rejects heat at 30°C with W. = 0 kW. Does this satisfy the inequality of Clausius?
a) yes
b) no
c) cannot said
d) none of the mentioned
View AnswerAnswer: a
Explanation: ⌠ dQ/T = (6000/523) – (6000/303) = –8.33 kW/K < 0. [/expand]

12. A heat engine receives 6 kW from a source at 250°C and rejects heat at 30°C with W. = 6 kW. Does this satisfy the inequality of Clausius?
a) yes
b) no
c) cannot said
d) none of the mentioned
[expand title="View Answer"]Answer: b
Explanation: ⌠ dQ/T = (6000/523) - (0/303) = 11.47 kW/K > 0.

« Prev - Thermodynamics Questions and Answers – Absolute Thermodynamic Temperature Scale» Next - Thermodynamics Questions and Answers – The Property of EntropyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “The Property of Entropy”.

1. Integral of dQ/T is independent of reversible path connecting bebetween two points.
a) true
b) false
View AnswerAnswer: a
Explanation: For two reversible paths, dQ/T doesn’t depend on the path taken.

2. Integral of dQ/T of a reversible path is given by
a) Si-Sf
b) Sf-Si
c) Si+Sf
d) -Si-Sf
View AnswerAnswer: b
Explanation: Integral of dQ/T is = Sf-Si where i=initial equilibrium state and f=final equilibrium state.

3. Entropy is a
a) path function, intensive property
b) path function, extensive property
c) point function, intensive property
d) point function, extensive property
View AnswerAnswer: d
Explanation: Fact about entropy and unit of entropy is J/K.

4. Specific entropy is given by(where m is the mass)
a) Sm
b) m/S
c) S/m
d) none of the mentioned
View AnswerAnswer: c
Explanation: s=S/m with unit J/kg K.

5. For any process which is undergone by a system
a) dQ/T>=ds
b) dQ/T<=ds
c) dQ/T≠ds
d) none of the mentioned
View AnswerAnswer: b

Explanation: For any process dQ/T<=ds and this comes from Clausius theorem.
6. For a reversible process,
a) dS=dQ/T
b) dS>dQ/T
c) dS<dQ/T
d) none of the mentioned
View AnswerAnswer: a
Explanation: For a reversible process, dQ/T is equal to the net change in entropy.
7. For an irreversible process,
a) dS=dQ/T
b) dS>dQ/T
c) dS<dQ/T
d) none of the mentioned
View AnswerAnswer: b
Explanation: For a irreversible process, change in entropy is greater than dQ/T.

8. For two different paths bebetween same two points, entropy change is
a) depends on path taken
b) different
c) same
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause entropy is a property.
9. For the general case, we can write
a) S2-S1<=dQ/T for a path
b) S2-S1>=dQ/T for a path
c) S2-S1≠dQ/T for a path
d) none of the mentioned
View AnswerAnswer: b
Explanation: The equality sign holds good for a reversible process and the inequality sign for an irreversible process.
10. When two equilibrium states are infinitesimally near,
a) dQ/T=dS
b) dQ/T>dS
c) dQ/T<dS
d) none of the mentioned
View AnswerAnswer: a
Explanation: dS is an exact differential cause S is a point function and a property.

« Prev - Thermodynamics Questions and Answers – Clausius' Theorem and the Inequality of Clausius» Next - Thermodynamics Questions and Answers – Temperature-Entropy PlotThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Temperature-Entropy Plot".

1. For a reversible heat transfer and process ing adiabatic, which of the following is true?
a) dQ=0
b) dS=0
c) S=constant
d) all of the mentioned
View AnswerAnswer: d
Explanation: dQ=0 since process is reversible and adiabatic and dS=dQ/T.

2. A reversible adiabatic process is an isentropic process.
a) true
b) false
View AnswerAnswer: a
Explanation: dQ=0 and dS=0 and hence S=constant.

3. The area under the curve ∫TdS is equal to the
a) work done
b) heat transferred
c) internal energy change
d) none of the mentioned
View AnswerAnswer: b
Explanation: Q(reversible)=∫TdS.

4. Which of the following statement is true?
a) for reversible isothermal heat transfer, Q=t(Sf-Si)
b) for reversible adiabatic process, S=constant
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: For reversible isothermal heat transfer, T=constant and for reversible adiabatic process, dS=0.

5. A Carnot cycle has following processes.
a) 4 reversible isotherms
b) 4 reversible adiabatics
c) 2 reversible isotherms and 2 reversible adiabatics

d) none of the mentioned
View AnswerAnswer: c
Explanation: Two reversible isotherms and two reversible adiabatics constitute a Carnot cycle.
6. Net work in a Carnot cycle is given by (T1=temperature of heat addition and T2=temperature of heat rejection)
a) (T2-T1)(S1-S4)
b) (T1-T2)(S1-S4)
c) (T1-T2)(S4-S1)
d) none of the mentioned
View AnswerAnswer: b
Explanation: Net work=Q1-Q2=(T1-T2)(S1-S4).
7. According to the principle of Caratheodory, the first law in differential form is written as dQ=Adx+Bdy+Cdz.
a) true
b) false
View AnswerAnswer: a
Explanation: Here, x,y,z are the three thermodynamic coordinates and A,B,C are the functions of x,y,z.

8. For adiabatic, reversible transition,
a) Adx+Bdy+Cdz=-1
b) Adx+Bdy+Cdz=1
c) Adx+Bdy+Cdz=0
d) none of the mentioned
View AnswerAnswer: c
Explanation: dQ=Adx+Bdy+Cdz=0 for adiabatic and reversible process.
9. For quasi-static, adiabatic path
a) Adx+Bdy+Cdz=TdS
b) Adx+Bdy+Cdz=1
c) Adx+Bdy+Cdz=0
d) none of the mentioned
View AnswerAnswer: a
Explanation: This comes from Caratheodory’s theorem.
10. The infinitesimal change in entropy dS due to reversible heat transfer dQ at temperature T is dS=dQ/T.
a) true
b) false
View AnswerAnswer: a
Explanation: For a reversible process, dS=dQ/T .

« Prev - Thermodynamics Questions and Answers – The Property of Entropy» Next - Thermodynamics Questions and Answers – Entropy Principle and its Applications-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Entropy Principle and its Applications".
1. Which of the following is true?
a) for an isolated system, dS>=0
b) for a reversible process, dS=0
c) for an irreversible process, dS>0
d) all of the mentioned
View AnswerAnswer: d
Explanation: For an isolated system which does not undergo any energy interaction with the surroundings, dQ=0 and also dS>=dQ/T.

2. The entropy of an isolated system can never ____
a) increase
b) decrease
c) zero
d) none of the mentioned
View AnswerAnswer: b
Explanation: The entropy of an isolated system always increases and remains constant only when the process is reversible.
3. According to entropy principle, the entropy of an isolated system can never decrease and remains constant only when the process is reversible.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the statement for the principle of increase of entropy.
4. Entropy may decrease locally at some region within the isolated system. How can this statement justified?
a) this cannot possible
b) this is possible cause entropy of an isolated system can decrease.
c) it must compensated by a greater increase of entropy somewhere within the system.
d) none of the mentioned
View AnswerAnswer: c
Explanation: The net effect of an irreversible process is an entropy increase of the whole system.

5. Clausius summarized the first and second laws of thermodynamics as
a) the energy of the world is constant
b) the entropy of the world tends towards a maximum
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two statements were given by Clausius.
6. The entropy of an isolated system always ____ and comes a ____ at the state of equilibrium.
a) decreases, minimum
b) increases, maximum
c) increases, minimum
d) decreases, maximum
View AnswerAnswer: b
Explanation: If entropy of an isolated system varies with some parameter, then there is a certain value of that parameter which maximizes the entropy.
7. Entropy principle is the quantitative statement of the second law of thermodynamics.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a general fact about entropy principle.

8. Which of the following can considered as an application of entropy principle?
a) transfer of heat through a finite temperature difference
b) mixing of two fluids
c) maximum temperature obtainable from two finite bodies
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some basic applications of entropy principle.
9. The final temperatures of two bodies, initially at T1 and T2 can range from
a) (T1-T2)/2 to sqrt(T1*T2)
b) (T1+T2)/2 to sqrt(T1*T2)
c) (T1+T2)/2 to (T1*T2)
d) (T1-T2)/2 to (T1*T2)
View AnswerAnswer: b
Explanation: (T1+T2)/2 is the temperature when there is no delivery of work and sqrt(T1*T2) is the temperature with maximum delivery of work.
10. Which of the following processes exhibit external mechanical irreversibility?
a) isothermal dissipation of work
b) adiabatic dissipation of work

c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These processes exhibit external mechanical irreversibility.

« Prev - Thermodynamics Questions and Answers – Temperature-Entropy Plot» Next - Thermodynamics Questions and Answers – Entropy Principle and its Applications-2This set of Thermodynamics Interview Questions and Answers for experienced focuses on "Entropy Principle and its Applications-2"

1. For the flow of electric current through a resistor,
a) at steady state, internal energy of resistor is constant
b) at steady state, temperature of resistor is constant
c) W=Q
d) all of the mentioned
View AnswerAnswer: d
Explanation: Internal energy is dependent on temperature and by first law $Q=\Delta E+W$.

2. When stirring work is supplied to a viscous thermally insulated liquid, temperature of the liquid
a) remains constant
b) increases
c) decreases
d) none of the mentioned
View AnswerAnswer: d

3. A car uses power of 25 hp for a one hour in a round trip. A thermal efficiency of 35% can assumed? Find the change in entropy if we assume ambient at 20°C?
a) 554.1 kJ/K
b) 654.1 kJ/K
c) 754.1 kJ/K
d) 854.1 kJ/K
View AnswerAnswer: b
Explanation: $E = \int W\,dt = 25 \text{ hp} \times 0.7457 \text{ (kW/hp)} \times 3600 \text{ s} = 67\,113 \text{ kJ} = \eta Q$
$Q = E / \eta = 67\,113 / 0.35 = 191\,751 \text{ kJ}$
$\Delta S = Q / T = 191\,751 / 293.15 = 654.1 \text{ kJ/K}$.

4. In a Carnot engine working on ammonia, the high temperature is 60°C and as QH is received, the ammonia changes from saturated liquid to saturated vapor. The ammonia pressure at low temperature is 190 kPa. Find the entropy.

a) 4.6577 kJ/kg K
b) 5.6577 kJ/kg K
c) 6.6577 kJ/kg K
d) 7.6577 kJ/kg K
View AnswerAnswer: a
Explanation: $q_H = \int T ds = T (s_2 - s_1) = T s(fg) = h_2 - h_1 = h(fg) = 997.0$ kJ/kg
$T_L = T_3 = T_4 = T_{sat}(P) = -20°C$
$\eta(cycle) = 1 - (T_l/T_h) = 1 - (253.2/333.2) = 0.24$
$s_3 = s_2 = s_g(60°C) = 4.6577$ kJ/kg K.

5. A slab of concrete, 5 × 8 × 0.3 m, is used as a thermal storage mass in a house. The slab cools overnight from 23°C to 18°C in an 18°C house, find the net entropy change associated with this process?
a) 0.4 kJ/K
b) 1.4 kJ/K
c) 2.4 kJ/K
d) 3.4 kJ/K
View AnswerAnswer: d
Explanation: $V = 5 \times 8 \times 0.3 = 12\ m^3$; $m = \rho V = 2200 \times 12 = 26400$ kg
V = constant so $_1W_2 = 0$; $_1Q_2 = mC\Delta T = 26400 \times 0.88(-5) = -116160$ kJ
$\Delta S(SYST) = m(s_2 - s_1) = mC \ln(T_2/T_1) = 26400 \times 0.88 \ln (291.2/296.2) = -395.5$ kJ/K
$\Delta S(SURR) = -{_1Q_2}/T_0 = +116160/291.2 = +398.9$ kJ/K
$\Delta S(NET) = -395.5 + 398.9 = +3.4$ kJ/K.

6. A foundry form box with 25 kg of 200°C hot sand is dropped into a bucket with 50 L water at 15°C. Assuming there is no heat transfer with the surroundings and no boiling away of water, calculate the net entropy change for the process.
a) 2.37 kJ/K
b) 2.47 kJ/K
c) 2.57 kJ/K
d) 2.67 kJ/K
View AnswerAnswer: c
Explanation: C.V. Sand and water, constant pressure process
$m(sand)\Delta h(sand) + m(H_2O)\Delta h(H_2O) = 0$
$m(sand)C\Delta T(sand) + m(H_2O)C(H_2O)\Delta T(H_2O) = 0$
$25 \times 0.8\times(T_2 - 200) + (50\times10^{-3}/0.001001) \times 4.184 \times (T_2 - 15) = 0$
hence $T_2 = 31.2°C$
$\Delta S = 25 \times 0.8 \ln(304.3/473.15) + 49.95 \times 4.184 \ln(304.3/288.15)$
$= 2.57$ kJ/K.

7. Calculate the change in entropy if 1 kg of saturated liquid at 30°C is converted into superheated steam at 1 bar and 200°C .
a) 5.3973 kJ/K
b) 6.3973 kJ/K

c) 7.3973 kJ/K
d) none of the mentioned
View AnswerAnswer: c
Explanation: si= sf @30 C = 0.4369 kJ/kg.K,
se = sg @1 bar and 200 C = 7.8342 kJ/kg.K
Change in entropy (ΔS) = m*(se – si) = 1*(7.8342 – 0.4369) = 7.3973 kJ/K.

8. Two kilograms of water at 120°C with a quality of 25% has its temperature raised by 20°C in a constant volume process. What is the new specific entropy?
a) 3.01517 kJ/kg.K
b) 4.01517 kJ/kg.K
c) 5.01517 kJ/kg.K
d) 7.01517 kJ/kg.K
View AnswerAnswer: b
Explanation: v1 = vf @120 C + x1*vfg @120 C = 0.00106 + 0.25*0.8908 = 0.22376 m3/kg
v2 = v1 = vf @145 C + x2*vfg @145 C = 0.00108 + x2*0.50777
∴ x2 = 0.4385
New specific entropy (s2) = sf @145 C + x2*sfg @145 C = 1.739 +0.4385*5.1908 = 4.01517 kJ/kg.K.
9. A thermal reservoir at 538°C is brought into thermal communication with another thermal reservoir at 260°C, and as a result 1055 kJ of heat is transferred only from the higher to lower temperature reservoir. Determine the change in entropy of the universe due to the exchange of heat bebetween these two thermal reservoirs.
a) 0.378182 kJ/K
b) 0.478182 kJ/K
c) 0.578182 kJ/K
d) 0.678182 kJ/K
View AnswerAnswer: d
Explanation: (ΔS)System = ∫δQ/T = –1055/(538 + 273.15) + 1055/(260 + 273.15)= 0.678182 kJ/K
(ΔS)Surroundings = ∫δQ/T = 0
Change in entropy of the universe ((ΔS)Universe) = (ΔS)System + (ΔS)Surroundings = 0.678182 kJ/K.
10. A glass jar is filled with saturated water at 500 kPa of quality 25%, and a tight lid is put on. Now it is cooled to -10°C. What is the mass fraction of solid at this temperature?
a) 99.98%
b) 98.98%
c) 93.98%
d) 95.98%
View AnswerAnswer: a
Explanation: Constant volume v1=v2=V/m

from steam table, Psat = 500 kPa and hence Tsat = 151.8°C
v1 = 0.001093 + 0.25*0.3738 = 0.094543
v2 = 0.0010891 + x2*466.756 = v1 = 0.094543
x2 = 0.002 mass fraction vapour
x(solid) = 1- x2 = 0.9998 or 99.98%.

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« Prev - Thermodynamics Questions and Answers – Entropy Principle and its Applications-1» Next - Thermodynamics Questions and Answers – Entropy Transfer MechanismsThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Entropy Transfer Mechanisms".

1. Entropy can transferred to or from a system in which of the following forms?
a) heat transfer
b) mass flow
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Entropy is transferred by these two forms while energy id transferred by work also.

2. Entropy transfer for an adiabatic transfer is zero.
a) true
b) false
View AnswerAnswer: a
Explanation: The only form of entropy interaction associated with a fixed mass or closed system is heat transfer.

3. If heat Q flows reversibly from the system to the surroundings at To,
a) entropy increase of the surroundings is Q/To
b) entropy of the system is reduced by Q/To
c) system has lost entropy to the surroundings
d) all of the mentioned
View AnswerAnswer: d
Explanation: We can say that there is entropy transfer from the system to the surroundings along with heat flow.

4. The sign of entropy transfer is opposite to the sign of heat transfer.
a) true

b) false
View AnswerAnswer: b
Explanation: The sign of entropy transfer is same as the sign of heat transfer: positive, if into the system, and negative, if out of the system.

5. ____ is exchanged during work interaction, whereas both ____ and ____ are exchanged during heat transfer.
a) energy, energy and entropy
b) entropy, energy and entropy
c) mass, energy and entropy
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the distinction bebetween heat transfer and work which is brought about by the second law.
6. Mass contains
a) entropy
b) energy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is a basic fact and the entropy and energy of a system are proportional to the mass.
7. The entropy of a system ____ by ____ when the mass of amount m enters it.
a) decreases, ms
b) increases, ms
c) decreases, s/m
d) increases, s/m
View AnswerAnswer: b
Explanation: When mass m enters a system, an entropy of amount ms, s ing the specific entropy, accompanies it.

8. What happens when heat is added to the system?
a) dQ is positive
b) dS=dQ/T
c) entropy of the system increases
d) all of the mentioned
View AnswerAnswer: d
Explanation: dS=dQ/T and when heat is added, dQ=positive and thus dS=positive.
9. The first law of thermodynamics makes no distinction bebetween heat transfer and work.

a) true
b) false
View AnswerAnswer: a
Explanation: The first law of thermodynamics considers both work and heat transfer equal.
10. Which of the following explains that there is no entropy transfer associated with work.
a) working of flywheel
b) compression of spring
c) raising of weight by a certain height
d) all of the mentioned
View AnswerAnswer: d
Explanation: In all these examples, there is work done but there is no entropy transfer.

« Prev - Thermodynamics Questions and Answers – Entropy Principle and its Applications-2» Next - Thermodynamics Questions and Answers – Entropy Generation in a Closed and Open System-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Entropy Generation in a Closed and Open System-1”.
1. The entropy of any closed system can increase in which if the following way?
a) by heat interaction in which there is entropy transfer
b) dissipative effects or internal irreversibilities
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two processes increase the entropy of a closed system.

2. Entropy increase dS of the system can expressed as
a) dS=dS(due to external heat interaction)-dS(due to internal irreversibility)
b) dS=dS(due to external heat interaction)+dS(due to internal irreversibility)
c) dS=-dS(due to external heat interaction)-dS(due to internal irreversibility)
d) dS=-dS(due to external heat interaction)+dS(due to internal irreversibility)
View AnswerAnswer: b
Explanation: Total entropy increase of the system is the sum of these two entropies.
3. The entropy increase due to internal irreversibility is also called entropy production or entropy generation.
a) true

b) false
View AnswerAnswer: a
Explanation: This entropy is generated during the process within the system.
4. Which of the following statement is true?
a) if the isentropic process is reversible, it must adiabatic
b) if the isentropic process is adiabatic, it cannot but reversible
c) if the process is adiabatic and reversible, it must isentropic
d) all of the mentioned
View AnswerAnswer: d
Explanation: An adiabatic process need not isentropic, since entropy can also increase due to friction.
5. Lost work is given by
a) pdV-dW
b) pdV+dW
c) -pdV-dW
d) pdV*dW
View AnswerAnswer: a
Explanation: The lost work d(LW) indicates the work that is lost due to irreversibility.

6. The amount of entropy generation is given by
a) S2+S1+∫(dQ/T)
b) S2-S1+∫(dQ/T)
c) S2-S1-∫(dQ/T)
d) none of the mentioned
View AnswerAnswer: c
Explanation: Here (S2-S1) is the entropy change of the system and ∫(dQ/T) is the entropy transfer.
7. Any thermodynamic process is accompanied by entropy generation.
a) true
b) false
View AnswerAnswer: a
Explanation: This comes from the second law.
8. Which of the following statement is false?
a) for a reversible process, entropy generation is zero
b) the entropy generation does not depend on the path the system follows
c) for an irreversible process, entropy generation is greater than zero
d) none of the mentioned
View AnswerAnswer: b
Explanation: Entropy generation is not a thermodynamic property and depends on the path that system follows.
9. If the path A causes more entropy generation than path B, then
a) path A is more irreversible than path B
b) path A involves more lost work
c) both of the mentioned
d) none of the mentioned

View AnswerAnswer: c
Explanation: The amount of entropy generation quantifies the intrinsic irreversibility of the process.

10. In an open system, there is a transfer of which of the following quantity?
a) mass
b) energy
c) entropy
d) all of the mentioned
View AnswerAnswer: d
Explanation: In an open system, there is a transfer of all these three quantities.
11. The rate of entropy increase of the control volume ____ or ____ the net rate of entropy transfer to it.
a) exceeds or is less than
b) exceeds, is equal to
c) is less than, or equal to
d) none of the mentioned
View AnswerAnswer: b
Explanation: The difference is the entropy generated within the control volume due to irreversibility.
12. Mass and energy are conserved quantities, but entropy is generally not conserved.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a basic fact about entropy.
13. The rate at which entropy is transferred out must ____ the rate at which entropy enters the control volume.
a) less than
b) equal to
c) exceed
d) none of the mentioned
View AnswerAnswer: c
Explanation: The difference is the rate of entropy generated within the control volume owing to irreversibilities.

14. A chip dissipates 2 kJ of electric work and rejects it as heat transfer

from its surface which is at 50°C to 25°C air. How much entropy is generated in the chip?
a) 4.19 J/K
b) 5.19 J/K
c) 6.19 J/K
d) 7.19 J/K
View AnswerAnswer: c
Explanation: C.V.1 Chip with surface at 50°C, we assume chip state is constant.
U2 – U1 = 0 = 1Q2 – 1W2 = W(electrical,in) – Q(out,1)
S2 – S1 = 0 = – [Q(out,1)]/[T(surf)] + 1S2(gen1)
1S2(gen1) = [Q(out,1)]/[T(surf)] = W(electrical,in) / T(surf)
= 2/323.15 = 6.19 J/K.
15. A chip dissipates 2 kJ of electric work and rejects it as heat transfer from its surface which is at 50°C to 25°C air. How much entropy is generated outside the chip?
a) 0.419 J/K
b) 0.519 J/K
c) 0.619 J/K
d) 0.719 J/K
View AnswerAnswer: b
Explanation: C.V.2 From chip surface at 50°C to air at 25°C, assume constant state.
U2 – U1 = 0 = 1Q2 – 1W2 = Q(out,1) – Q(out,2)
S2 – S1 = 0 = [Q(out,1) / T(surf)] – [Q(out,2) / T(air)] + 1S2(gen2)
1S2(gen2) = [Q(out,2) / T(air)] – [Q(out,1) / T(surf)] = (2/298.15) – (2/323.15) = 0.519 J/K.

« Prev - Thermodynamics Questions and Answers – Entropy Transfer Mechanisms» Next - Thermodynamics Questions and Answers – Entropy Generation in a Closed and Open System-2This set of Thermodynamics Test focuses on “Entropy Generation in a Closed and Open System”.
1. 1 kg of air at 300 K is mixed with 1 kg air at 400 K in a constant pressure process at 100 kPa and Q = 0. Find the entropy generation in the process.
a) 0.0207 kJ/K
b) 0.0307 kJ/K
c) 0.0407 kJ/K
d) 0.0507 kJ/K
View AnswerAnswer: a
Explanation: U2 – U1 + W = U2 – U1 + P(V2 – V1) = H2 – H1 = 0
H2 – H1 = mA(h2 – h1)A + mB(h2 – h1)B = mACp(T2 – TA1) + mBCp(T2 – TB1) = 0
T2 =(mATA1 + mBTB1)/(mA + mB) = (TA1/2) + (TB1/2) = 350 K
1S2 gen = mACp ln(T2/TA1) + mBCp ln(T2/TB1)
= 1 × 1.004 ln [350/300] + 1 × 1.004 ln[350/400]
= = 0.15477 – 0.13407 = 0.0207 kJ/K.

2. A window receives 200 W of heat transfer at its inside surface of 20°C and transmits this 200 W from its outside surface at 2°C to ambient air at 5°C. Find the window's rate of entropy generation.
a) 0.015 W/K
b) 0.025 W/K
c) 0.035 W/K
d) 0.045 W/K
View AnswerAnswer: d
Explanation: S (inside) = 200/293.15 = 0.682 W/K
S (window) = 200/275.15 = 0.727 W/K
S (ambient) = 200/268.15 = 0.746 W/K
Window only: S(gen win) = S(window) – S(inside)
= 0.727 – 0.682 = 0.045 W/K.
3. An insulated cylinder/piston contains R-134a at 1 MPa, 50°C, volume of 100 L. The R-134a expands, dropping the pressure in the cylinder to 100 kPa. The R-134a does 190 kJ of work against the piston during this process. Is that possible?
a) yes
b) no
c) cannot determined
d) none of the mentioned
View AnswerAnswer: a
Explanation: v1 = 0.02185 m^3/kg, u1 = 409.39 kJ/kg,
s1 = 1.7494 kJ/kg K, m = V1/v1 = 0.1/0.02185 = 4.577 kg
m(u2 – u1) = 1Q2 – 1W2 = 0 – 190 hence u2 = u1 – 1W2/m = 367.89 kJ/kg
T2 = -19.25°C ; s2 = 1.7689 kJ/kg K
m(s2 – s1) = ⌡⌠dQ/T + 1S2(gen) = 1S2(gen)
1S2(gen) = m(s2 – s1) = 0.0893 kJ/K
This is possible since 1S2(gen) > 0.
4. A hot metal piece is cooled rapidly to 25°C, removing 1000 kJ from the metal. Calculate the change of entropy if saturated liquid R-22 at –20°C absorbs the energy so that it comes saturated vapor.
a) 1.950 kJ/K
b) 2.950 kJ/K
c) 3.950 kJ/K
d) 4.950 kJ/K
View AnswerAnswer: c
Explanation: R-22 boiling at -20°C; m = 1Q2 /h(fg) = 1000/220.327 = 4.539 kg
ΔS(R-22) = ms(fg) = 4.539(0.8703) = 3.950 kJ/K.
5. A hot metal piece is cooled rapidly to 25°C, removing 1000 kJ from the metal. Calculate the change of entropy if energy is absord by ice.
a) 2.662 kJ/K
b) 3.662 kJ/K
c) 4.662 kJ/K
d) 5.662 kJ/K
View AnswerAnswer: b

Explanation: Ice melting at 0°C; m = 1Q2 /h(fg) = 1000/333.41 = 2.9993 kg

ΔS(H2O) = ms(ig) = 2.9993(1.221) = 3.662 kJ/K.

6. A hot metal piece is cooled rapidly to 25°C, removing 1000 kJ from the metal. Calculate the change of entropy if energy is absord by vaporizing liquid nitrogen at 101.3 kPa pressure.

a) 9.929 kJ/K
b) 10.929 kJ/K
c) 11.929 kJ/K
d) 12.929 kJ/K

View AnswerAnswer: d

Explanation: Nitrogen boiling at 101.3 kPa; m = 1Q2 /h(fg) = 1000/198.842 = 5.029 kg

ΔS(N2) = ms(fg) = 5.029(2.5708) = 12.929 kJ/K.

7. A piston cylinder has 2.5 kg ammonia at -20°C, 50 kPa. It is heated to 50°C at constant pressure from external hot gas at 200°C. Find the total entropy generation.

a) 0.511 kJ/K
b) 0.611 kJ/K
c) 0.711 kJ/K
d) 0.811 kJ/K

View AnswerAnswer: a

Explanation: v1 = 2.4463 m^3/kg, h1 = 1434.6 kJ/kg, s1 = 6.3187 kJ/kg K

v2 = 3.1435 m^3/kg, h2 = 1583.5 kJ/kg, s2 = 6.8379 kJ/kg K

1Q2 = m(h2 – h1) = 2.5 (1583.5 – 1434.6) = 372.25 kJ

1S2(gen) = m(s2 – s1) – 1Q2/T(gas)

= 2.5 (6.8379 – 6.3187) – 372.25/473.15 = 0.511 kJ/K.

8. A piston/cylinder contains 1 kg water at 20°C, 150 kPa. The pressure is linear in volume. Heat is added from 600°C source until the water is at 1 MPa, 500°C. Find the total change in entropy.

a) 1.751 kJ/K
b) 2.751 kJ/K
c) 3.751 kJ/K
d) 4.751 kJ/K

View AnswerAnswer: c

Explanation: v1 = 0.001002 m^3/kg; u1 = 83.94 kJ/kg; s1 = 0.2966 kJ/kg K

v2 = 0.35411 m^3/kg; u2 = 3124.3 kJ/kg; s2 = 7.7621 kJ/kg K

1W2 = ½ (1000 + 150) 1 (0.35411 – 0.001002) = 203 kJ

1Q2 = 1(3124.3 – 83.94) + 203 = 3243.4 kJ

m(s2 – s1) = 1(7.7621 – 0.2968) = 7.4655 kJ/K;

1Q2/T(source) = 3.7146 kJ/K

1S2 gen = m(s2 – s1) – 1Q2/T(SOURCE) = ΔStotal

= ΔS(H2O) + ΔS(source) = 7.4655 – 3.7146 = 3.751 kJ/K.

9. 1kg of ammonia is contained in a piston/cylinder, as saturated liquid at –20°C. Heat is added at 100°C until a final condition of 70°C, 800 kPa is reached. Assuming the process is reversible, find the entropy generation.

a) 1.007 kJ/K
b) 1.107 kJ/K

c) 1.207 kJ/K
d) 1.307 kJ/K
View AnswerAnswer: d
Explanation: $P1 = 190.08$ kPa, $v1 = 0.001504\ m^3/kg$, $u1 = 88.76$ kJ/kg, $s1 = 0.3657$ kJ/kg K
$v2 = 0.199\ m^3/kg$, $u2 = 1438.3$ kJ/kg, $s2 = 5.5513$ kJ/kg K
$1W2 =(1/2)(190.08 + 800)1(0.1990 – 0.001504) = 97.768$ kJ
$1Q2 = m(u2 – u1) + 1W2 = 1(1438.3 – 88.76) + 97.768 = 1447.3$ kJ
$1S2(gen) = m(s2 – s1) – 1Q2/T(res) = 1(5.5513 – 0.3657) – (1447.3/373.15) = 1.307$ kJ/K.

10. A piston/cylinder device keeping a constant pressure has 1 kg water at 20°C and 1 kg water at 100°C both at 500 kPa separated by a membrane. The membrane is broken and the water comes to a uniform state with no external heat transfer. Find the entropy generation for the process.
a) 0.0507 kJ/K
b) 0.0607 kJ/K
c) 0.0707 kJ/K
d) 0.0807 kJ/K
View AnswerAnswer: b
Explanation: $m2u2 + P2V2 = m2h2 = mAuA + mBuB+ PV1 = mAhA + mBhB$
$hA= 84.41$ kJ/kg, $sA= 0.2965$ kJ/kg K; $hB = 419.32$ kJ/kg, $sB= 1.3065$ kJ/kg K
$h2 =(mA/m2)hA + (mB/m2)hB = (84.41/2) + (419.32/2) = 251.865$ kJ/kg
$h2 = 251.865$ kJ/kg & $P2 = 500$ kPa; $T2 = 60.085°C$, $s2 = 0.83184$ kJ/kg K
$1S2(gen) = m2s2 – mAsA – mBsB = 2 × 0.83184 – 1 × 0.2965 – 1 × 1.3065 = 0.0607$ kJ/K.

11. A 4 L jug of milk at 25°C is placed in refrigerator where it is cooled down to a temperature of 5°C. Assuming the milk has the property of liquid water, find the entropy generated in the cooling process.
a) 0.0215 kJ/K
b) 0.0315 kJ/K
c) 0.0415 kJ/K
d) 0.0515 kJ/K
View AnswerAnswer: c
Explanation: $v1 = vf = 0.001003$ m3/kg, $h = hf = 104.87$ kJ/kg; $sf = 0.3673$ kJ/kg K
$h = hf = 20.98$ kJ/kg, $s = sf = 0.0761$ kJ/kg K
$P = constant = 101$ kPa => $1W2 = mP(v2 – v1)$;
$m = V/v1 = 0.004 / 0.001003 = 3.988$ kg

$1Q2 = m(h2 - h1) = 3.988 (20.98 - 104.87) = -3.988 \times 83.89 = -334.55$ kJ

$1S2(gen) = m(s2 - s1) - 1Q2/T(refrig)$

$= 3.988 (0.0761 - 0.3673) - (-334.55 / 278.15) = - 1.1613 + 1.2028$

$= 0.0415$ kJ/K.

12. A pan contains 5 L of engine oil at 20°C, 100 kPa. Now 2 L of hot 100°C oil is mixed into the pan. Find the entropy generation.

a) 0.0728 kJ/K
b) 0.0828 kJ/K
c) 0.0928 kJ/K
d) 0.1028 kJ/K

View AnswerAnswer: a

Explanation: $\rho = 885$ kg/m3; From energy equation,

$T2 = (mA/m2)TA + (mB/m2)TB = (5/7)20 + (2/7)100 = 42.868°C = 316.02$ K

$S2 - S1 = m2s2 - mAsA - mBsB = mA(s2 - sA) + mB(s2 - sB)$

$= 0.005 \times 885 \times 1.9 \ln (316.02/293.15) + 0.002 \times 885 \times 1.9 \ln (316.02/373.15)$

$= 0.6316 - 0.5588 = + 0.0728$ kJ/K.

13. Argon in a light bulb is at 90 kPa and heated from 20°C to 60°C with electrical power. Find the total entropy generation per unit mass of argon.

a) 0.01 kJ/kg K
b) 0.02 kJ/kg K
c) 0.03 kJ/kg K
d) 0.04 kJ/kg K

View AnswerAnswer: d

Explanation: $1s2(gen) = s2 - s1 = Cp \ln (T2/T1) - R \ln (P2/ P1)$

$= Cp \ln (T2/T1) - R \ln (T2/ T1) = Cv \ln(T2/T1)$

$= 0.312 \ln [(60 + 273)/(20 + 273)] = 0.04$ kJ/kg K.

14. Oxygen gas in a piston cylinder at 300 K, 100 kPa with volume 0.1m^3 is compressed in a reversible adiabatic process to a final temperature of 700 K. Find the final pressure and volume.

a) 2015 kPa, 0.0116 m3
b) 3015 kPa, 0.0216 m3
c) 1015 kPa, 0.0416 m3
d) 4015 kPa, 0.0216 m3

View AnswerAnswer: a

Explanation: Process: Adiabatic $1q2 = 0$, Reversible $1s2$ gen $= 0$

Entropy Eq.: $s2 - s1 = \int dq/T + 1s2 \text{ gen} = 0$

$\therefore s2 = s1$ (isentropic compression process)

$P2 = P1(T2 / T1)^{(k/k-1)} = 2015$ kPa

$V2 = V1(T2 / T1)^{(1/1-k)} = 0.1 \times (700/300)^{(1/1-1.393)} = 0.0116$ m^3.

15. Argon in a light bulb is at 90 kPa and heated from 20°C to 60°C with electrical power. Find the total entropy generation per unit mass of argon.
a) 0.02 kJ/kg K
b) 0.03 kJ/kg K
c) 0.04 kJ/kg K
d) 0.05 kJ/kg K
View AnswerAnswer: c
Explanation: Energy Eq. : $m(u_2 – u_1) = {}_1W_2$ electrical
Entropy Eq.: $s_2 – s_1 = \int dq/T + {}_1s_2 \text{ gen} = {}_1s_2 \text{ gen}$
Process: $v = c$ & ideal gas $\therefore P_2/ P_1 = T_2/T_1$
${}_1s_2 \text{ gen} = s_2 – s_1 = C_p \ln(T_2/T_1) – R \ln (P_2/P_1)$
$= C_p\ln(T_2/T_1) – R \ln(T_2/T_1) = C_v \ln(T_2/T_1)$
$= 0.312 \ln\{(60+273)/(20+273)\} = 0.04$ kJ/kg K.
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« Prev - Thermodynamics Questions and Answers – Entropy Generation in a Closed and Open System-1» Next - Thermodynamics Questions and Answers – First and Second Laws CombinedThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “First and Second Laws Combined”.
1. The equation TdS=dU+pdV is obtained from which law?
a) first law
b) second law
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: By first law, dQ=dU+pdV and from second law, dQ=TdS.

2. Which of the following equation is true?
a) TdS=dH+Vdp
b) TdS=dH-Vdp
c) TdS=-dH-Vdp
d) TdS=-dH+Vdp
View AnswerAnswer: b
Explanation: It comes from TdS=dU+pdV and H=U+pV.
3. The equation dQ=dE+dW holds good for
a) any process, reversible or irreversible
b) only reversible process
c) only irreversible process
d) none of the mentioned
View AnswerAnswer: a
Explanation: This equation holds good for any process and for any system.
4. The equation dQ=dU+pdW holds good for any process undergone by a closed stationary system.

a) true
b) false
View AnswerAnswer: a
Explanation: When a closed stationary system undergoes a process, this equation holds true.

5. The equation dQ=dU+pdV holds good for
a) open system
b) closed system
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: This equation is true only for a reversible(quasi-static) process.
6. The equation TdS=dU+pdV holds good for
a) reversible process
b) reversible process
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This equation holds good for any process undergone by a closed system since it is a relation among properties which are independent of the path.
7. The equation dQ=TdS is true only for a reversible process.
a) true
b) false
View AnswerAnswer: a
Explanation: This comes from the second law.

8. The equation TdS=dH-Vdp
a) relates only the properties of a system
b) there is no path function term in the equation
c) the equation holds good for any process
d) all of the mentioned
View AnswerAnswer: d
Explanation: Since there is no path function in the equation hence the equation holds good for any process.
9. The entropy change of a system bebetween two identifiable equilibrium state is ___ when the intervening process is reversible or change of state is irreversible.
a) different
b) same
c) depends on the process

d) none of the mentioned
View AnswerAnswer: b
Explanation: To determine the change in entropy, a known reversible path is made to connect the two end states and integration is performed on this path.
10. It is tter to state that “the change of state is irreversible, rather than say it is an irreversible process”.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause no irreversible path or process can plotted on thermodynamic coordinates.

« Prev - Thermodynamics Questions and Answers – Entropy Generation in a Closed and Open System-2» Next - Thermodynamics Questions and Answers – Reversible Adiabatic Work in a Steady Flow System and Entropy and DisorderThis set of Thermodynamics Quiz focuses on “Reversible Adiabatic Work in a Steady Flow System and Entropy and Disorder”.
1. The equation W=∫vdp holds good for
a) work-producing machine like an engine or turbine
b) work-absorbing machine like a pump or a compressor
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The equation given here is used for steady flow process and also when the fluid undergoes reversible adiabatic expansion or compression.

2. Only those processes are possible in nature which would give an entropy ____ for the system and the surroundings together.
a) decrease
b) increase
c) remains same
d) none of the mentioned
View AnswerAnswer: b
Explanation: The entropy of an isolated system can never decrease.
3. A process always occurs in such a direction as to cause an increase in the entropy of the universe.
a) true

b) false
View AnswerAnswer: a
Explanation: This comes from the second law which indicates the direction in which a process takes place.
4. When the potential gradient is ____, the entropy change of the universe is ____
a) large, zero
b) infinitesimal, zero
c) infinitesimal, negative
d) none of the mentioned
View AnswerAnswer: b
Explanation: This makes the process reversible.
5. At equilibrium, the isolated system exists at the peak of the entropy-hill and
a) dS=-1
b) dS=1
c) dS=infinity
d) dS=0
View AnswerAnswer: d
Explanation: At equilibrium, the entropy comes maximum and hence change in entropy is zero.

6. Which of the following is true?
a) the KE of a gas is due to the coordinated motion of of all the molecules with same average velocity in same direction
b) the PE is due to the displacement of molecules from their normal positions
c) heat energy is due to the random thermal motion of molecules in a disorderly fashion
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the main causes of Kinetic energy, Potential energy and thermal energy of gas molecules.
7. Orderly energy can easily converted into disorderly energy.
a) true
b) false
View AnswerAnswer: a
Explanation: An example can , converting mechanical and electrical energy into internal energy by friction.
8. When work is dissipated into internal energy, what is the change in the disorderly motion of molecules.
a) decreases
b) increases
c) remains same
d) none of the mentioned
View AnswerAnswer: b
Explanation: We know that increase in internal energy causes more random motion.
9. When heat is imparted to a system,
a) the disorderly motion of molecules increases

b) the entropy of the system increases
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: As heat is given to a system, its internal energy increases, thus increasing the entropy of the system.

10. Which of the following relation is correct?
a) S=lnK/W
b) S=K/lnW
c) S=lnK*W
d) S=K*lnW
View AnswerAnswer: d
Explanation: S=K*lnW where S is the entropy, W is the thermodynamic probability, and K is the Boltzmann constant.
11. In the reversible adiabatic expansion of a gas the increase in disorder due to an increase in volume is compensated by the decrease in disorder due to a decrease in temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: This ensures that the disorder numr or entropy remains constant.
12. When does the entropy of a system come zero?
a) W=0
b) W=1
c) W=-1
d) none of the mentioned
View AnswerAnswer: b
Explanation: When thermodynamic probablity W=1, we get S=0 from S=K*lnW and this happens only at T=0K.
13. According to the Boltzmann,
a) he introduced the thermodynamic probability with each state
b) increase in entropy implies that the system proceeds by itself towards a state of higher thermodynamic probability
c) an irreversible process goes on happening until the most probable is achieved
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is how Boltzmann introduced statistical concepts to define disorder.

14. When W=1, we get S=0 which can occur only at T=0K. This is the Nernst-Simon statement of third law of thermodynamics.
a) true
b) false
View AnswerAnswer: a
Explanation: But the state of T=0K cannot reached in a finite numr of operations.

« Prev - Thermodynamics Questions and Answers – First and Second Laws Combined»
Next - Thermodynamics Questions and Answers – Available Energy Referred to a CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Available Energy Referred to a Cycle".
1. Which of the following is a type of energy?
a) high grade energy
b) low grade energy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are two types in which the sources of energy can divided into.

2. Which of the following is an example of high grade energy?
a) mechanical work
b) electrical energy
c) water power and wind power
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some examples of the high grade energy.
3. The complete conversion of heat into shaft-work is impossible.
a) true
b) false
View AnswerAnswer: a
Explanation: This statement can proved by the second law of thermodynamics.
4. Which of the following is an example of low grade energy?
a) heat or thermal energy
b) heat from nuclear fission or fusion
c) heat from combustion of fossil fuel
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are few examples of low grade energy.
5. The part of ____ available for conversion is referred to ____
a) high grade energy, available energy

b) low grade energy, available energy
c) low grade energy, unavailable energy
d) high grade energy, unavailable energy
View AnswerAnswer: b
Explanation: Only some part of low grade energy is available for conversion.

6. The ____ obtainable from a certain heat input in a cyclic heat engine is called ____
a) minimum work output, available energy
b) maximum work output, available energy
c) minimum work input, unavailable energy
d) none of the mentioned
View AnswerAnswer: b
Explanation: Q1=AE+UE and the minimum energy that has to rejected is called the unavailable energy.
7. The unavailable energy is the product of the lowest temperature of heat rejection and the change of entropy of system during the process of supplying heat.
a) true
b) false
View AnswerAnswer: a
Explanation: U.E.=T0*(change in entropy).
8. The lowest practicable temperature of heat rejected is the
a) given temperature
b) 0K
c) temperature of surroundings
d) 273K
View AnswerAnswer: c
Explanation: Work done and hence efficiency will maximum when heat is rejected at the temperature of surroundings.
9. The available energy is known as ____ and the unavailable energy is known as ____
a) energy, exergy
b) exergy, energy
c) both are called exergy
d) both are called energy
View AnswerAnswer: b
Explanation: Rant was the one who coined these terms.

10. Whenever heat is transferred through a finite temperature difference, there is always a decrease in the availability of energy so transferred.
a) true

b) false
View AnswerAnswer: a
Explanation: This is cause of exergy lost due to irreversible heat transfer.
11. Exergy is lost due to
a) irreversible heat transfer
b) through finite temperature difference
c) during the process of heat addition
d) all of the mentioned
View AnswerAnswer: d
Explanation: The decrease in exergy is given by the product of lowest feasible temperature of heat rejection and the additional entropy change in the system.
12. Energy is said to degraded each time it flows through a finite temperature difference.
a) true
b) false
View AnswerAnswer: a
Explanation: The exergy is mainly lost due to irreversible heat transfer through a finite temperature difference.
13. When considering a finite energy source, its working fluid expands,
a) reversibly
b) adiabatically
c) reversibly and adiabatically
d) none of the mentioned
View AnswerAnswer: c
Explanation: For a finite energy source, expansion of working fluid is reversibly and adiabatically.

« Prev - Thermodynamics Questions and Answers – Reversible Adiabatic Work in a Steady Flow System and Entropy and Disorder» Next - Thermodynamics Questions and Answers – Quality of EnergyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Quality of Energy”.
1. A hot gas flowing through a pipeline can considered as a
a) reversible process
b) irreversible process
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: The process given here is irreversible.

2. For an infinitesimal reversible process at constant pressure,
a) dS=m*dT/T
b) dS=Cp*dT/T
c) dS=m*dT/T
d) dS=m*Cp*dT/T
View AnswerAnswer: d
Explanation: Here m is the mass of gas flowing, Cp is its specific heat, and T is the gas temperature.
3. Adequate insulation must provided for high temperature fluids.
a) true
b) false
View AnswerAnswer: a
Explanation: This is done to prevent heat loss which would high at high temperatures.
4. The loss of exergy is more when,
a) the heat loss occurs at a higher temperature
b) the heat loss occurs at a lower temperature
c) depends on the process
d) none of the mentioned
View AnswerAnswer: a
Explanation: Higher the temperature, more will the exergy loss.
5. The exergy of a fluid at a higher temperature is ___ than that at a lower temperature and ___ as the
temperature decreases.
a) less, increases
b) more, increases
c) more, decreases
d) less, decreases
View AnswerAnswer: c
Explanation: Higher is the temperature, higher will the exergy and it decreases as the temperature decreases.

6. The second law affixes a quality to energy of a system at any state.
a) true
b) false
View AnswerAnswer: a
Explanation: For example we can say that the quality of energy of a gas at say 1000K is superior to that
at say 300K.
7. The available energy of a system ___ as its temperature or pressure decreases and approaches that of
the surroundings.
a) increases
b) decreases

c) remains constant
d) none of the mentioned
View AnswerAnswer: b
Explanation: As temperature decreases, exergy decreases.
8. At ambient temperature, exergy of the fluid is
a) neagtive
b) positive
c) infinity
d) zero
View AnswerAnswer: d
Explanation: As the temperature of fluid decreases, its exergy decreases adn when the temperature reaches ambient temperature, its exergy comes zero.
9. Which of the following is true?
a) the first law states that the energy is always conserved quantity-wise
b) the second law states that the energy always degrades quality-wise
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Energy is always conserved according to first law but its quality is degraded.

10. If the first law is the conservation of energy, then the second law is called the law of degradation of energy.
a) true
b) false
View AnswerAnswer: a
Explanation: Though energy is always conserved but its quality is always degraded.
11. When a gas is throttled adiabatically from a high to a low pressure,
a) the enthalpy remains same
b) there is degradation of energy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause of the fact that energy always degrades quality-wise.
12. The ___ in entropy in an irreversible change is a measure of the extent to which energy ___ in that change.
a) decrease, degrades
b) increase, degrades
c) increase, increases
d) decrease, increases
View AnswerAnswer: b
Explanation: Also, to get maximum work from a system, changes must performed in a

reversible manner.
13. If two bodies were allowed to reach thermal equilibrium, one by heat conduction and other by operating a Carnot engine bebetween them and extracting work, the final equilibrium temperatures would
different.
a) this is cause of the lower value of the total internal energy
b) this is cause of the higher value of the total internal energy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: Work is done at the expense of internal energy.

14. Adequate insulation is not that important for low temperature fluids.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause the loss of available energy from such fluids would low.

« Prev - Thermodynamics Questions and Answers – Available Energy Referred to a Cycle» Next - Thermodynamics Questions and Answers – Maximum Work in a Reversible ProcessThis set of Thermodynamics Multiple Choice Questions & Answers focuses on “Maximum Work in a Reversible Process”.
1. For a process from state 1 to state 2, heat transfer in a reversible process is given by
a) Q for reversible=(To)*(S1-S2)
b) Q for reversible=(To)*(S2-S1)
c) Q for reversible=(To)/(S1-S2)
d) Q for reversible=(To)/(S2-S1)
View AnswerAnswer: b
Explanation: To is the temperature of the surroundings and S1,S2 are the entropies at state 1 and 2 respectively and ΔS(universe)=0.

2. For a process from state 1 to state 2, heat transfer in an irreversible process is given by
a) Q for irreversible=(To)*(S1-S2)
b) Q for irreversible>(To)*(S1-S2)
c) Q for irreversible<(To)*(S1-S2)

d) none of the mentioned
View AnswerAnswer: c
Explanation: To is the temperature of the surroundings and S1,S2 are the entropies at state 1 and 2 respectively ans ΔS(universe)>0.
3. Which of the following is true?
a) Q for reversible > Q for irreversible and work for reversible < work for irreversible
b) Q for reversible < Q for irreversible and work for reversible > work for irreversible
c) Q for reversible < Q for irreversible and work for reversible < work for irreversible
d) Q for reversible > Q for irreversible and work for reversible > work for irreversible
View AnswerAnswer: d
Explanation: This is cause, Q for reversible=(To)*(S2-S1) and Q for irreversible<(To)*(S1-S2).
4. Work done in all reversible processes is equal.
a) true
b) false
View AnswerAnswer: a
Explanation: Reversible processes bebetween the same end states must coincide and and produce equal amounts of work.
5. In an open system, for maximum work, the process must entirely
a) irreversible
b) reversible
c) adiabatic
d) none of the mentioned
View AnswerAnswer: b
Explanation: A reversible process gives the maximum work.

6. Which of the following is true for a steady flow system?
a) mass entering = mass leaving
b) mass does not enter or leave the system
c) mass entering can more or less than the mass leaving
d) none of the mentioned
View AnswerAnswer: a
Explanation: For a steady flow process, mass entering the system is equal to the mass leaving the system.
7. Which of the following is true for a closed system?
a) mass entering = mass leaving
b) mass does not enter or leave the system
c) mass entering can more or less than the mass leaving
d) none of the mentioned
View AnswerAnswer: b
Explanation: For a closed system mass does not change.
8. Which of the following is mostly neglected while doing calculations for finding

maximum work?
a) KE
b) PE
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The changes in KE and PE are very small, hence they are neglected.
9. The work done by a closed system in a reversible process is always ___ that done in an irreversible process.
a) less than or more than
b) equal to
c) less than
d) more than
View AnswerAnswer: d
Explanation: A reversible process always produces maximum work.

10. The proof that work done in all reversible processes is same can done by violating Kelvin-Planck statement.
a) true
b) false
View AnswerAnswer: a
Explanation: During the proof, we end up violating the Kelvin-Planck statement.
11. A piston cylinder contains air at 600 kPa, 290 K and a volume of 0.01m^3. A constant pressure process gives 54 kJ of work out. Find the final volume of the air.
a) 0.05 m^3
b) 0.01 m^3
c) 0.10 m^3
d) 0.15 m^3
View AnswerAnswer: c
Explanation: $W = \int P\, dV = P\Delta V$

$\Delta V = W/P = 54/600 = 0.09$ m^3

$V2 = V1 + \Delta V = 0.01 + 0.09 = 0.1$ m^3.

12. A piston-cylinder device initially contains air at 150 kPa and 27°C. At this state, the volume is 400 litre. The mass of the piston is such that a 350 kPa pressure is required to move it. The air is now heated until its volume has doubled. Determine the total heat transferred to the air.
a) 747 kJ
b) 757 kJ
c) 767 kJ
d) 777 kJ
View AnswerAnswer: c
Explanation: $Qin - Wout = \Delta U = m(u3 - u1)$

$m = P1V1/RT1 = 0.697$ kg

u1 = 300 K = 214.36 kJ/kg

u3 = 1400 K = 1113.43 kJ/kg
Therefore Qin = 767 kJ.

13. A piston cylinder contains 0.5 kg of air at 500 kPa and 500 K. The air expands in a process so pressure is linearly decreasing with volume to a final state of 100 kPa and 300 K. Find the work in the process.

a) 56.1 kJ
b) 66.1 kJ
c) 76.1 kJ
d) 86.1 kJ

View AnswerAnswer: d

Explanation: Work = $\int PdV = (1/2)(P1 + P2)(V2 - V1)$

$V1 = mR\ T1/ P1 = 0.5 \times 0.287 \times (500/500) = 0.1435\ m^3$

$V2 = mR\ T2/ P2 = 0.5 \times 0.287 \times (300/100) = 0.4305\ m^3$

$W = (1/2)(500 + 100)(0.4305 - 0.1435) = 86.1$ kJ.

« Prev - Thermodynamics Questions and Answers – Quality of Energy» Next - Thermodynamics Questions and Answers – Boundary Work in a Multistep ProcessThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Boundary Work in a Multistep Process”.

1. A cylinder contains 1kg of ammonia. Initially the ammonia is at 180°C, 2 MPa and is now cooled to saturated vapour at 40°C, and then further cooled to 20°C, at which point the quality is 50%. Find the total work for the process, assuming a linear variation of P versus V.

a) -19.4 kJ
b) -29.4 kJ
c) -39.4 kJ
d) -49.4 kJ

View AnswerAnswer: d

Explanation: State 1: (T, P) v1 = 0.10571 m3/kg; State 2: (T, x) sat. vap. P2 = 1555 kPa, v2 = 0.08313 m3/kg

State 3: (T, x) P3 = 857 kPa, v3 = (0.001638 + 0.14922)/2 = 0.07543 m3/kg

Work = $\int PdV = (P1 + P2)m(v2 - v1)/2 + (P2 + P3)m(v3 - v2)/2$
$= (2000 + 1555)1(0.08313 - 0.10571)/2 + (1555 + 857)1(0.07543 - 0.08313)/2$
$= -49.4$ kJ.

2. A piston cylinder has 1.5 kg of air at 300 K, 150 kPa. It is now heated up in a two step process. First constant volume to 1000 K (state 2) then followed by a constant pressure process to 1500 K, state 3. Find the work in the process.
a) 205.3 kJ
b) 215.3 kJ
c) 225.3 kJ
d) 235.3 kJ
View AnswerAnswer: b
Explanation: 1 -> 2: Constant volume $V_2 = V_1$ and 2 -> 3: Constant pressure $P_3 = P_2$
State 1: T, P => $V_1 = mRT_1/P_1 = 1.5 \times 0.287 \times 300/150 = 0.861$ m3
State 2: $V_2 = V_1$ => $P_2 = P_1 (T_2/T_1) = 150 \times 1000/300 = 500$ kPa
State 3: $P_3 = P_2$ => $V_3 = V_2 (T_3/T_2) = 0.861 \times 1500/1000 = 1.2915$ m3
Total work = $P_3(V_3 - V_2) = 500(1.2915 - 0.861) = 215.3$ kJ.
3. A piston-cylinder assembly has 1kg of R-134a at state 1 with 600 kPa, 110°C, and is then brought to saturated vapour, state 2, by cooling. The cooling continues to state 3 where the R-134a is saturated liquid. Find the work in each of the two steps, 1 to 2 and 2 to 3.
a) 0, -20.22 kJ
b) -20.22 kJ,0
c) 0, 0
d) -20.22 kJ, -20.22 kJ
View AnswerAnswer: a
Explanation: State 1: (T,P) => v = 0.04943 m3/kg; State 2: $v_2 = v_1$ and $x_2 = 1.0$
$v_2 = v_1 = v_g = 0.04943$ m3/kg => T = 10°C
State 3 reached at constant P (F = constant) $v_3 = v_f = 0.000794$ m3/kg
Since no volume change from 1 to 2 => $_1W_2 = 0$
From 2 to 3: $\int P\, dV = P(V_3 - V_2) = mP(v_3 - v_2) = 415.8 (0.000794 - 0.04943)(1)$
= -20.22 kJ.
4. R-22 is contained in a piston-cylinder, where the volume is 11 L when the piston hits the stops. The initial state is 150 kPa, –30°C with V=10 L. This system warms up to 15°C. Find the work done by R-22 during this process.
a) 0.35 kJ
b) 0.25 kJ
c) 0.15 kJ
d) 0.05 kJ
View AnswerAnswer: c
Explanation: Initially piston floats, V < V(stop) so piston moves at constant P(ext) = P1
until it reaches the stops or 15°C, whichever is first.
$v_1 = 0.1487$ m3/kg; $m = V/v = 0.010/0.1487 = 0.06725$ kg
now, $P_{1a} = 150$ kPa, v = V(stop)/m and $v_{1a} = V/m = 0.011/0.06725 = 0.16357$ m3/kg
=> $T_{1a} = -9$°C & $T_2 = 15$°C
Since $T_2 > T_{1a}$ then it follows that $P_2 > P_1$ and the piston is against stop.
Work = $\int P(ext)\, dV$ = P9ext)$(V_2 - V_1) = 150(0.011 - 0.010) = 0.15$ kJ.
5. A piston-cylinder contains 50 kg of water at 200 kPa with V=0.1 m3. Stops in the

cylinder restricts the enclosed volume to 0.5 m3. The water is now heated to 200°C. Find the work done by the water.
a) 50 kJ
b) 60 kJ
c) 70 kJ
d) 80 kJ
View AnswerAnswer: d
Explanation: Initially the piston floats so the equilibrium lift pressure is 200 kPa
1: 200 kPa, v1= 0.1/50 = 0.002 m3/kg, and 2: 200°C
v(stop) = 0.5/50 = 0.01 m3/kg;
State 2 two phase => P2 = Psat(T2) = 1.554 MPa, V2 = V(stop) = 0.5 m3
1W2 = 1W(stop) = 200 (0.5 – 0.1) = 80 kJ.

6. Ammonia in a piston/cylinder arrangement is at 80°C, 700 kPa. It is now cooled at constant pressure to saturated vapour (state 2) at which point the piston is locked with a pin. The cooling continues to –10°C (state 3). Find the work.
a) -28.64 kJ/kg
b) -38.64 kJ/kg
c) -48.64 kJ/kg
d) -58.64 kJ/kg
View AnswerAnswer: b
Explanation: 1W3 = 1W2 + 2W3 = ∫PdV = P1(V2 – V1) = mP1(v2 – v1)
Since constant volume from 2 to 3; v1 = 0.2367 m3/kg, P1 = 700 kPa,
v2 = vg = 0.1815 m3/kg, 1w3 = P1(v2- v1) = 700 × (0.1815 – 0.2367)
= -38.64 kJ/kg.
7. A piston-cylinder contains 1 kg of liquid water at 300 kPa, 20°C. Initially the piston floats, with a maximum enclosed volume of 0.002 m3 if the piston touches the stops. Now heat is added so that the final pressure is 600 kPa. Find the work in the process.
a) 0.30 kJ
b) 0.40 kJ
c) 0.50 kJ
d) 0.60 kJ
View AnswerAnswer: a
Explanation: State 1: Compressed liquid v = vf(20) = 0.001002 m3/kg
v(stop) = 0.002 m3/kg , 300 kPa
v2 = v(stop) = 0.002 m3/kg and V = 0.002 m3
Work is done while piston moves at P(lift) = constant = 300 kPa
1W2 = ∫ P dV = m*P(lift)*(v2 -v1) = 1 × 300(0.002 – 0.001002) = 0.30 kJ.
8. 10 kg of water in a piston-cylinder exists as saturated liquid/vapour at 100 kPa, with a quality of 50%. It is now heated till the volume triples. The mass of the piston is such that a cylinder pressure of 200kPa will float it. Find the work given

out by the water.
a) 3090 kJ
b) 3190 kJ
c) 3290 kJ
d) 3390 kJ
View AnswerAnswer: d
Explanation: Process: v = constant until P = P(lift) then P is constant.
State 1: $v1 = vf + x\ vfg = 0.001043 + 0.5 \times 1.69296 = 0.8475$ m3/kg
State 2: v2, P2 ≤ P(lift) => $v2 = 3 \times 0.8475 = 2.5425$ m3/kg;
T2 = 829°C ; V2 = m*v2 = 25.425 m3
Work = $\int P\, dV = P(lift)\times(V2 - V1) = 200$ kPa × 10 kg × (2.5425 – 0.8475) m3/kg
= 3390 kJ.

9. Ammonia at 10°C with a mass of 10 kg is in a piston-cylinder arrangement with an initial volume of 1 m3. The piston initially resting on the stops has a mass such that a pressure of 900 kPa will float it. The ammonia is now slowly heated to 50°C. Find the work in the process.
a) 483.2 kJ
b) 583.2 kJ
c) 683.2 kJ
d) 783.2 kJ
View AnswerAnswer: b
Explanation: Process: V = constant unless P = P(float)
State 1: T = 10°C, v1 = V/m = 1/10 = 0.1 m3/kg;
also v(f) < v < v(g) hence x1 = [v - v(f)]/v(fg) = (0.1-0.0016)/0.20381 = 0.4828
State 1a: P = 900 kPa, v = v1 = 0.1 < vg at 900 kPa;
two-phase T1a = 21.52°C Since T2 > T1a then v2 > v1a
State 2: 50°C => 900 kPa which is superheated vapor hence v2 = 0.1648 m3/kg, V2 = mv2 = 1.648 m3
Work = $\int P\, dV = P(float)\,(V2 - V1) = 900\,(1.648 - 1.0) = 583.2$ kJ.

10. A piston-cylinder contains 0.1 kg saturated liquid and vapour water at 100 kPa with quality 25%. The mass of the piston is such that a pressure of 500 kPa will float it. The water is heated to 300°C. Find the work.
a) 2.91 kJ
b) 3.91 kJ
c) 4.91 kJ
d) 5.91 kJ
View AnswerAnswer: c
Explanation: Process: v = constant until P = P(lift)

To locate state 1: $v_1 = 0.001043 + 0.25 \times 1.69296 = 0.42428$ m3/kg

1a: $v_{1a} = v_1 = 0.42428$ m3/kg > v_g at 500 kPa, so state 1a is Sup.Vapor $T_{1a} = 200°C$

State 2 is 300°C so heating continues after state 1a to 2 at constant P

=> 2: T2, P2 = P(lift) => $v_2 = 0.52256$ m3/kg ; $V_2 = mv_2 = 0.05226$ m3

$_1W_2 = P(lift)*(V_2 - V_1) = 500(0.05226 - 0.04243) = 4.91$ kJ.

11. A constant pressure piston cylinder contains 0.2 kg water in the form of saturated vapour at 400 kPa. It is now cooled to occupy half the original volume. Find the work in the process.
a) -12.5 kJ
b) -24.5 kJ
c) -8.5 kJ
d) -18.5 kJ
View AnswerAnswer: d
Explanation: $v_1 = 0.4625$ m3/kg, $V_1 = mv_1 = 0.0925$ m3
$v_2 = v_1/2 = 0.23125$ m3/kg, $V_2 = V_1/2 = 0.04625$ m3
Process: P = C
$W = \int PdV = P(V_2-V_1) = 400 \text{ kPa} \times (0.04625 - 0.0925) \text{ m3} = -18.5$ kJ.

12. A piston cylinder contains air at 600 kPa, 290 K and volume of 0.01 m3. A constant pressure process gives out 54 kJ of work. Find the final temperature of the air.
a) 2700 K
b) 2800 K
c) 2900 K
d) 3000 K
View AnswerAnswer: c
Explanation: $W = \int P\,dV = P\Delta V$ hence $\Delta V = W/P = 54/600 = 0.09$m3
$V_2 = V_1 + \Delta V = 0.01 + 0.09 = 0.1$ m3
Assuming ideal gas, PV = mRT,
$T_2 = P_2 V_2/(m R) = [(P_2 V_2)/(P_1 V_1)] T_1 = T_1 (V_2/V_1) = (0.1 \times 290)/0.01$
$= 2900$ K.

13. A piston/cylinder has 5m of liquid 20°C water on top of piston with cross-sectional area of 0.1 m2. Air is let in under the piston that rises and pushes the water out. Find the necessary work to push all the water out.
a) 62.88 kJ
b) 52.88 kJ
c) 92.88 kJ
d) 42.88 kJ
View AnswerAnswer: a
Explanation: $P_1 = P_o + \rho g H = 101.32 + 997 \times 9.807 \times 5 / 1000 = 150.2$ kPa
$\Delta V = H \times A = 5 \times 0.1 = 0.5$ m3
Work = Area = $\int P\,dV = \frac{1}{2}(P_1 + P_o)(V_{max} - V_1)$
$= \frac{1}{2}(150.2 + 101.32) \text{ kPa} \times 0.5 \text{ m3}$
$= 62.88$ kJ.

14. A piston/cylinder contains 1 kg water at 20°C with volume 0.1 m3. While the water is heated to saturated vapour, the piston is not allowed to move. Find the final temperature.
a) 201.7°C
b) 211.7°C
c) 215.7°C
d) 221.7°C
View AnswerAnswer: b
Explanation: $V2 = V1 = 0.1\ m3$
$T2 = Tsat = 210 + 5[(0.1 – 0.10324)/(0.09361 – 0.10324)]$
$= 211.7°C.$
15. A piston cylinder contains 3 kg of air at 20°C and 300 kPa. It is now heated at a constant pressure to 600 K. Find the work in the process.
a) 244.2 kJ
b) 254.2 kJ
c) 264.2 kJ
d) 274.2 kJ
View AnswerAnswer: c
Explanation: $V1 = mR\ T1 / P1 = 3 × 0.287 × 293.15/300 = 0.8413\ m3$
$V2 = mR\ T2 / P2 = 3 × 0.287 × 600/300 = 1.722\ m3$
$work = ∫ PdV = P (V2 – V1) = 300 (1.722 – 0.8413) = 264.2\ kJ.$

« Prev - Thermodynamics Questions and Answers – Maximum Work in a Reversible Process» Next - Thermodynamics Questions and Answers – Work in a Reversible Process-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Work in a Reversible Process-1”.
1. Hot air at 1500 K expands in a polytropic process to a volume 6 times as large with n = 1.5. Find the specific boundary work.
a) 309.5 kJ/kg
b) 409.5 kJ/kg
c) 509.5 kJ/kg
d) 609.5 kJ/kg
View AnswerAnswer: c
Explanation: $u1 = 444.6\ kJ/kg,\ u2 = 1205.25\ kJ/kg$
$T2 = T1(v1/v2)^{(n-1)} = 1500(1/6)^{0.5} = 612.4\ K$
$1w2 = R(T2-T1)/(1-n) = 0.287(612.4 – 1500)/(1 – 1.5) = 509.5\ kJ/kg.$

2. In a Carnot-cycle heat pump, heat is rejected from R-22 at 40°C, during which the R-22 changes from saturated vapor to saturated liquid. The heat is transferred to the R-22 at 0°C. Determine the COP for the cycle.
a) 6.83
b) 7.83
c) 8.83
d) 9.83
View AnswerAnswer: b
Explanation: $s_4 = s_3 = 0.3417$ kJ/kg K $= 0.1751 + x_4(0.7518)$ => $x_4 = 0.2216$
$s_1 = s_2 = 0.8746$ kJ/kg K $= 0.1751 + x_1(0.7518)$ => $x_1 = 0.9304$
$\beta' = q/w = T_h/(T_h - T_l) = 313.2/40 = 7.83$.
3. 1kg of ammonia in a piston/cylinder at 50°C, 1000 kPa is expanded in a reversible isothermal process to 100 kPa. Find the work for this process.
a) 333.75 kJ
b) 343.75 kJ
c) 353.75 kJ
d) 363.75 kJ
View AnswerAnswer: d
Explanation: $_1W_2 = \int PdV$
State 1: $u_1 = 1391.3$ kJ/kg; $s_1 = 5.265$ kJ/kg K
State 2: $u_2 = 1424.7$ kJ/kg; $s_2 = 6.494$ kJ/kg K; $v_2 = 1.5658$ m^3/kg; $h_2 = 1581.2$ kJ/kg
$_1Q_2 = 1$ kg $(273 + 50)$ K $(6.494 - 5.265)$ kJ/kg K $= 396.967$ kJ
$_1W_2 = {}_1Q_2 - m(u_2 - u_1) = 363.75$ kJ.
4. 1kg of ammonia in a piston/cylinder at 50°C, 1000 kPa is expanded in a reversible isobaric process to 140°C. Find the work in the process.
a) 50.5 kJ
b) 60.5 kJ
c) 70.5 kJ
d) 80.5 kJ
View AnswerAnswer: a
Explanation: $_1W_2 = mP(v_2 - v_1)$
$v_1 = 0.145$ m^3/kg, $u_1 = 1391.3$ kJ/kg
$v_2 = 0.1955$ m^3/kg, $u_2 = 1566.7$ kJ/kg
$_1W_2 = 1 \times 1000(0.1955 - 0.145) = 50.5$ kJ.
5. 1kg of ammonia in a piston/cylinder at 50°C, 1000 kPa is expanded in a reversible adiabatic process to 100 kPa. Find the work for this process.
a) 222.4 kJ
b) 232.4 kJ
c) 242.4 kJ
d) 252.4 kJ
View AnswerAnswer: b
Explanation: $_1Q_2 = 0 \Rightarrow s_2 = s_1$ and $u_1 = 1391.3$ kJ/kg, $s_1 = 5.2654$ kJ/kg K
$s_{g2} = 5.8404$ kJ/kg K, $s_f = 0.1192$ kJ/kg K; $x_2 = (s - s_f)/s_{fg}$
$x_2 = (5.2654 - 0.1192)/5.7212 = 0.90$;

$u_2 = u_f + x_2 u_{fg} = 27.66 + 0.9×1257.0 = 1158.9$ kJ/kg
$_1W_2 = 1 × (1391.3 – 1158.9) = 232.4$ kJ.

6. A cylinder-piston contains ammonia at 50°C, 20% quality, volume ing 1 L. The ammonia expands slowly, and heat is transferred to maintain a constant temperature. The process continues until all liquid is gone. Determine the work for this process.
a) 7.11 kJ
b) 9.11 kJ
c) 5.11 kJ
d) 8.11 kJ
View AnswerAnswer: a
Explanation: $T_1 = 50°C$, $x_1 = 0.20$, $V_1 = 1$ L, $v_1 = 0.001777 + 0.2 ×0.06159 = 0.014095$ m^3/kg
$s_1 = 1.5121 + 0.2 × 3.2493 = 2.1620$ kJ/kg K,
$m = V_1/v_1 = 0.001/0.014095 = 0.071$ kg
$v_2 = v_g = 0.06336$ m^3/kg, $s_2 = s_g = 4.7613$ kJ/kg K
Process: T = constant to $x_2 = 1.0$, P = constant = 2.033 MPa
$_1W_2 = \int PdV = Pm(v_2 – v_1) = 2033 × 0.071 × (0.06336 – 0.014095)$
$= 7.11$ kJ.

7. An insulated cylinder fitted with a piston contains 0.1 kg of water at 100°C and 90% quality. The piston is moved, compressing the water till it reaches a pressure of 1.2 MPa. How much work is required in the process?
a) -27.5 kJ
b) -47.5 kJ
c) -17.5 kJ
d) -37.5 kJ
View AnswerAnswer: d
Explanation: $_1Q_2 = 0 = m(u_2 – u_1) + {}_1W_2$
State 1: 100°C, $x_1 = 0.90$: $s_1 = 1.3068 + 0.90×6.048 = 6.7500$ kJ/kg K
$u_1 = 418.91 + 0.9 × 2087.58 = 2297.7$ kJ/kg
State 2: $s_2 = s_1 = 6.7500$ and $P_2 = 1.2$ MPa which gives $T_2 = 232.3°C$ and $u_2 = 2672.9$ kJ/kg
$_1W_2 = -m(u_2 – u_1) = -0.1(2672.9 – 2297.7) = -37.5$ kJ.

8. Compression and heat transfer brings R-134a from 50°C, 500 kPa to saturated vapour in an isothermal process. Find the specific work.
a) -24.25 kJ/kg
b) -25.25 kJ/kg
c) -26.25 kJ/kg
d) -27.25 kJ/kg
View AnswerAnswer: c
Explanation: Process: T = C and assume reversible ⇒ $_1q_2 = T (s_2 – s_1)$
$u_1 = 415.91$ kJ/kg, $s_1 = 1.827$ kJ/kg K
$u_2 = 403.98$ kJ/kg, $s_2 = 1.7088$ kJ/kg K

$1q2 = (273 + 50) \times (1.7088 - 1.827) = -38.18$ kJ/kg
$w2 = 1q2 + u1 - u2 = -38.18 + 415.91 - 403.98 = -26.25$ kJ/kg.

9. 1kg of water at 300°C expands against a piston in a cylinder until it reaches 100 kPa, at which point the water has a quality of 90.2%. The expansion is reversible and adiabatic. How much work is done by the water?
a) 371.2 kJ
b) 471.2 kJ
c) 571.2 kJ
d) 671.2 kJ
View AnswerAnswer: b
Explanation: Process: Adiabatic Q = 0 and reversible => s2 = s1
P2 = 100 kPa, x2 = 0.902, thus $s2 = 1.3026 + 0.902 \times 6.0568 = 6.7658$ kJ/kg K
$s2 = 1.3026 + 0.902 \times 6.0568 = 6.7658$ kJ/kg K
State 1 At T1 = 300°C, s1 = 6.7658 and ⇒ P1 = 2000 kPa, u1 = 2772.6 kJ/kg
$1W2 = m(u1 - u2) = 1(2772.6 - 2301.4) = 471.2$ kJ.

10. A piston/cylinder has 2kg ammonia at 100 kPa, 50°C which is compressed to 1000 kPa. The temperature is assumed to constant. Find the work for the process assuming it to reversible.
a) -727.6 kJ
b) -794.2 kJ
c) -723.6 kJ
d) -743.2 kJ
View AnswerAnswer: a
Explanation: Process: T = constant and assume reversible process
v1 = 1.5658 m^3/kg, u1 = 1424.7 kJ/kg, s1 = 6.4943 kJ/kg K
v2 = 0.1450 m^3/kg, u2 = 1391.3 kJ/kg, s2 = 5.2654 kJ/kg K
$1Q2 = mT(s2 - s1) = 2 \times 323.15 (5.2654 - 6.4943) = -794.2$ kJ
$1W2 = 1Q2 - m(u2 - u1) = -794.24 - 2(1391.3 - 1424.62) = -727.6$ kJ.

11. A piston cylinder has R-134a at 100 kPa, –20°C which is compressed to 500 kPa in a reversible adiabatic process. Find the specific work.
a) -41.63 kJ/kg
b) -11.63 kJ/kg
c) -21.63 kJ/kg
d) -31.63 kJ/kg
View AnswerAnswer: d
Explanation: Process: Adiabatic and reversible => s2 = s1
u1 = 367.36 kJ/kg, s1 = 1.7665 kJ/kg K
P2 = 500 kPa, s2 = s1 = 1.7665 kJ/kg K

very close at 30°C, $u_2 = 398.99$ kJ/kg
$_1w_2 = u_2 - u_1 = 367.36 - 398.99 = -31.63$ kJ/kg.

12. A cylinder containing R-134a at 150 kPa, 10°C has an initial volume of 20 L. A piston compresses the R-134a in a isothermal, reversible process until it reaches the saturated vapour state. Calculate the required work in the process.
a) -1.197 kJ
b) -2.197 kJ
c) -3.197 kJ
d) -4.197 kJ
View AnswerAnswer: c
Explanation: Process: T = constant, reversible
$u_1 = 388.36$ kJ/kg, $s_1 = 1.822$ kJ/kg K, $m = V/v_1 = 0.02/0.148283 = 0.1349$ kg
$u_2 = 383.67$ kJ/kg, $s_2 = 1.7218$ kJ/kg K
$_1Q_2 = \int T ds = mT(s_2 - s_1) = 0.1349 \times 283.15 \times (1.7218 - 1.822) = -3.83$ kJ
$_1W_2 = m(u_1 - u_2) + {_1Q_2} = 0.1349 \times (388.36 - 383.67) - 3.83 = -3.197$ kJ.

13. A piston/cylinder has 2kg water at 250°C, 1000 kPa which is now cooled with a constant load on the piston. This isobaric process ends when the water has reached a state of saturated liquid. Find the work.
a) -363.1 kJ
b) -463.1 kJ
c) -563.1 kJ
d) -663.1 kJ
View AnswerAnswer: b
Explanation: Process: $P = C \Rightarrow W = \int P\,dV = P(V_2 - V_1)$
State 1: $v_1 = 0.23268$ m^3/kg, $s_1 = 6.9246$ kJ/kg K, $u_1 = 2709.91$ kJ/kg
State 2: $v_2 = 0.001127$ m^3/kg, $s_2 = 2.1386$ kJ/kg K, $u_2 = 761.67$ kJ/kg
$_1W_2 = m P (v_2 - v_1) = 2 \times 1000 (0.001127 - 0.23268) = -463.1$ kJ.

14. Water at 250°C, 1000 kPa is brought to saturated vapour in a piston/cylinder with an isothermal process. Find the specific work.
a) -38 kJ/kg
b) -138 kJ/kg
c) -238 kJ/kg
d) -338 kJ/kg
View AnswerAnswer: d
Explanation: Process: T = constant, reversible
State 1: $v_1 = 0.23268$ m^3/kg; $u_1 = 2709.91$ kJ/kg; $s_1 = 6.9246$ kJ/kg K

State 2: $v_2 = 0.05013\ m^3/kg$, $u_2 = 2602.37$ kJ/kg, $s_2 = 6.0729$ kJ/kg K

$_1q_2 = \int T\, ds = T(s_2 - s_1) = (250 + 273)(6.0729 - 6.9246) = -445.6$ kJ/kg

$_1w_2 = {}_1q_2 + u_1 - u_2 = -445.6 + 2709.91 - 2602.37 = -338$ kJ/kg.

15. Water at 250°C, 1000 kPa is brought to saturated vapour in a rigid container. Find the specific heat transfer in this isometric process.
a) –132 kJ/kg
b) –232 kJ/kg
c) –332 kJ/kg
d) –432 kJ/kg
View AnswerAnswer: a
Explanation: Process: v = constant => $_1w_2 = 0$

State 1: $u_1 = 2709.91$ kJ/kg, $v_1 = 0.23268\ m^3/kg$

State 2: x = 1 and $v_2 = v_1$, thus P_2=800 kPa

$T_2 = 170 + 5 \times (0.23268 - 0.24283)/(0.2168 - 0.24283) = 170 + 5 \times 0.38993 = 171.95°C$

$u_2 = 2576.46 + 0.38993 \times (2580.19 - 2576.46) = 2577.9$ kJ/kg

$_1q_2 = u_2 - u_1 = 2577.9 - 2709.91 = -132$ kJ/kg.

« Prev - Thermodynamics Questions and Answers – Boundary Work in a Multistep Process» Next - Thermodynamics Questions and Answers – Work in a Reversible Process-2This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Work in a Reversible Process-2".

1. Water at 250°C, 1000 kPa is brought to saturated vapour in a piston/cylinder with an isobaric process. Find the specific work.
a) -18.28 kJ/kg
b) -48.28 kJ/kg
c) -28.28 kJ/kg
d) -38.28 kJ/kg
View AnswerAnswer: d
Explanation: Process: P = C => $w = \int P\, dv = P(v_2 - v_1)$

1: $v_1 = 0.23268$ m3/kg, $s_1 = 6.9246$ kJ/kgK, $u_1 = 2709.91$ kJ/kg

2: $v_2 = 0.19444$ m3/kg, $s_2 = 6.5864$ kJ/kg K, $u_2 = 2583.64$ kJ/kg, $T_2 = 179.91°C$

$_1w_2 = P(v_2 - v_1) = 1000(0.1944 - 0.23268) = -38.28$ kJ/kg.

2. A heavily insulated cylinder/piston contains ammonia at 60°C, 1200 kPa. The piston is moved, expanding the ammonia in a reversible process until the temperature is –20°C during which 600 kJ of work is given out by ammonia. What was

the initial volume of the cylinder?
a) 0.285 m3
b) 0.385 m3
c) 0.485 m3
d) 0.585 m3
View AnswerAnswer: b
Explanation: State 1: $v_1 = 0.1238$ m3/kg, $s_1 = 5.2357$ kJ/kg K,
$u_1 = h - Pv = 1553.3 - 1200 \times 0.1238 = 1404.9$ kJ/kg
Process: reversible ($_1S_{2(gen)} = 0$) and adiabatic ($dQ = 0$) => $s_2 = s_1$
State 2: T_2, $s_2 \Rightarrow x_2 = (5.2357 - 0.3657)/5.2498 = 0.928$
$u_2 = 88.76 + 0.928 \times 1210.7 = 1211.95$ kJ/kg
$_1Q_2 = 0 = m(u_2 - u_1) + {_1W_2} = m(1211.95 - 1404.9) + 600 \Rightarrow m = 3.110$ kg
$V_1 = mv_1 = 3.11 \times 0.1238 = 0.385$ m3.

3. Water at 250°C, 1000 kPa is brought to saturated vapor in a piston/cylinder with an adiabatic process. Find the specific work.
a) 139.35 kJ/kg
b) 149.35 kJ/kg
c) 159.35 kJ/kg
d) 169.35 kJ/kg
View AnswerAnswer: c
Explanation: State 1: $v_1 = 0.23268$ m3/kg, $u_1 = 2709.91$ kJ/kg, $s_1 = 6.9246$ kJ/kg K
State 2: $x = 1$ and $s_2 = s_1 = 6.9246$ kJ/kg K
$T_2 = 140.56$°C, $P_2 = 367.34$ kPa, $v_2 = 0.50187$ m3/kg, $u_2 = 2550.56$ kJ/kg
$_1w_2 = u_1 - u_2 = 2709.91 - 2550.56 = 159.35$ kJ/kg.

4. A piston/cylinder contains 2kg water at 200°C, 10 MPa. The water expands in an isothermal process to a pressure of 200 kPa. Any heat transfer takes place with an ambient at 200°C and whole process is assumed reversible. Calculate the total work.
a) 1290.3 kJ
b) 1390.3 kJ
c) 1490.3 kJ
d) 1590.3 kJ
View AnswerAnswer: a
Explanation: State 1: $v_1 = 0.001148$ m3/kg, $u_1 = 844.49$ kJ/kg,
$s_1 = 2.3178$ kJ/kg K, $V_1 = mv_1 = 0.0023$ m3
State 2: $v_2 = 1.08034$ m3/kg, $u_2 = 2654.4$ kJ/kg,
$s_2 = 7.5066$ kJ/kg K, $V_2 = mv_2 = 2.1607$ m3
$_1Q_2 = mT(s_2 - s_1) = 2 \times 473.15\ (7.5066 - 2.3178) = 4910$ kJ
$_1W_2 = {_1Q_2} - m(u_2 - u_1) = 1290.3$ kJ.

5. A piston/cylinder of total 1kg steel contains 0.5 kg ammonia at 1600 kPa both masses at 120°C with minimum volume ing 0.02 m3. The whole system is cooled down to 30°C by heat transfer to the ambient at 20°C, and during the process the steel keeps same temperature as the ammonia. Find the work.
a) – 28.14 kJ
b) – 38.14 kJ
c) – 48.14 kJ
d) – 58.14 kJ
View AnswerAnswer: d

Explanation: 1 : $v_1 = 0.11265$ m3/kg, $u_1 = 1516.6$ kJ/kg,
$s_1 = 5.5018$ kJ/kg K, $V_1 = mv_1 = 0.05634$ m3

2 : 30°C < T(stop) so $v_2 = v(stop) = 0.04$ m3/kg

$_1W_2 = \int P\,dV = (P_1)m(v_2-v_1) = 1600 \times 0.5\,(0.04 - 0.11265) = -58.14$ kJ.

6. A mass of 1 kg of air contained in a cylinder at 1000 K, 1.5 MPa, expands in a reversible isothermal process to a volume 10 times larger. Calculate the heat transfer during the process.

a) 460.84 kJ
b) 560.84 kJ
c) 660.84 kJ
d) 760.84 kJ

View AnswerAnswer: c

Explanation: Process: T = constant so with ideal gas => $u_2 = u_1$

$$_1Q_2 = {_1W_2} = \int P\,dV = P_1V_1 \ln (V_2/V_1) = mRT_1 \ln (V_2/V_1)$$
$$= 1 \times 0.287 \times 1000 \ln (10) = 660.84 \text{ kJ}.$$

7. A piston/cylinder contains air at 400 K, 100 kPa which is compressed to a final pressure of 1000 kPa. Consider the process to a reversible adiabatic process. Find the specific work.

a) -166.7 kJ/kg
b) -266.7 kJ/kg
c) -366.7 kJ/kg
d) -466.7 kJ/kg

View AnswerAnswer: b

Explanation: We have constant s, an isentropic process

$$T_2 = T_1(P_2 / P_1)^{[(k-1)/k]} = 400(1000/100)^{(0.4/1.4)} = 400 \times 10^{(0.28575)} = 772 \text{ K}$$
$$_1w_2 = u_1 - u_2 = C_v(T_1 - T_2) = 0.717(400 - 772) = -266.7 \text{ kJ/kg}.$$

8. A piston/cylinder contains air at 400 K, 100 kPa which is compressed to a final pressure of 1000 kPa. Consider the process to a reversible isothermal process. Find the specific work.

a) −264 kJ/kg
b) −364 kJ/kg
c) −464 kJ/kg
d) −564 kJ/kg

View AnswerAnswer: a

Explanation: For this process $T_2 = T_1$ so since ideal gas we get $u_2 = u_1$ and also $_1w_2 = {_1q_2}$

$$_1w_2 = {_1q_2} = T(s_2 - s_1) = -RT \ln(P_2/P_1)$$
$$= - 0.287 \times 400 \ln 10 = -264 \text{ kJ/kg}.$$

9. Consider a small air pistol with a cylinder volume of 1 cm3 at 27°C, 250 kPa. The bullet acts as a piston and is released so the air expands in an adiabatic process. If the pressure should 100 kPa as the bullet leaves the cylinder find the work done by the air.

a) 0.115 J
b) 0.125 J
c) 0.135 J
d) 0.145 J
View AnswerAnswer: d
Explanation: Process: Adiabatic 1q2 = 0 Reversible 1s2(gen) = 0
this is an isentropic expansion process giving s2 = s1
$T2 = T1(P2 / P1)^{[(k-1)/k]} = 300(100/250)^{(0.4/1.4)} = 300 \times 0.4^{(0.28575)} = 230.9$ K
$V2 = V1\ P1\ T2/P2\ T1 = 1 \times 250 \times 230.9/100 \times 300 = 1.92$ cm3
Work $= [1/(k-1)](P2V2 – P1V1) = [1/(1-1.4)](100 \times 1.92 – 250 \times 1) \times 10^{(-6)}$
= 0.145 J.

10. A spring loaded piston cylinder contains 1.5 kg air at 160 kPa and 27°C. It is heated in a process where pressure is linear in volume, P = A + BV, to twice the initial volume where it reaches 900 K. Find the work assuming a source at 900 K.
a) 61.4 kJ
b) 161.4 kJ
c) 261.4 kJ
d) 361.4 kJ
View AnswerAnswer: b
Explanation: State 1: u1 = 214.36 kJ/kg, $V1 = mRT1/ P1 = (1.5 \times 0.287 \times 300) / 160 = 0.8072$ m3
State 2: u2 = 674.824 kJ/kg,
$P2 = RT2/v2 = RT2/(2v1) = T2\ P1/(2T1)= P1(T2/2)T1$
$= 160 \times 900 / 2 \times 300 = 240$ kPa
$1W2 = \int PdV = 0.5 \times (P1 + P2) (V2 – V1) = 0.5 \times (P1 + P2) V1$
$= 0.5 \times (160 + 240)\ 0.8072 = 161.4$ kJ.
11. Helium contained in a cylinder at ambient conditions, 100 kPa, 20°C, is compressed in a reversible isothermal process to 600 kPa, after which the gas is expanded back to 100 kPa in a reversible adiabatic process. Calculate the net work per kilogram of helium.
a) -623.6 kJ/kg
b) +467.4 kJ/kg
c) -1091.0 kJ/kg
d) none of the mentioned
View AnswerAnswer: a
Explanation: The adiabatic reversible expansion gives constant s
$T3 = T2(P3/P2)^{[(k-1)/k]} = 293.15\ (100/600)^{0.4} = 143.15$ K
The isothermal process: $1w2 = -RT1 \ln(P2/P1)$
$= -2.0771 \times 293.15 \times \ln(600/100) = -1091.0$ kJ/kg
The adiabatic process: 2w3 = CVo(T2-T3) = 3.116 (293.15 –

143.15) = +467.4 kJ/kg
The net work is the sum: w(NET) = -1091.0 + 467.4 = -623.6 kJ/kg.

12. A cylinder/piston contains 1kg methane gas at 100 kPa, 20°C. The gas is compressed reversibly to a pressure of 800 kPa. Calculate the work required if the process is adiabatic.
a) -112.0 kJ
b) -212.0 kJ
c) -312.0 kJ
d) -412.0 kJ
View AnswerAnswer: c
Explanation: Process: 1Q2 = 0 => s2 = s1 thus isentropic process
$T2 = T1(P2/P1)^{[(k-1)/k]} = 293.2(800/100)^{0.230} = 473.0$ K
$1W2 = -mCv(T2 – T1) = -1 \times 1.7354 (473.0 – 293.2) = -312.0$ kJ.

13. A piston/cylinder contains air at 100 kPa, 300 K. It is now compressed in a reversible adiabatic process to a volume 7 times as small. Use constant heat capacity and find the specific work.
a) -233.6 kJ/kg
b) -243.6 kJ/kg
c) -253.6 kJ/kg
d) -263.6 kJ/kg
View AnswerAnswer: c
Explanation: $v2/ v1 = 1/7$; $P2 /P1 = (v2/v1)^{(-k)} = 7^{(1.4)} = 15.245$
$P2 = P1[7^{(1.4)}] = 100 \times 15.245 = 1524.5$ kPa
$T2 = T1 (v1/v2)^{(k-1)} = 300 \times 7^{(0.4)} = 653.4$ K
1q2 = 0 kJ/kg; work = $R(T2-T1)/(1-k) = 0.287*(653.4 – 300)/(-0.4) = -253.6$ kJ/kg.

14. A gas confined in a piston-cylinder is compressed in a quasi-static process from 80 kPa and 0.1 m3 to 400 kPa and 0.03m3. If the pressure and volume are related by PV^n= constant, calculate the work involved in the process.
a) – 12.87 kJ
b) 12.87 kJ
c) – 11.87 kJ
d) 11.87 kJ
View AnswerAnswer: c
Explanation: $n = \ln(P2/P1)/\ln(V1/V2) = \ln(400/80)/\ln(0.1/0.03) = 1.337$
Work involved in the process (1W2) = $(P2V2 – P1V1)(1 – n) = – 11.87$ kJ.

15. One kg of steam at 200 kPa with 20% quality is heated at constant pressure to 400°C. Calculate the work done by the system .
a) 274.261 kJ

b) 374.261 kJ
c) 474.261 kJ
d) 574.261 kJ
View AnswerAnswer: a
Explanation: $v_1 = 0.001061 + 0.2*0.88467 = 0.177995$ m3/kg; $v_2 = 1.5493$ m3/kg
work done by the system during this process ($_1W_2$) = $mP(v_2 – v_1)$
= 1*200*(1.5493 – 0.177995) = 274.261 kJ.

« Prev - Thermodynamics Questions and Answers – Work in a Reversible Process-1»
Next - Thermodynamics Questions and Answers – Work in a Reversible Process-3This set of Thermodynamics online test focuses on “Work in a Reversible Process-3”.

1. A reversible adiabatic air compressor takes in air at 100 kPa, 25°C and delivers it at 1 MPa. Assuming the specific heat is constant, calculate the specific work.
a) 145.6 kJ/kg
b) 324.6 kJ/kg
c) 178.6 kJ/kg
d) 278.6 kJ/kg
View AnswerAnswer: d
Explanation: From data book, for air: $c_p = 1.004$ kJ/kg.K and $k = 1.4$;
$T_2 = T_1(P_2/P_1)^{[(k-1)/k]} = 575.6$ K
Specific work (w) = $\Delta h = c_p\Delta T = 1.004*(575.64 – 298.15)$
= 278.6 kJ/kg.

2. The force needed to compress a non-linear spring is given by $F = 200x + 30x^2$, where F is force in Newton and x is displacement of the spring in meter. Determine the work needed to compress the spring a distance of 0.6 m.
a) 32.46 J
b) 23.43 J
c) 38.16 J
d) 48.87 J
View AnswerAnswer: c
Explanation: Work needed to compress the spring (W) = $\int F dx = \int(200x + 30x^2)dx$
$= 100x^2 + 10x^3 = 100*0.6^2 + 10*0.6^3 = 38.16$ J.

3. 19 mm thick fibre panels with thermal conductivity of 0.12 W/m.K are used for false ceiling of an AC room. If the floor area of the room is 17.65 m^2 and the temperature difference across the fibre panel is 15°C, calculate the heat transfer rate.
a) 4.672 kW
b) 3.672 kW
c) 2.672 kW
d) 1.672 kW
View AnswerAnswer: d
Explanation: Heat transfer rate = $kA\Delta T/x = 0.12*17.65*15/0.019$

$= 1672.1$ Watt $= 1.672$ kW.

4. Air (an ideal gas) at 227°C and 500 kPa is allowed to expand to a pressure of 100 kPa in an ideal throttling process. What will the final temperature of the expanded air?

a) 230°C
b) 227°C
c) 300°C
d) 327°C

View AnswerAnswer: b

Explanation: In an ideal throttling process, enthalpy is constant; hence for an ideal gas the temperature is also constant.

Final temperature of the expanded air (Tf) = 227°C.

5. A 250 L rigid tank contains methane at 500 K, 1500 kPa. It is now cooled down to 300 K. Find the heat transfer using ideal gas.

a) –402.4 kJ
b) –502.4 kJ
c) –602.4 kJ
d) –702.4 kJ

View AnswerAnswer: b

Explanation: Assume ideal gas, $P2 = P1 \times (T2 / T1) = 1500 \times 300 / 500 = 900$ kPa

$m = P1V/RT1 = 1500 \times 0.250.5183 \times 500 = 1.447$ kg

$u2 – u1 = Cv(T2–T1) = 1.736(300–500)= –347.2$ kJ/kg

$1Q2 = m(u2 – u1) = 1.447(-347.2) = –502.4$ kJ.

6. A piston cylinder contains 3 kg of air at 20°C and 300 kPa. It is now heated up in a constant pressure process to 600 K. Find the heat transfer.

a) 641 kJ
b) 741 kJ
c) 841 kJ
d) 941 kJ

View AnswerAnswer: d

Explanation: Ideal gas: $PV = mRT$

$P2V2 = mRT2$ thus $V2 = mRT2 / P2 = 3\times0.287\times600 / 300 = 1.722$ m^3

Process: $P =$ constant,

$1W2 = \int PdV = P (V2 – V1) = 300 (1.722 – 0.8413) = 264.2$ kJ

$U2 – U1 = 1Q2 – 1W2 = m(u2 – u1)$

$1Q2 = U2 – U1 + 1W2 = 3(435.097 – 209.45) + 264.2$

$= 941$ kJ.

7. A steam turbine inlet is at 1200 kPa, 500°C. The actual exit is at 300 kPa, 300°C with an actual work of 407 kJ/kg. What is its reversible work output if ambient temperature is at 25°C?

a) 414.9 kJ/kg
b) 314.9 kJ/kg
c) 214.9 kJ/kg
d) 614.9 kJ/kg

View AnswerAnswer: a
Explanation: $T_0 = 25^0C = 298.15$ K
The turbine is assumed to adiabatic, so $q = 0$.
Inlet state: $h_i = 3476.28$ kJ/kg; $s_i = 7.6758$ kJ/kg K
$h_e = h_i - w(ac) = 3476.28 - 407 = 3069.28$ kJ/kg
Actual exit state: $P_e = 300$ kPa, $T_e = 300\ ^0C$; $s_e = 7.7022$ kJ/kg K
$w(rev) = (h_i - T_o s_i) - (h_e - T_o s_e) + q(T_0/T_H) = (h_i - h_e) + T_o(s_e - s_i)$
$= (3476.28 - 3069.28) + 298.15(7.7022 - 7.6758) + 0$
$= 407 + 7.87 = 414.9$ kJ/kg.

8. Find the specific reversible work for a R-134a compressor with inlet state of –20°C, 100 kPa and an exit state of 600 kPa, 50°C. Use a 25°C ambient temperature.
a) -18.878 kJ/kg
b) -28.878 kJ/kg
c) -38.878 kJ/kg
d) -48.878 kJ/kg
View AnswerAnswer: c
Explanation: The compressor is assumed to adiabatic so $q = 0$.
$w_{rev} = T_0(s_e - s_i) - (h_e - h_i)$
$h_i = 387.22$ kJ/kg; $s_i = 1.7665$ kJ/kg K
$h_e = 438.59$ kJ/kg; $s_e = 1.8084$ kJ/kg K
$\therefore w_{rev} = 298.15(1.8084 - 1.7665) - (438.59 - 387.22) = -38.878$ kJ/kg.

9. A steam turbine receives steam at 6 MPa, 800°C. It has a heat loss of 49.7 kJ/kg and an isentropic efficiency of 90%. For an exit pressure of 15 kPa and surroundings at 20°C, find the actual work.
a) 2233.79 kJ/kg
b) 2423.95 kJ/kg
c) 2483.95 kJ/kg
d) 1648.79 kJ/kg
View AnswerAnswer: d
Explanation: Reversible adiabatic turbine
$h_i = 4132.74$ kJ/kg, $s = s_i = 7.6566$ kJ/kg K
$x = (7.6566 - 0.7548)/7.2536 = 0.9515$
$h = 225.91 + 0.9515 \times 2373.14 = 2483.95$ kJ/kg
$w = h_i - h = 4132.74 - 2483.95 = 1648.79$ kJ/kg.

10. The refrigerant R-22 is contained in a piston/cylinder where the volume is 11 L when the piston hits the stops. The initial state is –30°C, 150 kPa with a volume of 10 L. This system is brought indoors and warms up to 15°C. Find the work done by the R-22 during this process.
a) -0.15 kJ
b) 0.15 kJ
c) -0.35 kJ
d) 0.35 kJ
View AnswerAnswer: b
Explanation: Work done at constant $P_{ext} = P_1$.
${}_1W_2 = \int P_{ext}\, dV = P_{ext}(V_2 - V_1) = 150(0.011 - 0.010) = 0.15$ kJ.

11. A piston cylinder contains 1 kg of liquid water at 20°C and 300 kPa. There is a linear spring mounted on the piston such that when the water is heated the pressure reaches 3 MPa with a volume of 0.1m^3. Find the final temperature.
a) 400°C
b) 404°C
c) 408°C
d) none of the mentioned
View AnswerAnswer: b
Explanation: State 1: Compressed liquid, take saturated liquid at same temperature.
v1 = vf @20°C = 0.001002 m^3/kg
State 2: v2 = V2/m = 0.1/1 = 0.1 m^3/kg and P = 3000 kPa
Superheated vapor close to T = 400°C
Interpolate: T2 = 404°C.
12. A piston cylinder contains 1 kg of liquid water at 20°C and 300 kPa. There is a linear spring mounted on the piston such that when the water is heated the pressure reaches 3 MPa with a volume of 0.1m^3. Find the work in the process.
a) 163.35 kJ
b) 263.35 kJ
c) 363.35 kJ
d) 463.35 kJ
View AnswerAnswer: a
Explanation: Work is done while piston moves at linearly varying pressure, so we get:
1W2 = ∫ P dV = area = Pavg (V2 – V1) = (P1 + P2)*(V2 – V1)/2
= 0.5 (300 + 3000)(0.1 – 0.001) = 163.35 kJ.
13. A Carnot heat engine receives heat at 750 K and rejects the waste heat to the environment at 300 K. The net work output of the heat engine is used to drive a Carnot refrigerator, whose COP is 6.14. If the heat removal rate from the refrigerated space is 6.6 kW, determine the rate of heat supply to the heat engine?
a) 2.79 kW
b) 1.79 kW
c) 4.79 kW
d) 7.79 kW
View AnswerAnswer: b
Explanation: W(HE) = (1 – T(L)/T(H))*Q(H) = 0.6*Q(H); W(R) = W(HE);
Q(L)/COP(R) = 0.6*Q(H); ∴ Q(H) = Q(L)/(0.6*COP(R))
Rate of heat supply to the heat engine (Q(H)) = 1.79 kW.
14. During the winter season, a room is heated by central heating furnace which delivers the 750 W of heat energy by burning wood pellets. How much power can saved if heat pump with a COP of 3 is used instead of furnace?
a) 100 W
b) 500 W
c) 1000 W

d) 1500 W
View AnswerAnswer: b
Explanation: COP(HP) = QH/W ⇒ W = QH/COP(HP) = 250 W
Power saved by replacing the furnace with heat pump (QL) = QH – W = 750 – 250 = 500 W.

15. A Korean refrigerator is bought to maintain the cool space at 8°C and a Japanese refrigerator is bought to main the cool space at -20°C in a laboratory room having constant temperature of 25°C. If the both refrigerators run on a reversed Carnot cycle, state the refrigerator that delivers maximum COP.
a) Korean refrigerator
b) Japanese refrigerator
c) both have same COP
d) none of the mentioned
View AnswerAnswer: a
Explanation: COP(Korean) = TL/(TH – TL) = (273.15 + 8)/(25 – 8) = 16.54;
COP(Japanese) = TL/(TH – TL) = (273.15 – 20)/(25 – (–20)) = 5.63
Refrigerator that delivers maximum COP = Korean refrigerator.
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« Prev - Thermodynamics Questions and Answers – Work in a Reversible Process-2»
Next - Thermodynamics Questions and Answers – Useful WorkThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Useful Work”.
1. Useful work is given by
a) actual work + p(V2-V1)
b) actual work – p(V2-V1)
c) actual work + p(V2+V1)
d) none of the mentioned
View AnswerAnswer: b
Explanation: Useful work = actual work – work performed on the atmosphere.

2. In a steady flow system, which of the following does not change?
a) mass
b) volume
c) both of the mentioned

d) none of the mentioned
View AnswerAnswer: b
Explanation: The volume of the system remains constant for a steady flow system.
3. Which of the following is true?
a) in a steady flow system, no work is done on the atmosphere
b) in case of unsteady flow system, the volume of the system changes
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: In a steady flow system, the volume of the system does not change but it changes for unsteady flow system.
4. Availability function for a closed system is given by
a) U-pV+TS
b) U+pV+TS
c) U-pV-TS
d) U+pV-TS
View AnswerAnswer: d
Explanation: This term comes very frequent and is considered as availability function.

5. When a system exchanges heat with a thermal energy reservoir in addition to the atmosphere, the maximum useful work
a) increases
b) decreases
c) remains constant
d) none of the mentioned
View AnswerAnswer: a
Explanation: The maximum useful work increases in this case.
6. When the system is in equilibrium with the surroundings, this state of the system is known as dead state.
a) true
b) false
View AnswerAnswer: a
Explanation: In this state, the system has pressure and temperature as that of surroundings, there is no chemical reaction mass transfer and has minimum potential energy.
7. When a system exchanges heat with a thermal energy reservoir at temperature Tr in addition to the atmosphere, the maximum useful work increases by
a) dQ(1+Tr/To)
b) dQ(1-Tr/To)
c) dQ(1+To/Tr)
d) dQ(1-To/Tr)
View AnswerAnswer: d
Explanation: The maximum useful work will increased by dQ(1-To/Tr) where dQ is the heat received by the system.

8. When a system changes its state towards that of surroundings, the opportunity to produce more work
a) increases
b) decreases
c) remains constant
d) none of the mentioned
View AnswerAnswer: b
Explanation: More the system goes towards surroundings, lesser is the opportunity to produce more work.
9. When the system is in equilibrium with the surroundings, it must in
a) pressure equilibrium
b) temperature equilibrium
c) chemical equilibrium
d) all of the mentioned
View AnswerAnswer: d
Explanation: When the system is in equilibrium with the surroundings, its pressure and temperature is Po and To and there should not any chemical reaction or mass transfer.
10. All spontaneous processes terminate at the dead state.
a) true
b) false
View AnswerAnswer: a
Explanation: At dead state, the system is in equilibrium with the surroundings and hence the opportunity of producing work ceases to exist.

« Prev - Thermodynamics Questions and Answers – Work in a Reversible Process-3» Next - Thermodynamics Questions and Answers – Availability-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Availability-1”.
1. When we obtain useful work during a process in which a finite system undergoes a change of state, when should that process terminate?
a) when the pressure of system equals the pressure of surroundings
b) when the temperature of system equals the temperature of surroundings
c) when the system has reached the dead state
d) all of the mentioned
View AnswerAnswer: d
Explanation: The process goes on until the system reaches the dead state.

2. The availability(A) of a given system is defined as the ____ work that is obtainable in a process in which system comes to equilibrium with its surroundings.
a) useful work
b) maximum useful work
c) minimum useful work
d) none of the mentioned
View AnswerAnswer: b
Explanation: Maximum useful work is given by total work minus pdV work.
3. Availability is a composite property.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause it depends on the state of both the system and surroundings.
4. Availability function for a steady flow system is given by
a) H+TS+(m*V*V/2)+(m*g*z)
b) H-TS+(m*V*V/2)+(m*g*z)
c) H-TS-(m*V*V/2)-(m*g*z)
d) H-TS-(m*V*V/2)+(m*g*z)
View AnswerAnswer: b
Explanation: This term comes very frequent and is considered as availability function for a steady flow system.
5. Availability function for a closed system is given by
a) u-pv-Ts
b) u+pv+Ts
c) u-pv+Ts
d) u+pv-Ts
View AnswerAnswer: d
Explanation: This term comes very frequent and is considered as availability function for a closed system.

6. Which of the following is true for an internal combustion engine?
a) the reactants are in pressure and temperature equilibrium with the surroundings
b) the products are in pressure and temperature equilibrium with the surroundings
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is true if the products are cooled to atmospheric temperature To fore ing discharged from the engine.

7. The Helmholtz function F is given by
a) U-TS
b) U+TS
c) -U-TS
d) -U+TS
View AnswerAnswer: a
Explanation: Helmholtz function F is a property which is defined by the relation F=U-TS.
8. Which of the following statement is true?
a) maximum work is done when process is reversible
b) if the process is irreversible, work is less than the maximum
c) W<=(F1-F2)
d) all of the mentioned
View AnswerAnswer: d
Explanation: W<=(F1-F2) when initial and final temperature of system is same as that of surroundings.
9. Gibbs function G is given by
a) G=H-TS
b) G=U+pV-TS
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: G=H-TS and H=U+pV.

10. If the process is irreversible, the useful work is less than the maximum.
a) true
b) false
View AnswerAnswer: a
Explanation: Useful work is maximum for a reversible process.
11. Find the availability when 100 kW is delivered at 500 K when the ambient temperature is 300 K.
a) 20 kW
b) 30 kW
c) 40 kW
d) 50 kW
View AnswerAnswer: c
Explanation: Φ = W(revHE) = [1-(To/T)]Q = [1-(300/500)](100) = 40 kW.
12. A control mass gives out 10 kJ of energy in the form of heat transfer at 500°C. Find the change in availability of the control mass.
a) –4.14 kJ
b) –5.14 kJ
c) –6.14 kJ
d) –7.14 kJ

View AnswerAnswer: b
Explanation: $\Delta\Phi = -[1-(To/Th)]Q = -[1-(298.15/773.15)](10) = -6.14$ kJ.
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« Prev - Thermodynamics Questions and Answers – Useful Work» Next - Thermodynamics Questions and Answers – Availability-2This set of Thermodynamics online quiz focuses on "Availability-2".

1. The compressor in a refrigerator takes R-134a in at 100 kPa, –20°C and then compresses it to 1 MPa, 40°C. With the room temperature at 20°C find the minimum compressor work.
a) -48.19 kJ/kg
b) -58.19 kJ/kg
c) -68.19 kJ/kg
d) -78.19 kJ/kg
View AnswerAnswer: a
Explanation: $w(c) = h1 – h2 + q(rev)$
$w(min) = h1 – h2 + To(s2 – s1) = 387.22 – 420.25 + 293.15 \times (1.7148 – 1.7665)$
$= -48.19$ kJ/kg.

2. Find the specific reversible work for a steam turbine with inlet at 4 MPa, 500°C and an actual exit state of 100 kPa, x = 1.0 with a 25°C ambient temperature.
a) 550.0 kJ/kg
b) 650.0 kJ/kg
c) 750.0 kJ/kg
d) 850.0 kJ/kg
View AnswerAnswer: d
Explanation: To = 25°C = 298.15 K, hi = 3445.2 kJ/kg; si = 7.090 kJ/kg K,
he = 2675.5 kJ/kg; se = 7.3593 kJ/kg K
$w(rev) = (hi – Tosi) – (he – Tose) = (hi – he) + To(se – si)$

$= (3445.2 – 2675.5) + 298.2(7.3593 – 7.0900)$

$= 769.7 + 80.3 = 850.0$ kJ/kg.

3. Find the specific reversible work for a compressor using R-134a with inlet state of –20°C, 100 kPa and an exit state of 50°C, 600 kPa. Use 25°C as ambient temperature.

a) -28.878 kJ/kg
b) -38.878 kJ/kg
c) -48.878 kJ/kg
d) -58.878 kJ/kg

View AnswerAnswer: b

Explanation: The compressor is assumed to adiabatic so $q = 0$

$w(rev) = T_o(s_e – s_i) – (h_e – h_i)$

$h_i = 387.22$ kJ/kg; $s_i = 1.7665$ kJ/kg K;

$h_e = 438.59$ kJ/kg; $s_e = 1.8084$ kJ/kg K

$w(rev) = 298.15\ (1.8084 – 1.7665) – (438.59 – 387.22)$

$= -38.878$ kJ/kg.

4. A steady stream of R-22 at ambient temperature of 10°C, and at 750 kPa enters a solar collector. The stream exits at 80°C, 700 kPa. Calculate the change in availability.

a) 4.237 kJ/kg
b) 5.237 kJ/kg
c) 6.237 kJ/kg
d) 7.237 kJ/kg

View AnswerAnswer: c

Explanation: $h_i = 56.46$ kJ/kg, $s_i = 0.2173$ kJ/kg K,

$h_e = 305.91$ kJ/kg, $s_e = 1.0761$ kJ/kg K

$\Delta\psi_{ie} = \psi_e – \psi_i = (h_e – h_i) – T_0(s_e – s_i)$

$= (305.912 – 56.463) – 283.2(1.0761 – 0.2173)$

$= 6.237$ kJ/kg.

5. Cold water is running in a river at 2°C and the air temperature is 20°C. What is the availability of water relative to the ambient temperature?

a) 2.157 kJ/kg
b) 2.857 kJ/kg
c) 3.457 kJ/kg
d) 2.457 kJ/kg

View AnswerAnswer: d

Explanation: $\psi = h_1 – h_0 – T_0(s_1 – s_0)$

$\psi = 8.392 – 83.96 – 293.15(0.03044 – 0.2966)$

$= 2.457$ kJ/kg.

6. Nitrogen is flowing in a pipe with a of velocity 300 m/s at 500 kPa, 300°C. What is its availability relative to an ambient at 100 kPa, 20°C?

a) 272 kJ/kg
b) 252 kJ/kg
c) 292 kJ/kg
d) 232 kJ/kg

View AnswerAnswer: a

Explanation: $\psi = h1 - h0 + (1/2)V^2 - T0(s1 - s0)$

$= Cp(T1 - T0) + (1/2)V^2 - T0[Cp \ln(T1/T0) - R \ln(P1/P0)]$

$= 1.042(300-20)+(300^2)/2000 - 293.15[1.042 \ln(573.15/293.15) - 0.2968\ln(500/100)]$

$= 272$ kJ/kg.

7. R-12 at 30°C, 0.75 MPa enters a steady flow device and exits at 30°C, 100 kPa. Assuming the process to isothermal and reversible, find the change in availability of the refrigerant.

a) -26.1 kJ/kg
b) -36.1 kJ/kg
c) -46.1 kJ/kg
d) -56.1 kJ/kg

View AnswerAnswer: b

Explanation: hi = 64.59 kJ/kg, si = 0.2399 kJ/kg K,
and he = 210.02 kJ/kg, se = 0.8488 kJ/kg K

$\Delta\psi = he - hi - T0(se - si) = 210.02 - 64.59 - 298.15(0.8488 - 0.2399)$

$= -36.1$ kJ/kg.

8. A wooden bucket(2 kg) with 10 kg hot liquid water, both at 85°C, is lowered down to 400 m into a mineshaft. What is the availability of water and bucket with respect to the surface with ambient temperature of 20°C?

a) 232.2 kJ
b) 242.2 kJ
c) 212.2 kJ
d) 252.2 kJ

View AnswerAnswer: a

Explanation: $\phi1 - \phi0 = m(wood)[u1 - u0 - T0(s1- s0)] + m(H2O)[u1- u0- T0(s1- s0)] + m(tot)g(z1- z0)$

$= 2[1.26(85 - 20) - 293.15\times 1.26 \ln\{(273.15 + 85)/293.15\} + 10[355.82 - 83.94 - 293(1.1342 - 0.2966)] + 12 \times 9.807 \times (-400) /1000$

$= 15.85 + 263.38 - 47.07 = 232.2$ kJ.

9. Air in a piston/cylinder arrangement is at 25°C, 110 kPa with a volume of 50 L. It goes through a reversible polytropic process to final state of 500 K, 700 kPa and exchanges heat with the ambient at 25°C. Find the total work from the ambient.

a) -9.28 kJ
b) -9.38 kJ
c) -9.48 kJ
d) -9.58 kJ

View AnswerAnswer: d

Explanation: $ma*(u2 - u1) = 1Q2 - 1W2,(tot)$; $ma*(s2 - s1) = 1Q2/T0$

$ma = 110 \times 0.05/0.287 \times 298.15 = 0.0643$ kg

$1Q2 = T0*ma*(s2 - s1) = 298.15 \times 0.0643[7.3869 - 6.8631 - 0.287 \ln (700/110)]$
$= -0.14$ kJ

$1W2,(tot) = 1Q2 - ma*(u2 - u1) = -0.14 - 0.0643 \times (359.844 - 213.037)$
$= -9.58$ kJ.

10. Find the specific reversible work for a R-134a compressor with inlet state of –20°C, 100 kPa and an exit state of 600 kPa, 50°C. Use a 25°C ambient temperature.
a) 48.878 kJ/kg
b) -38.878 kJ/kg
c) 48.878 kJ/kg
d) -38.878 kJ/kg
View AnswerAnswer: b
Explanation: This is a steady state flow device
and the compressor is assumed to adiabatic so q = 0,
w(rev) = T0(se – si) – (he – hi)
= 298.15(1.8084 – 1.7665) – (438.59 – 387.22)
= -38.878 kJ/kg.
11. A steady stream of R-22 at ambient temperature, 10°C, and at 750 kPa enters a solar collector. The stream exits at 80°C, 700 kPa. Calculate the change in availability of the R-22 bebetween these two states.
a) 8.762 kJ/kg
b) 8.143 kJ/kg
c) 7.237 kJ/kg
d) 6.237 kJ/kg
View AnswerAnswer: d
Explanation: Change in availability = (he – hi) – T0(se – si)
= (305.912 – 56.463) – 283.2(1.0761 – 0.2173)
= 6.237 kJ/kg.
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« Prev - Thermodynamics Questions and Answers – Availability-1» Next - Thermodynamics Questions and Answers – Irreversibility and Gouy-Stondola TheoremThis set of Thermodynamics question bank focuses on “Irreversibility and Gouy-Stondola Theorem”.
1. The actual work done by a system is always ____ than the reversible work, and the difference bebetween the two is called ____ of the process.
a) more, irreversibility
b) less, irreversibility
c) more, reversibility
d) less, reversible
View AnswerAnswer: b
Explanation: Irreversibility=Maximum work – Actual work.

2. Irreversibility(I) is also called
a) degradation
b) dissipation
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are other names of irreversibility.
3. For a non-flow process bebetween equilibrium states, when the system exchanges heat only with the environment
a) I=0
b) I>0
c) I<0
d) I>=0
View AnswerAnswer: d
Explanation: I>0 for all processes bit for a reversible process, I=0.
4. For irreversibility, same expression applies to both flow and non-flow processes.
a) true
b) false
View AnswerAnswer: a
Explanation: I=To*(sum of change in entropy of the system and surroundings).
5. The quantity [To*(ΔSsystem + ΔSsurroundings)] represents an increase in
a) available energy
b) unavailable energy
c) exergy
d) all of the mentioned
View AnswerAnswer: b
Explanation: The quantity [To*(ΔSsystem + ΔSsurroundings)] represents an increase in unavailable energy.

6. Which of the following is true?
a) rate of loss of exergy does not depend on the rate of entropy generation
b) rate of loss of exergy is inversely proportional to the rate of entropy generation
c) rate of loss of exergy is directly proportional to the rate of entropy generation
d) none of the mentioned
View AnswerAnswer: c
Explanation: This comes from the Gouy-Stondola theorem.
7. A thermodynamically efficient process would involve ____ exergy loss with ____ rate of entropy generation.
a) minimum, minimum
b) maximum, maximum
c) minimum, maximum
d) maximum, minimum
View AnswerAnswer: a

Explanation: This is cause rate of loss of exergy is directly proportional to the rate of entropy generation.
8. Heat transfer through a finite temperature difference is equivalent to the destruction of its exergy.
a) true
b) false
View AnswerAnswer: a
Explanation: When heat transfers through a final temperature difference, all of its exergy is lost.
9. The decrease in availability or lost work is proportional to
a) pressure drop
b) mass flow rate
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Lost work = (mass flow rate)*R*To*Δp/p1.

10. Entropy generation numr can given by
a) (rate of entropy generation)*(mass flow rate/specific heat)
b) (rate of entropy generation)/(mass flow rate/specific heat)
c) (rate of entropy generation)*(mass flow rate*specific heat)
d) (rate of entropy generation)/(mass flow rate*specific heat)
View AnswerAnswer: d
Explanation: Entropy generation numr is a dimensionless quantity and given by above formula.
11. If two streams with equal temperature are mixing, then the entropy generation numr comes
a) 0
b) 1
c) -1
d) infinity
View AnswerAnswer: a
Explanation: Putting T1=T2 in the relation for entropy generation numr, we get the value as zero.
11. A flow of air at 1000 kPa, 300 K is throttled to 500 kPa. What is the irreversibility?
a) 39.6 kJ/kg
b) 49.6 kJ/kg
c) 59.6 kJ/kg
d) 69.6 kJ/kg
View AnswerAnswer: c
Explanation: A throttle process is constant enthalpy if we neglect kinetic energies.
Process: he = hi, so ideal gas => Te = Ti
se – si = s(gen), s(gen) = 0 – R*ln(Pe/Pi)

$s(gen) = - 0.287 \ln (500 / 1000) = 0.2$ kJ/kg K

$i = (T0)*s(gen) = 298*0.2 = 59.6$ kJ/kg.

12. A heat exchanger increases the availability of 3 kg/s water by 1650 kJ/kg by using 10 kg/s air which comes in at 1400 K and leaves with 600 kJ/kg less availability. What is the irreversibility?
a) 1020 kW
b) 1030 kW
c) 1040 kW
d) 1050 kW
View AnswerAnswer: d
Explanation: The irreversibility is the destruction of exergy (availability) so

$I = \Phi(destruction) = \Phi(in) - \Phi(out) = 10 \times 600 - 3 \times 1650 = 1050$ kW.

13. A 2-kg piece of iron is heated from temperature 25°C to 400°C by a heat source which is at 600°C. What is the irreversibility in the process?
a) 96.4 kJ
b) 86.4 kJ
c) 76.4 kJ
d) 66.4 kJ
View AnswerAnswer: a
Explanation: $1Q2 = m(h2 - h1) = mC(T2 - T1) = 2 \times 0.42 \times (400 - 25) = 315$ kJ

S(gen) = m(s2 – s1) – 1Q2/ = mC ln (T2/T1) – 1Q2/

$= 2 \times 0.42 \times \ln (673.15/298.15) - (315/873.15) = 0.3233$ kJ/K

$I = To (S\ gen) = 298.15 \times 0.3233 = 96.4$ kJ.

14. A rock d(at 70°C) consists of 6000 kg granite. A house with mass of 12000 kg wood and 1000 kg iron is at 15°C. They are brought to a uniform final temperature. Find the irreversibility of the process, assuming an ambient temperature of 15°C.
a) 17191 kJ
b) 18191 kJ
c) 19191 kJ
d) 20191 kJ
View AnswerAnswer: b
Explanation: $(mC)(rock)(T2 - 70) + [mC(wood) + mC(Fe)](T2 - 15) = 0$
hence $T2 = 29.0°C = 302.2$ K

$S2 - S1 = \sum mi(s2 - s1)i = 0 + Sgen$

$Sgen = \sum mi(s2 - s1)i = 5340 \ln(302.2/343.15) + 15580 \ln(302.2/288.15) = 63.13$ kJ/K

$I = (T0)Sgen = 288.15 \times 63.13 = 18191$ kJ.

15. 7. A compressor is used to bring saturated water vapour initially at 1 MPa up to 17.5 MPa, where the actual exit temperature is 650°C. Find the irreversibility.
a) 40.48 kJ/kg

b) 41.48 kJ/kg
c) 43.48 kJ/kg
d) 44.48 kJ/kg
View AnswerAnswer: d
Explanation: hi = 2778.1 kJ/kg, si = 6.5864 kJ/kg K
Actual compressor: h(e,ac) = 3693.9 kJ/kg, s(e,ac) = 6.7356 kJ/kg K
-w(c,ac) = h(e,ac) – hi = 915.8 kJ/kg
i = T0[s(e,ac) – si] = 298.15 (6.7356 – 6.5864) = 44.48 kJ/kg.
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« Prev - Thermodynamics Questions and Answers – Availability-2» Next - Thermodynamics Questions and Answers – Availability or Exergy BalanceThis set of Thermodynamics Questions & Answers for entrance exams focuses on “Availability or Energy Balance”.
1. Which of the following clearly defines availability or exergy?
a) it is the maximum useful work obtainable from a system as it reaches the dead state
b) it is the minimum work required to bring the closed system from the dead state to the given state
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The given statements clearly explain exergy.

2. The maximum work or exergy cannot negative.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause any change in state of the closed system to the dead state can accomplished with zero work.
3. Energy is ____ conserved and exergy is ____ conserved.
a) always, generally
b) always, not generally
c) not always, always
d) always, always
View AnswerAnswer: b
Explanation: Exergy is destroyed due to irreversibilities.
4. When the closed system is allowed to undergo a spontaneous change from a given state to a dead state, its exergy is ____ destroyed ____ producing useful work.
a) not completely, though
b) not completely, without

c) completely, though
d) completely, without
View AnswerAnswer: d
Explanation: The potential to develop work which was originally present is completely wasted in such a spontaneous process.
5. The difference in exergy entering a system and that leaving out is the exergy which is destroyed.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause exergy is not conserved.

6. The exergy of an isolated system can ____
a) increase
b) decrease
c) never increase
d) never decrease
View AnswerAnswer: c
Explanation: It is the counterpart of the entropy principle which states that the entropy of an isolated system can never decrease.
7. Since irreversibility > 0, the only processes allowed by the second law are those for which the exergy of the isolated system
a) increases
b) decreases
c) remains constant
d) none of the mentioned
View AnswerAnswer: b
Explanation: The above statement also means that the exergy of an isolated system can never increase.
8. For a closed system, availability or exergy transfer occurs through
a) heat interactions
b) work interactions
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the two ways in which exergy transfer can take place.
9. For an isolated system, the exergy balance gives
a) $\Delta A=-I$
b) $\Delta A=I$
c) $\Delta A=0$
d) none of the mentioned
View AnswerAnswer: a
Explanation: Change in availability = – irreversibility.

10. Which law is used for exergy balance?
a) first law
b) second law
c) first law and second law
d) third law
View AnswerAnswer: c
Explanation: Both first and second laws are used to balance exergy.
11. Evaluate the steady state exergy flux due to a heat transfer of 250 W through a wall with 400 K on one side and 600 K on the other side. Also find the exergy destruction in the wall.
a) 52 W
b) 62 W
c) 72 W
d) 82 W
View AnswerAnswer: b
Explanation: $\Phi(Q) = [1 - (T0/T)]Q$
$\Phi1(Q) = [1 - (T0/T1)]Q = [1-(298/600)](250) = 125.8$ W
$\Phi2(Q) = [1 - (T0/T2)]Q = [1-(298/400)](250) = 63.8$ W
$\Phi(\text{destruction}) = \Phi1 - \Phi2 = 125.8 - 63.8 = 62$ W.
12. A constant pressure piston/cylinder contains 2 kg of water at 5 MPa and 100°C. Heat is added from a reservoir at 700°C to the water until it reaches 700°C. Find the total irreversibility in the process.
a) 1572 kJ
b) 1672 kJ
c) 1772 kJ
d) 1872 kJ
View AnswerAnswer: a
Explanation: This process is : P = C hence $1W2 = P(V2 - V1)$
$1Q2 = m(u2 - u1) + 1W2 = m(h2 - h1)$
$= 2(3900.13 - 422.71) = 6954.8$ kJ
$1S2\ gen = m(s2 - s1) - 1Q2/T$
$= 2(7.5122 - 1.303) - 6954.8273 + 700 = 5.2717$ kJ/K
irreversibility $= m\ 1i2 = T0\ 1S2\ gen$
$= 298.15\ K \times 5.2717$ kJ/K
$= 1572$ kJ.
13. A flow of air at 1000 kPa, 300 K is throttled to 500 kPa. What is the irreversibility?
a) 47.63 kJ/kg
b) 57.63 kJ/kg
c) 67.63 kJ/kg
d) 77.63 kJ/kg
View AnswerAnswer: b
Explanation: A throttle process is a constant enthalpy process
Process: he = hi so ideal gas => Te = Ti
Entropy Eq.: $se - si = sgen$
$sgen = - 0.287 \ln (500/1000) = 0.2$ kJ/kg K

$i = To*s = 288.15 X 0.2 = 57.63$ kJ/kg.

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« Prev - Thermodynamics Questions and Answers – Irreversibility and Gouy-Stondola Theorem» Next - Thermodynamics Questions and Answers – Second Law Efficiency-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Second Law Efficiency-1".

1. The first law efficiency is defined as the ratio of the output energy to the input energy.
a) true
b) false
View AnswerAnswer: a
Explanation: First law efficiency = output energy / input energy.

2. Which of the following statement is true about the first law?
a) it is concerned only with the quantities of energy
b) it disregards the form in which the energy exists
c) it does not discriminate bebetween the energies available at different temperatures
d) all of the mentioned
View AnswerAnswer: d
Explanation: It is the second law which provides a means of assigning a quality index to energy.
3. With the concept of exergy available, which of the following is possible?
a) to analyse means of minimizing the consumption of available energy to perform a given process
b) to ensure most efficient possible conversion of energy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These statements tell us why the concept of exergy is so important.
4. Second law efficiency is defined as
a) actual exergy intake / minimum exergy intake
b) minimum exergy intake / actual exergy intake
c) actual exergy intake / maximum exergy intake
d) maximum exergy intake / minimum exergy intake

View AnswerAnswer: b
Explanation: It is the ratio of minimum exergy which must consumed to do a task divided by the actual amount of exergy consumed in performing the task.
5. For a power plant, second law efficiency can given by desired output(W) / available energy(Wmax).
a) true
b) false
View AnswerAnswer: a
Explanation: Here, A=Wmax and Amin=W, hence second law efficiency = Amin/A = W/Wmax.

6. Second law efficiency can also given as
a) 1 / (first law efficiency * Carnot efficiency)
b) Carnot efficiency * first law efficiency
c) Carnot efficiency / first law efficiency
d) first law efficiency / Carnot efficiency
View AnswerAnswer: d
Explanation: First law efficiency = W/Q1 = (W/Wmax)*(Wmax/Q1) = second law efficiency * Carnot efficiency.
7. If work is involved, Amin= ____ and if heat is involved, Amin= ____
a) w, Q(1+To/T)
b) W, Q(1-To/T)
c) Q(1+To/T), W
d) Q(1-To/T), W
View AnswerAnswer: b
Explanation: This is cause, Wmax=Q1(1-To/T).
8. If solar energy Qr is available at a reservoir storage temperature of Tr and if quantity of heat Qa is transferred by the solar collector at temperature Ta, then which of the following is true?
a) first law efficiency = Qa/Qr
b) second law efficiency = exergy output / exergy input
c) second law efficiency = (first law efficiency)*(1-To/Ta)/(1-To/Tr)
d) all of the mentioned
View AnswerAnswer: d
Explanation: Second law efficiency = first law efficiency / Carnot efficiency.
9. In case of a heat pump, second law efficiency is given as
a) (first law efficiency)*(1-Ta/To)
b) (first law efficiency)*(1+To/Ta)
c) (first law efficiency)*(1-To/Ta)
d) none of the mentioned
View AnswerAnswer: c
Explanation: First law efficiency = Qa/Wi and second law efficiency = Qa*(1-To/Ta)/Wi.

10. Both first law efficiency and second law efficiency indicate how effectively the input has en converted into the product.
a) true
b) false
View AnswerAnswer: a
Explanation: First law of efficiency does this on energy basis and second law efficiency does it on exergy basis.
11. For proper utilization of exergy, it is desirable to make first law efficiency ____ and the source and use temperatures should ____
a) as close to unity, different
b) as close to unity, match
c) as close to zero, match
d) as close to zero, different
View AnswerAnswer: b
Explanation: If first law efficiency is close to unity, the all the energy carried in by heat transfer is used and no heat is lost to the surroundings.

« Prev - Thermodynamics Questions and Answers – Availability or Exergy Balance» Next - Thermodynamics Questions and Answers – Second Law Efficiency-2This set of Thermodynamics Questions & Answers for campus interviews focuses on “Second Law Efficiency-2”.
1. As Ta approaches Tr, second law efficiency
a) half
b) first law efficiency
c) zero
d) unity
View AnswerAnswer: d
Explanation: The lower the Ta, lower will second law efficiency, here Tr=source temperature and Ta=use temperature.

2. Which of the following statement explains the concept of energy cascading?
a) the fuel should first used for high temperature applications
b) the heat rejected from these applications can then cascaded to applications at lower temperatures
c) it ensures more efficient energy utilization
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the main features of energy cascading.

3. Second law efficiency of different components can expressed in different forms.
a) true
b) false
View AnswerAnswer: a
Explanation: It is derived using the exergy balance rate.
4. A steam turbine inlet is at 1200 kPa and 500°C. The actual exit is at 300 kPa having an actual work of 407 kJ/kg. Find its second law efficiency?
a) 0.88
b) 0.98
c) 0.78
d) 0.68
View AnswerAnswer: b
Explanation: To = 25°C = 298.15 K, hi = 3476.28 kJ/kg; si = 7.6758 kJ/kg K
he = hi – w(ac) = 3476.28 – 407 = 3069.28 kJ/kg
Te = 300°C; se = 7.7022 kJ/kg K
wrev = (hi – Tosi) – (he – Tose) = (hi – he) + To(se – si)
= (3476.28 – 3069.28) + 298.15(7.7022 – 7.6758)
= 407 + 7.87 = 414.9 kJ/kg
second law efficiency = w(ac)/w(rev) = 407 / 414.9 = 0.98.

5. A heat exchanger increases the availability of 3 kg/s water by 1650 kJ/kg by using 10 kg/s air which comes in at 1400 K and leaves with 600 kJ/kg less availability. What is the second law efficiency?
a) 0.625
b) 0.825
c) 0.925
d) 0.725
View AnswerAnswer: b
Explanation: I = Φ(destruction) = Φ(in) – Φ(out) = 10 × 600 – 3 × 1650 = 1050 kW
second law efficiency = Φ(out)/Φ(in) = (3 × 1650)/(10 × 600)
= 0.825.
6. A heat engine receives 1 kW heat at 1000 K and gives out 600 W as work with the rest as heat to the ambient. Find the second law efficiency.
a) 0.655
b) 0.755
c) 0.855
d) 0.955
View AnswerAnswer: c
Explanation: First law efficiency = 0.6/1 = 0.6
Φ(H) = [1-(To/Th)]Q = [1-(298.15/100)](1) = 0.702 kW
second law efficiency = 0.6/ 0.702 = 0.855.
7. A heat pump has a COP of 2 using a power input of 2 kW. Its low temperature is To and high temperature is 80°C, with an ambient at To. Find the second law efficiency.
a) 0.11
b) 0.41

c) 0.51
d) 0.31
View AnswerAnswer: d
Explanation: $\Phi(H) = [1-(To/Th)]Q$, $Q = \beta*W = 2*2 = 4$ kW
second law efficiency = $\Phi(H)/W = [1-(298.15/353.15)](4/2) = 0.31$.

8. The condenser in a refrigerator receives R-134a at 50°C, 700 kPa and it exits as saturated liquid at 25°C. The flow-rate is 0.1 kg/s and air flows in the condenser at ambient 15°C and leaving at 35°C. Find the heat exchanger second-law efficiency.
a) 0.77
b) 0.87
c) 0.47
d) 0.67
View AnswerAnswer: a
Explanation: $m1h1 + mah3 = m1h2 + mah4$ (here m is the mass flow-rate)
$ma = m1 \times (h1 - h2)/(h4 - h3) = 0.1 \times (436.89 - 234.59)/(1.004(35 - 15)) = 1.007$ kg/s
$\psi1 - \psi2 = h1 - h2 - T0(s1 - s2) = 436.89 - 234.59 - 288.15(1.7919 - 1.1201) = 8.7208$ kJ/kg
$\psi4 - \psi3 = h4 - h3 - T0(s4 - s3) = 1.004(35 - 15) - 288.15 \times 1.004 \times \ln(308.15/288.15) = +0.666$ kJ/kg
$\eta(II) = ma(\psi4 - \psi3)/m1(\psi1 - \psi2) = 1.007(0.666)/[0.1(8.7208)] = 0.77$.
9. Steam enters a turbine at 550°C, 25 MPa and exits at 5 MPa, 325°C at a flow rate of 70 kg/s. Determine the second law efficiency.
a) 0.68
b) 0.78
c) 0.88
d) 0.98
View AnswerAnswer: c
Explanation: hi = 3335.6 kJ/kg, si = 6.1765 kJ/kg K,
he = 2996.5 kJ/kg, se = 6.3289 kJ/kg K
Actual turbine: $w,ac = hi - he = 339.1$ kJ/kg
Rev. turbine: $w,rev = w,ac + T0(se - si) = 339.1 + 45.44 = 384.54$ kJ/kg
$\eta(II) = w,ac/w,rev = 339.1/384.54 = 0.88$.
10. A compressor is used to bring saturated water vapour initially at 1 MPa up to 17.5 MPa, where the actual exit temperature is 650°C. Find the second-law efficiency.

a) 0.651
b) 0.751
c) 0.851
d) 0.951
View AnswerAnswer: d
Explanation: h_i = 2778.1 kJ/kg, s_i = 6.5864 kJ/kg K
Actual compressor: $h_{(e,ac)}$ = 3693.9 kJ/kg, $s_{(e,ac)}$ = 6.7356 kJ/kg K
$-w_{(c,ac)} = h_{(e,ac)} – h_i$ = 915.8 kJ/kg
$i = T_0[s_{(e,ac)} – s_i]$ = 298.15 (6.7356 – 6.5864) = 44.48 kJ/kg
$w_{(rev)} = i + w_{(c,ac)}$ = -915.8 + 44.48 = -871.32 kJ/kg
$\eta_{(II)} = -w_{(rev)}/w_{(c,ac)}$ = 871.32/915.8 = 0.951.

« Prev - Thermodynamics Questions and Answers – Second Law Efficiency-1» Next - Thermodynamics Questions and Answers – Comments on ExergyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Comments on Exergy”.
1. ____ is conserved but ____ is not conserved.
a) exergy, energy
b) energy, exergy
c) both exergy and energy are conserved
d) neither exergy nor energy is conserved
View AnswerAnswer: b
Explanation: Energy is conserved but once the exergy is wasted, it can never recovered.

2. Exergy is a composite property.
a) true
b) false
View AnswerAnswer: a
Explanation: It depends on the state of the system and the surroundings.
3. A dead state
a) is in equilibrium with its surroundings
b) has zero exergy

c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the basic fact about dead state which we have seen earlier.
4. Which of the following statement is true?
a) KE is entirely available energy
b) PE is entirely exergy
c) The exergy of thermal energy of reservoirs is equivalent to the work output of a Carnot engine operating bebetween the reservoir at temperature T and environment To.
d) all of the mentioned
View AnswerAnswer: d
Explanation: W=Q(1-To/T).
5. Useful work is given by
a) difference bebetween the actual work and the surrounding work
b) W – W for surroundings
c) W – p(V2-V1)
d) all of the mentioned
View AnswerAnswer: d
Explanation: Some work is lost to the surroundings and hence the useful work is reduced.

6. The surrounding work is zero for
a) cyclic devices
b) steady flow devices
c) system with fixed boundaries
d) all of the mentioned
View AnswerAnswer: d
Explanation: There is no work ing done on surroundings in all these cases.
7. The maximum amount of useful work that can obtained from a system as it undergoes a process bebetween two specified states is called
a) adiabatic work
b) reversible work
c) irreversible work
d) none of the mentioned
View AnswerAnswer: b
Explanation: Reversible work is the maximum work that we can get in a process.
8. If the final state of the system is the dead state, the ____ and the ____ come identical.
a) reversible work, exergy
b) irreversible work, exergy
c) reversible work, irreversible work
d) none of the mentioned
View AnswerAnswer: a
Explanation: For a dead state, reversible work and exergy are same.
9. The difference bebetween the reversible work and the useful work for a process is called irreversibility.

a) true
b) false
View AnswerAnswer: a
Explanation: Irreversibility is given by the product of To and rate of entropy generation, where To is the environment temperature.

10. For a total reversible process,
a) W reversible = useful work
b) irreversibility = 0
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: I = W in reversible – useful work = To * rate of entropy generation.
11. Two engines having same thermal efficiency but supplied with heat from source at different temperatures,
a) will convert same fraction of heat they receive into work
b) from second law, one will perform tter than other
c) this can considered as a deficiency of the first law
d) all of the mentioned
View AnswerAnswer: d
Explanation: This proves that we need second law efficiency.
12. Second law efficiency is defined as the ratio of actual thermal efficiency to the maximum possible thermal efficiency.
a) true
b) false
View AnswerAnswer: a
Explanation: Second law efficiency = first law efficiency / efficiency of a reversible process.
13. Which of the following is true?
a) for work producing devices, second law efficiency = useful work / reversible work
b) for work absorbing devices, second law efficiency = reversible work / useful work
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Both of the above statements are true and comes from the formula of second law efficiency.

14. In the context of first law efficiency and second law efficiency, which

of the following statement is true?
a) first law efficiency = energy output / energy input and their difference is the energy loss
b) second law efficiency = exergy output / exergy input and their difference is irreversibility
c) by reducing energy loss, first law efficiency can reduced and by reducing irreversibilities, second law efficiency can reduced
d) all of the mentioned
View AnswerAnswer: d
Explanation: All of these statements just give a summary of what we have learned in first law efficiency and second law efficiency.

« Prev - Thermodynamics Questions and Answers – Second Law Efficiency-2» Next - Thermodynamics Questions and Answers – P-V diagram for Pure SubstanceThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "P-V diagram for Pure Substance".
1. Which of the following is a property of a pure substance?
a) it has constant chemical composition throughout its mass
b) it is a one-component system
c) it may exist in one or more phases
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some of the properties of a pure substance.

2. For water, as temperature increases, volume always increases?
a) true
b) false
View AnswerAnswer: b
Explanation: From 0 degree Celsius to 4 degree Celsius as temperature increases, volume of water decreases which is a peculiarity of water.
3. A saturation state is a state from which a change of phase may occur
a) without a change of pressure or temperature
b) with a change of pressure or temperature
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: For example, water at 0 degree Celsius and at 100 degree Celsius.
4. In which of the following state does water exist?
a) saturated solid state
b) saturated liquid state
c) saturated vapour state
d) all of the mentioned
View AnswerAnswer: d

Explanation: Water exists in these states at 0 degree Celsius and at 100 degree Celsius.
5. Which of the following exists in a p-V diagram for water?
a) saturated solid line
b) saturated liquid lines
c) saturated vapour line
d) all of the mentioned
View AnswerAnswer: d
Explanation: The p-V diagram for water has all these three lines.

6. The triple point is a line on the p-V diagram, where all the three phases, solid, liquid and gas exist.
a) true
b) false
View AnswerAnswer: a
Explanation: At triple point, all these three phases exists in equilibrium.
7. At a pressure low the triple point line,
a) the substance cannot exist in the liquid phase
b) the substance when heated transforms from solid to vapour
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This phenomenon is known as sublimation and takes place by absorbing the latent heat of sublimation from the surroundings.
8. Which of the following statement is true?
a) to the left of saturated solid line is the solid region
b) bebetween saturated solid line and saturated liquid line with respect to solidification there exists the solid-liquid mixture region
c) bebetween two saturated liquid lines is the compressed liquid region
d) all of the mentioned
View AnswerAnswer: d
Explanation: These statements come from the p-V diagram for a pure substance.
9. The isotherm passing through the critical point is called the critical isotherm.
a) true
b) false
View AnswerAnswer: a
Explanation: At critical point, all the quantities like pressure, temperature and volume attain their critical values.

10. The greater the temperature, the ____ is the vapour pressure.

a) lower
b) higher
c) depends on the substance
d) none of the mentioned
View AnswerAnswer: b
Explanation: The vapour pressure mainly depends on the temperature.
11. Phase change occurs at
a) constant pressure
b) constant temperature
c) constant pressure and temperature
d) none of the mentioned
View AnswerAnswer: c
Explanation: For phase change, pressure and temperature must constant like water at 0 degree Celsius and at 100 degree Celsius.
12. Which of the following statement is true?
a) saturation temperature is a function of pressure
b) saturation pressure is a function of temperature
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: At saturation temperature, a pure liquid transforms into vapour and at saturation pressure, the liquid boils.

« Prev - Thermodynamics Questions and Answers – Comments on Exergy» Next - Thermodynamics Questions and Answers – Pure SubstanceThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Pure Substance”.
1. Which of the following represents the specific volume during phase transition.
a) Vf-Vg
b) Vg-Vf
c) Vf+Vg
d) none of the mentioned
View AnswerAnswer: b
Explanation: Here Vg is the specific volume of the saturated vapour and Vf is the specific volume of the saturated liquid.

2. At critical point, value of Vg-Vf is
a) two
b) one
c) zero
d) infinity
View AnswerAnswer: c
Explanation: As pressure increases, there is a decrease in Vg-Vf and at critical point its value comes zero.
3. Above the critical point, the isotherms are continuous curves.
a) true
b) false
View AnswerAnswer: a
Explanation: These continuous curves approach equilateral hyperbolas at large volumes and low pressures.
4. A rigid tank contains 50 kg of saturated liquid water at 90°C. Determine the pressure in the tank and the volume of the tank.
a) 0.0518 m3
b) 0.0618 m3
c) 0.0718 m3
d) 0.0818 m3
View AnswerAnswer: a
Explanation: P = C = 70.183 kPa
v = C = 0.001036 m3/kg
Total volume of the tank = mv = (50kg)(0.001036 m3/kg) = 0.0518 m3.
5. A piston –cylinder device contains 0.06m3 of saturated water vapour at 350 kPa pressure. Determine the temperature and mass of the vapour inside the cylinder.
a) 0.104 kg
b) 0.124 kg
c) 0.134 kg
d) 0.114 kg
View AnswerAnswer: d
Explanation: T = = 138.86°C
v = = 0.52422 m3/kg
m = V/v = 0.06 m3/0.52422 m3/kg = 0.114 kg.

6. A rigid tank contains 10 kg of water at 90°C. If 8 kg of the water is in the liquid form and the rest is in the vapour form, determine the pressure in the tank.
a) 60.183 kPa
b) 70.183 kPa
c) 80.183 kPa

d) 90.183 kPa
View AnswerAnswer: b
Explanation: P = °C = 70.183 kPa.
7. A rigid tank contains 10 kg of water at 90°C. If 8 kg of the water is in the liquid form and the rest is in the vapour form, determine the volume of the tank.
a) 1.73 m3
b) 2.73 m3
c) 3.73 m3
d) 4.73 m3
View AnswerAnswer: d
Explanation: P = °C = 70.183 kPa
@ 90°C, vf = 0.001036 m3/kg and vg = 2.3593 m3/kg
V = Vf + Vg = mf vf + mg vg = 4.73 m3.
8. An 80 litre vessel contains 4 kg of R-134a at a pressure of 160 kPa. Determine the temperature.
a) -10.60°C
b) -13.60°C
c) -15.60°C
d) -19.60°C
View AnswerAnswer: c
Explanation: v = V/m = 0.080 m3/4 kg = 0.02 m3/kg
@ 160kPa, vf = 0.0007437 m3/kg; vg = 0.12348 m3/kg
vf < v < vg Therefore T = = -15.60°C.

9. An 80 litre vessel contains 4 kg of R-134a at a pressure of 160 kPa. Determine the quality.
a) 0.127
b) 0.137
c) 0.147
d) 0.157
View AnswerAnswer: d
Explanation: v = V/m = 0.080 m3/4 kg = 0.02 m3/kg
@ 160kPa, vf = 0.0007437 m3/kg; vg = 0.12348 m3/kg.
vf < v < vg
x = (v –vf)/ vfg = 0.157.

10. An 80 litre vessel contains 4 kg of R-134a at a pressure of 160 kPa. Determine the volume occupied by the vapour phase.
a) 0.0775 m3
b) 0.0575 m3
c) 0.0975 m3
d) 0.0375 m3
View AnswerAnswer: a
Explanation: v = V/m = 0.080 m3/4 kg = 0.02 m3/kg

@ 160kPa, vf = 0.0007437 m3/kg; vg = 0.12348 m3/kg
vf < v < vg
x = (v –vf)/ vfg = 0.157
mg = x*m(total) = 0.628kg
Vg = mg*vg = 0.0775 m3 or 77.5 litre.

11. Determine the specific volume of R-134a at 1 MPa and 50°C, using ideal gas equation of state.
a) 0.022325 m3/kg
b) 0.024325 m3/kg
c) 0.025325 m3/kg
d) 0.026325 m3/kg
View AnswerAnswer: b
Explanation: v = RT/P = (0.0815 kJ/kg.K)* (323 K)/(1000 kPa)
= 0.026325 m3/kg.

« Prev - Thermodynamics Questions and Answers – P-V diagram for Pure Substance»
Next - Thermodynamics Questions and Answers – P-T and T-S diagram for Pure SubstanceThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “P-T and T-S diagram for Pure Substance”.

1. Which of the following curves meet at triple point?
a) fusion curve and vaporization curve
b) fusion curve and sublimation curve
c) vaporization curve and sublimation curve
d) fusion curve and vaporization curve and sublimation curve
View AnswerAnswer: d
Explanation: At triple point, all these three curves meet.

2. The slopes of sublimation and vaporization curves for all substances are
a) negative
b) positive
c) zero
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is true for all substances.

3. The slope of the fusion curve for water is
a) negative
b) positive
c) zero
d) none of the mentioned
View AnswerAnswer: a
Explanation: The slope of fusion curve for most substances is positive but for water it is negative.

4. The temperature at which a liquid boils is very sensitive to pressure but the

temperature at which a solid melts is not such a strong function of pressure.
a) true
b) false
View AnswerAnswer: a
Explanation: The slope of the fusion curve is small.

5. Which of the following statement is true?
a) the triple point of water is 273.16 K
b) the triple point of CO_2 is 216.55 K
c) when solid CO_2 is exposed to 1atm pressure, it gets transformed into vapour directly
d) all of the mentioned
View AnswerAnswer: d
Explanation: The solid CO_2 absorbs the latent heat of sublimation from the surroundings which gets cooled.
6. The equation which forms the basis of the Mollier diagram is
a) Tds=-dh+vdp
b) Tds=dh+vdp
c) Tds=dh-vdp
d) none of the mentioned
View AnswerAnswer: c
Explanation: This equation form the basis of the h-s diagram of a pure substance also called the Mollier diagram.
7. Which of the following statements is true?
a) the slope of an isobar on h-s coordinates is equal to the absolute saturation temperature at that pressure
b) is the temperature remains constant, the slope will also remain constant
c) if the temperature increases, the slope of the isobar will also increase
d) all of the mentioned
View AnswerAnswer: d
Explanation: Here absolute saturation temperature is given by Tsat+273.

8. Which of the following represents the latent heat of vaporization at a particular pressure.
a) Hf-Hg
b) Hg-Hf
c) Hf+Hg
d) none of the mentioned
View AnswerAnswer: b
Explanation: Here Hg is the specific enthalpy of the saturated vapour and Hf is the

specific enthalpy of the saturated water.
9. At critical pressure, value of Hg-Hf is
a) two
b) one
c) zero
d) infinity
View AnswerAnswer: c
Explanation: As pressure increases, there is a decrease in Hg-Hf and at critical pressure its value comes zero.
10.In the Mollier diagram, the constant pressure lines diverge from one another.
a) true
b) false
View AnswerAnswer: a
Explanation: As the pressure increases, the saturation temperature also increases, increasing the slope of the isobar.

« Prev - Thermodynamics Questions and Answers – Pure Substance» Next - Thermodynamics Questions and Answers – Quality or Dryness Fraction and Charts of Thermodynamics PropertiesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Quality or Dryness Fraction and Charts of Thermodynamics Properties”.
1. Quality indicates the
a) mass fraction of liquid in a liquid vapour mixture
b) mass fraction of vapour in a liquid vapour mixture
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: Quality, x is given as mass of vapour divided by the total mass of liquid-vapour mixture.

2. If 1 kg of liquid-vapour mixture is considered and x is the quality of that mixture, then
a) mass of vapour is x kg
b) mass of liquid is (1-x) kg
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c

Explanation: Quality indicates the mass fraction of vapour in a liquid vapour mixture.

3. Which of the following statements is true?
a) the value of x varies bebetween 0 and 1
b) for saturated water, x=0
c) for saturated vapour, x=1
d) all of the mentioned
View AnswerAnswer: d
Explanation: When water just starts boiling, x=0 and when vaporization is complete, x=1.

4. Total volume of a liquid vapour mixture is given by
a) volume of the saturated liquid
b) volume of the saturated vapour
c) sum of volumes of saturated liquid and saturated vapour
d) none of the mentioned
View AnswerAnswer: c
Explanation: V=Vf+Vg.

5. Voidage is given by
a) specific volume of saturated vapour / specific volume of liquid vapour mixture
b) specific volume of liquid vapour mixture / specific volume of saturated vapour
c) specific volume of saturated liquid / specific volume of liquid vapour mixture
d) specific volume of liquid vapour mixture / specific volume of saturated liquid
View AnswerAnswer: a
Explanation: Voidage is the volume fraction of vapour.

6. Specific volume of the mixture is given by
a) (1+x)vf + (x)vg
b) (1-x)vf + (x)vg
c) (1-x)vf – (x)vg
d) none of the mentioned
View AnswerAnswer: b
Explanation: Here vf=specific volume of saturated solid and vg=specific volume of saturated vapour.

7. Which of the following is correct?
a) v=vf + (x*vfg)
b) h=hf + (x*hfg)
c) s=sf + (x*sfg)
d) all of the mentioned
View AnswerAnswer: d
Explanation: Here, fg for each property is f-g for each property.

8. Which of the following statement is true about a chart of thermodynamic property?
a) the manner of variation of properties is clearly given in a chart
b) there is no problem in interpolation
c) the precision is not as much as in steam tables
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some advantages and disadvantages of a chart.
9. The temperature-entropy plot and enthalpy-entropy plot are commonly used.
a) true
b) false
View AnswerAnswer: a
Explanation: But its scale is small and limited in use.
10. Which of the following statement is true?
a) the temperature-entropy plot shows the vapour dome and the lines of constant volume, constant pressure, constant enthalpy, constant entropy and constant superheat
b) the scale of temperature-entropy plot is small which limits its use
c) enthalpy-entropy plot has a larger scale to provide data suitable for many computations
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some basic facts about temperature-entropy plot and enthalpy-entropy plot.

« Prev - Thermodynamics Questions and Answers – P-T and T-S diagram for Pure Substance» Next - Thermodynamics Questions and Answers – Steam TablesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Steam Tables “.
1. The properties of water are arranged in the steam tables as functions of
a) pressure
b) temperature
c) pressure and temperature
d) none of the mentioned
View AnswerAnswer: c
Explanation: The properties of water are arranged in steam tables as functions of both pressure and temperature.

2. The internal energy of saturated water at the triple point is
a) 1
b) 0
c) -1
d) infinity
View AnswerAnswer: b
Explanation: This value is arbitrarily chosen.
3. The entropy of saturated water is chosen to zero at triple point.
a) true
b) false
View AnswerAnswer: a
Explanation: This is arbitrarily chosen and form the basic assumptions for steam tables.
4. When a liquid and its vapour are in equilibrium at a certain pressure and temperature, then which of the following is required to identify the saturation state.
a) pressure
b) temperature
c) both pressure and temperature
d) pressure or temperature
View AnswerAnswer: d
Explanation: If one of the quantity is given, then other gets fixed.
5. Saturated liquid or the saturated vapour has how many independent variables?
a) one
b) two
c) three
d) none of the mentioned
View AnswerAnswer: a
Explanation: Only one property is required to known to fix up the state.

6. If data are required for intermediate temperatures or pressures, linear interpolation is normally accurate.
a) true
b) false
View AnswerAnswer: a
Explanation: To reduce the amount of interpolation required, two tables are provided.
7. For a liquid-vapour mixture, which of the following can give us all the properties of the mixture?
a) p or t and the quality of the mixture are given
b) p or t and any one of the property is given
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c

Explanation: In first case, properties can directly evaluated and in second case we can find the quality first and then evaluate all other properties.
8. When does a vapour come superheated?
a) when the temperature of vapour is less than the saturation temperature at given pressure
b) when the temperature of vapour is more than the saturation temperature at given pressure
c) when the temperature of vapour is equal to the saturation temperature at given pressure
d) none of the mentioned
View AnswerAnswer: b
Explanation: For a superheated vapour, temperature of vapour must greater than the saturation temperature.
9. The superheat or degree of superheat is given by
a) difference bebetween the temperature of saturated liquid and saturation temperature
b) difference bebetween the temperature of superheated vapour and saturation temperature
c) sum of the temperature of superheated vapour and saturation temperature
d) none of the mentioned
View AnswerAnswer: b
Explanation: Superheat= T1(temperature of superheated vapour) – T(saturated).

10. When the temperature of a liquid is less than the saturation temperature at the given pressure, the liquid is called compressed liquid.
a) true
b) false
View AnswerAnswer: a
Explanation: For a compressed liquid, temperature of liquid must less than the saturation temperature.
11. The properties of liquid _____ with pressure.
a) do not vary
b) vary largely
c) vary little
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the reason why properties are taken from the saturation tables at the temperature of the compressed liquid.
12. Which of the following statement is true?
a) a subcooled liquid is one which is cooled low its saturation temperature at a certain pressure
b) subcooling is the difference bebetween the saturation temperature and the actual liquid temperature
c) both of the mentioned

d) none of the mentioned
View AnswerAnswer: c
Explanation: This is what a subcooled liquid means.

« Prev - Thermodynamics Questions and Answers – Quality or Dryness Fraction and Charts of Thermodynamics Properties» Next - Thermodynamics Questions and Answers – Measurement of Steam QualityThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Measurement of Steam Quality”.
1. A pure substance is said to have ____ degrees of freedom.
a) one
b) two
c) three
d) four
View AnswerAnswer: b
Explanation: The state of a pure substance gets fixed if two independent properties are given.

2. Which of the following statement is true?
a) it is easiest to measure the temperature and pressure of a substance
b) when pressure and temperature are independent properties, they are measured to determine that state of the substance
c) it is measured in the compressed liquid region or the superheated vapour region
d) all of the mentioned
View AnswerAnswer: d
Explanation: Of all the thermodynamic properties, it is easiest to measure the temperature and pressure of a substance.
3. For a substance in two-phase region,
a) both pressure and temperature are independent properties
b) if pressure is given, the saturation temperature gets fixed
c) no other property is required to known
d) all of the mentioned

View AnswerAnswer: b
Explanation: For a substance in two-phase region, only one out of p and t is fixed and one more property is also required.
4. Devices such as calorimeters are used to for determining the quality or enthalpy of the mixture.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause it is difficult to measure the specific volume of a mixture.

5. For the measurement of quality, the state of the substance is brought from the two-phase region to
a) single-phase region
b) superheated region
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: cause in these regions, both pressure and temperature are independent.
6. To fix the state and determine the quality of the mixture, we can do this by
a) adiabatic throttling
b) electric heating
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the two ways of measuring the quality of a mixture.
7. To sure that steam after throttling is in the single-phase or superheated vapour, a minimum of ____ is desired.
a) 10 degree Celsius
b) -5 degree Celsius
c) 0 degree Celsius
d) 5 degree Celsius
View AnswerAnswer: d
Explanation: This superheat helps in ensuring that after throttling steam is in single-phase or superheated vapour region.

8. A combined separating and throttling calorimeter is also used to measure the quality.
a) true
b) false

View AnswerAnswer: a
Explanation: It is used when the steam is wet and the pressure after throttling is not low enough to take steam to the superheated region.
9. In a combined separating and throttling calorimeter,
a) steam is first passed through a separator
b) in separator, some moisture separates out due to sudden change in direction
c) then the partially dry vapour is throttled and taken to the superheated region
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is how a combined separating and throttling calorimeter works.
10. The quality of wet steam can also measured by an electric calorimeter.
a) true
b) false
View AnswerAnswer: a
Explanation: In this the sample of steam is passed in steady flow through an electric heater.

« Prev - Thermodynamics Questions and Answers – Steam Tables» Next - Thermodynamics Questions and Answers – Equations of State of a GasThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Equations of State of a Gas”.
1. A mole of a substance has a mass equal to the molecular weight of the substance.
a) true
b) false
View AnswerAnswer: a
Explanation: 1gm of oxygen has mass of 32gm and 1gm of nitrogen has a mass of 28gm and so on.

2. According to Avogadro’s law, volume of a g mol of all gases at the pressure of ____ and temperature of ____ is same.
a) 760 mm Hg, 100 degree Celsius
b) 760 mm Hg, 0 degree Celsius
c) 750 mm Hg, 100 degree Celsius
d) 750 mm Hg, 0 degree Celsius
View AnswerAnswer: b
Explanation: This is the Avogadro law and these temperature and pressure condition is know as normal temperature and pressure(NTP).

3. At NTP, the volume of a g mol of all gases is(in litres)
a) 22.1
b) 22.2
c) 22.3
d) 22.4
View AnswerAnswer: d
Explanation: This comes from the Avogadro's law.
4. Which of the following statement is true?
a) numr of kg moles of a gas = mass / molecular weight
b) molar volume = total volume of the gas / numr of kg moles
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Numr of moles is in kgmoles and molar volume is in (m^3)/kg mol.

5. The equation of state is a functional relationship bebetween
a) pressure
b) molar or specific volume
c) temperature
d) all of the mentioned
View AnswerAnswer: d
Explanation: It is expressed in the form f(p,v,T)=0.
6. If two properties (out of p,v,T) of a gas are known, the third can evaluated.
a) true
b) false
View AnswerAnswer: a
Explanation: The third property can calculated from the equation of state.
7. Which of the following statement is true about a gas?
a) lim(pv) with p tending to 0 is independent of the nature of gas
b) lim(pv) with p tending to 0 depends only on the temperature
c) this holds true for all the gases
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is one of the fundamental property for all the gases.

8. Universal gas constant is given by
a) lim(pv) / 273.16
b) R
c) 0.083 litre-atm/gmol K
d) all of the mentioned

View AnswerAnswer: d
Explanation: Putting the value of lim(pv) = 22.4 litre-atm/gmol we get the value of R.
9. The equation of state of a gas is lim(pv)=RT .
a) true
b) false
View AnswerAnswer: a
Explanation: The limit is calculated with p tending to 0 and v is the molar volume here.
10. For which of the following gases, does the product (pv) when plotted against p gives depends only on temperature?
a) nitrogen
b) hydrogen
c) air and oxygen
d) all of the mentioned
View AnswerAnswer: d
Explanation: It is a fundamental property of gas that lim(pv) with p tending to 0 is independent of the nature of gas and depends only on the temperature.

« Prev - Thermodynamics Questions and Answers – Measurement of Steam Quality»
Next - Thermodynamics Questions and Answers – Ideal Gas-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Ideal Gas-1”.
1. An ideal gas is one which oys the law pv=RT at all pressures and temperatures.
a) true
b) false
View AnswerAnswer: a
Explanation: Though such a gas is hypothetical.

2. The value of universal gas constant is
a) 8.2353
b) 8.3143
c) 8.5123
d) none of the mentioned
View AnswerAnswer: b
Explanation: This value comes from the Avogadro law when we put p=760 mm Hg = 1.013*10^5 N/m^2 , T=273.15 K , v=22.4 m^3/kgmol.
3. Which of the following statement is true?

a) characteristic gas constant is given by dividing the universal gas constant by the molecular weight
b) Avogadro’s numr (A) = 6.023 * 10^26 molecules/kgmol
c) Boltzmann constant (K) = 1.38 * 10^-23 J/molecule K
d) all of the mentioned
View AnswerAnswer: d
Explanation: The Boltzmann constant is given by universal gas constant divided by Avogadro numr.
4. The equation of state of an ideal gas is given by
a) pV=mRT, here R is characteristic gas constant
b) pV=nRT, here R is universal gas constant
c) pV=NKT
d) all of the mentioned
View AnswerAnswer: d
Explanation: Characteristic gas constant is given by dividing the universal gas constant by the molecular weight and Boltzmann constant is given by universal gas constant divided by Avogadro numr.
5. Specific heats are constant for an ideal gas.
a) true
b) false
View AnswerAnswer: a
Explanation: For an ideal gas, specific heats are constant and it satisfies the equation of state.

6. For real gases,
a) specific heats vary appreciably with temperature
b) specific heats vary little with pressure
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is in contrast to an ideal gas for which specific heats are constant.
7. At constant temperature, (u ing the internal energy)
a) u change when v or p changes
b) u does not change when v or p changes
c) u does not change when t changes
d) u always remains constant
View AnswerAnswer: b
Explanation: Internal energy does not change with change in v or p but changes only when temperature changes.
8. For an ideal gas, internal energy is a function of temperature only.
a) true
b) false
View AnswerAnswer: a
Explanation: This is known as Joule’s law.
9. Which of the following statement is true? (c is the specific heat at constant

volume)
a) the equation du=c*dT holds good for an ideal gas for any process
b) for gases other than ideal ones, the equation holds true for a constant volume process only
c) for an ideal gas c is constant and hence $\Delta u=c*\Delta T$
d) all of the mentioned
View AnswerAnswer: d
Explanation: All these statements are true and also internal energy is a function of temperature only.

10. Which of the following statement is correct for an ideal gas?
a) h=u+pv
b) h=u+RT
c) h=f(T)
d) all of the mentioned
View AnswerAnswer: d
Explanation: For an ideal gas, pv=RT and hence h is a function of temperature only.
11. Characteristic gas constant is given by (here cp=specific heat at constant pressure and cv is the specific heat at constant volume)
a) R=cv – cp
b) R=cp + cv
c) R=cp – cv
d) none of the mentioned
View AnswerAnswer: c
Explanation: $\Delta h=(cv+R)\Delta T = cp*\Delta T$.

« Prev - Thermodynamics Questions and Answers – Equations of State of a Gas»
Next - Thermodynamics Questions and Answers – Ideal Gas-2This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Ideal Gas-2”.
1. The value of cp and cv depend on
a) temperature of the gas
b) ɣ and R
c) pressure of the gas
d) all of the mentioned
View AnswerAnswer: b
Explanation: The value of cp and cv depends on the numr of atoms in a molecule and the molecular weight of the gas.

2. Which of the following statement is true?
a) value of ɣ for monoatomic gases is 5/3
b) value of ɣ for diatomic gases is 7/5
c) for polyatomic gases, the value of ɣ is approximately taken as 4/3
d) all of the mentioned
View AnswerAnswer: d
Explanation: These values of ɣ can shown by the classical kinetic theory of gases.
3. The maximum and minimum values of ɣ is
a) 1.33, 1
b) 2.00, 1
c) 1.67, 1
d) 1.25, 1
View AnswerAnswer: c
Explanation: ɣ=1 when cp=cv and ɣ=1.67=5/3 for monoatomic gases.
4. Which of the following equation can used to compute the entropy change bebetween any two states of an ideal gas?
a) s2-s1 = cv*ln(T2/T1) + R*ln(v2/v1)
b) s2-s1 = cp*ln(T2/T1) – R*ln(p2/p1)
c) s2-s1 = cp*ln(v2/v1) + cv*ln(p2/p1)
d) all of the mentioned
View AnswerAnswer: d
Explanation: Any of the given three equations can used.
5. For a reversible adiabatic change, ds=0.
a) true
b) false
View AnswerAnswer: a
Explanation: For a reversible adiabatic process, change in entropy is zero.

6. For a reversible adiabatic process,
a) p*(v^ɣ) = constant
b) T*(v^(ɣ-1)) = constant
c) T*(p^(1-ɣ)/ɣ) = constant
d) all of the mentioned
View AnswerAnswer: d
Explanation: All these relations come from the pv=RT and p*(v^ɣ) = constant.
7. Which of the following is true for a polytropic process?
a) p(v^n) is used to descri the process
b) it is not adiabatic
c) it can reversible
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the properties of an adiabatic process.
8. In the equation p(v^n), n is calculated by
a) (logp1 + logp2) / (logv2 + logv1)
b) (logp1 – logp2) / (logv2 – logv1)

c) (logp1 – logp2) / (logv2 + logv1)
d) none of the mentioned
View AnswerAnswer: b
Explanation: It comes from the p1*(v1^n) = p2*(v2^n).
9. For entropy change in a polytropic process, which of the following statement is true?
a) when n=ɣ, the entropy change comes zero
b) if p2>p1, for n<=ɣ, the entropy of the gas decreases
c) for n>ɣ, the entropy of the gas increases
d) all of the mentioned
View AnswerAnswer: d
Explanation: This comes from the relation s2-s1 = [(n-ɣ)/{n(ɣ-1)}]*R*ln(p2/p1).

10. Polytropic specific heat is given by cn=cv(ɣ-n)/(1-n) .
a) true
b) false
View AnswerAnswer: a
Explanation: The polytropic specific heat is used in the relation Qr=cn*ΔT.
11. Which of the following is true?
a) for n>ɣ, there will positive heat transfer and gain in entropy
b) for n<ɣ, there will negative heat transfer and decrease in entropy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This comes from the relation Qr=cn*ΔT and cn=cv(ɣ-n)/(1-n).

« Prev - Thermodynamics Questions and Answers – Ideal Gas-1» Next - Thermodynamics Questions and Answers – Ideal Gas-3This set of Thermodynamics Aptitude Test focuses on “Ideal Gas-3”.
1. The ratio of cp/cv is designated by the symbol ɣ.
a) true
b) false
View AnswerAnswer: a
Explanation: This ratio is of importance in ideal gas computations.

2. Which of the following relation is correct?
a) cv = R/(ɣ-1)

b) $c_p = \gamma R/(\gamma-1)$
c) $\gamma = c_p/c_v$
d) all of the mentioned
View AnswerAnswer: d
Explanation: Since $\gamma=c_p/c_v$ and $c_p-c_v=R$.
3. Which of the following values of n are correct?
a) for isobaric process, n=0
b) for isothermal process, n=1
c) for isentropic process, $n=\gamma$
d) all of the mentioned
View AnswerAnswer: d
Explanation: For isobaric process, pressure=constant, for isothermal process, temperature=constant and for isentropic process, entropy=constant.
4. For a isometric or isochoric process, n=infinity.
a) true
b) false
View AnswerAnswer: a

5. A spherical helium balloon of 10m diameter is at 15°C and 100 kPa. How much helium does it contain?
a) 57.5 kg
b) 67.5 kg
c) 77.5 kg
d) 87.5 kg
View AnswerAnswer: a
Explanation: $V = (4\pi/3)r^3 = (\pi/6)D^3 = 523.6\ m^3$
$m(He) = \rho V = PV/RT$
$=(100 \times 523.6)/(2.0771 \times 288) = 87.5$ kg.
6. A rigid tank of 1 m^3 contains nitrogen gas at 600 kPa and 400 K. If 0.5 kg of gas flows out then what is the final pressure given the final temperature is 375 K?
a) 501.9 kPa
b) 503.9 kPa
c) 506.9 kPa
d) none of the mentioned
View AnswerAnswer: c
Explanation: $m =(PV/RT) = (600 \times 1)/(0.2968 \times 400) = 5.054$ kg
therefore $m2 = m - 0.5 = 5.054 - 0.5 = 4.554$ kg
$P2 = (m2RT2)/V = (4.554 \times 0.2968 \times 375)/1 = 506.9$ kPa.
7. A cylindrical gas tank 1 m long having inside diameter of 20 cm, is evacuated and filled with carbon dioxide gas at 25°C. What pressure should the pressure if there is to 1.2 kg of carbon dioxide?
a) 2052 kPa
b) 2152 kPa
c) 2252 kPa
d) 2352 kPa
View AnswerAnswer: b

Explanation: $V = A \times L = (\pi/4)[(0.2)^2] \times 1 = 0.031416\ m^3$

$PV = mRT$

$P = [1.2 \times 0.1889 \times (273.15 + 25)\ K)]/(0.031416\ m^3)$

$= 2152$ kPa.

8. A hollow metal sphere having an inside diameter of 150-mm is weighed first when evacuated and then after ing filled to 875 kPa with an unknown gas. If the difference in mass is 0.0025 kg, and the temperature is 25°C, find the gas.

a) helium
b) argon
c) hydrogen
d) nitrogen

View AnswerAnswer: a

Explanation: $V = (\pi/6)(0.15)^3 = 0.001767\ m^3$

$M = (mRT/PV) = (0.0025 \times 8.3145 \times 298.2)/(875 \times 0.001767) = 4.009$

this is the mass of helium gas.

9. An auto-mobile tire has air at –10°C and 190 kPa. After sometime, the temperature gets up to 10°C. Find the new pressure.

a) 210.4 kPa
b) 224.4 kPa
c) 200.4 kPa
d) 204.4 kPa

View AnswerAnswer: d

Explanation: Assume constant volume and that air is an ideal gas

$P2 = P1 \times T2/T1$

$= 190 \times (283.15/283.15)$

$= 204.4$ kPa.

10. A piston cylinder contains air at 600 kPa, 290 K and a volume of $0.01m^3$. A constant pressure process gives 54 kJ of work out. Find the final temperature of the air.

a) 2700 K
b) 2800 K
c) 2900 K
d) 3000 K

View AnswerAnswer: c

Explanation: $W = \int P\ dV = P\Delta V$

$\Delta V = W/P = 54/600 = 0.09\ m^3$

$V2 = V1 + \Delta V = 0.01 + 0.09 = 0.1\ m^3$

Assuming ideal gas, $PV = mRT$, then we have

$T2 = P2V2/(mR) = (P2V2)*T1/(P1V1)= (V2/V1)*T1$

$= (0.1/0.01)*290 = 2900$ K.

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« Prev - Thermodynamics Questions and Answers – Ideal Gas-2» Next - Thermodynamics Questions and Answers – Gas CompressionThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Gas Compression”.

1. In a gas compressor,
a) work is done on the gas to raise its pressure
b) there is an appreciable increase in its density
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the main function of a gas compressor.

2. For ɣ>n>1 and for the same pressure ratio p2/p1, the maximum work is needed for
a) isothermal compression
b) adiabatic compression
c) polytropic compression
d) all need same work
View AnswerAnswer: b
Explanation: This comes when these three reversible compression processes are plotted on the p-V diagram.
3. Staging of compression process is done with intermediate cooling.
a) true
b) false
View AnswerAnswer: a
Explanation: The work of compression is reduced by staging.
4. A two-stage compression process includes,
a) the gas is first compressed isentropically in the low pressure cylinder
b) it is cooled in the intercooler to its original temperature
c) it is compressed isentropically in the high pressure cylinder
d) all of the mentioned
View AnswerAnswer: d
Explanation: All these processes take place in the order a-b-c in a two-stage compressor.
5. For minimum work the intermediate pressure is the _____ of the suction and discharge pressures.
a) arithmetic mean

b) geometric mean
c) sum
d) difference
View AnswerAnswer: b
Explanation: The intermediate pressure p2=sqrt(p1*p4), where p1 is the suction pressure and p4 is the discharge pressure.

6. The intermediate pressure that produces minimum work will also result in
a) equal pressure ratios in the two stages of compression
b) equal work for the two stages
c) equal discharge temperatures
d) all of the mentioned
View AnswerAnswer: d
Explanation: This comes from the pressure-temperature relations.
7. Heat rejected in the intercooler is given by (here cp is the specific heat at constant pressure)
a) cp*(T3-T2)
b) cp*(T3+T2)
c) cp*(T2-T3)
d) none of the mentioned
View AnswerAnswer: c
Explanation: The process of intercooling is from 2-3.
8. If there are N stages of compression, then the pressure ratio in each stage is
a) p2/p1 = (discharge pressure/suction pressure)^(1/N)
b) p2/p1 = (suction pressure/discharge pressure)^(1/N)
c) p2/p1 = (discharge pressure/suction pressure)^N
d) p2/p1 = (suction pressure/discharge pressure)^N
View AnswerAnswer: a
Explanation: This is true irrespective of the numr of stages in compression.
9. The isothermal efficiency of a compressor is given by
a) p1*v1/ total work of compression
b) p1*v1*ln(p2/p1) / total work of compression
c) total work of compression / p1*v1*ln(p2/p1)
d) total work of compression / p1*v1
View AnswerAnswer: b
Explanation: In gas compression, the desirable idealized process is often a reversible isothermal process.

10. The ratio of the actual volume of gas taken into cylinder during suction stroke to the piston displacement volume is called the volumetric efficiency.

a) true
b) false
View AnswerAnswer: a
Explanation: Volumetric efficiency = mass flow rate*specific volume of gas at inlet / piston displacement per cycle.
11. Clearance(C) is defined as
a) (piston displacement per cycle / clearance volume)^n
b) piston displacement per cycle / clearance volume
c) clearance volume / piston displacement per cycle
d) (clearance volume / piston displacement per cycle)^n
View AnswerAnswer: c
Explanation: This is used to make the calculations easier.
12. The volumetric efficiency is given by
a) 1-C+C(p2/p1)^(1/n)
b) 1+C-C(p2/p1)^(1/n)
c) 1+C+C(p2/p1)^(1/n)
d) 1-C-C(p2/p1)^(1/n)
View AnswerAnswer: b
Explanation: This comes from the basic formula of volumetric efficiency.
13. Volumetric efficiency decreases as the clearance _____ and as the pressure _____
a) decreases, increases
b) increases, decreases
c) decreases, decreases
d) increases, increases
View AnswerAnswer: d
Explanation: We know that (p2/p1)^(1/n) is always greater than 1 and volumetric efficiency is given by 1+C-C(p2/p1)^(1/n).

14. Compressors are built with the maximum clearance.
a) true
b) false
View AnswerAnswer: b
Explanation: Compressors are built with minimum clearance cause as clearance decreases, volumetric efficiency increases.
15. For a fixed clearance, as the pressure ratio is increased, the volumetric efficiency of a compressor
a) decreases
b) increases
c) remains constant
d) none of the mentioned
View AnswerAnswer: a
Explanation: As the pressure ratio increases, the volumetric efficiency of a compressor decreases.

« Prev - Thermodynamics Questions and Answers – Ideal Gas-3» Next - Thermodynamics Questions and Answers – Equations of StateThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Equations of State".

1. For the ideal gas equation, what assumptions are made?
a) there is little or no attraction bebetween the molecules of the gas
b) the volume occupied by the molecules is negligibly small compared to the volume of the gas
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The ideal gas equation pv=RT is established from the postulates of the kinetic theory of gases considering these two assumptions.

2. When does a real gas oy the ideal gas equation closely?
a) at high pressure and low temperature
b) at low pressure and high temperature
c) at low pressure and temperature
d) at high pressure and temperature
View AnswerAnswer: b
Explanation: At low pressure and high temperature, the intermolecular attraction and the volume of the molecules compared to the total volume of the gas are not of much significance.

3. The real gases deviate from the ideal gas equation when the pressure increases.
a) true
b) false
View AnswerAnswer: a
Explanation: With increase in pressure, the intermolecular forces of attraction and repulsion increase, and also the volume of the molecules comes appreciable compared to the gas volume.

4. The corrected gas equation is given by
a) (p+a/(v2))(v+b)=RT
b) (p-a/(v2))(v-b)=RT
c) (p-a/(v2))(v+b)=RT
d) (p+a/(v2))(v-b)=RT
View AnswerAnswer: d
Explanation: The two correction terms were introduced by van der Waals.

5. Which of the following statement is true about the correction terms?
a) the coefficient a was introduced to account for the existence of mutual

attraction bebetween the molecules
b) the term a/(v2) is called the force of cohesion
c) the coefficient b was introduced to account for the volumes of the molecules and is known as co-volume
d) all of the mentioned
View AnswerAnswer: d
Explanation: These coefficients were also introduced by van der Waals.
6. Real gases conform more closely with the van der Waals equation of state than the ideal gas equation of state.
a) true
b) false
View AnswerAnswer: a
Explanation: This happens particularly at higher pressures.
7. The following also gave two-constant equations of state.
a) rthelot
b) Dieterici
c) Redlich-Kwong
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are also two-constant equations of state other than the van der Waals equation.

8. Compressibility factor Z is given by
a) RT/pv
b) pv/RT
c) (RT/pv)2
d) (pv/RT)2
View AnswerAnswer: b
Explanation: This ratio is known as compressibility factor.
9. For an ideal gas, Z has the value
a) 0
b) 2
c) 1
d) infinity
View AnswerAnswer: c
Explanation: For an ideal gas, pv=RT hence Z=1.
10. The magnitude of Z at a particular pressure and temperature indicates the extent of deviation of the gas from the ideal gas haviour.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a basic fact about the compressibility factor.

« Prev - Thermodynamics Questions and Answers – Gas Compression» Next - Thermodynamics Questions and Answers – Law of Corresponding StatesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Law of Corresponding States”.

1. For a gas, the compressibility factor Z depends on
a) pressure and volume
b) pressure and temperature
c) volume and temperature
d) pressure, volume and temperature
View AnswerAnswer: b
Explanation: For a particular gas, Z depends on pressure and temperature.

2. We can use Z instead of directly plotting v.
a) true
b) false
View AnswerAnswer: a
Explanation: The main advantage of using Z instead of v is a smaller range of values in plotting.

3. How could we use one compressibility factor chart for all the substances?
a) it would more convenient
b) the general shapes of the vapour dome and of the constant temperature lines on the p-v plane can similar for all substances
c) their similarity can exploited using dimensionless properties
d) all of the mentioned
View AnswerAnswer: d
Explanation: These dimensionless properties called reduced properties can used for all the substances.

4. Which of the following property is used as the dimensionless property?
a) reduced pressure
b) reduced volume
c) reduced temperature
d) all of the mentioned
View AnswerAnswer: d
Explanation: The reduced pressure is the ratio of existing pressure to the critical pressure of the substance and like this all other properties are written.

5. Which of the following statement is true?
a) the specific volumes of different gases at same pressure and temperature are different

b) the reduced volumes of different gases at same reduced pressure and reduced temperature are same
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is found from the experimental data and cause of this reduced properties are used.

6. Value of critical compressibility factor Zc is taken to constant.
a) true
b) false
View AnswerAnswer: a
Explanation: The experimental values of Zc fall within a narrow range of 0.20-0.30, hence it is taken constant.
7. The generalized compressibility chart is a plot in
a) when reduced pressure is plotted as a function of reduced temperature and Z
b) when reduced temperature is plotted as a function of reduced pressure and Z
c) when Z is plotted as a function of reduced pressure and reduced temperature
d) none of the mentioned
View AnswerAnswer: b
Explanation: The generalized compressibility chart is found to satisfactory for a great variety of substances.
8. The law of corresponding states is a relation among
a) reduced pressure and reduced temperature
b) reduced volume and reduced temperature
c) reduced volume and reduced pressure
d) reduced pressure and reduced temperature and reduced volume
View AnswerAnswer: d
Explanation: This relation can derived from the equations of state.
9. The corrected gas equation is a cubic in v, which of the following statement is true about its roots?
a) at low temperature, three positive real roots exists
b) at critical temperature, the three real roots come equal
c) at high temperature, only one real root exists
d) all of the mentioned
View AnswerAnswer: d
Explanation: The equation has three roots which are different for different temperature and pressure.

10. The value of compressibility factor at the critical state for a van der

Waals gas is
a) 0.325
b) 0.350
c) 0.375
d) 0.400
View AnswerAnswer: c
Explanation: This value comes from the relation, R=(8/3)(p*v/T) where p,v,T are critical values.
11. At very low pressures Z approaches
a) zero
b) unity
c) 0.50
d) infinity
View AnswerAnswer: b
Explanation: At very low pressures, a real gas approaches the ideal gas haviour.
12. Which of the following statement is true about the reduced equation of state?
a) the individual coefficients a,b,R for a particular gas have disappeared
b) it reduces the properties of all gases to one formula
c) it tells us that to what extent a real gas oys van der Waals equation
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the properties of the reduced equation of state.
13. The Boyle temperature is given by
a) a/(b*R)
b) b/(a*R)
c) R/(a*b)
d) 1/(a*b*R)
View AnswerAnswer: a
Explanation: It is obtained when the value of B=b-a/(RT) is zero, i.e., B=0.

« Prev - Thermodynamics Questions and Answers – Equations of State» Next - Thermodynamics Questions and Answers – Dalton's Law of Partial Pressures and Gibbs FunctionThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Dalton's Law of Partial Pressures and Gibbs Function".
1. The expression which represents the pressure exerted by a gas is
a) nVRT
b) nRT/V
c) V/nRT
d) 1/nVRT
View AnswerAnswer: b
Explanation: This expression comes from the gas equation where V is the volume occupied by the gas at temperature T.

2. The expression nRT/V is called the partial pressure of a gas.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the partial pressure that a gas exerts.
3. According to the Dalton's law of partial pressures, the total pressure of a mixture of ideal gases is equal to the
a) difference of the highest and lowest pressure
b) product of the partial pressures
c) sum of the partial pressures
d) none of the mentioned
View AnswerAnswer: c
Explanation: According to the Dalton's law of partial pressures, p=p1+p2+p3+…..+pc.
4. Which of the following relation is correct?
a) mole fraction of the Kth gas = moles of the Kth gas / total numr of moles of gas
b) partial pressure of Kth gas = (mole fraction of the Kth gas)*(sum of the partial pressures)
c) sum of mole fractions of all the gases is unity
d) all of the mentioned
View AnswerAnswer: d
Explanation: All these statements come from the Dalton's law of partial pressures.

5. The gas constant of the mixture is the ____ of the gas constants of the components.
a) average
b) weighted mean
c) sum
d) difference of the highest and the lowest
View AnswerAnswer: b
Explanation: It can found from the Dalton's law and gas equation.
6. A quantity called partial volume of a component of mixture is used.
a) true
b) false
View AnswerAnswer: a
Explanation: It is the volume which the component alone would occupy at the pressure and temperature of the mixture.
7. Which of the following statement is true?
a) V=V1+V2+….+Vc , where V is the partial volume of the component
b) 1/v = 1/(v1) + 1/(v2) + …….. + 1/(vc) , where v is the specific volume of the component

c) total density is equal to the sum of the densities of the components
d) all of the mentioned
View AnswerAnswer: d
Explanation: these relations come from the Dalton’s law and the gas equation.

8. The total entropy of a mixture of gases is the ____ of the partial entropies.
a) average
b) weighted mean
c) sum
d) difference of the highest and the lowest
View AnswerAnswer: c
Explanation: This is given by the Gibbs theorem.
9. When gases which are at equal pressure and temperature are mixed adiabatically without work, then
a) internal energy of the gaseous system remains constant
b) heat transfer of the gaseous system remains constant
c) entropy of the gaseous system remains constant
d) all of the mentioned
View AnswerAnswer: a
Explanation: This is cause of the first law.
10. The fact that internal energy of a mixture is equal to the sum of the partial internal energies of the gases can also applied to properties like H,Cv,Cp,S,F, and G.
a) true
b) false
View AnswerAnswer: a
Explanation: This statement comes from the Gibbs theorem.

« Prev - Thermodynamics Questions and Answers – Law of Corresponding States»
Next - Thermodynamics Questions and Answers – Maxwell’s Equations and TDS EquationsThis set of Thermodynamics Problems focuses on “Maxwell’s Equations and TDS Equations”.
1. If a relation exists among variables x,y,z then z may expressed as a function of x and y as, dz=Mdx+Ndy .
a) true
b) false

View AnswerAnswer: a
Explanation: Here, M,N and z are functions of x and y.

2. A pure substance which exists in a single phase has ____ independent variables.
a) zero
b) one
c) two
d) three
View AnswerAnswer: c
Explanation: Of all the quantities, any one can expressed as a function of any two others.
3. Which of the following relation is correct?
a) $dU=TdS-pdV$
b) $dH=TdS+Vdp$
c) $dG=Vdp-SdT$
d) all of the mentioned
View AnswerAnswer: d
Explanation: These relations are true for a pure substance which undergoes an infinitesimal reversible process.
4. Maxwell’s equations consists of ____ equations.
a) four
b) three
c) two
d) one
View AnswerAnswer: a
Explanation: Maxwell’s equations consists of four equations.

5. Which of the following is not a Maxwell equation?
a) $(\partial T/\partial V) = -(\partial p/\partial S)$
b) $(\partial T/\partial p) = -(\partial V/\partial S)$
c) $(\partial p/\partial T) = (\partial S/\partial V)$
d) $(\partial V/\partial T) = -(\partial S/\partial p)$
View AnswerAnswer: b
Explanation: The correct equation is $(\partial T/\partial p) = (\partial V/\partial S)$.
6. The condition for exact differential is
a) $(\partial N/\partial y) = (\partial M/\partial x)$
b) $(\partial M/\partial y) = (\partial N/\partial x)$
c) $(\partial M/\partial y) = -(\partial N/\partial x)$
d) all of the mentioned

View AnswerAnswer: b
Explanation: This is the condition for perfect or exact differential and here M and N are the functions of x and y.
7. The first TdS equation is
a) $TdS=Cv*dT + T(\partial T/\partial p)dV$
b) $TdS=Cv*dT - T(\partial p/\partial T)dV$
c) $TdS=Cv*dT + T(\partial p/\partial T)dV$
d) $TdS=Cv*dT - T(\partial T/\partial p)dV$
View AnswerAnswer: c
Explanation: This equation comes when entropy is defined as a function of T and V and using Cv and Maxwell's third equation.

8. The second TdS equation is
a) $TdS=Cp*dT + T(\partial V/\partial T)dp$
b) $TdS=Cp*dT - T(\partial V/\partial T)dp$
c) $TdS=Cp*dT + T(\partial T/\partial V)dp$
d) $TdS=Cp*dT - T(\partial T/\partial V)dp$
View AnswerAnswer: b
Explanation: This equation comes when entropy is defined as a function of T and p and using Cp and Maxwell's fourth equation.
9. Which of the following is true?
a) $(\partial p/\partial V)*(\partial V/\partial T)*(\partial T/\partial p)=$ infinity
b) $(\partial p/\partial V)*(\partial V/\partial T)*(\partial T/\partial p)= 0$
c) $(\partial p/\partial V)*(\partial V/\partial T)*(\partial T/\partial p)= 1$
d) $(\partial p/\partial V)*(\partial V/\partial T)*(\partial T/\partial p)= -1$
View AnswerAnswer: d
Explanation: This is the relation bebetween the thermodynamic variables, p,V and T.
10. For getting TdS equations, we assume entropy to a function of T and V and also of T and p.
a) true
b) false
View AnswerAnswer: a
Explanation: For first TdS equation, we assume entropy as a function of T and V and for second TdS equation, we assume entropy as a function of T and p .

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« Prev - Thermodynamics Questions and Answers – Dalton's Law of Partial Pressures and Gibbs Function» Next - Thermodynamics Questions and Answers – Difference in Heat Capacities and their RatioThis set of Basic Thermodynamics questions and answers focuses on "Difference in Heat Capacities and their Ratio".

1. What do we get on equating the first and second TdS equations?
a) Cp-Cv = T*(∂T/∂p)*(∂V/∂T)
b) Cp-Cv = T*(∂p/∂T)*(∂V/∂T)
c) Cp+Cv = T*(∂p/∂T)*(∂V/∂T)
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is the relation we get on equating first and second TdS equations.

2. Consider the equation Cp-Cv = -T*(∂p/∂V)(∂V/∂T)2 , which of the following is correct?
a) (∂V/∂T)2 is always positive
b) (∂p/∂V) for any substance is negative
c) (Cp-Cv) is always positive
d) all of the mentioned
View AnswerAnswer: d
Explanation: From this we can conclude that, Cp is always greater than Cv.
3. When do we have the condition Cp=Cv?
a) as T approaches 0K, Cp tends to approach Cv
b) when (∂V/∂T)=0, Cp=Cv
c) both of the mentioned are correct
d) none of the mentioned are correct
View AnswerAnswer: c
Explanation: These facts come from the equation Cp-Cv = -T*(∂p/∂V)(∂V/∂T)2.
4. For an ideal gas,
a) Cp-Cv = R
b) Cp-Cv = mR
c) Cp=Cv
d) all of the mentioned
View AnswerAnswer: b
Explanation: This comes from the ideal gas equation, pV=mRT.
5. The volume expansivity and isothermal compressibility is defined as
a) volume expansivity = (1/V)*(∂V/∂T) at p and isothermal compressibility = (-1/V)*(∂V/∂T) at T
b) volume expansivity = (1/V)*(∂V/∂T) at p and isothermal compressibility = (-1/V)*(∂V/∂T) at T
c) volume expansivity = (1/V)*(∂V/∂T) at p and isothermal compressibility = (-1/V)*(∂V/∂T) at T
d) none of the mentioned
View AnswerAnswer: a
Explanation: These two terms are used for tter representation of the original

equation.

6. The equation $Cp-Cv = -T*(\partial p/\partial V)(\partial V/\partial T)2$ can also expressed as
a) $Cp-Cv = T*V*$(isothermal compressibility)2 / (volume expansivity)
b) $Cp-Cv = T*V*$(isothermal compressibility) / (volume expansivity)
c) $Cp-Cv = T*V*$(volume expansivity)2 / (isothermal compressibility)
d) $Cp-Cv = T*V*$(volume expansivity) / (isothermal compressibility)
View AnswerAnswer: c
Explanation: This comes from the equation $Cp-Cv = -T*(\partial p/\partial V)(\partial V/\partial T)2$ when we use volume expansivity and isothermal compressibility in it.
7. At constant entropy, the two TdS equations give us the relation
a) $Cp+Cv = 0$
b) $Cp=Cv$
c) $Cp-Cv = mR$
d) $Cp/Cv = \gamma$
View AnswerAnswer: d
Explanation: This relation is obtained on dividing the two TdS equations.
8. The slope of an isentrope is ____ the slope of an isotherm on p-v diagram.
a) less than
b) greater than
c) equal to
d) less than or equal to
View AnswerAnswer: b
Explanation: This comes from the fact that $\gamma>1$.
9. Work done in reversible and isothermal compression is ____ the work done in reversible and adiabatic compression.
a) equal to
b) greater than
c) less than
d) less than or equal to
View AnswerAnswer: c
Explanation: We get this from the p-v diagram for compression work in different reversible processes.

10. Isothermal compression requires minimum work.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause work in isothermal is less than the work in adiabatic process and that of polytropic process lies in bebetween these values.

11. Which of the following relation gives ɣ .
a) 1/(isothermal compressibility *adiabatic compressibility)
b) isothermal compressibility * adiabatic compressibility
c) adiabatic compressibility / isothermal compressibility
d) isothermal compressibility / adiabatic compressibility
View AnswerAnswer: d
Explanation: The adiabatic compressibility is defined as $(-1/V)*(\partial V/\partial p)$.

« Prev - Thermodynamics Questions and Answers – Maxwell's Equations and TDS Equations» Next - Thermodynamics Questions and Answers – Energy Equation-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Energy Equation-1".

1. For a system which undergoes an infinitesimal reversible process bebetween two equilibrium states, the change in internal energy is
a) $dU = pdV - TdS$
b) $dU = TdS + pdV$
c) $dU = TdS - pdV$
d) $dU = -TdS - pdV$
View AnswerAnswer: c
Explanation: This is a basic equation for change in internal energy for an infinitesimal reversible process.

2. The energy equation is given by
a) $(\partial U/\partial V) = T*(\partial p/\partial T) + p$
b) $(\partial U/\partial V) = T*(\partial p/\partial T) - p$
c) $(\partial U/\partial V) = -T*(\partial p/\partial T) - p$
d) $(\partial U/\partial V) = p - T*(\partial p/\partial T)$
View AnswerAnswer: b
Explanation: We get this equation when we substitute the first TdS equation in $dU = TdS - pdV$ and U is taken as a function of T and V.
3. If temperature is constant, internal energy does not change.
a) true
b) false
View AnswerAnswer: a
Explanation: U does not change with change in V if the temperature is constant.
4. If the temperature is constant, internal energy
a) changes with change in p
b) changes with change in V
c) changes with change in both p and V
d) does not change with change in p or V
View AnswerAnswer: d
Explanation: The internal energy of an ideal gas is a function of temperature only.

5. The equation $dU=C_v*dT$ holds good for
a) any process for an ideal gas, even when the volume changes
b) for other substances it is true only when the volume is constant
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: For an ideal gas, $pV=nRT$ and $T(\partial p/\partial T) - p = 0$.

6. Thermal radiation in equilibrium with enclosing walls possesses an energy that depends on volume and temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: It depends on temperature and volume only and not on any other thermodynamic property.
7. If the temperature is constant, enthaply
a) changes with change in p
b) changes with change in V
c) changes with change in both p and V
d) does not change with change in p or V
View AnswerAnswer: d
Explanation: The enthaply of an ideal gas is a function of temperature only and does not depend on pressure and volume.
8. The equation $dH=C_p*dT$ holds good for
a) any process for an ideal gas, even when the pressure changes
b) for other substances it is true only when the pressure is constant
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: For an ideal gas, $pV=nRT$ and $V - T(\partial V/\partial T) = 0$.
9. If u is the energy density then pressure(p) exerted by the black-body radiation in an enclosure is
a) $u/2$
b) $u/3$
c) $u/4$
d) u
View AnswerAnswer: b
Explanation: Here energy density, $u=U/V$.

10. The Stefan-Boltzmann law is given by

a) u = b*(T2)
b) u = b*(T3)
c) u = b*(T4)
d) u = b*T
View AnswerAnswer: c
Explanation: Here b is a constant and this equation is derived from the basic energy equation.
11. For a reversible isothermal change of volume, heat to supplied reversibly to keep temperature constant is given by
a) Q = (4/3)b*(T4)*(ΔV)
b) Q = (2/3)b*(T2)*(ΔV)
c) Q = (1/3)b*(T)*(ΔV)
d) none of the mentioned
View AnswerAnswer: a
Explanation: This relation comes from the first TdS equation.
12. If the temperature is half the original temperature, the volume of black-body radiation is to ____ adiabatically ____ times its original volume for radiation to remain at equilibrium.
a) decreased, four
b) decreased, eight
c) increased, four
d) increased, eight
View AnswerAnswer: d
Explanation: This comes form the relation V*(T^3) = constant.

« Prev - Thermodynamics Questions and Answers – Difference in Heat Capacities and their Ratio» Next - Thermodynamics Questions and Answers – Energy Equation-2This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Energy Equation-2”.
1. A 100L rigid tank contains nitrogen at 3 MPa, 900 K. The tank is then cooled to 100 K. What is the heat transfer for this process?
a) -490.7 kJ
b) -590.7 kJ
c) -690.7 kJ
d) -790.7 kJ
View AnswerAnswer: c
Explanation: V = constant hence work = 0 ; Energy Eq: m(u2 – u1) = 1Q2 – 1W2

State 1: $v1 = 0.0900$ m3/kg => $m = V/v1 = 1.111$ kg, $u1 =$ 691.7 kJ/kg
State 2: 100 K, $v2 = v1 = V/m$
interpolating for v (bebetween 200kPa and 400kPa) we get $P2 = 200 + 200 (0.09 - 0.1425)/(0.0681 - 0.1425) = 341$ kPa
$u2 = 71.7 + (69.3 - 71.7)(0.09 - 0.1425)/(0.0681 - 0.1425) = 70.0$ kJ/kg,
$1Q2 = m(u2 - u1) = 1.111 (70.0 - 691.7) = -690.7$ kJ.

2. A rigid container has 0.75kg water at 1200 kPa, 300°C. Now, the water is cooled to a final pressure of 300 kPa. Find the heat transfer in the process.
a) -2348 kJ
b) -1348 kJ
c) -2148 kJ
d) -1148 kJ
View AnswerAnswer: d
Explanation: Energy Eq.: $U2 - U1 = 1Q2 - 1W2$; V = constant hence work = 0
State 1: 300°C, 1200 kPa => superheated vapor, thus $v = 0.21382$ m3/kg, $u = 2789.22$ kJ/kg
State 2: 300 kPa and $v2 = v1$ and $v2 < vg$ two-phase we get $T2 = Tsat = 133.55$°C
$x2 = (v2 - vf)/v(fg) = (0.21382 - 0.001073)/0.60475 = 0.35179$
$u2 = uf + (x2)*u(fg) = 561.13 + x2\ 1982.43 = 1258.5$ kJ/kg
$1Q2 = m(u2 - u1) + 1W2 = m(u2 - u1) = 0.75 (1258.5 - 2789.22) = -1148$ kJ.

3. A cylinder fitted with a piston contains 2kg of superheated R-134a vapour at 100°C, 350 kPa. The cylinder is then cooled so that R-134a remains at constant pressure till it reaches a quality of 75%. Calculate the heat transfer in this process.
a) -174.6 kJ
b) -274.6 kJ
c) -374.6 kJ
d) -474.6 kJ
View AnswerAnswer: b
Explanation: Energy Eq: $m(u2 - u1) = 1Q2 - 1W2$
Process: P = constant ⇒ $1W2 = \int PdV = P\Delta V = P(V2 - V1) = Pm(v2 - v1)$
State 1: $h1 = (490.48 + 489.52)/2 = 490$ kJ/kg
State 2: $h2 = 206.75 + 0.75 \times 194.57 = 352.7$ kJ/kg (350.9 kPa)
$1Q2 = m(u2 - u1) + 1W2 = m(u2 - u1) + Pm(v2 - v1) = m(h2 - h1)$
$1Q2 = 2 \times (352.7 - 490) = -274.6$ kJ.

4. Ammonia at 0°C, quality 60% is contained in a 200L tank. The tank and ammonia is now heated to a final pressure of 1 MPa. Determine the heat transfer for the process.
a) 520.75 kJ
b) 620.75 kJ
c) 720.75 kJ
d) 820.75 kJ
View AnswerAnswer: c
Explanation: Energy Eq: $m(u_2 – u_1) = {}_1Q_2 – {}_1W_2$
Process: Constant volume hence $_1W_2 = 0$
State 1: two-phase state and $v_1 = 0.001566 + x_1 \times 0.28783 = 0.17426$ m3/kg
$u_1 = 179.69 + 0.6 \times 1138.3 = 862.67$ kJ/kg, $m = V/v_1 = 0.2/0.17426 = 1.148$ kg
State 2: P_2 , $v_2 = v_1$ superheated vapor ⇒ $T_2 \cong 100°C$, $u_2 \cong 1490.5$ kJ/kg
$_1Q_2 = m(u_2 – u_1) = 1.148(1490.5 – 862.67) = 720.75$ kJ.

5. Water in a 150L closed, rigid tank is at 100°C, 90% quality. The tank is cooled to –10°C. Calculate the heat transfer during this process.
a) -163.3 kJ
b) -263.3 kJ
c) -363.3 kJ
d) -463.3 kJ
View AnswerAnswer: b
Explanation: Energy Eq: $m(u_2 – u_1) = {}_1Q_2 – {}_1W_2$; Process: V = constant, $_1W_2 = 0$
State 1: Two-phase thus $v_1 = 0.001044 + 0.9\times1.6719 = 1.5057$ m3/kg
and $u_1 = 418.94+0.9\times2087.6 = 2297.8$ kJ/kg
State 2: T_2, $v_2 = v_1$ ⇒ mix of saturated solid + vapour
$v_2 = 1.5057 = 0.0010891 + x_2 \times 466.7 \Rightarrow x_2 = 0.003224$
$u_2 = -354.09 + 0.003224 \times 2715.5 = -345.34$ kJ/kg; $m = V/v_1 = 0.15/1.5057 = 0.09962$ kg
$_1Q_2 = m(u_2 – u_1) = 0.09962(-345.34 – 2297.8) = -263.3$ kJ.

6. A cylinder with constant volume of 0.1 L contains water at critical point. It then cools down to room temperature of 20°C. Calculate the heat transfer from the water.
a) -61.7 kJ
b) -71.7 kJ
c) -81.7 kJ
d) -91.7 kJ
View AnswerAnswer: a
Explanation: Energy Eq: $m(u_2 – u_1) = {}_1Q_2 – {}_1W_2$
Process: Constant volume ⇒ $v_2 = v_1$ hence work done is zero.

State 1: $v1 = vc = 0.003155$ m3/kg, $u1 = 2029.6$ kJ/kg and $m = V/v1 = 0.0317$ kg

State 2: T2, $v2 = v1 = 0.001002 + x2 \times 57.79$

$x2 = 3.7\times10^{-5}$, $u2 = 83.95 + x2 \times 2319 = 84.04$ kJ/kg

$1Q2 = m(u2 - u1) = 0.0317(84.04 - 2029.6) = -61.7$ kJ.

7. A constant pressure piston-cylinder contains 0.2 kg water as saturated vapour at 400 kPa. It is now cooled so that the water occupies half the original volume. Find the heat transfer in the process.

a) –203.9 kJ
b) –233.9 kJ
c) –223.9 kJ
d) –213.9 kJ

View AnswerAnswer: d

Explanation: Energy Eq: $m(u2 - u1) = 1Q2 - 1W2$
and P = constant => $1W2 = Pm(v2 - v1)$

thus $1Q2 = m(u2 - u1) + 1W2 = m(u2 - u1) + Pm(v2 - v1) = m(h2 - h1)$

State 1: $v1 = 0.46246$ m3/kg; $h1 = 2738.53$ kJ/kg

State 2: $v2 = v1 / 2 = 0.23123 = vf + x\, v(fg)$

$x2 = (v2 - vf) / v(fg) = (0.23123 - 0.001084) / 0.46138 = 0.4988$

$h2 = hf + (x2)*h(fg) = 604.73 + 0.4988 \times 2133.81 = 1669.07$ kJ/kg

$1Q2 = 0.2\,(1669.07 - 2738.53) = -213.9$ kJ.

8. 2kg water at 120°C with a quality of 25% has its temperature raised 20°C in a constant volume process. What is the heat transfer in the process?

a) 877.8 kJ
b) 887.8 kJ
c) 897.8 kJ
d) 907.8 kJ

View AnswerAnswer: a

Explanation: Energy Eq.: $m\,(u2 - u1\,) = 1Q2 - 1W2$ and V = constant thus work is zero

State 1: T, x1 and $v1 = vf + (x1)*v(fg) = 0.00106 + 0.25 \times 0.8908 = 0.22376$ m3/kg

$u1 = uf + (x1)*u(fg) = 503.48 + 0.25 \times 2025.76 = 1009.92$ kJ/kg

State 2: T2, $v2 = v1 < vg2 = 0.50885$ m3/kg so two-phase

$x2 = (v2 - vf2)/v(fg2) = (0.22376 - 0.00108)/0.50777 = 0.43855$

$u2 = u(f2) + (x2)*u(fg2) = 588.72 + x2 \times 1961.3 = 1448.84$ kJ/kg

From the energy equation, $1Q2 = m(u2 - u1) = 2\,(\,1448.84 - 1009.92\,) = 877.8$ kJ.

9. A 25 kg mass moving with 25 m/s is brought to a complete stop with a constant deceleration over a period of 5 seconds by a brake system. The brake energy is absord by 0.5kg water initially at 100 kPa, 20°C. Assume that the mass is at constant P and T. Find the energy the brake removes from the mass assuming P = C.

a) 7.6125 kJ
b) 7.7125 kJ
c) 7.8125 kJ

d) 7.9125 kJ
View AnswerAnswer: c
Explanation: $E2 – E1= \Delta E = 0.5 mV2 = 0.5 \times 25 \times 25^{(2)}/1000 = 7.8125$ kJ.

10. An insulated cylinder fitted with a piston contains R-12 at 25°C with a quality of 90% and V=45 L. The piston moves and the R-12 expands until it exists as saturated vapour. During this, R-12 does 7kJ of work against the piston. Determine the final temperature, assuming that the process is adiabatic.
a) -5°C
b) -15°C
c) -25°C
d) -35°C
View AnswerAnswer: b
Explanation: Energy Eq.: $m(u2 – u1) = 1Q2 – 1W2$
State 1: $(T, x) \Rightarrow v1 = 0.000763 + 0.9 \times 0.02609 = 0.024244$ m3/kg
$m = V1/v1 = 0.045/0.024244 = 1.856$ kg and $u1 = 59.21 + 0.9 \times 121.03 = 168.137$ kJ/kg
$Q = 0 = m(u2 – u1) + 1W2 = 1.856 \times (u2 – 168.137) + 7.0$
$\Rightarrow u2 = 164.365$ kJ/kg = ug at T2 and T2 comes out to -15°C.
11. A reactor filled with water having volume 1 m3 is at 360°C, 20 MPa and placed inside a containment room which is well insulated and initially evacuated. Due to a failure, the reactor ruptures and water fills the room. Find the minimum room volume so that the final pressure does not exceed 200 kPa.
a) 257.7 m3
b) 267.7 m3
c) 277.7 m3
d) 287.7 m3
View AnswerAnswer: d
Explanation: Mass: $m2 = m1 = V(reactor)/v1 = 1/0.001823 = 548.5$ kg
Energy: $m(u2 – u1) = 1Q2 – 1W2 = 0 – 0 = 0$ hence $u2 = u1$
State 1: $v1 = 0.001823$ m3/kg; $u1 = 1702.8$ kJ/kg which is also equal to u2
State 2: $P2 = 200$ kPa, $u2 < ug$ hence => Two-phase
$x2 = (u2 – uf)/u(fg) = (1702.8 – 504.47)/2025.02 = 0.59176$
$v2 = 0.001061 + 0.59176 \times 0.88467 = 0.52457$ m3/kg
$V2 = m2\ v2 = 548.5 \times 0.52457 = 287.7$ m3.
12. A piston-cylinder has the piston loaded with outside atmospheric pressure and piston mass to a pressure of 150 kPa. It contains water at –2°C, which is heated until the water comes saturated vapour. Find the specific work for the process.
a) 163.7 kJ/kg
b) 173.7 kJ/kg
c) 183.7 kJ/kg

d) 193.7 kJ/kg
View AnswerAnswer: b
Explanation: Energy Eq. per unit mass: $u_2 - u_1 = {}_1q_2 - {}_1w_2$
Process: P = constant = P_1, => work = $P_1(v_2 - v_1)$
State 1: T_1 , P_1 => saturated solid; $v_1 = 1.09\times10^{-3}$ m3/kg, u_1 = -337.62 kJ/kg
State 2: x = 1, $P_2 = P_1$ = 150 kPa; $v_2 = v_g(P_2)$ = 1.1593 m3/kg,
T_2 = 111.4°C ; u_2 = 2519.7 kJ/kg
work = $P_1(v_2 - v_1) = 150[1.1593 - 1.09\times10^{-3}] = 173.7$ kJ/kg.

« Prev - Thermodynamics Questions and Answers – Energy Equation-1» Next - Thermodynamics Questions and Answers – Energy Equation-3This set of Advanced Thermodynamics Questions & Answers focuses on “Energy Equation-3”.

1. Superheated R-134a at 0.5 MPa, 20°C is cooled in a piston-cylinder at constant temperature to a final two-phase state with quality of 50%. The refrigerant mass is 5 kg, and during the process 500 kJ of heat is removed. Find the necessary work.
a) -67.9 kJ
b) -77.9 kJ
c) -87.9 kJ
d) -97.9 kJ
View AnswerAnswer: c
Explanation: Energy Eq.: $m(u_2 - u_1) = {}_1Q_2 - {}_1W_2 = -500 - {}_1W_2$
State 1: T_1, P_1, v_1 = 0.04226 m3/kg ; u_1 = 390.52 kJ/kg
=> $V_1 = mv_1$ = 0.211 m3
State 2: T_2 , x_2 ⇒ $u_2 = 227.03 + 0.5 \times 162.16 = 308.11$ kJ/kg,
$v_2 = 0.000817 + 0.5 \times 0.03524 = 0.018437$ m3/kg
=> $V_2 = m(v_2)$ = 0.0922 m3
work = $-500 - m(u_2 - u_1) = -500 - 5 \times (308.11 - 390.52) = -87.9$ kJ.

2. Air at 600 K flows with 3 kg/s into a heat exchanger and out at 100°C. How much (kg/s) water coming in at 100 kPa, 20°C can the air heat to the boiling point?
a) 0.37 kg/s
b) 0.17 kg/s
c) 0.27 kg/s
d) 0.57 kg/s
View AnswerAnswer: c
Explanation: C.V. :Heat Exchanger, No external heat transfer and no work.
Writing the Steady State Energy Equation (SSEE) and putting values,
we get the water flow rate at the exit is 0.27 kg/s.
3. Nitrogen gas flows into a convergent nozzle at 200 kPa, 400 K and very low velocity. It flows out of the nozzle at 100 kPa, 330 K. If the nozzle is insulated find the exit velocity.
a) 681.94 m/s
b) 581.94 m/s
c) 481.94 m/s
d) none of the mentioned
View AnswerAnswer: d
Explanation: C.V.: Nozzle; steady state; one inlet and exit flow; insulated so it is adiabatic.
SSEE: h1 + 0 = h2 + [(V2)2] / 2
[(V2)2] = 2(h1 – h2) = 2Cp(T1 – T2)
= 2 × 1.042 (400 – 330)
= 145.88 kJ/kg = 145 880 J/kg
V2 = 381.94 m/s.
4. A steam turbine has an inlet of 2 kg/s water at 1000 kPa, 350°C and velocity of 15 m/s. The exit is at 100 kPa, x = 1 and very low velocity. Find the specific work.
a) 382.3 kJ/kg
b) 482.3 kJ/kg
c) 582.3 kJ/kg
d) 682.3 kJ/kg
View AnswerAnswer: b
Explanation: SSEE is W/m = (h1 – h2) + [(V1)2 – (V2)2]/2 + g(z1 – z2)
here z1=z2 and V2=0 hence w = (h1 – h2) + [(V1)2]/2
h1 = 3157.65 kJ/kg, h2 = 2675.46 kJ/kg
wT = 3157.65 – 2675.46 + ½ (152/1000) = 482.3 kJ/kg.

5. A steam turbine has an inlet of 2 kg/s water at 1000 kPa, 350°C and velocity of 15 m/s. The exit is at 100 kPa, x = 1 and very low velocity. Find the power produced.
a) 664.6 kW

b) 764.6 kW
c) 864.6 kW
d) 964.6 kW
View AnswerAnswer: d
Explanation: SSEE is W/m = (h1 – h2) + [(V1)2 – (V2)2]/2 + g(z1 – z2)
here z1=z2 and V2=0 hence w = (h1 – h2) + [(V1)2]/2
h1 = 3157.65 kJ/kg, h2 = 2675.46 kJ/kg
wT = 3157.65 – 2675.46 + ½ (152/1000) = 482.3 kJ/kg
thus power produced = (2 kg/s)(482.3 kJ/kg) = 964.6 kW.
6. 10kg of water in a piston-cylinder exists as saturated liquid/vapour at 100 kPa, with a quality of 50%. It is now heated till the volume triples. The mass of piston is such that a cylinder pressure of 200 kPa will float it. Find the heat transfer in the process.
a) 23961 kJ
b) 24961 kJ
c) 25961 kJ
d) 26961 kJ
View AnswerAnswer: c
Explanation: m(u2 – u1) = 1Q2 – 1W2
Process: v = constant until P = Plift , then P is constant.
State 1: Two-phase; u1 = 417.33 + 0.5 × 2088.72 = 1461.7 kJ/kg
and v1 = 0.001043 + 0.5 × 1.69296 = 0.8475 m3/kg
State 2: v2, P2 ≤ Plift => v2 = 3 × 0.8475 = 2.5425 m3/kg ;
Interpolate: T2 = 829°C, u2 = 3718.76 kJ/kg
=> V2 = mv2 = 25.425 m3
1W2 = P(lift)(V2 –V1) = 200 × 10 (2.5425 – 0.8475) = 3390 kJ
1Q2 = m(u2 – u1) + 1W2 = 10×(3718.76 – 1461.7) + 3390 = 25961 kJ.
7. A 1L capsule of water at 150°C, 700 kPa is placed in a larger insulated (otherwise evacuated) vessel. The capsule breaks resulting which its contents fill the entire volume. If the final pressure is not to exceed 125 kPa, find the vessel volume?
a) 115 L
b) 125 L
c) 135 L
d) 145 L
View AnswerAnswer: a
Explanation: m2 = m1 = m = V/v1 = 0.916 kg
Process: expansion with 1Q2 = 0, 1W2 = 0
Energy: m(u2 – u1) = 1Q2 – 1W2 = 0 ⇒ u2 = u1
State 1: v1 = vf = 0.001091 m3/kg; u1 = uf = 631.66 kJ/kg
State 2: P2 , u2 ⇒ x2 =(631.66 – 444.16)/2069.3 = 0.09061
v2 = 0.001048 + 0.09061 × 1.37385 = 0.1255 m3/kg
V2 = m(v2) = 0.916 × 0.1255 = 0.115 m3 = 115 L.
8. A vertical cylinder fitted with a piston contains 5 kg of R-22 at 10°C. Heat is transferred causing the piston to rise until the volume has doubled. Additional heat is transferred until the temperature inside reaches 50°C, at which point the pressure inside the cylinder is 1.3 MPa. Find the work done.

a) 34.1 kJ
b) 44.1 kJ
c) 54.1 kJ
d) 64.1 kJ
View AnswerAnswer: a
Explanation: Process: 1 -> 2 -> 3
As piston floats, pressure is constant (1 -> 2) and the volume is constant for the second part (2 -> 3). So we have: $v_3 = v_2 = 2 \times v_1$
State 3: (P,T) $v_3 = 0.02015$ m3/kg, $u_3 = 248.4$ kJ/kg
$v_1 = 0.010075 = 0.0008 + x_1 \times 0.03391 \Rightarrow x_1 = 0.2735$
$u_1 = 55.92 + 0.2735 \times 173.87 = 103.5$ kJ/kg
State 2: $v_2 = 0.02015$ m3/kg, $P_2 = P_1 = 681$ kPa this is still 2-phase
Work $= P_1(V_2 - V_1) = 681 \times 5\ (0.02 - 0.01) = 34.1$ kJ.

9. A 250L rigid tank contains methane at 1500 kPa, 500 K. It is now cooled down to 300K. Find the heat transfer.
a) –402.4 kJ
b) –502.4 kJ
c) –602.4 kJ
d) –702.4 kJ
View AnswerAnswer: b
Explanation: Assume ideal gas, $P_2 = P_1 \times (T_2 / T_1) = 1500 \times 300 / 500 = 900$ kPa
$m = P_1V/RT_1 = (1500 \times 0.25)/(0.5183 \times 500) = 1.447$ kg
$u_2 - u_1 = C_v\ (T_2 - T_1) = 1.736\ (300 - 500) = -347.2$ kJ/kg
$_1Q_2 = m(u_2 - u_1) = 1.447(-347.2) = -502.4$ kJ.
10. A rigid container has 2kg of carbon dioxide gas at 1200 K, 100 kPa that is heated to 1400 K. Find the heat transfer using heat capacity.
a) 231.2 kJ
b) 241.2 kJ
c) 251.2 kJ
d) 261.2 kJ
View AnswerAnswer: d
Explanation: Energy Eq.: $U_2 - U_1 = m\ (u_2 - u_1) = {}_1Q_2 - {}_1W_2$
Process: $\Delta V = 0 \Rightarrow {}_1W_2 = 0$
For constant heat capacity we have: $u_2 - u_1 = C_v\ (T_2 - T_1)$
$_1Q_2 = mC_v\ (T_2 - T_1) = 2 \times 0.653 \times (1400 - 1200) = 261.2$ kJ.
11. A piston cylinder contains 3kg of air at 20°C and 300 kPa. It is now heated up in a constant pressure process to 600 K. Find the heat transfer.
a) 941 kJ
b) 951 kJ
c) 961 kJ
d) 971 kJ
View AnswerAnswer: a

Explanation: Ideal gas PV = mRT

$P_2V_2 = mRT_2$; $V_2 = mR\,T_2 / P_2 = 3\times0.287\times600 / 300 = 1.722\ m^3$

Process: P = constant, work = $\int PdV = P(V_2 - V_1) = 300 (1.722 - 0.8413) = 264.2$ kJ

Energy equation: $U_2 - U_1 = {}_1Q_2 - {}_1W_2 = m(u_2 - u_1)$

$Q_2 = U_2 - U_1 + {}_1W_2 = 3(435.097 - 209.45) + 264.2 = 941$ kJ.

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« Prev - Thermodynamics Questions and Answers – Energy Equation-2» Next - Thermodynamics Questions and Answers – Joule-Kelvin EffectThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Joule-Kelvin Effect”.

1. When a gas undergoes continuous throttling process by a valve and its pressure and temperature are plotted, then we get a

a) isotherm

b) isenthalpe

c) adiabatic

d) isobar

View AnswerAnswer: b

Explanation: All the points plotted on p-T diagram have the same enthaply.

2. A family of isenthalpes can obtained for the gas.

a) true

b) false

View AnswerAnswer: a

Explanation: The initial pressure and temperature of gas are set to new values and we obtain a family of isenthalpes by throttling to different states.

3. The curve passing through the ____ of the isenthalpes is called the inversion curve.

a) minima

b) maxima

c) both of the mentioned

d) none of the mentioned

View AnswerAnswer: b

Explanation: The maxima is considered here for obtaining the inversion curve.

4. Which of the following statement is true?

a) the value of slope of an isenthalpe on the T-p diagram at any point is called the Joule-Kelvin coefficient
b) the region inside inversion curve is called the cooling region
c) the region outside inversion curve is called the heating region
d) all of the mentioned
View AnswerAnswer: d
Explanation: The region depends on the Joule-Kelvin coefficient on the T-p diagram.

5. The locus of all points at which the Joule-Kelvin coefficient is ____ is the inversion curve.
a) negative
b) positive
c) zero
d) infinity
View AnswerAnswer: c
Explanation: The inversion curve passes through the maxima of the isenthalpes and the value of Joule-Kelvin coefficient is zero there.
6. The region inside the inversion curve has ____ Joule-Kelvin coefficient and the region outside the inversion curve has ____ Joule-Kelvin coefficient.
a) positive, positive
b) negative, negative
c) negative, positive
d) positive, negative
View AnswerAnswer: d
Explanation: The region having positive Joule-Kelvin coefficient is called the cooling region and the one having negative Joule-Kelvin coefficient is called the heating region.
7. When an ideal gas is made to undergo a Joule-Kelvin expansion, i.e., throttling, there is no change in temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: For an ideal gas, the value of Joule-Kelvin coefficient comes out to zero.

8. For a gas ing throttled, the change in temperature can
a) positive
b) negative
c) zero
d) all of the mentioned

View AnswerAnswer: d
Explanation: The change in temperature depends upon the final pressure after throttling.
9. Maximum temperature drop occurs if the initial state lies ____ the inversion curve.
a) above
b) on
c) low
d) all of the mentioned
View AnswerAnswer: b
Explanation: This can explained from the diagram fro maximum cooling by Joule-Kelvin expansion.
10. For an ideal gas,
a) volume expansivity = T and Joule-Kelvin coefficient = 0
b) volume expansivity = (1/T) and Joule-Kelvin coefficient = 1
c) volume expansivity = (1/T) and Joule-Kelvin coefficient = 0
d) volume expansivity = T and Joule-Kelvin coefficient = 1
View AnswerAnswer: c
Explanation: These values come from the expression for Joule-Kelvin coefficient and pv=RT.

« Prev - Thermodynamics Questions and Answers – Energy Equation-3» Next - Thermodynamics Questions and Answers – Clausius-Clapeyron EquationThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Clausius-Clapeyron Equation”.
1. During phase transitions like vaporization, melting and sublimation
a) pressure and temperature remains constant
b) volume and entropy changes
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is what happens during a phase transition.

2. Which of the following requirement is satisfied by a phase change of the first order?
a) there are changes of volume and entropy
b) the first-order derivative of the Gibbs function changes discontinuously

c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These requirements must satisfied for a phase change to of first order.
3. The Clausius-Clapeyron equation is given by
a) dp/dT = l / T(vf+vi)
b) dp/dT = l / T(vf-vi)
c) dT/dp = l / T(vf+vi)
d) dT/dp = l / T(vf-vi)
View AnswerAnswer: b
Explanation: Here vf is the final specific volume and vi is the initial specific volume and l is the latent heat.
4. Water ____ on melting and has the fusion curve with a ____ slope.
a) contracts, negative
b) contracts, positive
c) expands, negative
d) expands, positive
View AnswerAnswer: a
Explanation: Unlike other substances which expands on melting, water contracts on melting and hence the slope of the fusion curve is negative.
5. The vapour pressure curve is of the form ln(p) = A + B/T + C*lnT + DT.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the form of vapour pressure curve where A,B,C, and D are constants.

6. According to Trouton’s rule, the ratio of latent heat of vaporization to the boiling point at 1.013 bar is
a) 77 kJ/kgmol K
b) 88 kJ/kgmol K
c) 99 kJ/kgmol K
d) 100 kJ/kgmol K
View AnswerAnswer: b
Explanation: This is the statement of Trouton’s rule.
7. The vapour pressure p in kPa at temperature T can given by the relation
a) p = 101.325 exp (88/R)(1+T/Tb)
b) p = 101.325 exp (88/R)(1+Tb/T)
c) p = 101.325 exp (88/R)(1-T/Tb)
d) p = 101.325 exp (88/R)(1-Tb/T)
View AnswerAnswer: d
Explanation: Here Tb is the boiling point at 1.013 bar and this relation comes from the latent heat of vaporization and Trouton’s rule.
8. At the triple point, l(sublimation) = l(vaporization) – l(fusion).
a) true

b) false
View AnswerAnswer: b
Explanation: At the triple point, l(sublimation) = l(vaporization) + l(fusion), where l is the latent heat.
9. The slope of sublimation curve is ____ the slope of the vaporization curve at triple point.
a) equal to
b) less than
c) greater than
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause at triple point, l(sublimation) > l(vaporization).

10. Latent heat of sublimation is given by
a) l(sublimation) = -2.303*(R)*(d(1/T)/d(log p))
b) l(sublimation) = +2.303*(R)*(d(log p)/d(1/T))
c) l(sublimation) = +2.303*(R)*(d(1/T)/d(log p))
d) l(sublimation) = -2.303*(R)*(d(log p)/d(1/T))
View AnswerAnswer: d
Explanation: This is the expression for finding the latent heat of sublimation.
11. An application requires R-12 at –140°C. The triple-point temperature is –157°C. Find the pressure of the saturated vapour at the required condition.
a) 0.0058 kPa
b) 0.0098 kPa
c) 0.0068 kPa
d) 0.0088 kPa
View AnswerAnswer: b
Explanation: The lowest temperature for R-12 is -90°C, so it must extended to -140°C using the Clapeyron equation.
at T1= -90°C = 183.2 K, P1 = 2.8 kPa
R = 8.3145/120.914 = 0.068 76 kJ/kg K
ln P/P1 = (hfg/R)(T-T1)/(T*T1)
= (189.748/0.068 76)[(133.2 – 183.2)/(133.2 × 183.2)] = -5.6543
P = 2.8 exp(-5.6543) = 0.0098 kPa.
12. Ice (solid water) at –3°C and 100 kPa, is compressed isothermally until it comes liquid. Find the required pressure.
a) 20461 kPa
b) 30461 kPa
c) 40461 kPa
d) 50461 kPa
View AnswerAnswer: c
Explanation: Water, triple point T = 0.01°C, P = 0.6113 kPa, vf = 0.001 m^3/kg, hf = 0.01 kJ/kg, vi= 0.001 0908 m^3/kg, hi = -333.4 kJ/kg
dPif/dT = (hf – hi)/[(vf – vi)T] = 333.4/(-0.0000908 ×

273.16) = -13442 kPa/K

$\Delta P = (dPif/dT)*\Delta T = -13442(-3 - 0.01) = 40460$ kPa

$P = P(tp) + \Delta P = 40461$ kPa.

13. Estimate the freezing temperature of liquid water at a pressure of 30 MPa.
a) -2.2°C
b) 0°C
c) -0.2°C
d) -1.2°C
View AnswerAnswer: a
Explanation: At the triple point,
vif = vf – vi = 0.001000 – 0.0010908 = -0.0000908 m^3/kg
hif = hf – hi = 0.01 – (-333.40) = 333.41 kJ/kg
dPif/dT = 333.41/[(273.16)(-0.0000908)] = -13 442 kPa/K
at P = 30 MPa, T = 0.01 + (30 000-0.6)/(-13 442) = =
-2.2°C.

« Prev - Thermodynamics Questions and Answers – Joule-Kelvin Effect» Next - Thermodynamics Questions and Answers – Evaluation of Thermodynamic Properties from an Equation of StateThis set of tricky Thermodynamics questions and answers focuses on “Evaluation of Thermodynamic Properties from an Equation of State”.

1. An equation of state can also used to calculate internal energy, enthalpy and entropy.
a) true
b) false
View AnswerAnswer: a
Explanation: Apart form calculating volume, temperature and pressure, an equation of state can also used to find other thermodynamic properties.

2. The changes in properties like T,p and v
a) depend on the path taken
b) are independent of path

c) depends on the property to evaluated
d) none of the mentioned
View AnswerAnswer: b
Explanation: The changes in these properties depend only on the end states.
3. When does an equation of state reduces to the ideal gas equation?
a) when the pressure approaches zero
b) when the temperature approaches infinity
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This can seen clearly in a generalized compressibility factor chart.
4. When does the compressibility factor take the value 1?
a) for an ideal gas
b) when pressure approaches zero
c) when temperature approaches infinity
d) all of the mentioned
View AnswerAnswer: d
Explanation: We have lim(pv/RT) = 1 when p tends to zero and when T tends to infinity.

5. Which of the following statement is true?
a) for equation of state, the critical isotherm should have a point of inflection at the critical point
b) the isochore of an equation of state on a p-T diagram should straight
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: $(\partial p/\partial v)=0$ and $(\partial p/\partial T)=\text{constant}$.
6. On a Z-p compressibility factor chart as p approaches zero, at the Boyle temperature the slope of the isotherm is
a) zero
b) unity
c) negative
d) positive
View AnswerAnswer: a
Explanation: $(\partial z/\partial p) = 0$ at Boyle temperature.
7. On a Z-p compressibility factor chart as p approaches zero, the slope of the isotherm should ____ at lower temperatures and ____ at higher temperatures.
a) positive, negative
b) negative, positive
c) negative, negative
d) positive, positive
View AnswerAnswer: b
Explanation: These are trends seen on a Z-p compressibility factor chart.

8. For the inversion curve, Joule-Kelvin coefficient is unity.
a) true
b) false
View AnswerAnswer: b
Explanation: the value of Joule-Kelvin coefficient is zero.
9. According to the equation of state, the Boyle temperature is
a) 2.56*Tc
b) 2.50*Tc
c) 2.52*Tc
d) 2.54*Tc
View AnswerAnswer: d
Explanation: Here Tc is the critical temperature.
10. An isotherm of maximum slope on Z-p plot as p approaches zero is called the foldback isotherm and its value is
a) 10*Tc
b) 2*Tc
c) 5*Tc
d) 2.54*Tc
View AnswerAnswer: c
Explanation: Here Tc is the critical temperature and this value is correct for many gases.

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« Prev - Thermodynamics Questions and Answers – Clausius-Clapeyron Equation»
Next - Thermodynamics Questions and Answers – Mixtures of Variable CompositionThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Mixtures of Variable Composition”.
1. For a system of variable composition, the internal energy depends on
a) entropy
b) volume
c) moles
d) all of the mentioned
View AnswerAnswer: d
Explanation: If some substance is added to the system, then energy of the system increases.

2. If the composition of system does not change, then dU=TdS-pdV .
a) true
b) false
View AnswerAnswer: a
Explanation: If the composition changes, then the relation includes many other terms.
3. The molal chemical potential is given by
a) ∂U/∂S
b) ∂U/∂n
c) ∂U/∂V
d) all of the mentioned
View AnswerAnswer: b
Explanation: The molal chemical potential signifies the change in internal energy per unit mole of a component when S,V and numr of moles of all other components are constant.
4. The Gibbs entropy equation is given by
a) TdS = dU – pdV – Σ(molal chemical potential)*dn
b) TdS = dU + pdV + Σ(molal chemical potential)*dn
c) TdS = dU + pdV – Σ(molal chemical potential)*dn
d) TdS = dU – pdV + Σ(molal chemical potential)*dn
View AnswerAnswer: c
Explanation: Here summation is taken for all the components present in the system.
5. An equation in Gibbs energy is given by
a) dG = Vdp + SdT + Σ(molal chemical potential)*dn
b) dG = Vdp – SdT – Σ(molal chemical potential)*dn
c) dG = Vdp + SdT – Σ(molal chemical potential)*dn
d) dG = Vdp – SdT + Σ(molal chemical potential)*dn
View AnswerAnswer: d
Explanation: For this we use G=U+pV-TS and here the summation is taken for all the components present in the system.

6. The equation written for Gibbs energy can also written for
a) H
b) F
c) Both of the mentioned
d) None of the mentioned
View AnswerAnswer: c
Explanation: From the equation dG = Vdp – SdT + Σ[(molal chemical potential)*dn], we can write similar equations for F and H..
7. Chemical potential is an extensive property.
a) true

b) false
View AnswerAnswer: b
Explanation: Chemical potential is an intensive property.
8. If the phase of a multi-component system is enlarged, which of the following will happen?
a) U,S and V will increase and T,p and chemical potential will remain same
b) U,S and V will decrease and T,p and chemical potential will remain same
c) U,S and V will increase and T,p and chemical potential will decrease
d) U,S and V will decrease and T,p and chemical potential will increase
View AnswerAnswer: a
Explanation: This depends on the type of property.
9. The Gibbs-Duhem equation is given by
a) SdT + Vdp – Σ(n)*d(molal chemical potential)
b) -SdT + Vdp – Σ(n)*d(molal chemical potential)
c) SdT + Vdp – Σ(n)*d(molal chemical potential)
d) -SdT – Vdp – Σ(n)*d(molal chemical potential)
View AnswerAnswer: b
Explanation: This equation shows the relationship for simultaneous changes in p,T and chemical potential.

10. For a phase which has only one constituent,
a) chemical potential = n/G
b) chemical potential = 1/(G*n)
c) chemical potential = G*n
d) chemical potential = G/n
View AnswerAnswer: d
Explanation: This means that chemical potential is the molar Gibbs function and is a function of p and T only.
11. If a closed system is in equilibrium, which of the following remains constant?
a) entropy
b) volume
c) internal energy
d) all of the mentioned
View AnswerAnswer: d
Explanation: In a closed system, there is no interaction with surroundings hence these quantities along with mass remains constant.
12. At chemical equilibrium, G will minimum subjected to the equations of constraint.
a) true
b) false
View AnswerAnswer: a
Explanation: This minimum occurs at a constant p and T.
13. The Gibbs phase rule for a non-reactive system is given by
a) f = C + (numr of phases) + 2

b) f = C – (numr of phases) – 2
c) f = C – (numr of phases) + 2
d) f = C – (numr of phases) – 2
View AnswerAnswer: c
Explanation: Here f is the variance or the degree of freedom and C is the numr of constituents.

14. For a pure substance existing in a single phase,
a) C=1
b) numr of phases = 1
c) f=2
d) all of the mentioned
View AnswerAnswer: d
Explanation: Hence we need to know two properties to fix up the state of the system at equilibrium.
15. Which of the following statement is true?
a) if C=1 and numr of phases=2, then f=1
b) if C=1 and numr of phases=3, then f=0
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This comes from the Gibbs phase rule.

« Prev - Thermodynamics Questions and Answers – Evaluation of Thermodynamic Properties from an Equation of State» Next - Thermodynamics Questions and Answers – Types of EquilibriumThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Types of Equilibrium”.
1. For an isolated system,
a) dS<0
b) dS>0
c) dS=0
d) none of the mentioned
View AnswerAnswer: b
Explanation: We have dU+pdV-TdS<0 and for isolated system, U and V are constant.

2. The entropy of an isolated system always ____ and reaches ____ when equilibrium is reached.

a) remains constant, maximum
b) decreases, minimum
c) increases, maximum
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause dS>0 for an isolated system.
3. Which constraints must imposed on system to make the Helmholtz function decrease?
a) constant T and p
b) constant U and T
c) constant U and V
d) constant T and V
View AnswerAnswer: d
Explanation: In these constraints, the Helmholtz function decreases and comes minimum at final equilibrium state.
4. If the constraints are constant p and T, then the Gibbs function of a system decreases.
a) true
b) false
View AnswerAnswer: a
Explanation: The Gibbs function comes minimum at the final equilibrium state.
5. Which of the following statement is true?
a) a system is in equilibrium state if, when it is disturd, it comes back to its original state
b) if there is a spontaneous change in the state, the system is not in equilibrium
c) during a spontaneous change, the entropy of system increases
d) all of the mentioned
View AnswerAnswer: d
Explanation: During a spontaneous change, the entropy of system increases and reaches a maximum when equilibrium is reached.

6. A system is said to in a state of unstable equilibrium when
a) dG<0, dF<0, dS<0
b) dG<0, dF<0, dS>0
c) dG>0, dF>0, dS>0
d) dG>0, dF>0, dS<0
View AnswerAnswer: b
Explanation: These conditions refer to a spontaneous change which makes unstable equilibrium.
7. What is the criterion of stability?
a) dG<0, dF<0, dS<0
b) dG<0, dF<0, dS>0
c) dG>0, dF>0, dS>0
d) dG>0, dF>0, dS<0
View AnswerAnswer: d
Explanation: For these conditions, a system is said to in a state of stable

equilibrium.
8. For a system to in a state of neutral equilibrium,
a) dS=dG=dF=0
b) dS=0, dG=dF<0
c) dS=0, dG=dF>0
d) none of the mentioned
View AnswerAnswer: a
Explanation: The thermodynamic criterion of equilibrium thus remains at constant value for all possible variations.
9. If a system is stable to small but not large disturbances, it is said to in metastable equilibrium.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the definition of metastable equilibrium and an example can mixture of oxygen and hygrogen.

10. Which of the following is true for a system at equilibrium?
a) S=Smax and ∂S=0
b) F=Fmin and ∂F=0
c) G=Gmin and ∂G=0
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are necessary but not the sufficient conditions for equilibrium.
11. For thermal stability,
a) Cv>0
b) (∂p/∂V)<0, at constant entropy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: Since T>0K , Cv>0 for thermal stability.
12. For mechanical stability,
a) Cv>0
b) (∂p/∂V)<0, at constant entropy
c) (∂p/∂V)<0, at constant temperature
d) all of the mentioned
View AnswerAnswer: c
Explanation: This is the condition for mechanical stability.
13. For total stability,
a) Cv>0
b) (∂p/∂V)<0, at constant entropy
c) (∂p/∂V)<0, at constant temperature
d) all of the mentioned
View AnswerAnswer: d

Explanation: All these three conditions are required for stability.

14. The third law is a fundamental law of nature and cannot proved.
a) true
b) false
View AnswerAnswer: a
Explanation: The third law is not derivable from second law and cannot proved as is the case with zeroth, first and second laws.
15. For magnetic cooling, ____ salt is used.
a) diamagnetic
b) paramagnetic
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: A paramagnetic salt like gadolinium sulphate is used for magnetic cooling.

« Prev - Thermodynamics Questions and Answers – Mixtures of Variable Composition» Next - Thermodynamics Questions and Answers – Simple Steam Power Cycle and Rankine CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Simple Steam Power Cycle and Rankine Cycle”.
1. A power cycle continuously converts ____ into ____
a) heat, heat
b) work, heat
c) heat, work
d) work, work
View AnswerAnswer: c
Explanation: Here heat is the energy released by burning of fuel and work is done as shaft work.

2. In the vapour power cycle, working fluid undergoes a change of phase.
a) true
b) false
View AnswerAnswer: a
Explanation: Here working fluid is water.
3. The path followed in a vapour power cycle is
a) boiler-condenser-turbine-pump

b) boiler-turbine-condenser-pump
c) boiler-turbine-pump-condenser
d) boiler-pump-turbine-condenser
View AnswerAnswer: b
Explanation: In the boiler, water takes heat then expands in turbine going into condenser where it condenses into water and then it is pumped back into boiler.
4. For a fluid undergoing cycle process,
a) there is no net change in its internal energy
b) energy transfer as heat is equal to the energy transfer as work
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: When a fluid undergoes a cycle process, this changes take place.
5. For a vapour power cycle,
a) net heat input is converted into net work output
b) Q1-Q2 = Wt-Wp
c) efficiency = 1 – (Q2/Q1)
d) all of the mentioned
View AnswerAnswer: d
Explanation: Here Q1 is the heat transferred to the fluid and Q2 is the heat rejected, Wt is work transferred from fluid and Wp is work transferred into fluid.

6. In a Rankine cycle, all the processes are ideal.
a) true
b) false
View AnswerAnswer: a
Explanation: The Rankine cycle is an ideal cycle and also a reversible cycle.
7. For a Rankine cycle, which of the following is true?
a) a reversible constant pressure heating process happens in steam boiler
b) reversible adiabatic expansion of steam in turbine
c) reversible constant pressure heat rejection in condenser
d) all of the mentioned
View AnswerAnswer: d
Explanation: All the processes are ideal in Rankine cycle.
8. The liquid water handled by pump is
a) incompressible
b) with increase in pressure, there is a little change in density or specific volume
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: In a pump, reversible adiabatic compression of liquid takes place.
9. The work ratio is defined as the ratio of
a) positive work output to net work output
b) net work output to positive work output
c) heat input to work output
d) none of the mentioned

View AnswerAnswer: b
Explanation: The work ratio = Wnet / Wt.

10. Steam rate is the rate of steam flow required to produce unit shaft output.
a) true
b) false
View AnswerAnswer: a
Explanation: It is the capacity of a steam plant and steam rate = 1/(Wt-Wp).
11. Heat rate is given by (in kJ/kWh)
a) cycle efficiency
b) 3600 / cycle efficiency
c) cycle efficiency / 3600
d) cycle efficiency * 3600
View AnswerAnswer: b
Explanation: Heat rate is the rate input required to produce unit work output.
12. Which of the following statement is true?
a) during compression, specific volume of the fluid should kept small
b) during expansion, specific volume of the fluid should kept large
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The larger the specific volume, more is the work produced or consumed by the steady-flow device.
13. Work output of turbine is ____ the work input to the pump.
a) much larger
b) much smaller
c) equal to
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the reason why steam power plants is so popular.

« Prev - Thermodynamics Questions and Answers – Types of Equilibrium» Next - Thermodynamics Questions and Answers – Actual Vapor Cycle Processes and Comparison of Rankine and Carnot CyclesThis set of tough Thermodynamics questions and answers focuses on “Actual Vapor Cycle Processes and Comparison of Rankine and Carnot Cycles”.

1. The thermal efficiency of the cycle is
a) Q2 / Wnet
b) Wnet / Q2
c) Wnet / Q1
d) Q1 / Wnet
View AnswerAnswer: c
Explanation: These work and heat quantities are the measured values for actual cycle.

2. Which of the following losses occur in a cycle?
a) piping losses
b) pump losses
c) turbine losses
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the major losses that happen in a cycle including condenser losses.
3. The important piping losses include
a) pressure drop due to friction
b) heat loss to surroundings
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two factors contribute to the piping losses.
4. The heat transfer and the pressure drop reduces the availability of steam.
a) true
b) false
View AnswerAnswer: a
Explanation: These two factors reduces the steam availability entering the turbine.
5. The losses in boiler include
a) pressure drop from pump to boiler
b) pressure drop in boiler
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Due to this, water entering the boiler is pumped at a very high pressure hence requiring additional pump work.

6. The main losses in turbine include
a) heat loss to surroundings

b) friction losses
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the two major losses in turbine.
7. Heat loss from turbine is generally neglected.
a) true
b) false
View AnswerAnswer: a
Explanation: This is true except for small turbines where we have to consider turbine losses.
8. The losses in pump is due to
a) heat loss to surroundings
b) irreversibilities associated with fluid friction
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: The losses in pump are similar to those of turbine.
9. The losses in condenser are ____
a) small
b) large
c) always constant
d) none of the mentioned
View AnswerAnswer: a
Explanation: Hence condenser losses are mostly neglected.

10. The condenser losses include
a) loss of pressure
b) cooling of condensate low saturation temperature
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are main losses in condenser which are very small.
11. The efficiency of Carnot cycle is ____ the efficiency of Rankine cycle.
a) less than
b) greater than
c) equal to
d) none of the mentioned
View AnswerAnswer: b
Explanation: The Carnot cycle has the maximum possible efficiency.
12. The only process which is different in Carnot and Rankine cycle is
a) compression in pump
b) expansion in turbine
c) heat rejection process

d) heat addition process
View AnswerAnswer: d
Explanation: In Rankine cycle, the heat addition process is reversible and at constant pressure and in Carnot cycle it is reversible and isothermal.
13. The Carnot cycle cannot realized in practice.
a) true
b) false
View AnswerAnswer: a
Explanation: The reason ing that the pump work is very large.

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« Prev - Thermodynamics Questions and Answers – Simple Steam Power Cycle and Rankine Cycle» Next - Thermodynamics Questions and Answers – Mean Temperature of Heat Addition and Reheat CycleThis set of tough Thermodynamics Questions focuses on "Mean Temperature of Heat Addition and Reheat Cycle".
1. In the Rankine cycle, heat is added reversibly at
a) constant pressure and constant temperature
b) constant pressure and infinite temperature
c) infinite pressure and constant temperature
d) infinite pressure and infinite temperature
View AnswerAnswer: b
Explanation: This is a basic fact about Rankine cycle.

2. The efficiency of Rankine cycle is given by
a) 1 – (Q1/Q2)
b) 1 – (Tmean/T2)
c) 1 – (T2/Tmean)
d) none of the mentioned
View AnswerAnswer: c
Explanation: Here T2 is the temperature of heat rejection and Tmean is the mean temperature of heat addition.
3. Which of the following statement is true?
a) for given Tmean, lower is the T2, higher will the efficiency of Rankine cycle
b) the lowest possible temperature of heat rejection is the surroundings temperature
c) higher is the mean temperature of heat addition, higher will the efficiency

d) all of the mentioned
View AnswerAnswer: d
Explanation: The efficiency of the Rankine cycle = 1 – (T2/Tmean).
4. If we ____ the superheat at constant pressure then the cycle efficiency ____
a) decrease, increases
b) increase, decreases
c) increase, increases
d) decrease, decreases
View AnswerAnswer: c
Explanation: Increasing the superheat at constant pressure increases the mean temperature of heat addition and cycle efficiency also increases.
5. The maximum temperature of steam that can used is not fixed.
a) true
b) false
View AnswerAnswer: b
Explanation: It is fixed from metallurgical considerations.

6. To prevent erosion of blades, quality should not fall low
a) 85%
b) 90%
c) 95%
d) 100%
View AnswerAnswer: a
Explanation: Thus the maximum moisture content which is allowed at the turbine exhaust is not to exceed 15%.
7. To fix the maximum steam pressure at the inlet of turbine we need to first fix
a) the maximum steam temperature at turbine inlet
b) minimum temperature of heat rejection
c) the minimum quality of steam at turbine exhaust
d) all of the mentioned
View AnswerAnswer: d
Explanation: These all are needed to fixed to fix to maximum steam pressure at turbine inlet.
8. Which of the following is true about a reheat cycle?
a) used to limit the quality at turbine exhaust at 0.85 when steam pressure is higher than (p1)max
b) after partial expansion in turbine, steam is brought back to boiler
c) the steam is reheated by combustion gases
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is the functioning of a reheat cycle.
9. The correct sequence of expansion in a reheat cycle is
a) HP turbine – LP turbine – constant pressure in boiler
b) HP turbine – constant pressure in boiler – LP turbine
c) LP turbine – constant pressure in boiler – HP turbine
d) LP turbine – HP turbine – constant pressure in boiler

View AnswerAnswer: b
Explanation: Here HP is the high pressure turbine and LP is the low pressure turbine.

10. Why is steam not allowed to to expand deep into two-phase region fore ing taken for reheating.
a) to protect the reheater tus
b) to prevent solid deposits ing left hind while evaporating
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These solid deposits are difficult to remove from the reheater tus.
11. Why should the reheat pressure optimized?
a) a low reheat pressure brings down the mean temperature of heat addition and hence the cycle efficiency
b) a high reheat pressure increases the moisture content at turbine exhaust
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the reasons why we need to optimize reheat pressure.
12. The optimum reheat pressure is ____ times that of the initial steam pressure.
a) 0.2
b) 0.23
c) 0.25
d) all of the mentioned
View AnswerAnswer: d
Explanation: It lies in the range 0.2-0.25 for most of the modern power plants.
13. With the use of reheat,
a) the net work output of the plant increases
b) there is only a marginal increase in cycle efficiency
c) the quality of steam at turbine exhaust is kept within a limit
d) all of the mentioned
View AnswerAnswer: d
Explanation: These can considered the main advantages of using reheat.

14. More than three reheats have not en used so far.
a) true
b) false

View AnswerAnswer: b
Explanation: The maximum numr of reheats used till now is two only.
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« Prev - Thermodynamics Questions and Answers – Actual Vapor Cycle Processes and Comparison of Rankine and Carnot Cycles» Next - Thermodynamics Questions and Answers – Ideal Regenerative Cycle and Regenerative CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Ideal Regenerative Cycle and Regenerative Cycle".

1. The mean temperature of heat addition can increased by
a) increasing the amount of heat supplied at high temperatures
b) decreasing the amount of heat added at low temperatures
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the two ways of increasing mean temperature of heat addition.

2. In the ideal regenerative cycle, the condensate after leaving the pump circulates around the turbine casing.
a) true
b) false
View AnswerAnswer: a
Explanation: Through this heat transfer takes place bebetween the vapour flowing through the turbine and liquid flowing around the turbine.
3. The efficiency of an ideal regenerative cycle is given by
a) 1 – (T1/T2)
b) 1 – (T2/T1)
c) 1 – (Q1/Q2)
d) none of the mentioned
View AnswerAnswer: b
Explanation: The efficiency of a cycle is given by 1 – (Q2/Q1).
4. The efficiency of an ideal regenerative cycle is ____ the Carnot cycle efficiency.
a) greater than
b) equal to
c) less than
d) none of the mentioned
View AnswerAnswer: b
Explanation: For both the cycles, efficiency is given by 1 – (T2/T1).

5. When compared with the Rankine cycle, the ideal regenerative cycle has
a) less net work output
b) more steam rate
c) more efficient
d) all of the mentioned
View AnswerAnswer: d
Explanation: These indiate that the ideal regenerative cycle is tter than the Rankine cycle but it is not practicable.
6. The ideal regenerative cycle is not practicable cause
a) reversible heat transfer can’t obtained in finite time
b) heat exchanger in turbine is mechanically impracticable
c) there is high moisture content of steam in the turbine
d) all of the mentioned
View AnswerAnswer: d
Explanation: These reasons result in the ideal regenerative cycle ing not used practically.
7. For a regenerative cycle, which of the following is true?
a) efficiency = (Q1-Q2)/Q1
b) efficiency = (Wt-Wp)/Q1
c) steam rate = 3600/(Wt-Wp)
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the expressions for steam rate and cycle efficiency for a regenerative cycle.

8. The efficiency of regenerative cycle will ____ the efficiency of the Rankine cycle.
a) greater than
b) equal to
c) less than
d) none of the mentioned
View AnswerAnswer: a
Explanation: The reason ing, with regeneration, the mean temperature of heat addition increases.
9. Which of the following is an assumption for heaters?
a) they are adequately insulated
b) there is no heat gain from or heat loss to the surroundings
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This assumption is necessary for the heaters.
10. The heating of feedwater by steam bled from the turbine, carnotizes the Rankine cycle.

a) true
b) false
View AnswerAnswer: a
Explanation: This comes from the equation obtained for the regenerative cycle.

« Prev - Thermodynamics Questions and Answers – Mean Temperature of Heat Addition and Reheat Cycle» Next - Thermodynamics Questions and Answers – Reheat-Regenerative Cycle and Feedwater HeatersThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Reheat-Regenerative Cycle and Feedwater Heaters”.

1. The reheating of steam is used when the vaporization pressure is ____.
a) low
b) high
c) both when low or high
d) always
View AnswerAnswer: b
Explanation: When vaporization pressure is high, the reheating of steam is adopted.

2. Why both reheating and regeneration is used together?
a) the effect of reheat alone on efficiency is very small
b) regeneration has a marked effect on efficiency
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Thus a modern steam power plant has both reheating and regeneration.

3. How many types of feedwater heaters are present?
a) one
b) two
c) three
d) four
View AnswerAnswer: b
Explanation: The two types are open heaters and closed heaters.

4. Which of the following statement is true?
a) open heater is also known as contact-type heater
b) in an open type heater the extracted or bled steam is allowed to mix with the feedwater
c) in a closed heater, the fluids are not allowed to mix together

d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the details of open and closed type heater.
5. The temperature of feedwater leaving a heater is ____ the saturation temperature at steam extraction pressure.
a) less than
b) equal to
c) more than
d) none of the mentioned
View AnswerAnswer: a
Explanation: Their difference is known as the terminal temperature difference of heater.

6. Which of the following is true for an open heater?
a) it is simple, has low cost and low heat transfer capacity
b) a pump is required at each heater
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: The open heater has high heat transfer capacity.
7. Deaerator is a type of open heater.
a) true
b) false
View AnswerAnswer: a
Explanation: In steam power plants, closed heaters are favoured but one open heater is used for the purpose of feedwater deaeration.
8. Which of the following is true for a closed heater?
a) it requires a single pump regardless of the numr of heaters
b) it is costly
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Closed heaters may not give as high feedwater temperature as do open heaters.
9. The higher the numr of heaters used, the ____ will the cycle efficiency.
a) lower
b) higher
c) efficiency does not depend on numr of heaters
d) none of the mentioned
View AnswerAnswer: b
Explanation: The cycle efficiency varies according to the numr of heaters.

10. If n heaters are used, the greatest gain in efficiency occurs when overall temperature rise is ____ times the difference bebetween condenser and boiler saturation temperatures.
a) (n-1) / n
b) (n+1) / n
c) n / (n-1)
d) n / (n+1)
View AnswerAnswer: d
Explanation: This gives us the greatest gain in efficiency.
11. The efficiency gain follows the law of diminishing return with the increase in the numr of heaters.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause the cycle efficiency is proportional to the temperature rise of feedwater.
12. Which of the following statement is true?
a) in some cases, an increase in feedwater temperature may reduce the boiler efficiency
b) numr of heaters are optimized
c) most often, five points of extraction are used
d) all of the mentioned
View AnswerAnswer: d
Explanation: The numr of heaters get fixed by the exergy balance of the whole plant.
13. The thermal irreversibility should ____ to improve the performance.
a) reduced
b) increased
c) kept constant
d) none of the mentioned
View AnswerAnswer: a
Explanation: The major exergy destruction due to irreversibility takes place in the steam generation.

« Prev - Thermodynamics Questions and Answers – Ideal Regenerative Cycle and Regenerative Cycle» Next - Thermodynamics Questions and Answers – Characteristics of an Ideal Working Fluid in Vapor Power CyclesThis set of Thermodynamics assessment questions focuses on “Characteristics of an Ideal Working Fluid in Vapor Power Cycles”.
1. Which of the following statement is true about steam?
a) the maximum temperature that can used in steam cycles is 600 degree Celsius
b) the critical temperature of steam is around 375 degree Celsius

c) large superheating is required
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are certain drawbacks with steam as working fluid.

2. With steam as working fluid, as pressure increases
a) metal stresses increases
b) thickness of walls of tus, boiler drums, etc increases
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These changes take place very rapidly cause of prevalence of high temperature.
3. At the heat rejection temperature of 40 degree Celsius, the saturation pressure of steam is 0.075 bar.
a) true
b) false
View AnswerAnswer: a
Explanation: This pressure is considerably lower than the atmospheric pressure.
4. The working fluid should have ____ critical temperature.
a) low
b) high
c) it does not matter
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is to have a low saturation pressure at the maximum allowed temperature.

5. The saturation pressure at heat rejection temperature should ____ atmospheric pressure.
a) equal to
b) low
c) above
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is done to avoid the necessity of vacuum in the condenser.
6. The specific heat of the working fluid should ____
a) small
b) large
c) very large

d) none of the mentioned
View AnswerAnswer: a
Explanation: This is done so that little heat transfer is required to raise the liquid to its boiling point.
7. The freezing point of fluid should ____ room temperature.
a) equal to
b) low
c) above
d) none of the mentioned
View AnswerAnswer: b
Explanation: So that the fluid does not get solidified when it flows through pipelines.

8. The fluid should chemically ____ and ____ contaminate the material of construction.
a) unstable, should
b) unstable, should not
c) stable, should
d) stable, should not
View AnswerAnswer: d
Explanation: The working fluid used should stable and should not contaminate at any temperature.
9. The fluid should not toxic, corrosive or excessively viscous.
a) true
b) false
View AnswerAnswer: a
Explanation: Also the working fluid should low in cost.
10. Why is superheat desired?
a) to reduce piping losses
b) to improve efficiency
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The thermal efficiency of the cycle is close to Carnot efficiency.

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« Prev - Thermodynamics Questions and Answers – Reheat-Regenerative Cycle and Feedwater Heaters» Next - Thermodynamics Questions and Answers – Binary Vapor CyclesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Binary Vapor Cycles”.

1. Which of the following fluid can used in place of water?
a) diphenyl ether
b) aluminium bromide
c) mercury
d) all of the mentioned
View AnswerAnswer: d
Explanation: These fluids are tter than water in high temperature range.

2. Which of the following statement is true?
a) only mercury has en used in place of water
b) diphenyl ether decomposes at high temperatures
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Also aluminium bromide is a possibility which can considered.

3. Mercury is a tter fluid in high temperature range.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause its vaporization pressure is relatively low even at higher temperatures.

4. Why is mercury unsuitable at low temperatures?
a) its saturation pressure comes very high
b) its specific volume is very low at such a high pressure
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: d
Explanation: Its saturation pressure comes very low and specific volume is very large.

5. In a binary cycle, ____ cycles with ____ working fluid are coupled.
a) two, same
b) two, different
c) three, same
d) three, different

View AnswerAnswer: b
Explanation: In a binary cycle, heat rejected by one can utilized by other.
6. To vaporize one kg of water, ____ kg of mercury must condense.
a) 5-6
b) 6-7
c) 7-8
d) 8-9
View AnswerAnswer: c
Explanation: This depends on the properties of mercury and water.
7. When mercury cycle is added to the steam cycle,
a) the mean temperature of heat addition increases
b) efficiency decreases
c) maximum pressure is high
d) all of the mentioned
View AnswerAnswer: a
Explanation: The increase in the mean temperature of heat addition increases the efficiency and the maximum pressure is also low.

8. Initially in a reciprocating steam engine,
a) a binary cycle was used
b) steam was used in the high temperature
c) ammonia or sulphur dioxide was used in the low temperature range
d) all of the mentioned
View AnswerAnswer: d
Explanation: Steam from engine at higher temperature and pressure was used to evaporate sulphur dioxide or ammonia which operated in another cycle.
9. In a mercury-steam cycle, mercury cycle is called ____ and steam cycle is called ____
a) bottoming cycle, topping cycle
b) topping cycle, bottoming cycle
c) both are called bottoming cycle
d) both are called topping cycle
View AnswerAnswer: b
Explanation: The mercury-steam cycle represents a two-fluid cycle.
10. We can get a tertiary cycle if a sulphur dioxide cycle is added to mercury-steam cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: In this three-fluid cycle, sulphur dioxide cycle is added in the low temperature range.

« Prev - Thermodynamics Questions and Answers – Characteristics of an Ideal Working Fluid in Vapor Power Cycles» Next - Thermodynamics Questions and Answers – Thermodynamics of Coupled CyclesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Thermodynamics of Coupled Cycles”.

1. The efficiency of a binary cycle is given by(here E=efficiency)
a) E = (1-E1)(1-E2)
b) E = 1 – (1-E1)(1-E2)
c) E = 1 / (E1-1)(E2-1)
d) none of the mentioned
View AnswerAnswer: b
Explanation: Here E1 is the efficiency of topping cycle and E2 is the efficiency of bottoming cycle.

2. For n cycles, overall efficiency would
a) E = (1-E1)(1-E2)(1-E3)……(1-En) – 1
b) E = 1 / (1-E1)(1-E2)(1-E3)……(1-En)
c) E = (1-E1)(1-E2)(1-E3)……(1-En)
d) E = 1 – (1-E1)(1-E2)(1-E3)……(1-En)
View AnswerAnswer: d
Explanation: Hence we can say total loss = product of losses in all cycles.

3. By combining two cycles in series, we can get high combined efficiency even if the individual efficiencies are low.
a) true
b) false
View AnswerAnswer: a
Explanation: Such a high efficiency cannot achieved by a single cycle.

4. How can we generate required power and required quantity of steam in a single process?
a) by modifying initial steam pressure
b) by modifying exhaust pressure
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: We require modification in both the pressures.

5. In a back pressure turbine,
a) exhaust steam from turbine is used for process heating
b) the process heater replaces the condenser of Rankine cycle
c) exhaust pressure from turbine is the desired saturation pressure
d) all of the mentioned
View AnswerAnswer: d
Explanation: In a back pressure turbine we modify both initial steam pressure and exhaust pressure.
6. A cogeneration plant produces,
a) power
b) process heat
c) both power and process heat
d) none of the mentioned
View AnswerAnswer: c
Explanation: In cogeneration plant, both power and process heat are produced.
7. In a by-product power cycle,
a) the basic need is power produced and process steam is a by-product
b) the basic need is process steam and power produced is a by-product
c) both process steam and power is the basic need
d) both process steam and power is a by-product
View AnswerAnswer: b
Explanation: Here, power produced is a by-product and the basic need is process steam.

8. In a by-product power cycle, condenser losses is ____
a) high
b) low
c) zero
d) infinity
View AnswerAnswer: c
Explanation: In a normal steam plant, this is the biggest loss but in a by-product power cycle it is zero.
9. The fraction of energy utilized in a by-product power cycle is ____
a) very high
b) very low
c) zero
d) infinity
View AnswerAnswer: a
Explanation: The reason ing the condenser losses is zero.
10. The power available from back pressure turbine through which the heating steam flows is very less.
a) true
b) false
View AnswerAnswer: a

Explanation: The reason ing relatively high back pressure or may small heating requirement.

« Prev - Thermodynamics Questions and Answers – Binary Vapor Cycles» Next - Thermodynamics Questions and Answers – Efficiencies in Steam Power PlantThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Efficiencies in Steam Power Plant “.

1. The maximum work output that can obtained per unit mass of steam is
a) reversible and isobaric enthalpy drop in turbine
b) reversible and isochoric enthalpy drop in turbine
c) reversible and adiabatic enthalpy drop in turbine
d) all of the mentioned
View AnswerAnswer: c
Explanation: The maximum work can obtained from a reversible and adiabatic enthalpy drop in turbine but no real process is reversible.

2. The work done in irreversible adiabatic expansion by the turbine is called
a) external work
b) internal work
c) zero work
d) useful work
View AnswerAnswer: b
Explanation: This is cause only the irreversibilities within flow passages of turbine are affecting steam state at turbine exhaust.
3. The internal efficiency is given by
a) internal output / ideal output
b) ideal output / internal output
c) internal output / heat supplied
d) none of the mentioned
View AnswerAnswer: a
Explanation: Here internal output is the ideal output minus the friction losses and other losses within the turbine.
4. The generator efficiency is given by brake output / output at generator terminals.
a) true
b) false

View AnswerAnswer: b
Explanation: The generator (alternator) efficiency is given by output at generator terminals / brake output of turbine.

5. The brake efficiency is given by
a) brake output / internal output
b) internal output / brake output
c) brake output / heat supplied
d) brake output / ideal output
View AnswerAnswer: d
Explanation: The brake output is also called shaft output and is given by internal output minus external losses.
6. The mechanical efficiency is given by
a) brake output / ideal output
b) brake output / internal output
c) brake output / heat supplied
d) internal output / brake output
View AnswerAnswer: b
Explanation: The brake output (shaft output) and is given by internal output minus external losses.
7. The brake efficiency is given by
a) mechanical efficiency / internal efficiency
b) internal efficiency / mechanical efficiency
c) internal efficiency * mechanical efficiency
d) none of the mentioned
View AnswerAnswer: c
Explanation: This comes from the relations of internal efficiency and mechanical efficiency.

8. Which of the following efficiency is true?
a) internal efficiency takes internal losses into consideration
b) mechanical efficiency only considers the external losses
c) brake efficiency considers both internal and external losses
d) all of the mentioned
View AnswerAnswer: d
Explanation: This the differences in internal, mechanical and brake efficiency.
9. The efficiency of boiler is given by
a) energy supplied / energy utilized
b) energy utilized / energy supplied
c) heat supplied / energy utilized

d) none of the mentioned
View AnswerAnswer: b
Explanation: The efficiency of boiler is the energy utilized / energy supplied.
10. Compressing steam in vapour form requires less work than compressing it in liquid form for same pressure rise.
a) true
b) false
View AnswerAnswer: b
Explanation: Compressing steam in vapour form requires 500 times more work than compressing it in liquid form for same pressure rise.

« Prev - Thermodynamics Questions and Answers – Thermodynamics of Coupled Cycles» Next - Thermodynamics Questions and Answers – Carnot Cycle, Stirling Cycle and Ericsson CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Efficiencies in Steam Power Plant “.
1. In a gas power cycle,
a) the working fluid is gas
b) it does not undergo phase change
c) engines which operate on gas cycle can cyclic or non-cyclic
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are basic facts about gas power cycles.

2. A Carnot cycle consists of
a) two reversible isotherms and two reversible isobars
b) two reversible isotherms and two reversible adiabatics
c) two reversible isotherms and two reversible isochores
d) two reversible isobars and two reversible adiabatics
View AnswerAnswer: b
Explanation: This is what a Carnot cycle means.
3. The efficiency of a Carnot cycle is given by
a) 1 – (T1/T2)
b) heat supplied / net work
c) net work / heat supplied
d) all of the mentioned
View AnswerAnswer: c
Explanation: Here T1 is the temperature of heat addition and T2 is the temperature

of heat rejection.
4. For a Carnot cycle, the large back work is a big disadvantage.
a) true
b) false
View AnswerAnswer: a
Explanation: This is true for both Carnot gas cycle and Carnot vapour cycle.

5. The Stirling cycle consists of
a) two reversible isotherms and two reversible isobars
b) two reversible isotherms and two reversible adiabatics
c) two reversible isotherms and two reversible isochores
d) two reversible isobars and two reversible adiabatics
View AnswerAnswer: c
Explanation: The Stirling cycle consists of these processes.
6. The efficiency of Stirling cycle is ____ the efficiency of Carnot cycle.
a) more than
b) less than
c) equal to
d) none of the mentioned
View AnswerAnswer: b
Explanation: The reason ing in Stirling cycle, heat transfers are constant volume processes.
7. The efficiency of regenerative Stirling cycle is ____ the efficiency of Carnot cycle.
a) more than
b) less than
c) equal to
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause of the regenerative arrangement used.

8. The Ericsson cycle consists of
a) two reversible isotherms and two reversible isobars
b) two reversible isotherms and two reversible adiabatics
c) two reversible isotherms and two reversible isochores
d) two reversible isobars and two reversible adiabatics
View AnswerAnswer: a
Explanation: The Ericsson cycle is made up of these processes.
9. The efficiency of Ericsson cycle is ____ the efficiency of Carnot cycle.
a) more than

b) less than
c) equal to
d) none of the mentioned
View AnswerAnswer: b
Explanation: In Ericsson cycle, part of heat is transferred at constant temperature and part at constant pressure.
10. The regenerative, Stirling and Ericsson cycles have same efficiency as Carnot cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: But the back work is less compared to Carnot cycle.

« Prev - Thermodynamics Questions and Answers – Efficiencies in Steam Power Plant» Next - Thermodynamics Questions and Answers – An Overview of Reciprocating EnginesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "An Overview of Reciprocating Engines".
1. The top dead centre is the position of piston when it forms ____ volume in cylinder and bottom dead centre is the position of piston when it forms ____ volume in cylinder.
a) largest, smallest
b) smallest, largest
c) equal, equal
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is the definition of TDC and BDC.

2. The distance bebetween TDC and BDC is called ____
a) piston
b) bore
c) stroke
d) none of the mentioned
View AnswerAnswer: c
Explanation: It is the largest distance that piston can travel in one direction.
3. The diameter of piston is called ____
a) piston
b) bore

c) stroke
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is what a bore means.
4. The air or air-fuel mixture is ____ into cylinder through intake valve and ____ out of cylinder through exhaust valve.
a) drawn, expelled
b) taken, thrown
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is what an intake valve and exhaust valve does.
5. The clearance volume is the ____ volume formed in cylinder when piston is at TDC.
a) minimum
b) maximum
c) average
d) none of the mentioned
View AnswerAnswer: a
Explanation: When the piston is at TDC, the volume is minimum.

6. The volume displaced by piston when it moves bebetween TDC and BDC is called
a) swept volume
b) displacement volume
c) clearance volume
d) none of the mentioned
View AnswerAnswer: b
Explanation: Displacement volume is, how much the piston gets displaced when it moves from TDC to BDC and vice-versa.
7. The compression ratio is given by
a) Vmax / total volume
b) Vmin / Vmax
c) V(at TDC) / V(at BDC)
d) V(at BDC) / V(at TDC)
View AnswerAnswer: d
Explanation: The compression ratio of an engine is given by V(at BDC) / V(at TDC) which is also equal to Vmax / Vmin.
8. The net work produced during a cycle is given by
a) (mean effective pressure)*(piston area)*(stroke)
b) (mean effective pressure)*(displacement volume)
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The mean effective pressure is a fictitious pressure.
9. The compression ratio is a pressure ratio.
a) true

b) false
View AnswerAnswer: b
Explanation: The compression ratio is a volume ratio.

10. Which of the following is a classification of reciprocating engines?
a) spark-ignition engines
b) compression-ignition engines
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two are classified based on how combustion process is initiated in the cylinder.
11. Which of the following statement is true?
a) in S.I. engines, combustion of air-fuel mixture is initiated by spark plug
b) in C.I. engines, combustion of air-fuel mixture is self-ignited
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: In the C.I. engines,self-ignition takes place cause of compression of mixture above self-ignition temperature.
12. A gasoline engine has a volumetric compression ratio of 10. Find the overall cycle efficiency.
a) 0.602
b) 0.302
c) 0.502
d) 0.702
View AnswerAnswer: a
Explanation: $\eta = 1 – r^{(1-k)}$
$= 1 – 10^{(-0.4)}$
$= 0.602$.
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« Prev - Thermodynamics Questions and Answers – Carnot Cycle, Stirling Cycle and Ericsson Cycle» Next - Thermodynamics Questions and Answers – Otto CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Otto Cycle”.
1. The Otto cycle is the
a) air standard cycle of CI engine
b) air standard cycle of SI engine
c) vapour power cycle of CI engine
d) vapour power cycle of SI engine
View AnswerAnswer: b
Explanation: The Otto cycle is air standard cycle and is used in SI engine.

2. In a four-stroke internal combustion engine,
a) the piston does four complete strokes within cylinder
b) for each cycle, the crankshaft completes two revolutions
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the functioning of a four-stroke internal combustion engine.
3. The correct sequence of strokes in a four-stroke SI engine is
a) intake->compression->exhaust->expansion
b) intake->expansion->compression->exhaust
c) intake->exhaust->compression->expansion
d) intake->compression->expansion->exhaust
View AnswerAnswer: d
Explanation: The correct sequence is intake->compression->expansion->exhaust and expansion stroke is also called power stroke.
4. The spark plug fires shortly fore the ____ stroke.
a) compression
b) expansion
c) intake
d) exhaust
View AnswerAnswer: b
Explanation: The spark plug fires shortly fore the piston reaches TDC and after this ignition the expansion stroke takes place.
5. The pressure in cylinder is ____ the atmospheric value during exhaust stroke and ____ it during intake stroke.
a) above, low
b) low, above
c) equal to, equal to
d) equal to, above
View AnswerAnswer: a
Explanation: This is done to ensure that all the exhaust gases are thrown out of the cylinder and enough amount of intake mixture enters the cylinder.

6. In a two-stroke engine, the four functions performed in SI engine are done in which two strokes?
a) expansion stroke and compression stroke
b) intake stroke and exhaust stroke
c) compression stroke and power stroke
d) compression stroke and expansion stroke
View AnswerAnswer: c
Explanation: In a two-stroke engine, these two strokes perform all the functions.
7. A two-stroke engine is used in motorcycles and scooters.
a) true
b) false
View AnswerAnswer: a
Explanation: The reason is that these vehicles need engines of small size and weight.
8. In a two-stroke engine,
a) the crankcase is sealed
b) the outward motion of piston is used to pressurize the air-fuel mixture
c) the intake and exhaust valves are replaced by opening in lower part of cylinder wall
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the modifications done in a two-stroke engine.
9. The two-stroke engine is ____ the four-stroke engine.
a) more efficient than
b) less efficient than
c) equally efficient to
d) none of the mentioned
View AnswerAnswer: b
Explanation: The reason ing incomplete removal of exhaust gases in a two-stroke engine.

10. The two-stroke engine is
a) simple and expensive
b) high power-to-weight ratio
c) low power-to-volume ratio
d) all of the mentioned
View AnswerAnswer: b
Explanation: The two-stroke engine is inexpensive and has high power-to-volume ratio.
11. The intake and exhaust processes are not considered in the p-V diagram of Otto

cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: The reason is these two processes cancel each other.
12. The efficiency of Otto cycle is given by (rk is the compression ratio)
a) 1/(rk)^(ɣ-1)
b) 1 – 1/(rk)^(ɣ)
c) 1 – 1/(rk)^(ɣ-1)
d) 1/(rk)^(ɣ)
View AnswerAnswer: c
Explanation: This is the expression for efficiency of Otto cycle and rk=compression ratio=Vmax/Vmin.
13. Which of the following statement is true?
a) efficiency of air standard cycle is a function of compression ratio and temperature levels
b) higher the compression ratio, higher will the efficiency
c) efficiency is dependent on the temperature levels at which the cycle operates
d) all of the mentioned
View AnswerAnswer: b
Explanation: The efficiency of air standard cycle = 1 – 1/[(rk)^(ɣ-1)] and it does not depend on the temperature levels.

14. ɣ for air is equal to
a) 1.0
b) 1.2
c) 1.3
d) 1.4
View AnswerAnswer: d
Explanation: In sir standard cycle, air is the working fluid and ɣ for air is 1.4.
15. The Otto cycle consists of
a) two reversible isotherms and two reversible isobars
b) two reversible isochores and two reversible adiabatics
c) two reversible isotherms and two reversible isochores
d) two reversible isobars and two reversible adiabatics
View AnswerAnswer: b
Explanation: This can shown in a p-V and T-s diagrams.

« Prev - Thermodynamics Questions and Answers – An Overview of Reciprocating Engines» Next - Thermodynamics Questions and Answers – Diesel Cycle and Dual CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Diesel Cycle and Dual Cycle”.
1. In SI engines,

a) air-fuel mixture is compressed
b) compression ratio is limited
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The onset of engine knock or auto-ignition limits the compression ratio in SI engines.

2. In CI engines,
a) during compression stroke, only air is compressed
b) compression ratios can much higher
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is an advantage of CI engine over SI engine.
3. The correct sequence of processes in CI engine is
a) intake->fuel injection and combustion->compression->expansion->exhaust
b) intake->compression->fuel injection and combustion->expansion->exhaust
c) intake->compression->expansion->fuel injection and combustion->exhaust
d) intake->compression->exhaust->fuel injection and combustion->expansion
View AnswerAnswer: b
Explanation: The correct sequence of processes in CI engine is intake->compression->fuel injection and combustion->expansion->exhaust.
4. The processes in CI engine cycle is completed in ____ strokes of piston and ____ revolutions of crankshaft.
a) four, four
b) two, two
c) two, four
d) four, two
View AnswerAnswer: d
Explanation: There are four strokes and numr of revolutions of crankshaft required are two.
5. The Diesel cycle consists of
a) two reversible isotherms and two reversible isobars
b) one reversible isochore and two reversible adiabatics and one reversible isobar
c) one reversible isotherm and two reversible isochores and one reversible isobar
d) two reversible isobars and two reversible adiabatics
View AnswerAnswer: b
Explanation: These four processes comprises Diesel cycle.

6. Which of the following is the relation bebetween compression ratio, expansion ratio and cut-off ratio?
a) rc=(rk)*(re)
b) re=(rk)*(rc)
c) rk=(re)*(rc)
d) none of the mentioned
View AnswerAnswer: c
Explanation: Here rk=compression ratio, re=expansion ratio and rc=cut-off ratio.
7. The efficiency of Diesel cycle is ____ the efficiency of Otto cycle.
a) less than
b) greater than
c) equal to
d) none of the mentioned
View AnswerAnswer: a
Explanation: This comes from the formula for the efficiency of Diesel cycle.
8. In Dual cycle,
a) all the heat is added at constant volume
b) all the heat is added at constant pressure
c) some heat is added at constant volume and remaining at constant pressure
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the reason why Dual cycle is also called Mixed cycle.
9. The constant volume pressure ratio is given by the ratio of pressures of constant volume heat addition.
a) true
b) false
View AnswerAnswer: a
Explanation: This ratio is used in Dual cycle.

10. Detonation in SI engine is
a) noisy and destructive combustion phenomenon
b) limits the compression ratio
c) it depends on engine design and fuel
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is what detonation means and its causes.
11. The premature ignition of fuel is called ____
a) engine knock
b) auto-ignition
c) detonation
d) all of the mentioned
View AnswerAnswer: b
Explanation: Engine knock or detonation is the audible noise produces by auto-ignition.

12. The auto-ignition
a) reduces performance of engine
b) can cause damage to engine
c) sets upper limit to compression ratios used in SI engines
d) all of the mentioned
View AnswerAnswer: d
Explanation: Thus auto-ignition should always avoided.
13. Many a times, tetraethyl ether is added to gasoline.
a) true
b) false
View AnswerAnswer: a
Explanation: This is done to raise the octane rating of fuel.

14. For a given compression raise, the highest efficiency can obtained by using
a) triatomic gases
b) diatomic gases
c) monoatomic gases
d) all of the mentioned
View AnswerAnswer: c
Explanation: Monoatomic gases like helium and argon has highest value of ɣ.
15. ɣ ____ with temperature.
a) increases
b) decreases
c) remains constant
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is a property of ɣ .

« Prev - Thermodynamics Questions and Answers – Otto Cycle» Next - Thermodynamics Questions and Answers – Brayton Cycle-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Brayton Cycle-1”.
1. A gas turbine power plant uses
a) Otto cycle
b) Rankine cycle
c) Brayton cycle
d) Diesel cycle
View AnswerAnswer: c
Explanation: The Brayton cycle is the air standard cycle for gas turbine power plant.

2. The Brayton cycle consists of
a) two reversible isotherms and two reversible isobars
b) two reversible isochores and two reversible adiabatics
c) two reversible isotherms and two reversible isochores
d) two reversible isobars and two reversible adiabatics
View AnswerAnswer: d
Explanation: These are the processes of Brayton cycle.
3. Which of the following is true for the Brayton cycle?
a) first sir is compressed reversibly and adiabatically
b) heat is added reversibly at constant pressure
c) air expands in turbine reversibly and adiabatically
d) all of the mentioned
View AnswerAnswer: d
Explanation: These processes take place in the Brayton cycle.
4. The efficiency of Brayton cycle is given by (rk is the compression ratio)
a) 1/(rk)^(ɣ-1)
b) 1 – 1/(rk)^(ɣ)
c) 1 – 1/(rk)^(ɣ-1)
d) 1/(rk)^(ɣ)
View AnswerAnswer: c
Explanation: This is the expression for efficiency of Brayton cycle and rk=compression ratio.
5. The efficiency of Brayton cycle depends on
a) compression ratio
b) pressure ratio
c) either compression ratio or pressure ratio
d) both compression ratio and pressure ratio
View AnswerAnswer: c
Explanation: The reason ing, compression ratio can expressed in terms of pressure ratio.

6. For the same compression ratio, the efficiency of Brayton cycle is ____ the efficiency of Otto cycle.
a) less than
b) equal to
c) greater than
d) none of the mentioned
View AnswerAnswer: b
Explanation: The expressions for efficiency of Brayton cycle and Otto cycle are same.
7. Both Rankine cycle and Brayton cycle consists of two reversible isochores and two reversible adiabatics.

a) true
b) false
View AnswerAnswer: b
Explanation: Both Rankine cycle and Brayton cycle consists of two reversible isobars and two reversible adiabatics.
8. In Rankine cycle, working fluid ____ , in Brayton cycle working fluid ____
a) undergoes phase change, remains in gaseous phase
b) remains in gaseous phase, undergoes phase change
c) undergoes phase change, undergoes phase change
d) remains in gaseous phase, remains in gaseous phase
View AnswerAnswer: a
Explanation: This is a difference in Rankine cycle and Brayton cycle.
9. For Brayton cycle, average specific volume of air that compressor handles is ____ the same of gas in a gas turbine.
a) equal to
b) more than
c) less than
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause the gas temperature is much higher.

10. A steam power plant works on ____ and a gas turbine works on ____
a) both work on Rankine cycle
b) both work on Brayton cycle
c) Brayton cycle, Rankine cycle
d) Rankine cycle, Brayton cycle
View AnswerAnswer: d
Explanation: This is a difference in a steam power plant and a gas turbine.
11. Which of the following is more popular for electricity generation?
a) gas turbine
b) steam power plant
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: cause in Rankine cycle, specific volume of water in pump is less than that of steam expanding in steam turbine.
12. For the same compression ratio and work capacity, Brayton cycle handles ____ range of volume and ____ range of pressure and temperature than does Otto cycle.
a) larger, smaller
b) smaller, larger
c) both are same
d) none of the mentioned
View AnswerAnswer: a
Explanation: This can seen in the p-V diagram of Brayton cycle and Otto cycle.

13. Why is Otto cycle more suitable in reciprocating engine field?
a) reciprocating engine field cannot handle large volume of low pressure gas
b) the engine size increases
c) the friction losses come more
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is the reason why Brayton cycle is not preferred in reciprocating engine field.

14. In turbine plants, Otto cycle is more suitable than Brayton cycle.
a) true
b) false
View AnswerAnswer: b
Explanation: In turbine plants, Brayton cycle is used instead of Otto cycle.
15. Which of the following statement is true?
a) an IC engine is exposed to highest temperature only for a short period
b) a gas turbine plant is always exposed to highest temperature used
c) in a gas turbine plant, maximum temperature used should less than that used in IC engine
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is the reason why in turbine plants, Brayton cycle is preferred.

« Prev - Thermodynamics Questions and Answers – Diesel Cycle and Dual Cycle» Next - Thermodynamics Questions and Answers – Brayton Cycle-2This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Brayton Cycle-2".
1. How can regeneration used to improve the efficiency of Brayton cycle?
a) the energy of exhaust gas can used to heat up the air which leaves the compressor
b) heat supplied from external source thus decreases
c) the amount of heat rejected also decreases
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is how a regenerator can used in Brayton cycle.

2. The temperature of air leaving turbine is less than that of air leaving

compressor.
a) true
b) false
View AnswerAnswer: b
Explanation: The temperature of air leaving turbine is more than that of air leaving compressor.
3. In the regenerator,
a) temperature of air leaving the compressor is raised
b) temperature of air leaving the turbine is raised
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is done by using the heat from the turbine exhaust.
4. Which of the following statement is true for a regenerator?
a) mean temperature of heat addition decreases
b) mean temperature of heat rejection decreases
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: The mean temperature of heat addition increases by using a regenerator.
5. By using a regenerator,
a) efficiency increases, work output decreases
b) both efficiency and work output increases
c) efficiency increases, work output remains unchanged
d) efficiency remains same, work output increases
View AnswerAnswer: c
Explanation: This is cause mean temperature of heat addition increases and mean temperature of heat rejection decreases by using regenerator.

6. Which of the following is true about a regenerator?
a) it is costly
b) it is heavy and bulky
c) it causes pressure losses
d) all of the mentioned
View AnswerAnswer: d
Explanation: This loss in pressure decreases the cycle efficiency.
7. When we add a regenerator, cycle efficiency always increases.
a) true
b) false
View AnswerAnswer: b
Explanation: The addition of regenerator after a certain pressure ratio decreases the cycle efficiency as compared to Brayton cycle.
8. When the turbine efficiency and compressor efficiency decreases, the cycle efficiency ____
a) decreases
b) increases

c) remains same
d) none of the mentioned
View AnswerAnswer: a
efficiency: The Brayton cycle is very sensitive to the efficiency of the turbine and compressor.
9. The ____ the pressure ratio, the ____ will efficiency.
a) less, more
b) less, less
c) more, more
d) more, less
View AnswerAnswer: c
Explanation: This comes from the Brayton cycle efficiency in terms of pressure ratio.

10. As the pressure ratio increases, the efficiency steadily ____
a) decreases
b) increases
c) remains constant
d) none of the mentioned
View AnswerAnswer: b
Explanation: As pressure ratio increases, the mean temperature of heat addition increases and the mean temperature of heat rejection decreases.
11. The maximum pressure ratio is given by
a) (Tmin/Tmax)^((ɣ-1)/ɣ)
b) (Tmin/Tmax)^(ɣ/(ɣ-1))
c) (Tmax/Tmin)^((ɣ-1)/ɣ)
d) (Tmax/Tmin)^(ɣ/(ɣ-1))
View AnswerAnswer: d
Explanation: Here Tmax is the maximum temperature and Tmin is the minimum temperature which is the temperature of surroundings.
12. The optimum value of pressure ratio at which work capacity comes maximum is given by
a) (Tmin/Tmax)^((ɣ-1)/2ɣ)
b) (Tmax/Tmin)^(ɣ/2(ɣ-1))
c) (Tmax/Tmin)^(2(ɣ-1)/ɣ)
d) (Tmax/Tmin)^(2ɣ/(ɣ-1))
View AnswerAnswer: b
Explanation: This is the optimum value of pressure ratio.
13. The relation bebetween maximum pressure ratio and optimum pressure ratio is given by
a) optimum pressure ratio = (maximum pressure ratio)/2
b) optimum pressure ratio = maximum pressure ratio
c) optimum pressure ratio = sqrt(maximum pressure ratio)
d) optimum pressure ratio = (maximum pressure ratio)^2

View AnswerAnswer: c
Explanation: This relation comes from the expressions of optimum pressure ratio and maximum pressure ratio.

14. Which of the following statement is true?
a) maximum work done = (specific heat at constant preferred)*(sqrt(Tmax) – sqrt(Tmin))^2
b) efficiency of cycle = 1- sqrt(Tmin/Tmax)
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These expressions come from the maximum pressure ratio.
15. The efficiency of Brayton cycle can increased by using staged heat supply or by use of staged compression with intercooling.
a) true
b) false
View AnswerAnswer: a
Explanation: The staged heat supply is also called reheat.

« Prev - Thermodynamics Questions and Answers – Brayton Cycle-1» Next - Thermodynamics Questions and Answers – Aircraft PropulsionThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Aircraft Propulsion”.
1. Gas turbines are used in aircraft propulsion cause
a) they are light
b) they are compact
c) they have high power-to-weight ratio
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the reasons why aircraft propulsion uses gas turbines.

2. The type of aircraft gas turbines include
a) turbojet
b) turbofan
c) turboprop
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the types of aircraft gas turbines.

3. In the ideal case, turbine work is greater than the compressor work.
a) true
b) false
View AnswerAnswer: b
Explanation: The turbine work is equal to the compressor work in ideal case.
4. The processes in compressor, turbine, diffuser and nozzle are
a) reversible
b) adiabatic
c) reversible and adiabatic
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is an assumption for the aircraft gas turbine.
5. The thrust developed in turbojet engine is the
a) unbalanced force
b) balanced force
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: It is caused by the difference in momentum of air entering the engine and exhaust gases leaving the engine.

6. Which of the following statement is true?
a) mass flow rates of gases at engine inlet and exit are same
b) the pressure at inlet and exit of engine are ambient pressures
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: The mass flow rates at engine exit and inlet are different cause of different combustion rate of fuel.
7. The air-fuel ratio used in jet engine is very small.
a) true
b) false
View AnswerAnswer: b
Explanation: The air-fuel ratios used in jet propulsion is usually very high.
8. When flying at high altitudes,
a) air is of less density
b) air exerts less drag force on aircraft
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the reason why commercial airplanes fly at high altitudes to save fuel.
9. The propulsive efficiency is given by
a) work done by engine / propulsive power
b) propulsive power / work done by engine
c) energy input rate / propulsive power

d) propulsive power / energy input rate
View AnswerAnswer: d
Explanation: This tells us how efficiently the energy which is released during combustion is getting converted to propulsive power.

10. We cannot use regenerators and intercoolers on aircraft engines.
a) true
b) false
View AnswerAnswer: a
Explanation: The reason ing space and weight limitations.
11. In aircraft propulsion the most widely used engine is
a) turbojet
b) turbofan
c) turboprop
d) all of the mentioned
View AnswerAnswer: b
Explanation: In turbofan engine, turbine drives a large fan which forces air through a duct surrounding the engine.
12. The bypass ratio is the ratio of
a) mass flow rates of two streams
b) pressure ratio of inlet and exit
c) volume flow rate of inlet and exit
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the definition of bypass ratio.
13. Increasing the bypass ratio of turbofan engine ____ thrust.
a) does not affect
b) decreases
c) increases
d) none of the mentioned
View AnswerAnswer: c
Explanation: As the bypass ratio increases, the thrust also increases.

14. Removing the cowl from the fan gives us
a) turbojet
b) turbofan
c) turboprop
d) all of the mentioned

View AnswerAnswer: c
Explanation: This is how we get a turboprop engine.
15. In turbofans, the bypass ratio is 5-6 and in turboprop it is as high as 100.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the main difference in turbofan and turboprop engine.

« Prev - Thermodynamics Questions and Answers – Brayton Cycle-2» Next - Thermodynamics Questions and Answers – Reversed Heat EngineThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Reversed Heat Engine”.
1. Refrigeration is the cooling of any system low its surroundings temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: This is what refrigeration means.

2. Dry ice is suitable for ____ temperature refrigeration.
a) high
b) low
c) all range of
d) none of the mentioned
View AnswerAnswer: b
Explanation: Dry ice when exposed to atmosphere sublimates by absorbing latent heat of sublimation.
3. A reversed heat engine
a) receives heat from a low temperature region
b) gives heat to a high temperature region
c) receives a net inflow of work
d) all of the mentioned
View AnswerAnswer: d
Explanation: This is the basic working of reversed heat engine.
4. Which of the following is a reversed heat engine cycle?
a) heat pump cycle
b) refrigeration cycle
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the reversed heat engine cycles.
5. For a heat pump, coefficient of performance is given by (Q1 is the heat taken from low temperature region and Q2 is the heat given to high temperature region)
a) Q1/(Q1-Q2)

b) Q2/(Q1-Q2)
c) 1- (Q1/Q2)
d) 1- (Q2/Q1)
View AnswerAnswer: a
Explanation: For a heat pump, COP = Q1/W = Q1/(Q1-Q2).

6. For a regenerator, coefficient of performance is given by (Q1 is the heat taken from low temperature region and Q2 is the heat given to high temperature region)
a) Q1/(Q1-Q2)
b) Q2/(Q1-Q2)
c) 1- (Q1/Q2)
d) 1- (Q2/Q1)
View AnswerAnswer: b
Explanation: For a heat pump, COP = Q2/W = Q2/(Q1-Q2).
7. The working fluid in a refrigeration cycle is known as refrigerant.
a) true
b) false
View AnswerAnswer: a
Explanation: A refrigerant is referred particularly to a refrigeration cycle.
8. Which of the following happens in a reversed Carnot cycle?
a) the refrigerant is compressed reversibly and adiabatically
b) it is condensed reversibly
c) it expands reversibly and adiabatically
d) all of the mentioned
View AnswerAnswer: d
Explanation: These processes take place in a reversed Carnot cycle.
9. For a heat pump, coefficient of performance is given by (T1 is the temperature of heat rejection and T2 is the temperature of heat absorption)
a) T1/(T1-T2)
b) T2/(T1-T2)
c) 1- (T1/T2)
d) 1- (T2/T1)
View AnswerAnswer: a
Explanation: For a heat pump, COP = Q1/W = T1/(T1-T2).

10. For a regenerator, coefficient of performance is given by (T1 is the temperature of heat rejection and T2 is the temperature of heat absorption)
a) T1/(T1-T2)
b) T2/(T1-T2)

c) 1- (T1/T2)
d) 1- (T2/T1)
View AnswerAnswer: b
Explanation: For a heat pump, COP = Q2/W = T2/(T1-T2).
11. For the same T1 and T2, COP increases with ____ in temperature difference.
a) increase
b) decrease
c) no change
d) none of the mentioned
View AnswerAnswer: b
Explanation: This means, closer the temperatures T1 and T2, the higher is the COP.

« Prev - Thermodynamics Questions and Answers – Aircraft Propulsion» Next - Thermodynamics Questions and Answers – Vapor Compression Refrigeration Cycle-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Vapor Compression Refrigeration Cycle-1".
1. In vapour refrigeration cycle, which of the following is used for expansion?
a) expansion engine
b) throttling valve or capillary tu
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is cause in expansion engine, power recovery is small and hence its cost is not justified.

2. Which of the following operations occur in a vapour refrigeration cycle?
a) compression
b) cooling and condensing
c) expansion and evaporation
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the processes which constitute the vapour refrigeration cycle.
3. Compression can
a) dry compression
b) wet compression
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Dry compression starts with saturated vapour and wet compression starts with wet vapour.
4. Wet compression is preferred over dry compression.
a) true

b) false
View AnswerAnswer: b
Explanation: Dry compression is always preferred.
5. Why is wet compression not preferred?
a) the liquid refrigerant can trapped in the head of cylinder
b) this may damage the valves or cylinder head
c) liquid refrigerant can wash away the lubricating oil thus accelerating wear
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the reasons why dry compression is preferred over wet compression.

6. In the cooling and condensing, correct sequence of processes is
a) desuperheated->condensed->saturated liquid
b) desuperheated->saturated liquid->condensed
c) condensed->desuperheated->saturated liquid
d) saturated liquid->condensed->desuperheated
View AnswerAnswer: a
Explanation: This is the correct sequence of processes and heat is transferred out.
7. The expansion process is
a) isentropic
b) reversible
c) adiabatic
d) all of the mentioned
View AnswerAnswer: c
Explanation: The expansion process is adiabatic but not isentropic and is irreversible.
8. The evaporation process is a
a) constant volume reversible process
b) constant pressure reversible process
c) adiabatic throttling process
d) reversible adiabatic process
View AnswerAnswer: b
Explanation: This is the last process and it completes the cycle.
9. The evaporator produces the cooling or refrigerating effect.
a) true
b) false
View AnswerAnswer: a
Explanation: It absorbs heat from the surroundings by evaporation.

10. In the expansion process, which of the following remains constant?
a) work done
b) heat supplied
c) internal energy
d) enthalpy
View AnswerAnswer: d
Explanation: The expansion is an adiabatic throttling process in which enthalpy remains unchanged.
11. The COP of cycle is given by(Q2=heat absord by evaporator and Wc=work done by compressor)
a) 1- (Q2/Wc)
b) 1- (Wc/Q2)
c) Q2/Wc
d) Wc/Q2
View AnswerAnswer: c
Explanation: This is the COP of vapour refrigeration cycle.
12. One tonne of refrigeration is given as the rate of heat removal from surroundings equivalent to heat required for melting one tonne of ice in a day.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the definition of “one tonne of refrigeration”.
13. Which of the following is recommended in a refrigeration cycle?
a) superheating of vapour
b) subcooling of liquid
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The superheating of vapour is done at evaporator outlet and subcooling of liquid occurs at condenser outlet.

14. Superheating of vapour and subcooling of liquid ____ the refrigerating effect.
a) decreases
b) increases
c) no change
d) none of the mentioned
View AnswerAnswer: b
Explanation: The refrigerating effect is increased by using these techniques.
15. A condenser must ____ and then ____ the compressed refrigerant.
a) superheat, evaporate
b) desuperheat, evaporate
c) superheat, condense
d) desuperheat, condense

View AnswerAnswer: d
Explanation: This is the function of a condenser.

« Prev - Thermodynamics Questions and Answers – Reversed Heat Engine» Next - Thermodynamics Questions and Answers – Vapor Compression Refrigeration Cycle-2This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Vapor Compression Refrigeration Cycle-2".

1. Which of the following statement is true for a condenser?
a) it can air-cooled or water-cooled
b) small self-contained units use water-cooled condenser
c) large installations use air-cooled condenser
d) all of the mentioned
View AnswerAnswer: a
Explanation: We use air-cooled condenser for small self-contained units and water-cooled condenser for large installations.

2. For an expansion device, which of the following is true?
a) it increases the pressure of refrigerant
b) it regulates the flow of refrigerant to evaporator
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: The expansion device reduces the pressure of refrigerant.
3. Which of the following is a type of expansion device?
a) capillary tus
b) throttle valves
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are the two types of expansion devices.
4. Throttle valves are used in ____
a) small units
b) larger units
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: They regulate the flow of refrigerant according to load on evaporator.
5. Capillary tus are used in ____
a) small units
b) larger units
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: a

Explanation: In their case, id size and length are fixed, the evaporator pressure also gets fixed.

6. Types of compressor include
a) reciprocating
b) centrifugal
c) rotary
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the three types of compressor.
7. When volume flow rate of refrigerant is large, which compressor is used?
a) reciprocating
b) centrifugal
c) rotary
d) all of the mentioned
View AnswerAnswer: b
Explanation: For plants with higher capacities, centrifugal compressors are used.
8. Which of the following statement is true?
a) rotary compressors are mostly used for small units
b) reciprocating compressors are employed in plants with capacity up to 100 tonnes
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the difference in reciprocating and rotary compressors.
9. In reciprocating compressors, actual volume of gas drawn in cylinder is ____ the volume displaced by piston.
a) less than
b) more than
c) equal to
d) none of the mentioned
View AnswerAnswer: a
Explanation: The reason ing, leakage, clearance and throttling effects.

10. The clearance volumetric efficiency is equal to
a) $1 + C + C(p2/p1)^{(1/n)}$
b) $1 - C - C(p2/p1)^{(1/n)}$
c) $1 - C + C(p2/p1)^{(1/n)}$
d) $1 + C - C(p2/p1)^{(1/n)}$
View AnswerAnswer: d
Explanation: Here C is the clearance and p1,p2 are pressures.

11. Plate evaporator is a common type of evaporator.
a) true
b) false
View AnswerAnswer: a
Explanation: In a plate evaporator, a coil is brazed on to a plate.
12. Why is multistage compression with intercooling adopted?
a) using a single stage with high pressure ratio decreases volumetric efficiency
b) high pressure ratio with dry compression gives high compressor discharge temperature
c) the refrigerant is damaged
d) all of the mentioned
View AnswerAnswer: d
Explanation: cause of these reasons we have to use multistage compression with intercooling.
13. The intercooler pressure is given by
a) p1*p2
b) sqrt(p1*p2)
c) (p1*p2)/(p1+p2)
d) (p1+p2)/2
View AnswerAnswer: b
Explanation: Here p1 is the evaporator pressure and p2 is the condenser pressure.

14. The most widely used refrigerants are
a) freon
b) genetron
c) arcton
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are a group of halogenated hydrocarbons.
15. Why is ammonia used in food refrigeration?
a) high COP
b) low cost
c) lower energy cost
d) all of the mentioned
View AnswerAnswer: d
Explanation: Also ammonia can detected easily in case of a leak.

« Prev - Thermodynamics Questions and Answers – Vapor Compression Refrigeration Cycle-1» Next - Thermodynamics Questions and Answers – Absorption Refrigeration CycleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “First Law for a Closed System”.
1. Energy has different forms which include
a) heat

b) work
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Basic fact about energy.

2. Work input is directly proportional to heat and the constant of proportionality is called
a) joule’s equivalent
b) mechanical equivalent of heat
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: True for a closed system undergoing a cycle.
3. The value of constant of proportionality, J, has the value
a) 1
b) 0
c) -1
d) infinity
View AnswerAnswer: a
Explanation: In the S.I. system, both heat and work are measured in the derived unit of energy, the Joule.
4. It was Joule who first established that heat is a form of energy, and thus laid the foundation of the first law of thermodynamics.
a) true
b) false
View AnswerAnswer: a
Explanation: Prior to Joule, heat was considered to an invisible fluid flowing from a body of higher calorie to a body of lower calorie.

5. Which of the following represents the energy in storage?
a) heat
b) work
c) internal energy
d) none of the mentioned
View AnswerAnswer: c
Explanation: Energy in storage is internal energy or the energy of the system.
6. By first law of thermodynamics,
a) $Q=\Delta E-W$
b) $Q=\Delta E+W$

c) $Q=-\Delta E-W$
d) $Q=-\Delta E+W$
View AnswerAnswer: b
Explanation: Q-W is the net energy stored in system and is called internal energy of system.
7. The expression $(\Sigma W)_{cycle}=(\Sigma Q)_{cycle}$ applies only to systems undergoing cycles.
a) true
b) false
View AnswerAnswer: a
Explanation: The above expression holds for a closed cycle.

8. Which of the following is the first law for a closed system undergoing a cycle?
a) $\oint dW=\oint dQ$
b) $J\oint dW=\oint dQ$
c) $\oint dW=J\oint dQ$
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the expression for first law of thermodynamics where ∫ denotes the cyclic integral for the closed path.
9. Which of the following an considered as the definition of energy?
a) $Q=\Delta E+W$
b) $Q-W=\Delta E$
c) first law of thermodynamics
d) all of the mentioned
View AnswerAnswer: d
Explanation: The first law is a particular formulation of the principle of the conservation of energy.
10. The first law of thermodynamics gives only the change on energy ΔE for the process.
a) true
b) false
View AnswerAnswer: a
Explanation: An absolute value of energy E, is not given by the first law.

« Prev - Thermodynamics Questions and Answers – Heat Transfer» Next - Thermodynamics Questions and Answers – EnergyThis set of Thermodynamics Multiple

Choice Questions & Answers (MCQs) focuses on “Energy”.
1. Energy is a
a) point function
b) property of the system
c) extensive property
d) all of the mentioned
View AnswerAnswer: d
Explanation: Energy has a definite value for every state of the system.

2. The specific energy, e=E/m is an extensive property.
a) true
b) false
View AnswerAnswer: b
Explanation: The specific energy is an intensive property.
3. (m*V*V)/2 gives the
a) macroscopic kinetic energy
b) microscopic kinetic energy
c) macroscopic potential energy
d) microscopic potential energy
View AnswerAnswer: a
Explanation: The formula gives the macroscopic kinetic energy of the fluid element by virtue of its motion.
4. (m*g*z) gives the
a) macroscopic kinetic energy
b) microscopic kinetic energy
c) macroscopic potential energy
d) microscopic potential energy
View AnswerAnswer: c
Explanation: The above formula gives the macroscopic potential energy of the fluid element by virtue of its position.

5. Which of the following types of energy can present in molecules?
a) translational and rotational kinetic energy
b) electronic energy and vibrational energy
c) chemical energy and nuclear energy
d) all of the mentioned
View AnswerAnswer: d
Explanation: The molecules may subjected to rotation as well as vibration due to a collision.
6. The total internal energy of the system is given by

a) $U=N/\varepsilon$
b) $U=N\varepsilon$
c) $U=\varepsilon/N$
d) none of the mentioned
View AnswerAnswer: b
Explanation: $U=N\varepsilon$ where N is the total numr of molecules in the system and ε represents the energy of one molecule.
7. In an ideal gas there are no intermolecular forces of attraction and repulsion, and the internal energy is a function of temperature only.
a) true
b) false
View AnswerAnswer: a
Explanation: For an ideal gas U depends only on T.

8. Which of the following is true in regard to the energy of an isolated system?
a) $dQ \neq 0$
b) $dW \neq 0$
c) E=constant
d) all of the mentioned
View AnswerAnswer: c
Explanation: For an isolated system, $dQ=dW=0$ and hence, $dE=0$ by first law.
9. A perpetual motion machine of first kind
a) is a fictitious machine
b) can supply mechanical work without dissipating energy
c) violates first law
d) all of the mentioned
View AnswerAnswer: d
Explanation: There cannot any machine which would continuously supply mechanical energy without other form of energy ing dissipated.
10. The limitation of the first law is
a) does not indicate the possibility of a spontaneous process proceeding in a definite direction
b) it assigns a quality to different forms of energy
c) indicates the direction of any spontaneous process
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the main limitation of first law and the second law overcomes it.

« Prev - Thermodynamics Questions and Answers – First Law for a Closed System» Next - Thermodynamics Questions and Answers – EnthalpyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “First Law for a Closed System”.

1. Energy has different forms which include
a) heat
b) work
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Basic fact about energy.

2. Work input is directly proportional to heat and the constant of proportionality is called
a) joule’s equivalent
b) mechanical equivalent of heat
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: True for a closed system undergoing a cycle.
3. The value of constant of proportionality, J, has the value
a) 1
b) 0
c) -1
d) infinity
View AnswerAnswer: a
Explanation: In the S.I. system, both heat and work are measured in the derived unit of energy, the Joule.
4. It was Joule who first established that heat is a form of energy, and thus laid the foundation of the first law of thermodynamics.
a) true
b) false
View AnswerAnswer: a
Explanation: Prior to Joule, heat was considered to an invisible fluid flowing from a body of higher calorie to a body of lower calorie.

5. Which of the following represents the energy in storage?

a) heat
b) work
c) internal energy
d) none of the mentioned
View AnswerAnswer: c
Explanation: Energy in storage is internal energy or the energy of the system.
6. By first law of thermodynamics,
a) $Q=\Delta E-W$
b) $Q=\Delta E+W$
c) $Q=-\Delta E-W$
d) $Q=-\Delta E+W$
View AnswerAnswer: b
Explanation: Q-W is the net energy stored in system and is called internal energy of system.
7. The expression $(\Sigma W)_{cycle}=(\Sigma Q)_{cycle}$ applies only to systems undergoing cycles.
a) true
b) false
View AnswerAnswer: a
Explanation: The above expression holds for a closed cycle.

8. Which of the following is the first law for a closed system undergoing a cycle?
a) $\int dW=\int dQ$
b) $J\int dW=\int dQ$
c) $\int dW=J\int dQ$
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is the expression for first law of thermodynamics where ∫ denotes the cyclic integral for the closed path.
9. Which of the following an considered as the definition of energy?
a) $Q=\Delta E+W$
b) $Q-W=\Delta E$
c) first law of thermodynamics
d) all of the mentioned
View AnswerAnswer: d
Explanation: The first law is a particular formulation of the principle of the conservation of energy.
10. The first law of thermodynamics gives only the change on energy ΔE for the process.
a) true
b) false
View AnswerAnswer: a
Explanation: An absolute value of energy E, is not given by the first law.

« Prev - Thermodynamics Questions and Answers – Heat Transfer» Next - Thermodynamics Questions and Answers – EnergyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Energy”.
1. Energy is a
a) point function
b) property of the system
c) extensive property
d) all of the mentioned
View AnswerAnswer: d
Explanation: Energy has a definite value for every state of the system.

2. The specific energy, e=E/m is an extensive property.
a) true
b) false
View AnswerAnswer: b
Explanation: The specific energy is an intensive property.
3. (m*V*V)/2 gives the
a) macroscopic kinetic energy
b) microscopic kinetic energy
c) macroscopic potential energy
d) microscopic potential energy
View AnswerAnswer: a
Explanation: The formula gives the macroscopic kinetic energy of the fluid element by virtue of its motion.
4. (m*g*z) gives the
a) macroscopic kinetic energy
b) microscopic kinetic energy
c) macroscopic potential energy
d) microscopic potential energy
View AnswerAnswer: c
Explanation: The above formula gives the macroscopic potential energy of the fluid element by virtue of its position.

5. Which of the following types of energy can present in molecules?
a) translational and rotational kinetic energy
b) electronic energy and vibrational energy
c) chemical energy and nuclear energy
d) all of the mentioned
View AnswerAnswer: d
Explanation: The molecules may subjected to rotation as well as vibration due to a collision.
6. The total internal energy of the system is given by
a) $U=N/\varepsilon$
b) $U=N\varepsilon$
c) $U=\varepsilon/N$
d) none of the mentioned
View AnswerAnswer: b
Explanation: $U=N\varepsilon$ where N is the total numr of molecules in the system and ε represents the energy of one molecule.
7. In an ideal gas there are no intermolecular forces of attraction and repulsion, and the internal energy is a function of temperature only.
a) true
b) false
View AnswerAnswer: a
Explanation: For an ideal gas U depends only on T.

8. Which of the following is true in regard to the energy of an isolated system?
a) $dQ\neq0$
b) $dW\neq0$
c) E=constant
d) all of the mentioned
View AnswerAnswer: c
Explanation: For an isolated system, $dQ=dW=0$ and hence, $dE=0$ by first law.
9. A perpetual motion machine of first kind
a) is a fictitious machine
b) can supply mechanical work without dissipating energy
c) violates first law
d) all of the mentioned
View AnswerAnswer: d
Explanation: There cannot any machine which would continuously supply mechanical energy without other form of energy ing dissipated.
10. The limitation of the first law is
a) does not indicate the possibility of a spontaneous process proceeding in a definite direction
b) it assigns a quality to different forms of energy
c) indicates the direction of any spontaneous process

d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the main limitation of first law and the second law overcomes it.

« Prev - Thermodynamics Questions and Answers – First Law for a Closed System» Next - Thermodynamics Questions and Answers – EnthalpyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Enthalpy”.
1. The enthalpy of a substance(denoted by h), is defined as
a) h=u-pv
b) h=u+pv
c) h=-u+pv
d) h=-u-pv
View AnswerAnswer: b
Explanation: This is a basic definition for enthalpy.

2. In a constant volume process, internal energy change is equal to
a) heat transferred
b) work done
c) zero
d) none of the mentioned
View AnswerAnswer: a
Explanation: In a constant volume process, there is no work other than the pdV work.
3. For an ideal gas, enthalpy comes
a) h=u-RT
b) h=-u-RT
c) h=u+RT
d) h=-u+RT
View AnswerAnswer: c
Explanation: For an ideal gas, pv=RT.
4. Enthalpy is an intensive property of a system.
a) true
b) false
View AnswerAnswer: a
Explanation: Enthalpy is an intensive property measured mostly in kJ/kg.

5. Heat transferred at constant pressure _____ the enthalpy of a system.
a) decreases
b) increases
c) first decreases then increases
d) first increases then decreases
View AnswerAnswer: b
Explanation: At constant pressure, (dQ)=dh where h=u+pv is the specific enthalpy of the system.
6. The enthalpy of an ideal gas depends only on the temperature.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause the internal energy of an ideal gas depends only on the temperature.
7. Total enthalpy of a system H is given by
a) H=h/m
b) H=m/h
c) H=mh
d) none of the mentioned
View AnswerAnswer: c
Explanation: Total enthalpy equals (mass*enthalpy) of substance.

8. The enthalpy and internal energy are the function of temperature for
a) all gases
b) steam
c) water
d) ideal gas
View AnswerAnswer: d
Explanation: The enthalpy of an ideal gas depends only on the temperature cause the internal energy of an ideal gas depends only on the temperature.
9. Change in enthalpy of a system is due to heat supplied at
a) constant volume
b) constant pressure
c) both at constant volume and pressure
d) none of the mentioned
View AnswerAnswer: b
Explanation: Change in enthalpy occurs when heat is given to a system at constant pressure.
10. At constant pressure
a) pdv=d(pv)
b) dQ=du+d(pv)

c) dQ=d(u+pv)
d) all of the mentioned
View AnswerAnswer: d
Explanation: For a constant pressure process, dQ=du+pdv.

« Prev - Thermodynamics Questions and Answers – Energy» Next - Thermodynamics Questions and Answers – Specific Heat at Constant Volume and Pressure and Control VolumeThis set of Thermodynamics Questions and Answers for freshers focuses on "Specific Heat at Constant Volume and Pressure and Control Volume".

1. The specific heat of a substance at constant volume is defined as the rate of change of ___ with respect to ___
a) specific internal energy, temperature
b) work, pressure
c) specific internal energy, pressure
d) heat, temperature
View AnswerAnswer: a
Explanation: cv=∂u/∂T at constant volume.

2. Heat transferred at constant _____ increases the _____ of a system.
a) pressure, increases
b) volume, increases
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: At constant pressure, (dQ)=dh and at constant volume, Q=Δu.
3. Specific heat of a substance at constant volume is a property of the system.
a) true
b) false
View AnswerAnswer: a
Explanation: Since T,v and u are the properties of the system, specific heat at a constant volume is a property of the system.
4. The specific heat of a substance at constant pressure is defined as the rate of change of ___ with respect to ___
a) work, pressure
b) enthalpy, temperature
c) enthalpy, pressure
d) heat, temperature

View AnswerAnswer: b
Explanation: $cp=\partial h/\partial T$ at constant pressure.

5. The heat capacity at constant pressure Cp
a) m/cp
b) cp/m
c) mcp
d) none of the mentioned
View AnswerAnswer: c
Explanation: Cp=(mass*specific heat at constant pressure).
6. Specific heat of a substance at constant pressure is a property of the system.
a) true
b) false
View AnswerAnswer: a
Explanation: cp is a property of a substance just like cv.
7. When there is mass transfer across the system boundary, the system is called
a) isolated system
b) closed system
c) open system
d) none of the mentioned
View AnswerAnswer: c
Explanation: Basic definition of an open system.

8. If a certain mass of steam is considered as the thermodynamic system, then the energy equation comes
a) $Q=\Delta KE + \Delta PE - \Delta U + W$
b) $Q=\Delta KE + \Delta PE - \Delta U - W$
c) $Q=-\Delta KE - \Delta PE + \Delta U + W$
d) $Q=\Delta KE + \Delta PE + \Delta U + W$
View AnswerAnswer: d
Explanation: $Q=\Delta E + W$ and $E=KE + PE + U$.
9. The surface of the control volume is known as the control surface.
a) true
b) false
View AnswerAnswer: a
Explanation: This is same as the system boundary of the open system.
10. Steady flow means that the rates of flow of mass and energy across the control surface
a) varies
b) remains constant

c) depends on the control surface
d) none of the mentioned
View AnswerAnswer: b
Explanation: In a steady flow rate of flow remains constant.

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« Prev - Thermodynamics Questions and Answers – Enthalpy» Next - Thermodynamics Questions and Answers – Mass Balance and Energy Balance in a Simple Steady Flow ProcessThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Mass Balance and Energy Balance in a Simple Steady Flow Process”.
1. Equation of continuity comes from
a) conservation of energy
b) conservation of mass
c) conservation of work
d) conservation of heat
View AnswerAnswer: b
Explanation: w1=w2 i.e., we get (AV/v)1=(AV/v)2 and this is called equation of continuity(where w1 & w2 are mass flow rates).

2. In a flow process, the work transfer may of which type?
a) external work
b) flow work
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Flow work is the displacement work and external work mostly comprises of shaft work.
3. The total rate of flow of all energy streams entering the control volume must equal to that of leaving the control volume.
a) true
b) false
View AnswerAnswer: a
Explanation: Given statement is true by the conservation of energy.
4. Which of the following represents the steady flow energy equation?
a) Q+Wx=(h2-h1)-(V2-V1)(V2+V1)/2+g(Z2-Z1)
b) Q+Wx=(h2-h1)+(V2-V1)(V2+V1)/2+g(Z2-Z1)

c) Q-Wx=(h2-h1)-(V2-V1)(V2+V1)/2+g(Z2-Z1)
d) Q-Wx=(h2-h1)+(V2-V1)(V2+V1)/2+g(Z2-Z1)
View AnswerAnswer: d
Explanation: This equation is the general form of SFEE and it involves conservation of mass and energy.

5. When more than one fluid stream is in a control volume, which of the following is more convenient?
a) energy flow per unit time
b) energy flow per unit mass
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: a
Explanation: It makes calculations less difficult.
6. In the differential form, the SFEE comes
a) dQ+dW=dh+VdV+gdZ
b) dQ-dW=dh+VdV+gdZ
c) dQ+dW=dh-VdV-gdZ
d) dQ-dW=dh-VdV+gdZ
View AnswerAnswer: b
Explanation: This equation is the differential form of SFEE.
7. The steady flow energy equation is applied to which of the following processes?
a) pipe line flows
b) heat transfer processes
c) combustion processes
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the applications of SFEE.

8. When more than one fluid stream enters or leaves the control volume, which type of balance is taken?
a) mass balance
b) energy balance
c) mass balance and energy balance
d) none of the mentioned
View AnswerAnswer: c
Explanation: Both energy and mass balance are considered here.
9. What are the different kinds of external work?
a) shear work
b) electrical work

c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Given two kinds of external work are important.
10. The flow work is the displacement work done by the fluid and is given by
a) -pvdm
b) pvdm
c) pvdm or -pvdm depending on whether it is inlet or exit
d) none of the mentioned
View AnswerAnswer: c
Explanation: At inlet, flow work=-pvdm and at exit, flow work=pvdm.

« Prev - Thermodynamics Questions and Answers – Specific Heat at Constant Volume and Pressure and Control Volume» Next - Thermodynamics Questions and Answers – Examples of Steady Flow ProcessesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Examples of Steady Flow Processes”.
1. What does a nozzle do?
a) decreases the velocity of a fluid at the cost of its pressure gain
b) increases the velocity of a fluid at the cost of its pressure drop
c) increases the velocity of a fluid and also its pressure
d) none of the mentioned.
View AnswerAnswer: b
Explanation: A nozzle increases KE of fluid and reduces its pressure.

2. What does a diffuser do?
a) increases the pressure of the fluid at the expense of its KE
b) decreases the pressure of the fluid and also increases its KE
c) increases the pressure of the fluid and also its KE
d) decreases the pressure of the fluid and also its KE
View AnswerAnswer: a
Explanation: A diffuser increases the pressure at the expense of its KE.
3. For an insulated nozzle, SFEE of the control surface gives (considering change in PE is zero and inlet velocity is small compared to exit velocity)
a) V2=sqrt(4*Δh)
b) V2=sqrt(Δh)
c) V2=sqrt(Δh/2)
d) V2=sqrt(2*Δh)

View AnswerAnswer: d
Explanation: $dQ/dm=0$, $dW/dm=0$, $\Delta h=h1-h2$.
4. Fluid flow through which of the following throttles the flow?
a) partially opened valve
b) orifice
c) porous plug
d) all of the mentioned
View AnswerAnswer: d
Explanation: In all of the given cases, there is an appreciable drop in pressure and hence the flow is throttled.
5. In a throttling device, what do we get as SFEE when changes in PE and KE are taken zero?
a) $dQ/dm\neq 0$
b) $dW/dm\neq 0$
c) $h1=h2$
d) none of the mentioned
View AnswerAnswer: c
Explanation: Enthalpy of the fluid fore throttling is equal to the enthalpy of the fluid after throttling.

6. Turbines and engines ____ positive power output, and compressors and pumps ____ power input.
a) require, give
b) give, require
c) give, give
d) require, require
View AnswerAnswer: b
Explanation: This is the basic information about turbines, engines, compressors and pumps.
7. For a turbine, it is seen that work is done by the fluid at the expense of its enthalpy.
a) true
b) false
View AnswerAnswer: a
Explanation: For a turbine, $W/m=h1-h2$.
8. For an adiabatic compressor or pump,
a) the enthalpy of fluid remains constant with the amount of work input
b) the enthalpy of fluid decreases by the amount of work input
c) the enthalpy of fluid increases by the amount of work input
d) none of the mentioned
View AnswerAnswer: c
Explanation: For an adiabatic pump or compressor, $W/m=h2-h1$.
9. A heat exchanger is a device in which heat is transferred from one fluid to another.
a) true
b) false

View AnswerAnswer: a
Explanation: Basic fact about heat exchanger.

10. For an inviscid frictionless fluid flowing through a pipe, Euler equation is given by
a) Vdp+VdV+gdZ=0
b) Vdp-VdV+gdZ=0
c) Vdp-VdV-gdZ=0
d) none of the mentioned
View AnswerAnswer: a
Explanation: Euler equation is derived from steady flow energy equation.
11. The rnoulli equation is restricted to _____ fluids but the SFEE is valid for _____ fluids as well.
a) viscous compressible, frictionless incompressible
b) frictionless incompressible, viscous compressible
c) viscous incompressible, frictionless compressible
d) none of the mentioned
View AnswerAnswer: b
Explanation: This statement tells us that the rnoulli equation is a limiting case of SFEE.

« Prev - Thermodynamics Questions and Answers – Mass Balance and Energy Balance in a Simple Steady Flow Process» Next - Thermodynamics Questions and Answers – Variable Flow ProcessesThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Variable Flow Processes”.
1. Variable flow processes include
a) filling up a gas cylinder
b) evacuating a gas cylinder
c) all of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These are variable flow processes which can analysed by the control volume technique.

2. The rate at which the mass of fluid within the control volume is accumulated is equal to the net rate of mass flow across the control surface.
a) true

b) false
View AnswerAnswer: a
Explanation: (dm/dt)=w1-w2, where m is the mass of fluid within the control volume at any instant.
3. Rate of energy increase within the control volume is given by
a) rate of energy inflow + rate of energy outflow
b) rate of energy inflow – rate of energy outflow
c) rate of energy inflow = rate of energy outflow
d) none of the mentioned
View AnswerAnswer: b
Explanation: The rate of accumulation of energy within the control volume is equal to the net energy flow across the control surface.
4. Which of the following is true for steady flow?
a)(dE/dt)=0
b)(dE/dt)>0
c)(dE/dt)<0
d) none of the mentioned
View AnswerAnswer: a
Explanation: Rate of change of energy of fluid with respect to time within the control volume is constant.
5. Variable flow processes can analysed by
a) system technique
b) constant volume technique
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two are the main techniques used for analysing variable flow process.

6. Using system technique, energy balance for the process comes out to
a) m2u2+m1u1+(m2-m1)(((V^2)/2)+(h/2))
b) m2u2-m1u1+(m2-m1)(((V^2)/2)+(h/2))
c) m2u2+m1u1-(m2-m1)(((V^2)/2)+(h/2))
d) m2u2-m1u1-(m2-m1)(((V^2)/2)+(h/2))
View AnswerAnswer: d
Explanation: This comes from the first law by neglecting PE, KE and E is the energy of the gas.
7. Both the techniques for analysing variable flow processes gives same result.
a) true
b) false
View AnswerAnswer: a
Explanation: This is cause these techniques have same initial assumptions and hence give same result.
8. In ____ filling a bottle with air at 300K, the gas temperature rises to 420K due to flow work ing converted to ____ increase.
a) adiabatically, heat

b) adiabatically, internal energy
c) constant pressure, heat
d) none of the mentioned
View AnswerAnswer: b
Explanation: In the energy equation, m1=0, Q=0, h>>(V^2)/2, we will get we will get that flow work is converted to increase in molecular internal energy.
9. Which of the following is true for a discharging tank?
a) the process is adiabatic
b) the process is quasi-static
c) dQ=0
d) all of the mentioned
View AnswerAnswer: d
Explanation: Applying first law to the control volume and dW=0, dm=0 and KE and PE of the fluid are assumed to small.

10. For charging a tank,
a) enthalpy is converted to work done
b) work done is converted to enthalpy
c) enthalpy is converted to internal energy
d) internal energy is converted to work done
View AnswerAnswer: c
Explanation: Tank is initially taken to empty and ΔU=(m2u2-m1u1)=(mh) at constant state of the fluid in the pipeline.
11. For a variable flow process
a) P.E. terms are neglected
b) K.E. of the fluid is assumed to small
c) the process is not steady
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some of the basic assumptions for a variable flow process.

« Prev - Thermodynamics Questions and Answers – Examples of Steady Flow Processes» Next - Thermodynamics Questions and Answers – Polytropic Process-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Polytropic Process-1".
1. A polytropic process(n = – 1) starts with P = 0, V = 0 and ends with P= 600 kPa, V = 0.01 m3. Find the boundary work done.
a) 1 kJ
b) 2 kJ
c) 3 kJ
d) 4 kJ
View AnswerAnswer: c
Explanation: W = ⌠ PdV

$= (1/2)(P1 + P2)(V2 - V1)$
$= (1/2)(P2 + 0)(V2 - 0)$
$= (1/2)(600*0.1)$
$= 3$ kJ.

2. The piston/cylinder contains carbon dioxide at 300 kPa, with volume of 0.2 m3 and at 100°C. Mass is added at such that the gas compresses with PV^(1.2) = constant to a final temperature of 200°C. Determine the work done during the process.
a) -80.4 kJ
b) -40.4 kJ
c) -60.4 kJ
d) -50.4 kJ
View AnswerAnswer: a
Explanation: Work done = (P2V2 – P1V1)/(1-n) and mR = (P1V1)/T1 = 0.1608 kJ/K
Work done = 0.1608(473.2 – 373.2)/(1 – 1.2) = -80.4 kJ.
3. Neon at 400 kPa, 20°C is brought to 100°C in a polytropic process with n = 1.4. Find the work done.
a) -52.39 kJ/kg
b) -62.39 kJ/kg
c) -72.39 kJ/kg
d) -82.39 kJ/kg
View AnswerAnswer: d
Explanation: For Neon, k = γ = 1.667 so n < k, Cv = 0.618, R = 0.412
1w2 = [R/(1-n)](T2 – T1) = -82.39 kJ/kg.
4. A mass of 1kg of air contained in a cylinder at 1000 K, 1.5 MPa, expands in a reversible adiabatic process to 100 kPa. Calculate the work done during the process using Constant specific heat.
a) 286.5 kJ
b) 386.5 kJ
c) 486.5 kJ
d) 586.5 kJ
View AnswerAnswer: b
Explanation: Process: 1Q2 = 0, 1S2 gen = 0 => s2 = s1
T2 = T1(P2/P1)^[(k-1)/k] = 1000(0.1/1.5)0.286 = 460.9 K
1W2 = -(U2 – U1) = mCv(T1 – T2)
= 1 × 0.717(1000 – 460.9) = 386.5 kJ.
5. A cylinder/piston contains 1kg methane gas at 100 kPa, 20°C. The gas is compressed reversibly to a pressure of 800 kPa. Calculate the work required if the process is isothermal.
a) -216.0 kJ
b) -316.0 kJ
c) -416.0 kJ
d) -516.0 kJ

View AnswerAnswer: b

Explanation: Process: T = constant. For ideal gas then $u_2 = u_1$ $_1W_2 = {}_1Q_2$ and $\int dQ/T = {}_1Q_2/T$

$$_1W_2 = {}_1Q_2 = mT(s_2 - s_1) = -mRT \ln(P_2/P_1)$$
$$= -0.51835\times 293.2 \ln(800/100) = -316.0 \text{ kJ}.$$

6. A cylinder/piston contains 1kg methane gas at 100 kPa, 20°C. The gas is compressed reversibly to a pressure of 800 kPa. Calculate the work required if the process is polytropic, with exponent n = 1.15.

a) -314.5 kJ
b) -414.5 kJ
c) -514.5 kJ
d) -614.5 kJ

View AnswerAnswer: a

Explanation: Process: Pv^{n} = constant with n = 1.15 ;

$$T_2 = T_1(P_2/P_1)^{[(n-1)/n]} = 293.2(800/100)^{0.130} = 384.2 \text{ K}$$
$$_1W_2 = \int mP\, dv = m(P_2v_2 - P_1v_1)/(1 - n) = mR\,(T_2 - T_1)/(1 - n)$$
$$= 1*0.51835(384.2 - 293.2)/(1 - 1.15) = -314.5 \text{ kJ}.$$

7. Helium in a piston/cylinder at 20°C, 100 kPa is brought to 400 K in a reversible polytropic process with exponent n = 1.25. Helium can assumed to an ideal gas with constant specific heat. Find the specific work.

a) -587.7 kJ/kg
b) -687.7 kJ/kg
c) -787.7 kJ/kg
d) -887.7 kJ/kg

View AnswerAnswer: d

Explanation: Process: $Pv^{n} = C$ & $Pv = RT \Rightarrow Tv^{(n-1)} = C$

$$C_v = 3.116 \text{ kJ/kg K},\ R = 2.0771 \text{ kJ/kg K}$$
$$v_2 / v_1 = (T_1 / T_2)^{[1/(n-1)]} = 0.2885$$
$$P_2 / P_1 = (v_1 / v_2)^{n} = 4.73 \Rightarrow P_2 = 473 \text{ kPa}$$
$$W = (P_2 v_2 - P_1 v_1)/(1-n) = R(T_2-T_1)/(1-n) = -887.7 \text{ kJ/kg}.$$

8. Consider air in a cylinder volume of 0.2 L at 7 MPa, 1800K. It now expands in a reversible polytropic process with exponent, n = 1.5, through a volume ratio of 8:1. Calculate the work for the process.

a) 1.61 kJ
b) 1.71 kJ
c) 1.81 kJ
d) 1.91 kJ

View AnswerAnswer: c

Explanation: Process: $PV^{1.50}$ = constant, $V_2/V_1 = 8$

State 1: $P_1 = 7$ MPa, $T_1 = 1800$ K, $V_1 = 0.2$ L, $m_1 = P_1V_1/RT_1 = 2.71\times10^{-3}$ kg

State 2: $T_2 = T_1 (V_1/V_2)^{(n-1)} = 1800(1/8)^{(0.5)} = 636.4$ K

$$_1W_2 = \int PdV = mR(T_2 - T_1)/(1 - n)$$

$= 2.71\times10^{-3} \times 0.287(636.4 - 1800)/(1-1.5) = 1.81$ kJ.

9. A cylinder/piston contains carbon dioxide at 300°C, 1 MPa with a volume of 200L. The total external force acting on the piston is proportional to V3. This system is allowed to cool to room temperature, 20°C. Find the work.
a) -24.4 kJ
b) -34.4 kJ
c) -44.4 kJ
d) -54.4 kJ
View AnswerAnswer: a
Explanation: PV^{-3} = constant

State 1: $m = P_1V_1/RT_1 = (1000 \times 0.2)/(0.18892 \times 573.2) = 1.847$ kg

$P_2 = P_1(T_2/T_1)^{[n/(n-1)]} = 1000(293.2/573.2)^{(3/4)} = 604.8$ kPa

$V_2 = V_1(T_1/T_2)^{[1/(n-1)]} = 0.16914$ m^3

Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = [604.8 \times 0.16914 - 1000 \times 0.2] / [1-(-3)]$
$= -24.4$ kJ.

10. A cylinder/piston contains 100L of air at 25°C, 110 kPa. The air is compressed in a reversible polytropic process to a final state of 200°C, 800 kPa. Assume the heat transfer is with the ambient at 25°C. Find the work done by the air.
a) -11.28 kJ
b) -21.28 kJ
c) -31.28 kJ
d) -41.28 kJ
View AnswerAnswer: b
Explanation: $m = P_1V_1 /(RT_1) = 110 \times 0.1/(0.287 \times 298.15) = 0.1286$ kg

$T_2/T_1 = (P_2/P_1)^{[(n-1)/n]} \Rightarrow 473.15/298.15 = (800/110)^{[(n-1)/n]}$
$\Rightarrow (n-1)/n = 0.2328$ hence $n = 1.3034$

$V_2 = V_1(P_1/P_2)^{(1/n)} = 0.1(110/800)^{(0.7672)} = 0.02182$ m^3

Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = (800 \times 0.02182 - 110 \times 0.1)/(1 - 1.3034)$
$= -21.28$ kJ.

11. A mass of 2 kg ethane gas at 100°C, 500 kPa, undergoes a reversible polytropic expansion with n = 1.3, to a final temperature of 20°C. Find the work done.
a) 43.7 kJ/kg
b) 53.7 kJ/kg
c) 63.7 kJ/kg
d) 73.7 kJ/kg
View AnswerAnswer: d
Explanation: $P_2 = P_1(T_2/T_1)^{[n/(n-1)]} = 500(293.2/373.2)^{(4.333)} = 175.8$ kPa

Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = R(T_2-T_1)/(1-n)$

$= 0.2765(293.2-373.2)/(1-1.30) = 73.7$ kJ/kg.

12. A piston/cylinder contains air at 100 kPa, 300 K. A reversible polytropic process with n = 1.3 brings the air to 500 K. Any heat transfer if it comes in is from a 325°C reservoir and if it goes out it is to the ambient at 300 K. Find the specific work.

a) -171.3 kJ/kg
b) -181.3 kJ/kg
c) -191.3 kJ/kg
d) -201.3 kJ/kg

View AnswerAnswer: c

Explanation: Process : $Pv^{n} = C$

Work $= \int PdV = (P_2V_2 - P_1V_1)/(1-n) = R(T_2-T_1)/(1-n)$

$= 0.287\ (500 - 300)/(1 - 1.3) = -191.3$ kJ/kg.

13. A cylinder/piston contains saturated vapour R-22 at 10°C; the volume is 10 L. The R-22 is compressed to 60°C, 2 MPa in a reversible polytropic process. If all the heat transfer during the process is with the ambient at 10°C, calculate the work done.

a) –6.26 kJ
b) –7.26 kJ
c) –8.26 kJ
d) –9.26 kJ

View AnswerAnswer: b

Explanation: State 1: $P_1 = 0.681$ MPa, $v_1 = 0.03471$; $m = V_1/v_1 = 0.01/0.03471 = 0.288$ kg

State 2: $v_2 = 0.01214\ m^3/kg$; $P_2/P_1 = 2.0/0.681 = (0.03471/0.01214)^{n}$

$\Rightarrow n = 1.0255$

Work $= \int PdV = m(P_2v_2 - P_1v_1)/(1-n)$

$= 0.288(2000 \times 0.01214 - 681 \times 0.03471)/(1 - 1.0255) = -7.26$ kJ.

« Prev - Thermodynamics Questions and Answers – Variable Flow Processes» Next - Thermodynamics Questions and Answers – Polytropic Process-2This set of Thermodynamics Inteview Questions and Answers for freshers focuses on “Polytropic Process-2”.

1. A cylinder/piston contains air at 100 kPa and 20°C with a $V=0.3\ m^3$. The air is compressed to 800 kPa in a reversible polytropic process with n = 1.2, after which it is expanded back to 100 kPa in a reversible adiabatic process. Find the net work.

a) -174.6 kJ/kg
b) -154.6 kJ/kg
c) -124.6 kJ/kg
d) -194.6 kJ/kg

View AnswerAnswer: a

Explanation: $m = P_1V_1/RT_1 = (100 \times 0.3)/(0.287 \times 293.2) = 0.3565$ kg

$T_2/T_1 = (P_2/P_1)^{[(n-1)/n]} = 293.2(800/100)^{(0.167)} = 414.9$ K

$W = (P_2 v_2 - P_1 v_1)/(1-n) = R(T_2-T_1)/(1-n) = 0.287(414.9-293.2)/(1-1.20) = -174.6$ kJ/kg.

2. A piston-cylinder contains carbon dioxide at 2MPa with V=50 L. The device has a mass of 4 kg. Everything is initially at 200°C. By heat transfer the whole system cools to 25°C, at which point the gas pressure is 1.5 MPa. Find the work done.

a) -10.0 kJ
b) -12.0 kJ
c) -14.0 kJ
d) -16.0 kJ

View AnswerAnswer: c

Explanation: CO_2: $m = P_1V_1/RT_1 = 2000 \times 0.05/(0.18892 \times 473.2) = 1.1186$ kg

$V_2 = V_1(P_1/P_2)(T_2/T_1) = 0.05(2/1.5)(298.2/473.2) = 0.042$ m^3

Work $= \int PdV = (P_1 + P_2)(V_2 - V_1)/2 = (2000 + 1500)(0.042 - 0.050)/2 = -14.0$ kJ.

3. A gas initially at 500°C, 1 MPa is contained in a piston-cylinder arrangement with an initial volume of 0.1 m^3. It is then slowly expanded according to the relation PV = constant until a final pressure of 100 kPa is attained. Determine the work for this process.

a) 200.3 kJ
b) 210.3 kJ
c) 220.3 kJ
d) 230.3 kJ

View AnswerAnswer: d

Explanation: Process: $PV = C \Rightarrow V_2 = P_1V_1/P_2 = 1000 \times 0.1/100 = 1$ m^3

$_1W_2 = \int P\, dV = \int CV^{(-1)}dV = C \ln(V_2/V_1)$

$_1W_2 = P_1V_1 \ln(V_2/V_1) = 1000 \times 0.1 \ln(1/0.1) = 230.3$ kJ.

4. Helium gas expands from 350 K, 125 kPa and 0.25 m^3 to 100 kPa in a polytropic process with n = 1.667. How much work does it give out?

a) 3.09 kJ
b) 4.09 kJ
c) 5.09 kJ
d) 6.09 kJ

View AnswerAnswer: b

Explanation: Process: $PV^n = \text{constant} = P_1(V_1)^n = P_2(V_2)^n$

$V_2 = V_1 (P_1/P_2)^{(1/n)} = 0.25 \times (125/100)^{(0.6)} = 0.2852$ m^3

Work $= (P_2V_2 - P_1V_1)/(1-n) = (100\times 0.2852 - 125\times 0.25)/(1 - 1.667) = 4.09$ kJ.

5. Air goes through a polytropic process from 325 K, 125 kPa to 500 K, 300 kPa. Find the specific work in the process.
a) -51.8 kJ/kg
b) -61.8 kJ/kg
c) -71.8 kJ/kg
d) -81.8 kJ/kg
View AnswerAnswer: a
Explanation: Process: $Pv^{(n)} = Const = P1(v1)^n = P2(v2)^n$
Ideal gas $Pv = RT$ hence $v1 = RT/P = 0.287 \times 325/125 = 0.7462\ m^3/kg$
$v1 = RT/P = 0.287 \times 500/300 = 0.47833\ m^3/kg$
$n = \ln(P2/P1) / \ln(v1/v2) = \ln 2.4 / \ln 1.56 = 1.969$
$Work = (P2v2 - P1v1)/(1-n) = R(T2-T1)/(1-n) = 0.287(500 - 325)/(1-1.969)$
$= -51.8$ kJ/kg.

6. A piston-cylinder contains 0.1 kg air at 400 K, 100 kPa which goes through a polytropic compression process (n = 1.3) to a pressure of 300 kPa. How much work has en done by air in the process?
a) -277 kJ
b) -377 kJ
c) -477 kJ
d) -577 kJ
View AnswerAnswer: c
Explanation: Process: $Pv^{(n)} = Const$;
$T2 = T1 (P2 V2 / P1V1) = T1 (P2 / P1)(P1 / P2)^{(1/n)}$
$= 400 \times (300/100)^{(1 - 1/1.3)} = 515.4$ K
$Work = (P2V2 - P1V1)/(1-n) = mR(T2-T1)/(1-n)$
$= (0.2 \times 0.287)(515.4-400)/(1 - 1.3) = -477$ kJ.
7. A balloon haves according to the equation $P = (C2)V^{(1/3)}$, C2 = 100 kPa/m. The balloon is blown up with air from a volume of 1 m^3 to a volume of 3 m^3. Find the work done by the air assuming it is at 25°C.
a) 219.5 kJ
b) 229.5 kJ
c) 239.5 kJ
d) 249.5 kJ
View AnswerAnswer: d
Explanation: The process is polytropic with exponent n = -1/3.
$P1 = (C2)V^{(1/3)} = 100 \times 1^{(1/3)} = 100$ kPa
$P1 = (C2)V^{(1/3)} = 100 \times 3^{(1/3)} = 144.22$ kPa
$Work = \int PdV = (P2V2 - P1V1)/(1-n) = (144.22 \times 3 - 100 \times 1)/(1 - (-1/3))$
$= 249.5$ kJ.
8. A balloon haves such that pressure inside it is proportional to the diameter squared. It contains 2kg of ammonia at 0°C, 60% quality. They are now heated so that the final pressure is 600 kPa. Find the work done in the process.

a) 117.5 kJ
b) 127.5 kJ
c) 137.5 kJ
d) 147.5 kJ
View AnswerAnswer: a
Explanation: Process : $P \propto D^2$, with $V \propto D^3$ this implies $P \propto D^2 \propto V^{(2/3)}$
so $PV^{(-2/3)}$ = constant, hence $n = -2/3$

$V1 = mv1 = 2(0.001566 + 0.6 \times 0.28783) = 0.3485\ m^3$

$V2 = V1*(P2/P1)^{(3/2)} = 0.3485(600/429.3)^{(3/2)} = 0.5758\ m^3$

Work = $\int PdV = (P2V2 - P1V1)/(1-n) = (600 \times 0.5758 - 429.3 \times 0.3485)/[1 - (-2/3)]$
$= 117.5$ kJ.

9. Consider a piston-cylinder with 0.5 kg of R-134a as saturated vapour at -10°C. It is compressed to a pressure of 500 kPa in a polytropic process with n = 1.5. Determine the work done during the process.
a) -6.07 kJ
b) -7.07 kJ
c) -8.07 kJ
d) -9.07 kJ
View AnswerAnswer: b
Explanation: $Pv^{(1.5)}$ = constant until P = 500 kPa

1: $v1 = 0.09921\ m3/kg$, $P = Psat = 201.7$ kPa

2: $v2 = v1(P1/P2)^{(1/1.5)} = 0.09921 \times (201.7/500)^{(2/3)} = 0.05416$
hence it is superheated vapour at T2 = 79°C

Work = $\int PdV = m(P2\ v2 - P1\ v1)/(1-1.5) = 2*(500 \times 0.05416 - 201.7 \times 0.09921)/(-0.5)$
$= -7.07$ kJ.

10. R-12 in a piston-cylinder arrangement is initially at 50°C, x = 1. It is then expanded in a process so that $P = Cv^{(-1)}$ to a pressure of 100 kPa. Find the work.
a) 23.2 kJ/kg
b) 33.2 kJ/kg
c) 43.2 kJ/kg
d) 53.2 kJ/kg
View AnswerAnswer: c
Explanation: State 1: 50°C, x=1, P1 = 1219.3 kPa, v1 = 0.01417 m^3/kg

Process: $P = Cv^{(-1)} \Rightarrow$ Work = $\int P\ dv = C \ln(v2/v1)$

State 2: 100 kPa thus $v2 = (v1)(P1)/P2 = 0.1728\ m^3/kg$
hence T = – 13.2°C

Work = $P1v1[\ln(v2/v1)] = 1219.3 \times 0.01417 \times \ln(0.1728/0.01417)$

= 43.2 kJ/kg.

11. A piston-cylinder contains water at 3 MPa, 500°C. It is cooled in a polytropic process to 1 MPa, 200°C. Find the specific work in the process.
a) 155.2 kJ
b) 165.2 kJ
c) 175.2 kJ
d) 185.2 kJ
View AnswerAnswer: a
Explanation: Pv^(n) = C thus (P1/P2) = (v2/v1)^n
n= ln(P1/P2) / ln(v2/v1) = 1.0986/0.57246 = 1.919
Work = ⌠PdV = (P2 v2 – P1 v1)/(1-n) = (1000 × 0.20596 – 3000 × 0.11619)/(1 – 1.919)
= 155.2 kJ.

12. A piston/cylinder contains carbon dioxide at 300 kPa, 100°C with a volume of 0.2 m^3. Weights are added at such a rate that the gas compresses according to the relation PV^1.2 = constant to a final temperature of 200°C. Determine the work done during the process.
a) 70.4 kJ
b) -70.4 kJ
c) 80.4 kJ
d) -80.4 kJ
View AnswerAnswer: d
Explanation: For the Polytropic process PV^n = constant
1W2 = ∫PdV = (P2V2 – P1V1)/(1 – n)
Assuming ideal gas, PV = mRT
But mR = P1V1/T1 = 300 × 0.2/373.15 = 0.1608 kJ/K
1W2 = 0.1608(473.15 – 373.15)/(1 – 1.2) = -80.4 kJ.

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« Prev - Thermodynamics Questions and Answers – Polytropic Process-1» Next - Thermodynamics Questions and Answers – Second Law of ThermodynamicsThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Second Law of Thermodynamics”.

1. Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the net power output for this heat engine.

a) 30 MW
b) 40 MW
c) 50 MW
d) 60 MW
View AnswerAnswer: a
Explanation: Net power output = 80 – 50 MW = 30 MW.

2. Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the thermal efficiency for this heat engine.
a) 47.5 %
b) 27.5 %
c) 37.5 %
d) none of the mentioned
View AnswerAnswer: c
Explanation: The thermal efficiency of heat engine = net work output / heat input
= 30/80 = 0.375 = 37.5 %.
3. A car engine with a power output of 50 kW has a thermal efficiency of 24 percent. Determine the fuel consumption rate of this car if the fuel has a heating value of 44,000 kJ/kg .
a) 0.00273 kg/s
b) 0.00373 kg/s
c) 0.00473 kg/s
d) 0.00573 kg/s
View AnswerAnswer: c
Explanation: Q = 50/0.24 = 208.3 kW,
hence fuel consumption rate = 208.3 kW / 44000 kJ/kg = 0.00473 kg/s.
4. The food compartment of a refrigerator is maintained at 4°C by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2kW, determine the coefficient of performance of the refrigerator.

a) 4
b) 3
c) 2
d) 1
View AnswerAnswer: b
Explanation: COP = (360/2)(1/60) = 3.
5. The food compartment of a refrigerator is maintained at 4°C by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2kW, determine the rate of heat rejection to the room that houses the refrigerator.
a) 450 kJ/min
b) 460 kJ/min
c) 470 kJ/min
d) 480 kJ/min

View AnswerAnswer: d
Explanation: Q = 360 + (2)(60/1) = 480 kJ/min.

6. A heat pump is used to meet the heating requirements of a house and maintain it at 20°C. On a day when the outdoor air temperature drops to 2°C, the house is estimated to lose heat at a rate of 80,000 kJ/h. If the heat pump under these conditions has a COP of 2.5, determine the power consumed by the heat pump.
a) 32000 kJ/h
b) 33000 kJ/h
c) 34000 kJ/h
d) 35000 kJ/h
View AnswerAnswer: a
Explanation: W = Q/COP = 80000 kJ/h / 2.5 = 32000 kJ/h.
7. A heat pump is used to meet the heating requirements of a house and maintain it at 20°C. On a day when the outdoor air temperature drops to 2°C, the house is estimated to lose heat at a rate of 80,000 kJ/h. If the heat pump under these conditions has a COP of 2.5, determine the rate at which heat is absord from the cold outdoor air.
a) 32000 kJ/h
b) 48000 kJ/h
c) 54000 kJ/h
d) 72000 kJ/h
View AnswerAnswer: b
Explanation: The rate at which heat is absord = 80000 – 32000 = 48000 kJ/h.
8. An air-conditioner provides 1 kg/s of air at 15°C cooled from outside atmospheric air at 35°C. Estimate the amount of power needed to operate the air-conditioner.
a) 1.09 kW
b) 1.19 kW
c) 1.29 kW
d) 1.39 kW
View AnswerAnswer: d
Explanation: Q = m*cp*(temperature change) = 20.08 kW
COP = (15+273)/(35-15) = 14.4
hence power needed = 20/14.4 = 1.39 kW.
9. A cyclic machine, as shown low, receives 325 kJ from a 1000 K energy reservoir. It rejects 125 kJ to a 400 K energy reservoir and the cycle produces 200kJ of work as output. Is this cycle reversible, irreversible, or impossible?
a) reversible
b) irreversible
c) impossible
d) none of the mentioned
View AnswerAnswer: c
Explanation: The Carnot efficiency = 1 – (400/1000) = 0.6 and real efficiency = (300/325) = 0.615 which is greater than the Carnot efficiency hence cycle is impossible.

10. In a cryogenic experiment you need to keep a container at -125°C although it gains 100 W due to heat transfer. What is the smallest motor you would need for a heat pump absorbing heat from the container and rejecting heat to the room at 20°C?
a) 97.84 kW
b) 98.84 kW
c) 99.84 kW
d) 95.84 kW
View AnswerAnswer: a
Explanation: COP = 1.022 and thus power required = 100/1.022 = 97.84 kW.
11. A car engine operates with a thermal efficiency of 35%. Assume the air-conditioner has a coefficient of performance of 3 working as a refrigerator cooling the inside using engine shaft work to drive it. How much fuel energy should spend extra to remove 1 kJ from the inside?
a) 0.752 kJ
b) 0.952 kJ
c) 0.852 kJ
d) none of the mentioned
View AnswerAnswer: b
Explanation: W = thermal efficiency * Q(fuel) thus Q(fuel) = 1/(0.35*3) = 0.952 kJ.

« Prev - Thermodynamics Questions and Answers – Polytropic Process-2» Next - Thermodynamics Questions and Answers – Cyclic Heat EngineThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Cyclic Heat Engine”.
1. The first law of thermodynamics doesn’t tell us whether a thermodynamic process is feasible or not.
a) true
b) false
View AnswerAnswer: a
Explanation: The second law of thermodynamics provides criterion as to the probability of a process.

2. According to Joule’s experiments,
a) heat can completely converted into work
b) work can completely converted into heat
c) both heat and work are completely interchangeable
d) all of the mentioned

View AnswerAnswer: b
Explanation: Work transfer -> internal energy increase -> heat transfer.
3. Which of the following is true?
a) work is a high grade energy
b) heat is a low grade energy
c) complete conversion of low grade energy into high grade energy in a cycle is impossible
d) all of the mentioned
View AnswerAnswer: d
Explanation: These facts are in accordance with Joule’s work and underlies the work of Carnot.
4. In a cyclic heat engine there is
a) net heat transfer to the system and net work transfer from the system
b) net heat transfer from the system and net work transfer to the system
c) depends on the conditions of cycle
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the basic concept of cycle heat engine.
5. Boiler, turbine, condenser and pump together constitute a heat engine.
a) true
b) false
View AnswerAnswer: a
Explanation: It is an example for a cyclic heat engine.

6. In a heat engine cycle, which of the following process occurs?
a) heat is transferred from furnace to boiler
b) work is produced in turbine rotor
c) steam is condensed in condenser
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are the basic processes occurring in a heat engine cycle comprising of furnace, boiler condenser and a turbine.
7. The function of a heat engine cycle is to _____ continuously at the expense of _____ to the system.
a) heat input, produce work
b) produce work, heat input
c) can both of the mentioned
d) none of the mentioned
View AnswerAnswer: b
Explanation: Net work and heat input are of primary interest in a cycle.
8. Efficiency of a heat engine is defined as
a) total heat output / net work input
b) total heat input / net work output
c) net work output / total heat input
d) net work input / total heat output
View AnswerAnswer: c

Explanation: Basic definition of efficiency.
9. A thermal energy reservoir is a large body of
a) small heat capacity
b) large heat capacity
c) infinite heat capacity
d) none of the mentioned
View AnswerAnswer: c
Explanation: Basic fact about TER.

10. Processes inside a thermal energy reservoir are quasi-static.
a) true
b) false
View AnswerAnswer: a
Explanation: The changes taking place in TER are very slow and minute.
11. A TER which transfers heat to system is called ____ and one which receives heat is called ____
a) source, sink
b) sink, source
c) sink, sink
d) source, source
View AnswerAnswer: a
Explanation: A source transfers heat while a sink receives heat.
12. Which if the following statements are true for a mechanical energy reservoir(MER)?
a) it is a large body enclosed by an adiabatic impermeable wall
b) stores work as KE or PE
c) all processes within an MER are quasi-static
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some important features of an MER.

« Prev - Thermodynamics Questions and Answers – Second Law of Thermodynamics» Next - Thermodynamics Questions and Answers – Kelvin-Planck Statement and Clausius' Statement of Second LawThis set of Thermodynamics Questions and Answers for experienced focuses on "Kelvin-Planck Statement and Clausius' Statement of Second Law".

1. According to Kelvin-Planck statement, it is ____ for a heat engine to produce net work in a complete cycle if it exchanges heat only with bodies at ____
a) impossible, single fixed temperature
b) possible, changing temperature
c) impossible, changing temperature
d) possible, single fixed temperature
View AnswerAnswer: a
Explanation: This is the basic definition of Kelvin-Planck statement.

2. If heat rejected from the system Q2 is zero, then
a) net work=Q1 and efficiency=1.00
b) heat is exchanged only with one reservoir
c) it violates the Kelvin-Planck statement
d) all of the mentioned
View AnswerAnswer: d
Explanation: Such a heat engine is called a perpetual motion machine of the second kind(PMM2).

3. A PMM2 is possible.
a) true
b) false
View AnswerAnswer: b
Explanation: A PMM2 is impossible cause it violates the Kelvin-Planck statement.

4. A heat engine has to exchange heat with ___ energy reservoir at ___ different temperatures to produce net work in a complete cycle.
a) one, one
b) one, two
c) two, two
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is required to produce power.

5. The second law is not a deduction of the first law.
a) true
b) false
View AnswerAnswer: a

Explanation: The first law is a separate law of nature.
6. The continual operation of a machine that creates its own energy and thus violates the first law is called
a) PMM2
b) PMM1
c) PMM0
d) none of the mentioned
View AnswerAnswer: b
Explanation: This is a basic fact about PMM1.
7. Which of the following is true?
a) heat always from a high temperature body to a low temperature body
b) heat always from a low temperature body to a high temperature body
c) heat can flow from both low to high and high to low temperature body
d) none of the mentioned
View AnswerAnswer: a
Explanation: The reverse process never occurs spontaneously.

8. According to Clausius statement
a) it is impossible to construct a device than can transfer heat from a cooler body to a hotter body without any effect
b) it is impossible to construct a device than can transfer heat from a hotter body to a cooler body without any effect
c) it is possible to construct a device than can transfer heat from a cooler body to a hotter body without any effect
d) none of the mentioned
View AnswerAnswer: a
Explanation: To transfer heat from a cooler body to a hotter body, some work must expended.
9. If the second law were not true
a) a ship could driven by extracting heat from the ocean
b) run a power plant by extracting heat from the air
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: Both of the above possibilities do not violate the first law but do violate the second law.
10. The operation of a machine that utilizes the internal energy of only one TER, thus violating second law is called
a) PMM0
b) PMM1
c) PMM2
d) none of the mentioned
View AnswerAnswer: b
Explanation: PMM2 violates the second law.

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« Prev - Thermodynamics Questions and Answers – Cyclic Heat Engine» Next - Thermodynamics Questions and Answers – Refrigerator and Heat PumpThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Refrigerator and Heat Pump”.

1. Which device maintains a body at a temperature lower than the temperature of the surroundings?
a) PMM1
b) PMM2
c) refrigerator
d) heat pump
View AnswerAnswer: c
Explanation: This is the main function of a refrigerator.

2. What does a refrigerant do?
a) absorbs the heat leakage into body from surroundings
b) evaporates in the evaporator
c) absorbs latent heat of vaporization form the body which is cooled
d) all of the mentioned
View AnswerAnswer: d
Explanation: Refrigerant is required for the proper functioning of a refrigerator.

3. Coefficient of performance(COP) is defined as
a) heat leakage/work input
b) work input/heat leakage
c) latent heat of condensation/work input
d) work input/latent heat of condensation
View AnswerAnswer: a
Explanation: Coefficient of performance is the performance parameter used in a refrigerator cycle.

4. Which device maintains a body at a temperature higher than the temperature of the surroundings?
a) PMM1
b) PMM2
c) refrigerator
d) heat pump

View AnswerAnswer: d
Explanation: This is the main function of a heat pump.

5. In a heat pump, there is heat leakage from the body to the surroundings.
a) true
b) false
View AnswerAnswer: a
Explanation: This is just opposite to a refrigerator.
6. What is the relation bebetween COP of heat pump and refrigerator?
a) COP of pump=COP of refrigerator – 1
b) COP of pump=COP of refrigerator + 1
c) COP of pump=COP of refrigerator – 2
d) COP of pump=COP of refrigerator + 2
View AnswerAnswer: b
Explanation: This relation comes from the COP of pump and refrigerator.
7. Heat leakage from a heat pump to surroundings is always greater than work done on pump.
a) true
b) false
View AnswerAnswer: a
Explanation: (Heat leakage from a heat pump to surroundings)=(COP of refrigerator + 1)*(work done on pump).

8. Which of the following statements are true?
a) a heat pump provides a thermodynamic advantage over direct heating
b) COP for both refrigerator and pump cannot infinity
c) work input for both refrigerator and pump is greater than zero
d) all of the mentioned
View AnswerAnswer: d
Explanation: W is the electrical energy used to drive the pump or refrigerator which cannot zero.
9. Kelvin-Planck's and Clausius' statements are
a) not connected to each other
b) virtually two parallel statements of second law
c) violation of one doesn't violate the other
d) none of the mentioned
View AnswerAnswer: b
Explanation: Kelvin-Planck's and Clausius' statements are equivalent in all aspects.
10. If one of the Kelvin-Planck's or Clausius' statement is violated, then other is also violated.

a) true
b) false
View AnswerAnswer: a
Explanation: This shows the equivalence of Kelvin-Planck's and Clausius' statements.

« Prev - Thermodynamics Questions and Answers – Kelvin-Planck Statement and Clausius' Statement of Second Law» Next - Thermodynamics Questions and Answers – Reversibility, Irreversibilty and causes of IrreversibiltyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Reversibility, Irreversibilty and causes of Irreversibilty".

1. A reversible process is performed in such a way that
a) at the conclusion of process, both system and surroundings can restored to their initial states without producing any change
b) it should not leave any trace to show that the process had ever occurred
c) it is carried out infinitely slowly
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some basic concepts of a reversible process.

2. A reversible process coincides with a quasi-static process.
a) true
b) false
View AnswerAnswer: a
Explanation: A reversible process is carried out very slowly and every state it passes through is an equilibrium state.
3. Irreversibility of a process may due to
a) lack of equilibrium during the process
b) involvement of dissipative effects
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two are the major causes of irreversibility.
4. A heat transfer process approaches reversibility as the temperature difference bebetween two bodies approaches
a) infinity
b) zero
c) -1

d) 1
View AnswerAnswer: b
Explanation: For heat transfer to reversible, heat must transferred through an infinitesimal temperature difference.
5. All actual heat transfer processes are
a) irreversible
b) take place through a finite temperature difference
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: An infinitesimal temperature difference is not easy to attain.

6. Free expansion is irreversible.
a) true
b) false
View AnswerAnswer: a
Explanation: It can demonstrated by the second law.
7. Which of the following can a cause of irreversibility?
a) friction, viscosity
b) inelasticity
c) electrical resistance, magnetic hysteresis
d) all of the mentioned
View AnswerAnswer: d
Explanation: These effects are known as dissipative effects.
8. The continual motion of a movable device in the complete absence of friction is known as
a) PMM2
b) PMM3
c) PMM1
d) PMM0
View AnswerAnswer: b
Explanation: This is not possible since lubrication cannot completely eliminated.
9. The friction present in moving devices makes a process reversible.
a) true
b) false
View AnswerAnswer: b
Explanation: Friction lakes the process irreversible.

10. Which of the following is irreversible?
a) stirring work

b) friction work in moving devices
c) current flowing through a wire
d) all of the mentioned
View AnswerAnswer: d
Explanation: All these processes includes a particular cause of irreversibility.
11. A process will reversible if it has
a) no dissipative effects
b) dissipative effects
c) depends on the given conditions
d) none of the mentioned
View AnswerAnswer: a
Explanation: Without any dissipative effects, a process can perform in a reversible manner.
12. Irreversibility can distinguished in how many types?
a) 0
b) 1
c) 2
d) 3
View AnswerAnswer: c
Explanation: Tow types of irreversibility are internal and external irreversibility.
13. Internal irreversibility is caused by
a) internal dissipative effects
b) friction, turbulence
c) electrical resistance, magnetic hysteresis
d) all of the mentioned
View AnswerAnswer: d
Explanation: Internal dissipative effects are the major cause of internal irreversibility.

14. The external irreversibility occurs at the system boundary.
a) true
b) false
View AnswerAnswer: a
Explanation: This mainly includes heat interaction with the surroundings due to a finite temperature gradient.
15. Which of the following is true?
a) mechanical irreversibility is due to finite pressure gradient
b) thermal irreversibility is due to finite temperature gradient
c) chemical irreversibility is due to finite concentration gradient
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some other distinctions of irreversibility.

« Prev - Thermodynamics Questions and Answers – Refrigerator and Heat Pump» Next - Thermodynamics Questions and Answers – Carnot Theorem, Carnot Cycle and Reversed Heat EngineThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Carnot Theorem, Carnot Cycle and Reversed Heat Engine”.

1. Carnot cycle is a reversible cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: A reversible cycle is an ideal hypothetical cycle in which all processes are reversible.

2. A reversible cycle has following processes.
a) 4 isothermal processes
b) 4 adiabatic processes
c) 2 isothermal and 2 adiabatic processes
d) none of the mentioned
View AnswerAnswer: c
Explanation: Two reversible isotherms and two reversible adiabatics constitute a Carnot cycle.

3. The correct sequence of the processes taking place in a carnot cycle is
a) adiabatic -> adiabatic -> isothermal -> isothermal
b) adiabatic -> isothermal -> adiabatic -> isothermal
c) isothermal -> isothermal -> adiabatic -> adiabatic
d) isothermal -> adiabatic -> isothermal -> adiabatic
View AnswerAnswer: d
Explanation: Carnot cycle consists if these four processes in succession.

4. The reversed heat engine takes heat from a ___ temperature body, then discharges it to a ___ temperature body and ___ an inward flow of network.
a) high, low, receives
b) low, high, receives
c) high, low, gives
d) low, high, gives
View AnswerAnswer: b
Explanation: In reversed heat engine, the magnitude of energy transfers remains same and only directions change.

5. Example of reversed heat engine is
a) heat pump
b) refrigerator
c) both of the mentioned

d) none of the mentioned
View AnswerAnswer: c
Explanation: Heat pump and refrigerator are the types of reversed heat engine.
6. According to Carnot’s theorem, all heat engines operating bebetween a given constant temperature source and sink, none has a higher efficiency than a reversible engine.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the statement of Carnot’s theorem .
7. The efficiency of all reversible heat engines operating bebetween the same heat reservoirs is
a) same
b) independent of the nature of working substance
c) independent of the amount of working substance
d) all of the mentioned
View AnswerAnswer: d
Explanation: This statement is a corollary of Carnot’s theorem.

8. Efficiency of a reversible heat engine is given by
a) 1-(T1/T2)
b) 1-(T2/T1)
c) (T1/T2)-1
d) (T2/T1)-1
View AnswerAnswer: b
Explanation: Efficiency=1-(Q2/Q1) and T2,T1 are temperatures at which heat is rejected and received.
9. For a reversible refrigerator, Coefficient of Performance is given by
a) T2/(T1-T2)
b) T1/(T1-T2)
c) T2/(T2-T1)
d) T1/(T2-T1)
View AnswerAnswer: a
Explanation: For a reversible refrigerator, (Q1/Q2)=(T1/T2).
10. For a reversible heat pump, COP is given by
a) T2/(T1-T2)
b) T1/(T1-T2)
c) T2/(T2-T1)
d) T1/(T2-T1)
View AnswerAnswer: b
Explanation: For a reversible heat pump we have, (Q1/Q2)=(T1/T2).

« Prev - Thermodynamics Questions and Answers – Reversibility, Irreversibilty and causes of Irreversibilty» Next - Thermodynamics Questions and Answers – Absolute Thermodynamic Temperature ScaleThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Absolute Thermodynamic Temperature Scale”.

1. It is necessary to have a temperature difference to obtain work of any cycle.
a) true
b) false
View AnswerAnswer: a
Explanation: It comes from the second law of thermodynamics.

2. The absolute thermodynamic temperature scale is also known as
a) celsius scale
b) kelvin scale
c) fahrenheit scale
d) none of the mentioned
View AnswerAnswer: b
Explanation: It was proposed by Kelvin.

3. In defining the temperature scale, the standard reference point is taken as
a) zero kelvin
b) boiling point of water
c) triple point of water
d) none of the mentioned
View AnswerAnswer: c
Explanation: Triple point of water is taken as the standard reference point.

4. When the heat transferred isothermally bebetween the given _____ decreases, the temperature ____
a) isotherms, increases
b) isotherms, decreases
c) adiabatics, increases
d) adiabatics, decreases
View AnswerAnswer: d
Explanation: This comes from the equation, T=(273.16)(Q/Q1).

5. If a system undergoes a reversible isothermal process without transfer of heat, the temperature at which this process takes place is called

a) absolute zero
b) triple point of water
c) boiling point of water
d) none of the mentioned
View AnswerAnswer: a
Explanation: The smallest possible value of Q which is the amount of heat supply is zero and the corresponding temperature is zero.
6. At absolute zero, an isotherm and an adiabatic are identical.
a) true
b) false
View AnswerAnswer: a
Explanation: At absolute zero, there is no heat transfer.
7. A definite zero point ___ on the absolute temperature scale but this point ___ reached ___ violation of the second law.
a) doesnot, can, without
b) exists, cannot, without
c) exists, can, with
d) none of the mentioned
View AnswerAnswer: b
Explanation: When the heat rejected approaches zero, the temperature of heat rejection approaches zero as a limit.

8. Which law is stated here, "It is impossible to reduce any system to the absolute zero of temperature in a finite numr of operations.
a) first law of thermodynamics
b) second law of thermodynamics
c) third law of thermodynamics
d) none of the mentioned
View AnswerAnswer: c
Explanation: Any attainable value of absolute temperature is always greater than zero.
9. The statement of third law is also called the Fowler-Guggenheim statement of the third law.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a fact about third law of thermodynamics.
10. The Kelvin temperature is numerically equal to the _____ and may measured by means of a _____
a) gas temperature, liquid thermometer
b) ideal gas temperature, gas thermometer
c) ideal gas temperature, liquid thermometer
d) none of the mentioned
View AnswerAnswer: b

Explanation: θ=T=273.16K .

« Prev - Thermodynamics Questions and Answers – Carnot Theorem, Carnot Cycle and Reversed Heat Engine» Next - Thermodynamics Questions and Answers – Clausius' Theorem and the Inequality of ClausiusThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Clausius' Theorem and the Inequality of Clausius".

1. Any reversible path can substituted by a reversible zigzag path bebetween the same states.
a) true
b) false
View AnswerAnswer: a
Explanation: It should consist of a reversible adiabatic, followed by a reversible isotherm and then by a reversible adiabatic.

2. According to the Clausius' theorem, the cyclic integral of ____ for a reversible cycle is zero.
a) dW/dT
b) dH/dT
c) dQ/dT
d) dE/dT
View AnswerAnswer: c
Explanation: Q is the total heat supplied or heat rejected in the complete cycle.
3. Two reversible adiabatic paths can intersect each other.
a) true
b) false
View AnswerAnswer: b
Explanation: If we assume they intersect, then the Kelvin-Planck statement of the second law will violated.
4. The efficiency of a general cycle will _____ the efficiency of a reversible cycle.
a) equal to
b) less than
c) equal to or greater than
d) equal to or less than
View AnswerAnswer: d
Explanation: The efficiency of a reversible cycle is maximum.

5. The cyclic integral of entropy is____
a) one
b) zero
c) infinity
d) cannot determined
View AnswerAnswer: b
Explanation: The cyclic integral of any property is zero and entropy is a property.

6. Which of the following is known as the inequality of Clausius?
a) cyclic integral of dQ/T<=0
b) cyclic integral of dQ/T>=0
c) cyclic integral of dW/T<=0
d) cyclic integral of dW/T>=0
View AnswerAnswer: a
Explanation: It provides the criterion for the reversibility of a cycle.
7. If the cyclic integral of dQ/T is zero then the cycle is
a) irreversible but not possible
b) irreversible but possible
c) impossible
d) reversible
View AnswerAnswer: d
Explanation: This comes from the inequality of Clausius.
8. If the cyclic integral of dQ/T is less than zero then the cycle is
a) irreversible but not possible
b) irreversible and possible
c) impossible
d) reversible
View AnswerAnswer: b
Explanation: This comes from the inequality of Clausius.
9. If the cyclic integral of dQ/T is greater than zero then the cycle is
a) irreversible but not possible
b) irreversible but possible
c) impossible
d) reversible
View AnswerAnswer: c
Explanation: This comes from the inequality of Clausius.

10. If dQ is the heat supplied at T and dQ2 is the heat rejected at T2, then efficiency is given by
a) 1-(dQ2/dQ)

b) 1-(dQ/dQ2)
c) (dQ/dQ2)-1
d) (dQ2/dQ)-1
View AnswerAnswer: a
Explanation: Efficiency is given by = 1-(heat reached/heat supplied).
11. A heat engine receives 6 kW from a source at 250°C and rejects heat at 30°C with W. = 0 kW. Does this satisfy the inequality of Clausius?
a) yes
b) no
c) cannot said
d) none of the mentioned
View AnswerAnswer: a
Explanation: ⌠ dQ/T = (6000/523) – (6000/303) = –8.33 kW/K < 0. [/expand]

12. A heat engine receives 6 kW from a source at 250°C and rejects heat at 30°C with W. = 6 kW. Does this satisfy the inequality of Clausius?
a) yes
b) no
c) cannot said
d) none of the mentioned
[expand title="View Answer"]Answer: b
Explanation: ⌠ dQ/T = (6000/523) - (0/303) = 11.47 kW/K > 0.

« Prev - Thermodynamics Questions and Answers – Absolute Thermodynamic Temperature Scale» Next - Thermodynamics Questions and Answers – The Property of EntropyThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “The Property of Entropy”.
1. Integral of dQ/T is independent of reversible path connecting bebetween two points.
a) true
b) false
View AnswerAnswer: a
Explanation: For two reversible paths, dQ/T doesn’t depend on the path taken.

2. Integral of dQ/T of a reversible path is given by
a) Si-Sf
b) Sf-Si
c) Si+Sf
d) -Si-Sf
View AnswerAnswer: b
Explanation: Integral of dQ/T is = Sf-Si where i=initial equilibrium state and f=final equilibrium state.
3. Entropy is a

a) path function, intensive property
b) path function, extensive property
c) point function, intensive property
d) point function, extensive property
View AnswerAnswer: d
Explanation: Fact about entropy and unit of entropy is J/K.
4. Specific entropy is given by(where m is the mass)
a) Sm
b) m/S
c) S/m
d) none of the mentioned
View AnswerAnswer: c
Explanation: s=S/m with unit J/kg K.

5. For any process which is undergone by a system
a) dQ/T>=ds
b) dQ/T<=ds
c) dQ/T≠ds
d) none of the mentioned
View AnswerAnswer: b
Explanation: For any process dQ/T<=ds and this comes from Clausius theorem.
6. For a reversible process,
a) dS=dQ/T
b) dS>dQ/T
c) dS<dQ/T
d) none of the mentioned
View AnswerAnswer: a
Explanation: For a reversible process, dQ/T is equal to the net change in entropy.
7. For an irreversible process,
a) dS=dQ/T
b) dS>dQ/T
c) dS<dQ/T
d) none of the mentioned
View AnswerAnswer: b
Explanation: For a irreversible process, change in entropy is greater than dQ/T.

8. For two different paths bebetween same two points, entropy change is
a) depends on path taken
b) different
c) same

d) none of the mentioned
View AnswerAnswer: c
Explanation: This is cause entropy is a property.
9. For the general case, we can write
a) S2-S1<=dQ/T for a path
b) S2-S1>=dQ/T for a path
c) S2-S1≠dQ/T for a path
d) none of the mentioned
View AnswerAnswer: b
Explanation: The equality sign holds good for a reversible process and the inequality sign for an irreversible process.
10. When two equilibrium states are infinitesimally near,
a) dQ/T=dS
b) dQ/T>dS
c) dQ/T<dS
d) none of the mentioned
View AnswerAnswer: a
Explanation: dS is an exact differential cause S is a point function and a property.

« Prev - Thermodynamics Questions and Answers – Clausius' Theorem and the Inequality of Clausius» Next - Thermodynamics Questions and Answers – Temperature-Entropy PlotThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Temperature-Entropy Plot".
1. For a reversible heat transfer and process ing adiabatic, which of the following is true?
a) dQ=0
b) dS=0
c) S=constant
d) all of the mentioned
View AnswerAnswer: d
Explanation: dQ=0 since process is reversible and adiabatic and dS=dQ/T.

2. A reversible adiabatic process is an isentropic process.
a) true
b) false
View AnswerAnswer: a
Explanation: dQ=0 and dS=0 and hence S=constant.

3. The area under the curve $\int TdS$ is equal to the
a) work done
b) heat transferred
c) internal energy change
d) none of the mentioned
View AnswerAnswer: b
Explanation: Q(reversible)=$\int TdS$.
4. Which of the following statement is true?
a) for reversible isothermal heat transfer, Q=t(Sf-Si)
b) for reversible adiabatic process, S=constant
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: For reversible isothermal heat transfer, T=constant and for reversible adiabatic process, dS=0.

5. A Carnot cycle has following processes.
a) 4 reversible isotherms
b) 4 reversible adiabatics
c) 2 reversible isotherms and 2 reversible adiabatics
d) none of the mentioned
View AnswerAnswer: c
Explanation: Two reversible isotherms and two reversible adiabatics constitute a Carnot cycle.
6. Net work in a Carnot cycle is given by (T1=temperature of heat addition and T2=temperature of heat rejection)
a) (T2-T1)(S1-S4)
b) (T1-T2)(S1-S4)
c) (T1-T2)(S4-S1)
d) none of the mentioned
View AnswerAnswer: b
Explanation: Net work=Q1-Q2=(T1-T2)(S1-S4).
7. According to the principle of Caratheodory, the first law in differential form is written as dQ=Adx+Bdy+Cdz.
a) true
b) false
View AnswerAnswer: a
Explanation: Here, x,y,z are the three thermodynamic coordinates and A,B,C are the functions of x,y,z.

8. For adiabatic, reversible transition,
a) Adx+Bdy+Cdz=-1
b) Adx+Bdy+Cdz=1
c) Adx+Bdy+Cdz=0
d) none of the mentioned
View AnswerAnswer: c
Explanation: dQ=Adx+Bdy+Cdz=0 for adiabatic and reversible process.
9. For quasi-static, adiabatic path
a) Adx+Bdy+Cdz=TdS
b) Adx+Bdy+Cdz=1
c) Adx+Bdy+Cdz=0
d) none of the mentioned
View AnswerAnswer: a
Explanation: This comes from Caratheodory's theorem.
10. The infinitesimal change in entropy dS due to reversible heat transfer dQ at temperature T is dS=dQ/T.
a) true
b) false
View AnswerAnswer: a
Explanation: For a reversible process, dS=dQ/T .

« Prev - Thermodynamics Questions and Answers – The Property of Entropy» Next - Thermodynamics Questions and Answers – Entropy Principle and its Applications-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on "Entropy Principle and its Applications".
1. Which of the following is true?
a) for an isolated system, dS>=0
b) for a reversible process, dS=0
c) for an irreversible process, dS>0
d) all of the mentioned
View AnswerAnswer: d
Explanation: For an isolated system which does not undergo any energy interaction with the surroundings, dQ=0 and also dS>=dQ/T.

2. The entropy of an isolated system can never ____
a) increase
b) decrease

c) zero
d) none of the mentioned
View AnswerAnswer: b
Explanation: The entropy of an isolated system always increases and remains constant only when the process is reversible.
3. According to entropy principle, the entropy of an isolated system can never decrease and remains constant only when the process is reversible.
a) true
b) false
View AnswerAnswer: a
Explanation: This is the statement for the principle of increase of entropy.
4. Entropy may decrease locally at some region within the isolated system. How can this statement justified?
a) this cannot possible
b) this is possible cause entropy of an isolated system can decrease.
c) it must compensated by a greater increase of entropy somewhere within the system.
d) none of the mentioned
View AnswerAnswer: c
Explanation: The net effect of an irreversible process is an entropy increase of the whole system.

5. Clausius summarized the first and second laws of thermodynamics as
a) the energy of the world is constant
b) the entropy of the world tends towards a maximum
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two statements were given by Clausius.
6. The entropy of an isolated system always ____ and comes a ____ at the state of equilibrium.
a) decreases, minimum
b) increases, maximum
c) increases, minimum
d) decreases, maximum
View AnswerAnswer: b
Explanation: If entropy of an isolated system varies with some parameter, then there is a certain value of that parameter which maximizes the entropy.
7. Entropy principle is the quantitative statement of the second law of thermodynamics.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a general fact about entropy principle.

8. Which of the following can considered as an application of entropy principle?
a) transfer of heat through a finite temperature difference
b) mixing of two fluids
c) maximum temperature obtainable from two finite bodies
d) all of the mentioned
View AnswerAnswer: d
Explanation: These are some basic applications of entropy principle.
9. The final temperatures of two bodies, initially at T1 and T2 can range from
a) (T1-T2)/2 to sqrt(T1*T2)
b) (T1+T2)/2 to sqrt(T1*T2)
c) (T1+T2)/2 to (T1*T2)
d) (T1-T2)/2 to (T1*T2)
View AnswerAnswer: b
Explanation: (T1+T2)/2 is the temperature when there is no delivery of work and sqrt(T1*T2) is the temperature with maximum delivery of work.
10. Which of the following processes exhibit external mechanical irreversibility?
a) isothermal dissipation of work
b) adiabatic dissipation of work
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These processes exhibit external mechanical irreversibility.

« Prev - Thermodynamics Questions and Answers – Temperature-Entropy Plot» Next - Thermodynamics Questions and Answers – Entropy Principle and its Applications-2This set of Thermodynamics Interview Questions and Answers for experienced focuses on “Entropy Principle and its Applications-2”
1. For the flow of electric current through a resistor,
a) at steady state, internal energy of resistor is constant
b) at steady state, temperature of resistor is constant
c) W=Q
d) all of the mentioned
View AnswerAnswer: d
Explanation: Internal energy is dependent on temperature and by first law Q=ΔE+W.

2. When stirring work is supplied to a viscous thermally insulated liquid, temperature of the liquid

a) remains constant
b) increases
c) decreases
d) none of the mentioned

View AnswerAnswer: d

3. A car uses power of 25 hp for a one hour in a round trip. A thermal efficiency of 35% can assumed? Find the change in entropy if we assume ambient at 20°C?

a) 554.1 kJ/K
b) 654.1 kJ/K
c) 754.1 kJ/K
d) 854.1 kJ/K

View AnswerAnswer: b

Explanation: $E = \int W\,dt = 25\text{ hp} \times 0.7457\text{ (kW/hp)} \times 3600\text{ s} = 67\,113\text{ kJ} = \eta Q$

$Q = E / \eta = 67\,113 / 0.35 = 191\,751\text{ kJ}$

$\Delta S = Q / T = 191\,751 / 293.15 = 654.1\text{ kJ/K}$.

4. In a Carnot engine working on ammonia, the high temperature is 60°C and as QH is received, the ammonia changes from saturated liquid to saturated vapor. The ammonia pressure at low temperature is 190 kPa. Find the entropy.

a) 4.6577 kJ/kg K
b) 5.6577 kJ/kg K
c) 6.6577 kJ/kg K
d) 7.6577 kJ/kg K

View AnswerAnswer: a

Explanation: $q_H = \int T ds = T (s_2 - s_1) = T s(fg) = h_2 - h_1 = h(fg) = 997.0\text{ kJ/kg}$

$T_L = T_3 = T_4 = T_{sat}(P) = -20°C$

$\eta(cycle) = 1 - (T_l/T_h) = 1 - (253.2/333.2) = 0.24$

$s_3 = s_2 = s_g(60°C) = 4.6577\text{ kJ/kg K}$.

5. A slab of concrete, 5 × 8 × 0.3 m, is used as a thermal storage mass in a house. The slab cools overnight from 23°C to 18°C in an 18°C house, find the net entropy change associated with this process?

a) 0.4 kJ/K
b) 1.4 kJ/K
c) 2.4 kJ/K
d) 3.4 kJ/K

View AnswerAnswer: d

Explanation: $V = 5 \times 8 \times 0.3 = 12\text{ m}^3$; $m = \rho V = 2200 \times 12 = 26400\text{ kg}$

V = constant so $_1W_2 = 0$; $_1Q_2 = mC\Delta T = 26400 \times 0.88(-5) = -116160\text{ kJ}$

$\Delta S(SYST) = m(s_2 - s_1) = mC \ln(T_2/T_1) = 26400 \times 0.88 \ln$

(291.2/296.2) = -395.5 kJ/K

$\Delta S(SURR) = -1Q2/T0 = +116160/291.2 = +398.9$ kJ/K

$\Delta S(NET) = -395.5 + 398.9 = +3.4$ kJ/K.

6. A foundry form box with 25 kg of 200°C hot sand is dropped into a bucket with 50 L water at 15°C. Assuming there is no heat transfer with the surroundings and no boiling away of water, calculate the net entropy change for the process.
a) 2.37 kJ/K
b) 2.47 kJ/K
c) 2.57 kJ/K
d) 2.67 kJ/K
View AnswerAnswer: c
Explanation: C.V. Sand and water, constant pressure process

$m(sand)\Delta h(sand) + m(H2O)\Delta h(H2O) = 0$

$m(sand)C\Delta T(sand) + m(H2O)C(H2O)\Delta T(H2O) = 0$

$25 \times 0.8\times(T2 - 200) + (50\times10^{(-3)}/0.001001) \times 4.184 \times (T2 - 15) = 0$

hence T2 = 31.2°C

$\Delta S = 25 \times 0.8 \ln(304.3/473.15) + 49.95 \times 4.184 \ln(304.3/288.15)$
= 2.57 kJ/K.

7. Calculate the change in entropy if 1 kg of saturated liquid at 30°C is converted into superheated steam at 1 bar and 200°C .
a) 5.3973 kJ/K
b) 6.3973 kJ/K
c) 7.3973 kJ/K
d) none of the mentioned
View AnswerAnswer: c
Explanation: si= sf @30 C = 0.4369 kJ/kg.K,

se = sg @1 bar and 200 C = 7.8342 kJ/kg.K

Change in entropy (ΔS) = m*(se – si) = 1*(7.8342 – 0.4369) = 7.3973 kJ/K.

8. Two kilograms of water at 120°C with a quality of 25% has its temperature raised by 20°C in a constant volume process. What is the new specific entropy?
a) 3.01517 kJ/kg.K
b) 4.01517 kJ/kg.K
c) 5.01517 kJ/kg.K
d) 7.01517 kJ/kg.K
View AnswerAnswer: b
Explanation: v1 = vf @120 C + x1*vfg @120 C = 0.00106 + 0.25*0.8908 = 0.22376 m3/kg

v2 = v1 = vf @145 C + x2*vfg @145 C = 0.00108 + x2*0.50777 ∴ x2 = 0.4385

New specific entropy (s2) = sf @145 C + x2*sfg @145 C

= 1.739 +0.4385*5.1908 = 4.01517 kJ/kg.K.

9. A thermal reservoir at 538°C is brought into thermal communication with another thermal reservoir at 260°C, and as a result 1055 kJ of heat is transferred only from the higher to lower temperature reservoir. Determine the change in entropy of the universe due to the exchange of heat bebetween these two thermal reservoirs.

a) 0.378182 kJ/K
b) 0.478182 kJ/K
c) 0.578182 kJ/K
d) 0.678182 kJ/K

View AnswerAnswer: d

Explanation: $(\Delta S)_{System} = \int \delta Q/T = -1055/(538 + 273.15) + 1055/(260 + 273.15) = 0.678182$ kJ/K

$(\Delta S)_{Surroundings} = \int \delta Q/T = 0$

Change in entropy of the universe ($(\Delta S)_{Universe}$)

$= (\Delta S)_{System} + (\Delta S)_{Surroundings} = 0.678182$ kJ/K.

10. A glass jar is filled with saturated water at 500 kPa of quality 25%, and a tight lid is put on. Now it is cooled to -10°C. What is the mass fraction of solid at this temperature?

a) 99.98%
b) 98.98%
c) 93.98%
d) 95.98%

View AnswerAnswer: a

Explanation: Constant volume $v_1=v_2=V/m$

from steam table, P_{sat} = 500 kPa and hence T_{sat} = 151.8°C

$v_1 = 0.001093 + 0.25*0.3738 = 0.094543$

$v_2 = 0.0010891 + x_2*466.756 = v_1 = 0.094543$

$x_2 = 0.002$ mass fraction vapour

$x(solid) = 1- x_2 = 0.9998$ or 99.98%.

« Prev - Thermodynamics Questions and Answers – Entropy Principle and its Applications-1» Next - Thermodynamics Questions and Answers – Entropy Transfer MechanismsThis set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Entropy Transfer Mechanisms”.

1. Entropy can transferred to or from a system in which of the following forms?

a) heat transfer
b) mass flow
c) both of the mentioned
d) none of the mentioned

View AnswerAnswer: c

Explanation: Entropy is transferred by these two forms while energy id transferred by work also.

2. Entropy transfer for an adiabatic transfer is zero.
a) true
b) false
View AnswerAnswer: a
Explanation: The only form of entropy interaction associated with a fixed mass or closed system is heat transfer.
3. If heat Q flows reversibly from the system to the surroundings at To,
a) entropy increase of the surroundings is Q/To
b) entropy of the system is reduced by Q/To
c) system has lost entropy to the surroundings
d) all of the mentioned
View AnswerAnswer: d
Explanation: We can say that there is entropy transfer from the system to the surroundings along with heat flow.
4. The sign of entropy transfer is opposite to the sign of heat transfer.
a) true
b) false
View AnswerAnswer: b
Explanation: The sign of entropy transfer is same as the sign of heat transfer: positive, if into the system, and negative, if out of the system.

5. ____ is exchanged during work interaction, whereas both ____ and ____ are exchanged during heat transfer.
a) energy, energy and entropy
b) entropy, energy and entropy
c) mass, energy and entropy
d) none of the mentioned
View AnswerAnswer: a
Explanation: This is the distinction bebetween heat transfer and work which is brought about by the second law.
6. Mass contains
a) entropy
b) energy
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: This is a basic fact and the entropy and energy of a system are proportional to the mass.

7. The entropy of a system ____ by ____ when the mass of amount m enters it.
a) decreases, ms
b) increases, ms
c) decreases, s/m
d) increases, s/m
View AnswerAnswer: b
Explanation: When mass m enters a system, an entropy of amount ms, s ing the specific entropy, accompanies it.

8. What happens when heat is added to the system?
a) dQ is positive
b) dS=dQ/T
c) entropy of the system increases
d) all of the mentioned
View AnswerAnswer: d
Explanation: dS=dQ/T and when heat is added, dQ=positive and thus dS=positive.
9. The first law of thermodynamics makes no distinction bebetween heat transfer and work.
a) true
b) false
View AnswerAnswer: a
Explanation: The first law of thermodynamics considers both work and heat transfer equal.
10. Which of the following explains that there is no entropy transfer associated with work.
a) working of flywheel
b) compression of spring
c) raising of weight by a certain height
d) all of the mentioned
View AnswerAnswer: d
Explanation: In all these examples, there is work done but there is no entropy transfer.

« Prev - Thermodynamics Questions and Answers – Entropy Principle and its Applications-2» Next - Thermodynamics Questions and Answers – Entropy Generation in a Closed and Open System-1This set of Thermodynamics Multiple Choice Questions & Answers (MCQs) focuses on “Entropy Generation in a Closed and Open System-1”.

1. The entropy of any closed system can increase in which if the following way?
a) by heat interaction in which there is entropy transfer
b) dissipative effects or internal irreversibilities
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: These two processes increase the entropy of a closed system.

2. Entropy increase dS of the system can expressed as
a) dS=dS(due to external heat interaction)-dS(due to internal irreversibility)
b) dS=dS(due to external heat interaction)+dS(due to internal irreversibility)
c) dS=-dS(due to external heat interaction)-dS(due to internal irreversibility)
d) dS=-dS(due to external heat interaction)+dS(due to internal irreversibility)
View AnswerAnswer: b
Explanation: Total entropy increase of the system is the sum of these two entropies.
3. The entropy increase due to internal irreversibility is also called entropy production or entropy generation.
a) true
b) false
View AnswerAnswer: a
Explanation: This entropy is generated during the process within the system.
4. Which of the following statement is true?
a) if the isentropic process is reversible, it must adiabatic
b) if the isentropic process is adiabatic, it cannot but reversible
c) if the process is adiabatic and reversible, it must isentropic
d) all of the mentioned
View AnswerAnswer: d
Explanation: An adiabatic process need not isentropic, since entropy can also increase due to friction.
5. Lost work is given by
a) pdV-dW
b) pdV+dW
c) -pdV-dW
d) pdV*dW
View AnswerAnswer: a
Explanation: The lost work d(LW) indicates the work that is lost due to irreversibility.

6. The amount of entropy generation is given by
a) S2+S1+∫(dQ/T)

b) S2-S1+∫(dQ/T)
c) S2-S1-∫(dQ/T)
d) none of the mentioned
View AnswerAnswer: c
Explanation: Here (S2-S1) is the entropy change of the system and ∫(dQ/T) is the entropy transfer.
7. Any thermodynamic process is accompanied by entropy generation.
a) true
b) false
View AnswerAnswer: a
Explanation: This comes from the second law.
8. Which of the following statement is false?
a) for a reversible process, entropy generation is zero
b) the entropy generation does not depend on the path the system follows
c) for an irreversible process, entropy generation is greater than zero
d) none of the mentioned
View AnswerAnswer: b
Explanation: Entropy generation is not a thermodynamic property and depends on the path that system follows.
9. If the path A causes more entropy generation than path B, then
a) path A is more irreversible than path B
b) path A involves more lost work
c) both of the mentioned
d) none of the mentioned
View AnswerAnswer: c
Explanation: The amount of entropy generation quantifies the intrinsic irreversibility of the process.

10. In an open system, there is a transfer of which of the following quantity?
a) mass
b) energy
c) entropy
d) all of the mentioned
View AnswerAnswer: d
Explanation: In an open system, there is a transfer of all these three quantities.
11. The rate of entropy increase of the control volume ____ or ____ the net rate of entropy transfer to it.
a) exceeds or is less than
b) exceeds, is equal to
c) is less than, or equal to
d) none of the mentioned
View AnswerAnswer: b
Explanation: The difference is the entropy generated within the control volume due

to irreversibility.
12. Mass and energy are conserved quantities, but entropy is generally not conserved.
a) true
b) false
View AnswerAnswer: a
Explanation: This is a basic fact about entropy.
13. The rate at which entropy is transferred out must ____ the rate at which entropy enters the control volume.
a) less than
b) equal to
c) exceed
d) none of the mentioned
View AnswerAnswer: c
Explanation: The difference is the rate of entropy generated within the control volume owing to irreversibilities.

14. A chip dissipates 2 kJ of electric work and rejects it as heat transfer from its surface which is at 50°C to 25°C air. How much entropy is generated in the chip?
a) 4.19 J/K
b) 5.19 J/K
c) 6.19 J/K
d) 7.19 J/K
View AnswerAnswer: c
Explanation: C.V.1 Chip with surface at 50°C, we assume chip state is constant.
U2 – U1 = 0 = 1Q2 – 1W2 = W(electrical,in) – Q(out,1)
S2 – S1 = 0 = – [Q(out,1)]/[T(surf)] + 1S2(gen1)
1S2(gen1) = [Q(out,1)]/[T(surf)] = W(electrical,in) / T(surf)
= 2/323.15 = 6.19 J/K.
15. A chip dissipates 2 kJ of electric work and rejects it as heat transfer from its surface which is at 50°C to 25°C air. How much entropy is generated outside the chip?
a) 0.419 J/K
b) 0.519 J/K
c) 0.619 J/K
d) 0.719 J/K
View AnswerAnswer: b
Explanation: C.V.2 From chip surface at 50°C to air at 25°C, assume constant state.
U2 – U1 = 0 = 1Q2 – 1W2 = Q(out,1) – Q(out,2)
S2 – S1 = 0 = [Q(out,1) / T(surf)] – [Q(out,2) / T(air)] + 1S2(gen2)
1S2(gen2) = [Q(out,2) / T(air)] – [Q(out,1) / T(surf)]

= (2/298.15) – (2/323.15) = 0.519 J/K.

« Prev - Thermodynamics Questions and Answers – Entropy Transfer Mechanisms» Next - Thermodynamics Questions and Answers – Entropy Generation in a Closed and Open System-2This set of Thermodynamics Test focuses on “Entropy Generation in a Closed and Open System”.

1. 1 kg of air at 300 K is mixed with 1 kg air at 400 K in a constant pressure process at 100 kPa and Q = 0. Find the entropy generation in the process.
a) 0.0207 kJ/K
b) 0.0307 kJ/K
c) 0.0407 kJ/K
d) 0.0507 kJ/K
View AnswerAnswer: a
Explanation: U2 – U1 + W = U2 – U1 + P(V2 – V1) = H2 – H1 = 0
H2 – H1 = mA(h2 – h1)A + mB(h2 – h1)B = mACp(T2 – TA1) + mBCp(T2 – TB1) = 0
T2 =(mATA1 + mBTB1)/(mA + mB) = (TA1/2) + (TB1/2) = 350 K
1S2 gen = mACp ln(T2/TA1) + mBCp ln(T2/TB1)
= 1 × 1.004 ln [350/300] + 1 × 1.004 ln[350/400]
= = 0.15477 – 0.13407 = 0.0207 kJ/K.

2. A window receives 200 W of heat transfer at its inside surface of 20°C and transmits this 200 W from its outside surface at 2°C to ambient air at 5°C. Find the window’s rate of entropy generation.
a) 0.015 W/K
b) 0.025 W/K
c) 0.035 W/K
d) 0.045 W/K
View AnswerAnswer: d
Explanation: S (inside) = 200/293.15 = 0.682 W/K
S (window) = 200/275.15 = 0.727 W/K
S (ambient) = 200/268.15 = 0.746 W/K
Window only: S(gen win) = S(window) – S(inside)
= 0.727 – 0.682 = 0.045 W/K.

3. An insulated cylinder/piston contains R-134a at 1 MPa, 50°C, volume of 100 L. The R-134a expands, dropping the pressure in the cylinder to 100 kPa. The R-134a does 190 kJ of work against the piston during this process. Is that possible?
a) yes
b) no
c) cannot determined
d) none of the mentioned
View AnswerAnswer: a
Explanation: v1 = 0.02185 m^3/kg, u1 = 409.39 kJ/kg,

$s1 = 1.7494$ kJ/kg K, $m = V1/v1 = 0.1/0.02185 = 4.577$ kg

$m(u2 - u1) = 1Q2 - 1W2 = 0 - 190$ hence $u2 = u1 - 1W2/m = 367.89$ kJ/kg

$T2 = -19.25°C$; $s2 = 1.7689$ kJ/kg K

$m(s2 - s1) = ∫dQ/T + 1S2(gen) = 1S2(gen)$

$1S2(gen) = m(s2 - s1) = 0.0893$ kJ/K

This is possible since $1S2(gen) > 0$.

4. A hot metal piece is cooled rapidly to 25°C, removing 1000 kJ from the metal. Calculate the change of entropy if saturated liquid R-22 at –20°C absorbs the energy so that it comes saturated vapor.
a) 1.950 kJ/K
b) 2.950 kJ/K
c) 3.950 kJ/K
d) 4.950 kJ/K

View AnswerAnswer: c

Explanation: R-22 boiling at -20°C; $m = 1Q2 /h(fg) = 1000/220.327 = 4.539$ kg

$ΔS(R\text{-}22) = ms(fg) = 4.539(0.8703) = 3.950$ kJ/K.

5. A hot metal piece is cooled rapidly to 25°C, removing 1000 kJ from the metal. Calculate the change of entropy if energy is absord by ice.
a) 2.662 kJ/K
b) 3.662 kJ/K
c) 4.662 kJ/K
d) 5.662 kJ/K

View AnswerAnswer: b

Explanation: Ice melting at 0°C; $m = 1Q2 /h(fg) = 1000/333.41 = 2.9993$ kg

$ΔS(H2O) = ms(ig) = 2.9993(1.221) = 3.662$ kJ/K.

6. A hot metal piece is cooled rapidly to 25°C, removing 1000 kJ from the metal. Calculate the change of entropy if energy is absord by vaporizing liquid nitrogen at 101.3 kPa pressure.
a) 9.929 kJ/K
b) 10.929 kJ/K
c) 11.929 kJ/K
d) 12.929 kJ/K

View AnswerAnswer: d

Explanation: Nitrogen boiling at 101.3 kPa; $m = 1Q2 /h(fg) = 1000/198.842 = 5.029$ kg

$ΔS(N2) = ms(fg) = 5.029(2.5708) = 12.929$ kJ/K.

7. A piston cylinder has 2.5 kg ammonia at -20°C, 50 kPa. It is heated to 50°C at constant pressure from external hot gas at 200°C. Find the total entropy generation.
a) 0.511 kJ/K
b) 0.611 kJ/K
c) 0.711 kJ/K
d) 0.811 kJ/K

View AnswerAnswer: a

Explanation: $v1 = 2.4463$ m^3/kg, $h1 = 1434.6$ kJ/kg, $s1 = 6.3187$ kJ/kg K

$v2 = 3.1435$ m^3/kg, $h2 = 1583.5$ kJ/kg, $s2 = 6.8379$ kJ/kg K

$1Q2 = m(h2 - h1) = 2.5 (1583.5 - 1434.6) = 372.25$ kJ
$1S2(gen) = m(s2 - s1) - 1Q2/T(gas)$
$= 2.5 (6.8379 - 6.3187) - 372.25/473.15 = 0.511$ kJ/K.

8. A piston/cylinder contains 1 kg water at 20°C, 150 kPa. The pressure is linear in volume. Heat is added from 600°C source until the water is at 1 MPa, 500°C. Find the total change in entropy.
a) 1.751 kJ/K
b) 2.751 kJ/K
c) 3.751 kJ/K
d) 4.751 kJ/K
View AnswerAnswer: c
Explanation: $v1 = 0.001002$ m^3/kg; $u1 = 83.94$ kJ/kg; $s1 = 0.2966$ kJ/kg K
$v2 = 0.35411$ m^3/kg; $u2 = 3124.3$ kJ/kg; $s2 = 7.7621$ kJ/kg K
$1W2 = ½ (1000 + 150) 1 (0.35411 - 0.001002) = 203$ kJ
$1Q2 = 1(3124.3 - 83.94) + 203 = 3243.4$ kJ
$m(s2 - s1) = 1(7.7621 - 0.2968) = 7.4655$ kJ/K;
$1Q2/T(source) = 3.7146$ kJ/K
$1S2\ gen = m(s2 - s1) - 1Q2/T(SOURCE) = \Delta Stotal$
$= \Delta S(H2O) + \Delta S(source) = 7.4655 - 3.7146 = 3.751$ kJ/K.

9. 1kg of ammonia is contained in a piston/cylinder, as saturated liquid at –20°C. Heat is added at 100°C until a final condition of 70°C, 800 kPa is reached. Assuming the process is reversible, find the entropy generation.
a) 1.007 kJ/K
b) 1.107 kJ/K
c) 1.207 kJ/K
d) 1.307 kJ/K
View AnswerAnswer: d
Explanation: $P1 = 190.08$ kPa, $v1 = 0.001504$ m^3/kg, $u1 = 88.76$ kJ/kg, $s1 = 0.3657$ kJ/kg K
$v2 = 0.199$ m^3/kg, $u2 = 1438.3$ kJ/kg, $s2 = 5.5513$ kJ/kg K
$1W2 =(1/2)(190.08 + 800)1(0.1990 - 0.001504) = 97.768$ kJ
$1Q2 = m(u2 - u1) + 1W2 = 1(1438.3 - 88.76) + 97.768 = 1447.3$ kJ
$1S2(gen) = m(s2 - s1) - 1Q2/T(res) = 1(5.5513 - 0.3657) - (1447.3/373.15)$
$= 1.307$ kJ/K.

10. A piston/cylinder device keeping a constant pressure has 1 kg water at 20°C and 1 kg water at 100°C both at 500 kPa separated by a membrane. The membrane is broken and the water comes to a uniform state with no external heat transfer. Find the entropy generation for the process.
a) 0.0507 kJ/K
b) 0.0607 kJ/K
c) 0.0707 kJ/K

d) 0.0807 kJ/K
View AnswerAnswer: b
Explanation: $m_2u_2 + P_2V_2 = m_2h_2 = m_Au_A + m_Bu_B + PV_1 = m_Ah_A + m_Bh_B$
$h_A = 84.41$ kJ/kg, $s_A = 0.2965$ kJ/kg K; $h_B = 419.32$ kJ/kg, $s_B = 1.3065$ kJ/kg K
$h_2 = (m_A/m_2)h_A + (m_B/m_2)h_B = (84.41/2) + (419.32/2) = 251.865$ kJ/kg
$h_2 = 251.865$ kJ/kg & $P_2 = 500$ kPa; $T_2 = 60.085°C$, $s_2 = 0.83184$ kJ/kg K
$_1S_2(gen) = m_2s_2 - m_As_A - m_Bs_B = 2 \times 0.83184 - 1 \times 0.2965 - 1 \times 1.3065$
$= 0.0607$ kJ/K.
11. A 4 L jug of milk at 25°C is placed in refrigerator where it is cooled down to a temperature of 5°C. Assuming the milk has the property of liquid water, find the entropy generated in the cooling process.
a) 0.0215 kJ/K
b) 0.0315 kJ/K
c) 0.0415 kJ/K
d) 0.0515 kJ/K
View AnswerAnswer: c
Explanation: $v_1 = v_f = 0.001003$ m3/kg, $h = h_f = 104.87$ kJ/kg; $s_f = 0.3673$ kJ/kg K
$h = h_f = 20.98$ kJ/kg, $s = s_f = 0.0761$ kJ/kg K
P = constant = 101 kPa => $_1W_2 = mP(v_2 - v_1)$;
$m = V/v_1 = 0.004 / 0.001003 = 3.988$ kg
$_1Q_2 = m(h_2 - h_1) = 3.988 (20.98 - 104.87) = -3.988 \times 83.89 = -334.55$ kJ
$_1S_2(gen) = m(s_2 - s_1) - {}_1Q_2/T(refrig)$
$= 3.988 (0.0761 - 0.3673) - (-334.55 / 278.15) = -1.1613 + 1.2028$
$= 0.0415$ kJ/K.
12. A pan contains 5 L of engine oil at 20°C, 100 kPa. Now 2 L of hot 100°C oil is mixed into the pan. Find the entropy generation.
a) 0.0728 kJ/K
b) 0.0828 kJ/K
c) 0.0928 kJ/K
d) 0.1028 kJ/K
View AnswerAnswer: a
Explanation: $\rho = 885$ kg/m3; From energy equation,
$T_2 = (m_A/m_2)T_A + (m_B/m_2)T_B = (5/7)20 + (2/7)100 = 42.868°C = 316.02$ K
$S_2 - S_1 = m_2s_2 - m_As_A - m_Bs_B = m_A(s_2 - s_A) + m_B(s_2 - s_B)$
$= 0.005 \times 885 \times 1.9 \ln (316.02/293.15) + 0.002 \times 885 \times 1.9 \ln (316.02/373.15)$
$= 0.6316 - 0.5588 = + 0.0728$ kJ/K.
13. Argon in a light bulb is at 90 kPa and heated from 20°C to 60°C with electrical power. Find the total entropy generation per unit mass of argon.
a) 0.01 kJ/kg K
b) 0.02 kJ/kg K
c) 0.03 kJ/kg K
d) 0.04 kJ/kg K
View AnswerAnswer: d

Explanation: 1s2(gen) = s2 – s1 = Cp ln (T2/T1) – R ln (P2/ P1)
= Cp ln (T2/T1) – R ln (T2/ T1) = Cv ln(T2/T1)
= 0.312 ln [(60 + 273)/(20 + 273)] = 0.04 kJ/kg K.

14. Oxygen gas in a piston cylinder at 300 K, 100 kPa with volume 0.1m^3 is compressed in a reversible adiabatic process to a final temperature of 700 K. Find the final pressure and volume.
a) 2015 kPa, 0.0116 m3
b) 3015 kPa, 0.0216 m3
c) 1015 kPa, 0.0416 m3
d) 4015 kPa, 0.0216 m3
View AnswerAnswer: a
Explanation: Process: Adiabatic 1q2 = 0, Reversible 1s2 gen = 0
Entropy Eq.: s2 – s1 = ∫ dq/T + 1s2 gen = 0
∴s2 = s1 (isentropic compression process)
P2 = P1(T2 / T1)^(k/k-1) = 2015 kPa
V2 = V1(T2 / T1)^(1/1-k) = 0.1 × (700/300)^(1/1–1.393)
= 0.0116 m^3.
15. Argon in a light bulb is at 90 kPa and heated from 20°C to 60°C with electrical power. Find the total entropy generation per unit mass of argon.
a) 0.02 kJ/kg K
b) 0.03 kJ/kg K
c) 0.04 kJ/kg K
d) 0.05 kJ/kg K
View AnswerAnswer: c
Explanation: Energy Eq. : m(u2 – u1) = 1W2 electrical
Entropy Eq.: s2 – s1 = ∫ dq/T + 1s2 gen = 1s2 gen
Process: v = c & ideal gas ∴ P2/ P1 = T2/T1
1s2 gen = s2 – s1 = Cp ln(T2/T1) – R ln (P2/P1)
= Cpln(T2/T1) – R ln(T2/T1) = Cv ln(T2/T1)
= 0.312 ln{(60+273)/(20+273)} = 0.04 kJ/kg K.
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