SSC JE PYQ (09-10-2023)

Engineers Wallah

Mechanical Engineering

Q 1 If the lower temperature fixed by the refrigeration application is high, the C.O.P. of the Carnot refrigerator will be_____.

(A) Very less
(B) The same
(C) High
(D) Less

Q 2 A closed vessel contains 5 kg of air, and 50 kJ of heat is given to it. If 75 kJ of work is done by the system, then which of the following is true?

(A) The temperature of the air will decrease by 34.8°
(B) The temperature of the air will decrease by 7°
(C) The temperature of the air will increase by 5°
(D) The temperature of the air will increase by 7°

Q 3 The value of the gross stage efficiency and Blade efficiency of the single stage of the impulse turbine are 65% and 78% respectively then the value of the nozzle efficiency will be

(A) 100% (B) 83.33%
(C) 50.7% (D) 50%

Q 4 A solid circular shaft of diameter d is subjected to the twisting moment T. Which of the following relation can be used to determine the stress developed in the shaft?

(A) $\tau = \frac{32T}{\pi d^3}$
(B) $\tau = \frac{60T}{\pi d^3}$
(C) $\tau = \frac{16T}{\pi d^3}$
(D) $\tau = \frac{128T}{\pi d^3}$

Q 5 In the case of dual cycle of an IC engine, heat addition is _____.

(A) both an isochroic and an isobaric process
(B) only an isochroic process
(C) an isentropic process
(D) only an isobaric process

Q 6 The function of an air pre–heater is _____.

(A) to increase the temperature of air after entering the furnace
(B) to decrease the temperature of air after entering the furnace
(C) to increase the temperature of air before entering the furnace
(D) to decrease the temperature of air before entering the furnace

Q 7 The process of pushing the heated billet or slug of metal through an ide orifice, thus forming an elongated part of a uniform cross–section corresponding to the shape of the die orifice is known as_____.

(A) Rolling process
(B) Drawing process
(C) Machining process
(D) Extrusion process

Q 8 For the same temperature limit, which of the following cycles has maximum efficiency?

(A) Carnot cycle (B) Diesel cycle
(C) Normal stirling cycle (D) Otto cycle

Q 9 Scavenging phenomenon occurred in Two–stroke IC engine when.

(A) Both inlet and outlet Valve are opened for a while simultaneously
(B) Both transfer Port and exhaust port are opened for a while simultanesouly
(C) Both inlet and outlet Valve are fully closed
(D) Both transfer port and exhaust port are fully closed

Q 10 In the boiler mountings, the blow–off cock is fitted at _____.

(A) The top of the boiler shell
(B) The bottom of the boiler shell
(C) The middle of the boiler shell
(D) Near the steam supply line

Q 11 In the Bell–Coleman refrigeration cycle, the temperature of the refrigerant is maximum at the:

(A) End of isentropic expansion
(B) End of isentropic compression
(C) End of constant pressure cooling process
(D) Start of isentropic compression

Q 12 Which of the following is the advantage of axial flow pump?

(A) High head (B) Low volumetric discharge
(C) High volumetric discharge (D) Medium discharge pressure

Q 13 The unit of density in FPS (Foot Pound System) is given by.

(A) lb/ft^1 (B) lb/ft^2
(C) lb/ft^3 (D) lb^2/ft^3

Q 14 Which of the following Statements is INCORRECT about the Benson boiler?

(A) The average operating pressure for the Benson boiler is higher than 200 bar.
(B) Benson boilers can be switched on verty quickly.
(C) The Benson boiler is heavier than other boilers.
(D) In Benson boilers, drums are not used.

Q 15 The continuity equation $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$ is valid for a_____.

(A) steady, 2D, incompressible flow

(B) unsteady, 2D, compressible flow

(C) steady, 2D, compresible flow

(D) unsteady, 2D, incompresible flow

Q 16 The point of intersection of the line of action of the resultant hydrostatic force and the submerged surface is called_____.

(A) centre of mass (B) centre of gravity

(C) centre of pressure (D) centre of buoyancy

Q 17 The dimensional formula for specific gravity is given by:

(A) $M^1L^1T^0$ (B) $M^0L^0T^0$

(C) $M^1L^0T^1$ (D) $M^0L^{-1}T^1$

Q 18 In Bell–Coleman Cycle, the pressure at the end of isentropic compression is same as:

(A) the pressure at the start of isentropic expansion

(B) the pressure at the endof isentropic expansion

(C) the pressure at the start of isentropic compression

(D) the pressure in constant pressure expansion

Q 19 Which of the following types of simple manometers measures the gauge pressure of only incompressible fluids?

(A) Single column manometer

(B) U–tube manometer

(C) Piezometer

(D) Differential U–tube manometer

Q 20 If difference of axial components of velocity at inlet and outlet of a de–Laval turbine is found to be 120 m/s and mass flow rate of steam is 7 kg/s then axial thrust on the rotor is

(A) 7 N (B) 17.14 N

(C) 840 N (D) 120 N

Q 21 The bent tube of a Bourdon tube pressure gauge will change its shape when exposed to variations of _____.

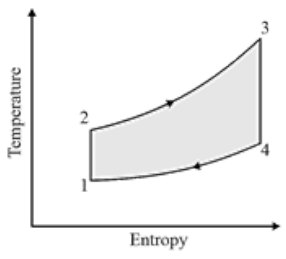
(A) displacement

(B) pressure

(C) voltage

(D) resistance

Q 22 In the given T–S diagram of Otto cycle, which of the following processes is a heat addition process?



(A) 4–1 (B) 3–4

(C) 2–3 (D) 1–2

Q 23 The pressure intensity at a point in a fluid is given as 3.924 N/cm^2. What will be the corresponding height of fluid when the fluid is water?

(A) 4 m of water (B) 2.5 m of water

(C) 6 m of water (D) 3.5 m of water

Q 24 The direction of the friction force is:

(A) in the direction of motion of the body

(B) in the inclined direction of the motion of the body.

(C) in the opposite direction of motion of the body or in the opposite direction of the tendency to move

(D) in the perpendicular direction of the motion of the body

Q 25 Which of the following statements is correct about water–tube and fire–tube boilers?

(A) In case of water–tube boilers, hot gases flow in the tubes.

(B) In case of fire–tube boilers, hot gases are surrounded over the tubes.

(C) In case of fire–tube boilers, hot gases flow in the tubes.

(D) In case of fire–tube boilers, water flow in the tubes.

Q 26 Which of the following statements is true about hot working process?

(A) It is a process of working above recrystallisation temperature of the materials.

(B) It is a process of working above room temperature.

(C) Hot working process of tin is also a cold working process.

(D) All hot working processes must be done above local environment temperature.

Q 27 Heat addition, during the constant pressure process is equal to_____.

(A) Change is entropy

(B) Change in internal energy

(C) Change in enthalpy

(D) Specific heat

Q 28 Which fluid is used to increase the rate of evaporation of the liquid ammonia passing through the evaporator in domestic Electrolux refrigeration system?

(A) Water (B) Ammonia

(C) Hydrogen (D) Mercury

Q 29 What will be the ratio of the pressure intensities of two fluids, one with a liquid column of 0.4 m of water and the other with a liquid column of 0.2 m of an oil of specific gravity 0.8?

(A) $\frac{7}{2}$ (B) $\frac{5}{2}$

(C) 2 (D) $\frac{3}{2}$

Q 30 If the manometric efficiency and mechanical efficiency of a centrifugal pump are 70% and 80% respectively, then the overall efficiency will be:

(A) 80% (B) 75%

(C) 56% (D) 40%

Q 31 Which of the following is a forced circulation type of boiler?

(A) Lancahsire boiler

(B) LaMont boiler

(C) Babcocok & Wilcox boiler

(D) Cochran boiler

Q 32 Which of the following is NOT the part of venturi meter setup?

(A) converging part

(B) Float

(C) Diverging part

(D) Throat

Q 33 Which of the following statements related to rope drives in INCORRECT?

(A) Rope drives have high mechanical efficiency.

(B) Shafts do not require exact alignment.

(C) It is used to transmit power only for shorter distances.

(D) It has good crushing resistance.

Q 34 What will be the specific weight of one litre of petrol of specific gravity 0.7? (Take g = 9.81 m/sec^2)

(A) 6256 N/m^3 (B) 7286 N/m^3

(C) 6867 N/m^3 (D) 5436 N/m^3

Q 35 An impulse turbine is running at 1000 rpm with a net head 600 m. If the discharge through the nozzle is 0.1 m^3/s, then what will be the power available at the nozzle? Take g = 10 m/s^2.

(A) 700 kW (B) 600 kW

(C) 525 kW (D) 450 kW

Q 36 Which of the following is NOT a type of steam separator?

(A) Reciprocating type

(B) Impact or baffle type

(C) Centrifugal type

(D) Reverse current type

Q 37 If the temperature of 'A' is equal to the temperature of 'B' and 'C', then the temperature of 'B' will be equal to the temperature of 'C'. This is known as:

(A) Law of thermal equilibrium

(B) Law of equality of temperature

(C) Joule's law

(D) Zeroth law of thermodynamics

Q 38 In the context of work done of turbine, the power developed by the runner depend on which of the following parameters?

(A) Whirl and blade velocities

(B) Whirl velocity only

(C) Blade velocity

(D) Velocity at the exit of draft tube

Q 39 If the cutter and workpiece movements are in opposite directions, the milling process is known as–

(A) Side milling

(B) Up milling

(C) Face milling

(D) Down milling

Q 40 Ammonia is NOT used in domestic refrigeration and comfort air-conditioning because:

(A) its heat transfer coefficient is very low

(B) lubricating oil is not soluble in ammonia at all

(C) it is not soluble in water

(D) it is toxic and flammable

Q 41 In a Carnot cycle, _____.

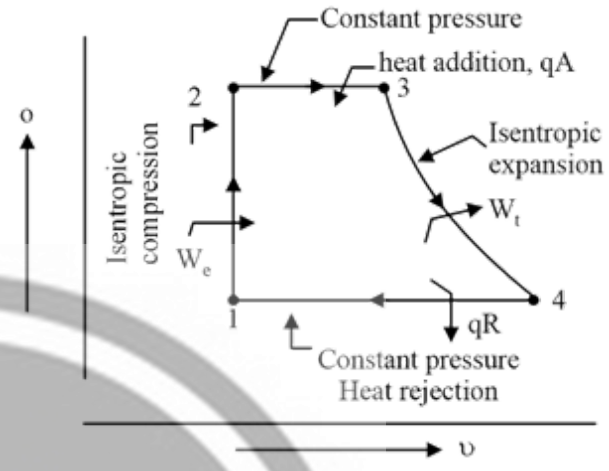
(A) all processes are reversible

(B) all processes are irreversible

(C) only isothermal processes are reversible

(D) only adiabatic processes are reversible

Q 42 The figure shows the P–V diagram of the _____.



(A) otto cycle (B) steam engine

(C) open cycle gas turbine (D) steam turbine

Q 43 0.2 m^3 of an ideal gas at the pressure of 2 MPa and 600 K is expanded isothermally to 5 initial volume. It is then cooled to 300 K at constant volume and then, compressed back polytropically to its initial state. The pressure just after the constant volume process is _____.

(A) 0.8 MPa (B) 0.4 MPa

(C) 2.0 MPa (D) 0.2 MPa

Q 44 Which of the following equations is NOT used in deriving the expression for discharge through the steam nozzle?

(A) Steady flow energy equation

(B) Continuity equation

(C) Newton's equation of viscosity

(D) Momentum equation

Q 45 A cantilever beam carries a uniformly distributed load over a span of 1 m as shown in the figure below. The reactive moment at point A is _____.

(A) 30 kN–m (B) 0 kN–m

(C) 5 kN–m (D) 10 kN–m

Q 46 For a laminar flow through a circular pipe, the wall shear stress across a section is a function of _____.

(A) the pressure gradient $\frac{dp}{dz}$ and the radial coordinate r

(B) the pressure gradient $\frac{dp}{dz}$ and the radius R

(C) only the pressure gradient $\frac{dp}{dz}$

(D) the pressure gradient $\frac{dp}{dz}$ and the axial velocity V_z

Q 47 Which of the following is NOT an example of brittle material?

(A) Aluminium (B) Ceramic materials

(C) High carbons steel (D) Cast iron

Q 48 If the line of stroke of a follower passes through the centre of rotation of a cam, then the cam is called _____.

(A) globoidal cam (B) radial cam
(C) offset cam (D) osicllating cam and follower

Q 49 Which of the following is NOT a merit of dead weight safety valve?

(A) Simplicity of design
(B) Suitable for high pressure boiler
(C) It is a good choice for low–pressure vessels
(D) Gives satifactory performance during operation

Q 50 What pressure head of kerosene of specific gravity 0.8 will be equivalent to a pressure head of 100 m of water?

(A) 100 m (B) 110 m
(C) 125 m (D) 120 m

Q 51 A workpiece is taper turned using lathe, where large diameter of work piece is D and small diameter d. If the length of this workpiece is L, then half angle α is given by

(A) $\tan\alpha = \frac{(D-d)}{3L}$
(B) $\tan\alpha = \frac{(D-d)}{L}$
(C) $\tan\alpha = \frac{(D-d)}{4L}$
(D) $\tan\alpha = \frac{(D-d)}{2L}$

Q 52 Which of the following is the correct item for Double volute in centrifugal pumps?

(A) Flow is separated into two equal streams by two cut water that are 180° apart
(B) Flow separation does not take place
(C) Flow is separated into two equal streams by two cut water that are 90° apart
(D) Flow is separated into two unequal streams by two cut water that are 90° apart

Q 53 In which of the following cycles does heat addition not take place at constant volume?

(A) Otto cycle (B) Lenoir cycle
(C) Dual cycle (D) Diesel cycle

Q 54 Which of the following equations is used to calculate major losses in pipes?

(A) Reynold's equation
(B) Momentum equation
(C) Darcy Weisbach equation
(D) Continuity equation

Q 55 What will be the atmospheric pressure at a location where the barometric reading is 750 mm Hg and the gravitational acceleration is g = 9.81 m/s^2? Assume the density of mercury to be 13,600 kg/m^3.

(A) 10.006 kPa (B) 1000.6 kPa
(C) 100.06 kPa (D) 100.06 kPa

Q 56 Which of the following is an isochoric process?

(A) Heat supplied is zero
(B) Heating of steam in a cylinder containing a sliding piston
(C) Heat is supplied during evaporation
(D) Heating of steam in a closed rigid vessel

Q 57 Functionality of nozzle is that _____.

(A) It produces steam at very low velocity
(B) It produces steam jet at very high velocity
(C) It produces steam at very low pressure
(D) It produces steam jet at very high pressure

Q 58 The velocity of flow between two adjacent streamlines is inversely proportional to the

(A) Volume flow rate
(B) Circulation
(C) Spacing of the streamlines
(D) Specific weight

Q 59 Match the types of refrigerants with their representations.

Type of refrigerant	Representation
1. CFC refrigerants	a. R-22
2. HFC refrigerants	b. R-11
3. HC refrigerants	c. R-134a
4. HCFC refrigerants	d. R-290

(A) 1-a; 2-d; 3-b; 4-c
(B) 1-b; 2-c; 3-d; 4-a
(C) 1-a; 2-c; 3-d; 4-b
(D) 1-b; 2-d; 3-c; 4-a

Q 60 On the stress strain diagram the material Obeys Hooke's law till

(A) Upper yield point
(B) Point of ultimate stress
(C) Elastic limit
(D) Lower yield point

Q 61 According to _____ the intensity of pressure in a liquid at a rest is constant in all directions.

(A) Boyle's law
(B) Hydrostatic law
(C) Newton's law
(D) Pascal's law

Q 62 If the COP of 1 TR ammonia water absorption refrigeration plant is 0.5, then the heat supplied in the generator is _____ (1 TR = 3.5 kW)

(A) 10.5 kW (B) 3.5 kW
(C) 7 kW (D) 1.5 kW

Q 63 Which of the following is a suitable unit for measuring the capacity of refrigeration?

(A) kJ (B) TR
(C) kW/kg (D) kg

Q 64 Which one of the following is correct statements about blade cross sectional fluid flow area from inlet to outlet of a turbine?

(A) Constant for impulse turbine and converging for reaction turbine
(B) Constant for reaction turbine and diverging for impulse turbine

(C) Constant for reaction turbine and converging for impulse turbine
(D) Constant for impulse turbine and diverging for reaction turbine

Q 65 The ratio of the actual mass flow rate to that due to isentropic expansion in the steam nozzle is known as _____.
(A) Mach number
(B) Coefficient of discharge
(C) Nozzle efficiency
(D) Critical pressure ratio

Q 66 If the pressure intensity at a point in a fluid is given as 2.7 N/cm^2, then what will be the pressure head of oil of specific gravity 0.9 at that point? Take g = 10 m/s^2
(A) 3 cm of oil
(B) 30 cm of oil
(C) 3 m of oil
(D) 3 mm of oil

Q 67 If heat imparted by impeller to water to equal to manometric head, the manometric efficiency of the centrifugal pump will be
(A) 75%
(B) 0%
(C) 50%
(D) 100%

Q 68 What is the value of the density of water at 4°C?
(A) 1000 gm/cm^3
(B) 100 gm/cm^3
(C) 1 gm/cm^3
(D) 10 gm/cm^3

Q 69 A thermometer works on the principle of _____.
(A) 3rd law of thermodynamics
(B) Zeroth law of law of thermodynamics
(C) Joule's law
(D) 2nd law of thermodynamics

Q 70 The correct expression for the dimensional formula of volumetric discharge in the fluid equations is given by _____.
(A) L^3T^{-3}
(B) L^2T^{-1}
(C) L^3T^{-2}
(D) L^3T^{-1}

Q 71 The reversible adiabatic process in Mollier chart is represented by _____
(A) A line parallel to the saturated water line
(B) A line parallel to the saturated vapour line
(C) A vertical line
(D) A horizontal line

Q 72 In two stroke petrol engines, the air fuel mixture is prepared.
(A) Inside the trnasfer port
(B) Inside the Crank case chamber
(C) Inside the carburetor and inside the cylinder
(D) Inside the carburetor but outside the cylinder

Q 73 Which of the following about work transfer is not correct?
(A) Work transfer is a boundary phenomenon
(B) Work is a transiesnt phenomenon
(C) Work is given by the area under the curve on p-V diagram in case of non flow process
(D) Work transfer is a thermodynamics property

Q 74 Which of the following pressure measurement devices consists of a hollow metal tube bent like a hook whose end is closed and connected to a dial indicator needle?
(A) Piezoelectric transducers
(B) Pressure transducers
(C) Bourdon tube
(D) Strain gauge pressur transducers

Q 75 Which of the following statements is correct about the forced draught fan used in steam boiler?
(A) The power required by an induced draught fan is equal to that required by a forced draught fan for the same amount of draught
(B) The power required by an induced draught fan is greater than that required than that required by a forced draught fan for the same amount of draught
(C) The power required by an induced draught fan is less that that required by a forced draught fan for the same amount of draught
(D) The power required by an induced draught fan may be greater than or less than that required by a forced draught fan for the same amount of draught

Q 76 The difference in low temperature cascade condenser temperature and high temperature cascade evaporator temperature is called _____
(A) average temperature
(B) temperature overlap
(C) degreee of superheat
(D) degree of subcooling

Q 77 What is the unit of measurement of actual evaporation in steam boilers?
(A) kg fuel burnt/kg water evaporated
(B) kg
(C) kg water evaporated/kg fuel burnt
(D) m^3/kg

Q 78 Which of the following ideal gas processes has the highest polytropic index?
(A) Isentropic process
(B) Isobaric process
(C) Isochoric process
(D) Isothermal process

Q 79 Which of the following statements is correct regarding governor?
(A) It is not a compulsory device of the prime mover
(B) It controls the temperature of the prime mover
(C) It controls acceleration of the prime mover
(D) It controls the mean speed of the prime mover

Q 80 Which among the following options has the same thermal efficiency under ideal conditions (operate within the same temperature)?
(A) Carnot cycle and Otto cycle
(B) Carnot and dual cycle
(C) Carnot cycle and Brayton cycle
(D) Carnot cycle and Sterling cycle

Q 81 Water is flowing steadily at a velocity of 20 m/s through a pipe of diameter 0.2 m. The pressure and elevation at point X are 400 kN/m^2 and 32 m, respectively, while those at another point Y are 300 kN/m^2 and 34 m, respectively. What will be the head loss between the points X and Y?

(Take g = 10 m/s^2)

(A) 10 m (B) 8 m

(C) 4 m (D) 6 m

Q 82 In which percentage generally is lubricating oil mixed with the fuel, which is then inducted into the carburetor in a mist lubricating system?

(A) 3% to 6% (B) Zero

(C) 30% to 40% (D) 40% to 50%

Q 83 Latent heat of vaporization is not _____.

(A) heat required for complete conversion of ice into water

(B) heat added at constant temeprature of 100°C to convert water into steam

(C) heat required for complete conversion of saturated liquid into dry saturated vapour

(D) sum of internal latent heat and external work of evaporation

Q 84 Which of the following evaporators are also known as prime surface evaporators?

(A) Plate evaporators

(B) Shell and tube evaporators

(C) Bare tube coil evaporators

(D) Finned tube evaporators

Q 85 In aqua ammonia absorption refrigeration system, incomplete rectification leads to accumulation of water in

(A) heat exchanger

(B) condenser

(C) absorber

(D) evaporator

Q 86 In the refrigeration system, heat rejection factor is the ratio of _____.

(A) heat rejected to the refrigeration capacity

(B) refrigeration capacity to the work done by compressor

(C) work done by compressor to the refrigeration capacity

(D) load on the condenser to the COP

Q 87 In actual air conditioning applications for R-12 and R-22 refrigerant and operating at a condenser temperature of 40°C and an evaporator temperature of 5°C, the heat rejection factor is about

(A) 2.15 (B) 1.25

(C) 1 (D) 5.12

Q 88 The amount of water striking the runner of the reaction turbine is controlled by _____.

(A) guide mechanism

(B) draft tube

(C) spear arrangement

(D) casing

Q 89 Which of the following statements holds true, according to Kelvin Planck's statements?

(A) It restricts the engine to have mechanical efficiency lesser than unity

(B) Perpetual motion machine of the 2nd kind is impossible

(C) Some amount of heat taken from a source must be rejected to a higher temperature sink

(D) A heat engine must exchange heat from a single heat reservoir

Q 90 Which of the following point angles of a twist drill is used for general purpose work?

(A) 118° (B) 138°

(C) 108º (D) 128°

Q 91 The evaporation of feed water at 100°C into dry and saturated steam at 100°C at atmospheric pressure is known as _____

(A) boiler efficiency

(B) actual evaporation

(C) boiler horsepower

(D) equivalent evaporation

Q 92 A Kaplan turbine has an outside diameter of runner and hub diameter as 4 m and 2 m, respectively. If the velocity of flow at inlet is 8 m/s, then what will be the discharge passing through the turbine?

(A) 6.8 m^3/s (B) 7.536 m^3/s

(C) 75.36 m^3/s (D) 68 m^3/s

Q 93 Which of the following is the correct expression for pressure intensity?

(A) P = 1.5 ρgh

(B) P = 0.5 ρgh

(C) P = 2 ρgh

(D) P = ρgh

Q 94 A closed system undergoes a process in which the work done by the system is 100 J and the internal energy decreases by 50 J. According to the first law of thermodynamics, what is the amount of heat transferred into or out of the system?

(A) –50 J (B) 50 J

(C) –150 J (D) 150 J

Q 95 Which of the following about equilibrium is correct?

(A) Summation of all the forces acting in all the possible directions must be non zero

(B) Summation of all the forces acting in one direction must not be zero

(C) Summation of all the forces acting in all the possible directions must be zero

(D) Summation of all the forces acting in one direction must be zero

Q 96 What is the main function of the condenser in a Rankine cycle power plant?

(A) To condense the steam till it transforms into saturated liquid

(B) To increase the temperature of the cooling water

(C) To decrease the efficiency of the cycle

(D) To increase the pressure of the steam

Q 97 A circular opening, 3 m diameter, in a vertical side of a tank is closed by a disc of 3 m diameter which can rotate about a horizontal diameter and depth of centre of gravity from free surface is 4 m. What will be the total pressure on the disc?

(A) 277.4 kN (B) 175.7 kN

(C) 100 kN (D) 234.89 kN

Q 98 The SI unit of specific heat is

(A) Jkg/K (B) J/kg.K

(C) JK/kg (D) J/kg

Q 99 Which of the following turbine has 50% degree of reaction?

(A) Curtis turbine

(B) Parson's turbine

(C) Hero's turbine

(D) Rateau turbine

Q 100 If 5 litres of certain oil weights 30 BN, then what will be the specific weights of that oil?

(A) $300\ N/m^3$ (B) $3000\ N/m^3$

(C) $600\ N/m^3$ (D) $6000\ N/m^3$

Answer Key

Q1	C
Q2	B
Q3	B
Q4	C
Q5	A
Q6	C
Q7	D
Q8	A
Q9	B
Q10	B
Q11	B
Q12	C
Q13	C
Q14	C
Q15	A
Q16	C
Q17	B
Q18	A
Q19	C
Q20	C
Q21	B
Q22	C
Q23	A
Q24	C
Q25	C
Q26	A
Q27	C
Q28	C
Q29	B
Q30	C
Q31	B
Q32	B
Q33	C
Q34	C
Q35	B
Q36	A
Q37	D
Q38	A
Q39	B
Q40	D
Q41	A
Q42	C
Q43	D
Q44	C
Q45	C
Q46	B
Q47	A
Q48	B
Q49	B
Q50	C
Q51	D
Q52	A
Q53	D
Q54	C
Q55	C
Q56	D
Q57	B
Q58	C
Q59	B
Q60	C
Q61	D
Q62	C
Q63	B
Q64	A
Q65	B
Q66	C
Q67	D
Q68	C
Q69	B
Q70	D
Q71	C
Q72	D
Q73	D
Q74	C
Q75	B
Q76	B
Q77	C
Q78	C
Q79	D
Q80	D
Q81	B
Q82	A
Q83	D
Q84	C
Q85	C
Q86	A
Q87	C
Q88	A
Q89	B
Q90	A
Q91	D
Q92	C
Q93	D
Q94	B
Q95	C
Q96	A
Q97	A
Q98	B
Q99	B
Q100	D

Hints & Solutions

Q 1 Text Solution:

COP of Carnot refrigerant is given by

$(COP)_{carnot} = \frac{T_L}{T_H - T_L}$

or

$\frac{1}{\frac{T_H}{T_L} - 1}$

As $T_L \rightarrow$ High $\rightarrow$ $(T_H/T_L - 1) \rightarrow$ Low

It gives high COP.

Q 2 Text Solution:

For a closed system, from thermodynamics first law

$\oint Q = \Delta U + \oint w$

Given data:

Q = 50 kJ

m = 5 kg

W = 75 kJ

Put values in equatiion

50 = ΔU + 75

ΔU = –25 kJ

For closed system

$\Delta U = mc_v \Delta T$

$mc_v \Delta T = -25$

5 (0.718) $\Delta T = -25$

[$\Delta T = -7°$]

So the temperature of the air will decrease by 7°C.

Q 3 Text Solution:

A turbine stage consists of a nozzle and blade, so the gross stage efficiency is given by

$\eta_{gs} = \eta_{nozzle} \times \eta_{blade}$

Given data:

η_{gs} = 65% or 0.65

η_{blade} = 78% or 0.78

Thus,

0.65 = $\eta_{nozzle} \times 0.78$

η_{nozzle}= 0.8333 or η_{nozzle} = 83.33%

Q 4 Text Solution:

In case of pure Torrision,

$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$

Stress developed in solid shaft

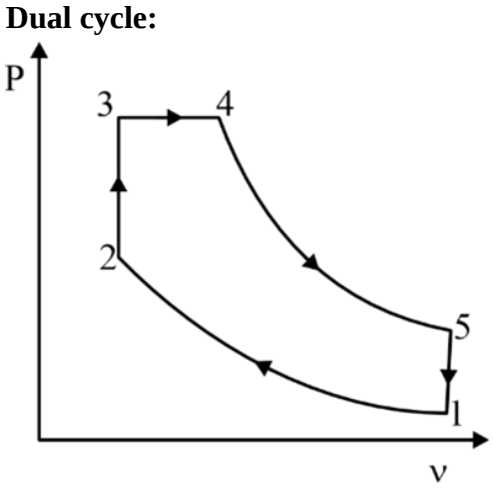
$\tau = \frac{T}{J} \cdot r$

or $\boxed{\tau = \frac{16T}{\pi d^3}}$

$\because J_s = \frac{\pi}{32} d^4$

Q 5 Text Solution:

Dual cycle:



Process 1-2 → Isentropic Compression

Process 2-3 → Constant Volume heat addition

Process 3-4 → Constant Pressure heat addition

Process 4-5 → Isentropic Expansion

Process 5-1 → Constant Volume heat Rejection

Thus in case of dual cycle, heat addition takes place in both isochronic and isobaric process.

Q 6 Text Solution:

An air pre-heater is a device used in power plants and industrial furnaces to recover heat from the flue gases and use it to preheat the air before it enters the combustion chamber or furnace. This helps improve the system's thermal efficiency by increasing the temperature of the incoming air, which reduces the amount of fuel needed to achieve the desired furnace temperature.

Q 7 Text Solution:

In extrusion, a heated billet or slug of metal is forced through a die orifice to create a continuous, elongated shape with a uniform cross-section corresponding to the die's shape. This process is commonly used in the production of various metal products, such as rods, bars, tubes, and profiles.

Q 8 Text Solution:

Among the given options, the Carnot cycle has the maximum efficiency for the same temperature limits. The Carnot cycle is an idealized thermodynamic cycle that provides the upper limit of efficiency for a heat engine operating between two temperature reservoirs. It is known for its maximum efficiency and is often used as a reference for comparing the efficiency of other cycles. The efficiency of a Carnot cycle depends only on the temperature difference between the hot and cold reservoirs and is higher than that of the other cycles mentioned.

Q 9 Text Solution:

In a two-stroke engine, the intake and exhaust processes are controlled by ports (not valves, as in four-stroke engines). Scavenging is the process of replacing the exhaust gases in the cylinder with a fresh air-fuel mixture. This is achieved by opening both the transfer port (for intake) and the exhaust port simultaneously to allow fresh mixture to enter and exhaust gases to exit the cylinder. This process helps ensure proper air-fuel mixing and efficient combustion in a two-stroke engine.

Q 10 Text Solution:

The blow-off cock is used to discharge or blow off impurities and sediments (such as sludge, scale, and other contaminants) that accumulate at the bottom of the boiler. It is a valve located at the lowest point of the boiler shell, allowing these impurities to be periodically removed from the system, ensuring the boiler operates efficiently and safely.

Q 11 Text Solution:

The Bell-Coleman refrigeration cycle, also known as the reverse Brayton cycle, is used in air liquefaction and refrigeration processes. During the compression process (isentropic compression), the temperature of the refrigerant increases significantly, and it reaches its maximum value at the end of this compression process. This high-temperature gas is then cooled to lower temperatures during subsequent stages of the cycle, ultimately resulting in the desired cooling or refrigeration effect.

Q 12 Text Solution:

Axial flow pumps are designed to move a large volume of fluid with a relatively low head (pressure) requirement. They are well-suited for applications where the primary goal is to achieve a high flow rate, such as in irrigation, drainage, or circulating large volumes of water in industrial processes. Axial flow pumps are efficient at moving a significant quantity of fluid, making them advantageous when high volumetric discharge is needed.

Q 13 Text Solution:

Density is defined as $\rho = \frac{\text{mass}}{\text{volume}}$

In FPS system mass $\rightarrow$ lb

length $\rightarrow$ ft

thus,

unit of density will be lb/ft^3

Q 14 Text Solution:

Benson boilers are known for their lightweight design and rapid startup capabilities. They are often used in applications where quick steam generation and efficient performance are required. Benson boilers do not have traditional steam drums, which contributes to their compact and lightweight design.

Q 15 Text Solution:

Continuity equation in Cartesian coordinates is given by

$$\frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x}\left(\rho u\right) + \frac{\partial}{\partial y}\left(\rho v\right) + \frac{\partial}{\partial z}\left(\rho w\right) = 0$$

For steady and incompressible flow, we can write

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

For 2-D flow

$$\boxed{\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0}$$

So, the given continuity equation is valid for steady, 2D, incompressible flow.

Q 16 Text Solution:

The center of pressure is an important concept in fluid mechanics and hydrostatics. It represents the point where the total hydrostatic force on a submerged surface acts. This point can vary depending on the shape and orientation of the submerged surface.

Q 17 Text Solution:

Specific gravity is defined as:

$$S \cdot G = \frac{\text{weight density of fluid}}{\text{weight density of standard fluid}}$$

So, basically, specific gravity is a dimensionless unit.

The dimensional formula for specific gravity can be written as $M^0L^0T^0$.

Q 18 Text Solution:

The Bell-Coleman refrigeration cycle is a thermodynamic process that consists of isentropic compression and isentropic expansion. During these compression and expansion processes, the pressure at the end of isentropic compression is the same as the pressure at the beginning of isentropic compression. This ensures that the cycle operates effectively to provide cooling or refrigeration.

Q 19 Text Solution:

Piezometers is the type of simple manometers that use to measure the gauge pressure of incompressible fluids. It can not be use to measure gauge pressure of gases.

Q 20 Text Solution:

Axial thrust is given by

$$F_T = \dot{m}(V_{f_1} - V_{f_2})$$

Given

$$V_{f_1} - V_{f_2} = 120 \text{ m/s}$$

$$\dot{m} = 7 \text{ kg/s}$$

Put values in equation.

$F_T = 7 \times 120$

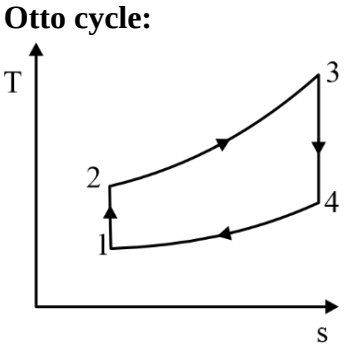
$F_T = 840$ N

Q 21 Text Solution:

Bourdon tube pressure gauges are designed to measure pressure by the deformation of a curved, hollow tube. When pressure is applied, the tube tends to straighten or uncoil, and this motion is used to indicate the pressure on a dial or scale. Variations in pressure cause the Bourdon tube to change its shape, allowing for the measurement of pressure.

Q 22 Text Solution:

Otto cycle:



Process 1-2 ® Isentropic compression

Process 2-3 ® Constant volume heat addition

Process 3-4 ® Isentropic Expansion

Process 4-1 ® Constant volume heat rejection

Q 23 Text Solution:

Given data:

$P = 3.924$ N/cm^2

or $P = 3.924 \times 10^4$ N/m^2

In terms of water head

$P = r_w g h_w = 3.924 \times 10^4$

$h_w = \frac{3.924 \times 10^4}{\rho_w g} \Rightarrow \frac{3.924 \times 10^4}{1000 \times 9.81}$

$\boxed{h_w = 4 \text{ m}}$

Q 24 Text Solution:

Friction is a force that opposes the relative motion or the tendency for motion between two surfaces in contact. The frictional force acts in the opposite direction to the applied force or motion, which is why it's often referred to as a "opposite direction of motion" or "opposite direction of the tendency to move." This force is essential in preventing objects from sliding or moving uncontrollably and plays a crucial role in everyday physics.

Q 25 Text Solution:

In case of fire-tube boilers, hot gases flow in the tubes.

In fire-tube boilers, hot gases from the combustion process flow through the tubes, and water surrounds the tubes.

Q 26 Text Solution:

Hot working involves deforming a material above its recrystallization temperature, which is the temperature at which the material's internal structure is changed, and it becomes more malleable. Hot working processes include forging, extrusion, and rolling, among others, and they are typically performed at elevated temperatures to reduce the material's strength and improve its formability.

Q 27 Text Solution:

In a constant pressure process, the heat added to or removed from a system is equal to the change in enthalpy (ΔH) of the system. This is expressed by the equation:

$Q = \Delta H$

Q 28 Text Solution:

Since Hydrogen is the lightest gas so it is used to increase the rate of evaporation of liquid ammonia passing through the evaporator in domestic electrolux refrigeration system.

Q 29 Text Solution:

Pressure due to water column:

$P_w = r_w g h_w$

Pressure due to oil column:

$P_o = r_o g h_o$

Ratio $\frac{P_w}{P_o} = \frac{\rho_w g h_w}{\rho_o g h_o}$

$= \frac{1000 \times 9.81 \times 0.4}{0.8 \times 1000 \times 9.81 \times 0.2}$

$\boxed{\frac{P_w}{P_o} = \frac{5}{2}}$

Q 30 Text Solution:

Overall efficiency of pump is given by:

$h_o = h_m \times h_{mech}$

$= 0.7 \times 0.8$

$h_o = 0.56$

or $h_o = 56\%$

Q 31 Text Solution:

The LaMont boiler is a type of forced circulation boiler, where water is circulated by a pump, ensuring a consistent flow of water and steam throughout the system.

Q 32 Text Solution:

Venturimeters are used to measure the flow rate of fluids and consist of three main parts: the converging section, the throat (the narrow part where the pressure is lowest), and the diverging section. A float is not a standard component of a venturimeter setup. Instead, venturimeters primarily use the pressure difference between the throat and the converging/diverging sections to measure the flow rate.

Q 33 Text Solution:

Rope drives can be used to transmit power for both short and long distances, and they are often employed in applications where flexibility and the ability to transmit power over greater distances are advantageous. The other statements are generally correct. Rope drives can have high mechanical efficiency, do not require exact alignment like some other types of drives, and have good crushing resistance.

Q 34 Text Solution:

Given data:

Specific gravity = 0.7

Specific weight = density × acceleration due to gravity

$w = rg$

$= 0.7 \times 1000 \times 9.81$

$w = 6867\ N/m^3$

Q 35 Text Solution:

Given data:

$N = 1000$ rpm

$H = 600$ m

$Q = 0.1\ m^3/s$

$g = 10\ m/s^2$

Power available at Nozzle

(Assuming water as working fluid)

$W_P = 600 \times 10^3$ watt

or $W_P = 600$ kW

Q 36 Text Solution:

Reciprocating steam separators are not commonly used in the same way as the other types mentioned. Steam separators are typically designed to remove moisture or impurities from the steam in various industrial applications, and the most common types are impact or baffle type, centrifugal type, and reverse current type.

Q 37 Text Solution:

The zeroth law of thermodynamics states that if two systems are each in thermal equilibrium with a third system, they are in thermal equilibrium with each other. It establishes the concept of temperature and

thermal equilibrium, allowing us to compare temperatures between different systems.

Q 38 Text Solution:

Whirl velocity refers to the tangential component of velocity, and blade velocity is the velocity of the rotating blades in a turbine. These velocities are significant factors in understanding the performance and operation of a turbine.

Power developed by turbine/kg = $V_w.u$

Here V_w = Whirl velocity

u = Blade velocity

Q 39 Text Solution:

In up-milling (or conventional milling), the cutter rotates against the direction of the feed of the workpiece. This is the milling process where the cutter and workpiece move in opposite directions. Up milling is often used in certain applications but may produce a rougher surface finish compared to down milling. Thank you for pointing out the error.

Q 40 Text Solution:

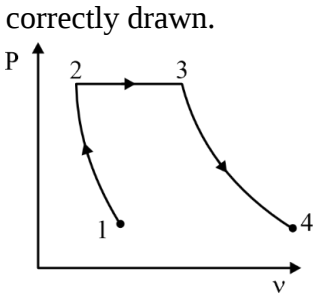
Ammonia is an effective refrigerant, but its toxicity and flammability make it less suitable for household applications, where safety is a primary concern. In domestic refrigeration and air conditioning, more commonly used refrigerants like hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs) are preferred due to their lower toxicity and flammability.

Q 41 Text Solution:

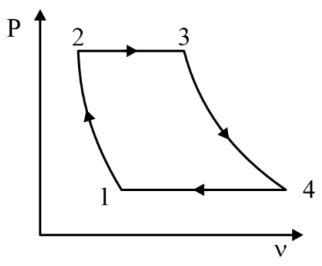
A Carnot cycle is an idealized thermodynamic cycle where all the processes are reversible. It serves as a theoretical standard for the maximum possible efficiency of a heat engine operating between two temperature reservoirs.

Q 42 Text Solution:

The given power cycle shows the closed gas turbine. Also the isentropic compression process is not correctly drawn.



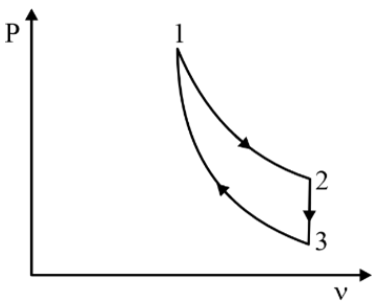
Open cycle gas Turbine



Closed cycle gas Turbine

Q 43 Text Solution:

Given data:



$V_1 = 0.2\ m^2$

$P_1 = 2$ MPa

$T_1 = 600$ K

$V_2 = 5V_1 = 1\ m^3$ $T_3 = 300$ K

For isothermal process (1 - 2)

$T_1 = T_2 = 600$ K

$$P_2 = \frac{P_1V_1}{V_2}$$

$$P_2 \Rightarrow \frac{2\times0.2}{1}$$

$[P_2 = 0.4$ MPa]

For constant volume (2 - 3)

$P \mu T$

$$\frac{P_3}{P_2} = \frac{T_3}{T_2}$$

$$\frac{P_3}{0.4} = \frac{300}{600}$$

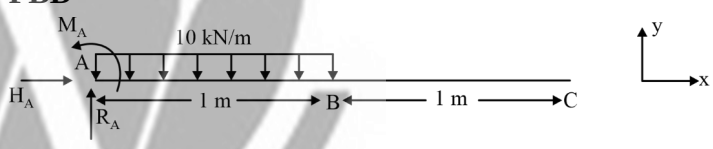
$P_3 = 0.2$ MPa

Q 44 Text Solution:

Newton's equation of viscosity is not used in deriving the expression of discharge through the steam nozzle.

Q 45 Text Solution:

FBD



Using equation of equillibrium

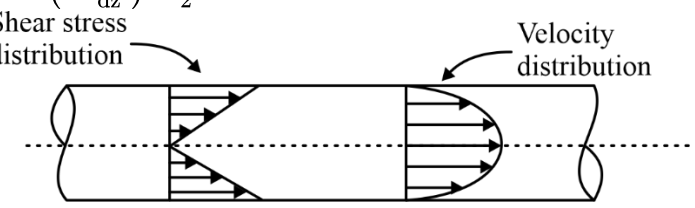
$$M_A - (10 \times 1)\left(\frac{1}{2}\right) = 0$$

$M_A = 5$ kN.m

Q 46 Text Solution:

In laminar flow through a circular pipe, shear stress is given by

$$\tau = \left(-\frac{dP}{dz}\right) \cdot \frac{R}{2}$$



So shear stress is function of

$$\boxed{\tau = f\left(\left(\frac{dP}{dz}\right), R\right)}$$

Q 47 Text Solution:

Aluminum is a ductile material, which means it can deform plastically without fracturing easily. In contrast, ceramic materials, high carbon steel, and cast iron are typically considered brittle materials, as they tend to fracture rather than deform under stress.

Q 48 Text Solution:

In a radial cam, the follower's motion is in a direction radial to the center of rotation of the cam. This is one of the basic types of cam profiles used in cam and follower mechanisms.

Q 49 Text Solution:

Merit of dead weight safety value:

- Simple design
- Satisfactory performance during operation
- Can not be easily tempered from pressure adjustment view.

Demerits of dead weight safety value:

- Not suitable for boiler where extensive vibration and movement are experienced. Mostly useed for stationary boiler.
- Not suitable for high pressure boiler.

Q 50 Text Solution:

Given data:

Specific gravity = 0.8

h_w = 125 m

Head of kerosine

$h_k r_k = h_w r_w$ (r_w = 1000 kg/m^3)

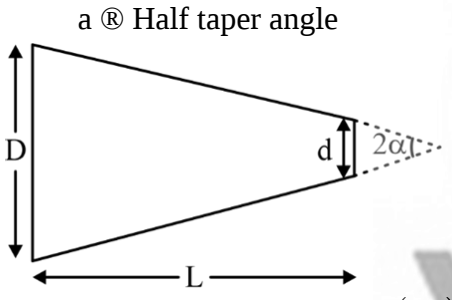
$h_k = \frac{h_w \rho_w}{\rho_k} \Rightarrow \frac{100 \times 1000}{0.8 \times 1000}$

h_k = 125 m

Q 51 Text Solution:

Here 2a ® Full taper angle

a ® Half taper angle



From figure we can write $\tan\left(\frac{2\alpha}{2}\right) = \frac{(D-d)/2}{L}$

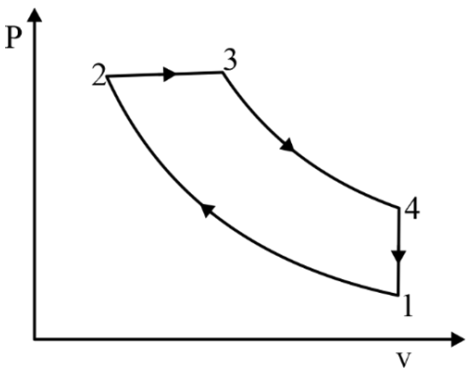
$$\boxed{\tan\alpha = \frac{D-d}{2L}}$$

Q 52 Text Solution:

In a double volute design, the volute is divided into two equal halves (180° apart) to help balance the hydraulic forces on the impeller, which reduces radial forces and helps improve the pump's overall performance and efficiency. This design is used to minimize radial thrust, leading to better stability and reduced wear on the bearings.

Q 53 Text Solution:

Diesel cycle:



Process 1-2 Þ Isentropic compression

Process 2-3 Þ Isobaric heat addition

Process 3-4 Þ Isentropic expansion

Process 4-1 Þ Isochronic heat rejection

So on diesel cycle, heat addition is not taking place at constant volume.

Q 54 Text Solution:

The Darcy-Weisbach equation is commonly used to calculate the head loss (major losses) in a pipe due to friction. It relates the head loss, fluid velocity, pipe diameter, pipe length, and the Darcy friction factor. This equation is a fundamental tool in fluid mechanics and pipe flow analysis.

Q 55 Text Solution:

Given data:

h = 750 mm of Hg

r = 13600 kg/m^3

Atmospheric Pressure

P_{atm} = rgh

Þ $13600 \times 9.81 \times \frac{750}{1000}$

$P_{atm} = 100.06 \times 10^3$ Pa

or P_{atm} = 100.06 kPa

Q 56 Text Solution:

In a closed rigid vessel, the volume remains constant, and if heat is added to the system, it will result in an isochoric process with an increase in pressure and temperature. The other options involve changes in volume, and thus, they do not represent isochoric processes.

Q 57 Text Solution:

Nozzles are designed to accelerate the flow of a fluid, such as steam or a gas, by converting the pressure energy into kinetic energy, resulting in a high-velocity jet. This principle is used in various applications, including steam turbines and rocket engines, to achieve high-speed fluid flow.

Q 58 Text Solution:

In fluid dynamics, the spacing between streamlines is directly related to the fluid velocity. Closer streamlines represent higher fluid velocity, and more spaced-out streamlines represent lower fluid velocity. So, the velocity of flow is inversely proportional to the spacing of the streamlines.

Q 59 Text Solution:

Type of Refrigerant	Representation
CFC refrigerants	R – 11
HFC refrigerants	R – 1340
HC refrigerants	R – 290
HCFC refrigerants	R - 22

Q 60 Text Solution:

Hooke's law states that stress is directly proportional to strain within the elastic limit of a material. Beyond the elastic limit, the material will exhibit plastic deformation, and the relationship between stress and strain is no longer linear.

Q 61 Text Solution:

The intensity of pressure in a liquid at rest is constant in all directions. Pascal's law states that when a change in pressure is applied to an enclosed fluid, the pressure change is transmitted undiminished to all portions of the fluid and to the walls of its container. This principle is fundamental in fluid mechanics and has various practical applications, including in hydraulic systems.

Q 62 Text Solution:

Given data:

Refrigeration capacity

R.E = 1 TR or 3.5 kW

COP = 0.5

COP for refrigeration is defined as

$$\text{COP} = \frac{\text{R.E}}{\text{Q}_{\text{supplied}}}$$

$$0.5 = \frac{3.5}{\text{Q}_{\text{supplied}}}$$

$\text{Q}_{\text{supplied}}$ = 7 kW

Q 63 Text Solution:

The capacity of refrigeration is measured in Ton of Refrigeration (TR)

- 1 TR is defined as the amount of heat transferred to freeze 1 ton of ice at 0°C in 24 hours.

1 TR = 3.5 kW or 210 kJ/min

Q 64 Text Solution:

The blade cross-sectional fluid flow area from inlet to outlet of turbine is constant for impulse turbine while it converge for reaction turbine to get reaction effect.

Q 65 Text Solution:

The asked question is not complete.

- The question may be asked for nozzle efficiency which is defined as the ratio of the actual enthalpy drop in the nozzle to the enthalpy drop due to isentropic expansion.
- Coefficient of discahrge (C_D) = $\frac{\text{Actual discharge}}{\text{Ideal discharge}}$
- Mach number (Ma) = $\frac{\text{Actual velocity}}{\text{Sonic velocity}}$
- Critical pressure ratio is defined for the nozzle for which we get a maximum discharge. It is given by

$$\frac{\text{P}_2}{\text{P}_1} = \left(\frac{2}{\text{n}+1}\right)^{\frac{\text{n}}{\text{n}-1}}$$

Q 66 Text Solution:

Given data:

P = 2.7 N/cm^2 or 2.7 × 10^4 N/m^2

Specific Gravity = 0.9

g = 10 m/s^2

Pressure head

$$\text{h} = \frac{\text{P}}{\rho\text{g}} \Rightarrow \frac{2.7\times10^4}{0.9\times10^3\times10}$$

$$\boxed{\text{h} = 3\ \text{m}}$$

Q 67 Text Solution:

Manometer efficiency is given by

$$\eta_{\text{m}} = \frac{\text{head imparted by impeller}}{\text{Manometric head}}$$

$\because$ head imparted by impeller = manometric head

So manometric efficiency

h_m = 1 or 100%

Q 68 Text Solution:

The density of water at 4°C is approximately 1 gram per cubic centimeter (1 gm/cm^3).

Q 69 Text Solution:

The Zeroth Law of Thermodynamics states that if two systems are each in thermal equilibrium with a third system, they are in thermal equilibrium with each other. This principle is fundamental for the operation of thermometers, allowing them to measure temperature by comparing the thermal equilibrium of the thermometer with the system being measured.

Q 70 Text Solution:

We know that,

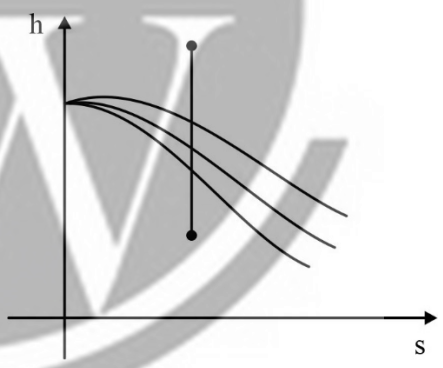
Volumetric discharge = cross-sectional area × velocity of fluid.

Q = A × V

'Q' is measured in m^3/sec.

$\therefore$ dimensional formula = [M^{0}L^{3}T^{-1}]

Q 71 Text Solution:



In a Mollier chart, a reversible adiabatic process is represented by a vertical line. Adiabatic processes are characterized by the absence of heat exchange with the surroundings, and in a Mollier chart, they are depicted as vertical lines.

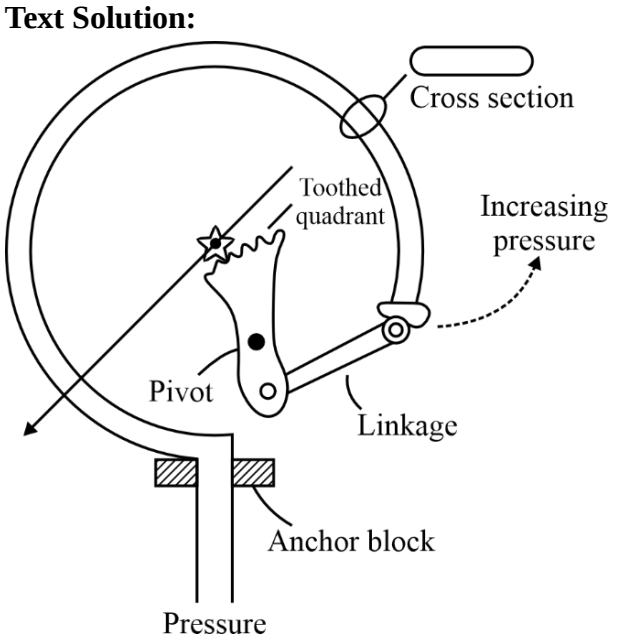
Q 72 Text Solution:

In a two-stroke petrol engine, the air Fuel mixture is prepared Inside the carburetor but outside the cylinder.

Q 73 Text Solution:

Work is not a thermodynamic property. Work is a process-dependent quantity related to the energy transfer that occurs during a thermodynamic process. It is not an inherent property of the system; rather, it depends on the path of the process. Thermodynamic properties, on the other hand, are characteristics of a system that depend only on the current state of the system and are independent of the process history.

Q 74 Text Solution:



A Bourdon tube is a common mechanical pressure-measuring device that utilizes a curved, hollow metal tube to measure pressure. When pressure is applied to the inside of the tube, it tends to straighten out, and this movement is translated into a rotational movement of a pointer or dial indicator, which can be read to determine the pressure.

Q 75 Text Solution:

In a forced-draught system, the fan is placed at the inlet of the boiler, pushing air into the system at a pressure higher than atmospheric pressure. In contrast, an induced-draught system has the fan at the outlet, creating a negative pressure or suction to draw air out of the system. The induced-draught fan requires more power to overcome this suction effect and maintain the required draught compared to a forced-draught fan for the same draught level.

Q 76 Text Solution:

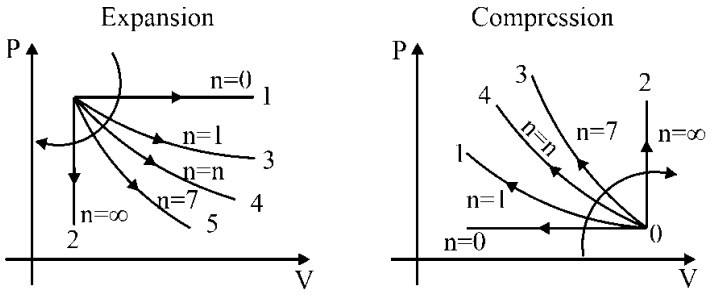
The difference between low-temperature cascade condenser temperature and high-temperature cascade evaporator temperature is called "temperature overlap." Therefore, the correct answer is temperature overlap.

Q 77 Text Solution:

The unit of measurement for actual evaporation in steam boilers is typically expressed as kilograms of water evaporated per kilogram of fuel burnt.

∴ actual evaporation in steam boilers = kg water evaporated / kg fuel burnt

Q 78 Text Solution:



The polytropic index (n) for an ideal gas process is given by the equation:

n = Cp\Cv

where:

Cp is the specific heat at constant pressure.

Cv is the specific heat at constant volume.

Among the given options:

1. Isentropic process: An isentropic process is an adiabatic and reversible process, where n is the highest.

2. Isobaric process: In an isobaric process, C_p, and C_v are equal, so n = 1.

3. Isochoric process: In an isochoric process, there is no change in volume (C_v is infinity for an isochoric process), so n = ∞.

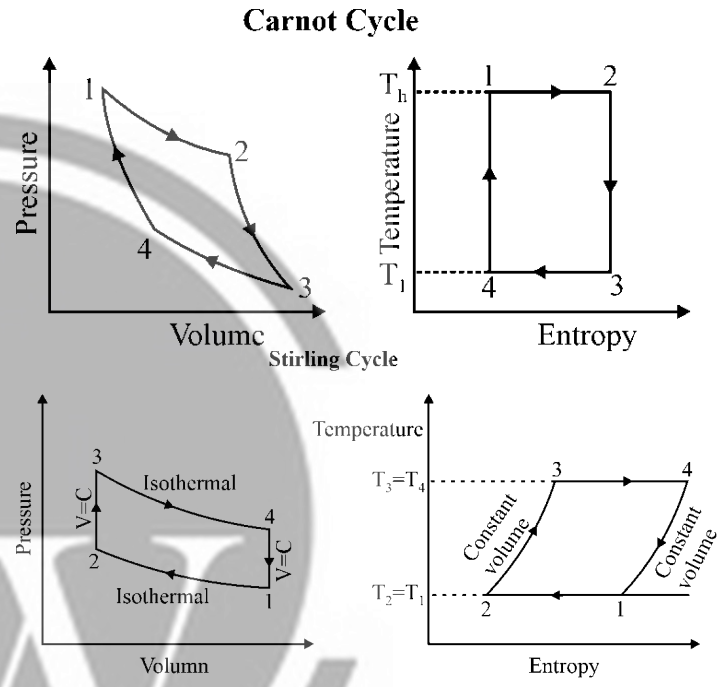
4. Isothermal process: In an isothermal process, C_p and C_v are equal, so n = 1.

Therefore, the process with the highest polytropic index is an isochoric process (n = ∞).

Q 79 Text Solution:

A governor is a device used to regulate the speed of an engine or machine by controlling the supply of fuel or working fluid to the prime mover. Its primary function is to maintain a relatively constant mean speed of the prime mover (such as an engine) by adjusting the fuel or energy input based on changes in load or other operating conditions. The governor achieves this by controlling the flow of fuel or energy to the engine, which in turn affects the speed of the prime mover.

Q 80 Text Solution:



The thermal efficiency of a thermodynamic cycle is given by:

Efficiency $=1-T_{hot}/T_{cold}$

Where:

• T_{cold} is the temperature of the cold reservoir (in Kelvin)

• T_{hot} is the temperature of the hot reservoir (in Kelvin)

Given that the cycles operate within the same temperature range, the cycles with the same thermal efficiency would be those that have the same T_{cold} and T_{hot}.

The Carnot cycle is known to have the maximum thermal efficiency and operates between two temperature reservoirs, making it an ideal reference.

Q 81 Text Solution:

Given data:

$V_x = V_y = V = 20$ m/s

$d_x = d_y = d = 0.2$ m

$P_x = 400$ kN/m^2 = 400 kPa

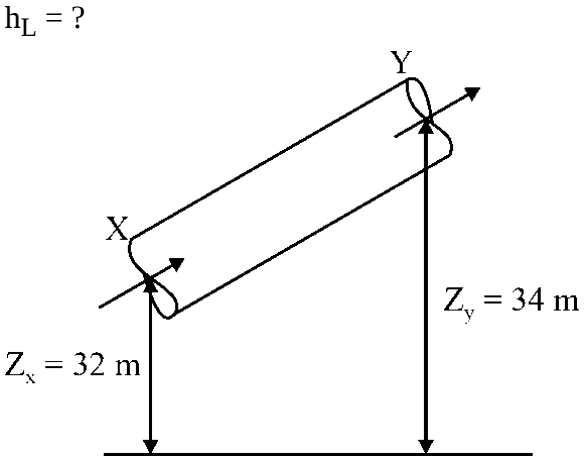
$Z_x = 32$ m

$P_y = 300$ kN/m^2 = 300 kPa

$Z_y = 34$

$g = 10$ m/s^2

h_L = ?



Applying Bernoulli's equation between x and y.

$$\left(\frac{p}{\rho g}+\frac{v^2}{2g}+Z\right)_x=\left(\frac{p}{\rho g}+\frac{v^2}{2g}+Z\right)_y+h_L$$

For uniform diameter pipe. From continuity equation.

$A_xV_x = A_yV_y$

$V_x = V_y = V$

$$\therefore h_L=\left(\frac{p}{\rho g}+Z\right)_x-\left(\frac{p}{\rho g}+Z\right)_y \qquad (\because V_x = V_y)$$

$$h_L=\left(\frac{400\times10^3}{1000\times10}+32\right)-\left(\frac{300\times10^3}{1000\times10}+34\right)$$

$$\boxed{h_L = 8\ m}$$

Q 82 Text Solution:

In a mist lubricating system where, lubricating oil is mixed with the fuel and then inducted into the carburetor, the typical percentage of lubricating oil mixed with the fuel is generally around 3% to 6%.

Q 83 Text Solution:

The latent heat of vaporization is the heat energy required to change a substance from a liquid to a gas at a constant temperature and pressure. It is the heat added to the substance to breaks the intermolecular bonds and change its phase from liquid to gas, without a change in temperature.

The correct understanding of the options is as follows:

- Option 1 is correct: It refers to the heat required for the complete conversion of ice into water at a constant temperature of 0°C.
- Option 2 is correct: It refers to the heat added at a constant temperature of 100°C to convert water into steam.
- Option 3 is correct: It refers to the heat required for the complete conversion of a saturated liquid into dry saturated vapour, typically at a constant temperature and pressure.

Q 84 Text Solution:

Bare-tube coil evaporators are often referred to as prime-surface evaporators. The term "prime surface" indicates that the surface directly in contact with the substance to be cooled (such as air or water) is the primary surface for heat transfer. These evaporators typically have bare tubes without fins, and the surface of the tubes is the main surface for heat exchange during the evaporation process.

Q 85 Text Solution:

Incomplete rectification in the rectifier can cause an excess of water to carry over into the condenser, affecting the efficiency and proper functioning of the refrigeration system.

Q 86 Text Solution:

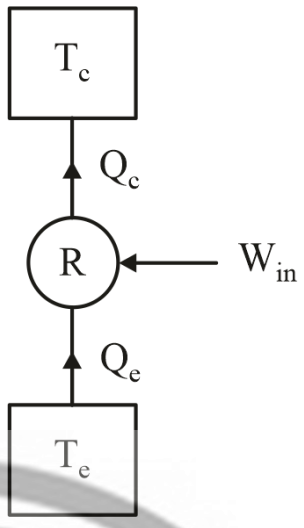
The heat rejection factor in a refrigeration system is defined as the ratio of heat rejected (Q_r) to the refrigeration capacity (Q_c):

Heat Rejection Factor = Q_r / Q_C

It provides a measure of how much heat is rejected from the refrigeration system compared to the refrigeration capacity achieved.

Q 87 Text Solution:

Given data:



$T_c = 40°C = 313\ K$

$T_e = 5°C = 278\ K$

HRF = ?

Assuming condition of carnot refrigeration

$$COP=\frac{T_e}{T_c-T_e}=\frac{Q_e}{Q_c-Q_e}$$

$$COP=\frac{278}{313-278}$$

$COP = 7.942 \approx 8$

We know that,

$$\text{Heat rejection factor (HRF)} = 1+\frac{1}{COP}$$

$$\therefore HRF = 1+\frac{1}{8}$$

$$\boxed{HRF = 1.25}$$

Q 88 Text Solution:

The guide mechanism in a reaction turbine helps regulate the flow and direction of water entering the runner, allowing for efficient and controlled operation of the turbine. It directs the water flow onto the runner blades, optimizing the turbine's performance based on various factors such as load demand and operating conditions.

Q 89 Text Solution:

Perpetual motion machine of the 2nd kind is impossible:

Kelvin-Planck's statement is one of the statements of the second law of thermodynamics and it states that it is impossible to construct a perpetual motion machine of the second kind, a machine that operates in a cycle and delivers work while receiving heat from a single thermal reservoir. In practical terms, it implies that not all the heat taken in by a heat engine can be converted into work, and some amount of heat must be rejected to a lower-temperature reservoir.

Q 90 Text Solution:

A 118° point angle is the standard point angle for twist drills and is suitable for a wide range of materials and applications. It is commonly used for drilling into materials such as metal, wood, plastics, and more.

Q 91 Text Solution:

Actual evaporation refers to the quantity of steam generated from water at a given temperature and pressure. In this case, it's the evaporation of feedwater at 100°C into dry and saturated steam at 100°C at atmospheric pressure. Boiler efficiency and equivalent evaporation are related concepts but are not

specifically referring to this particular process. Boiler horsepower is a measure of the boiler's capacity to produce steam.

Q 92 Text Solution:

Given data:

D = 4 m

d_h = 2 m

V_f = 8 m/s

Q = ?

We know that,

$Q = A_f \times V_f$

$Q = \frac{\pi}{4}\left(D^2 - d_h^2\right) \times 8$

$Q = \frac{\pi}{4} \times \left(4^2 - 2^2\right) \times 8$

$\boxed{Q = 75.36\ m^3/s}$

Q 93 Text Solution:

From pascal's law.

Pressure intensity (P) = ρgh

where,

P → pressure intensity

ρ → density of fluid

g → acceleration due to gravity

h → head

Q 94 Text Solution:

Given data:

δW = 100 J

dU = – 50 J

δQ = ?

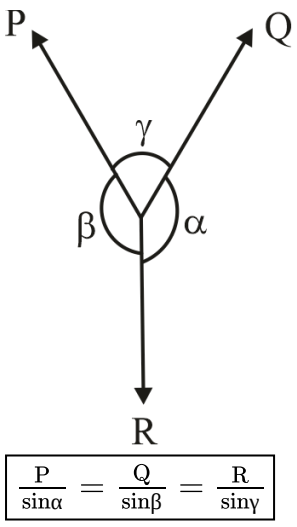
From first law of thermodynamics for closed system.

i.e. δQ = δU + δW

δQ = – 50 + 100

δQ = 50 J

Q 95 Text Solution:



$\boxed{\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}}$

In a state of equilibrium, the net force acting on an object in all possible directions must be zero. This is often summarized as the condition that the vector sum of forces must equal zero for an object to be in equilibrium. This means that the forces are balanced and there is no net force causing acceleration in any direction.

Q 96 Text Solution:

The condenser plays a crucial role in the Rankine cycle by receiving the low-pressure, high-temperature steam from the turbine and cooling it down, causing it to condense into a saturated liquid. This process allows for efficient use of the cooling medium (usually water) to extract heat from the steam, preparing it for re-entry into the boiler to be converted back into steam and continue the cycle.

Q 97 Text Solution:

$Given,$
$\rho = 1000\ kg/m^3,\ d\ =\ 3m,$
$\overline{x} = 4\ m$
$We\ know,$
$F\ =\ \rho g A \overline{x}$
$F\ =\ 1000 \times 9.81 \times \frac{\pi}{4}3^2 \times 4$
$F = 277.37\ kN$

Q 98 Text Solution:

We know that

Heat transfer (Q) = mcΔT

$C = \frac{Q}{m\Delta T} = \frac{J}{kg \cdot K}$

∴unit of specific heat (C) = J/kgK

Q 99 Text Solution:

The degree of reaction for a turbine is a measure of how the total enthalpy drop is divided between the nozzle and the blades. A degree of reaction of 50% implies that half of the enthalpy drop occurs in the nozzles (fixed vanes) and half occurs in the moving blades.

Among the options provided, the turbine with a 50% degree of reaction is **Parson's turbine**

Q 100 Text Solution:

Given data:

$V = 5\ litre = 5 \times 10^{-3}\ m^3$

W = 30 N

γ = ρg = ?

We know that,

$W = mg = \rho g \times V$ $\quad (\because \rho = m/v)$

$\gamma = \frac{W}{V} = \frac{30}{5 \times 10^{-3}}$

$\boxed{\gamma = 6000\ N/m^3}$