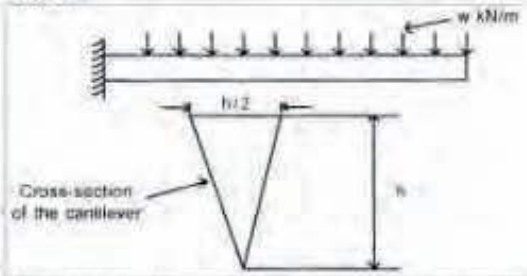
MECHANICAL ENGINEERING

1. Consider the cantilever loaded as shown below



What is the ratio of the maximum compressive to the maximum tensile stress?
a. 1.0
b. 2.0
c. 2.5
d. 3.0

2. A closed coil helical spring has 15 coils. If five coils of this spring are removed by cutting, the stiffness of the modified spring will
a. increase to 2.5 times
b. increase to 1.5 times
c. reduce to 0.66 times
d. remain unaffected

3. For $\sigma_1 \neq \sigma_2$ and $\sigma_3 = 0$, ... is the physical boundary for Rankine failure theory?
a. A rectangle
b. An ellipse
c. A square
d. A parabola

4. What is the number of instantaneous centers ... eight link mechanisms?
a. 15
b. ...
c. 36
d. ...

5. In an adiabatic process 6000 J of work is performed on a system. In the non-adiabatic process by which the system returns to its original state, 1000 J of heat is added to the system. What is the work done during non-adiabatic process?
a. + 7000 J
b. - 7000 J
c. + 5000 J
d. - 5000 J

6. Match List I (Applications) with List II (Choice of Bearings) and select the correct answer using the codes
List I
A. Granite table of a coordinate measuring machine
B. Headstock spindle of a lathe
C. Crank shaft of a diesel engine
D. Armature of 0.5 kW induction motor
List II
1. Hydrodynamic bearing
2. Deep groove ball bearing
3. Hydrostatic bearing
4. Taper roller bearing
Codes:

	A	B	C	D
a.	1	4	3	2
b.	3	3	2	1
c.	1	2	3	4
d.	3	4	1	2

7. If k = 3 for ball bearings and k = 3.33 for roller bearings, which one of the following correctly states the load (P) - Life (L) relationship for rolling contact bearings?
a. $\frac{L_1}{L_2} = \left(\frac{P_1}{P_2}\right)^k$
b. $\frac{L_2}{L_1} = \left(\frac{P_1}{P_2}\right)^{\frac{1}{k-1}}$
c. $\frac{L_2}{L_1} = \left(\frac{P_1}{P_2}\right)^k$
d. $\frac{L_2}{L_1} = \left(\frac{P_1}{P_2}\right)^{k-1}$

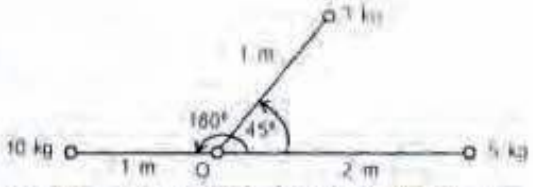
8. What is the purpose of a moderator in a nuclear reactor?
a. Moderate the fission temperature
b. Reduce the speed of fast moving neutrons
c. Reduce I and y rays
d. Absorb excess neutrons in the reactor

9. Heat flows between two reservoirs having tempera tures 1000 K and 500 K respectively. If the entropy change of the

cold reservoir is 10 kJ/K, then what is the entropy change for the hot reservoir?

a. - 10 kJ/K
b. - 5 kJ/K
c. 5 kJ/K
d. 10 kJ/K

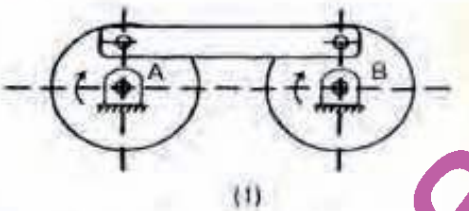
10.



For the rotor system shown in figure, the mass required for its complete balancing is

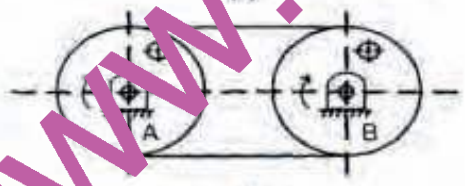
a. 1.5 kg at 2 m radius and at 225° from reference
b. 3 kg at 1 m radius and at 45° from reference
c. 8 kg at 1 m radius and at 225° from reference
d. 4 kg at 2 m radius and at 45° from reference

11.



(1)

(2)



(3)

The figures given above show different schemes suggested to transmit continuous rotary motion from axis A to axis B. Which of these schemes are not dynamically balanced?

a. 1 and 3
b. 2 and 3
c. 1 and 2
d. 1, 2 and 3

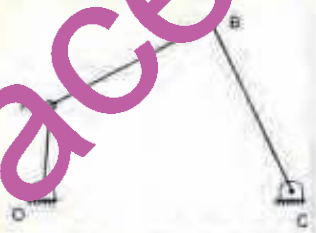
12. A spring-mass suspension has a natural frequency of 40 rad/s. What is the damping ratio required if it is desired to reduce this frequency to 20 rad/s by adding a damper to it?

a. $\sqrt{3}/2$
b. 1/2
c. $1/\sqrt{2}$
d. 1/4

13. What will be the maximum efficiency of the pipeline if one-third of the available head in flow through the pipeline is consumed by friction?

a. 33.33%
b. 50.00%
c. 66.66%
d. 75.00%

14.



The four bar mechanism shown in the figure (Given OA = 3 cm, AB = 5 cm, BC = 6 cm, DC = 7 cm) is a

a. Double crank mechanism
b. Double rocker mechanism
c. Crank rocker mechanism
d. Single slider mechanism

15. Steam flows at the rate of 10 kg/s through a supersonic nozzle. Throat diameter is 50 mm. Density ratio and velocity ratio with reference to throat and exit are respectively 2.45 and 0.8. What is the diameter at the exit?

a. 122.5 mm
b. 59 mm
c. 70 mm
d. 62.5 mm

16. An attemparator is used in some utility boilers

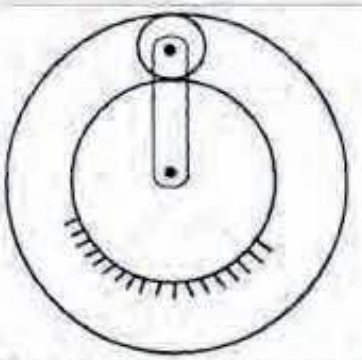
a. ahead of super heater for initial superheating
b. for optimizing team output from the generator
c. to regulate steam pressure
d. to control degree of superheat

17. Speed reduction in a gear box is achieved using a worm and worm wheel. The worm wheel has 30 teeth and a pitch diameter of

210 mm. If the pressure angle of the worm is 20°, what is the axial pitch of the worm?

a. 7 mm
b. 22 mm
c. 14 mm
d. 63 mm

18.



In the figure shown, the sun wheel has 48 teeth and the planet has 24 teeth. If the sun wheel is fixed, what is the angular velocity ratio between the internal wheel and arm?

a. 3.0
b. 1.5
c. 2.0
d. 4.0

19. Which one of the following is satisfied if the flow is irrigational for a two dimensional fluid element in the x - y plane?

a. $\frac{\partial v}{\partial x} = \frac{\partial u}{\partial y}$

b. $\frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$

c. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$

d. $\frac{\partial u}{\partial x} = -\frac{\partial v}{\partial y}$

20. 100 kW power is supplied to the machine through a gear box which uses an epicyclical gear train. The power is supplied at 100 rad/s. The speed of the output shaft of the gear box is 10 rad/s in a sense opposite to the input speed. What is the holding torque on the fixed gear of the train?

a. 8 kNm
b. 9 kNm
c. 10 kNm
d. 11 kNm

21. Consider the following statements:
In designing a plant layout, a Product Layout" should be preferred if

1. the variety of the products is low.
2. the variety of the products is very large.
3. the quantity of production is very small in each variety
4. the quantity of production is very large in each variety.
5. the in-process inspection is maximum.
6. the in-process inspection is minimum.

Which of the statements given above are correct?

a. 1, 3 and 6
b. 1, 4 and 5
c. 2, 3 and 4
d. 1, 4 and 6

22. Transmissibility is unity at two points. Which one of the following is true for these two points?

a. ω/ω_n is zero and $\sqrt{3}$ for all values of damping

b. ω/ω_n is zero and $\sqrt{2}$ for all values of damping

c. ω/ω_n is unity and 2 for all values of damping

d. ω/ω_n is unity and $\sqrt{3}$ for all values of damping

23. According to Stabler's rule, in oblique cutting the chip flow angle is equal to a constant multiplied by tool's

a. angle of inclination
b. normal rake angle
c. velocity rake angle
d. effective rake angle

24. Swiss type screw machines have

a. turrets
b. radial slides
c. spindle carriers
d. tool posts

25. Match List I (Name of the Casting Process) with List II (Process Definition) and select the correct answer using the codes given below:

List I

A. Die casting
B. Electroslag casting
C. Centrifugal casting
D. Precision casting

List II

1. This process involves use of a mould made of dried silica sand and phenolic resin mixture

2. In this process, molten metal is forced by pressure into a metal mould
3. This process employs a consumable electrode
4. This process involves rotating a mould while the metal solidifies
5. This process produces very smooth, highly accurate castings from both ferrous and non-ferrous alloys

Codes:

	A	B	C	D
a.	5	4	1	2
b.	2	3	4	5
c.	5	3	4	2
d.	2	4	1	5

26. Match List I (Casting Defects) with List II (Explanation) and select the correct answer using the codes given below:

List I

A. Metallic projections
B. Cavities
C. Inclusions
D. Discontinuities

List II

1. Consist of rounded or rough internal or exposed cavities including blow holes and pin holes
2. Formed during melting, solidification and moulding
3. Includes single folds, laps, scars, adhering sand layers and oxide scale
4. Include cracks, cold or hot tearing and cold shuts
5. Consist of fins, flash or massive projections and rough surfaces

Codes:

	A	B	C	D
a.	5	4	1	2
b.	2	3	4	5
c.	5	3	4	2
d.	2	4	1	5

27. Which of the following are produced by slush casting
a. Hollow castings with thick walls
b. Hollow castings with thin was
c. Thin castings
d. Thick castings

28. A liquid jet issues from a nozzle inclined at an angle of 60° to the horizontal and is directed upwards. If the velocity of the jet at the nozzle is 18 m/s, what shall approximately be the maximum vertical distance attained by the jet from the point of exit of the nozzle?
a. 4.2 m
b. 12.4 m
c. 14.3 m
d. 16.5 m

29. A bullet enters a plank of 30 mm thickness with a velocity of 100 m/s and emerges out from the plank with a velocity of 5 m/s. What is the minimum thickness of the plank so that the bullet remains embedded in the plank?
a. 100 mm
b. 80 mm
c. 60 mm
d. 40 mm

30. What is the work done if a bucket of water weighing 200 N is pulled up from a well 20 m deep by a rope weighing 1 N/m?
a. 200 N-m
b. 4000 N-m
c. 5000 N-m
d. 6000 N-m

31. Which one of the following statements is correct?
The work done in stretching an elastic string varies
a. as the square of the extension
b. as the square root of the extension
c. linearly with the extension
d. as the cube root of the extension

32. Which one of the following statements is true for effective temperature, ET?
a. ET increases with increase in level of activity and it decreases with increase in air velocity
b. ET decreases with increase in level of activity and it increases with increase in air velocity
c. ET increases with increase in level of activity and it increases with increase in air velocity
d. ET decreases with increase in level of activity and decreases with increase in air velocity

33. A train of weight 200×10^4 N is running on a horizontal track at a constant speed of 10 m/s, overcoming a constant frictional force of 20×10^3 N. What is the power of the engine driving the train?
a. 800 kW
b. 1200 kW
c. 200 kW

d. 400 kW

34. Match List I (Types of Tests and Materials) with List II (Types of Fractures) and select the correct answer using the codes given below:

List I

A. Tensile test on CI
B. Torsion test on MS
C. Tensile test on MS
D. Torsion test on CI

List II

1. Plain fracture on a transverse plane
2. Granular helecoidal fracture
3. Plain granular at 45° to the axis
4. Cup and cone
5. Granular fracture on a transverse plane

Codes:

	A	B	C	D
a.	4	2	3	1
b.	5	1	4	2
c.	4	1	3	2
d.	5	2	4	1

35. Which one of the following is the correct definition of critical ratio in scheduling?

a. Demand time/supply lead time
b. Supply lead time/demand time
c. Demand time/manufacturing lead time
d. Manufacturing lead time/demand time

36. What is the discharge for laminar flow through a pipe of diameter 40 mm having centre-line velocity of 1.5 m/s?

a. $\frac{3\pi}{50} m^3/s$

b. $\frac{3\pi}{2,500} m^3/s$

c. $\frac{3\pi}{5,000} m^3/s$

d. $\frac{3\pi}{10,000} m^3/s$

37. Which one of the following is the expression for momentum thickness θ of a boundary layer?

a. $\theta = \int_0^{\delta} \left[1 - \frac{U}{U_0}\right] dy$

b. $\theta = \int_0^{\delta} \left[1 - \frac{U}{U_0}\right]^2 dy$

c. $\theta = \int_0^{\delta} \frac{U}{U_0}\left[1 - \frac{U}{U_0}\right] dy$

d. $\theta = \int_0^{\delta} \frac{U}{U_0}\left[1 - \left(\frac{U}{U_0}\right)^2\right] dy$

38. The displacement thickness at a section, for an air stream (ρ = 1.2 kg/m^3) moving with a velocity of 10 m/s over a flat plate is 0.5 mm. What is the loss of mass rate of flow of air due to boundary layer formation in kg per meter width of plate per second?

a. 6×10^{-3}
b. 6×10^{-4}
c. 3×10^{-3}
d. 2×10^{-3}

39. In a simple impulse turbine, the nozzle angle at the entrance is 20°. What is the blade-speed ratio (u/V) for maximum diagram efficiency?

a. 0.25
b. 0.5
c. 0.433
d. 0.866

40. Which of the following are fertile materials?

a. U^{233} and Pu^{239}
b. U^{238} and Th^{239}
c. U^{238} and Th^{232}
d. U^{235} and Th^{236}

41. A simple supported beam of length 'l' is subjected to a symmetrical uniformly varying load with zero intensity at the ends and intensity w (load per unit length) at the mid span. What is the maximum bending moment?

a. $3wl^2/8$
b. $wl^2/12$
c. $wl^2/24$
d. $5wl^2/12$

42. Which one of the following correctly expresses the specific speed of a turbine and a pump, respectively?

a. $\frac{N\sqrt{Q}}{H^{3/4}}, \frac{N\sqrt{P}}{H^{5/4}}$

b. $\frac{N\sqrt{P}}{H^{3/4}}, \frac{N\sqrt{Q}}{H^{5/4}}$

c. $\frac{N\sqrt{P}}{H^{5/4}}, \frac{N\sqrt{Q}}{H^{3/4}}$

d. $\frac{N\sqrt{P}}{H^{3/4}}, \frac{N\sqrt{Q}}{H^{3/4}}$

43. In a laminar boundary layer over a flat plate, what would be the ratio of wall shear stress τ_1 and τ_2 at the two sections which

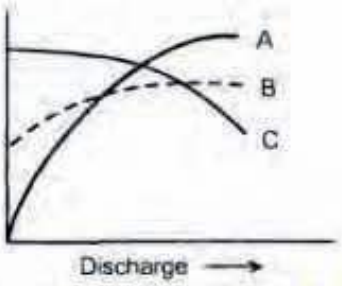
lie at distances $x_1 = 30$ cm and $x_2 = 90$ cm from the leading edge of the plate?

a. $\tau_1/\tau_2 = 3.0$
b. $\tau_1/\tau_2 = 1/3$
c. $\tau_1/\tau_2 = (3.0)^{1/2}$
d. $\tau_1/\tau_2 = (3.0)^{1/3}$

44. Total enthalpy of stream at the inlet of a nozzle is 2800 kJ while static enthalpy at the exit is 2555 kJ. What is the steam velocity at the exit if expansion is isentropic?

a. 70 m/s
b. 245 m/s
c. 450 m/s
d. 700 m/s

45.



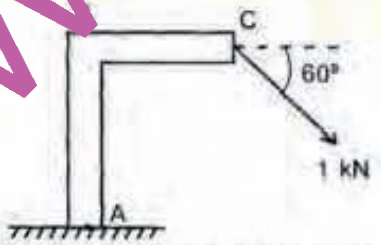
The above figure shows characteristics of three centrifugal pumps A, B and C. If E = Efficiency, H = Head and P = Power, the A, B and C respectively represent which one of the following ?

a. E, P, H
b. P, E, H
c. P, H, E
d. H, P, E

46. Which one of the following is represented by the area of the S.F. diagram from one end upto a given location on the beam?

a. B.M. at the location
b. Load at the location
c. Slope at the location
d. Deflection at the location

47.



What is the thrust at the point A in lamp post shown in the figure?

a. 0.866 kN
b. 0.5 kN
c. 1.366 kN
d. 1 kN

48. Given that the principal stresses $\sigma_1 > \sigma_2 > \sigma_3$ and σ_e is the elastic limit stress in simple tension, which one of the following must be satisfied such that the elastic failure does not occur in accordance with the maximum principal strain theory?

a. $\frac{\sigma_e}{E} < \left(\frac{\sigma_1}{E} - \mu\frac{\sigma_2}{E} - \mu\frac{\sigma_3}{E}\right)$
b. $\frac{\sigma_e}{E} > \left(\frac{\sigma_1}{E} - \mu\frac{\sigma_2}{E} - \mu\frac{\sigma_3}{E}\right)$
c. $\frac{\sigma_e}{E} > \left(\frac{\sigma_1}{E} + \mu\frac{\sigma_2}{E} + \mu\frac{\sigma_3}{E}\right)$
d. $\frac{\sigma_e}{E} < \left(\frac{\sigma_1}{E} + \mu\frac{\sigma_2}{E} - \mu\frac{\sigma_3}{E}\right)$

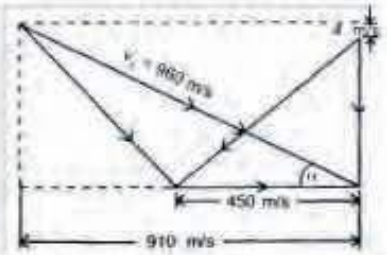
49. Which of the following is caused by the occurrence of a normal shock in the diverging section of a convergent divergent nozzle?

1. Velocity jump
2. Pressure jump
3. Velocity drop
4. Pressure drop

Select the correct answer using the codes given below

a. 1 only
b. 1 and 2
c. 2 and 3
d. 1 and 4

50.



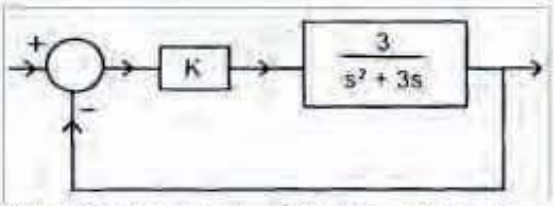
Velocity diagram shown above is for an impulse turbine stage. What are the tangential force and axial thrust per kg/s of steam, respectively?

a. 450 N, 8 N
b. 560 N, 8 N
c. 680 N, 4 N
d. 910 N, 4 N

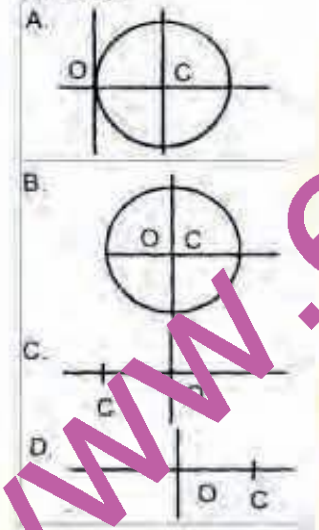
51. Which one of the following is the purpose of blow- down in a boiler?

a. To control drum level
b. To control solid concentration in the boiler water
c. To increase the steam temperature
d. To lower the steam temperature

52. For which one of the following columns, Euler buckling load = $\frac{4\pi^2 EI}{l^2}$?
a. Column with both hinged ends
b. Column with one end fixed and other end free
c. Column with both ends fixed
d. Column with one end fixed and other hinged

53.


What is the value of K for which the relative damping of the closed loop system shown above is equal to 0.5?
a. 2
b. 3
c. 4
d. 5

54. Match List I (Mohr's Circles of Stress) with List II (Types of Loading) and select the correct answer using the codes given below.
A. List I


List II
1. A shaft compressed all-round by a hub
2. Bending moment applied at the free end of a cantilever
3. Shaft under torsion
4. Thin cylinder under internal pressure
5. Thin spherical shell under internal pressure

Codes:

	A	B	C	D
a.	5	4	3	2
b.	2	4	1	3
c.	4	3	2	5
d.	2	3	1	5

55. A horizontal beam under bending has a maximum bending stress of 100 MPa and a maximum shear stress of 20 MPa. What is the maximum principal stress in the beam?
a. 20
b. 50
c. $50 + \sqrt{2900}$
d. 100

56. Consider the following statements for a simply supported beam subjected to a couple at its mid-span:
1. Bending moment is zero at the ends and maximum at the centre
2. Bending moment is constant over the entire length of the beam
3. Shear force is constant over the entire length of the beam
4. Shear force is zero over the entire length of the beam.
Which of the statements given above are correct?
a. 1, 3 and 4
b. 2, 3 and 4
c. 1 and 3
d. 2 and 4

57. Which one of the following welding processes consists of smaller Heat Affected Zone (HAZ)?
a. Arc welding
b. Electron beam welding
c. MIG welding
d. Thermit welding

58. In which of the following operations, micro motion study technique is used?
1. Short cycle operations lasting two minutes or less
2. Long cycle operations lasting more than five minutes
3. Medium cycle operations lasting between two and five minutes
Select the correct answer using the codes given below
a. 1 only
b. 1 and 2
c. 2 and 3
d. 1, 2 and 3

59. The following are the constituent steps in the process of powder metallurgy

1. Powder conditioning
2. Sintering
3. Production of metallic powder
4. Pressing or compacting into the desired shape

Identify the correct order in which they have to be performed and select the correct answer using the codes given below

a. 1, 2, 3, 4
b. 3, 1, 4, 2
c. 2, 4, 1, 3
d. 4, 3, 2, 1

60. A cutter breaks while cutting gears and is removed by the operator. Which of the following represents this activity on the flow process chart?

a. Delay — D
b. Operation — O
c. Operation cum transportation ⇔
d. Inspection □

61. Which of the following are the characteristics of the injection moulding of plastics?

1. It is the most economical method of mass producing a single item
2. In most cases finished products are obtained
3. There is lot of waste of thermoplastic since the runners and sprues cannot be reused

Select the correct answer by using the following codes

a. 1 and 2
b. 2 and 3
c. 1 and 3
d. 1, 2 and 3

62. Gear shaping is a process of manufacturing gears. Which one of the following principles is employed by it?

a. Forming with cutter
b. Generating tooth form with a reciprocating cutter
c. Generating tooth form by a rotating cutter
d. Generating form with a reciprocating and revolving cutter

63. Match List I (Name of the Process) with List II (Advantage) and select the correct answer using the codes:

List I

A. Sand casting
B. Ceramicmold casting
C. Die casting
D. Centrifugal casting

List II

1. Large cylindrical parts with good quality
2. Excellent dimensional accuracy and surface finish
3. Intricate shapes and close tolerance parts
4. Almost any metal is cast and there is no limit to size, shape and weight
5. Good dimensional accuracy, finish and low porosity

Codes

	A	B	C	D
a.	2	3	5	1
b.	4	1	2	3
c.	2	1	5	3
d.	4	3	2	1

64. Match List I with List II and select the correct answer using the codes given below:

List I

A. Bottle filling of gas
B. Nernst Simon statement
C. Joule Thomson effect
D. $\int P\,dv$

List II

1. Absolute zero temperature
2. Variable flow
3. Quasistatic path
4. Isenthalpic process
5. Dissipative effect
6. Low grade energy
7. Process and temperature during phase change

Codes;

	A	B	C	D
a.	6	5	4	3
b.	2	1	4	3
c.	2	5	7	4
d.	6	1	7	4

65. M_1 kg of water at T_1 is isobarically and adiabatically mixed with M_2 kg of water at $T_2 (T_1 > T_2)$. The entropy change of the universe is

a. Necessarily positive
b. Necessarily negative
c. Always zero
d. Negative or positive but not zero

66. A heat engine using lake water at 12°C as source and the surrounding atmosphere at 2°C as sink executes 1080 cycles per mm.

If amount of heat supplied per cycle is 57 J, what is the output of the engine?

a. 66W
b. 56W
c. 46W
d. 36W

67. A reversible heat engine runs between high temperatures T_1 arid low temperatures T_2. The work output of this heat engine is used to run a reversible refrigeration cycle absorbing heat at temperature T_3 and rejecting at temperature T_2. What is the COP of the combined system?

a. $\left(\frac{T_1-T_2}{T_1}\right)\left(\frac{T_3}{T_2-T_3}\right)$

b. $\left(\frac{T_2}{T_1-T_2}\right)\left(\frac{T_2-T_3}{T_3}\right)$

c. $\left(\frac{T_1}{T_1-T_2}\right)\left(\frac{T_3}{T_2-T_3}\right)$

d. $\left(\frac{T_3}{T_1-T_3}\right)\left(\frac{T_1}{T_2-T_1}\right)$

68. Match List I with List II and select the correct answer using the codes given below:

List I
A. Reversible cycle
B. Mechanical work
C. Zeroth Law
D. Heat

List II
1. Measurement of temperature
2. Clapeyron equation
3. Clausius Theorem
4. High grade energy
5. 3rd Law of thermodynamics
6. Inexact differential

Codes:

	A	B	C	D
a.	3	4	1	6
b.	2	6	1	3
c.	3	1	5	6
d.	1	4	5	2

69. When a refrigeration plant is started, the evaporator temperature decreases from room temperature to the required value. During this period, how does the compressor power requirement vary?

a. It increases continuously
b. It decreases and then becomes constant
c. It increases, reaches a peak and then decreases
d. It remains constant

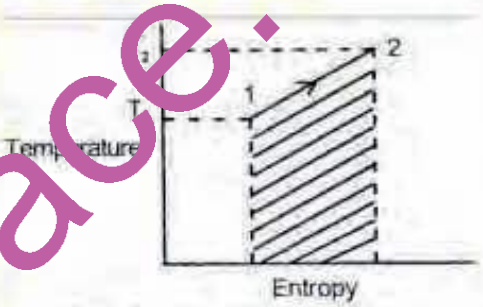
70. To meet short range changes in demand of a product, which of the following strategies can be considered?

1. Overtime
2. Subcontracting
3. Building up inventory
4. New investments

Select the correct answer from the codes given below

a. 1, 2 and 3
b. 1, 3 and 4
c. 2 and 3
d. 1 and 2

71.



In the T-S diagram shown in the figure, which one of the following is represented by the area under the curve?

a. Total work done during the process
b. Total heat absorbed during the process
c. Total heat rejected during the process
d. Degree of irreversibility

72. A refrigerating machine working on reversed Carnot cycle takes out 2 kW of heat from the system at 200 K while working between temperature limits of 300 K and 200 K. COP. and power consumed by the cycle will, respectively, be

a. 1 and 1 kW
b. 1 and 2 kW
c. 2 and 1 kW
d. 2 and 2 kW

73. If a gas obeys van der Waals' equation at the critical point, then what does RTIPV equal to?

a. zero
b. unity
c. 1.50
d. 2.67

74. In a simple gas turbine power plant operating on standard Brayton cycle power needed to drive the compressor is 175 kW, rate of heat supplied during constant

pressure heat addition process is 675 kW. Turbine output obtained during expansion is 425 kW. What is the rate of heat rejection during constant pressure heat rejection?

a. 75 kW
b. 425 kW
c. 500 kW
d. 925 kW

75. What is the efficiency of an ideal regenerative Rankine cycle power plant using saturated steam at 327°C and pressure 135 bar at the inlet to the turbine, and condensing temperature of 27°C (corresponding saturation pressure of 3.6 kPa)?

a. 92%
b. 33%
c. 50%
d. 42%

76. Which of the following can be solved by the Brown and Gibson procedure?

a. Transportation problem
b. CPM network
c. Site location problem
d. Product-mix problem

77. Consider the following

1. Simplified production planning and control systems
2. Reduced material handling
3. Flexibility of equipment and personnel

The advantages of flow-line layout in a manufacturing operation

a. 1, 2 and 3
b. 1 and 2
c. 2 and 3
d. 1 and 3

78. Several sequencing rules can be used to sequence jobs. The performance of these rules can be studied using several performance measures. Consider the following sequencing rules

SPT (Shortest Processing Time)
EDD (Expected Due Date)

and the following performance measures

MFT (Mean Flow Time)
ML (Mean Lateness)

Which one of the following is not correct?

a. SPT minimizes MFT
b. EDD minimizes MFT
c. EDD minimizes ML
d. SPT minimizes ML

79. Which of the flowing factors necessitate a change in schedule?

1. Change in Board of Directors
2. Capacity modification
3. Lack of capital
4. Change in priority
5. Unexpected rush orders

Select the correct answer using the codes given below

a. 2, 3 and 4
b. 1, 2 and 5
c. 2, 4 and 5
d. 1, 3 and 4

80. For economic manufacture, the total annual cost is given as $M\left(P+\frac{D}{Q}\right)$; where

M is number of parts made per month
P is processing cost per part
Which one of the following is represented by D/Q in the above expression?

a. Setting up cost
b. Profit per part
c. Bonus
d. Setting up cost/part

81. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Type of Chart)

A. Outline process chart
B. Multiple Activity chart
C. SIMO chart
D. Non-machine chart

List II (Definition)

1. It is used to record the activities of one subject in relation to one or more others
2. It is a chart in which activities of the machine or machines are recorded in relation to that of the operator
3. It records the main activities of the process through the symbols of operation and inspection
4. It is used to record the activities of the hands of an operator
5. It makes use of Therblig for charting minute elements of an operation

Codes;

	A	B	C	D
a.	3	2	5	1
b.	5	1	4	2
c.	3	1	5	2

d. 5 2 4 1

82. Profit volume chart technique is an effective tool of application for analysis when the Company is dealing with
a. one product only
b. a loss situation
c. only turn-key assignments
d. more than one product

83. Standard material cost of a product is Rs. 20/- @ Rs. 10 per kg. In one batch, on an average the consumption of material was 1.8 kg and rate of material was Rs. 12 per kg. What is the material usage variance?
a. Rs. 2/- adverse
b. Rs. 2/- favorable
c. Rs. 2.40 favorable
d. Rs. 1.60 adverse

84. Assertion (A) Angle of twist per unit length of a uniform diameter shaft depends upon its torsional rigidity.
Reason (R): The shafts are subjected to torque only.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

85. Assertion (A): Francis turbine may be used as prime mover for hydraulic power plant when the head available is around 300 m.
Reason (R): Francis turbine is a reaction turbine.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

86. Assertion (A): For high head and low-discharge hydraulic power plant, Pelton wheel is used as prime mover.
Reason (R): The non-dimensional specific speed of Pelton wheel at designed speed is high.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

87. Assertion (A): A beam subjected only to end moments will be free from shearing force.
Reason (R): The bending moment variation along the beam length is zero.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

88. Assertion (A): Uniaxial stress normally gives rise to triaxial strain.
Reason (R) Magnitude of strains in the perpendicular directions of applied stress is smaller than that in the direction of applied stress.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

89. Assertion (A): Spiral bevel gears designed to be used with an offset in their shafts are called Hypoid gears'.
Reason (R): The pitch surfaces of such gears are hyperboloids of revolution.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

90. Assertion (A): Hot working does not produce strain hardening.
Reason (R): Hot working is done above the recrystallization temperature.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

91. Assertion (A): Rolling requires high friction which increases forces and power consumption.
Reason (R): To prevent damage to the surface of the rolled products, lubricants should be used.
a. Both A and R are individually true and R is the correct explanation of A

b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

92. Assertion (A) Indirect extrusion operation can be performed either by moving ram or by moving the container.
Reason (R): Advantage in indirect extrusion is less quantity of scrap compared to direct extrusion.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

93. Assertion (A): Power input per TR of a refrigeration system increases with decrease in evaporator temperature.
Reason (R): COP of refrigeration system decreases with decrease in evaporator temperature.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

94. Assertion (A): Coils of concentric cylindrical helical springs, used to provide greater spring force in a limited space, are wound in opposite direction.
Reason (R): The winding of coils in opposite direction in case of concentric springs prevents locking of two coils during misalignment or buckling.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

95. Assertion (A): When the pressure ratio (p_2/p_1) in a nozzle reaches critical pressure ratio, the discharge becomes zero.
Reason (R): The nozzle gets choked.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

96. Which one of the following is true for the last few teeth of a broach which are meant for fine finishing?
a. They have equal diameter
b. They have increasing diameter
c. They have decreasing diameter
d. They have alternately increasing and decreasing diameter

97. The size effect refers to the increase in specific cutting energy at low values of unreformed chip thickness. It is due to which one of the following?
a. Existence of ploughing force
b. Work hardening
c. High strain rate
d. Presence of high friction at chip-tool interface

98. Which one of the following gating systems is best suited to obtain directional solidification?
a. Top grating
b. Parallel grating
c. Bottom grating
d. Stepped grating

99. Which one of the following is the purpose of a surge tank in a Pelton turbine station?
a. It acts as a temporary storage during load changes
b. It prevents hydraulic jump
c. It prevents surges at the transformer
d. It prevents water hammer due to sudden reduction in load

100. 100. A log of length 20 m, diameter 2 m and specific weight 500 N/m^3 rests on a level ground. What is the work done (in Nm) to make it to stand vertical?
a. $\pi (1^2) (200) (50) (20)$
b. $\pi (1^2) (200) (50) (10)$
c. $\pi (1^2) (200) (50) (9)$
d. $\pi (1^2) (200) (50) (8)$

101. Which one of the following helps in avoiding cavitations in centrifugal pumps?
a. Low suction pressure
b. High delivery pressure
c. Low delivery pressure
d. High suction pressure

102. 102. Consider the following statements with regard to the specific speeds of different types of turbine
1. High specific speed implies that it is a Pelton wheel
2. Medium specific speed implies that it is an axial flow turbine

3. Low specific speed implies that it is a Francis turbine

Which of these statements given above is/are correct?

a. 1 only
b. 2 only
c. 3 only
d. None

103. A circular plate of 1.5 m diameter is submerged in water with its greatest and least depths below the water surface being 2 m and 0.75 m respectively. What is the approximate magnitude of the total thrust on one face of the plate?

a. 24 kN
b. 28 kN
c. 12 kN
d. 16 kN

104. Which one of the following statements is correct?

A steady flow of diverging straight stream lines

a. is a uniform flow with local acceleration
b. has convective normal acceleration
c. has convective tangential acceleration
d. has both convective normal and tangential accelerations

105. Which one of the following is the expression of the rotational component for a two-dimensional fluid element in xy plane?

a. $\omega_z = \frac{1}{2}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$

b. $\omega_z = \frac{1}{2}\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)$

c. $\omega_z = \frac{1}{2}\left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right)$

d. $\omega_z = \frac{1}{2}\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)$

106. What is the percentage error in the estimation of the discharge due to an error of 2% in the measurement of the reading of a differential connected to an orifice meter?

a. 4
b. 3
c. 2
d. 1

107. Which one of the following is the characteristic of a fully developed laminar flow?

a. The pressure drop in the flow direction is zero
b. The velocity profile changes uniformly in the flow direction
c. The velocity profile does not change in the flow direction
d. The Reynolds number for the flow is critical

108. Which one of the following is the correct relation between the boundary layer thickness δ displacement thickness δ^* and the momentum thickness θ?

a. $\delta > \delta^* > \theta$
b. $\delta^* > \theta > \delta$
c. $\theta > \delta > \delta^*$
d. $\theta > \delta^* > \delta$

109. The thickness of turbulent boundary layer at a distance x from the leading edge on a flat plate varies as

a. $x^{4/5}$
b. $x^{3/5}$
c. $x^{1/2}$
d. $x^{1/3}$

110. When a flat plate of 0.1 m^2 area is pulled at a constant velocity of 30 cm/s parallel to another stationery plate located at a distance 0.01 cm from it and the space in between is filled with a fluid of dynamic viscosity = 0.001 Ns/m^2, the force required to be applied is

a. 0.3 N
b. 3 N
c. 10 N
d. 16 N

111. Which one of the following is the continuity equation in differential form? (The symbols have usual meanings)

a. $\frac{dA}{A} + \frac{dV}{V} + \frac{d\rho}{\rho} = \text{constant}$

b. $\frac{dA}{A} + \frac{dV}{V} + \frac{d\rho}{\rho} = 0$

c. $\frac{A}{dA} + \frac{V}{dV} + \frac{\rho}{d\rho} = \text{constant}$

d. $AdA + VdV + \rho\, d\rho = 0$

112. In on-off control refrigeration system, which one of the following expansion devices is used ?

a. Capillary tube
b. Thermostat

c. Automatic expansion valve
d. Float valve

113. When does L.P. cut-off occur in a refrigeration system?
a. If the ambient temperature is low
b. If non-condensable gases are present in the condenser
c. If refrigerant charge is owl
d. If lubricating oil gets accumulated in the condenser

114. Moist air exists at a pressure of 1.01 bar. The partial pressure and saturation pressure of water vapour are 0.01 bar and 0.02 bar respectively. What are the relative humidity and humidity ratio of the moist air, respectively?
a. 50% and 0.00622
b. 100%and0.0126
c. 50% and 0.01 26
d. 100% and 0.00622

115. In order to cool and dehumidify a stream of moist air, it must be passed over a coil at a temperature
a. which lies between the dry bulb and wet bulb temperatures of the incoming stream
b. which lies between the wet bulb and dew point temperatures of the incoming stream
c. which is lower than the dew point temperature of the incoming stream
d. of adiabatic saturation of incoming stream

116. Which of the features of expansion valves in the following lists are correctly matched?

Expansion	Device Feature
1. Capillary tube	Choking
2. Thermostatic expansion valve	Constant temperature
3. Automatic Expansion valve	Constatn degree of superheat
4. Float valve	Mass flow rate of refrigerant is proportional to load

Select the correct answer using the codes given below
a. 1 and 2
b. 1 and 3
c. 1 and 4
d. 3 and 4

117. If moist air is sensibly cooled above its dew point, which of the following statements are correct?
1. Relative humidity decreases
2. Wet bulb temperature decreases
3. Wet bulb temperature increases
4. Humidity ratio remains constant

Select the correct answer using the codes given below
a. 1 and 2
b. 1 and 3
c. 3 and 4
d. 2 and 4

118. Water in an insulative evaporative cooler evaporates at the rate of 0.02 kg/s. Air flow rate is 1 kg/s. What is the air temperature decrease if the specific heat of humid air is 1 kJ/kg K and latent heat of water is 2500 kJ/kg?
a. 2.5° C
b. 3.0° C
c. 75° C
d. 80° C

119. Match List I with List II and select the correct answer using the codes given below the lists:
List I
A. Sulphur candle test
B. Halide torch test
C. Soap and water test
D. Ammonia swab test
List II
1. Propane
2. Ammonia
3. Halocarbon refrigerants
4. Sulphur dioxide
Codes;

	A	B	C	D
a.	2	3	1	4
b.	4	1	3	2
c.	2	1	3	4
d.	4	3	1	2

120. In a stop-watch time study, the observed time was 0.16 minute; the performance rating factor was 125 on the 100 normal (percentage scale). What is the standard time in minutes if 10% allowances are permitted?
a. 0.180
b. 0.200
c. 0.220
d. 0.240