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Booklet Serial No. 0000317

Test Booklet Series

TEST BOOKLET - 2022
ASSISTANT ENGINEER - MECHANICAL ENGINEERING

A

Time Allowed: Two Hours ***Maximum Marks: 100***

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer /Response Sheet. Any omission/discrepancy will render the Response Sheet liable for rejection.**

3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** **write** ***anything else*** on the Test Booklet.

4. This Test booklet contains **100** items (questions). Each item comprises of four responses (answers). You will select the response which you want to mark on the Answer Sheet/Response Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.

5. You have to mark all your responses ***ONLY*** on the separate Answer /Response Sheet provided. *See directions in the Response Sheet.*

6. ***All*** items carry equal marks.

7. Before you proceed to mark in the Answer /Response Sheet, the response to various items in the Test Booklet, you have to fill in some particulars in the Answer /Response Sheet as per instructions sent to you with your Admission Certificate.

8. After you have completed filling in all your responses on the Response Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer /Response Sheet.*** You are permitted to take away with you the Test Booklet and ***Candidate's Copy of the Response Sheet .***

9. Sheets for rough work are appended in the Test Booklet at the end.

10. While writing Centre, Subject and Roll No. on the top of the Answer Sheet/Response Sheet in appropriate boxes use **"ONLY BALL POINT PEN".**

11. **Penalty for wrong answers:**

THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY THE CANDIDATE IN THE WRITTEN TEST (OBJECTIVE TYPE QUESTIONS PAPERS).

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **(0.25)** of the marks assigned to that question will be deducted as penalty.

(ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above for that question.

(iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

SEAL

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1. The design of a structural members subjected to fluctuating loads for the chosen factor of safety yields the most conservative estimates using.

A) Gerber equation
B) Soderberg equation
C) Goodman equation
D) Euler's equation

2. In a Mohr' s circle, the radius of the circle is given as (where symbols have their usual meanings)

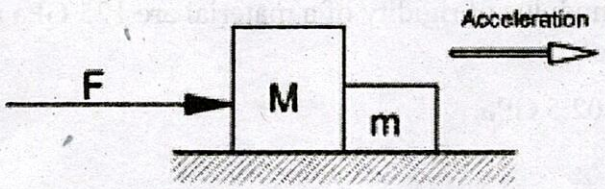
A) $\sqrt{(\sigma_x+\sigma_y)^2+(\tau_{xy})^2}$

B) $\sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2-(\tau_{xy})^2}$

C) $\sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2+(\tau_{xy})^2}$

D) $\sqrt{\left(\frac{\sigma_x+\sigma_y}{2}\right)^2+(\tau_{xy})^2}$

3. Two blocks with masses 'M' and 'm' are in contact with each other as shown in figure below, and are resting on a horizontal frictionless floor. When horizontal force (F) is applied to the heavier body mass 'M', the blocks accelerate in the direction of applied force. The force acting between the two blocks is



A) $\frac{Fm}{M+m}$

B) $\frac{Fm}{M}$

C) $\frac{F(M+m)}{m}$

D) $\frac{FM}{m}$

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

List - I	**List-II**
P. Bending moment is constant	1. Point of contraflexure
Q. Bending moment is zero	2. Shear force changes sign
R. Shear force is constant	3. Shear force is zero over the portion of the beam
S. Bending moment is maximum or minimum	4. Rate of loading is zero over the portion of the beam

A) P-4 Q-3 R-2 S-1

B) P-1 Q-4 R-3 S-2

C) P-3 Q-1 R-2 S-4

D) P-3 Q-1 R-4 S-2

5. A 1.5 m long column has a circular cross-section of 50mm diameter. One end of the column is fixed and another end is free. Assuming factor of safety as 3 and modulus of elasticity is 120 GN/m^2, safe load according to Euler's theory is

A) 33.00 kN

B) 23.25 kN

C) 13.46 kN

D) 6.87 kN

6. The bulk modulus and the modulus of rigidity of a material are 125 GPa and 75 Gpa respectively. Then the value of

1. Elasticity modulus is 202.5 GPa
2. Poisson's ratio is 0.25
3. Elasticity modulus is 187.5 GPa
4. Poisson's ratio is 0.35

Which of the above statements are correct?

A) 1 and 2

B) 3 and 4

C) 1 and 4

D) 2 and 3

7. If I = moment of inertia about the neutral axis, E = elasticity modulus and M = bending moment in pure bending under the symmetric loading of a beam, the radius of curvature of the beam increases with

1. Increase in E
2. Decrease in I
3. Increase in M
4. Decrease in M

Which of the above statements are correct?

A) 1 and 4

B) 2 and 4

C) 1 and 3

D) 2 and 3

8. A shaft transmitting a power P, rotates at N rpm with a permissible shear stress 'τ', the diameter of shaft is proportional to

A) $\left(\frac{P}{N}\right)^{1/2}$

B) $\left(\frac{P}{N}\right)^{2/3}$

C) $\left(\frac{P}{N}\right)$

D) $\left(\frac{P}{N}\right)^{1/3}$

9. What is the slenderness ratio of a 5m column with fixed ends if its cross-section is square of side 50 mm?

A) 110

B) 160

C) 173

D) 193

10. A rod with cross-sectional area 200×10^{-6} m^2 is subjected to a tensile load. Based on the Maximum Shear Stress theory, if the uniaxial yield stress of the material is 250 MPa, the failure load is

A) 20 kN

B) 50 kN

C) 100 kN

D) 500 kN

11. A car moving with uniform acceleration covers 300 m in a 5 second interval, and covers 500 m in the next 5 second interval. The acceleration of the car is

A) $8\ m/s^2$

B) $16\ m/s^2$

C) $25\ m/s^2$

D) $30\ m/s^2$

12. The radius of gyration of uniform rod of length L and mass M about an axis passing through its centre and perpendicular to its length is

A) $\frac{L}{\sqrt{2}}$

B) $\frac{L^2}{12}$

C) $\frac{L}{2\sqrt{3}}$

D) $\frac{L}{2}$

13. Match **List-I** (Crystal Structure) with **List-II** (Example) and select the correct answer using the codes given below:

List-I	**List-II**
P. Simple Cubic	1. Zinc
Q. Body Centred Cubic	2. Copper
R. Face Centred Cubic	3. Manganese
S. Hexagonal Close Packed	4. Alpha iron at room temperature

A) P-3 Q-4 R-2 S-1

B) P-2 Q-4 R-1 S-2

C) P-3 Q-1 R-4 S-2

D) P-1 Q-2 R-3 S-4

14. Which of the following case hardening processes, result in a change in the composition in a steel component?

1. Carburizing
2. Cyaniding
3. Nitriding
4. Flame hardening

Which of the above statements are correct?

A) 1, 2 and 3 only

B) 2, 3 and 4 only

C) 1, 3 and 4 only

D) 1, 2, 3 and 4

15. Liquid + solid (1) on cooling converts into solid (2) reaction is known as

A) Eutectoid reaction

B) Eutectic reaction

C) Peritectoid reaction

D) Peritectic reaction

16. **Assertion (A):** Cast iron is generally hard, brittle and wear resistant.

Reason (R): Cast iron contains more than 20% carbon and the percentage of cementite is higher.

A) both A and R are true and R is the correct explanation of A

B) both A and R are true but R is not a correct explanation of A

C) A is true but R is false

D) A is false but R is true

17. Babbitt is an alloy of

A) Sn and Cu

B) Sn, Cu, and Pb

C) Sn, Cu, Sb and Pb

D) Sn, Cu, and Sb

18. The alloy steel 40 Cr 18 Ni 2 designated by Bureau of Indian Standards contains

A) 0.4% C, 18% Cr and 2% Ni

B) 4.0% C, 1.8% Cr and 0.2% Ni

C) 0.4% C, 1.8% Cr and 2% Ni

D) 0.4% C, 1.8% Cr and 0.2% Ni

19. In low carbon steels, presence of small quantity of Sulphur improves

A) Formability

B) Weldability

C) Hardenability

D) Machinability

20. In a plate cam mechanism with reciprocating roller follower, in which one of the following cases the follower has constant acceleration?

A) Cycloidal motion

B) Simple harmonic motion

C) Parabolic motion

D) Uniform velocity motion

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

List-I	**List-II**
P. Whitworth mechanism	1. Simple harmonic motion
Q. Hart mechanism	2. Approximate straight line motion
R. Watt mechanism	3. Exact straight line motion
S. Scotch yoke mechanism	4. Quick return motion

A) P-4 Q-3 R-1 S-2

B) P-4 Q-3 R-2 S-1

C) P-3 Q-1 R-4 S-2

D) P- 1 Q-3 R-2 S-4

22. A 4-bar linkage with link lengths PQ = 150 mm, QR = 250 mm, RS=350 mm and SP = 300 mm. Which one of the following links should be fixed for the resulting machanism to be a double crank mechanism?

A) PQ

B) QR

C) RS

D) SP

23. An external gear with 60 teeth meshes with a pinion of 20 teeth, module being 6 mm. What is the centre distance in mm?

A) 120

B) 180

C) 240

D) 300

24. The arc of contact and the path of contact are 28 mm and 26.14 mm respectively, in a pair of involute spur gears. The value of the pressure angle is

A) 15°

B) 17°

C) 19°

D) 21°

25. For the engine running at 650 rpm, the magnitude of primary forces is observed to be 480 N. If the crank and connecting rod are of lengths, 200 mm and 800 mm, respectively, the magnitude of maximum secondary force is

A) 110

B) 120

C) 220

D) 310

26. The speed of an engine varies between 210 rad/s to 190 rad/s. During a cycle the change in kinetic energy is found to be 400 Nm. The inertia of the flywheel in kgm^2 is

A) 0.1

B) 0.2

C) 0.3

D) 0.4

27. **Assertion (A):** In damped vibration there is decrease in amplitude of vibration during each successive cycle.

Reason (R): Damping force is proportional to the amplitude.

A) both A and R are true and R is the correct explanation of A

B) both A and R are true but R is not a correct explanation of A

C) A is true but R is false

D) A is false but R is true

28. Consider a harmonic motion

$Y = 3.5 \sin(4t - \pi / 6)$ m.

Match **List-I** with **List-II** and select the correct answer using the codes given below:

List-I	**List-II**
P. Amplitude (m)	1. $2/\pi$
Q. Phase angle (rad)	2. 3.5
R. Frequency (cycle/s)	3. $1/4$
S. Time period (s)	4. $\pi/6$

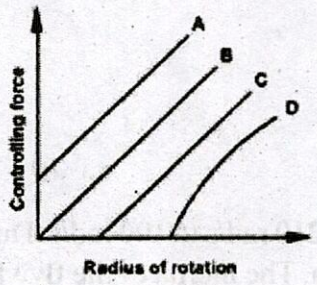
A) P-4 Q-3 R-1 S-2

B) P-2 Q-4 R-1 S-3

C) P-3 Q-1 R-4 S-2

D) P- 2 Q-1 R-3 S-4

29. The controlling force curves for a spring-controlled governor are shown in figure below, the curve representing an isochronous governor is



A) A

B) B

C) C

D) D

30. Minimum shear strain in orthogonal turning with a cutting tool of zero rake angle is

A) 0.0

B) 0.5

C) 1.0

D) 2.0

31. The high cutting speed and large rake angle of the tool, during machining of ductile materials, will result in the formation of

A) Continuous chips

B) Discontinuous chips

C) Continuous chips with built up edge

D) None of the above

32. Chip flow velocity during a machining process is 0.3 m/s with chip thickness ratio of 0.6. What is the value of cutting velocity?

A) 0.5 m/s

B) 1.0 m/s

C) 1.5 m/s

D) 2.0 m/s

33. In an machining operation, a cutting speed of 200 m/min gives the tool life as 16 minutes and a cutting speed of 400 m/min gives the tool life as 4 minutes, the values of Exponent (n) and Constant (C) respectively will be

A) 0.25 and 200

B) 0.25 and 400

C) 0.50 and 600

D) 0.50 and 800

34. An orthogonal cutting operation is being carried out under the following conditions: Cutting speed =2 m/s, depth of cut 0.4 mm, chip thickness = 0.8 mm, what will be the chip velocity?

A) 1 m/s

B) 2 m/s

C) 3 m/s

D) 4 m/s

35. In determining the various forces on the chip, Merchant assumed that the

A) the cutting edge of the tool is sharp and it does not make any flank contact with the work piece

B) only continuous chip without built-up edge is produced

C) cutting velocity remains constant

D) all of the above

36. The discriminating power of an operating characteristics curve in a single sampling plan increases by increasing the

A) rejection number

B) acceptance number

C) sample size

D) both rejection number and acceptance number

37. Typical machining operations are to be performed on hard-to-machine materials by using the processes listed below. Choose the best set Operation – Process combinations.

Operation	**Process**
P. Deburring (internal surface)	1. Plasma Arc Machining
Q. Die sinking	2. Abrasive Flow Machining
R. Fine hole drilling in thin sheets	3. Electric Discharge Machining
S. Tool sharpening	4. Ultrasonic Machining
	5. Laser beam Machining
	6. Electrochemical Grinding

A) P-1 Q-5 R-3 S-4

B) P-1 Q-4 R-1 S-2

C) P-5 Q-1 R-2 S-6

D) P-2 Q-3 R-5 S-6

38. Consider the following statements

The MIG welding process uses

1. Consumable electrode
2. Non-consumable electrode
3. A.C. Power supply
4. D.C. Power supply

Of these, the correct statements are

A) 1 and 3

B) 1 and 4

C) 2 and 3

D) 2 and 4

39. In a 5 × 5 transportation problem, degeneracy would arise if the number of filled slots are

A) equal to 25

B) equal to 9

C) less than 9

D) greater than 9

40. In Linear programming problem, If the i^{th} constraint of the primal (maximization problem) is equality, then the dual (minimization) variable y_i is

A) Greater than or equal to 0

B) Less than or equal to 0

C) Unrestricted in sign

D) None of the above

41. In a time series forecasting model, the demand for four time periods 9, 12, 14, 17. A linear regression fit resulted in an equation F=6.8+2.8t, where F is a forecast for a period t. The sum of the absolute deviation for the four periods will be

A) 0.2

B) 2.2

C) 3.2

D) 4.2

42. Consider the following data:

Annual demand: 2,000 units per year

Ordering cost : Rs.100 per order

Inventory holding rate: 25% of unit price

Unit price = Rs.10

The economic order quantity (in units) is

A) 300

B) 400

C) 500

D) 600

43. Classifying items in A, B and C categories for selective control in inventory management is done by arranging the items in decreasing order of :

A) Total inventory costs

B) Item value

C) Annual usage value

D) Item demand.

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

List-I	**List-II**
P. Tardiness	1. Johnson's Rule
Q. Makespan	2. Negative lateness
R. N/M job shop scheduling	3. SPT
S. WIP	4. Positive lateness
	5. NP Complete

A) P-4 Q-1 R-3 S-5

B) P-4 Q-1 R-5 S-3

C) P-2 Q-3 R-5 S-1

D) P-2 Q-1 R-3 S-5

45. Six sigma quality philosophy is based on the following number of defect per million in a single lot.

A) 2700

B) 1500

C) 3.4

D) 1.2

46. A time study was conducted in a machine shop for a manual operation. The observed time for the completion of the particular manual operation was 25 minute. The performance rating for the operator is 120%. The allowance factor is 20%. The standard time is :

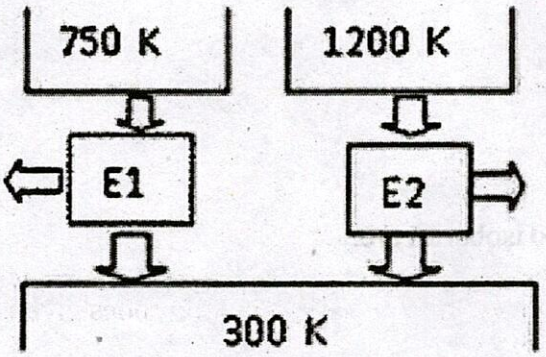
A) 20 minutes

B) 28 minutes

C) 32 minutes

D) 36 minutes

47.



The two heat engines E1 and E2 as shown in figure, receive same amount of heat from high temperature reservoirs and reject same amount of heat to low temperature reservoir. The correct statement about them is:

A) Thermal efficiency of E1 is more than that of E2

B) Second law efficiency of E1 is more than that of E2

C) Second law efficiency of E2 is more than that of E1

D) Second law efficiency cannot be obtained from the information.

48. The State - Postulate is defined as:

A) The state of a simple compressible system is defined by two independent intensive properties.

B) The state of a simple incompressible system is defined by two independent intensive properties.

C) The state of any system is defined by two independent intensive properties

D) The state of any system is defined by two independent extensive properties.

49. The vertical component of the hydrostatic force on a submerged curved surface is equal to :

A) Mass of liquid vertically above it

B) Force on a vertical projection of the surface

C) Product of pressure at the centroid and surface area

D) The gravity force of liquid vertically above the curved surface up to the free surface.

50. Following are the names of some ideal thermodynamic cycles,

(i) Stirling

(ii) Joule

(iii) Rankine

(iv) Vapour - Compression

The cycles with two isentropics and two isobarics are:

A) Only (i) and (ii)

B) Only (ii) and (iii)

C) Only (iii) and (iv)

D) Only (ii) and (iv)

51. The exhaust gases leaving the turbine in a gas turbine cycle is passed through a heat exchanger. The heat transferred by the gas is utilized to heat the air passing through the compressor. This process/ provision is known as :

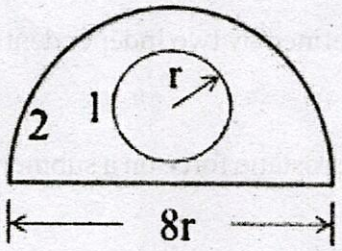
A) Reheating

B) Intercooling

C) Regeneration

D) Undercooling

52. A solid sphere 1 of radius 'r' is placed inside a hollow, closed hemispherical surface 2 of radius '4r'. The shape factor $F_{2\text{-}1}$ will be:



A) 1/12

B) 1/2

C) 2

D) 12

53. Saturated steam at 100°C condenses outside of a tube. Cold fluid enters the tube at 20°C and exits at 50°C. The value of Log Mean Temperature Difference (LMTD) in °C is

A) 0

B) 0.015

C) 63.8

D) 67.5

54. A 10mm diameter cylindrical conductor is covered by insulation of 2mm thickness. Thermal conductivity of the insulation is 0.08 W/m-K and the convective heat transfer coefficient of the insulation surface is 10 w/m^2-K. The effect of adding further insulation of the same material is :

A) To Increase heat loss continuously

B) To decrease heat loss continuously

C) To increase heat loss to a maximum and then decrease

D) To decrease heat loss to a minimum and then increase

55. The objective of providing fins on heat transfer surfaces is to increase:

A) temperature gradient to enhance convective heat transfer

B) effective surface area to enhance convective heat transfer

C) turbulence in flow to enhance convective heat transfer

D) pressure drop of the fluid.

56. Steam maintained at 200°C running through a pipe is kept in a large room at 30°C. If the emissivity of the pipe surface is 0.8; the value of $\sigma = 5.67 \times 10^{-8} W/m^2K^4$; the effective heat transfer coefficient due to radiation will be nearly

A) 8 W/m^2K

B) 11 W/m^2K

C) 14 W/m^2K

D) 17 W/m^2K

57. A parameter NTU in heat exchanger design is physically defined by:

A) Dimensionless area

B) Number of temperature units

C) $(UA)/(mc)_{max}$

D) $(mc)_{min}/(mc)_{max}$

58. An engine cylinder has got initial volume as 1 m^3. After compression the space available (clearance volume) at TDC is 5% of the initial volume. The compression ratio is:

A) 5

B) 10

C) 20

D) 50

59. For the same value of peak pressure, peak temperature and heat rejection, the correct order of efficiencies for Otto, Diesel and Dual cycles are

A) $\eta_{otto} > \eta_{Diesel} > \eta_{Dual}$

B) $\eta_{Diesel} > \eta_{otto} > \eta_{Dual}$

C) $\eta_{otto} > \eta_{Dual} > \eta_{Diesel}$

D) $\eta_{Diesel} > \eta_{Dual} > \eta_{otto}$

60. The statement which is incorrect in relation to the 'Dissociation' phenomenon during combustion in internal combustion engines, is

A) Disintegration of combustion products at higher temperature

B) Reverse of Combustion process

C) Significant at lean mixtures

D) NOT so pronounced in Compression Ignition Engines.

61. Exhaust Blow Down is exactly defined by

A) Increase of work due to early opening of valve

B) Increase of work due to delayed opening of valve

C) Loss of work due to early opening of valve

D) Loss of work due to delayed opening of valve

62. Choose the incorrect statement from these

A) Rating of SI Engine fuels are done by Octane number

B) Amyl-nitrate gives anti - knock properties in SI Engine fuels

C) Rating of CI Engine fuels are done by Cetane number

D) Ethyl Nitrate gives anti-knock properties in CI Engine fuels.

63. Match the **List - I** and **List - II** with respect to the A/F mixture requirement in SI Engines:

List - I	**List - II**
P Idling	1. Maximum fuel economy
Q Cruising	2. No load with almost closed throttle
R Power	3. Rich mixture
S Quantity Governing	4. Carburettor

A) P-2, Q-1, R-3, S-4

B) P-1, Q-2, R-3, S-4

C) P-2, Q-1, R-4, S-3

D) P-4, Q-1, R-3, S-2

64. Consider a simple ideal Rankine cycle with fixed boiler and condenser pressures. If the cycle is modified with reheating,

A) the turbine work output will decrease

B) the amount of heat rejected will decrease

C) the pump work input will decrease

D) the moisture content at turbine exit will decrease

65. The data for two vapour power cycles are as given below:

	Cycle - I	Cycle - II
Q_{in}	120	120
W_T	100	40
W_P	61	1

The correct statement about them, is

A) Heat rate of cycle - I is more than that of cycle - II

B) Heat rate of cycle - II is more than that of cycle - I

C) Work ratio of cycle - I is more than that of cycle - II

D) Work ratio of cycle - II is more than that of cycle - I

66. For increasing the thermal efficiency of Rankine cycle following provisions have been made :

(i) Increase the average temperature at which heat is transferred to the working fluid in the boiler.

(ii) Decrease the average temperature at which heat is transferred to the working fluid in the boiler.

(iii) Decrease the average temperature at which heat is rejected from the working fluid in the condenser.

(iv) Increase the average temperature at which heat is rejected from the working fluid in the condenser.

The correct statement about them is

A) Only (i) and (iii) are correct

B) Only (i) and (iv) are correct

C) Only (ii) and (iii) are correct

D) Only (ii) and (iv) are correct

67. A single stage steam turbine has blade velocity 200 m/s, velocity of steam coming out from nozzle 426 m/s, and the total velocity of whirl 392 m/s. The diagram efficiency of the turbine is :

A) 0.22

B) 0.43

C) 0.68

D) 0.86

68. Match the **List - I** and **List - II** with respect to the compounding of impulse steam turbines:

	List - I		List - II
P	Velocity compounding	1	Rateau turbine
Q	Pressure compounding	2	Pressure drop divided in number of velocity compounded stages
R	Pressure velocity compounding	3	Reduction of rotor velocity
S	Compounding	4	Curtise turbine

A) P-4, Q-1, R-3, S-2

B) P-1, Q-4, R-2, S-3

C) P-4, Q-1, R-2, S-3

D) P-1, Q-4, R-3, S-2

69. A single acting two-stage air compressor deals with $4m^3/min$ of air at 4 bar and 15°C with a speed of 250 rpm. The delivery pressure is 81 bar. If the inter cooling is perfect, the intermittent pressure after first stage will be

A) 4.5 bar

B) 18 bar

C) 20.25 bar

D) 42.5 bar

70. Heat rate of a thermal power plant is:

A) $\frac{3600}{\eta_{cycle}}\left[\frac{kJ}{kWh}\right]$

B) $\frac{3600}{w_{net}}\left[\frac{kJ}{kWh}\right]$

C) $\frac{\eta_{cycle}}{3600}\left[\frac{kJ}{kWh}\right]$

D) $\frac{Q_{net}}{3600}\left[\frac{kJ}{kWh}\right]$

71. Which one is the INCORRECT statement about Hygroscopic solution:

A) Brines, Glycols are the examples of it.

B) They exert higher vapour pressure compared to pure water at the same temperature.

C) Spray of Hygroscopic solution is more effective for dehumidification than water.

D) After absorbing moisture, diluted solution needs to be regenerated.

72. If the atmospheric pressure is 750mm of Hg and the saturation pressure of water vapour is 15mm of Hg, the humidity ratio (in grams of water vapour/kg of dry vapour) is

A) 79.3

B) 50

C) 49

D) 12.7

73. The FALSE statement for a Binary mixture is

A) 3 independent properties are required to define its thermodynamic state

B) Only 1 property is required to define its saturated liquid/vapour state

C) Composition is one of the essential property to define the thermodynamic state

D) It is a mixture of a higher boiling and a lower boiling component

74. Water at 20°C ambient temperature is converted to ice at 0°C. Temperature of the brine is -8°C. The refrigeration cycle used is a perfect reversed Carnot cycle. Latent heat of ice=335kJ/kg, and $C_{p\text{-water}} = 4.18$kJ/kg. The ice formed per kWh will be nearly

A) 81.4kg

B) 76.4kg

C) 71.8kg

D) 68.8kg

75. The maximum value of secondary unbalanced force as compared to the primary unbalanced force in a reciprocating engine is

A) 1/n times

B) n times

C) 2n times

D) n^2 times

76. For a long slender column of uniform cross-section, the ratio of critical buckling load for the case with both ends hinged to that of the case with both ends fixed is

A) 0.125

B) 0.25

C) 0.5

D) 4

77. **Assertion (A):** The elements of higher pairs must be force closed.

Reason (R): This is required in order to provide completely unconstrained motion.

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

78. Match **List I** and **List II** and select the correct answer from the codes given below.

List - I	**List-II**
P. Gear	1. Hunting
Q. Governor	2. Mobility of linkages
R. Grubler's rule	3. Instantaneous centers in linkages
S. Kennedy's theorem	4. Interference

A) P-1 Q-4 R-2 S-3

B) P-1 Q-4 R-3 S-2

C) P-4 Q-1 R-2 S-3

D) P-4 Q-1 R-3 S-2

79. The fatigue stress concentration factor (k_f) in terms of theoretical concentration factor (k_t) and notch sensitivity (q) is defined as

A) $(k_f) = 1 + 2q(k_t + 1)$

B) $(k_f) = 1 - 2q(k_t - 1)$

C) $(k_f) = 1 + q(k_t - 1)$

D) $(k_f) = 1 - 2q(k_t + 1)$

80. Match **List I** (Crystal structure) and **List II** (Atomic packing factor) and select the correct answer from the codes given below.

List - I	**List-II**
P. Simple cubic	1. 68%
Q. Body-centred cubic	2. 74%
R. Face-centred cubic	3. 52%
S. Hexagonal close packed	4. 74%

A) P-1 Q-4 R-3 S-2

B) P-1 Q-3 R-4 S-2

C) P-3 Q-1 R-2 S-4

D) P-3 Q-4 R-2 S-1

81. A basic hole, with reference to Metrology terminology, is one whose

A) lower deviation is zero

B) upper deviation is zero

C) lower and upper deviations are zero

D) none of these

82. Choose the best set Process - Mechanism of material removal combinations

Process	Mechanism of material removal
P. EDM	1. Erosion
Q. ECM	2. Thermal evaporation
R. AJM	3. Anodic dissolution
	4. Etching

A) P-2, Q-3, R-1

B) P-2, Q-4, R-1

C) P-1, Q-3, R-4

D) P-4 Q-3, R-1

83. A CNC vertical milling machine has to cut a straight slot of 10mm width and 2mm depth by a cutter of 10mm diameter between points (0, 0) and (100, 100) on the XY plane (dimensions in mm). The feed rate used for milling is 60mm/min. Milling time for the slot (in seconds) is

A) 111

B) 121

C) 141

D) 241

84. Shadow price in linear programming refers to

A) lowest sales price

B) maximum cost per item

C) value assigned to one unit

D) cost of bought out items

85. The fixed costs for a particular period are Rs.40,000. Variable cost per unit for the single product being made is Rs.6. Estimated sales for the period are valued at Rs.1,60,000. The number of units involved coincides with the expected volume of output. Each unit sells at Rs.10 each. Calculate the break-even point (in Rs.)

A) Rs.50,000

B) Rs.1,00,000

C) Rs.1,50,000

D) Rs.2,00,000

86. The margin of safety, in breakeven analysis, is the difference between

A) Planned sales and actual sales

B) Planned sales and break even sales

C) Planned profit and realized profit

D) Planned profit and fixed costs

87. A calorically perfect gas (specific heat at constant pressure 1000 J/kg-K) enters and leaves a gas turbine with the same velocity. The temperatures of the gas at the turbine entry and exit are 1100 K and 400K, respectively. The power produced is 4.6 MW and heat escapes at the rate of 300 kJ/s through the turbine casing. The mass flow rate of the gas (in kg/s) through the turbine is

A) 6.14

B) 7.00

C) 7.50

D) 8.00

88. **Assertion (A):** Dissociation in fuel-air analysis is not so pronounced in CI Engines

Reason (R): CI Engines have controlled excess air to ensure complete combustion

The correct statement about A and R is

A) A is correct and R is incorrect

B) A is incorrect and R is correct

C) Both A and R are correct and R is the correct explanation of A

D) Both A and R are correct but R is not the correct explanation of A

89. Advantage of air injection system in IC engines, are

(i) cheaper fuels can be used

(ii) mep is high

(iii) better atomization and distribution of fuel

A) Only (i) and (ii) are correct

B) Only (ii) and (iii) are correct

C) Only (i) and (iii) are correct

D) (i), (ii) and (iii) all are correct

90. Following are the statements about the combustion in IC engines.

(i) Knocking in CI engines takes place at the start of the combustion

(ii) Knocking in CI engines takes place at the end of the combustion

(iii) Detonation in SI engine takes place at the start of the combustion

(iv) Detonation in SI engine takes place at the end of the combustion

A) Only (i) and (iii) are correct

B) Only (i) and (iv) are correct

C) Only (ii) and (iii) are correct

D) Only (ii) and (iv) are correct

91. Following statements are given with respect to Supersaturation:

(i) It occurs during expansion through nozzles.

(ii) It occurs in high pressure boilers

(iii) The steam in this condition is said to be in metastable state.

A) Only (i) is correct

B) Only (ii) is correct

C) (i) and (iii) both are correct

D) (ii) and (iii) both are correct

92. In an ideal Rankine cycle, reducing the condenser pressure keeping other parameters constant, will lead to

A) Increase in turbine work

B) Increase in rejected heat at condenser

C) Increase in pump work

D) Increase in thermal efficiency

93. In an air-conditioning operation, air is passed through "X" with a spray of water. During the course of flow, the air may be heated or cooled, humidified or dehumidified, or simply adibatically saturated. "X" is called as

A) Evaporator

B) Condenser

C) Air-washer

D) Cooling/heating coil

94. Following is TRUE about the Azeotropic mixtures

A) Bubble point temperature is equal to dew point temperature

B) They are ideal mixtures

C) A minimum boiling Azeotrope will have large latent heat of vaporization

D) An Azeotrope with positive deviations from Raoult's law is called a maximum boiling Azeotrope

95. Following parameter(s) is (are) dependent on bypass factor of the apparatus

A) Room sensible and latent heat gains

B) Grand sensible heat factor (GSHF)

C) Ventilation air quantity

D) Dehumidified air quantity (cmm)

96. Condensate subcooling in vapor compression refrigeration system is beneficial as it

(i) Increases specific refrigeration effect

(ii) Decreases work of compression

(iii) Ensures liquid entry into expansion device

The correct statement is

A) Only (i) is correct

B) Only (ii) is correct

C) Only (i) and (ii) are correct

D) Only (i) and (iii) are correct

97. Compared to compression systems, absorption refrigeration systems offer the benefits of:

A) Higher COPs

B) Lower refrigeration temperatures

C) Possibility of using low-grade energy sources

D) Lower external work requirement

98. Which of the following statements is/are TRUE?

A) Natural convective type condensers are used in small capacity systems as the overall heat transfer coefficient obtained is small

B) Compared to natural convection type, forced convection type condensers have smaller weight per unit capacity.

C) Evaporative condensers are normally used in small capacity systems

D) Compared to water-cooled condensers, the water consumption is high in evaporative condensers.

99. Which of the following statements are TRUE?

A) The maximum amount of moisture air can hold depends upon its temperature and barometric pressure

B) Perfect gas model can be applied to air-water mixtures when the total pressure is high

C) The minimum number of independent properties to be specified for fixing the state of moist air is two

D) The minimum number of independent properties to be specified for fixing the state of moist air is three.

100. State which of the following statements is/are TRUE.

A) The purpose of psychrometric calculations is to fix the supply air conditions

B) The purpose of psychrometric calculations is to find the load on the building

C) In a 100% re-circulation system, the coil ADP is equal to room ADP

D) In a 100% re-circulation system, the coil ADP is less than room ADP

ROUGH WORK

ROUGH WORK

ROUGH WORK

SEAL