SSC Junior Engineer Solved Paper 2018

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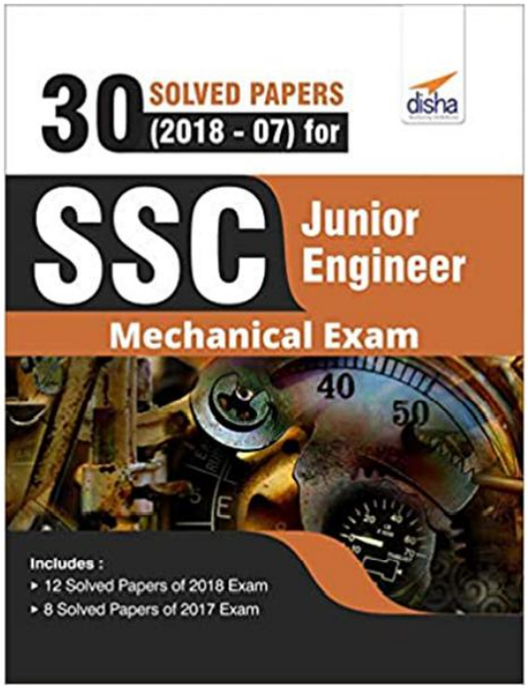

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SSC JUNIOR ENGINEER MECHANICAL SOLVED PAPER - 2018 (SET-1)

(Held on 22 Jan. Morning)

General Intelligence and Reasoning

DIRECTIONS (Qs. 1 – 9): Select the related word/letters/number from the given alternatives.

1. In the following question, select the related word pair from the given alternatives.
Rain : Clouds :: ? : ?
(a) Rice : food (b) Grey : Colour
(c) Heat : Sun (d) Snow : Mountains

2. In the following question, select the related word from the given alternatives.
Cactus : Plant :: Rice : ?
(a) Basmati (b) Crop
(c) White (d) Rabi

3. In the following question, select the related word from the given alternatives.
Pink : Colour :: Eagle : ?
(a) Black (b) Symbol
(c) Bird (d) Sky

4. In the following question, select the related letter pair from the given alternatives.
TOM : NIG :: ? : ?
(a) EAT : YUN (b) EAT : XXM
(c) FAT : LMV (d) EAT : ZXC

5. In the following question, select the related letters from the given alternatives.
LERI : PJVN :: MONT : ?
(a) WRTY (b) QTRY
(c) RITY (d) RQYB

6. In the following question, select the related letters from the given alternatives.
SAT : WEX :: MET : ?
(a) AQI (b) IYX
(c) FHY (d) QIX

7. In the following question, select the related number from the given alternatives.
43 : 7 :: 23 : ?
(a) 6 (b) 4
(c) 7 (d) 5

8. In the following question, select the related number from the given alternatives.
38 : 53 :: 53 : ?
(a) 72 (b) 68
(c) 79 (d) 87

9. In the following question, select the related number from the given alternatives.
9 : 81 :: 11 : ?
(a) 78 (b) 93
(c) 121 (d) 146

10. In the following question, select the odd word from the given alternatives.
(a) Goggle (b) Purse
(c) Accessories (d) Belt

11. In the following question, select the odd word from the given alternatives.
(a) Grapes (b) Guava
(c) Cauliflower (d) Orange

12. In the following question, select the odd word from the given alternatives.
(a) Sparrow (b) Rat
(c) Ostrich (d) Parrot

13. In the following question, select the odd letters from the given alternatives.
(a) GCXTO (b) KGBXS
(c) RNIEX (d) QMHDY

14. In the following question, select the odd letters from the given alternatives.
(a) SOKG (b) AWSO
(c) RNJF (d) CYTP

15. In the following question, select the odd letters from the given alternatives.
(a) KNQ (b) DGJ
(c) WZB (d) TWZ

16. In the following question, select the odd number from the given alternatives.
(a) 10 – 11 (b) 12 – 16
(c) 14 – 18 (d) 9 – 15

17. In the following question, select the odd number from the given alternatives.
(a) 2 – 4 (b) 3 – 9
(c) 4 – 18 (d) 5 – 25

18. In the following question, select the odd number pair from the given alternatives.
(a) 76 – 42 (b) 92 – 20
(c) 73 – 21 (d) 93 – 27

19. Arrange the given words in the sequence in which they occur in the dictionary.
(1) Flagrant (2) Flavour
(3) Flatter (4) Flick
(5) Flawed
(a) 13254 (b) 31254
(c) 23541 (d) 32541

20. According to dictionary, which of the following word will come at **THIRD** position?
(1) Heritage (2) Helpful
(3) Hectic (4) Heroic
(5) Heroism
(a) Hectic (b) Heritage
(c) Heroic (d) Helpful

21. From the given alternatives, according to dictionary, which word will come at **LAST** position?
(a) Juvenile (b) Justify
(c) Judge (d) Justice

22. A series is given with one term missing. Select the correct alternative from the given ones that will complete the series. F, M, T, ?, H, O
(a) B (b) C
(c) A (d) D

23. A series is given with one term missing. Select the correct alternative from the given ones that will complete the series. ROK, LIE, FCY, ZWS, ?
(a) LAQ (b) SRV
(c) TQM (d) FMQ

24. A series is given with one term missing. Select the correct alternative from the given ones that will complete the series. FAQ, LGW, RMC, ?, DYO
(a) VIR (b) XSI
(c) LSI (d) MIS

25. In the following question, select the missing number from the given alternatives.
14, 22, 49, 113, 238, ?
(a) 386 (b) 532
(c) 454 (d) 576

26. In the following question, select the missing number from the given alternatives.
42, 21, 21, 31.5, 63, ?
(a) 169.75 (b) 157.5
(c) 152.5 (d) 126.75

27. In the following question, select the missing number from the given alternatives.
14, 44, 135, 409, 1232, ?
(a) 2962 (b) 3340
(c) 3702 (d) 3406

28. E is sitting between D and A, B is to the right of A, C is at one of the ends and C and D are sitting next to each other. Who is sitting third?
(a) D (b) A
(c) B (d) E

29. Showing a photograph of a married couple B said that the gentleman in it was his father's father and A said that the lady in it was her mother. How is A related to B?
(a) A is B's mother's sister
(b) A is B's sister
(c) A is B's Father's sister
(d) A is B's mother

30. From the given alternative words select the word which cannot be formed using the letters of the given word.
MERCANTILE
(a) truce (b) learn
(c) trace (d) claim

31. If **OLYMPUS** is coded as **MJWKNSQ**, then how will **TEN** be coded as?
(a) RCL (b) GVM
(c) SDM (d) UFO

32. In a certain code language, 1875 means 'wound the round watch', 6143 means 'a cake is round' and 7321 means 'watch a round wheel'. Find the code for 'watch'.
(a) 1 (b) 8
(c) 5 (d) 7

33. In a certain code language, '+' represents '–', '–' represents '×', '×' represents '÷' and '÷' represents '+'. Find out the answer to the following question.
96 × 4 ÷ 125 + 25 – 5 = ?
(a) 23 (b) 24
(c) 50 (d) 8

34. If 17 $ 22 = 4 and 56 $ 13 = 7, then find the value of 71 $ 25 = ?
(a) 56 (b) 96
(c) 1 (d) 8

35. If A $ B means A is son of B, A # B means A is brother of B and If A * B means A is father of B, then what does X # Y * Z $ W mean?
(a) W is X's brother's wife (b) W is X's wife
(c) W is X's mother (d) W is X's sister

36. Select the missing number from the given responses

1	4	2
2	7	10
3	?	12

(a) 3 (b) 9
(c) – 3 (d) 11

37. Which of the following terms follows the trend of the given list?
OOXXXXX, OXOXXXX, OXXOXXX, OXXXOXX, OXXXXOX, _____.
(a) XOXXXXO (b) XOXXXOX
(c) OXXXOXX (d) OXXXXXO

38. A scientist is studying the behaviour of an ant. The ant picks food and walks 5 cm North, then it turns to its right and walks for another 11 cm. then it turns right and walks 3 cm, then it turns West and walks 15 cm, then finally it turns to its left and walks 2 cm. Where is the ant now with respect to its starting point?
(a) 4 cm East (b) 26 cm West
(c) 4 cm West (d) 26 cm East

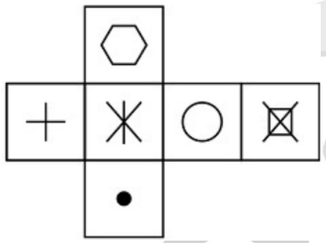
39. Two football players start running from the same point on the ground. Player A runs 10 km East, then turns to his left and runs 13 km. In the meanwhile Player B runs 6 km South, then he runs 3 km East, the he turns to his left and runs 19 km. Where is Player A with respect to Player B?
(a) 7 km West (b) 7 km East
(c) 13 km East (d) 13 km West

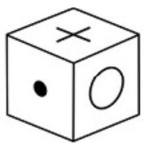
40. In the question two statements are given, followed by two conclusions, I and II. You have to consider the statements to be true even if it seems to be at variance from commonly known facts. You have to decide which of the given conclusions, if any, follows from the given statements.
Statement I: Some chapters are physics
Statement II: All science is physics
Conclusion I: All science is chapters
Conclusion II: Some physics is science

(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Both conclusions I and II follow
(d) Neither conclusion I nor conclusion II follows

41. In the question three statements are given, followed by three conclusions, I, II and III. You have to consider the statements to be true even if it seems to be at variance from commonly known facts. You have to decide which of the given conclusions, if any, follows from the given statements.
Statement I: All success is victory
Statement II: All luck is success
Statement III: Some hard work is luck
Conclusion I: Some success is hard work
Conclusion II: Some hard work is victory
Conclusion III: No victory is luck
(a) Only conclusion I and II follows
(b) Only conclusion II and III follows
(c) Only conclusions I and III follow
(d) All conclusions I, II and III follow

42. Which of the following cube in the answer figure cannot be made based on the unfolded cube in the question figure?



(a) 
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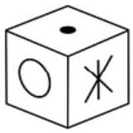
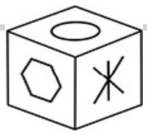
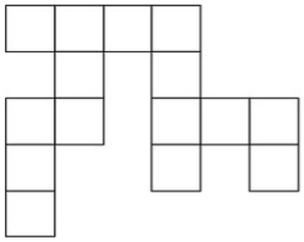
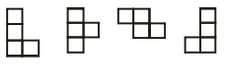
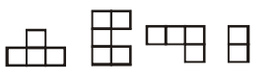
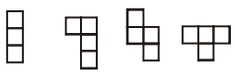
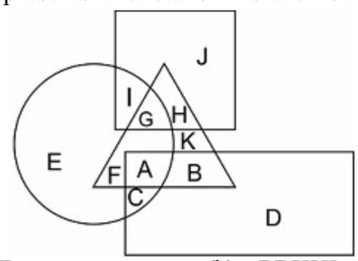
(c) 
(d) 

43. Which of the following answer figure patterns can be combined to make the question figure?



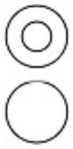
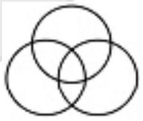
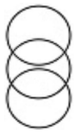
(a) 
(b) 
(c) 
(d) 

44. In the following figure, square represents Professors, triangle represents Social, Workers, circle represents Dieticians and rectangle represents Men. Which set of letters represents Dieticians who are not men?

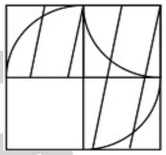


(a) EFGI (b) BDKHJ
(c) IGAC (d) DEJI

45. Which of the following Venn diagrams represents the relationship between Butterflies, Animals and Insects?

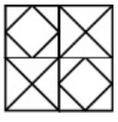
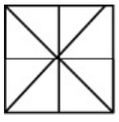
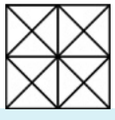
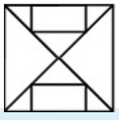
(a) 
(b) 
(c) 
(d) 

46. Which answer figure will complete the pattern in the question figure?

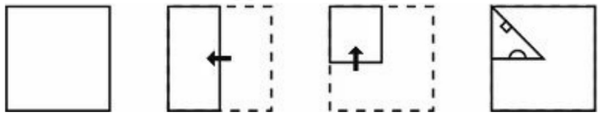


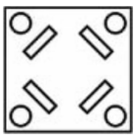
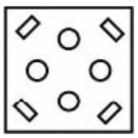
(a) 
(b) 
(c) 
(d) 

47. From the given answer figures, select the one in which the question figure is hidden/embeded.

(a) 
(b) 
(c) 
(d) 

48. A piece of paper is folded and punched as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.



(a) 
(b) 
(c) 
(d) 

49. If a mirror is placed on the line MN, then which of the answer figures is the right image of the given figure?

(a) 
(b) 
(c) 
(d) 

50. A word is represented by only one set of numbers as given in any one of the alternatives. The sets of numbers given in the alternatives are represented by two classes of alphabets as shown in the given two matrices. The columns and rows of Matrix-I are numbered from 0 to 4 and that of Matrix-II are numbered from 5 to 9. A letter from these matrices can be represented first by its row and next by its column, for example 'C' can be represented by 43, 41 etc and 'O' can be represented by 97, 98 etc. Similary, you have to identify the set for the word 'SPAN'

Matrix I

	0	1	2	3	4
0	M	M	M	I	E
1	A	M	I	I	A
2	F	I	M	I	E
3	I	J	A	L	K
4	D	C	A	C	L

Matrix II

	5	6	7	8	9
5	N	V	Q	U	S
6	R	S	T	U	N
7	S	Z	X	O	V
8	X	S	P	W	P
9	U	X	O	Y	Y

(a) 66,87,33,56
(b) 59,78,42,31
(c) 86,89,32,55
(d) 78,43,22,98

General Awareness

51. Preliminary expenses are the examples of _____.
(a) Capital expenditure
(b) Capital gain
(c) revenue expenditure
(d) deferred revenue expenditure

52. Which economic activity cannot be included in the tertiary sector?
(a) Working in a call-centre
(b) Tuition occupation
(c) Bee-keeping
(d) Banking

53. Which of the following statement is true for the Public Sector Unit?
(a) Most of assets is owned by a group of people
(b) Most of assets is owned by big companies
(c) Most of assets is owned by government
(d) Most of assets is owned by an individual

54. The percentage of India's population in the total population of the world as per 2011 census is: _____.
(a) 17.5%
(b) 18.01%
(c) 19.35%
(d) 20.25%

55. Which of the following five year plan of India recognized human development as the core of development efforts?
(a) Eighth five year plan
(b) Ninth five year plan
(c) Tenth five year plan
(d) Eleventh five year plan

56. Which of the following thinker is associated with "the concept of political sovereignty"?
(a) MacIver
(b) Socrates
(c) Rousseau
(d) Plato

57. Who said, "A good citizen makes a good state and a bad citizen makes a bad state"?
(a) Plato
(b) Aristotle
(c) G. B. Shaw
(d) Rousseau

58. Panchayat Samiti at the block level in India is a/an _____.
(a) Advisory Body
(b) Coordinating Authority only
(c) Supervisory Authority only
(d) Administrative Authority

59. According to Indian Constitution, who decides the salary of members of Parliament?
(a) Union Council of Ministers
(b) Parliament
(c) Supreme Court
(d) President of India

60. Which one of the following is not a correctly matched?
(a) Eighth Schedule : Languages
(b) Second Schedule : Form of Oath of office
(c) Fourth Schedule : Allocation of seats in Rajya Sabha
(d) Tenth Schedule : Defection related provisions

61. When did the Chinese traveler 'Sung Yun' come to India?
(a) 510 AD
(b) 518 AD
(c) 525 AD
(d) 528 AD

62. Which among the following state 'Odantpuri' education center was situated?
(a) Bengal
(b) Gujarat
(c) Bihar
(d) Tamil Nadu

63. Who was the founder of Bahmani Kingdom?
(a) Hasan Gangu
(b) Firoz Shah
(c) Mahmud Gawan
(d) Asaf Khan

64. During whose rule in India did the Khilafat movement begin?
(a) Lord Mountbatten
(b) Lord Dalhousie
(c) Lord Chelmsford
(d) Lord Curzon

65. Who among the following was the founder of the Arya Mahila Samaj in the early 1880s?
(a) Swami Dayananda Saraswati
(b) Swami Vivekananada
(c) Ramabai Ranade
(d) Pandita Ramabai

66. Dasht-e Kavir Desert is located in which country?
(a) Iran (b) Saudi Arab
(c) Iraq (d) Sudan

67. Which of the following layers is called "Barysphere"?
(a) Earth's most internal layer
(b) Earth's intermediate layer
(c) Earth's topmost layer
(d) Lowest part of the atmosphere where climate changes occur

68. The Blue Nile river originates from which of the following lakes?
(a) Lake Victoria (b) Lake Tana
(c) Lake Edward (d) Lake Albert

69. Which of the following states of India has the largest percentage of geographical area under forest as per the report of the Forest survey of India?
(a) Manipur (b) Meghalaya
(c) Mizoram (d) Nagaland

70. At which of the following towns the Alaknanda and the Bhagirathi combines to form River Ganga?
(a) Haridwar (b) Rishikesh
(c) Rudraprayag (d) Devprayag

71. 'Nirvana Fund' was set up by NSDC for financial help to _____.
(a) Entrepreneurs from the bottom rungs of society
(b) Displaced Kashmiri Pandits
(c) Old age people having no means of livelihood
(d) Ventures of selected candidates trained under PMKVY but did not get any job.

72. Nakul Swasthya Patra' is a scheme by the Government for which among the following purposes?
(a) Wellness of animals
(b) Wellness of animal owners
(c) Taking care of lactating mother in the rural areas
(d) Taking care of newborn babies in the rural areas

73. Which mine of India was in the news recently for becoming the country's first iron-ore mine to have a solar plant for reducing carbon footprint?
(a) Talchar mine (b) Koraput mine
(c) Noamundi mine (d) Ratnagiri mine

74. Where will the Summer Olympics be held in 2028?
(a) Sydney (b) Paris
(c) Los Angeles (d) Copenhagen

75. Which country has won the 2017 Davis Cup Tennis Tournament?
(a) Switzerland (b) Serbia
(c) France (d) Belarus

76. "You are Unique" is written by _____.
(a) Dr. A. P. J. Abdul Kalam
(b) Khushwant Singh
(c) Taslima Nasrin
(d) Arvind Adiga

77. The third Indian Council for Cultural Relations (ICCR) Distinguished Indologist Award for the year 2017 was awarded to Japanese professor _____.
(a) Hiroshi Marui (b) Shimamaru Marui
(c) Nagasaki Marui (d) Toyota Marui

78. Which of the following city has became first Indian city to get UNESCO's world heritage city tag?
(a) Jaipur (b) Ahmedabad
(c) Gandhi Nagar (d) Allahabad

79. In June 2017, which of the following countries have signed a protocol of co-operation in the field of archive?
(a) India and Israel (b) India and Portugal
(c) India and Netherland (d) India and Iran

80. India has signed an agreement to provide USD 318 million as line of credit for developing railway sector of which of the following country?
(a) Bangladesh (b) Nepal
(c) China (d) Sri Lanka

81. Dot Matrix is a type of _____.
(a) Tape (b) Disk
(c) Printer (d) Bus

82. The secondary storage devices can only store data but they cannot perform _____.
(a) Arithmetic operations (b) Logic operations
(c) Fetch operations (d) All options are correct.

83. In the modern periodic table metals, metalloids and non metals are found in which block?
(a) s-Block (b) p-block
(c) d-block (d) f-block

84. Cinnabar is ore of which of the following?
(a) Magnesium (b) Aluminium
(c) Mercury (d) Iron

85. In which of the following mirror size of image formed is always equal to the size of object?
(a) Convex mirror
(b) Concave mirror
(c) Plane mirror
(d) Both convex and concave mirror

86. Mass of a hydrogen atom is how many time the mass of an electron?
(a) 1000 (b) 8000
(c) 1837 (d) 5000

87. Which of the following are Fabrics that may contain polyester?
I. Polycot
II. Polywool
III. Terrycot
(a) Only I and II (b) Only I and III
(c) Only II and III (d) All I, II and III

88. Which of the following term does **NOT** represent electrical power in circuit?
(a) I^2R (b) IR^2
(c) VI (d) V^2/R

89. A positively charged particle projected towards west is deflected towards north by a magnetic field. What is the direction of magnetic field?
(a) toward south (b) toward east
(c) downward (d) upward

90. Which of the following is **NOT** positively charged?
(a) Alpha particle (b) Proton
(c) Helium nucleus (d) Electron

91. Which is a water soluble Vitamin?
(a) Vitamin A (b) Vitamin C
(c) Vitamin D (d) Vitamin K

92. Match the items given in column (A) with those in column (B).

Column - A		Column - B
I.	Frog	1. Skin
II.	Leaves	2. Stomata
III.	Earthworm	3. Lungs and skin

(a) I-3, II-2, III-1 (b) I-1, II-2, III-3
(c) I-3, II-1, III-2 (d) I-2, II-1, III-3

93. How many number of chambers are there in human heart?
(a) Two (b) Three
(c) Four (d) Five

94. Which of the following is **NOT** present in a matured stomata?
(a) Plasmodesma (b) Chloroplast
(c) Cell wall (d) Vacuole

95. What is/are the cause(s) of arise hypermetropia?
(a) Excessive curvature of the eye lens.
(b) Elongation of the eye ball.
(c) Focal length of the eye lens is too long.
(d) No option is correct.

96. Antibiotics are useful for which type of infections?
(a) Only bacteria
(b) Only virus
(c) Both bacteria and virus
(d) Neither bacteria nor virus

97. Which one of the following is **NOT** responsible for water shortage?
(a) Rapid growth of industries
(b) Increasing population
(c) Forestation
(d) Mismanagement of water resources

98. Which gas is major contributor to greenhouse effect?
(a) Carbon dioxide (b) Chloroflurocarbon
(c) Sulphur dioxide (d) Nitrogen dioxide

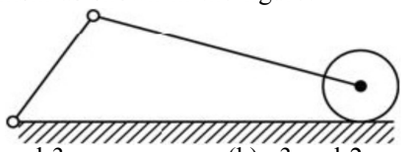
99. Which of the following is **NOT** a major problem in development of resources?
(a) Depletion of resources for satisfying the greed of few individuals.
(b) Accumulation of resources in few hands.
(c) An equitable distribution of resources.
(d) Indiscriminate exploitation of resources.

100. Which of the following is **NOT** man made ecosystem?
(a) Orchards (b) Home aquarium
(c) Botanical gardens (d) Grassland

Mechanical

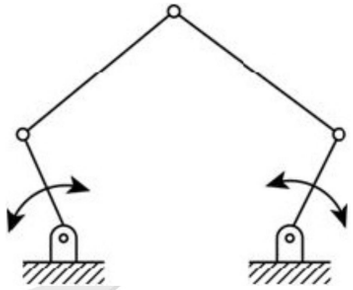
101. The number of links (I) which is required to form a kinematic chain can be expressed in term of the number of pairs (p) as _____.
(a) $I = 2p - 4$ (b) $I = 2p - 3$
(c) $I = 2p - 2$ (d) $I = 2p - 5$

102. What is the total number of links and joints in the mechanism as shown in the figure?



(a) 3 and 3 (b) 3 and 2
(c) 4 and 3 (d) 4 and 4

103. What is the degree of freedom of the mechanism shown below?



(a) 1 (b) 2
(c) 3 (d) 4

104. The graph of turning moment diagram is drawn between _____.
(a) crank angle and crank radius
(b) crank angle and crank effort
(c) crank effort and crank angle
(d) crank radius and crank angle

105. The mass of flywheel of a steam engine is 3250 kg with the radius of gyration of 1 m. The starting torque of the engine is 4500 N-m. What is the angular acceleration (rad/s^2) of the flywheel?
(a) 3.4 (b) 2
(c) 2.48 (d) 1.38

106. A pulley is driven by a flat belt and the maximum tension produced in the belt is of 1400 N. The belt has the density of 1000 kg/m^3, 100 mm wide and 5 mm thick. What is the speed (m/sec) of the belt for the maximum power?
(a) 32 (b) 31
(c) 30.55 (d) 3.05

107. The rotary internal combustion engine is the inversion of _____.
(a) four bar link chain
(b) double slider crank chain
(c) single slider crank mechanism
(d) None of these

108. The pressure distribution in the uniform wear theory is _____.
(a) directly proportional to radius
(b) directly proportional to the square of radius
(c) inversely proportional to radius
(d) inversely proportional to the square of radius

109. When the friction lining is new, the wear varies _____.
(a) directly to radius
(b) inversely to radius
(c) directly to the square of radius
(d) inversely to the square of radius

110. What is the radial distance of a tooth from the pitch circle to the top of the tooth known as?
(a) Dedendum
(b) Addendum
(c) Pitch circle diameter
(d) Module

111. Which of the following statement is **TRUE** about the contact ratio?
(a) Varies directly to the length of the arc of contact
(b) Inversely proportional to the module
(c) Inversely proportional to the circular pitch
(d) All options are correct

112. Which of the following is the type of pendulum governor?
(a) Hartnell governor
(b) Proell governor
(c) Porter governor
(d) Watt governor

113. Which of the following governors does not have central load attached to their sleeves?
(a) Porter governor (b) Watt governor
(c) Proell governor (d) None of these

114. What will be the vertical height (m) of a watt governor, if the speed of rotation is 80 rpm?
(a) 1.4 (b) 1.14
(c) 0.14 (d) 0.11

115. Which of the following term defines the size of the cam?
(a) Base circle (b) Prime circle
(c) Pitch circle (d) Pitch curve

116. What term is used for the combined effect of all the forces on a body?
(a) Load (b) Stress
(c) Strain (d) None of these

117. Which of the following load does not act on the considerable length of the beam?
(a) Uniformly distributed
(b) Triangular
(c) Point
(d) Uniformly varying

118. Which term states the S.I unit of stress?
(a) kN/mm (b) N/mm^2
(c) N/mm^3 (d) m^3/sec

119. Maximum shear stress theory was postulated by _____.
(a) ST Venant (b) Mohr
(c) Rankine (d) Tresca

120. The equivalent length of the column when both the ends are fixed is _____.
(a) 1 (b) 1/2
(c) 1/4 (d) 2l

121. The slenderness ratio of the columns is _____.
(a) directly proportional to the effective length
(b) directly proportional to the least radius of gyration
(c) directly proportional to the square of effective length
(d) directly proportional to the square of least radius of gyration

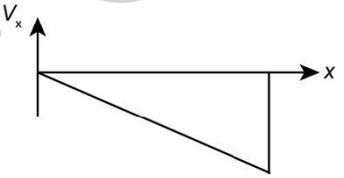
122. Rankine theory is applicable to the _____.
(a) Short strut/column
(b) Long column
(c) Both short and long column
(d) None of these

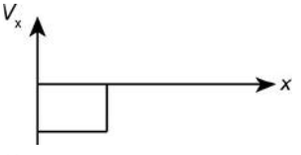
123. Which of the following assumptions is **INCORRECT** about the long column?
(a) The column behaves elastically.
(b) The load acts perfectly axial and passes through the centroid of the column section.
(c) The weight of the column is neglected.
(d) The material is non-homogeneous and anisotropic.

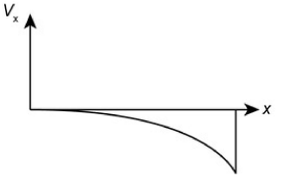
124. What is the maximum shear stress on the wall of a thin cylinder, if it has a diameter of d, thickness of t and the gauge pressure in the cylinder is p?
(a) $\frac{pd}{t}$ (b) $\frac{pd}{4t}$
(c) $\frac{pd}{2t}$ (d) $\frac{pd}{8t}$

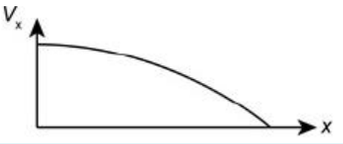
125. What is the volumetric strain in the thin cylinder subjected to internal pressure having hoop stress of 200 MPa, modulus of elasticity, E = 200 GPa and poissons ratio = 0.25?
(a) 20/1000 (b) 2/1000
(c) 0.2/1000 (d) 0.02/1000

126. The property of the material to regain its original shape after deformation when the external forces are removed is _____.
(a) plasticity (b) elasticity
(c) durability (d) None of these

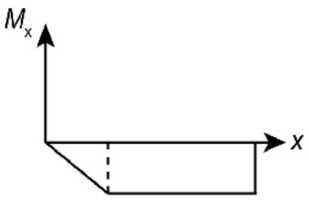
127. The correct shear force diagram for the cantilever beam with uniformly distributed load over the whole length of the beam is-
(a) 

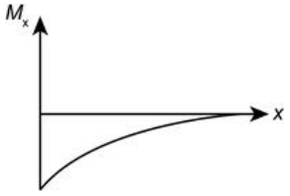
(b) 

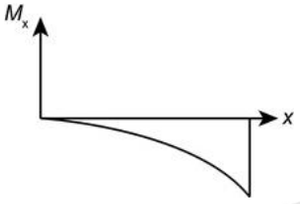
(c) 

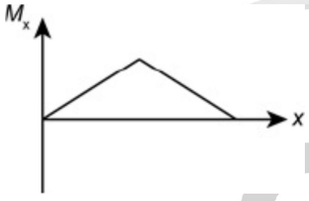
(d) 

128. Which of the following is the **CORRECT** bending moment diagram for the cantilever beam carrying uniformly varying load from zero at free and w/unit length at the fixed end?

(a) 

(b) 

(c) 

(d) 

129. A rod of dimension 20 mm × 20 mm is carrying an axial tensile load of 10 kN. The tensile stress developed is _____.
(a) 0.025 MPa (b) 0.25 MPa
(c) 25 MPa (d) 250 MPa

130. Which is the **CORRECT** option for the polar moment of inertia of the solid shaft?

(a) $J = \frac{\pi}{64} d^4$ (b) $J = \frac{\pi}{32} d^4$

(c) $J = \frac{\pi}{16} d^2$ (d) $J = \frac{\pi}{16} d^4$

131. The triple point on a P-V diagram is _____.
(a) a line (b) a point
(c) a triangle (d) not present

132. Which of the following statement related to entropy is TRUE?
(a) Minimum entropy is observed when the system is in equilibrium with the surrounding.
(b) At absolute zero temperature, the solid solutions have non-zero entropy.
(c) Substance in solid phase has the least entropy.
(d) Entropy conservation takes place in all irreversible processes.

133. If the COP of Carnot refrigerator is 4, then the thermal efficiency of the Carnot engine would be _____.
(a) 0.33 (b) 0.25
(c) 0.2 (d) 0.18

134. While working between temperatures 150 K and 300 K, the entropy change experienced by the Carnot engine during heat addition is 1 kJ/K, the work produced (kJ) by the engine is _____.
(a) 100 (b) 150
(c) 300 (d) 600

135. A heat engine working between the source at 200°C and rejects heat at 25°C receives 5 kW of heat. Work done for this engine is equal to 0 kW. Does this satisfy the inequality of Clausius?
(a) Yes (b) No
(c) Cannot be determined (d) None of these

136. An ideal gas with heat capacity ratio of 2 is used in an ideal Otto-cycle which operates between minimum and maximum temperatures of 200 K and 1800 K. What is the compression ratio of the cycle for maximum work output?
(a) 1.5 (b) 2
(c) 3 (d) 4

137. In an Otto cycle, air is compressed from 3 litres to 2.4 litres from a starting pressure of 1.5 kg/cm^2. The net output per cycle is 400 kJ. What is the mean effective pressure (kPa) of the cycle?
(a) 500 (b) 567
(c) 667 (d) 700

138. The combustion in a compression ignition engine is _____.
(a) heterogeneous (b) homogeneous
(c) laminar (d) turbulent

139. Which relation is the basis of Mollier Diagram?

(a) $C_p = \left(\frac{\partial h}{\partial T}\right)_p$ (b) $C_v = \left(\frac{\partial Q}{\partial T}\right)_v$

(c) $C_p - C_v = R$ (d) $T = \left(\frac{\partial h}{\partial S}\right)_p$

140. Which of the following formula holds **TRUE** for dryness fraction?

(a) $\frac{m_v}{m_v + m_i}$ (b) $\frac{m_i}{m_v + m_i}$

(c) $\frac{m_v + m_i}{m_v}$ (d) $\frac{m_v + m_i}{m_i}$

141. Which gas will produce the highest efficiency in an ideal Otto cycle for same compression ratio?
(a) Air (b) Carbon dioxide
(c) Helium (d) Oxygen

142. In Mollier diagram, the isotherm in the superheated region at low pressures becomes _____.
(a) diverge from one another
(b) horizontal
(c) parallel (d) vertical

143. If the heat rejected from the system is zero, then which of the following statements will hold **TRUE?**
(a) When net work is equal to the heat absorbed, work efficiency is 100%.
(b) Heat is exchanged from one heat reservoir only.
(c) It violates Kelvin-Plank statement.
(d) All options are correct

144. Clausius' statement and Kelvin-Planck's statement are _____.
(a) not connected
(b) two parallel statements of the second law
(c) violation of one does not violates the other
(d) false statements

145. For the same heat added and the same compression ratio, _____.
(a) Otto cycle is more efficient than diesel cycle.
(b) Diesel cycle is more efficient than Otto cycle.
(c) Both Diesel and Otto cycle are equally efficient.
(d) Cannot be determined.

146. A reversible engine operates between temperature T_1 and T_2. The energy rejected by this engine acts as an input for another reversible engine at temperature T_2, which rejects to a reservoir at temperature T_3. What is the relation between T_1, T_2 and T_3?
(a) $T_2 = \frac{T_1 + T_3}{2}$ (b) $T_2 = \sqrt{T_1^2 + T_3^2}$
(c) $T_2 = \sqrt{T_1 T_3}$ (d) $T_2 = \frac{T_1 - T_3}{2}$

147. Which equation defines the enthalpy (h) of a system?
(a) $U + \frac{pv}{J}$ (b) $U - \frac{pv}{J}$
(c) $U + \frac{R}{Jpv}$ (d) $U + Jpv$

148. Which gas can attain the highest efficiency for the same compression rise?
(a) Any of the gases (b) Diatomic gases
(c) Mono atomic gases (d) Tri-atomic gases

149. In Clausius theorem the reversible path is substituted by _____.
(a) reversible isobars
(b) reversible isotherms
(c) reversible isochoric
(d) None of these

150. Which of the relation represents an irreversible and possible process?
(a) $\oint \frac{dQ}{T} = 0$ (b) $\oint \frac{dQ}{T} > 0$
(c) $\oint \frac{dQ}{T} < 0$ (d) None of these

151. _____ does not certain tin as an alloying element.
(a) Babbitt metal
(b) White metal
(c) Solder
(d) All options are correct

152. Under microscope ferrite appears as
(a) White (b) Light
(c) Dark (d) None of these

153. _____ structure is obtained by austempering process of heat treatment.
(a) Sorbite (b) Bainite
(c) Martensite (d) Troostite

154. Preheating is essential in welding
(a) high speed steel
(b) cast iron
(c) all non-ferrous materials
(d) None of these

155. The melting point is the lowest for
(a) low carbon steel (b) high carbon steel
(c) cast iron (d) wrought iron

156. _____ is commonly used for making household utensils.
(a) Duralumin (b) Hindalium
(c) Y-alloy (d) Magnalium

157. Ball bearings are generally made up of
(a) carbon steel (b) carbon chrome steel
(c) stainless steel (d) grey iron

158. _____ has high tendency to get work hardened.
(a) Lead (b) Aluminium
(c) Brass (d) Silver

159. _____ is the hardest known material
(a) Cemented carbide (b) Ceramic
(c) Diamond (d) Alloy steel

160. _____ is obtained by isothermal hardening operation.
(a) Cementite (b) Sorbite
(c) Acicular troostite (d) Bainite

161. Fluid is a substance which offers no resistance to change of
(a) pressure (b) flow
(c) shape (d) volume

162. Density of water is maximum at
(a) 0^o C (b) 0^o K
(c) 4^o C (d) 100^oC

163. A perfect gas
(a) has constant viscosity (b) has zero viscosity
(c) is incompressible (d) None of these

164. A fluid in equilibrium can't sustain
(a) tensile stress (b) compressive stress
(c) shear stress (d) bending stress

165. For manometer, a better liquid combination is one having
(a) higher surface tension
(b) lower surface tension
(c) surface tension is no criterion
(d) high density and viscosity

166. The resultant upward pressure of the fluid on an immersed body is called
(a) upthrust (b) buoyancy
(c) centre of pressure (d) None of these

167. $V = 0.0022t - \frac{1.8}{t}$ is the equation to determine kinematic viscosity of liquids by
(a) Redwood Viscometer
(b) Engler Viscometer
(c) Saybolt universal viscometer
(d) Newton Viscometer

168. The capillary rise at 20 degree celsius in a clean glass tube of 1 mm bore containing water is approximately
(a) 3 mm (b) 5 mm
(c) 10 mm (d) 30 mm

169. The rise or depression of liquid in a tube due to surface tension with increase in size of tube will
(a) increase
(b) remain unaffected
(c) may increase or decrease depending on the characteristics of liquid
(d) decrease

170. In an isothermal atmosphere, the pressure
(a) decreases linearly with elevation
(b) remains constant
(c) varies in the same way as the density
(d) increases exponentially with elevation

171. The magnitude of rise of pressure due to water hammer in a rigid and non-elastic pipe carrying water of density ρ and bulk modules k will be equal to
(a) $\frac{k}{\sqrt{\rho}}$ (b) $\sqrt{k\rho}$
(c) $\sqrt{\frac{\rho}{k}}$ (d) $\frac{k}{\rho}$

172. The flow of any fluid, real or ideal, must fulfill the following
(a) Newton's law of viscosity
(b) Newton's second law of viscosity
(c) Velocity at boundary must be zero relative to the boundary
(d) the continuity equation

173. The most economical section of circular channel for maximum discharge is obtained when (Where, d is the diameter of circular section)
(a) depth of water = 0.95 d
(b) wetter perimeter = 2.6 d
(c) hydraulic mean depth = 0.29 d
(d) Any one of these

174. Borda's mouthpiece is
(a) a short cylindrical tube projecting inward, having length of ½ diameter
(b) a convergent tube having length of 2 – 3 diameters
(c) most commonly used
(d) rarely used

175. The critical velocity as
(a) maximum attainable velocity
(b) terminal velocity
(c) velocity when hydraulic jump occurs
(d) velocity above which the flow ceases to be streamlined

176. Reynolds number for non-circular cross section is:
[V = mean velocity
v = kinematic viscosity
P = Ratio of cross sectional area to the wetter perimeter]
(a) $\frac{V.4P}{v}$ (b) $\frac{V.P}{v}$
(c) $\frac{V.2P}{4v}$ (d) $\frac{V.P}{4v}$

177. In case of a two dimensional flow the components of velocity are given by $u = ax$; $v = by$, the streamlines will consist of a series of
(a) circular arcs (b) parabolic arcs
(c) hyperbolic arcs (d) elliptical arcs

178. Friction factor of pipes depends on
(a) rate of flow (b) fluid density
(c) viscosity (d) All options are correct

179. Time of flow from one tank in which water level is h_1 to another tank having level h_2 will be proportional to
(a) $h_1 - h_2$ (b) $\sqrt{h_1 - h_2}$
(c) $\sqrt{h_1} - \sqrt{h_2}$ (d) $h_1^{3/2} - h_2^{3/2}$

180. Which of the following represents steady uniform flow?
(a) flow through an expanding tube at an increasing rate
(b) flow through an expanding tube at constant rate
(c) flow through a long pipe at decreasing rate
(d) flow through a long pipe at constant rate

181. Chezy's equation is used to determine
(a) velocity of flow in open channel
(b) velocity of flow in pipe
(c) flow over weirs
(d) discharge through notch

182. Bluff body is the body of such a shape that pressure drag as compared to friction drag is
(a) same (b) more
(c) less (d) zero

183. For best hydraulic rectangular cross-section of an open channel, its depth should be equal to
(a) width
(b) two times the width
(c) half of the width
(d) three-eighth of the width

184. The value of coefficient of velocity for a sharp edged orifice is of the order of
(a) 0.45 (b) 0.5
(c) 0.62 (d) None of these

185. The discharge over a sharp-edged rectangular notch of width w depth h is equal to
(a) $\frac{2}{3} C_d w \sqrt{2g}\, h^{5/2}$ (b) $\frac{2}{3} C_d w \sqrt{2g}\, h$
(c) $\frac{2}{3} C_d w \sqrt{2g}\, h^{3/2}$ (d) $\frac{8}{15} C_d w \sqrt{2g}\, h^{3/2}$

186. When a liquid rotates at constant angular velocity about a vertical axis as a rigid body, the pressure
(a) increases linearly as its radial distance
(b) varies inversely as the altitude along any vertical line
(c) varies as the square of the radial distance
(d) decreases as the square of the radial distance

187. The discharge through a semi-circular weir is proportional
(a) $H^{(-1/2)}$ (b) $H^{(1/2)}$
(c) $H^{(3/2)}$ (d) None of these

188. The rate of change of moment of momentum represents the
(a) force exerted by fluid
(b) torque applied by the fluid
(c) work done by the fluid
(d) power developed by the fluid

189. Separation of flow occurs when pressure gradient
(a) tends to approach zero
(b) becomes negative
(c) reduces to a value when vapor formation starts
(d) None of these

190. The ratio of actual discharge to theoretical discharge through in orifice is
(a) C_c/D_d (b) C_d/C_v
(c) C_v/D_d (d) C_c/C_v

191. Cock is produce by
(a) pulverizing coal in inert atmosphere
(b) heating wood in a limited supply of air at temperatures below 300°C
(c) strongly heating coal continuously for about 48 hours in the absence of air in a closed vessel
(d) binding the pulverized coal into briquettes

192. One kg of steam sample contains 0.8 kg dry steam; it's dryness fraction is
(a) 0.2 (b) 0.8
(c) 0.6 (d) 0.5

193. At which pressure (in kg/cm^2) the properties of water and steam become identical
(a) 0.1 (b) 1
(c) 100 (d) 225.6

194. Cochran boiler is a
(a) horizontal fire-tube boiler
(b) horizontal water-tube boiler
(c) vertical water-tube boiler
(d) vertical fire tube boiler

195. The diameter of tubes for natural circulation boiler as compared to controlled circulation boilers is
(a) more
(b) less
(c) same
(d) could be more or less depending on other factors

196. Supercharging is the process of
(a) supplying the intake of an engine with air at a density greater than the density of the surrounding atmosphere
(b) providing forced cooling air
(c) injecting excess fuel for raising more load
(d) supplying compressed air to remove combustion products fully

197. The accumulation of carbon in a cylinder results in increase of
(a) clearance volume
(b) volumetric efficiency
(c) ignition time
(d) effective compression ratio

198. Which of the following is a false statement? Excess quantities of Sulphur in diesel fuel are objectionable because it may cause the following:
(a) piston ring and cylinder wear
(b) formation of hard coating on piston skirts
(c) oil sludge in the engine crank case
(d) detonation

199. Installation of supercharger on a four-cycle diesel engine can result in the following percentage increase in power
(a) upto 25% (b) upto 35%
(c) upto 50% (d) None of these

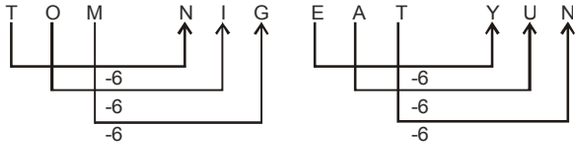
200. In order to prevent formation of carbon on the injector, the temperature (in °C) of nozzle tip should be
(a) less than 100 (b) between 100 – 250
(c) between 250 – 300 (d) beween 400 – 500

Answer Key

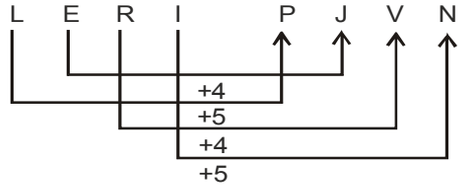
1	(c)	**21**	(a)	**41**	(a)	**61**	(b)	**81**	(c)	**101**	(a)	**121**	(a)	**141**	(c)	**161**	(c)	**181**	(a)
2	(b)	**22**	(c)	**42**	(a)	**62**	(c)	**82**	(d)	**102**	(c)	**122**	(c)	**142**	(b)	**162**	(c)	**182**	(b)
3	(b)	**23**	(c)	**43**	(d)	**63**	(a)	**83**	(b)	**103**	(b)	**123**	(d)	**143**	(d)	**163**	(d)	**183**	(c)
4	(a)	**24**	(b)	**44**	(a)	**64**	(c)	**84**	(c)	**104**	(c)	**124**	(d)	**144**	(b)	**164**	(c)	**184**	(d)
5	(b)	**25**	(c)	**45**	(a)	**65**	(d)	**85**	(c)	**105**	(d)	**125**	(b)	**145**	(a)	**165**	(a)	**185**	(c)
6	(d)	**26**	(b)	**46**	(c)	**66**	(a)	**86**	(c)	**106**	(c)	**126**	(b)	**146**	(c)	**166**	(b)	**186**	(c)
7	(d)	**27**	(c)	**47**	(c)	**67**	(a)	**87**	(d)	**107**	(c)	**127**	(a)	**147**	(a)	**167**	(c)	**187**	(d)
8	(b)	**28**	(d)	**48**	(c)	**68**	(b)	**88**	(b)	**108**	(c)	**128**	(c)	**148**	(c)	**168**	(d)	**188**	(b)
9	(c)	**29**	(c)	**49**	(d)	**69**	(c)	**89**	(d)	**109**	(a)	**129**	(c)	**149**	(b)	**169**	(d)	**189**	(d)
10	(c)	**30**	(a)	**50**	(c)	**70**	(d)	**90**	(d)	**110**	(b)	**130**	(b)	**150**	(c)	**170**	(c)	**190**	(d)
11	(c)	**31**	(a)	**51**	(a)	**71**	(d)	**91**	(b)	**111**	(d)	**131**	(a)	**151**	(b)	**171**	(a)	**191**	(c)
12	(b)	**32**	(d)	**52**	(c)	**72**	(a)	**92**	(a)	**112**	(d)	**132**	(c)	**152**	(a)	**172**	(d)	**192**	(b)
13	(c)	**33**	(b)	**53**	(c)	**73**	(c)	**93**	(c)	**113**	(b)	**133**	(c)	**153**	(b)	**173**	(d)	**193**	(d)
14	(d)	**34**	(c)	**54**	(a)	**74**	(c)	**94**	(a)	**114**	(c)	**134**	(b)	**154**	(b)	**174**	(a)	**194**	(d)
15	(c)	**35**	(a)	**55**	(a)	**75**	(c)	**95**	(c)	**115**	(a)	**135**	(a)	**155**	(c)	**175**	(d)	**195**	(a)
16	(d)	**36**	(d)	**56**	(c)	**76**	(a)	**96**	(a)	**116**	(a)	**136**	(c)	**156**	(d)	**176**	(a)	**196**	(a)
17	(c)	**37**	(d)	**57**	(b)	**77**	(a)	**97**	(c)	**117**	(c)	**137**	(c)	**157**	(b)	**177**	(c)	**197**	(d)
18	(b)	**38**	(b)	**58**	(d)	**78**	(b)	**98**	(a)	**118**	(b)	**138**	(a)	**158**	(c)	**178**	(d)	**198**	(d)
19	(a)	**39**	(b)	**59**	(b)	**79**	(b)	**99**	(c)	**119**	(d)	**139**	(d)	**159**	(c)	**179**	(d)	**199**	(d)
20	(b)	**40**	(b)	**60**	(b)	**80**	(d)	**100**	(d)	**120**	(b)	**140**	(a)	**160**	(c)	**180**	(d)	**200**	(c)

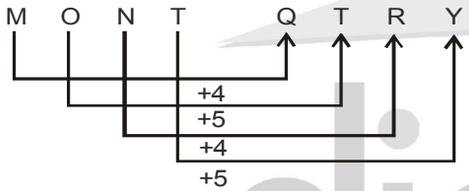
Hints & Solutions

1. (c) Rain is obtained from clouds. Similarly, heat is obtained from sun.
2. (b) Cactus is a plant. Similarly, rice is a crop.
3. (b) Pink is a colour. Eagle is a bird.
4. (a)

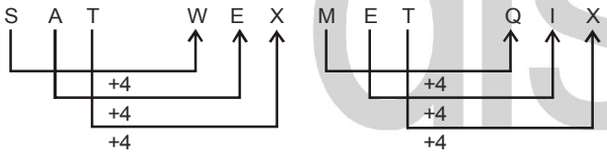


5. (b)

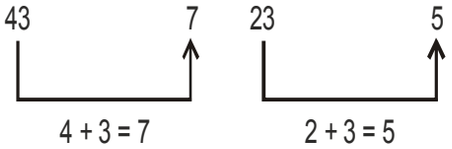




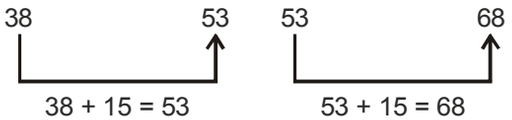
6. (d)



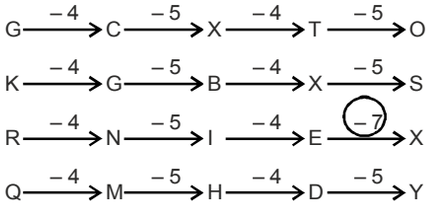
7. (d)



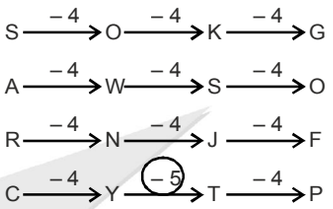
8. (b)



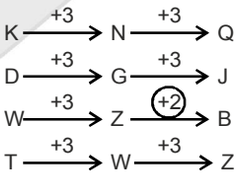
9. (c) $9 \xrightarrow{9 \times 9} 81$; $11 \xrightarrow{11 \times 11} 121$
10. (c) Goggles, Purse and Belt are accessories.
11. (c) Grapes, guava and orange are fruits. Couliflower is a vegetable.
12. (b) Sparrow, ostrich and parrot are birds. Rat is an animal.
13. (c)



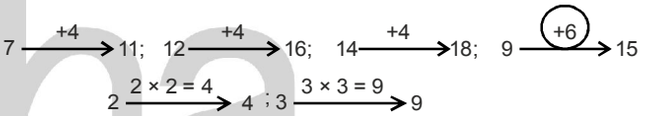
14. (d)



15. (c)



16. (d)



17. (c)

18. (b) $7 \times 6 = 42$, $9 \times 2 = 18 \neq 20$
$7 \times 3 = 21$, $9 \times 3 = 27$
19. (a) The order of the words as per dictionary are:
Flagrant (1)
Flavour (3)
Flatter (2)
Flick (5)
Flawed (4)
20. (b) The order of the words are:
Heritage–(3)
Helpful–(2)
Hectic–(1)
Heroic–(4)
Heroism–(5)

21. (a) The order of the words are:

Juvenile (4) Justify (3) Judge (1) Justice (2)

22. (c) F $\xrightarrow{+7}$ M $\xrightarrow{+7}$ T $\xrightarrow{+7}$ A $\xrightarrow{+7}$ H $\xrightarrow{+7}$ O

23. (c) R $\xrightarrow{-3}$ O $\xrightarrow{-4}$ K
L $\xrightarrow{-3}$ I $\xrightarrow{-4}$ E
F $\xrightarrow{-3}$ C $\xrightarrow{-4}$ Y
Z $\xrightarrow{-3}$ W $\xrightarrow{-4}$ S
T $\xrightarrow{-3}$ Q $\xrightarrow{-4}$ M

24. (b) F $\xrightarrow{-5}$ A $\xrightarrow{-10}$ Q
L $\xrightarrow{-5}$ G $\xrightarrow{-10}$ W
R $\xrightarrow{-5}$ M $\xrightarrow{-10}$ C
X $\xrightarrow{-5}$ S $\xrightarrow{-10}$ I
D $\xrightarrow{-5}$ Y $\xrightarrow{-10}$ O

25. (c) 14 $\xrightarrow{+8=2^3}$ 22 $\xrightarrow{+27=3^3}$ 49 $\xrightarrow{+64=4^3}$ 113 $\xrightarrow{+125=5^3}$ 238 $\xrightarrow{+216=6^3}$ 454

26. (b) 42 $\xrightarrow{\times 0.5}$ 21 $\xrightarrow{\times 1}$ 21 $\xrightarrow{\times 1.5}$ 31.5 $\xrightarrow{\times 2}$ 63 $\xrightarrow{\times 2.5}$ 157.5

27. (c) $14 \rightarrow 44 : 14 \times 3 + 2$
$44 \rightarrow 135 : 44 \times 3 + 3$
$135 \rightarrow 409 : 135 \times 3 + 4$
$409 \rightarrow 1232 : 409 \times 3 + 5$
$1232 \rightarrow 3702 : 1232 \times 3 + 6$

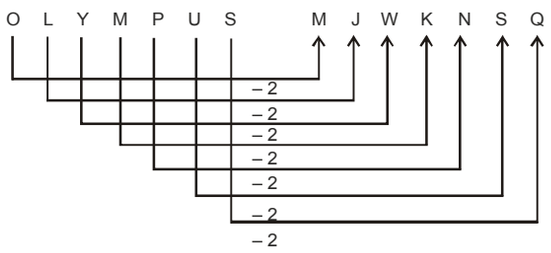
28. (d)

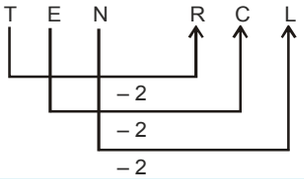
B	A	E	D	C

29. (c) Father's father is grandfather. So, the gentlemen in photograph is B's grandfather. Lady is A's mother. So, A is B's father sister.

30 (a) Truce cannot be formed as 'u' in not present in the given word.

31. (a)





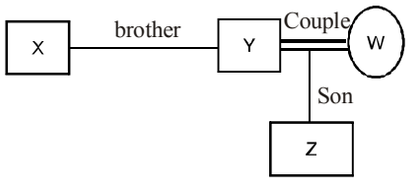
32. (d) (1) 8 [7] 5 → Wound the (round) [watch]
6 (1) 4 (3) → (a) cake is (round)
[7] (3) 2 (1) → [watch] (a) (round) wheel

1 is common in all the numbers, so is round. Similarly 3 is for a and 7 is for watch

33. (b) $96 \times 4 \div 125 + 25 - 5$
$\Rightarrow 96 \div 4 + 125 - 25 \times 5$
$\Rightarrow 24 + 125 - 125 = 24$

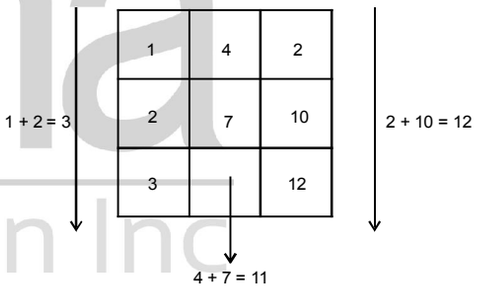
34. (c) $17 \$ 22 = 4$
$\Rightarrow (1 + 7) - (2 + 2) = 4$
$\Rightarrow 8 - 4 = 4$
$56 \$ 13 = 7$
$\Rightarrow (5 + 6) - (1 + 3) = 7$
$\Rightarrow 11 - 4 = 7$
$\Rightarrow 11 - 4 = 7$
Similary $71 \$ 25$
$\Rightarrow (7 + 1) - (2 + 5)$
$\Rightarrow 8 - 7 = 1$

35. (a) X # Y * Z $ W
$\Rightarrow$ X is brother of y, Y is father of Z and Z is son of W



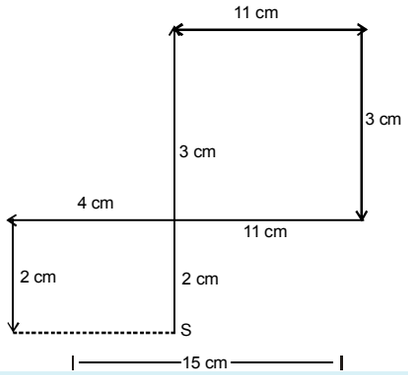
So, W is Y's wife or X's brother wife.

36. (d)

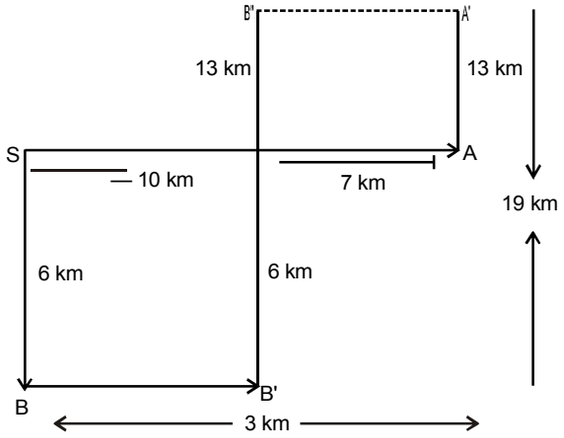


37. (d) In the given Sequence one '0' is fixed while second '0' shifts one position forward.

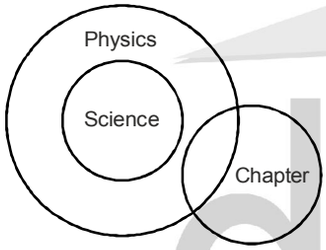
38. (c) Let S be the starting position so, the ant in now 4 cm west.



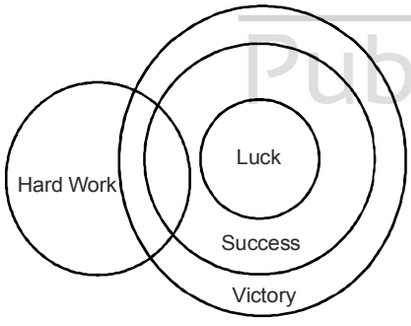
39. (b) Let, S be the starting position, so, player A is 7 km east w.r.t to B



40. (b) From the following Venn diagram it is clear that only conclusion II follows.



41. (a) From the venn diagram it is clear that both conclusions I and II follow.

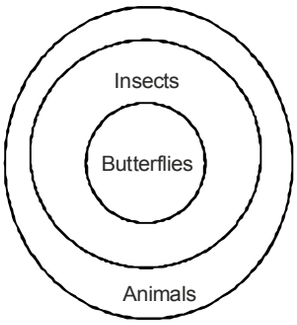


42. (a) Option (a) is correct as figures ⊞ and 0 are opposite to each other in the problem figure.

43. (d) Figures given in option (d) can be combined to make the question figure.

44. (a) Circle represents dietieians. Letters covered by circle are I, G, A, C, F and E, but A and C are also covered by the rectangle which represents men, so I, G, F, and E is the correct option.

45. (a) Butterflies are insects and insects are animals.



47. (c) Figure given in option (c) is embedded in the problem figure.

49. (d) Figure given in option (d) is the mirror image of the given figure.

50. (c) From the matrices, we can find that

S → 59, 66, 75, (86)

P → 87, (89)

A → 10, 14, (32) 42,

N → (55), 69, So, option (c) in correct

52. (c) The tertiary sector or service sector is the third of the three economic sectors of the three-sector theory. The others are the secondary sector, and the primary sector. The service sector consists of the production of services instead of end products. The tertiary sector is made of:· the market services sector (trade, transports, financial operations, business services, personal services, accommodation and food service activities, real estate, information-communication); the non-market sector (public administration, education, human health, social work activities).

59. (b) The Salary of Members of Parliament is governed by Salary and Allowances and Pension to Members of Parliament Act 1954 and rules framed there under. Its a Central Act and undergoes same procedure as applicable to any central legislation.

63. (a) The founder of the Bahmani kingdom was Alauddin Bahman Shah also known as Hasan Gangu in 1347. The Sultans of Southern India derived their origin from the conquests of Ala-ud-din (1303-1306).

70. (d) Devprayag is a town and a nagar panchayat (municipality) in Tehri Garhwal district in the state of Uttarakhand, India, and is one of the Panch Prayag (five confluences) of Alaknanda River where Alaknanda and Bhagirathi rivers meet and take the name Ganga.

78. (b) The walled city of Ahmedabad is first city in India to get World Heritage City status and third in Asia after Bhaktapur (Nepal) and Galle (Sri Lanka). India now has total 36 World Heritage Inscriptions 28 cultural, 7 natural and 1 mixed site.

84. (c) *Cinnabar* is a toxic mercury sulfide mineral with a chemical composition of HgS. It is the only important ore of mercury.

91. (b) Water-soluble vitamins are carried to the body's tissues but are not stored in the body. They are found in plant and animal foods or dietary supplements and must be taken in daily. Vitamin C and members of the vitamin B complex are water-soluble.

96. (a) An antibiotic is a type of antimicrobial substance active against bacteria and is the most important type of antibacterial agent for fighting bacterial infections. Antibiotic medications are widely used in the treatment and prevention of such infections. They may either kill or inhibit the growth of bacteria.

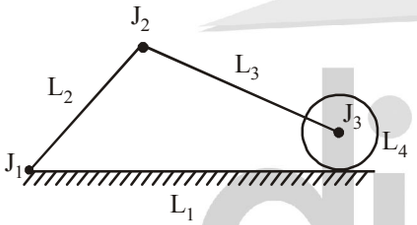
101. (a) A kinematic chain is described as a combination of kinematic pairs, connected in a manner that each link makes a portion of two pairs and there occurs a relative motion between the links is completely or successfully constrained. In order to form a kinematic chain, the following relation occurs,

$\ell = 2p - 4$

where, ℓ = Number of links required

p = Number of pairs

102. (c) Given :

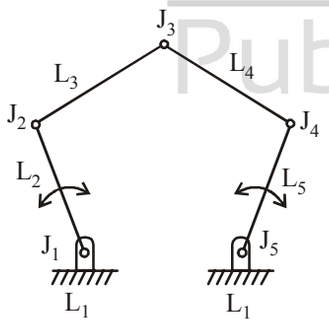


This is a case of the mechanism shown in above figure,

Total number of links (L) = 4 $\{L_1, L_2, L_3 \& L_4\}$

Total number of joints (J) =3 $\{J_1, J_2, J_3\}$

103. (b) Given:



Number of lines (L) = 5

Number of pairs (P) = 5

Now, according to above figure the Degree of freedom (DOF) of the mechanism

DOF = 3 (L – 1) – 2P

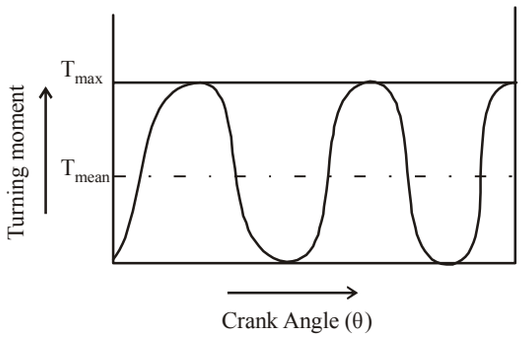
= 3 (5 –1) – 2 × 5

= 3× 4 – 10

= 12 – 10

DOF = 2

104. (c) The graph of turning moment diagram is drawn between crank effort and crank angle. Turning moment diagram is also known as crank effort diagram.



105. (d) Given : Mass of flywheel (M) = 3250kg

Radius of gyration (K) = 1M

Torque of engine (T) = 4500 N – M

Let, α = angular acceleration of fly-wheel

Now, Mass – moment of inertia (I) = MK^2

= 3250 $(1)^2$

= 3250 kg – m^2

$T = I \times \alpha$

$4500 = 3250 \times \alpha$

$$\alpha = \frac{4500}{3250} = 1.38$$

$\alpha = 1.38$ rad / s^2

106. (c) Given: Maximum tension produced (T_{max}) = 1400 N/L

density of belt (P) = 1000 kg /m^3

width of belt (B) = 100 mm = 100 × 10^{-3} M

thickness of belt (t) = 5 mm = 5× 10^{-3} M

Now, considering the following relation,

$$P = \frac{M}{V}$$

where , M = mass of belt

V = volume of belt for unit length

= $B \times t = 100 \times 10^{-3} \times 5 \times 10^{-3}$

$V = 500 \times 10^{-6}$ m^3

Now, $M = 1000 \times 500 \times 10^{-6} = 500 \times 10^{-3}$ kg

Let, V_{max} = speed of belt for the maximum power

$$= \sqrt{\frac{T_{max}}{3M}} = \sqrt{\frac{1400}{3 \times 500 \times 10^{-3}}}$$

$$= \sqrt{\frac{14}{15} \times 10^3} = \sqrt{933.3}$$

$$\boxed{V_{max} = 30.55 \text{ m/s}}$$

107. (c) The rotary internal combustion engine is the inversion of single slider crank mechanism. The other inversions of single slider crank mechanism are given as follows:

(i) Pendulum pump

(ii) Oscillating cylinder engine

(iii) Crank and slotted liver quick return mechanism

(iv) Whit worth quick return motion mechanism

108. (c) The pressure distribution in the uniform wear theory is inversely proportional to radius.

considering the following relation,

P.r = constant (c)

{According to uniform wear theory}

$$P = \frac{c}{r} \quad \text{So, } P \alpha \frac{1}{r}$$

where, P = pressure distribution and r = radius

110. (b) Addendum is defined as the radial distance of a tooth from the pitch circle to the top of the tooth.

111. (d) The contact ratio varies directly to the length of the arc of contact and inversely proportional to the module and circular pitch respectively.

If C.R = contact ratio

L_a = length of arc of contact

m = module

P_c = circular pitch

Then, $C.R \ \alpha \ \frac{La}{P_c \times m}$

112. (d) watt governor is a centrifugal type pendulum governor

114. (c) Given: Rotational speed of watt governor (N) = 80 rpm

vertical height of a watt governor = m

considering the following relations, angular speed

$$\omega = \frac{2\pi N}{60}$$

Now, $\omega = \frac{2 \times \frac{22}{7} \times 80}{60} = 8.38 \text{ rad/s}$

$$m = \frac{g}{\omega^2}$$

$$m = \frac{9.81}{(8.38)^2} \qquad \{\because g = 9.81 \text{ m/s}^2\}$$

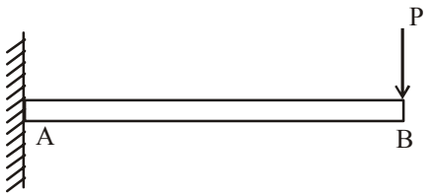
$$m = \frac{9.81}{70.22} = 0.139$$

m = 0.14

115. (a) Base circle defines the size of the cam. Base circle is defined as the circle of smallest diameter constructed upto the cam profile from the centre of rotation.

116. (a) combined effect of all the forces acting on the body is known as load.

117. (c) Point load is defined as the load acting on the point on the beam i.e load is concentrated at a point on the beam. A point load does not act on the considerable length of the beam as shown in figure given below.



In the above figure, a point load 'P' is acting at point 'B' of the cantilever beam 'AB'

119. (d) Maximum shear stress theory was postulated by Tresca. According to Tresca's theory, in a uniaxial tensile test, the failure occurs if the maximum shear stress exceeds the shear stress at yield point.

120 (b) When column's both ends are fixed, the crippling load (P) is given as:

$$P = \frac{\pi^2 EI}{L^2_E}$$

where, E = young's Modulus of elasticity

I = Moment of Inertia

L_E = Equivalent length or effective length

$$= \frac{L_A}{2}$$

L_A = Actual length

Hence, when both ends are fixed in case of column, the equivalent length of column is 1/2 of actual length.

121. (a) Slenderness ratio of the column is directly proportional to the effective length.

$$\text{slenderness ratio (S.R)} = \frac{L_E}{K_{min}}$$

where, L_E = effective length

$k_{min.}$ = least radius of gyration

S.R α L_E

122. (c) Rankine's theory is applicable to both short and long column. Rankine's formula is given as:

$$\frac{1}{P} = \frac{1}{P_C} + \frac{1}{P_E}$$

where, P = crippling load

P_C = crushing load = $\sigma_{cr.} \times A$

$$P_E = \text{Euler's Load} = \frac{\pi^2 EI}{L^2_E}$$

σ_{cr} = Crushing stress

A = Cross–sectional area

E = Young's modulus of elasticity

I = Moment of inertia

L_E = Equivalent length.

123 (d) The assumptions in case of long column are given as follows.

→ The column is straight and can be subjected to axially.

→ The material is homogenous, isotropic and perfectly elastic.

→ The length of column is much large than that of lateral dimensions

→ The cross–section of the column remains uniform along the length of column.

→ The value of binding stress is much higher than that of direct stress.

→ The buckling phenomenon alone is responsible for the failure.

125. (b) Given: In case of a thin cylinder,

Hoop stress (σ_h) = 200 M P_a = 200 × 10^6 P_a

=2 × 108 P_a

Modulus of elasticity (E)

= 200 GP_a = 200 × 10^9 P_a

= 2 × 10^{11} P_a

Poisson's ratio (μ) = 0.25

Now, considering the following relation,

$$\varepsilon_v = \frac{P_i d}{2tE}\left(\frac{5}{2} - 2\mu\right) \qquad \text{....(i)}$$

where, ε_v = volumetric strain

P_i = Internal pressure

d = diameters

t = thickness

E = Modulus of elasticity

Relation (i) can also be written as:

$$\varepsilon_v = \frac{\sigma_h}{E}\left[\frac{5}{2} - 2\mu\right] \quad \left\{\because \sigma_h = \frac{P_i d}{2t}\right\}$$

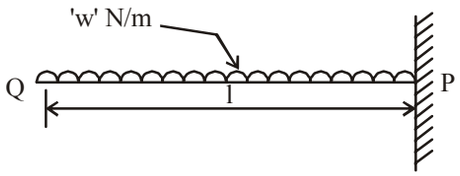
$$\frac{2\times10^8}{2\times10^{11}}\left[\frac{5}{2} - 2(0.25)\right]$$

$$= [2.5 - 0.5]\times10^{-3}$$

$$= 2 \times 10^{-3}$$

$$\varepsilon_v = \frac{2}{1000}$$

127. (a) Given



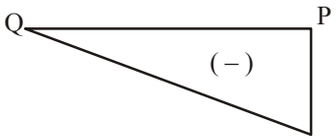
consider a cantilever beam 'PQ' of length 'l' which is free at the end Q. A uniformly distributed load (Udl) of 'w' N/m acting over the whole length of the beam.

Now, Let us consider a section x–x at a distance 'x' from the free end 'Q', Then,

Shear Force (SFx) = –wx

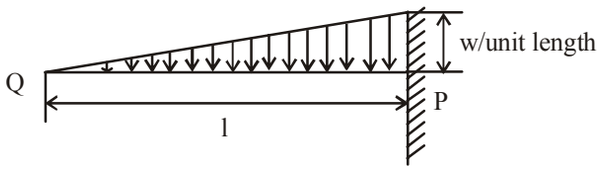
At 'Q', x= 0, $SF_Q = 0$

At 'P', x= l, $SF_P = -wL$



Shear Force Diagram

128. (c) Given:



consider a cantilever beam 'PQ' of length 'ℓ' consisting a uniformly varying load (Uvl), w/unit length which is zero at Q and w/unit length at 'P'.

Now, Let us consider a section x–x at a distance 'x' from the free end 'Q' , Then

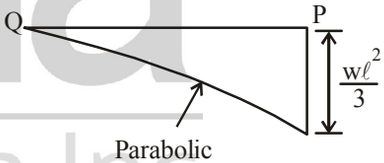
Bending Moment $(BM_x) = -\left(\frac{o+w}{2}\right)(x)\times\left(\frac{2}{3}x\right)$

$$= -\frac{w}{2}\times\frac{2}{3}\times x^2$$

$$BM_x = -\frac{w}{3}x^2$$

At point 'Q',$(BM_Q) = 0$

At point 'P', $(BM_P) = \frac{-w}{3}\ell^2$



Parabolic

129. (c) Given: tensile load acting axially (P_t) = 10 KN

= 10^4 N

cross–sectional area (A) = 20 × 20

= 400 mm^2

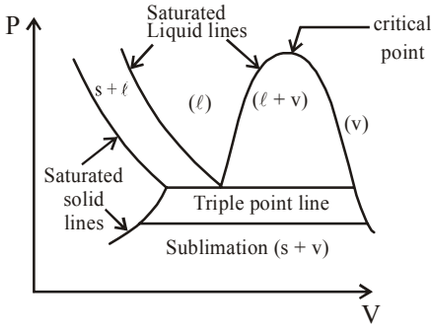
tensile stress developed $(\sigma_T) = \frac{P_t}{A} = \frac{10^4}{400}$

= 25 N/mm^2 = 25 MN/m^2 = 25 MPa

130. (b) Polar moment of inertia of solid shaft (J)

$= \frac{\pi}{32}d^4$ where, d = diameter of shafts

131. (a) The triple point is defined as a point at which the solid, liquid and gas phases co–exist. On a P–V diagram, it is shown as a triple point line. consider the following figure showing P–V diagram.



132. (c) Entropy of substance in solid phase has the least value. It is an extensive property and measured in terms of degree of randomness of molecules.

133. (c) Given: COP of carnot refrigerator, $(COP)_{Ref.} = 4$
Let, η_{TH} = Thermal efficiency of carnot engine using the following equation,

$$\eta_{TH} = \frac{1}{1+(COP)_{Ref.}} = \frac{1}{1+4} = \frac{1}{5}$$

$\eta_{TH.} = 0.2$

134. (b) Given: Lower temperatures $(T_L) = 150k$
Higher temperature $(T_H) = 300k$
Entropy change $(\Delta S) = 1KJ/K$
Let, $W_{o/p}$ = work produced by the engine

$$\text{then, } \Delta S = \frac{W_{o/p}}{T_L} = 1$$

$$\frac{W_{o/p}}{150} = 1 \text{ or } W_{o/p} = 150 \text{ KJ}$$

135. (a) Given:
source temperature $(T_H) = 200°C$
$= 200 + 273 = 473° K$
Sink temperature $(T_L) = 25°C$
$= 25 + 273 = 298° K$
Heat received (Q) = 5 KW
According to clausius inequality,

$$\oint \frac{dQ}{T} \le 0$$

$$\Rightarrow \oint \left\{\frac{dQ}{T_H} - \frac{dQ}{T_L}\right\}$$

$$\Rightarrow \oint \left\{\frac{1}{473} - \frac{1}{298}\right\} dQ$$

$$\Rightarrow \left\{\frac{5}{473} - \frac{5}{298}\right\} \le \text{Zero}$$ or Negative value is obtained.

Hence, heat engine satisfies the inequality of clausius.

136. (c) Given:
Heat capacity ratio $(\gamma) = 2$
Minimum temperature $(T_L) = 200k$
Maximum temperature $(T_H) = 1800k$
Let, r = compression ratio of cycle for maximum work output

Then, $(r)^{\gamma} = \frac{T_H}{T_L}$

$$r^2 = \frac{1800}{200} = 9$$

$$r = \sqrt{9}$$

$$r = 3$$

137. (c) Given: In case of an otto cycle,
volume before compression, $V_1 = 3$ Litres
$= 3 \times 10^{-3} m^3$
volume after compression, $V_2 = 2.4$ Litres
$= 2.4 \times 10^{-3} m^3$
Net work output /cycle, $W_{o/p} = 400KJ$

$$\text{Mean Effective pressure (MEP)} = \frac{W_{o/p}}{V_1 - V_2}$$

$$= \frac{400}{3\times10^{-3} - 2.4\times10^{-3}}$$

$$= \frac{400}{(3-2.4)\times10^{-3}}$$

$$MEP = \frac{400\times10^3}{0.6}$$

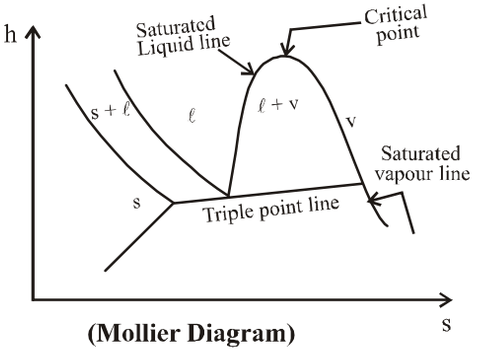
$= 666.67\times10^3$
$= 666.67 KPa$
$MEP \approx 667 KPa$

139. (d) Consider the following relation,
$Tds = dh - Vdp$ ...(i)
divide the equation (i) by 'ds',

$$\frac{Tds}{ds} = \frac{dh}{ds} - \frac{Vdp}{ds}$$

$$T = \frac{dh}{ds} - \frac{Vdp}{ds}$$

$$T = \left(\frac{dh}{ds}\right)_P = \left(\frac{\delta h}{\delta s}\right)_P$$



(Mollier Diagram)

140. (a) Dryness fraction $(x) = \frac{m_v}{m_v + m_f}$

where, m_v = volume of dry steam per kilogram of mixture
m_f = mass of suspended molecules of water per kilogram of mixture

141. (c) Helium gas will produce the highest efficiency in case of an ideal otto cycle for same compression ratio.

142. (b) In Mollier diagram, the isotherm in case of superheated region at low values of pressure becomes horizontal.

144. (b) According to Kelvin-Plank statement, it is impossible to make a system operating in a cyclic manner and developing no other effects than the heat-transfer from a single source or body for the purpose of generating work. According to clausius statement, it is impossible for designing a machine which is operated in a cycle and develops no effect other than transferring the heat from a low temperature reservoir to a high temperature reservoir. Hence, clausius statement and Kelvin-Plank's statement are two parallel statements of second law.

145. (a) For same heat added and same compression ratio,

$\eta_{otto} > \eta_{diesel}$

where, η_{otto} = efficiency of otto cycle

η_{diesel} = efficiency of diesel cycle

147. (a) The enthalpy (h) of a system is defined as the sum of internal energy and the product of pressure and volume. Mathematically, it is written as:

$$h = u + \frac{PV}{J}$$

148. (c) Monatomic gases can attain the highest efficiency for the same compression rise. Examples are helium, neon, argon, xenon, radon etc.

150. (c) Considering the following relations,

1. For internal reversible, $\oint \frac{dQ}{T} = 0$
2. For irreversible and possible process, $\oint \frac{dQ}{T} < 0$
3. For impossible process, $\oint \frac{dQ}{T} >$ Zero

151. (b) White metal is a lead based alloy.

152. (a) Ferrite appears as white under microscopic observation. Ferrite remains stable at room temperature. It is of two kinds given as follows:

1. Soft ferrite : Examples are cobalt, nickel, zinc, manganese etc.
2. Hard ferrite:

153. (b) Bainite structure (micro constituent of steel) is obtained by austempering process of heat-treatment. Bainite consists of ferrite and cementite.

154. (b) Preheating is required in welding of cast iron.

155. (c) The melting point of cast iron is lowest among the low and high carbon steels, wrought iron and cast iron. The melting point of cost iron lies in the range of 1150°C to 1215°C.

158. (c) Brass has high tendency to get work hardened. It is an alloy of copper and zinc and wear-resistant, corrosion resistant, ductile etc.

161. (c) Fluid is described as a substance which offers no resistance to the change of shape.

163. (d) A perfect gas is described as the gas in which the attractive forces acting between the molecules do not exist. Mathematically, the ideal gas law is written as follows:

$Pv = nRT$

where, P = Gas pressure
v = Gas volume
n = Number of moles
R = Universal gas constant
T = Temperature

164. (c) According to newton's law velocity, shear stress is directly proportional to the velocity gradient or shear strain rate.

165. (a) For manometer, a better liquid is combination is one having higher surface tension. Manometer is used to measure the pressure values by making a balance against the gravity of liquid.

167. (c) Saybolt universal viscometer is used for the purpose of determining kinematic viscosity of liquids. The following equation is used to calculate kinematic viscosity,

$$v = 0.0022t - \frac{1.8}{t}$$

168. (d) Given,

glass tube diameter (d) = 1 mm
$= 10^{-3}$m
temperature at capillary rise (T) = 20°C
= 20 + 273
= 293k

capillary rise $(h_c) = \frac{4\sigma}{\rho g d}$

$$= \frac{4 \times 0.075}{1000 \times 9.8 \times 10^{-3}}$$

= 0.03 m = 30 mm

169. (d) The rise or depression of liquid in a tube due to surface tension with increase in size of tube will decrease.

171. (a) Given: P = water density
K = bulk modulus
Now, in case of a rigid and non-elastic pipe, the rise

of pressure $= \frac{K}{\sqrt{P}}$

172. (d) The flow of real or ideal fluid must fulfill the continuity

equation.

Mathematically, continuity equation is given as:

$a_1v_1 = a_2v_2$ = constant (c)

a_1, a_2 = cross-sectional areas at sections '1' and '2'

v_1, v_2 = velocities at sections '1' and '2'

173. (d) Given: d = diameter of circular section.

In case of most economical section of circular channel for maximum discharge,

wetted perimeter = 2.6d

hydraulic mean depth = 0.29d

depth of water = 0.95d

174. (a) Borda's mouthpiece is described as a short cylindrical tube projecting inward, having length of half of its diameter. It is also known as Re-entrant mouthpiece.

176. (a) For non-circular cross-section,

If, V = mean velocity, V = kinematic viscosity

$$P = \frac{\text{cross} - \text{sectional area}}{\text{wetted perimeter}}$$

Now, Reynold's number (Re) = $\frac{V \times 4P}{\nu}$ or $\frac{4PV}{\nu}$

178. (d) Friction factor of pipes depends upon, rate of flow, density of fluid and viscosity, Reynold's number and surface roughness of pipe.

179. (d) Given: h_1 = level of water in first tank

h_2 = level of water in second tank

then flow time (T_f) will be proportional to $\left(h_1^{3/2} - h_2^{3/2}\right)$.

181. (a) chezy's equation or chezy's formula is used to determine the velocity of flow in open channel. Mathematically, the equation is known as:

$$V = C\sqrt{R_M \times S}$$

where, C = variable

R_M = hydraulic mean depth

S = slope of the bed of the channel

182. (b) A bluff body is described as the body having a shape such that the pressure drag is more as compared to friction drag. There occurs no overlapping with streamlines during flow of liquid.

185. (c) Discharge over a sharp edged rectangular notch,

$$Q_d = \frac{2}{3} C_d \, W\sqrt{2g}\, h^{5/2}$$

where, C_d = coefficient of discharge

w = width of rectangular notch

h = depth of rectangular notch

186. (c) When a liquid rotates at constant angular velocity about a vertical axis as a rigid body, the pressure varies as the square of the radial distance.

187. (d) Let, Q_w = discharge through semicircular weir,

then,

$$Q_w = C_d\left[10.12\left(\frac{H}{d}\right)^{1.975} - 2.66\left(\frac{H}{d}\right)^{3.78}\right](d)^{5/2}$$

where, C_d = coefficient of discharge

H = head of water on weir

d = weir diameter

188. (b) Torque applied by the fluid is associated with the rate of change of moment of momentum.

190. (d) Consider the following relation

$$\frac{Q_A}{Q_{TH}} = C_C \, C_V$$

where, Q_A = Actual discharge through an orifice

Q_{TH} = Theoretical discharge through an orifice

C_C = Coefficient of contraction

C_V = Coefficient of velocity

191. (c) Coke is manufactured by strongly (high) heating the coal continuously for about 48 hours in the absence of air in a closed vessel. The temperature range at which the coke is heated lies from 1150 – 1200°C.

192. (b) Given: Mass of steam sample (m_s) = 1 kg

Mass of dry steam (m_v) = 0.8 kg

$$\text{Dryness fraction } (x) = \frac{m_v}{m_s}$$

$$= \frac{0.8}{1}$$

$$x = 0.8$$

194. (d) Cochran boiler is a vertical, multitubular fire tube boiler. Cochran boiler comes under the category of natural circulated boiler.

196. (a) Supercharging is the process of supplying the intake of an engine with air at a density greater than the density of the surrounding atmosphere. Pressure is boosted in super charging process. There occurs three kinds of supercharger which are given as follows:

(i) Centrifugal type supercharger

(ii) Root's type supercharger

(iii) Vane type super charger

197. (d) Effective compression ratio is increased due to the accumulation of carbon particles in the engine cylinder.

199. (d) The installation of supercharger on a four-stroke (cycle) diesel engine increases the power upto 70–80%.

200. (c) During the operation of the fuel injector, the content is formed on the fuel injector. In order to prevent the formation of carbon, the temperature of nozzle tip should be between 250 – 300°C.