DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

COMBINED COMPETITIVE (PRELIMINARY) EXAMINATION, 2013

Serial No. ____

MECHANICAL ENGINEERING

Code No. 14

A

Time Allowed : Two Hours | ***Maximum Marks : 300***

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. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C OR D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE RESPONSE SHEET.
3. You have to enter your Roll Number on this Test Booklet in the Box provided alongside.
   DO NOT write *anything else* on the Test Booklet.

   Your Roll No. _____
4. This Booklet contains 120 items (questions). Each item comprises *four* responses (answers). You will select *one* response which you want to mark on the 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. In case you find any discrepancy in this test booklet in any question(s) or the Responses, a written representation explaining the details of such alleged discrepancy, be submitted within three days, indicating the Question No(s) and the Test Booklet Series, in which the discrepancy is alleged. Representation not received within time shall not be entertained at all.
6. You have to mark all your responses ONLY on the separate Response Sheet provided. *See directions in the Response Sheet.*
7. All items carry equal marks. Attempt ALL items. Your total marks will depend only on the number of correct responses marked by you in the Response Sheet.
8. Before you proceed to mark in the Response Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Response Sheet as per instructions sent to you with your Admit Card and Instructions.
9. While writing Centre, Subject and Roll No. on the top of the Response Sheet in appropriate boxes use **"ONLY BALL POINT PEN".**
10. 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 Response Sheet. You are permitted to take away with you the Test Booklet.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

ROUGH WORK

1. If two forces of magnitude P, act at an angle θ, their resultant will be :
   (A) $2P \cos \theta$ (B) $2P \cos \theta/2$
   (C) $2P \sin \theta$ (D) $P \cos 2\theta$

2. In a statically determinate problem, the number of non-trivial equilibrium equations :
   (A) equals the numbers of unknowns (B) is less than number of unknowns
   (C) is more than number of unknowns (D) cannot be determined

3. The number of independent scalar equations of equilibrium of a rigid body under concurrent force system is :
   (A) 4 (B) 3
   (C) 5 (D) 6

4. D'Alembert principle states that system of forces acting on a body is following type of equilibrium with the inertia force of the body :
   (A) static (B) dynamic
   (C) both (D) none

5. The law of conservation of mechanical energy is valid :
   (A) irrespective of the nature of force field
   (B) only in gravitational field
   (C) only if the total work done by the particle in moving around in a closed trajectory
   (D) only if the forces is tangential to the trajectory

6. In the impact problem the following conditions must always be satisfied :
   (A) the total kinetic energy remains unchanged
   (B) the total linear momentum remains unchanged
   (C) the magnitude of the total linear momentum is multiplied by the co-efficient of restitution
   (D) none of the above

7. The displacement of a particle undergoing rectilinear motion along the x-axis is given by $t^3 - 21t^2 + 60t$ meters. The acceleration of the particle, when its velocity is zero will be :
   (A) $-18\ m/s^2$ (B) $36\ m/s^2$
   (C) $9\ m/s^2$ (D) $-9\ m/s^2$

8. Two metallic blocks having masses in the ratio 2:3 are made to slide down a frictionless inclined plane starting from rest position. When the blocks reach the bottom of the inclined plane, they will have their kinetic energies in the ratio :
   (A) 2:3 (B) 3:5
   (C) 3:2 (D) 7:4

9. If a shaft made of ductile material is subjected to combined bending and twisting moments, calculation based on which one of the following theories would give the most conservative values ?
   (A) Maximum principle stress theory
   (B) Maximum shear stress theory
   (C) Maximum strain energy theory
   (D) Maximum distortion energy theory

10. If the area, length and the stress to which a bar is subjected be all doubled, then the elastic strain energy of the bar will be :
   (A) Doubled
   (B) Three times
   (C) Four times
   (D) Sixteen times

11. If a cantilever beam of length l, the concentrated load P at the end is replaced by a bending moment $P \times l$, the deflection will increase by :
   (A) 1 time
   (B) 1.5 times
   (C) 1.25 times
   (D) 2 times

12. A single degree of freedom spring mass damper system has a spring of stiffness k = 4 kN/m, mass m = 10 kg and a damper of damping constant c = 240 N-sec/m, its damped natural frequency will be :
   (A) 18 rad/sec
   (B) 16 rad/sec
   (C) 20 rad/sec
   (D) 22 rad/sec

13. The ratio of maximum displacement of the forced vibration to the deflection due to static force is known as :
   (A) Damping Factor
   (B) Damping Coefficient
   (C) Logarithmic Decrement
   (D) Magnification Factor

14. Stress concentration in static loading is :
   (A) Very serious in ductile material
   (B) Very serious in brittle material
   (C) Less serious in brittle material
   (D) None of the above

15. If n links are connected at the same joint, the joint is equivalent to :
   (A) (n – 1) binary joints
   (B) (n – 2) binary joints
   (C) (n – 3) binary joints
   (D) (2n – 1) binary joints

16. The mechanical advantage for a rigid link AB, whose driving end is A whereas driven end is B (neglecting friction effect), is given by :
   (A) V_A / V_B
   (B) V_B / V_A
   (C) $V_B . V_A$
   (D) None of the above

17. If a mechanism has n links, then the number of instantaneous centers would be equal to :
   (A) n
   (B) n(n – 1)/2
   (C) n/2
   (D) (n – 1)

18. If a constant velocity ratio of driving and driven shafts is required then the mechanism used is :
(A) Ackermann gearing
(B) Hooke's joint
(C) Double Hooke's joint
(D) Grass-Hopper mechanism

19. The train value of a gear train is :
(A) equal to velocity ratio
(B) reciprocal of velocity ratio
(C) always greater than unity
(D) none of the above

20. In a clock mechanism, the gear train used to connect minute hand to hour hand, is :
(A) Epicyclic gear train
(B) Reverted gear train
(C) Compound gear train
(D) Simple gear train

21. The maximum fluctuation of the energy is the :
(A) sum of maximum and minimum energies
(B) difference between the maximum and minimum energies
(C) ratio of the maximum energy and minimum energy
(D) ratio of mean resisting torque to the work done per cycle

22. If the rotating mass of a rim type flywheel is distributed on another rim type flywheel whose mean radius is half the mean radius of the former, then the energy stored in the latter at the same speed will be :
(A) Four times the first one
(B) Same at the first one
(C) One fourth of the first one
(D) One and half times the first one

23. For a cycloidal tooth profile, pressure angle at (i) Commencement of engagement, (ii) Pitch point and (iii) End of engagement will be :
(A) constant
(B) zero, maximum, zero
(C) maximum, zero, maximum
(D) zero, zero, maximum

24. Material having highest cutting speed is :
(A) Cast iron
(B) Bronze
(C) Aluminium
(D) High carbon steel

25. Angle between the shear plane and work surface is known as :
(A) lip angle
(B) rake angle
(C) cutting angle
(D) shear angle

26. Binding material used in cemented carbide tools is :
(A) Nickel
(B) Cobalt
(C) Chromium
(D) Silicon

27. The usual ratio of forward and return stroke in shaper is :
(A) 2:1
(B) 1:2
(C) 2:3
(D) 3:2

28. Tool life is most affected by :
(A) cutting speed
(B) tool geometry
(C) feed and depth
(D) microstructure of material being cut

29. Poor surface finish results due to :
(A) heavy depth of cut
(B) low cutting speed
(C) high cutting speed
(D) coarse feed

30. Abrasive used for grinding ceramics and tungsten carbide is :
(A) Diamond
(B) Alumina
(C) Silicon carbide
(D) Boron carbide

31. A twist drill is a :
(A) side cutting tool
(B) front cutting tool
(C) end cutting tool
(D) none of these

32. Gantt chart is used for :
(A) inventory control
(B) material handling
(C) production schedule
(D) machine repair schedules

33. The main object of scientific layout is :
(A) to produce better quality of product
(B) to utilise maximum floor area
(C) to minimise production delays
(D) all of these

34. In value engineering, the term value refers to :
(A) manufacturing cost of the product
(B) selling price of the product
(C) total cost of the product
(D) utility of the product

35. In inventory control theory, the economic order quantity is :
(A) average level of inventory
(B) optimum lot size
(C) capacity of a warehouse
(D) lost size corresponding to break-even analysis

36. Production cost refers to prime cost plus :
(A) factory overheads
(B) factory and administration overheads
(C) factory, administration and sales overheads
(D) factory, administration, sales overheads and profit

37. A systematic job improvement sequence will consist of :
(A) motion study
(B) time study
(C) job enrichment
(D) all of these

38. Military type of organisation is known as :
(A) line organisation
(B) functional organisation
(C) line and staff organisation
(D) line, staff and functional organisation

39. The procedure of modifying work content to give more meaning and enjoyment to the job by involving employees in planning, organisation and control of their work, is termed as :
(A) job enlargement
(B) job enrichment
(C) job rotation
(D) job evaluation

40. Fixed position layout is also known as :
(A) analytical layout
(B) synthetic layout
(C) static product layout
(D) none of these

41. Slag inclusion in casting is a :
(A) surface defect
(B) internal defect
(C) superficial defect
(D) none of the above

42. The most suitable material for die casting is :
(A) Steel
(B) Cast Iron
(C) Nickel
(D) Copper

43. Draft on pattern for casting is :
(A) shrinkage allowance
(B) identification number marked on it
(C) taper to facilitate its removal from mould
(D) for machining allowance

44. Sprue in casting refers to :
(A) gate
(B) runner
(C) riser
(D) vertical passage

45. Ornaments are cast by :
(A) die casting
(B) continuous casting
(C) pressed
(D) centrifugal casting

46. The aim of value engineering is to :
(A) find the depreciation value of a machine
(B) determine the selling price of a product
(C) minimize the cost without change in quality of the product
(D) all of the above

47. In time study, the rating factor is applied to determine :
(A) standard time of a job
(B) merit rating of the worker
(C) fixation of incentive rate
(D) normal time of a worker

48. CPM is the :
(A) time oriented technique
(B) event oriented technique
(C) activity oriented technique
(D) target oriented technique

49. Simplex method is the method used for :
(A) value analysis
(B) network analysis
(C) linear programming
(D) queuing theory

50. Which of the following wage incentive plans guarantees minimum wage to a worker and bonus is paid for the fixed percentage of time saved ?
(A) Halsey plan
(B) Gantt plan
(C) Rowan plan
(D) Emerson's efficiency plan

51. Job evaluation is the method of determining the :
(A) relative values of a job
(B) worker's performance on a job
(C) worth of the machine
(D) value of overall production

52. The routing function in a production system design is concerned with :
(A) manpower utilisation
(B) quality assurance of the product
(C) machine utilisation
(D) optimising material flow through the plant

53. Direct expenses include :
(A) factory expenses
(B) selling expenses
(C) administrative expenses
(D) none of these

54. String diagram is used :
(A) for checking the relative values of various layouts
(B) when a group of workers are working at a place
(C) where processes require the operator to be moved from one work place to another
(D) all of the above

55. Which of the following types of layout is suitable for automobile manufacturing concern ?
(A) product layout
(B) process layout
(C) fixed position layout
(D) combination layout

56. Queuing theory is associated with :
(A) inventory
(B) sales
(C) waiting time
(D) production time

57. PERT requires :
(A) single time estimate
(B) double time estimate
(C) triple time estimate
(D) none of these

58. Which of the following statements is correct ?
(A) A-B-C analysis is based on Pareto's principle
(B) Simulation can be used for inventory control
(C) Economic order quantity formula ignores variations in demand pattern
(D) all of the above

59. In break even analysis, total cost consists of :
(A) fixed cost + sales revenue
(B) variable cost + sales revenue
(C) fixed cost + variable cost
(D) fixed cost + variable cost + profit

60. In order to avoid excessive multiplication of facilities, the layout preferred is :
(A) product layout
(B) process layout
(C) group layout
(D) static layout

61. Which of the following can be regarded as gas so that gas law could be applicable within the commonly encountered temperature limits ?
(A) O_2, N_2, steam, CO_2
(B) O_2, N_2, water vapour
(C) SO_2, NH_3, CO_2, moisture
(D) O_2, N_2, H_2, air

62. A closed system is one in which :
(A) mass does not cross boundaries of the system, though energy may do so
(B) mass crosses the boundary but not the energy
(C) neither mass nor energy crosses the boundaries of the system
(D) both energy and mass cross the boundaries of the system

63. Absolute zero pressure will occur :
(A) at sea level
(B) at the centre of the earth
(C) when molecular momentum of the system becomes zero
(D) under vacuum conditions

64. Intensive property of a system is one whose value :
(A) depends on the mass of the system, like volume
(B) does not depend on the mass of the system, like temperature, pressure, etc.
(C) is not dependent on the path followed but on the state
(D) is dependent on the path followed and not on the state

65. The equation $\left(p + \frac{a}{v^2}\right)(v - b) = R$ is known as :
(A) Real gas equation
(B) Maxwell's equation
(C) van der Waal's equation
(D) Avogadro's equation

66. The basis for measuring thermodynamic property of temperature is given by :
(A) zeroth law of thermodynamics
(B) first law of thermodynamics
(C) second law of thermodynamics
(D) third law of thermodynamics

67. If a fluid expands suddenly into vacuum through an orifice of large dimension, then such a process is called :
(A) free expansion
(B) hyperbolic expansion
(C) adiabatic expansion
(D) parabolic expansion

68. Steam flow through a nozzle is considered as :
(A) constant volume flow
(B) constant pressure flow
(C) adiabatic flow
(D) isothermal flow

69. The following cycle is used for air craft refrigeration :
(A) Brayton cycle
(B) Joule cycle
(C) Carnot cycle
(D) Reversed-Brayton cycle

70. An ideal gas at 27ºC is heated at constant pressure till its volume becomes three times. The temperature of gas then will be :
(A) 81 ºC
(B) 900 ºC
(C) 627 ºC
(D) 927 ºC

71. When two gases suddenly mix up with each other then resultant entropy of the system will :
(A) decrease
(B) increase
(C) remain same
(D) attain negative value

72. If air is compressed adiabatically from atmospheric condition in a cylinder having compression ratio of 6, then pressure at the end of compression shall be :
(A) 6 ata
(B) less than 6 ata
(C) more than 6 ata
(D) less or more than 6 ata depending on temperature at the end of compression

73. The air-fuel ratio of the petrol engine is controlled by :
(A) fuel pump
(B) governor
(C) injector
(D) carburettor

74. Engine pistons are usually made of aluminum alloy because it :
(A) is lighter
(B) wears less
(C) absorbs shocks
(D) is stronger

75. For maximum power generation, the air fuel ratio for petrol engine vehicles is of the order of :
(A) 9 : 1
(B) 12 : 1
(C) 15 : 1
(D) 18 : 1

76. In a naturally aspirated diesel engine, the air is supplied by :
(A) a supercharger
(B) a centrifugal blower
(C) a vacuum chamber
(D) an injection tube

77. Ignition quality of petrol is expressed by :
(A) octane number
(B) cetane number
(C) calorific value
(D) self ignition temperature

78. Ignition timing of a multi cylinder petrol engine can be adjusted by :
(A) rotating the crank
(B) adjusting the spark plug gap
(C) adjusting ignition coil position
(D) rotating the distributor

79. The elements of most concern in regard to pollution caused by engines are :
(A) CO and CO_2
(B) CO and hydrocarbons
(C) CO_2 and hydrocarbons
(D) hot products of combustion

80. Water boils when its vapour pressure :
(A) equals that of the surroundings
(B) equals 760 mm of mercury
(C) equals to atmospheric pressure
(D) equals the pressure of water in the container

81. Which of the following gases has the highest calorific value ?
(A) producer gas
(B) coal gas
(C) coke oven gas
(D) blast furnace gas

82. The diameter of Cornish boiler is of the order of :
(A) 1-2 m
(B) 1.5-2.5 m
(C) 2-3 m
(D) 2.5-3.5 m

83. Which of the following is fire tube boiler ?
(A) locomotive boiler
(B) Babcock and Wilcox boiler
(C) Stirling boiler
(D) all of the above

84. Which device is used in thermal power plants to reduce level of pollution ?
(A) induced draft fan
(B) precipitator
(C) chimney
(D) pulveriser

85. De-aeration of feed water is carried out because it reduces :
(A) cavitation of boiler feed pumps
(B) corrosion caused by oxygen
(C) heat transfer coefficient
(D) pH value of water

86. As a result of blade friction the relative velocity at outlet of impulse turbine compared to inlet relative velocity is :
(A) nearly same
(B) 2% less
(C) 10-15% less
(D) 30% less

87. Commonly used method of governing in steam turbines is by :
(A) throttle governing
(B) nozzle control governing
(C) bypass governing
(D) hydraulic governing

88. Reheat cycle in steam power plant is used to :
(A) prevent excess of 10-12% moisture content in last stages of turbine
(B) utilize heat of the flue gases
(C) increase plant efficiency
(D) improve condenser performance

89. For a convergent divergent nozzle, the mass flow rate remains constant if the ratio of exit and inlet pressures :
(A) is less than critical pressure ratio
(B) is equal to the critical pressure ratio
(C) is more than critical pressure ratio
(D) is infinity

90. The maximum velocity attainable at the throat of a steam nozzle is :
(A) supersonic velocity
(B) slightly less than sonic velocity
(C) sonic velocity
(D) slightly more than sonic velocity

91. The effect of friction in nozzle is to :
(A) keep dryness fraction constant
(B) increase dryness fraction
(C) decrease dryness fraction
(D) first increase dryness fraction up to a certain limit and then decrease

92. The super saturation of steam results in slight :
(A) increase in entropy
(B) increase of final dryness fraction
(C) increase of discharge
(D) all of the above

93. The most efficient method of compressing air is to compress it :
(A) isothermally
(B) adiabatically
(C) isentropically
(D) as per law $PV^n = C$

94. Aeroplanes employ following type of compressor :
(A) radial flow
(B) axial flow
(C) centrifugal
(D) combination of above

95. Ratio of indicated horse power and brake horse power is known as :
(A) mechanical efficiency
(B) volumetric efficiency
(C) isothermal efficiency
(D) relative efficiency

96. A compressor at high altitude will draw :
(A) more power
(B) less power
(C) same power
(D) none of the above

97. Thermal conductivity of solid metals with rise is temperature normally :
(A) increases
(B) decreases
(C) remains constant
(D) unpredictable

98. Heat is transferred by all three modes, viz, conduction, convection and radiation in :
(A) electric heater
(B) steam condenser
(C) refrigerator condenser coils
(D) boiler

99. Ratio of heat flow q_1/q_2 from two walls of same thickness having their thermal conductivities as $k_1 = 2k_2$ will be :
(A) 0.5
(B) 1
(C) 2
(D) 4

100. In heat exchangers, degree of approach is defined as the difference between temperatures of :
(A) cold water inlet and outlet
(B) hot medium inlet and outlet
(C) hot medium outlet cold water inlet
(D) hot medium outlet cold water outlet

101. The value of Prandlt number for air is around :
(A) 0.1
(B) 0.3
(C) 0.7
(D) 1.7

102. The energy distribution of an ideal reflector at higher temperature is largely in the range of :
(A) shorter wavelength
(B) longer wavelength
(C) remains same at all wavelengths
(D) wavelength has nothing to do with it

103. The heat transfer equation $\nabla^2 T = 0$ is known as :
(A) Laplace equation
(B) General equation of heat transfer
(C) Fourier equation
(D) Poisson's equation

104. Thermal radiation extends over the range of :
(A) 0.01 to 0.1 μ
(B) 0.1 to 100 μ
(C) 100 to 250 μ
(D) 250 to 1000 μ

105. The boiling point of ammonia is :
(A) 0 ºC
(B) –50 ºC
(C) –33.3 ºC
(D) 33.3 ºC

106. One ton of refrigeration corresponds to :
(A) 210 kJ/min
(B) 210 kJ/h
(C) 335 kJ/min
(D) 335 kJ/h

107. The refrigerant for a refrigerator should have :
(A) high sensible heat
(B) high total heat
(C) high latent heat
(D) low latent heat

108. Refrigeration in aeroplanes usually employs the following refrigerant :
(A) CO_2
(B) Freon-11
(C) Freon-22
(D) Air

109. In a flooded type evaporator of a refrigerator, an accumulator at suction of the compressor is used to :
(A) collect liquid refrigerant and prevent it from going to compressor
(B) detect liquid in vapour
(C) superheat the vapour
(D) collect vapours

110. When two refrigerants are mixed in the proper ratio, the mixture forms a third refrigerant called :
(A) synthetic refrigerant
(B) auxiliary refrigerant
(C) high pressure refrigerant
(D) an azeotrope

111. The most suitable refrigerant for a commercial ice plant is :
(A) brine
(B) NH_3
(C) Freon
(D) air

112. Dew point temperature is constant as long as there is :
(A) no change in moisture content of the air
(B) no change in volume of air
(C) no change in dry bulb and wet bulb temperature
(D) no change in relative and specific humidity of air

113. The comfort conditions in air conditioning are :
(A) 22 ºC dry bulb temperature and 60% relative humidity
(B) 25 ºC dry bulb temperature and 100% relative humidity
(C) 20º C dry bulb temperature and 75% relative humidity
(D) 15º C bulb temperature and 80% relative humidity

114. Air is normally dehumidified by :
(A) injecting water
(B) passing steam
(C) heating
(D) cooling

115. A fluid in equilibrium cannot sustain :
(A) tensile stress
(B) compressive stress
(C) shear stress
(D) bending stress

116. Which of the following instrument can be used for measuring speed of an aeroplane ?
(A) orifice plate
(B) hot wire anemometer
(C) rotameter
(D) pitot tube

117. Euler's dimensionless number relates the following :
(A) Inertial force and gravity
(B) Viscous force and Inertial force
(C) Pressure force and Inertial force
(D) Pressure force and viscous force

118. Power transmitted through a pipe is maximum when the loss of head due to friction is :
(A) one-half of the total head supplied
(B) one-third of the total head supplied
(C) one-fourth of the total head supplied
(D) zero

119. The efficiency of a centrifugal pump is maximum when its blades are :
(A) straight
(B) bent forward
(C) bent backward
(D) bent forward first and then backward

120. In axial flow fans and turbines, fluid enters and leaves as follows :
(A) radially, axially
(B) axially, radially
(C) axially, axially
(D) radially, radially

ROUGH WORK