

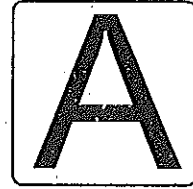
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T. B. C. : AEM – 2/2015

Test Booklet Series

Serial No.

27181



TEST BOOKLET

ASSISTANT EXECUTIVE ENGINEER
MECHANICAL ENGINEERING (PAPER – II)

Time Allowed : 3 Hours

Maximum Marks : 180

: INSTRUCTIONS TO CANDIDATES :

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 OF THE SAME SERIES ISSUED TO YOU.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES A, B, C OR D, AS THE CASE MAY BE, IN THE APPROPRIATE PLACE IN THE ANSWER SHEET USING BALL POINT PEN (BLUE OR BLACK).
3. You have to enter your Roll No. on the Test Booklet in the Box provided alongside. DO NOT write anything else on the Test Booklet.
4. This Test Booklet contains 90 items (questions). Each item (question) comprises four responses (answers). You have to select the correct response (answer) which you want to mark (darken) on the Answer Sheet. In case, you feel that there is more than one correct response (answer), you should mark (darken) the response (answer) which you consider the best. In any case, choose ONLY ONE response (answer) for each item (question).
5. You have to mark (darken) all your responses (answers) ONLY on the separate Answer Sheet provided, by using BALL POINT PEN (BLUE OR BLACK). See instructions in the Answer Sheet.
6. All items (questions) carry equal marks. All items (questions) are compulsory. Your total marks will depend only on the number of correct responses (answers) marked by you in the Answer Sheet. There will be no negative marking for wrong answer.
7. Before you proceed to mark (darken) in the Answer Sheet the responses to various items (questions) in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per the instructions in your Admission Certificate.
8. After you have completed filling in all your responses (answers) on the Answer Sheet and after conclusion of the examination, you should hand over to the Invigilator the Answer Sheet issued to you. You are allowed to take with you the candidate's copy/second page of the Answer Sheet along with the Test Booklet after completion of the examination for your reference.

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SEAL

1. The following is not true in case of thermodynamic work :
 - (A) $W = \int PdV$ for a reversible process only
 - (B) $W = 0$ if $dV = 0$
 - (C) $W \neq \int PdV$ for a free-expansion process
 - (D) W is an inexact differential

2. The internal energy of an ideal gas is a function of :
 - (A) Pressure only
 - (B) Volume only
 - (C) Absolute temperature only
 - (D) Pressure, volume and temperature only

3. During a certain compression process, 1 kJ of mechanical work input is supplied to 2 kg of a gas enclosed in a cylinder piston assembly and 400 J of heat is rejected to the cooling water being circulated in the jacket encasing the cylinder. This brings about a change in the specific internal energy by :
 - (A) -700 J kg^{-1}
 - (B) 600 J kg^{-1}
 - (C) 300 J kg^{-1}
 - (D) -300 J kg^{-1}

4. The correct statement regarding entropy is that :
 - (A) Entropy is a path function
 - (B) Entropy can be obtained from a direct measurement of Q and T
 - (C) During a change of a state of a system, the entropy change is the same whether that change has occurred via a reversible process or an irreversible one
 - (D) Entropy of an isolated system is zero

5. One Carnot heat engine operates between 1600 K and T_2 , while the other operates between T_2 and 400 K. Both have the same heat input and heat rejection then T_2 is :
 - (A) 800 K
 - (B) 1000 K
 - (C) 1200 K
 - (D) 1400 K

6. Gasohol is a mixture of :
 - (A) 90% ethanol + 10% gasoline
 - (B) 10% ethanol + 90% gasoline
 - (C) 40% ethanol + 60% gasoline
 - (D) 50% ethanol + 50% gasoline

7. Disadvantage of hydrogen as a fuel in IC engine :
- Storage is easy
 - Low NO_x emission
 - Detonating tendency
 - Easy handling
8. Major constituent of natural gas is :
- Ethane
 - Methane
 - Propane
 - Butane
9. Major disadvantage of LPG as a fuel in automobile is :
- Reduction in life of the engine
 - Less power compared to gasoline
 - Both (A) and (B)
 - Knocking tendency
10. The method of governing for a petrol engine is :
- Hit and misgoverning
 - Quality governing
 - Quantity governing
 - Misgoverning
11. Fuel is injected in a four-stroke CI engine :
- At the end of suction stroke
 - At the end of compression stroke
 - At the end of expansion stroke
 - At the end of exhaust stroke
12. Main advantage of pintaux nozzle is :
- Better cold starting performance
 - Ability to distribute the fuel
 - Good penetration
 - Good atomization
13. With increase in compression ratio flame speed :
- Increases
 - Remains same
 - Decrease
 - First increases and then remain constant
14. Scavenging means :
- Using fresh air for compressor
 - To reduce detonation
 - Using air for throwing burnt gases out of cylinder during exhaust stroke
 - Using correct air fuel mixture
15. At flash point temperature :
- Fuel ignites without any spark
 - Fuel emits vapours which produce an inflammable mixture with air
 - Fuel vaporize sat very high rate
 - The fuel spontaneously ignites for longer time

16. Cetane number is the measure of :
- Delay period
 - Detonation
 - Flash point
 - Ignition quality
17. If diesel is fed into petrol engine then the engine will :
- Not run
 - Knock
 - Detonate
 - Give lot of smoke
18. Duration between the time of injection and time of ignition in a diesel engine is called :
- Lead period
 - Delay period
 - Combustion period
 - Period of compression
19. If compression ratio is kept same then thermal efficiency of :
- Otto cycle is less than Dual cycle
 - Otto cycle is same as that for Diesel cycle
 - Otto cycle is less than that of Diesel cycle
 - Otto cycle is more than that of Diesel cycle
20. Stoichiometric ratio means :
- Chemically correct air-fuel ratio by mass
 - Air-fuel ratio for maximum efficiency
 - Chemically correct air-fuel ratio by volume
 - Oxygen-fuel ratio by volume
21. The MLT θ system the dimension of thermal conductivity is :
- $ML^{-1}T^{-1}\theta^{-3}$
 - $MLT^{-1}\theta^{-1}$
 - $ML\theta^{-1}T^{-3}$
 - $ML\theta^{-1}T^{-2}$
22. Two plane slabs of equal area but with thermal conductivities in the ratio 1 : 2 are held together with temperature between the two outer surfaces being T_1 and T_2 . If the junction temperature between the two surfaces is desired to be $\frac{T_1 + T_2}{2}$, then their thicknesses should be in the ratio of :
- 1 : 2
 - 2 : 1
 - 1 : 1
 - 3 : 1

23. Thermal diffusivity of a substance is :
- (A) Inversely proportional to the thermal conductivity
 - (B) Directly proportional to the density of the substance
 - (C) Inversely proportional to the specific heat
 - (D) Directly proportional to kinematic viscosity
24. If the temperature of a solid surface increases from 27°C to 627°C , its emissive power increases in the ratio :
- (A) 1 : 3
 - (B) 1 : 9
 - (C) 1 : 27
 - (D) 1 : 81
25. It is desired to reduce the radiation energy exchange between two infinite parallel planes by inserting radiation shields of the same emissivity. The number of shields required for 80% reduction will be :
- (A) 2
 - (B) 3
 - (C) 4
 - (D) 5
26. Fins are provided on heat transferring surface to :
- (A) Increase surface area to promote the rate of heat transfer
 - (B) Increase temperature gradient so as to enhance heat transfer
 - (C) Increase turbulence in flow for enhancing heat transfer
 - (D) Decrease the pressure drop of fluid
27. If the radius of any current carrying wire is less than the critical radius, then the addition of electrical insulation will enable the wire to carry a higher current because the :
- (A) Thermal resistance of the insulator is reduced
 - (B) Thermal resistance of the insulator is increased
 - (C) Heat loss from the wire is reduced
 - (D) Heat loss from the wire is increased
28. An ideal absorber of radiation is also an ideal emitter. It is known as :
- (A) Kirchhoff's law
 - (B) Wien's law
 - (C) Planck's law
 - (D) Lambert's law

29. A thin flat plate is hanging freely in air at 27°C . Solar radiation falls in one of its sides at the rate of 500 W/m^2 . For maintaining the temperature of the plate constant at 32°C , the value of heat transfer coefficient is :

- (A) 25 W/m^2
- (B) 50 W/m^2
- (C) 100 W/m^2
- (D) 200 W/m^2

30. The Nusselt number in natural convection is a function of :

- (A) Reynolds and Prandtl numbers
- (B) Grashof and Prandtl numbers
- (C) Reynolds and Grashof numbers
- (D) Grashof and Biot numbers

31. LMTD of a heat exchanger with ΔT_1 , and ΔT_2 being temperature differences between the hot and cold fluids at entrance and exit, respectively is :

(A)
$$\frac{\Delta T_2 - \Delta T_1}{\log \left[\frac{\Delta T_2}{\Delta T_1} \right]}$$

(B)
$$\frac{\Delta T_2 - \Delta T_1}{\log \left[\frac{\Delta T_1}{\Delta T_2} \right]}$$

(C)
$$\frac{\Delta T_2 - \Delta T_1}{\frac{\Delta T_2}{\Delta T_1}}$$

(D)
$$\log \left[\frac{\Delta T_2 - \Delta T_1}{\left[\frac{\Delta T_2}{\Delta T_1} \right]} \right]$$

32. Refrigerant flow is controlled by :

- (A) Capillary tube
- (B) Condenser
- (C) Solenoid
- (D) Expansion Valve

33. In a reversed Carnot refrigeration cycle, the condenser and evaporator are at 27°C and -13°C , respectively. The COP of this cycle is :

- (A) 6.5
- (B) 7.5
- (C) 10.5
- (D) 15.5

34. Usual secondary refrigerant in milk chilling unit is :

- (A) Ammonia solution
- (B) Sodium silicate
- (C) Glycol
- (D) Brine

35. In cooling tower, "approach" is the temperature difference between the :
- Hot inlet water and cold outlet water
 - Hot inlet water and wet bulb temperature
 - Cold outlet water and wet bulb temperature
 - Dry bulb and wet bulb temperature
36. A hermetically sealed unit implies :
- Compressor is sealed
 - Motor is sealed
 - Refrigerant cycle is sealed
 - Both compressor and motor are sealed
37. Chemical formula of Freon-12 is :
- CCl_2F_2
 - CCl_2F_3
 - CCl_3F_2
 - CCl_3F_3
38. Heating of air without changing its moisture content takes place on a psychometric chart along :
- A horizontal line of constant dew point
 - Rising line
 - Falling line
 - Curved line
39. Dry compression is preferred due to :
- High volumetric efficiency
 - High mechanical efficiency
 - Less chance of damage of the compressor
 - All of the above
40. Pipe material for the refrigerator with ammonia solution as working fluid should not be :
- Mild steel
 - Copper
 - Aluminum
 - Brass
41. Undercooling of refrigerant leads to :
- Decrease refrigerating effect
 - Reduce work done
 - Reduce COP
 - Increase the COP of the cycle
42. COP for refrigerator and heat pump are related as :
- $\text{COP}_h = \text{COP}_r - 1$
 - $\text{COP}_h = \text{COP}_r$
 - $\text{COP}_h = \text{COP}_r + 1$
 - $\text{COP}_h = \frac{1}{\text{COP}_r}$

43. If T_1 and T_2 are dry bulb temperature of air entering and leaving the coil and T_3 is ADP temperature (temperature of cooling coil), then T_1 bypass factor for sensible cooling of air is :

(A) $\frac{T_3 - T_1}{T_2 - T_1}$

(B) $\frac{T_1 - T_2}{T_2 - T_3}$

(C) $\frac{T_2 - T_3}{T_1 - T_3}$

(D) $\frac{T_2 - T_3}{T_1 - T_2}$

44. During mixing of steams in case of air conditioning, the process is associated with :

(A) Throttling

(B) Adiabatic

(C) Isobaric

(D) Isochoric

45. The presence of moisture in refrigeration effect is felt at :

(A) Evaporator

(B) Condenser pipes

(C) Expansion valve

(D) Compressor unit

46. The humidity ratio is also expressed as where p_s is the partial pressure of superheated vapour and p is the barometric pressure of mixture :

(A) $0.622 \frac{p_s}{(p - p_s)}$

(B) $0.622 \frac{p}{(p - p_s)}$

(C) $\frac{p}{p_s}$

(D) $0.622 \frac{p - p_s}{p_s}$

47. If we have 100% RH, then DPT, WBT and DBT can be related to each other as :

(A) DBT < DPT < WBT

(B) DBT = DPT = WBT

(C) DPT > WBT > DBT

(D) None of the above

48. The desuperheating coil in a condenser performs the function of :

(A) Improving the heat of superheat of the refrigerant before it goes into condenser

(B) Removing heat from condenser

(C) Improving condenser performance

(D) To humidity the refrigerant before it goes into condenser

49. In split system of air-conditioner, the condensing unit is located :
- (A) Inside the area to be conditioned
 (B) Outside the area to be conditioned
 (C) Near the refrigerator
 (D) None of the above
50. The refrigerant R-717 represents :
- (A) Carbon dioxide
 (B) Carbon monoxide
 (C) Ammonia
 (D) Methane
51. The maximum thickness of boundary layer in case of a pipe of radius R is :
- (A) R
 (B) $1/3 R$
 (C) $0.1 R$
 (D) $2/3 R$
52. How does pressure intensity varies when liquid rotates at an angular velocity of a vertical axis ?
- (A) Directly with radial distance
 (B) Directly with square of the radial distance
 (C) Inversely with square of the radial distance
 (D) None of the above
53. Pitot tube is used for measurement of :
- (A) Viscosity
 (B) Pressure
 (C) Flow
 (D) Velocity
54. The hydraulic mean depth of a circular pipe of diameter d running full is equal to :
- (A) $d/2$
 (B) $d/4$
 (C) $0.29 d$
 (D) d
55. In order to increase sensitivity of U-tube manometer, one leg is usually inclined by angle θ . Sensitivity of inclined tube to sensitivity of U-tube is equal to :
- (A) $\sin \theta$
 (B) $\cos \theta$
 (C) $\tan \theta$
 (D) $1/\sin \theta$

56. Euler's equation in differential form is given as :
- (A) $\frac{dp}{\rho^2} + v^2 dv + g dz = 0$
- (B) $\frac{dp}{\rho} + v dv + g^3 dz = 0$
- (C) $\frac{dp}{\rho} + v dv + g dz = 0$
- (D) $\frac{dp}{\rho} + v^2 dv + g^2 dz = 0$
57. For dimensional analysis the Buckingham's π -theorem finds the resulting equation in form of :
- (A) (n-m) dimensionless parameters
- (B) n dimensionless parameters
- (C) Geometric and kinetic variables
- (D) Mass, length and time
58. Ratio of inertia force to surface tension is known as :
- (A) Weber's number
- (B) Mach number
- (C) Froude number
- (D) Euler number
59. SI unit of viscosity is :
- (A) 1 poise
- (B) 10 poise
- (C) Centipoise
- (D) None of the above
60. For a liquid coming out of a nozzle, maximum height attained is :
- (A) $\frac{u^2 \sin^2 \theta}{g}$
- (B) $\frac{u^2 \sin^2 2\theta}{g}$
- (C) $\frac{u^2 \cos^2 \theta}{2g}$
- (D) $\frac{u^2 \sin^2 \theta}{2g}$
61. The equation of continuity is applicable when the flow :
- (A) Velocity is uniform at all cross sections
- (B) Is steady
- (C) Is one dimensional
- (D) All of the above
62. Cavitation is caused by :
- (A) Low surface tension
- (B) High pressure
- (C) Low pressure
- (D) Low velocity

63. The Centre of buoyancy is :
- (A) Centroid of displaced volume of fluid
 - (B) A point slightly above metacenter
 - (C) Centre of gravity of the body
 - (D) All of the above
64. All the terms of energy in Bernoulli's equation have dimension of :
- (A) Force
 - (B) Work
 - (C) Length
 - (D) Energy
65. Head loss at entrance to pipe is :
- (A) $\frac{3v^2}{2g}$
 - (B) $0.5 \frac{v^2}{2g}$
 - (C) $\frac{2v^3}{g}$
 - (D) $\frac{v^2}{2g}$
66. Separation flow occurs when pressure gradient :
- (A) Becomes less than zero
 - (B) Becomes zero
 - (C) Does not flow continuity equation
 - (D) Changes slowly
67. Drag force on a body is result of :
- (A) Fluid dynamic force acting on the object
 - (B) A component of resultant fluid dynamic force in the flow direction
 - (C) Pressure variation over the surface of object due to horizontal force
 - (D) None of the above
68. Sonic velocity C for adiabatic is mentioned as :
- (A) $C = \sqrt{\gamma RT}$
 - (B) $C = \gamma RT$
 - (C) $C = \sqrt{\gamma RT^2}$
 - (D) $C = [\gamma RT]^{1/3}$
69. The magnitude of velocity at stagnation point is an immersed body is :
- (A) Zero
 - (B) Large
 - (C) Small
 - (D) Half of the initial value

70. In a two-dimensional velocity field with velocities u and v along the x and y direction respectively, the convective acceleration along the x -direction is given by :
- (A) $u \frac{\partial v}{\partial x} + v \frac{\partial u}{\partial y}$
- (B) $u \frac{\partial u}{\partial x} + v \frac{\partial v}{\partial y}$
- (C) $v \frac{\partial u}{\partial x} + u \frac{\partial u}{\partial y}$
- (D) $u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y}$
71. Curtis turbine is :
- (A) Reaction steam turbine
- (B) Pressure velocity compounded steam turbine
- (C) Pressure compounded impulse steam turbine
- (D) Velocity compounded impulse steam turbine
72. For maximum blade efficiency for single stage impulse steam turbine with nozzle angle α is :
- (A) $\rho = \cos^2 \alpha$
- (B) $\rho = \cos \alpha$
- (C) $\rho = \frac{\cos \alpha}{2}$
- (D) $\rho = \frac{\cos^2 \alpha}{2}$
73. Steam flow in a steam generator is controlled by using :
- (A) Drum level sensor
- (B) Feed water flow sensor
- (C) Stem flow sensor
- (D) All of the above
74. In steam turbines the reheat factor :
- (A) Increases with the increase in number of stages
- (B) Decreases with the increase in number of stages
- (C) Remains same irrespective of number of stages
- (D) None of the above
75. Which of the following indicates the correct order in the path of the flue gas ?
- (A) Superheater, economizer, air preheater
- (B) Air preheater, economizer, superheater
- (C) Air preheater, superheater, economizer,
- (D) No definite order
76. In a centrifugal pump casing, the flow of water leaving the impeller, is :
- (A) Rectilinear flow
- (B) Radial flow
- (C) Free vortex flow
- (D) Forced vortex

77. If D is the diameter of impeller at inlet, w is the width of the impeller at inlet and V_f is the velocity of flow at inlet then discharge through a centrifugal pump is equal to :
- (A) $\pi D V_f$
 (B) $D V_f w$
 (C) $\pi D V_f w$
 (D) $\pi D w$
78. When a centrifugal pump is started, there will be no flow of water until the pressure rise in the impeller is large enough to overcome the :
- (A) Manometric head
 (B) Total head
 (C) Static head
 (D) Friction head
79. The specific speed of turbine is indicated as :
- (A) $\frac{N\sqrt{Q}}{H^{3/4}}$
 (B) $\frac{N\sqrt{P}}{H^{5/4}}$
 (C) $\frac{N\sqrt{Q}}{H^{2/3}}$
 (D) $\frac{N\sqrt{P}}{H^{3/2}}$
80. If α is the angle of blade tip at outlet, then maximum hydraulic efficiency of an impulse turbine is :
- (A) $\frac{1 + \cos \alpha}{2}$
 (B) $\frac{1 - \cos \alpha}{2}$
 (C) $\frac{1 + \sin \alpha}{2}$
 (D) $\frac{1 - \sin \alpha}{2}$
81. In reaction turbine :
- (A) The vanes are partly filled
 (B) Total energy of fluid is converted to kinetic energy in the runner
 (C) It is exposed to atmosphere
 (D) It is not exposed to atmosphere
82. In reaction turbine, draft tube is used :
- (A) To transport water downstream without eddies
 (B) To convert the kinetic energy to flow energy by a gradual expansion of the flow cross-section
 (C) For safety to turbine
 (D) To increase the flow rate

83. Which of the following is not a rotary pump ?
(A) Gear
(B) Vane
(C) Axial
(D) Screw
84. Air vessels used in a reciprocating pumps are initially filled with :
(A) Water
(B) Vacuum
(C) Compressed air
(D) None of the above
85. A plot between power generated in MW and time is known as :
(A) Load curve
(B) Load factor
(C) Demand curve
(D) Load duration curve
86. The ratio of maximum load to rated plant capacity is known as :
(A) Load factor
(B) Utilization factor
(C) Maximum load factor
(D) Capacity factor
87. Capacity of a hydroelectric plant in service in excess of the peak load is known as :
(A) Operating reserve
(B) Spinning reserve
(C) Peak reserve
(D) Cold reserve
88. In a Pelton wheel, the bucket peripheral speed is 10 m/s, the water jet velocity is 25 m/s and volumetric flow rate of the jet is $1.0 \text{ m}^3/\text{s}$. If the jet deflected angle is 120° and the flow is ideal, the power developed is :
(A) 15.0 kW
(B) 22.5 kW
(C) 7.5 kW
(D) 37.5 kW
89. If NPSH (Net Positive Suction Head) for a pump is not obeyed, then :
(A) The pump gets cavitated
(B) Proper head is not developed
(C) Pump has low efficiency
(D) More power is consumed
90. A hydraulic turbine generates 500 kW at 1500 rpm under a head of 60 m. During testing conditions, a scale model of 1:5 works under the head of 15 m. the power generated by the model will be :
(A) 2 kW
(B) 1.6 kW
(C) 3 kW
(D) 2.5 kW



SPACE FOR ROUGH WORK

SEAL