BARC 2019
Mechanical Engineering

Free Mock Test

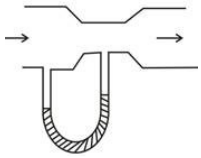
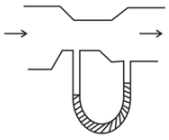
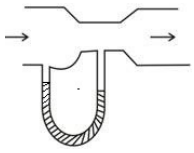
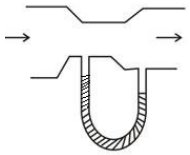
gradeup

1. Match the tables given below:

Table-1		Table-2		
P :	Psuedo-plastic fluid	1	:	Botenite Solution
Q :	Bingham Plastic Fluid	2	:	Toothpaste
R :	Thixotropic Fluid	3	:	Gelatine
S:	Rheopectic fluid	4	:	Printer's Ink

A. P – 3 Q – 2 R – 1 S – 4
B. P – 2 Q – 3 R – 4 S – 1
C. P – 3 Q – 2 R – 4 S – 1
D. P – 2 Q – 3 R – 1 S – 4

2. Which one of the following is correctly showing the level of manometer column.

1. 
2. 
3. 
4. 

A. 1 and 3 B. 2 and 4
C. 1 and 4 D. 2 and 3

3. A pipe having diameters 30cm and 10cm at the two sections A and B carries water that flows at a rate 50 L/s. Section A is 8m above datum and section B is 4m above datum .If the pressure at section is 5bar find the pressure at section B
A. 4.32 bar B. 3.42 bar
C. 5.2 bar D. 4 bar

4. A streamline and an equipotential line in a flow field
A. are parallel to each other
B. are perpendicular to each other
C. intersect at an acute angle
D. are identical

5. Bernoulli's equation is applicable for
A. viscous and compressible fluid flow
B. inviscid and compressible fluid flow
C. inviscid and incompressible fluid flow
D. viscous and income pressible fluid flow

6. For a fully developed flow or water in a pipe having diameter 10 cm, velocity 0.1 m/s and kinematic viscosity 10^{-5} m^2/s, the value of Darcy friction factor is _____
A. 0.06 B. 0.006
C. 0.007 D. 1.0

7. Oil flows through a 200 *mm* diameter horizontal cast iron pipe (friction factor, f = 0.0225) of length 500*m***.** The volumetric flow rate is 0.2 m^3/s. The head loss (in m) due to friction is (assume g = 9.81 m/s^2)
A. 116.19 B. 0.116
C. 18.22 D. 232.36

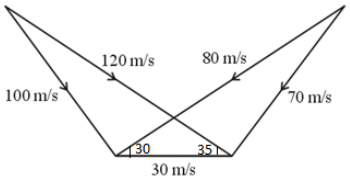
8. For air flow over a flat plate, velocity (U) and boundary layer thickness (δ) can be expressed respectively, as

$$\frac{U}{U_a}=\frac{3}{2}\frac{y}{\delta}-\frac{1}{2}\left(\frac{y}{\delta}\right)^3;\delta=\frac{4.64x}{\sqrt{Re_x}}$$

If the free stream velocity is 2m/s, and air has kinematic viscosity of 1.5×10^{-5} m2/s and density of 1.23 kg/m^3, the wall shear stress at x = 1m, is
A. 2.36 $\times10^2$ N/ m^2
B. 43.6 $\times10^{-3}$ N/m^2
C. 4.36 $\times10^{-3}$N/ m^2
D. 2.18 $\times10^{-3}$ N/ m^2

9. Calculate the mean bucket speed(m/s) of a Pelton wheel working under a head of 52m and producing 320kW. The diameter of nozzle is 178mm and coefficient of velocity is 0.98. The jet is deflected by 165 °.
A. 23.75 B. 14.97
C. 26.23 D. 30.61

10. The blade inlet and outlet velocity triangle for impulse turbine is shown in figure. At the inlet of turbine rotor the blade linear speed is 30 m/s. The magnitude of absolute velocity at inlet and outlet is 120 m/s and 70 m/s respectively

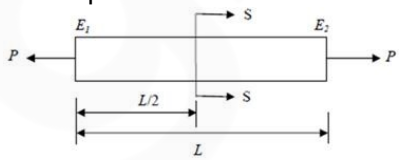


The hydraulic efficiency (in %) is
A. 70.83 B. 57.3
C. 61.43 D. 68.26

11. A steel bar of 40 mm × 40 mm square cross-section is subjected to an axial compressive load of 200 kN. If the length of the bar is 2m and E = 200 GPa, the elongation of the bar will be:
A. 1.25 mm B. 2.70 mm
C. 4.05 mm D. 5.40 mm

12. The maximum strain energy corresponding to the stress at the elastic limit is known as _____
A. Modulus of resilience
B. Toughness
C. Proof resilience
D. Resilience

13. A rod of length *L* having uniform cross-sectional area *A* is subjected to a tensile force *P* as shown in the figure below. If the Young's modulus of the material varies linearly from E_1 to E_2 along the length of the rod, the normal stress developed at the section-SS is



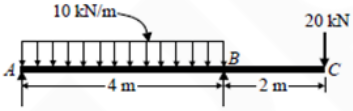
A. $\frac{P}{A}$ B. $\frac{P(E_1-E_2)}{A(E_1+E_2)}$

C. $\frac{PE_2}{AE_1}$ D. $\frac{PE_1}{AE_2}$

14. What is the value of bending stress for a bar of diameter 75 mm for moment of 6.75×10^3 Nm ?
A. 162.92 Mpa
B. 325.95 MPa
C. 625.95 Mpa
D. 651.90 MPa

15. In a bi-axial stress problem, the stresses in x and y directions are σ_x = 200 MPa and σ_y = 100 MPa the maximum principal stress in MPa is
A. 50 B. 100
C. 150 D. 200

16. For the overhanging beam shown in figure, the magnitude or maximum bending moment (in kN-m) is _____

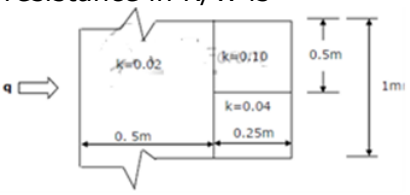


A. 45 B. 49
C. 40 D. 44

17. The buckling load for a column hinged at both ends is 10 kN. If the ends are fixed, the buckling load changes to
A. 40 kN B. 2.5 kN
C. 5 kN D. 20 kN

18. A 200 mm long stress free rod at room temperature is held between two immovable rigid walls. The temperature of the rod is uniformly raised by 250 °C. if the young's modulus and coefficient of thermal expansion are 100 GPa and $2*10^{-5}$ / °C respectively the magnitude of the longitudinal stress (in MPA. developed in the rod is
A. 600 MPa B. 200 MPa
C. 500 MPa D. 250 MPa

19. Heat flows through a composite slab, as shown below. The depth of the slab is 1 m. the k values are in W/m K. the overall thermal resistance in K/W is



A. 17.2 B. 21.9
C. 28.6 D. 39.2

20. A hollow cylinder has length L, inner radius r_1, outer radius r_2, and thermal conductivity k. The thermal resistance of the cylinder for radial conduction is

A. $\frac{\ln(r_2/r_1)}{2\pi kL}$ B. $\frac{\ln(r_1/r_2)}{2\pi kL}$

C. $\frac{2\pi kL}{\ln(r_2/r_1)}$ D. $\frac{2\pi kL}{\ln(r_1/r_2)}$

21. A plane wall 0.30 m thick generates heat uniformly at the rate of 5×10^4 W/m^3. The convective heat transfer coefficient between each face of the wall and the ambient air is 50 W/m^{2}K. Assume the ambient air temperature to be 25°C and the thermal conductivity of the wall material to be 25 W/m K. The maximum temperature (°C) in the wall is

A. 25 B. 150

C. 175 D. 197.5

22. In certain cases, we cannot apply lumped heat capacity analysis. we can use

A. Heiseler's chart

B. Frick's law

C. Frick's chart

D. Newton's law of cooling

23. In a counter flow heat exchanger heat capacity of hot fluid is and cold fluid is 3050W/K. If the overall heat transfer coefficient is 250W/m^2 K, find the effectiveness of heat exchanger if heat exchanger area is 50m^2.

A. 0.80 B. 0.67

C. 0.72 D. 0.84

24. The relation $Q_{\text{with shield}}/Q_{\text{without shield}} = 1/(n+1)$ (where Q = heat transfer and n = number of shields) holds when

A. emissivity(ε_1) of first surface is zero

B. emissivity of both surfaces ε_1 and ε_2 are equal

C. emissivity of surfaces as well as shields are equal i.e $\varepsilon_1 = \varepsilon_2 = \varepsilon_3$

D. none of these

25. A small sphere of outer area 2.4 m^2 is totally enclosed by a large cubical hall. The shape factor of hall w.r.t sphere is 0.004. What is the measure of the internal side of the cubical hall (in meters)?

A. 50 B. 80

C. 10 D. 70

26. Which of the following is the important conclusion of Wein's displacement law?

A. with increase in temperature, the value of wavelength at which monochromatic emnissive power of the black body is maximum shifted towards minimum wavelength.

B. with decrease in temperature, the value of wavelength at which monochromatic emnissive power of the black body is maximum shifted towards minimum wavelength.

C. with increase in temperature, the value of wavelength at which monochromatic emnissive power of the black body is maximum shifted towards maximum wavelength.

D. with decrease in temperature, the value of wavelength at which monochromatic emnissive power of the black body is maximum shifted towards maximum wavelength.

27. A energy transfer from a gray body is considered. A equivalent electrical network for heat radiation is produced, the resistance in an electrical circuit corresponds to;

A. Q_{net} B. $e_b - J$

C. $(1 - \varepsilon)/\varepsilon A$ D. ρG

28. Heat is lost from a 100 mm diameter steam pipe placed horizontally in ambient air at 30^{0}C. If the Nusselt number is 25 and thermal conductivity of air is 0.03 W/m-K, then heat transfer coefficient will be

A. 16.2 W/m^2-K

B. 7.5 W/m^2-K

C. 25.2 W/m^2-K

D. 30 W/m^2-K

29. A firm produces a product whose fixed cost is Rs 20,000 and the variable cost is Rs 20 per unit. The break even production of firm is 4,000 units. The number units to be produced to earn profit of Rs 15,000 is
A. 5000 B. 7000
C. 10000 D. 14000

30. After some simplex iterations, the following table is obtained:

C_B	Y_B	X_B	Y_1	Y_2	Y_3	Y_4	Y_5
0	Y_3	30	8 / 5	0	1	−1 / 5	0
10	Y_2	20	2 / 5	1	0	1 / 5	0
0	Y_5	30	4 / 5	0	0	−3 / 5	1
	Z_j		4	10	0	2	0
	$Z_j - c_j$		0	0	0	2	0

From this, one can conclude that
A. The LPP has a unique optimal solution
B. The LPP is infeasible
C. The LPP is unbounded
D. The LPP has multiple optimal solution

31. For an assignment problem, Initial basic feasible solution is given below.

	I	II	III	IV	V
P	10	10	14	25	[0]
Q	[0]	12	25	17	15
R	10	12	19	[0]	10
S	5	6	4	7	~~[0]~~
T	2	[0]	~~[0]~~	5	7

The optimal assignment is
A. P–V, Q–I, R–IV, S-III, T–II
B. P–V, Q–I, R–III, S-IV, T–II
C. P–V, Q–II, R–III, S-IV, T–I
D. P–I, Q–II, R–III, S-IV, T–V

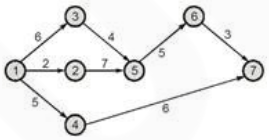
32. The probability distribution of weekly sale of a certain item is as follow:

Weekly sales (units)	0	1	2	3	4	5	6
Probability	0.01	0.06	0.25	0.35	0.20	0.03	0.10

The cost of carrying inventory is Rs. 30 per unit per week and the cost of unit shortage is Rs. 70 per week. The optimum stock level which minimized the total expected cost is _____ units.
A. 1 B. 2
C. 3 D. 4

33. For exchanging notes in a bank 50 customers arrived in 60 min which follows poisson's distribution and service time follows exponential distribution. Due to lack of notes there is single window for exchange and serves as first come first serve basis. Probability of more than 20 customers in system is 0.3 then, how much mean time required for exchanging notes for a customer on counter?
A. 2 min B. 1.13 min
C. 1.13 hr D. 2 hr

34. Consider the following PERT network:



The critical path duration of the network (in days) is _____.
A. 11 B. 17
C. 9 D. 18

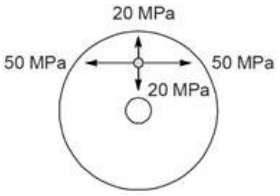
35. Five jobs are to be assigned at a particular firm. Their work (processing) time and due dates are given in the following table. If the sequence of processing is according to earliest due date (EDD) then the average no. of jobs in the system is

Job	Job work (processing) time	Job due date (in days)
A	6	8
B	2	6
C	8	18
D	3	15
E	9	23

A. 13.6 B. 3.68
C. 2.43 D. 2.32

36. Production flow analysis (PFA) is a method of identifying part families that uses data from
A. Engineering drawings
B. Production schedule
C. Bill of materials
D. Route sheets

37. In a gas turbine rotor, a radial stress of 20 MPa and a tangential stress of 50 MPa have been found at a point shown in figure. What is the maximum shear stress at this point in MPa?



A. 25 B. 50
C. 35 D. 70

38. A bar is subjected to fluctuating tensile load from 20 kN to 100 kN. The material has yield strength of 240 MPa and endurance limit in reversed bending is 160 MPa. According to the Soderberg principle, the area of cross-section (in mm^2)of the bar for a factor of safety of 2 is
A. 400 B. 600
C. 750 D. 1000

Direction (39-40): A 20 ° full depth involute spur pinion of 4 mm module and 21 teeth is to transmit 15 kW at 960 rpm. Its face width is 25 mm.

39. The tangential force transmitted (in N) is
A. 3552 B. 2611
C. 1776 D. 1305

40. A plate clutch with inside radius of contact is 100 mm and outside radius is 200 mm, which transmits the axial force of 8000N. Assuming uniform wear, what will be the maximum and minimum pressure (in kN/m2) in the plate clutch respectively.
A. 66.66 and 31.83
B. 255 and 127.5
C. 127.3 and 63.66
D. 211.5 and 105.75

41. Pre-tensioning of a bolted joint is used to
A. strain harden the bolt head
B. decrease stiffness of the bolted joint
C. increase stiffness of the bolted joint
D. prevent yielding of the thread root

42. A pulley of radius 500 mm is keyed to 25 mm radius of shaft by a 14 mm square key of length 150 mm. The tension in the tight side of the belt is 5000 N and tension ratio is 2 : 1. If ultimate shear strength is 250 MPa, then what will be the factor of safety in shear for key ?
A. 8.5 B. 21
C. 10.5 D. 5.25

43. If the a water cooled bearing has journal diameter of 50 mm and bearing length of 84mm also has a radial clearance of 0.025mm. The bearing pressure is 285.71 kN/m^2 as it supports a shaft running at 750rev/min. Determine the rate of heat generated assuming coefficient of friction to be 0.013.
A. 46.703 B. 30.63
C. 12.458 D. 36.484

44. A press machine exerts a force of 850 N on helical compression spring. A spring is required to be designed having a dia. of 8mm. It is assumed to have square and ground ends and no. of coils is 8. The gap between the consecutive coils is 1 mm. If the deflection was found to be 30mm calculate the pitch of coil.
A. 13.22mm B. 8.15 mm
C. 20.45 mm D. 10 mm

45. A wire drawing of 0.4mm dia is drawn from a rod of 15mm dia. dies giving reduction of 30%, 40%, 60% are available from min. error in final size, the no. of stage and reduction at each stage respectively would be.
A. 3 stages and 60% reduction for all three stages.
B. 4 stages and 60% reduction for 1st three stages followed by a finishing stage of 40% reduction.
C. 5 stages and 60%, 60%, 40%, 40%, 30% reduction in a sequence.
D. None of the above.

46. What is the optimum tool life (in min), if the Taylor's tool life, if the Taylor's tool life exponent is 0.4 and tool changing time is 1.2 min
A. 1.2 B. 1.4
C. 1.8 D. 1

47. Which of the following assumption is not made in the analysis of basic rolling operation?
A. Problem is of plane stress type
B. Problem is of plane strain type
C. Coefficient of friction between job roll interface is low
D. Rolls are straight and rigid cylinder

48. In rolling operation, diameter of roll is 200 mm, thickness of strip is 12 mm. Considering 20 % reduction, calculate roll strip contact length?
A. 12.69 B. 15.49
C. 18.28 D. 29.89

49. In a rolling operation, thickness of strip is reduced from 6 mm to 3 mm using 250 mm diameter rolls rotating at 100 rpm. The velocity (m/sec) of strip at neutral point is?
A. 23.871 B. 3.420
C. 1.308 D. 4.654

50. Two sheet of 16 mm thickness is to be joined with the help of electric arc process. No filler material is used during the welding process and weldments do not react with the environment gases. Find the electrode tip diameter in mm.
A. 32 mm B. 8 mm
C. 4 mm D. 1 mm

51. In order to clamp the tool and restrict all degree of freedom the 3,2,1 pin method is generally used for such application. How many pins are used for such constructions.
A. 5 pins at opposite plane
B. 3 pins at each perpendicular planes
C. 6 pins at each perpendicular plane
D. 3 pins at any plane followed by 2 pins at perpendicular plane and 1 pin at other perpendicular plane

52. Which of the following statement between the normalizing and annealing is true
A. annealing cooling are done in air while normalizing cooling is done is air
B. annealing produces harder structure than normalising
C. Fine grain structure is produced in normalizing than annealing
D. machinability is more after normalizing than annealing

53. Medium temperature tempering increases
i) endurance limit
ii) elastic limit
iii) hardness
A. i and ii B. i only
C. ii only D. All of these

54. Which of the following ceramic materials are used for piezoelectric applications?
A. Alumina and zirconium oxides
B. Boron titanite and silicon carbide
C. Barium titanite and lead-zirconate-titanite
D. Porcelain and fused silica glass

55. Consider the following statements with regard to the feeding system for a casting:
1. The feeder should be thermally adequate
2. The feeder should be volumetrically adequate
3. The feeder should have adequate feeding range
Which of the above statements are correct?
A. 1 and 2 only
B. 1 and 3 only
C. 2 and 3 only
D. 1, 2 and 3

56. Which of the following are the advantages of electrical discharge machining?
1. Fragile and slender workpieces can be machined
2. Fine holes can be easily drilled
3. Extremely hard workpieces can be machined
4. Sharp corners can be produced
A. 1, 2, 3 and 4
B. 1, 2 and 4 only
C. 3 and 4 only
D. 1, 2 and 3

57. Consider the following statements in the context of a CNC lathe machine:
1. The X axis controls the cross motion of the cutting tool
2. The Z axis controls the travel of the carriage towards or away from the headstock
3. The Y axis controls the motion of the job
4. The X-Y-Z axes are used for rotational movement of the table
Which of the above statements are correct?
A. 1 and 3 B. 1 and 2
C. 3 and 4 D. 2 and 3

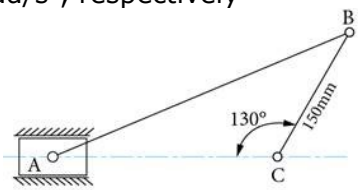
58. The difference between (i) a horizontal borer and (ii) a lathe is
A. In (i) the spindle is horizontal; in (ii) it is vertical
B. In (i) the tool rotates; in (ii) the object rotates
C. In (i) the object rotates; in (ii) tool rotates
D. (i) produces a plain surface; (ii) produces a cylindrical surface

59. Consider the following statements with respect to Laws of Robotics:
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm
2. A robot must obey orders to it by human beings, except where such orders would conflict with the above first law
3. A robot may or may not obey any order given to it by human beings
Which of the above statements are correct?
A. 1, 2 and 3
B. 1 and 3 only
C. 1 and 2 only
D. 2 and 3 only

60. **Statement (I):** A cold bend part has no spring back because deformation is plastic.
Statement (II): In cold bending, parts are normally over-bent slightly.
A. Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
B. Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I)
C. Statement (I) is true but Statement (II) is false
D. Statement (I) is false but Statement (II) is true

61. Electrode can be represented by following code
ER4321HjX
What does Digits represents in this code ?
A. Mechanical properties of electrode, Elongation, Welding Position and Welding Current & Voltage
B. Percentage of alloy, Elongation, Welding Position and Welding Current & Voltage
C. Percentage of alloy, Elongation, Welding type and Welding Current & Voltage
D. Mechanical properties of electrode, Elongation, Welding Position and welding power

62. For the given engine mechanism, calculate tangential acceleration of crank BC if crank rotates with an angular velocity and angular acceleration of 80 rad/sec and 1000 rad/s^2, respectively



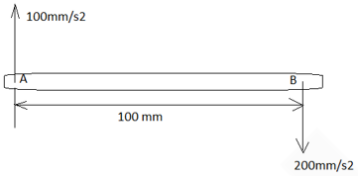
A. 75 m/s^2 B. 12 m/s^2
C. 150 m/s^2 D. 24 m/s^2

63. For two 20 ° spur gears in mesh, the pitch circle radii are 51.5 mm and 64.2 mm respectively. The outer circle radii are 57.5 mm and 71.2 mm respectively. If the larger gear has 20 teeth, what will be the contact ratio?
A. 1.32 B. 1.54
C. 1.83 D. 2.3

64. For a certain engine having an average speed of 1200 rpm, a flywheel approximated as a solid disc, is required for keeping the fluctuation of speed within 2% about the average speed. The fluctuation of kinetic energy per cycle is found to be 2kJ. What is the least possible mass of the flywheel if its diameter is not exceed 1m?
A. 40 kg B. 51 kg
C. 62 kg D. 73 kg

65. For a watt governor, calculate the percentage change in speed where θ decreases from 50 to 40. Take h = 350 cosθ
A. 8.4% B. 10.74 %
C. 21.8 % D. 27.94 %

66. A rigid body is undergoing a planar motion as shown in the figure below. The absolute tangential acceleration at the point A and B are 100mm/s2 and 200mm/s2 respectively in the shown direction. Find the angular velocity of the rigid link



A. 3 rad/s B. 1 rad/s
C. 6 rad/s D. 2 rad/s

67. The magnitude of the gyroscopic moment is needed to be found for a XUV all wheel drive . A XUV moves over a curved horizontal road of radius 100 m with a speed of 20 m/s. When viewed from the front of the XUV, the rotating masses of the engine have an angular speed of 100 rad/s in clockwise direction. The combined moment of inertia of the rotating masses is 10 kg-m^2.
A. 200 N-m B. 0.2 N-m
C. 200kN-m D. 0.1 N-m

68. A precision instrument package (m = 1 kg) needs to be mounted on a surface vibrating at 60 Hz. It is desired that only 5% of the base surface vibration amplitude be transmitted to the instrument. Assume that the isolation is designed with its natural frequency sig lesser than 60 Hz, so that the effect of damping may be ignored. The stiffness (in N/m) of the required mounting pad is
A. 6767.72 B. 6567.83
C. 6734.76 D. 7634.82

69. In a cooling tower, the DBT and WBT of air is 23°C and 28°C respectively while the temperature of water at inlet and outlet states is 32°C and 24°C repectively. The approach and range (in °C) in cooling tower respectively is
A. 1, 4 B. 8, 5
C. 1, 8 D. 5, 8

70. Long cylindrical aluminum rods (ρ = 2700 kg/m3 and Cp = 0.973 kJ/kg-K) of 5 cm diameter are heat treated from 20 °C to an average temperature of 400 °C by drawing them at a velocity of 10 m/min through a long oven. The rate of heat transfer (in kJ/s) to the rods in the oven is
A. 19596.22 B. 326.6
C. 53 D. 426.7

71. During steady flow compression process of a gas with mass flow rate of 2 kg/s, increase in specific enthalpy is 15 kJ/kg and decrease in K.E. is 2 kJ/kg. The rate of heat rejection to the environment is 5 kW. The power (in kW) needed to drive the compressor is
A. 31 B. 39
C. 34 D. 21

72. Entropy of a substance is highest in_____ phase and lowest in___ phase.
A. Liquid, solid B. Gas, solid
C. solid, gas D. liquid, gas

73. A positive value of Joule-Thomson coefficient of a fluid means
A. temperature drops during throttling
B. temperature remains constant during throttling
C. temperature rises during throttling
D. none of these

74. If M_1, M_2, M_3 be molecular weight of constituent gases and x_1, x_2, x_3 be their corresponding mass fractions, then the equivalent molecular weight (M_e) of mixture is

A. $M_1 x_1 + M_2 x_2 + M_3 x_3$

B. $\frac{1}{M1x1} + \frac{1}{M2x2} + \frac{1}{M3x3}$

C. $\frac{1}{M1x1 + M2x2 + M3x3}$

D. $M_1^2 x_1 + M_2^2 x_2 + M_3^2 x_3$

75. A vapour compression refrigerator system operating at an evaporator temperature of −5 °C and condenser temperature of 40 °C with mass flow rate of refrigerant is 21.0 kg/min. The refrigerant, R-12 is subcooled 5 °C before entering the expansion valve and vapour is superheated 6 ° C in evaporator coil. If the clearance is 2% then the piston displacement volume (in m^3/min) is

Properties of R-12

t^0C	p bar	V_g M^3/kg	h_f KJ/kg	h_g KJ/kg	s_f kJ/kgK	s_g kJ/gK
-5°C	2.6117	0.06531	195.33	350.22	0.98289	1.5605
+40°C	9.5944	0.01836	239.29	369.67	1.1324	1.5456

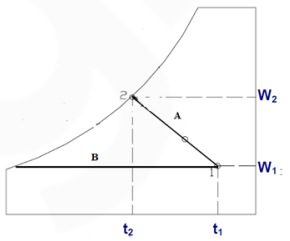
C_p (liquid)=0.963kJ/kgK

C_p (vapour)=0.7035kJ/kgK

A. 1.475 B. 2.580

C. 8.450 D. 1.075

76. For the Psychrometric chart shown in given figure, In case A air is adiabatically saturated and in case B air is isobarically saturated then saturation temperature in case of A and B are



A. DBT and WBT

B. DPT and WBT

C. WBT and DPT

D. WBT and DBT

77. In a Bell Coleman cycle refrigeration plant, compression and expansion of air are isentropic. If the temperature of air entering and leaving the expander are 500K and 250K, the COP of the plant is

A. 1.5 B. 1.2

C. 1 D. 2

78. Determine the minimum number of stage require in a air compressor in which air enters at a pressure of 1 bar and temperature at 27 ^{0}C and delivers at 81 bar. The maximum discharge temperature is limited to 100.72 ^{0}C and consider the index of polytropic compressor is 1.25 assuring perfect and optimum intercooling between stages

A. 1 B. 2

C. 3 D. 4

79. A close cycle of gas turbine plant operating on Brayton cycle between 27 °C and 927 °C with a pressure ratio of 5 and air-fuel ratio is 60. Compressor efficiency is 80% and combustion loss is 10% of heating value. What will be the calorific value (in kJ/kg) of fuel? [Take Cp = 1.005 kJ/kgK]

A. 45175 B. 44175

C. 43170 D. 48180

80. Calculate the efficiency of engine for an engine working on air-standard Otto cycle has a clearance volume, 10% of swept volume.

A. 55.4% B. 61.6%

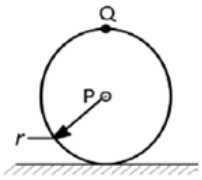
C. 39% D. 49.9%

81. The mechanical efficiency of a single-cylinder 4-stroke engine is 85%. The frictional power is estimated to be 28 kW. Calculate the Brake power (bp) developed by the engine.

A. 140 kW B. 168 kW

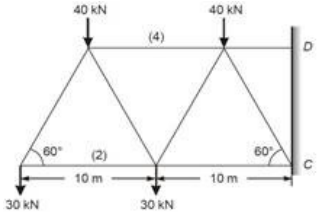
C. 112 kW D. 158.67 kW

82. A wheel of radius r rolls without slipping on a horizontal surface shown below. If the velocity of point P is 10 m/s in the horizontal direction, the magnitude of velocity of point Q (in m/s) is _____.



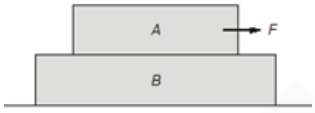
A. 10 m/s B. 15 m/s
C. 20 m/s D. 5 m/s

83. For the truss shown below, the ratio of magnitudes of forces in member 4 to member 2 will be



A. 1.22 B. 2.44
C. 3.33 D. 4.33

84. A block of mass 10 kg rests on a second block B of mass 8 kg.A force F equal to 100 N pulls block A. The coefficient of friction between A and B is 0.5, between B and ground, is 0.1. The speed of block A relative to Block B in 0.1 s if system starts from rest is _____ m/s.

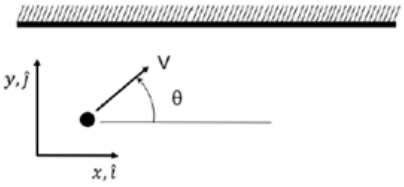


A. 0.09 B. 0.12
C. 0.17 D. 0.23

85. A block weighing 200 N is in contact with a level plane whose coefficients of static and kinetic friction are 0.4 and 0.2, respectively. The block is acted upon by a horizontal force (in newton) P=10t, where t denotes the time in seconds. The velocity (in m/s) of the block attained after 10 seconds is_____

A. 5 B. 6
C. 8 D. 3

86. A point mass having mass M is moving with a velocity V at an angle θ to the wall as shown in the figure. The mass undergoes a perfectly elastic collision with the smooth wall and rebounds. The total change (final minus initial) in the momentum of the mass is



A. $-2\,MV\cos\theta\,\hat{}$

B. $2\,MV\sin\theta\,\hat{}$

C. $2\,MV\cos\theta\,\hat{}$

D. $-2\,MV\sin\theta\,\hat{}$

87. Consider the matrix $A=\begin{bmatrix}2 & -1 & 1\\ -1 & 2 & -1\\ 1 & -1 & 2\end{bmatrix}$. The sum of its eigen values is _____.

A. 2 B. 4
C. 6 D. 0

88. One of the eigen vectors of the matrix $A=\begin{bmatrix}2 & 2\\ 1 & 3\end{bmatrix}$ is

A. $\begin{Bmatrix}2\\ -1\end{Bmatrix}$ B. $\begin{Bmatrix}2\\ 1\end{Bmatrix}$

C. $\begin{Bmatrix}4\\ 1\end{Bmatrix}$ D. $\begin{Bmatrix}1\\ -1\end{Bmatrix}$

89. $f(x) = x$, $g(x) = \frac{1}{x}$; by using Cauchy mean value theorem mean value for the function in [a,b] will be

A. $\sqrt{ab}$ B. $\frac{ab}{2}$

C. $\frac{a+b}{2}$ D. $\frac{2ab}{a+b}$

90. The area enclosed between the curves $y^2 = 4x$ and $x^2 = 4y$ is

A. 16/3 B. 8
C. 32/3 D. 16

91. If $x^2\frac{dy}{dx}+2xy=\frac{2\ln x}{x}$, and $y(1)= 0$, then what is $y(e)$?

A. e B. 1

C. $\frac{1}{e}$ D. $\frac{1}{e^2}$

92. f(z) = u(x, y) + iv(x, y) is an analytic function of complex variable z = x + iy where i = $\sqrt{-1}$. If u(x, y) = 2 xy, then v(x, y) may be expressed as
A. $-x^2+y^2+$constant
B. x^2-y^2 + constant
C. x^2+y^2 + constant
D. $-(x^2+y^2)$ + constant

93. Which of the following functions would have only odd powers of x in its Taylor series expansion about the point x = 0?
A. sin (x^3) B. sin(x^2)
C. cos (x^3) D. cos (x^2)

94. An unbiased coin is tossed five times. The outcome of each toss is either a head or a tail. The probability of getting at least one head is
A. 1/32 B. 13/32
C. 16/32 D. 31/32

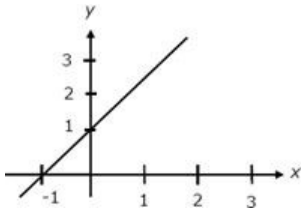
95. The standard deviation of a uniformly distributed random variable between 0 and 1 is
A. $\frac{1}{\sqrt{12}}$ B. $\frac{1}{\sqrt{3}}$
C. $\frac{5}{\sqrt{12}}$ D. $\frac{7}{\sqrt{12}}$

96. The integral $\int_1^3 \frac{1}{x}dx$, when evaluated by using Simpson's 1/3 rule on two equal subintervals each of length 1, equals
A. 1.000 B. 1.098
C. 1.111 D. 1.120

97. Consider an ordinary differential equation $\frac{dx}{dt}=4t+4$. If x = x_0 at t = 0, the increment in x calculated using Runge-Kutta fourth order multi-step method with a step size of Δt = 0.2 is
A. 0.22 B. 0.44
C. 0.66 D. 0.88

98. If a Fourier series is given by
$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}a_n\cos nx+\sum_{n=1}^{\infty}b_n\sin nx$
where a_0, a_n, and b_n are constant. Then the value of b_3 for the function given below will be
$$f(x)=\begin{cases}-1 & \text{for } -\pi<x<-\frac{\pi}{2}\\ 0 & \text{for } -\frac{\pi}{2}<x<\frac{\pi}{2}\\ 1 & \text{for } \frac{\pi}{2}<x<\pi\end{cases}$$
A. 0
B. $\frac{2}{\pi}$
C. $-\frac{2}{3\pi}$
D. $\frac{2}{3\pi}$

99. The following plot shows a function y which varies linearly with x. The value of the integral $I=\int_1^2 ydx$ is



A. 1.0 B. 2.5
C. 4.0 D. 5.0

100. The surface integral $\int\int_S F\cdot ndS$ over the surface S of the sphere x^2 + y^2 + z^2 = 9, where F = (x + y)I + (x + z)j +(y + z) k and n is the unit outward surface normal, yields ___.
A. 219.18 B. 223.17
C. 226.20 D. 229.34

ANSWER KEY

1. Ans. C.	26. Ans. A.	51. Ans. D.	76. Ans. C.
2. Ans. C.	27. Ans. C.	52. Ans. C.	77. Ans. C.
3. Ans. C.	28. Ans. B.	53. Ans. A.	78. Ans. D.
4. Ans. B.	29. Ans. B.	54. Ans. C.	79. Ans. A.
5. Ans. C.	30. Ans. D.	55. Ans. D.	80. Ans. B.
6. Ans. A.	31. Ans. A.	56. Ans. D.	81. Ans. D.
7. Ans. A.	32. Ans. D.	57. Ans. B.	82. Ans. C.
8. Ans. C.	33. Ans. B.	58. Ans. B.	83. Ans. C.
9. Ans. D.	34. Ans. D.	59. Ans. C.	84. Ans. B.
10. Ans. B.	35. Ans. C.	60. Ans. D.	85. Ans. A.
11. Ans. A.	36. Ans. D.	61. Ans. A.	86. Ans. D.
12. Ans. C.	37. Ans. A.	62. Ans. C.	87. Ans. C.
13. Ans. A.	38. Ans. D.	63. Ans. B.	88. Ans. A.
14. Ans. A.	39. Ans. A.	64. Ans. B.	89. Ans. A.
15. Ans. D.	40. Ans. C.	65. Ans. A.	90. Ans. A.
16. Ans. C.	41. Ans. C.	66. Ans. A.	91. Ans. D.
17. Ans. A.	42. Ans. C.	67. Ans. A.	92. Ans. A.
18. Ans. C.	43. Ans. B.	68. Ans. A.	93. Ans. A.
19. Ans. C.	44. Ans. A.	69. Ans. C.	94. Ans. D.
20. Ans. A.	45. Ans. B.	70. Ans. B.	95. Ans. A.
21. Ans. D.	46. Ans. C.	71. Ans. A.	96. Ans. C.
22. Ans. A.	47. Ans. A.	72. Ans. B.	97. Ans. D.
23. Ans. A.	48. Ans. B.	73. Ans. A.	98. Ans. D.
24. Ans. C.	49. Ans. C.	74. Ans. A.	99. Ans. B.
25. Ans. C.	50. Ans. C.	75. Ans. A.	100. Ans. C.

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