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SECTION 1-MECHANICAL

1 During the execution of a CNC part program block NO20 GO2 X45.0 Y25.0 R5.0 the type of tool motion will be

A) circular Interpolation — clockwise

B) circular Interpolation — counterclockwise

C) linear Interpolation

D) rapid feed

Answer : (A)

2 A component can be produced by any of the four processes I, II, III and IV. Process I has a fixed cost ofRs. 20 and variable cost of Rs. 3 per piece. Process II has a fixed cost Rs. 50 and variable cost of Re. 1 per piece. Process III has a fixed cost of Rs. 40 and variable cost of Rs. 2 per piece. Process IV has a fixed cost of Rs. 10 and variable cost of Rs. 4 per piece. If the company wishes to produce 100 pieces of the component, from economic point of view it should choose

A) Process I

B) Process II

C) Process III

D) Process IV

Answer : (B)

3 In an interchangeable assembly, shafts of size 25.000+0.040mm mate with holes of size 25.000+0.020 mm. The maximum possible clearance in the assembly will be

A) 10 microns

B) 20 microns

C) 30 microns

D) 60 microns

Answer : (D)

4 A company has two factories S1, S2 and two warehouses D1, D2. The supplies from S1 and S2 are 50 and 40 units respectively. Warehouse D1 requires a minimum of 20 units and a maximum of 40 units. Warehouse D2 requires a minimum of 20 units and, over and above, it can take as much as can be supplied. A balanced transportation problem is to be formulated for the above situation. The number of supply points, the

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number of demand points, and the total supply (or total demand) in the balanced transportation problem respectively are

A) 2, 4, 90

B) 2, 4, 110

C) 3, 4, 90

D) 3, 4, 110

Answer : (C)

5 An incompressible fluid (kinematic viscosity, 7.4 x 10-7 m2/s, specific gravity, 0.88) is held between two parallel plates. If the top plate is moved with a velocity of 0.5 m/s while the bottom one is held stationary, the fluid attains a linear velocity profile in the gap of 0.5 mm between these plates; the shear stress in Pascals on the surface of top plate is

A) 0.651 x 10-3

B) 0.651

C) 6.51

D) 0.651 x 103

Answer : (B)

6 The tool of an NC machine has to move along a circular arc from (5,5) to (10,10) while performing an operation. The centre of the arc is at (10,5). Which one of the following NC tool path commands performs the above mentioned operation?

A) N010 G02 X10 Y10 X5 Y5 R5

B) N010 G03 X10 Y10 X5 Y5 R5

C) N010 G01 X5 Y5 X10 Y10 R5

D) N010 G02 X5 Y5 X10 Y10 R5

Answer : (D)

7 During a Morse test on a 4 cylinder engine, the following measurements of brake power were taken at constant speed.

All cylinders firing 3037 kW

Number 1 cylinder not firing 2102 kW

Number 2 cylinder not firing 2102 kW

Number 3 cylinder not firing 2100 kW

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Number 4 cylinder not firing 2098 kW

The mechanical efficiency of the engine is

A) 91.53%

B) 85.07%

C) 81.07%

D) 61.22%

Answer : (C)

8 In terms of theoretical stress concentration factor (Kt) and fatigue stress concentration factor (Kf), the notch sensitivity 'q' is expressed as

A) (Kf -1) (Kt -1)

B) (Kf -1) (Kt +1)

C) (Kt -1) (Kf -1)

D) (Kf +1) (Kt +1)

Answer : (A)

9 Starting from x0 = 1, one step of Newton-Raphson method in solving the equation x3 + 3x -7 = 0 gives the next value (x1) as

A) x1 = 0.5

B) x1= 1.406

C) x1= 1.5

D) x1 = 2

Answer : (C)

10 The S-N curve for steel becomes asymptotic nearly at

A) 103 cycles

B) 104 cycles

C) 10 6 cycles

D) 10 9 cycles

Answer : (C)

11. In PERT analysis a critical activity has

A) maximum Float

B) zero Float

C) maximum Cost

D) minimum Cost

Answer : (B)

12 Environment friendly refrigerant R134a is used inthe new generation domestic refrigerators. Itschemical formula is

A) CH C1 F2

B) C2 C13 F3

C) C2 C12 F4

D) C2 H2 F4

Answer : (D)

13 A solid cylinder (surface 2) is located at the centreof a hollow sphere (surface 1). The diameter of the sphere is 1m, while the cylinder has a diameter and length of 0.5 m each. The radiation configuration factor F11 is

A) 0.375

B) 0.625

C) 0.75

D) 1

Answer : (C)

14 For a fluid flow through a divergent pipe of length L having inlet and outlet radii of R1 and R2 respectively and a constant flow rate of Q, assuming the velocity to be axial and uniform at any cross-section, the acceleration at the exit is

A) 2Q(R1 - R2) p LR23

B) 2Q2 (R1 - R2) p LR23

C) 2Q2 (R1 - R2) p2LR25

D) 2Q2 (R2 - R1) p2LR25

Answer : (C)

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B) 0.651

C) 6.51

D) 0.651 x 103

Answer : (B)

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Answer : (D)

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B) (Kf -1) (Kt +1)

C) (Kt -1) (Kf -1)

D) (Kf +1) (Kt +1)

Answer : (A)

19 Starting from x0 = 1, one step of Newton-Raphson method in solving the equation x3 + 3x -7 = 0 gives the next value (x1) as

A) x1 = 0.5

B) x1= 1.406

C) x1= 1.5

D) x1 = 2

Answer : (C)

20 A maintenance service facility has Poisson arrival rates, negative exponential service time and operates on a 'first come first served' queue discipline. Break downs occur on an average of 3 per day with a range of zero to eight. The maintenance crew can service an average of 6 machines per day with a range of zero to seven. The mean waiting time for an item to be serviced would be

A) 16 day

B) 13 day

C) 1 day

D) 3 days

Answer : (A)

21 The S-N curve for steel becomes asymptotic nearly at

A) 103 cycles

B) 104 cycles

C) 106 cycles

D) 109 cycles

Answer : (C)

22 In a rolling process, sheet of 25 mm thickness is rolled to 20 mm thickness. Roll is of diameter 600 mm and it rotates at 100 rpm. The roll strip contact length will be

A) 5 mm

B) 39 mm

C) 78mm

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D) 120mm

Answer : (A)

23 Water at 42°C is sprayed into a stream of air at atmospheric pressure, dry bulb temperature of 40°C and a wet bulb temperature of 20°C. The air leaving the spray humidifier is not saturated. Which of the following statements is true?

A) Air gets cooled and humidified

B) Air gets heated and humidified

C) Air gets heated and dehumidified

D) Air gets cooled and dehumidified

Answer : (B)

24 The angle between two unit-magnitude coplanar vectors P(0.866, 0.500,0) and Q(0.259, 0.966,0) will be

A) 0°

B) -30°

C) 45°

D) 60°

Answer : (C)

25 A lot has 10% defective items. Ten items are chosen randomly from this lot. The probability that exactly 2 of the chosen items are defective is

A) 0.0036

B) 0.1937

C) 0.2234

D) 0.3874

Answer : (B)

26 Stokes theorem connects

A) a line integral and a surface integral

B) a surface integral and a volume integral

C) a line integral and a volume integral

D) gradient of a function and its surface integral

Answer : (A)

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27 A solar collector receiving solar radiation at the rate of 0.6 k W/m2 transforms it to the internal energy of a fluid at an overall efficiency of 50%. The fluid heated to 350 K is used to run a heat engine which rejects heat at 313 K. If the heat engine is to deliver 2.5 kW power, the minimum area of the solar collector required would be

A) 8.33m2

B) 16.66m2

C) 39.68m2

D) 79.36m2

Answer : (D)

28 When the temperature of a solid metal increases,

A) strength of the metal decreaes but ductility increases

B) both strength and ductility of the metal decrease

C) both strength and ductility of the metal increase

D) strength of the metal increases but ductility decreases

Answer : (A)

29 A company produces two types of toys: P and Q. Production time of Q is twice that of P and the company has a maximum of 2000 time units per day. The supply of raw material is just sufficient to produce 1500 toys (of any type) per day. Toy type Q requires an electric switch which is available @ 600 pieces per day only. The company makes a profit of Rs. 3 and Rs. 5 on type P and Q respectively. For maximization of profits, the daily production quantities of P and Q toys should respectively be

A) 100, 500

B) 500, 1000

C) 800, 600

D) 1000, 1000

Answer : (C)

30 A spherical thermocouple junction of diameter 0.706 mm is to be used for the measurement Aof temperature of a gas stream. The convective heat transfer co-efficient on the bead surface is 400 W/m2K. Thermophysical properties of thermocouple material are k = 20 W/mK, C = 400 J/kg K and r = 8500 kg/m3. If the

thermocouple initially tot 30°C is placed in a hot stream of 300°C, the time taken by the bead to reach 298°C, is

A) 2.35 s

B) 4.9 s

C) 14.7 s

D) 29.4 s

Answer : (B)

31 In a spring-mass system, the mass is 0.1 kg and the stiffness of the spring is 1 kN/m. By introducing a damper, the frequency of oscillation is found to be 90% of the original value. What is the damping coefficient of the damper?

A) 1.2 N.s/m

B) 3.4 N.s/m

C) 8.7 N.s/m

D) 12.0 N.s/m

Answer : (C)

32.In a machining operation, doubling the cutting speed reduces the tool life to 1/8 of the original value. The exponent n in Taylor

A) 1/8

B) 1/4

C) 1/3

D) 1/2

Answer : (C)

33.In a rolling process, sheet of 25 mm thickness is rolled to 20 mm thickness. Roll is of diameter 600 mm and it rotates at 100 rpm. The roll strip contact length will be

A) 5 mm

B) 39 mm

C) 78 mm

D) 120 mm

Answer : (A)

34.A soldering operation was work-sampled over two days (16 hours) during which an employee soldered 108 joints. Actual working time was 90% of the total time and the

performance rating was estimated to be 120 percent. If the contract provides allowance of 20 percent of the total time available, the standard time for the operation would be

A) 8 min

B) 8.9 min

C) 10 min

D) 12 min

Answer : (D)

35. A welding operation is time-studied during which an operator was pace-rated as 120%. The operator took, on an average, 8 minutes for producing the weld-joint. If a total of 10% allowances are allowed for this operation, the expected standard production rate of the weld-joint (in units per 8 hour day) is

A) 45

B) 50

C) 55

D) 60

Answer : (A)

36. In PERT analysis a critical activity has

A) maximum Float

B) zero Float

C) maximum Cost

D) minimum Cost

Answer : (B)

37.Environment friendly refrigerant R134a is used in the new generation domestic refrigerators. Its chemical formula is

A) CH C1 F2

B) C2 C13 F3

C) C2 C12 F4

D) C2 H2 F4

Answer : (D)

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38. The parabolic arc y = x, 1 = x = 2 is revolved around the x-axis. The volume of the solid of revolution is

(A)4 p (B) 2 p   (C) 3 4 p   (D) 3 2

39. A moist air sample has dry bulb temperature of 30ºC and specific humidity of 11.5g water vapour per kg dry air. Assume molecular weight of air as 28.93. If

the saturation vapour pressure of water at 30ºC is 4.24kPa and the total pressure is 90kPa, then the relative humidity (in %) of air sample is

(A) 50.5 (B) 38.5 (C) 56.5 (D) 68.5

40. The value of the integral 2 dx 1 x 8 -8 + ? is

(A) -p (B) 2 p (C) 2 p (D) p

41. The modulus of the complex number 3 4i 1 2i ? + ? ? - ? ? ? is

(A) 5 (B) 5 (C)15(D)15

42. The function y = 2 - 3x

(A) is continuous ?x ? R and differentiable ?x ? R

(B) is continuous ?x ? R and differentiable ?x ? R except at x=3/2

(C) is continuous ?x ? R and differentiable ?x ? R except at x=2/3

(D) is continuous ?x ? R except at x=3 and differentiable ?x ? R

6. Mobility of a statically indeterminate structure is

(A) = -1 (B) 0 (C) 1 (D) = 2

43. There are two points P and Q on a planar rigid body. The relative velocity between the two points

(A) should always be along PQ

(B) Can be oriented along any direction

(C) should always be perpendicular to PQ

(D) should be along QP when the body undergoes pure translation

44. The state of plane-stress at a point is given by sx = -200MPa, sy = 100MPa and txy = 100MPa. The maximum shear stress in MPa is

(A) 111.8 (B) 150.1 (C) 180.3 (D) 223.6

45. Which of the following statements is INCORRECT?

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(A) Grashof's rule states that for a planar crank-rocker four bar mechanism, the sum of the shortest and longest link lengths cannot be less than the sum of the remaining two link lengths.

(B) Inversions of a mechanism are created by fixing different links one at a time.

(C) Geneva mechanism is an intermittent motion device

(D) Gruebler's criterion assumes mobility of a planar mechanism to be one.

46. The natural frequency of a spring-mass system on earth is ?n. The natural frequency of this system on the moon (gmoon = gearth / 6) is

(A) ?n (B)0.408?n (C) 0.204?n (D) 0.167?n

47. Tooth interference in an external involute spur gear pair can be reduced by

(A) decreasing center distance between gear pair

(B) decreasing module

(C) decreasing pressure angle

(D) increasing number of gear teeth

48. For the stability of a floating body, under the influence of gravity alone, which of the following is TRUE?

(A) Metacentre should be below centre of gravity

(B) Metacentre should be above centre of gravity

(C) Metacentre and centre of gravity must lie on the same horizontal line

(D) Metacentre and centre of gravity must lie on the same vertical line

49. The maximum velocity of a one-dimensional incompressible fully developed viscous flow, between two fixed parallel plates, is 6ms-1. The mean velocity (in ms-1) of the flow is

(A) 2 (B) 3 (C) 4 (D) 5

50. A phenomenon is modeled using n dimensional variables with k primary dimensions. The number of non-dimensional variables is

(A) k (B) n (C) n-k (D) n+k

51. A turbo-charged four-stroke direct injection diesel engine has a displacement volume of 0.0259m3 (25.9litres) . The engine has an output of 950kW at 2200rpm. The mean effective pressure in MPa is closest to

(A) 2 (B) 1 (C) 0.2 (D) 0.1

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52. One kilogram of water at room temperature is brought into contact with a high temperature thermal reservoir. The entropy change of the universe is

(A) equal to entropy change of the reservoir

(B) equal to entropy change of water

(C) equal to zero

(D) always positive

53. A hydraulic turbine develops 1000kW power for a head of 40m. If the head is reduced to 20m, the power developed (in kW) is

(A)   177 (B) 354 (C) 500 (D) 707

54. The material property which depends only on the basic crystal structure is

(A) fatigue strength (B) work hardening (C) fracture strength (D) elastic constant

55. In a gating system, the ratio 1:2:4 represents

(A) sprue base area: runner area: ingate area

(B) pouring basin area: ingate area: runner area

(C) sprue base area: ingate area: casting area

(D) runner area: ingate area: casting area

56. A shaft has a dimension, 0.009 .025 -- f . The respective values of fundamental deviation and tolerance are

(A) -0.025, ± 0.008 (B) -0.025,0.016

(C) -0.009, ±0.008 (D) -0.009,0.016

57. In a CNC program block, N002 G02 G91 X40 Z40…, G02 AND G91 refer to

(A) circular interpolation in counterclockwise direction and incremental dimension

(B) circular interpolation in counterclockwise direction and absolute dimension

(C) circular interpolation in clockwise direction and incremental dimension

(D) circular interpolation in clockwise direction and absolute dimension

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58. The demand and forecast for February are 12000 and 10275, respectively. Using single exponential smoothening method (smoothening coefficient = 0.25), forecast for the month of March is

(A) 431 (B) 9587 (C) 10706 (D) 11000

59. Little's law is relationship between

(A) stock level and lead time in an inventory system

(B) waiting time and length of the queue in a queuing system

(C) number of machines and job due dates in a scheduling problem

(D) uncertainty in the activity time and project completion time

60. Vehicle manufacturing assembly line is an example of

(A) product layout (B) process layout (C) manual layout (D) fixed layout

61. Simplex method of solving linear programming problem uses

(A) all the points in the feasible region

(B) only the corner points of the feasible region

(C) intermediate points within the infeasible region

(D) only the interior points in the feasible region.

62. Torque exerted on a flywheel over a cycle is listed in the table. Flywheel energy (in J per unit cycle) using Simpson's rule is Angle (degree) 0 60 120 180 240 300 360Torque (Nm) 0 1066 -323 0 323 -355 0

(A)   542 (B) 993 (C) 1444 (D) 1986

63. A lightly loaded full journal bearing has a journal of 50mm, bush bore of 50.05mm and bush length of 20mm. if rotational speed of journal is 1200rpmand average viscosity of liquid lubricant is 0.03 Pa s, the power loss (in W) will be

(A) 37 (B) 74 (C) 118 (D) 23