ISRO

Previous Year Paper
Scientist ME 2017 (I)

	INDIAN SPACE RESEARCH ORGANISATION	SET A
इसरो isro	Recruitment Entrance Test for Scientist/ Engineer 'SC' 2017	

1. A beam is fixed at one end and is vertically supported at the other end. What is the degree of statical indeterminacy?
   (a) 1   (b) 2   (c) 3   (d) 4

2. In a gas turbine power plant, reheating of gases between high pressure and low pressure turbine stages will
   (a) Improve turbine output   (b) Decrease turbine output
   (c) Increase compressor work   (d) Decrease compressor work

3. The resultant of two forces acting at 60° is 7 N and when acting at right angles is $\sqrt{34}$ N. The forces are
   (a) 25 N and 9 N   (b) 3 N and $\sqrt{5}$ N
   (c) 3 N and 5 N   (d) $\sqrt{3}$ N and $\sqrt{5}$ N

4. The metal removal rate in abrasive jet machining process is
   (a) high   (b) very high   (c) low   (d) very low

5. The air inside a space capsule is maintained at the required condition by passing it through a set of heat exchangers. The heat exchangers are designed such that the humid air passing through them is cooled and partial condensation of the water vapour occurs. On a psychrometric chart, this process appears as a line which is
   (a) Horizontal to the left   (b) Vertical downwards
   (c) Diagonal downwards to the left   (d) Diagonal upwards to the right

6. Two bolts A and B of same material and length are subjected to identical tensile load. If the elastic strain energy stored in bolt A is 16 times that of the bolt B and the mean diameter of bolt A is 13 mm, the mean diameter of bolt B (in mm) is
   (a) 52   (b) 36   (c) 24   (d) 16

7. The source of energy in ultrasonic machining process is
   (a) Mechanical   (b) Electrical   (c) Electric spark   (d) None of these

8. A turbine develops 500 kW power under a head of 100 m at 200 rpm. What would be its normal speed under a head of 81 m?
   (a) 100 rpm   (b) 180 rpm   (c) 1800 rpm   (d) 162 rpm

9. A solid rod of 12 mm diameter was tested for tensile strength with the gauge length of 50 mm. Final length = 80 mm; Final diameter = 4 mm; Yield load = 1130 N. What is the nearest yield stress and % reduction in area respectively?
   (a) 10 MPa and 10%
   (b) 90 MPa and 90%
   (c) 10 MPa and 90%
   (d) 90 MPa and 10%

10. When water at 0°C is heated, its specific volume under standard atmosphere
    (a) First increases then decreases
    (b) First decreases then increases
    (c) Increases steadily
    (d) Decreases steadily

11. A spherical joint has ————— degree (s) of freedom.
    (a) One
    (b) Two
    (c) Three
    (d) Four

12. Isometric projection of a sphere is
    (a) Circle
    (b) Ellipse
    (c) Hyperbola
    (d) Parabola

13. ABC inventory control focuses on those
    (a) Items not readily available
    (b) Items which consume less money
    (c) Items which have more demand
    (d) Items which consume more money

14. How does the viscosity of fluids vary with increase in temperature?
    (a) Increases for both liquids and gases
    (b) Increases for liquids, decreases for gases
    (c) Increases for gases, decreases for liquids
    (d) Decreases for both liquids and gases

15. It is required to connect two parallel shafts, the distance between whose axes is small and variable. They can be coupled by
    (a) Universal joint
    (b) Knuckle joint
    (c) Sleeve coupling
    (d) Oldham coupling

16. Under what condition does flow separation take place?
    (a) When dp/dx > 0
    (b) When dp/dx < 0
    (c) When dp/dx = 0
    (d) Not a function of dp/dx

17. The variety of cast iron which has maximum hardness is
    (a)   Gray iron
    (b)   Malleable iron
    (c)   Ductile iron
    (d)   White iron

18. The Kutzback criterion for determining the number of degrees of freedom (n) of a mechanism with L as number of links, J as number of lower pairs and H as number of higher pairs is
    (a) $3(J-1) - 2L - H$
    (b) $2(L-1) - 2J - H$
    (c) $3(L-1) - 2J - H$
    (d) $2(L-1) - 3J - H$

19. The crystal structure of cementite is
    (a)   FCC
    (b)   BCC
    (c)   Tetragonal
    (d)   Orthorhombic

20. Hardness will be highest after which of the following heat treatment process?
    (a)   Furnace cooling
    (b)   Air cooling
    (c)   Oil quenching
    (d)   Water quenching

21. In which of the following type of gear train, the first gear and last gear are co-axial.
    (a)   Compound gear train
    (b)   Simple gear train
    (c)   Reverted gear train
    (d)   None of these

22. For heat transfer across a composite slab with materials having different thermal conductivity, study the following statements.
    I.   Temperature is continuous always.
    II.   Temperature gradient is not continuous.
    III. Heat flow is not continuous.

    (a)   Statement I alone is correct
    (b)   Statement I and II are correct
    (c)   Statement II alone is correct
    (d)   All the statements are correct

23. Which of the following treatment does not improve hardness?
    (a) Quenching
    (b) Cyaniding
    (c) Normalising
    (d) Annealing

24. The ratio of the height of a porter governor (when the length of arms and links are equal) to the height of watt governor is: (m: mass of the ball; M: mass of the sleeve)
    (a) $\dfrac{m}{m + M}$
    (b) $\dfrac{M}{m + M}$
    (c) $\dfrac{m + M}{m}$
    (d) $\dfrac{m + M}{M}$

25. For a specified inlet and outlet temperatures, for which kind of heat exchanger will the log mean temperature difference, ΔT_{lm} will be highest?
    (a) Double pipe parallel flow heat exchanger
    (b) Double pipe counter flow heat exchanger
    (c) Cross flow heat exchanger
    (d) Multi pass shell and tube heat exchanger

26. Fatigue strength for non-ferrous materials is usually defined at ——————— stress cycles.
    (a) 10^4 (b) 10^7 (c) 10^9 (d) 10^{12}

27. If $A = \begin{pmatrix} 9 & 6 \\ 8 & 7 \end{pmatrix}$ then det $\left(A^{99} - A^{98}\right)$ is
    (a) 1   (b) 48   (c) 0   (d) 2^{99}

28. $\underset{\theta \to \pi/2}{Lim} \dfrac{\log(\theta - \pi/2)}{\tan \theta}$ is
    (a) 1   (b) $\pi/2$ (c) $\pi/4$ (d) 0

29. The solution of ODE $y\,dx + x\,dy = 0$ is
    (a) $y = \dfrac{k}{x}$ (b) $y = \dfrac{k}{y - x}$ (c) $y = \dfrac{x}{y}$ (d) $y = e^{kx}$

30. If φ is a scalar point function, the value of curl Grad φ is
    (a) 0   (b) 1   (c) 2   (d) 3

31. The point where the plane $x + 3y + 2z - 6 = 0$ meets the line joining $P\,(2, 1, 1)$ and $Q\,(1, 3, -2)$ is,
    (a) $(2, 1, 1)$ (b) $(1, 1, 1)$ (c) $(1, 3, -2)$ (d) $(-1, 3, 2)$

32. $\displaystyle\int_{0}^{\pi/2} \sin^7 x \; dx$ is
    (a) $\dfrac{8}{35}$ (b) $\dfrac{16}{35}$ (c) 0   (d) 1

33. Laplace transform of $t \cos(at)$ is

(a) $\dfrac{s^2 + a^2}{(s^2 - a^2)^2}$
(b) $\dfrac{s}{(s^2 - a^2)^2}$
(c) $\dfrac{s^2 - a^2}{(s^2 + a^2)^2}$
(d) $\dfrac{s}{(s^2 + a^2)^2}$

34. If two vectors $\vec{a} = 3i + 4j - 7k$ and $\vec{b} = Pi - 6j + 3k$ are perpendicular, the value of P is

(a) 1
(b) 0
(c) 12
(d) 15

35. The arithmetic mean of 12 data point is 79. Later it was found that two data points were wrongly taken as 83 and 68 in place of 78 and 97. The actual mean is

(a) 79
(b) 75
(c) 81
(d) 77

36. How does cetane number varies with octane number in fuels in IC engines?

(a) No relation
(b) Directly proportional
(c) Inversely proportional
(d) Both are equal

37. The relationship of the shear angle $\phi = \dfrac{\pi}{4} - \beta + \dfrac{\alpha}{2}$ is as per ('α' is rake angle and 'β' is friction angle)

(a) Ernst-Merchant theory
(b) Merchant's theory
(c) Stabler theory
(d) Lee and Shaffer theory

38. For a plate with an elliptical hole subjected to tensile stress, σ as shown in the figure, the maximum tensile stress at point P is

(a) σ
(b) 2σ
(c) 3σ
(d) more than 3σ
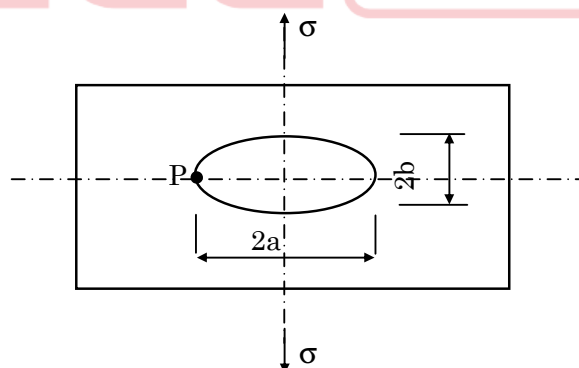
39. A centrifugal compressor is suitable for which of the following?

(a) High pressure ratio, low mass flow   (b) Low pressure ratio, low mass flow

(c) High pressure ratio, high mass flow   (d) Low pressure ratio, high mass flow

40. The optimum cutting speed for maximum production is ('n' is tool constant and 'Tc' is time required to change the tool)

(a) $$\dfrac{k}{\left[\left\{\dfrac{1}{n}+1\right\}Tc\right]^{\frac{n}{2}}}$$ (b) $$\dfrac{k}{\left[\left\{\dfrac{1}{n}-1\right\}Tc\right]^{n}}$$

(c) $$\dfrac{k}{\left[\left\{1-\dfrac{1}{n}\right\}Tc\right]^{2n}}$$ (d) $$\dfrac{k}{\left[\left\{\dfrac{1}{n}-1\right\}\dfrac{Tc}{2}\right]^{n}}$$

41. A rod of length L and area of cross section A has a modulus of elasticity E and coefficient of thermal expansion α. One end of the rod is fixed and other end is free. If the temperature of the rod is increased by ΔT, then

(a) Stress developed in the rod is $E\alpha\Delta T$ and strain developed in the rod is $\alpha\Delta T$

(b) Stress developed in the rod is zero and strain developed in the rod is $-\alpha\Delta T$

(c) Stress developed in the rod is zero and strain developed in the rod is $\alpha\Delta T$

(d) Stress developed in the rod is $E\alpha\Delta T$ and strain developed in the rod is zero

42. The entropy of a hot baked potato decreases as it cools.

(a) The above statement is correct

(b) The above statement is incorrect as it violates the increase in entropy principle

(c) Too less information to comment

(d) The above statement is incorrect as it violates second law of thermodynamics

43. During January, at a location in Rohtang, winds at –6°C can be observed. Several meters below the ground, the temperature remains at 27°C. A scientist claims to have devised a power cycle exploiting this situation that has a thermal efficiency of 10%. Whether the claim is true?
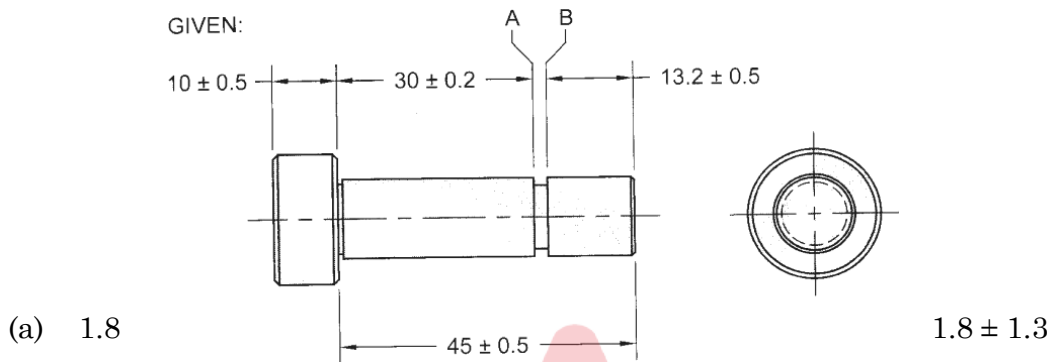
(a) True   (b) False   (c) Can't say   (d) Insufficient data

44. The side relief angle in a cutting tool signature of 10, 20, 7, 6, 8, 15, 2 is

(a) 10   (b) 7   (c) 6   (d) 8

45. The missing distance between A and B in the pin figure shown below is

GIVEN:

(a) 1.8 1.8 ± 1.3

46. In an ideal gas turbine cycle with intercooling, reheating and regeneration as the number of compression and expansion states are increased, which of the following statements are correct?

I.   The Brayton cycle reduces to Ericsson cycle.
II. The Brayton cycle reduces to Stirling cycle.
III. The cycle efficiency becomes equal to Carnot cycle efficiency.

(a) Statement I alone   (b) Statement III alone
(c) Statement I and II   (d) Statement II and III

47. Calculate the dynamic head ($P_A - P_{static}$) when a jet of water with a velocity, v strikes a flat plate moving with a velocity, u in the same direction as jet. (Take u = 4 m/s, v = 10 m/s and ρ = 1000 kg/m³)

stagnation point
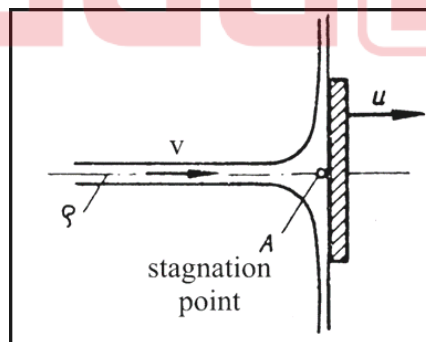
(a) 8000 Pa   (b) 50000 Pa   (c) 18000 Pa   (d) 98000 Pa

48. The method of development of a right regular prism is
(a) Parallel line method   (b) Radial line method

(c)   Triangulation method   (d)   Approximate method

49. A light plane flies at 720 km/hr in standard air at an altitude of 1000 m. Determine the stagnation pressure at the leading edge of the wing. Take, $P_{air} = 9.0 \times 10^4$ N/m^2, $\rho = 1.1$ kg/m^3.

(a)   90 kPa   (b)   119 kPa   (c)   112 kPa   (d)   100 kPa

50. Below the ductile to brittle transition temperature, weld joints show
(a)   High ductility   (b)   High toughness
(c)   Low toughness   (d)   Ductile fracture

51. What is the Prandtl number for a gas at 27°C and 1×10^5 Pa, with kinematic viscosity equal to 1.8×10^{-5} m^2/s, specific heat capacity at constant pressure = 700 J/kg-K and thermal conductivity of 0.02 W/m-K? (Take Gas constant = 300 J/kg-K)

(a)   0.52   (b)   0.62   (c)   0.70   (d)   0.78

52. In continuous casting process, the mould is generally made of
(a)   Cast iron   (b)   Bronze
(c)   Copper   (d)   Tungsten carbide

53. A re-entry module flies with Mach 10 at an ambient temperature of –27°C with $C_P = 840$ J/kg-K, gas constant $R = 140$ J/kg-K. What is the stagnation temperature at the tip of the nose of the re-entry module?

(a)   –23°C   (b)   1377°C   (c)   2477°C   (d)   –253°C

54. Which one of the following steels contains least percentage of carbon?
(a)   Mild steel   (b)   Stainless steel 304L
(c)   Stainless steel 316L   (d)   IF steel

55. The Lewis number which is a measure of relative thermal and concentration boundary layer thicknesses is defined as, (Re: Reynold's number, Pr: Prandtl number, Sc: Schmidt number)

(a) Re × Pr   (b) Sc/Pr   (c) Re/Sc   (d) Sc × Pr

56. The figure shows an Aluminium rod of 25 mm² cross sectional area. It is loaded at four points, K, L, M and N. Assume E = 67 GPa for Aluminium. The total change in length of the rod due to loading as shown is close to
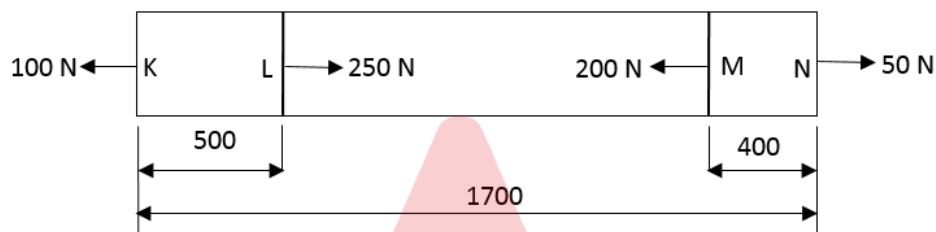
All dimensions are in mm

(a) 30 μm   (b) − 10 μm

(c) − 30 μm   (d) 10 μm

57. The basis of slip line field theory in metal cutting is

(a) Merchant theory   (b) Lee and Shaffer theory

(c) Ernst-Merchant theory   (d) None of these

58. A room contains 25 kg. of air at 100 kPa and 14°C. The room has a 250 W refrigerator and 1 kW electric resistance heater. During a cold winter day, it is observed that both the refrigerator and the heater are running continuously, but the air temperature in the room remains constant. The rate of heat loss from the room during that day is

(a) 3600 kJ/hr.   (b) 1250 kJ/hr.

(c) 4500 kJ/hr.   (d) 2700 kJ/hr.

59. The bar AC, 10m long supports a load of 6000 N as shown in figure. The cable BC is horizontal and 5m long. Forces in the cable and the bar are
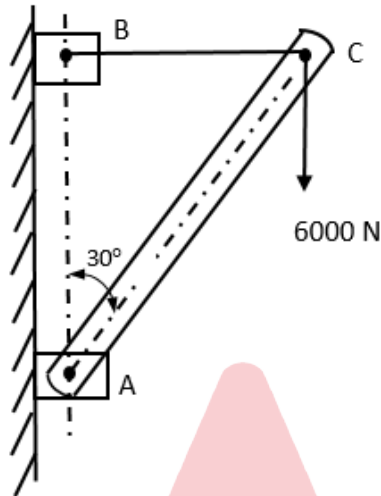
(a) 6928 N and 3464 N   (b) 3464 N and 6928 N
(c) 3464 N and 3464 N   (d) 6928 N and 6928 N

60. In a grinding wheel specification of 'wa36k8vbe', "wa" indicates
    (a) Grain size   (b) Type of grade
    (c) Type of abrasive   (d) Type of structure

61. Two Carnot heat engines are operating in series such that the heat sink of the first engine serves as the heat source of the second one. If the source temperature of the first engine is 1327°C, the sink temperature of the second engine is 127°C, and the thermal efficiency of both the engines are the same, the temperature of the intermediate reservoir is:
    (a) 627°C   (b) 410°C
    (c) 577°C   (d) 527°C

62. A body of mass 10 kg is initially stationary on a 45° inclined plane as shown in figure. The coefficient of dynamic friction between the body and the plane is 0.3. The body slides down the plane and attains a velocity of 20 m/s. The distance travelled (in metre) by the body along the plane is close to
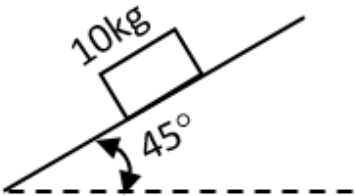
(a)   4.8   (d)   9.8

63. In metal forming, ring compression test is carried out to find out
   (a)   Compressive strength   (b)   Interface friction
   (c)   Upset ratio   (d)   None of these

64. Water flows into the top of an open drum at a constant mass flow rate. Water exits through a pipe near the base with a mass flow rate proportional to the height of the liquid. If the drum is initially empty, which of the following gives the plot of liquid height with time?
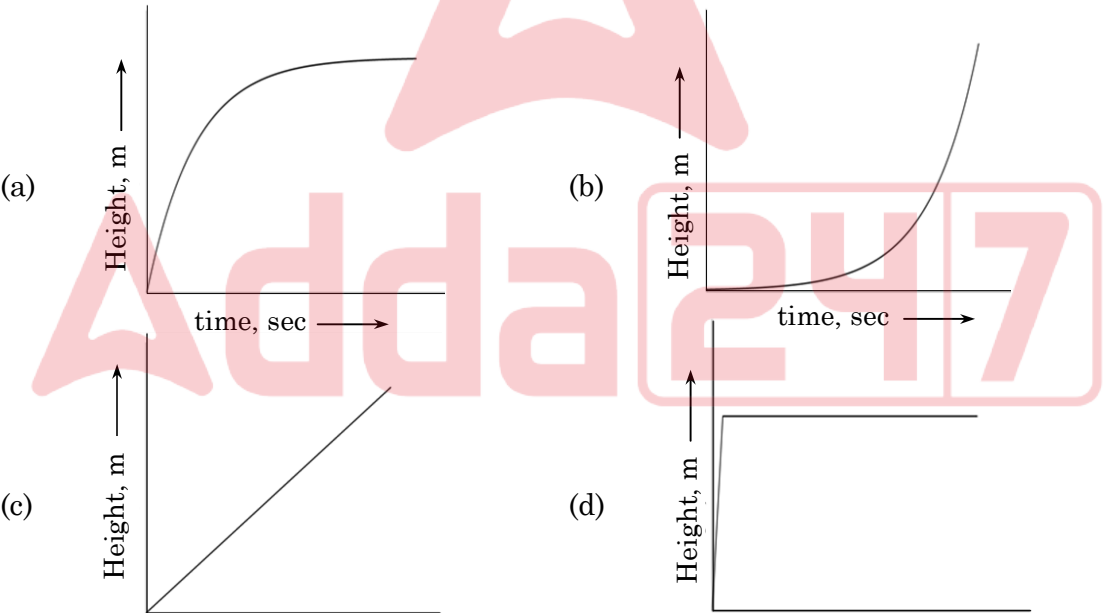
65. What is the approximate reaction moment at the fixed support A for the loaded frame shown below? (Take the diameter of the pulley as 250 mm)
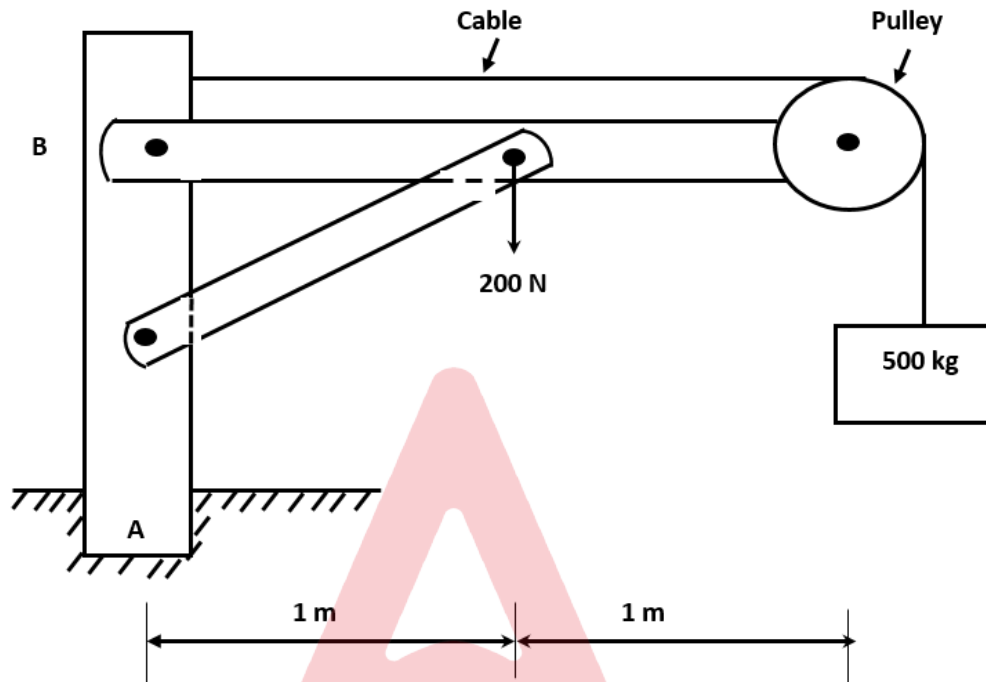
(a)   10010 Nm   (b)   10624 Nm   (c)   9810 Nm   (d)   1263 Nm

66. A radiator on a space capsule must dissipate heat generated inside the capsule, by radiating it into space. While on the bright side of earth, the capsule sees the earth's radiation and the solar radiation. The radiator surface has a solar absorptivity of 0.5 and an emissivity of 0.9. What is the maximum equilibrium surface temperature of the radiator, if the maximum heat generated in the capsule is 800 W/m²?

Assume earth's radiation = 100 W/m² and solar irradiation = 524 W/m².

Take Stefan Boltzmann constant as 5×10^{-8} W/m²-K⁴

(a)   400°C   (b)   100°C   (c)   127°C   (d)   160°C

67. For profile controls, datum is
    (a)   Allowed but not required   (b)   Not allowed
    (c)   Required   (d)   None of these

68. A simply supported beam of length L is subjected to a varying distributed load $\sin(\pi x / L)\, N/m$, where distance x is measured from the left support. The magnitude of the vertical reaction in N at the left support is

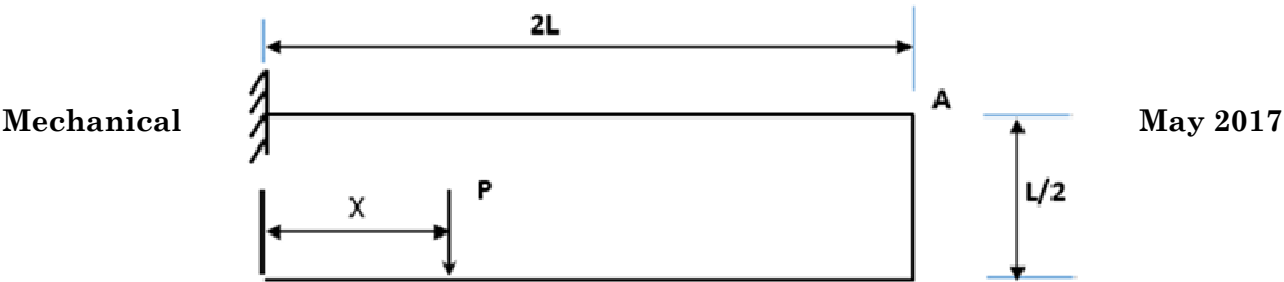(a) $3L/\pi$ (b) $2L/\pi$ (c) $L/2\pi$ (d) L/π

69. A packed bed of solid spheres acts as a thermal energy storage system. In a charging process, heat transfer from the hot gas increases thermal energy stored within the spheres. Consider two beds, one with aluminium spheres (ρ = 2700 kg/m³, C = 950 J/kg-K, k = 240 W/m-K) and other with copper spheres (ρ = 8900 kg/m³, C = 400 J/kg-K, k = 380 W/m-K). Select the correct graph for the temperature rise of a sphere at the inlet of the bed
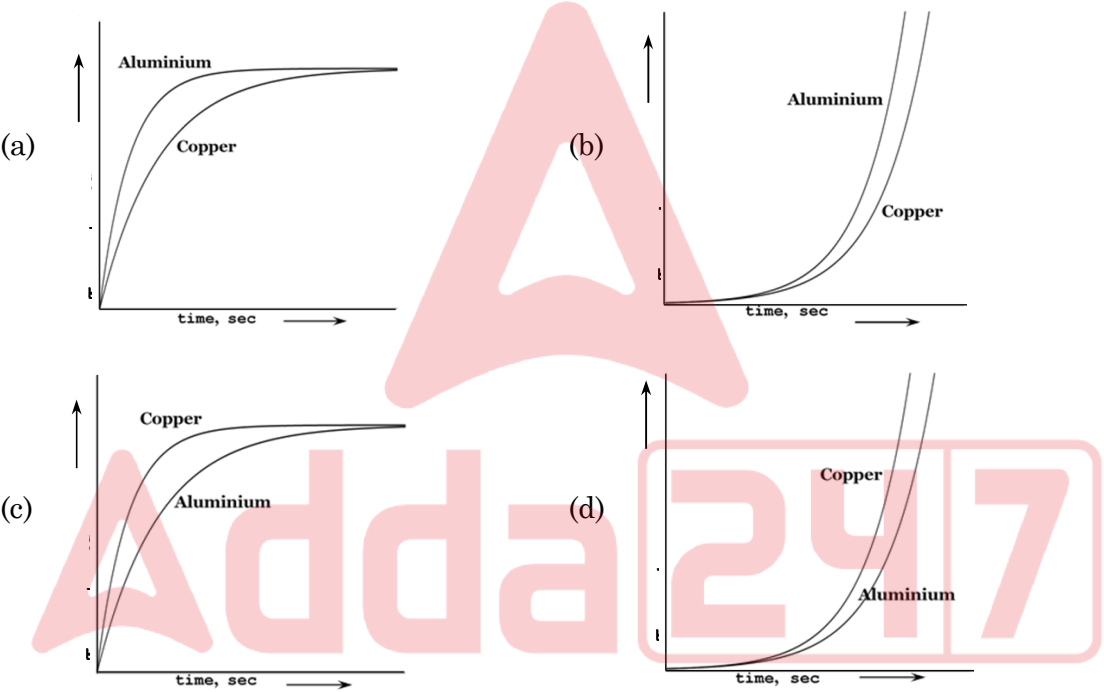
70. Compressive residual stresses in weld joints

   (a)   Decreases tensile strength   (b)   Increases cracking tendency

   (c)   Increases fatigue strength   (d)   Coarsen the grain structure

71. A force P is applied at a distance 'X' from the end of the beam as shown in the figure. What would be value of 'X' so that the displacement at 'A' is equal to zero?

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(a) 0.5 L   (b) 0.25 L   (c) 0.33 L   (d) 0.66 L

72. An electric heater is sandwiched between two plates each 0.3 m long and 0.1 m wide with a thickness of 30 mm. At steady state condition the heater is maintained at a temperature of 100°C, with a current of 0.25 A and voltage of 200 V. Assume the plates are perfectly insulated at the edges, and the heater is having perfect contact with the plates to give a temperature of 50°C on the outside of the plate surface. What is the thermal conductivity of the plate material?

(a) 1.0 W/m-K   (b) 0.5 W/m-K

(c) 0.015 W/m-K   (d) 0.3 W/m-K

73. Knife line or hairline cracking is observed in

(a) Ferritic stainless steel   (b) Martensitic stainless steel

(c) Austenitic stainless steel   (d) Stabilised stainless steel

74. Riser is designed so as to

(a) Freeze after the casting freezes

(b) Freeze before the casting freezes

(c) Freeze at the same time as the casting

(d) Minimise the time of pouring

75. A torque T is applied at the free end of a stepped rod of circular cross-sections as shown in the figure. The shear modulus of the material of the rod is G. The expression for diameter 'd' to produce an angular twist θ at the free end is
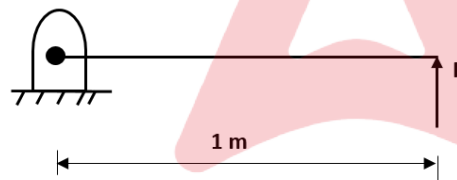

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(a) $\left(\dfrac{30TL}{\pi\theta G}\right)^{1/4}$

(b) $\left(\dfrac{33TL}{\pi\theta G}\right)^{1/4}$

(c) $\left(\dfrac{18TL}{\pi\theta G}\right)^{1/4}$

(d) $\left(\dfrac{24TL}{\pi\theta G}\right)^{1/4}$

76. A pin jointed uniform rigid rod of weight 981 N and length 1 m is kept horizontally by an external force F as shown in the figure below. The force F is removed suddenly. At the instant of force removal, the magnitude of vertical reaction (in N) developed at the support is close to
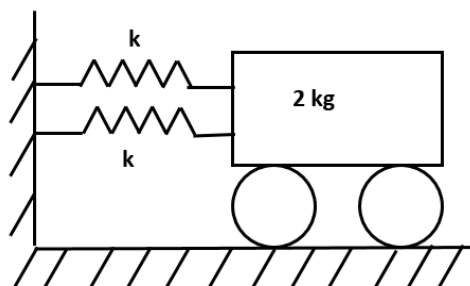

1 m

(a) Zero   (b) 245   (c) 490   (d) 981

77. The frictional torque transmitted in a conical pivot bearing considering uniform pressure is : (R: radius of shaft, α : semi angle of cone, μ : Coefficient of friction, W: load on bearing)

(a) $(1/2)\,\mu\,WR\,\mathrm{Cosec}\,\alpha$

(b) $(3/4)\,\mu\,WR\,\mathrm{Cos}\,\alpha$

(c) $(2/3)\,\mu\,WR\,\mathrm{Cos}\,\alpha$

(d) $(2/3)\,\mu WR\,\mathrm{Cosec}\,\alpha$

78. A mass of 2 kg is attached to two identical springs each with stiffness k = 40 kN/m as shown in the figure. Under frictionless condition, the natural frequency of the system in Hz is close to

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(a)   32   (b)   16

(c)   24   (d)   200

79. A rectangular steel plate is joined to a vertical post using four identical rivets arranged as shown below in the figure. The shear load on the worst loaded rivet (in N) approximately is
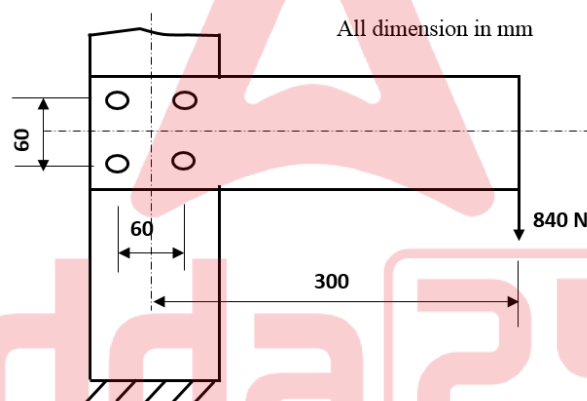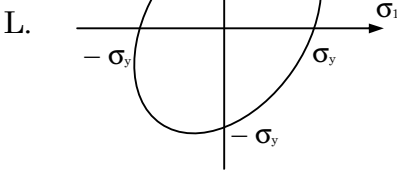

All dimension in mm

840 N

60

300

(a)   1700   (b)   1500
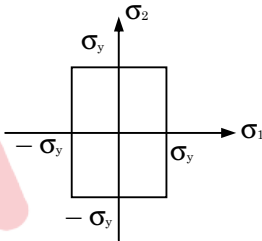(c)   1650   (d)   1750

80. Match the following criterion of material failure under biaxial stresses σ_1 and σ_2 and yield stress σ_y, with their corresponding graphic representations.
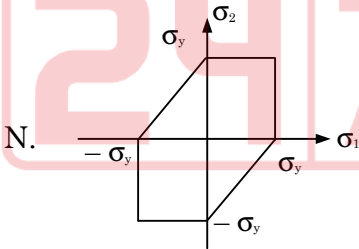
A. Maximum shear stress criterion   L.

B. Maximum distortion energy criterion   M.

C. Maximum normal stress criterion   N.

(a)   A – L, B – N, C – M
(b)   A – N, B – L, C – M
(c)   A – M, B – N, C – L
(d)   A – N, B – M, C – L

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	Recruitment Entrance Test for Scientist/ Engineer 'SC' 2017	A

Space for rough work