Set 2

1. In a new temperature scale say °p, the boiling and freezing points of water at one atmosphere are 100°p and 300°p respectively. Correlate this scale with the Centigrade scale. The reading of 0°p on the Centigrade scale is
   (a) 0°C
   (b) 50°C
   (c) 100°C
   (d) 150°C

2. A reversible heat engine operating between hot and cold reservoirs delivers a work output of 54 kJ while it rejects a heat of 66 kJ. The efficiency of this engine is
   (a) 0.45
   (b) 0.66
   (c) 0.75
   (d) 0.82

3. A system undergoes a state change from 1 to 2. According the second law of thermodynamics for the process to be feasible, the entropy change, S_2 - Si of the system

   (a) is positive or zero
   (b) is negative or zero
   (c) is zero
   (d) can be positive, negative or zero

4. The net entropy generation (considering the system and the thermal reservoir together) during the process is closest to
   (A) 7.5 J/K
   (B) 7.7 J/K
   (C) 8.5 J/K
   (D) 10 J/K

5. Saturated liquid at a high pressure Pi having enthalpy of saturated liquid 1000 kJ/kg is throttled to a lower pressure P_2. At pressure p_2 enthalpy of saturated liquid and that of the saturated vapour are 800 and 2800 kJ/kg respectively. The dryness fraction of vapour after throttling process is
   (a) 0.1
   (b) 0.5
   (c) 18/28
   (d) 0.8

6. The ideal cycle of steam power plant is the Rankine cycle instead of Carnot cycle because
   a) the Rankine cycle has higher efficiency
   b) the Rankine cycle efficiency is equal to carnot cycle efficiency

c) **the Rankine cycle has higher work ratio so it is easier to implement**

d) the carnot cycle gives lower turbine work

7. A link OP is 0.5 m long and rotate about point O. It has a slider at permit B. Centripetal acceleration of P relative to O is 8 m/sec^2. The sliding velocity of slider relative to P is 2m/sec. The magnitude of Coriolis component of acceleration is
    a) **16m/sec^2**
   b) 8m/sec.^{2}
    c) 32m/sec^2
    d) Data insufficient

8. In the diagram given below, the magnitude of absolute angular velocity of link 2 is 10 radians per second while that of link 3 is 6 radians per second. What is the angular velocity of link 3 relative to 2?
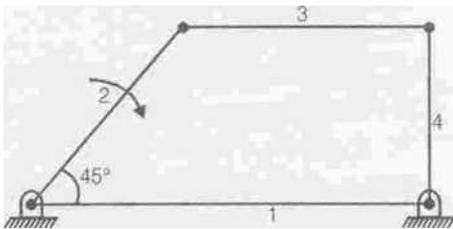
    a) 6 radians per second
    b) 16 radians per second
    c) **4 radians per second**
    d) 14 radians per second

9. The number of degrees of freedom of a five link planer mechanism with five revolute pairs as shown in the figure is
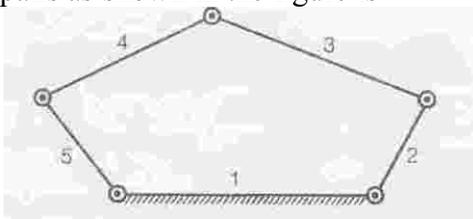
    e) **3**
    f) 4
    g) 2
    h) 1

10. The sun gear in the figure is driven clockwise at 100 rpm. The ring gear is held stationary. For the number of teeth shown on the gears, the arm rotates at

Ring 80 T
Arm
Sun 20 T
Planet 30 T
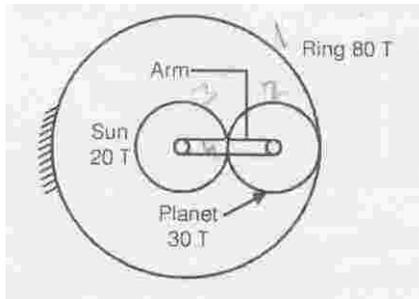
A.   0 rpm B.   **20 rpm**   C.   33.33 rpm   D.   66.67 rpm

11.   The moment of Inertia of a flywheel is 2000 kg m². Standing from rest, it is moving with a uniform acceleration of 0.5 rad/s². After 10 seconds from the start its kinetic energy will be

    a. 250 Nm
    b. 500 Nm
    c. **5000 Nm**
    d. 25000 Nm

12.   A mass m attached to a spring is subjected to a harmonic force as shown in figure. The amplitude of the forced motion is observed to be 50 mm. The value of m (in kg) is

$k = 3000\ N\,m^{-1}$ m $F(t) = 100\cos(100\ t)N$
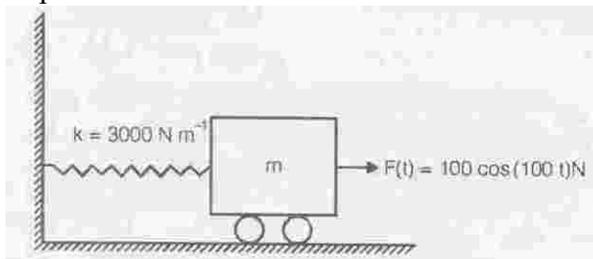
    a. **0.1**
    b. 1
    c. 0.3
    d. 0.5

13.   In the given figure E is a heat engine with efficiency of 0.4 and R is a refrigerator given that $Q_2 + Q_4 = 3Q_1$ the COP of the refrigerator is


Q_1 Q_4
W
E   R
Q_2 Q_3
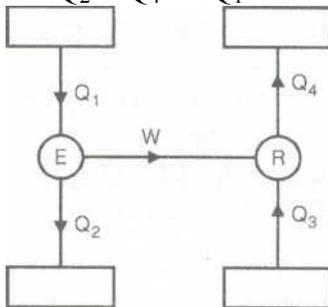
(a) 2.5
(b)   3.0
(c) 4.0

(d)   **5.0**

14.   A carnot refrigerator has a COP of 6. What is the ratio of the lower to the higher absolute
temperature
    a. 1/6
    b. 7/8
    c. 6/7
    d. 1/7

15.   For air with a relative humidity of 80%
    (a)   the dry bulb temperature is less than the wet bulb temperature
    (b)   **the dew point temperature is less than wet bulb temperature**
    (c)   the dew point and wet bulb temperatures are equal
    (d)   the dry bulb and dew point temperatures are equal

16.   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

17.   A column has a rectangular cross-section of 10 X 20 mm and a length of 1 m. The
slenderness ratio of the column is close to
(A) 200   (B) 346   **(C) 477**   (D) 1000

18.   A thin cylinder of inner radius 500 mm and thickness 10 mm is subjected to an internal
pressure of 5 MPa. The average circumferential (hoop) stress in MPa is
(A) 100   (B) 250   **(C) 500**   (D) 1000
Common data for q-19 and 20
A triangular shaped cantilever beam of uniform thickness is shown in the figure. The
young's modulus of the material of the beam is E. a concentrated load P is applied at the
free end of the beam
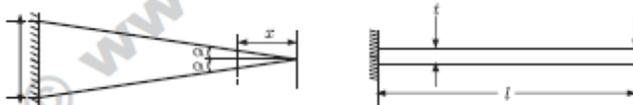
19.   The area moment of inertia about the neutral axis of a cross-section at a distance x
measured from the free end is
    a. $\dfrac{bxt^3}{6l}$
    b. $\dfrac{bxt^3}{12l}$
    c. $\dfrac{bxt^3}{24l}$
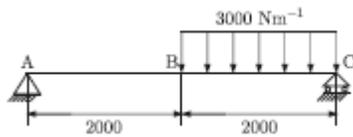
d. $\dfrac{bxt^3}{12l}$

20. The maximum deflection of the beam is

    A. $\dfrac{Pl^3}{bt^3}$

    B. $\dfrac{Pl^3}{bt^3}$

    C. $\dfrac{Pl^3}{bt^3}$

    D. $\dfrac{Pl^3}{bt^3}$

Common data for 21 and 22

A massless beam has a loading pattern as shown in the figure. The beam is of rectangular cross section with a width of 30 mm and height of 100 mm


21. The maximum bending moment occurs at

(A) Location B   (B) 2675 mm to the right of A

(C) 2500 mm to the right of A   (D) 3225 mm to the right of A

22. The maximum magnitude of bending stress (in MPa) is given by

(A) 60.0   **(B) 67.5**   (C) 200.0   (D) 225.0

23. A rigid bar AB is hinged at A and supported by a bronze rod GD of length 2L and steel road FC of length L. A load P is applied at the end B as shown in figure. The load carrying by each rod will be (A_{steel} = 1.5, A_{bronze}, E_{steel} = 2.5, E_{bronze})
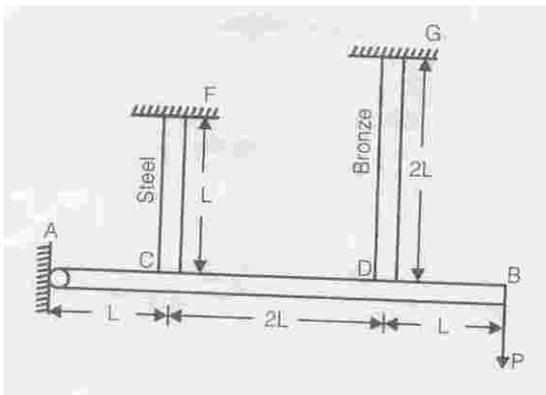
    a. $\dfrac{10}{11}P, \dfrac{9}{11}P$

    b. $\dfrac{16}{11}P, \dfrac{13}{11}P$

    c. $\dfrac{20}{11}P, \dfrac{8}{11}P$

d. $\frac{21}{11}P, \frac{3}{11}P$

24. The modulus of rigidity for a material is 5×10^5 N/mm^2. A 12 mm diameter rod of the material was subjected to an axial pull of 14 kN and change in diameter was observed is 3.6×10^{-3} mm. The value of Poisson's ratio of material will be
    a. 0.12
    b. 0.22
    c. 0.32
    d. 0.42

25. In a stressed body, an elementary cube of material is taken at a point with its faces perpendicular to X and Y reference axes. Tensile stresses equal to 15 kN/cm^2 and 9 kN/cm^2 are observed on these respective faces. They are also accompanied by shear stress equal to 4 kN/cm^2. The magnitude of the principal stresses at the point are
    a. 12 kN/cm^2 tensile and 3 kN/cm^2 tensile
    b. 17 kN/cm^2 tensile and 7 kN/cm^2 tensile
    c. 9.5 kN/cm^2 compressive and 6.5 kN/cm^2 compressive
    d. 12 kN/cm^2 tensile and 13 kN/cm^2 tensile

26. A residential school stipulates the study hours as 8.00 pm to 10.30 pm. Warden makes random checks on a certain student 11 occasions a day during the study hours over a period of 10 days and observes that he is studying on 71 occasions. Using 95% confidence interval, the estimated minimum hours of his study during that 10 day period is
    (A) 8.5 hours
    (B) 13.9 hours
    (C) 16.1 hours
    (D) 18.4 hours.

27. The sale of cycles in a shop in four consecutive months are given as 70, 68, 82, 95. Exponentially smoothing average method with a smoothing factor of 0.4 is used in forecasting. The expected number of sales in the next month is
    (A) 59
    (B) 72
    (C) 86
    (D) 136

28. Market demand for springs is 8,00,000 per annum. A company purchases these springs in lots and sells them. The cost of making a purchase order is Rs.1200 . The cost of storage of springs is Rs.120 per stored piece per annum. The economic order quantity is
    (A) 400
    (B) 2,828
    (C) 4,000
    (D) 8,000

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) 1000, 500
(B) 500, 1000
(C) 800, 600
(D) 1000,1000

30. 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 per cent. If the contract provides allowance of 20 percent of the time available, the standard time for the operation would be

(A) 8 min
(B) 8.9 min
(C) 10 min
(D) 12 min

31.   Consider the following statements:
1. In orthogonal cutting, the cutting edge of the tool is perpendicular to cutting direction.
2. In oblique cutting, the cutting edge and the cutting motion are not normal to each other.
3. Majority of the machining operations are based on orthogonal cutting.
4. The chip slides along the rake face of the tool.
Which of these statements are correct?
a. 1 and 2
b. 1 3, and 4
c. 1. 2 and 3
d. 1, 2 and 4

32.   In a blanking operation, the clearance is provided on
(A) the die
(B) both the die and the punch equally
(C) the punch
(D) neither the punch nor the die

33. The time taken to drill a hole through a 25 mm thick plate with the drill rotating at 300 rpm and moving at a feed rate of 0.25 mm/rev is
(A) 10 s
(B) 20 s
(C) 60s
(D) 100 s

34. Shrinkage allowance on pattern is provided to compensate for shrinkage when
(A)   the temperature of liquid metal drops from pouring to freezing temperature.
(B)   the metal changes from liquid to solid state at freezing temperature
(C)   the temperature of solid phase drops from freezing to room temperature
(D)   the temperature of metal drops from pouring to room temperature

35.   The cutting force in punching and blanking operations mainly depends on
(A)   the modulus of elasticity of metal
(B)   the shear strength of metal
(C)   the bulk modulus of metal
(D)   the yield strength of metal

36.   Allowance in limits and fits refers to
(A)   maximum clearance between shaft and hole
(B)   minimum clearance between shaft and hole
(C)   difference between maximum and minimum sizes of hole
(D)   difference between maximum and minimum sizes of shaft.

35.   A plane wall is 25 cm thick with an area of 1 m2, and has a thermal conductivity of 0.5W/mK. If a temperature difference of 60°C is imposed across it, what is the heat flow?
(a) 120W (b) 140W (c) 160W (d) 180W

36.   A steel ball of mass 1kg and specific heat 0.4 kJ/kg is at a temperature of 60°C. It is dropped into 1kg water at 20°C. The final steady state temperature of water is
(a) 23.5°C   (b) 300ºC   (c) 35°C   (d) 40°C

37.   For conduction through a spherical wall with constant thermal conductivity and with inner side temperature greater than outer wall temperature, (one dimensional heat transfer), what is the type of temperature distribution?
(a) Linear   (b) Parabolic   **(c) Hyperbolic** (d) None of the above

38.   A solid sphere and a hollow sphere of the same material and size are heated to the same temperature and allowed to cool in the same surroundings. If the temperature difference between the body and that of the surroundings is T, then
(a) both spheres will cool at the same rate for small values of T
(b) both spheres will cool at the same reactor small values of T
(c) the hollow sphere will cool at a faster rate for all the values of T
(d) the solid sphere will cool a faster rate for all the values of T

39.   A fluid of thermal conductivity 1.0 W/m-K flows in fully developed flow with Reynolds number of 1500 through a pipe of diameter 10 cm. The heat transfer coefficient for uniform heat flux and uniform wall temperature boundary conditions are, respectively
(a) 36.57 and 43.64 W/m^2 K (b) 43.64 and 36.57 W/m^2 K
(c) 43.64 W/m^2 K for both the cases d) 36.57 W/m^2 K for both the cases

40.   Which one of the following statements is correct?
The non-dimensional parameter known as Stanton number (St) is used in
(a) forced convection heat transfer in flow over flat plate

(b) condensation heat transfer with laminar film layer
(c) natural convection heat transfer over flat plate
(d) unsteady heat transfer from bodies in which internal temperature gradients cannot be neglected

41. When a hydraulic turbine is operated, it is Found that it has a high design efficiency and this efficiency remains constant over wide range of regulation from the design condition. What is the type of this turbine?
    (a) Pelton
    (b) Francis
    (c) Kaplan
    (d) Propeller

42. The function of which of the following hydraulic devices is analogous to that of the flywheel of a reciprocating engine and an electric storage battery?
    (a) Hydraulic ram
    (b) Hydraulic accumulator
    (c)   Hydraulic intensifier
    (d)   Hydraulic jack

43. The Euler's equation of motion is a statement of
    (a)   Energy balance
    (b)   Conservation of momentum for an inviscid fluid
    (c)   Conservation of momentum for an incompressible flow
    (d)   Conservation of momentum for a real fluid

44. A U-tube open at both ends and made of 8 mm diameter glass tube has mercury up to a height of 10 cm in both the limbs. If 19 cm^3 of water is added to one of the limbs, what is the difference in mercury levels in the two limbs at equilibrium?
    (a) 4.5 mm
    (b) 1.0 cm
    (c) 2.8 cm
    (d) 3.2 cm

45. Which one of the dimensionless numbers identifies the compressibility effect of a fluid?
    (a) Euler number
    (b) Froude number
    (c) Mach number
    (d) Weber number

46. A pelton wheel with single jet rotates at 600 rpm. The velocity of the jet from the nozzle is 100 m/s. If the ratio of the vane velocity to jet velocity is 0.44, what is the diameter of the pelton wheel?
    (a) 0.7 m
    (b) 1.4m
    (c) 2.1 m

(d) 2.8 m

Common question for 47 and 48

A single-cylinder four-stroke diesel engine running at 1800 rpm has a bore of 85 mm and a stroke of 110 mm. It takes 0.56 kg of air per minute and develops a brake power output of 6 kW while the air-fuel ratio is 20 :1. The calorific value of the fuel used is 42550 kJ/kg, and the ambient air density is 1.18 kg/m^3. The

47. volumetric efficiency is
(a) 85.6%
(b) 84.5%
(c) 68.6%
(d) 83.3%

48. Brake specific fuel consumption.
(a) 0.21 kg/kWh
(b) 0.32 kg/kWh
(c) 0.25 kg/kWh
(d) 0.28 kg/kWh

49.   Alloy steel designated as 40 Cr 18 Ni 2 by Bureau of Indian Standards contains
   a. 0.4%C 18% Cr and 2% Ni
   b. 4% C. 1.8% Cr and 0.2% Ni
   c. 0.4% C, 1.8% Cr and 2% Ni
   d. 0.4% C. 1.8% Cr and 0.2 Ni

50.   For good weld ability, the carbon equivalent (%) of steel should be in the range of
   A. 0.2-0.4
   B. 0.5-Q.8
   C. 0.7-0.8
   D. 0.9-1.0