Set 1

1. Two blocks which are at different states are brought into contact with each other and allowed to reach a final state of thermal equilibrium. The final temperature attained is specified by the
   (a) Zeroth law of thermodynamics
   (b) First law of thermodynamics
   (c) Second law of thermodynamics
   (d) Third law of thermodynamics

2. In a steady-flow adiabatic turbine, the changes in the internal energy, enthalpy, kinetic energy and potential energy of the working fluid, from inlet to exit, are -100 kJ/kg, -140 kJ/kg, -10 kJ/kg and 0 kJ/kg respectively. Which one of the following gives the amount of work developed by the turbine?

   a. 100 kJ/kg
   b. 110 kJ/kg
   c. 140 kJ/kg
   d. 150 kJ/kg

3. 170 kJ of heat is supplied to a system at constant volume. Then the system rejects 180 kJ of heat at constant pressure and 40 kJ of work is done on it. The system is finally brought to its original state by adiabatic process. If the initial value of internal energy is 100 kJ, then which one of the following statements is correct?

   a. The highest value of internal energy occurs at the end of the constant volume process
   b. The highest value of internal energy occurs at the end of constant pressure process.
   c. The highest value of internal energy occurs after adiabatic expansion
   d. Internal energy is equal at all points

4. For a steady flow process from state 1 to 2, enthalpy changes from h_1 = 400 kJ/kg to h_2 = 100 kJ/kg and entropy changes from s_1 = 1.1 kJ/kg-K to s_2 = 0.7 kJ/kg-K. Surrounding environmental temperature is 800 K. Neglect changes in kinetic and potential energy. The change in availability of the system is

   e. 420 kJ/kg
   f. 300 kJ/kg
   g. 180 kJ/kg
   h. 90 kJ/kg

5. A cylinder with a movable piston contains 2 kg of water vapour of dryness fraction 0.5. At a pressure of 200 kPa, heat is transferred to the vapour until the dryness fraction increases to .9. then the total heat transfer in kJ will be
   Given at 200 kPa, h_1 = 504.7 kJ/kg
   Hg = 2706.7 kJ/kg

   a) 880.8
   b) 912.4

c) 1824.8
d) 1761.6

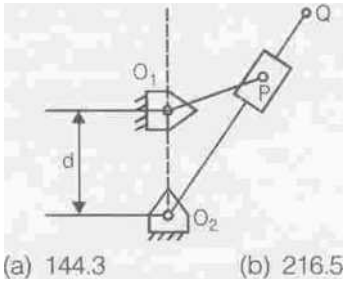
6. Two system A and B, possessing the same internal energy, contain saturated liquid vapour mixture of water at 1 MPa, the maximum value of ratio of mass of A to that of B is (given : $u_f = 761.67$ kJ/kg, $u_g = 2583.64$ kJ/kg)

a) 1.4
b) 2.4
c) 3.4
d) 4.4

7. The lengths of the links of a 4-bar linkage with revolute pairs only are p, q, r and s units. Given that p< q < r <s. Which of these links should be the fixed one, for obtaining a "double crank" mechanism?

a. links of length p
b. links of length q
c. link of length r
d. link of length s

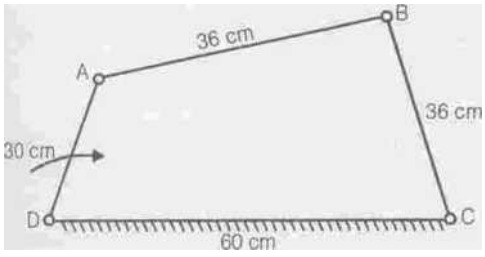
8. A simple quick return mechanism is shown in the fig. The forward to return ratio of the quick return mechanism is 2:1. If the radius of the crank O_1P is 125 mm, then the distance 'd' in mm) between the crank centre to lever pivot centre point should be



(a) 144.3 (b) 216.5

e. 144.3
f. 216.5
g. 240.0
h. 250.0

9. Consider the four bar mechanism shown in figure
The driving link DA is rotating uniformly at a speed of 100 rpm clockwise. The velocity of A will be

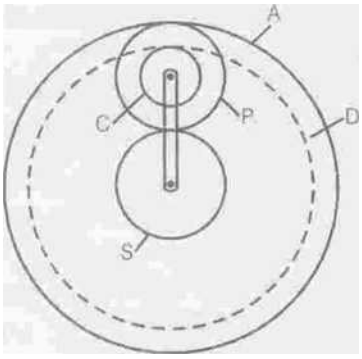


a) 300 cm/s
b) 314cm/s
c) 325cm/s

d) 400cm/s

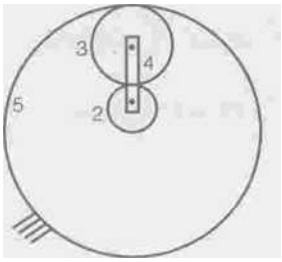
10. What will be the centre distance of two meshing gears if module is 4 and number of teeth are 25 and 75
    a) 100 mm
    b) 200 mm
    c) 300 mm
    d) 400 mm

11. In a reduction gear shown in figure given below, the input S has 24 teeth. P and C constitute a compound planet having 30 and 18 teeth respectively what will be the number of teeth in A and D respectively



    a) 84 and 60
    b) 72 and 60
    c) 84 and 72
    d) 60 and 48

12. An epicyclic gear train is shown schematically in the adjacent figure. The sun gear 2 on the input shaft is a 20 teeth external gear. The planet gear 3 is a 40 teeth external gear. The ring gear 5 is a 100 teeth internal gear. The ring gear 5 is fixed and the gear 2 is rotating at 60 rpm ccw (ccw = counter-clockwise and cw = clockwise)
The arm 4 attached to the output shaft will rotate at



    a) 10rpm ccw
    b) 10rpm cw
    c) 12rpm cw
    d) 12rpm ccw

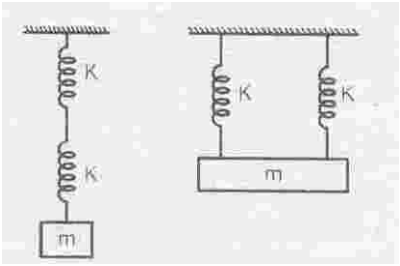
13. If C_f is the coefficient of speed fluctuation of a flywheel then the ratio of $\omega_{max}/\omega_{min}$ will be
    a. $\frac{1-2C_f}{1+2C_f}$

b. $\frac{2-C_f}{2+C_f}$

c. $\frac{1+2C_f}{1-2C_f}$

d. $\mathbf{\frac{2+C_f}{2-C_f}}$

14. Two identical springs of constant K are connected in series and parallel as shown in the figure. A mass m is suspended from them. The ratio of their frequencies of oscillations will be



A. 2 : 1

B. 1 : 2

C. 1 : 4

D. 4 : 1

15. If COP of a refrigerator is 5 and efficiency of a heat engine of the same temperature limit is 50%. Then what is the ratio of heat supplied to engine to heat absorbed by the refrigerator from the space

(a) 2.5

(b) **0.4**

(c) 4

(d) 0.25

16. If an engine of 40% thermal efficiency drives a refrigerator having a coefficient of performance of 5, then the heat input to engine for each kJ of heat removed from the cold body of the refrigerator is

(a) **0.50 kJ**

(b) 0.75 kJ

(c) 1 kJ

(d) 1.25 kJ

17. A room 7m x 4m x 4m is occupied by an air-water vapour mixture at 38°C. The atmospheric pressure is 1 bar & relative humidity is 70%. The mass of air is (take P_s at 38°C = 0.06624 bar)

(a) 50.7 kg

(b) 88.7 kg

(c) **119.7 kg**

(d) 139.7 kg

18. A moistair sample has dry bulb temperature of 30° and specific humidity of 11.5 g water vapour per kg dry air. Assume molecular weight of air is 28.93. If the saturation vapour pressure of water at 30°C is 4.24 kPa and the total pressure is 90 kPa, then the relative humidity (in %) of air sample is

(a) 50.5

(b**) 38.5**

(c) 56.5

(d) 68.5

19. A long thin walled cylindrical shell, closed at both the ends, is subjected to an internal pressure. The ratio of the hoop stress (circumferential stress) to longitudinal stress developed in the shell is
(A) 0.5
(B) 2.0
(C) 1.0
(D) 4.0

20. A simply supported beam of length L is subjected to a varying distributed load $\sin(3\pi x/L)$ Nm^{-1}, where the distance x is measured from the left support. The magnitude of the vertical reaction force in N at the left support is
(A) zero
(B) $L/3\pi$
(C) L/π
(D) $2L/\pi$

21. 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's 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

22. A cantilever beam of length L is subjected to a moment M at the free end. The moment of inertia of the beam cross section about the neutral axis is I and the Young s modulus is E. The magnitude of the maximum deflection is
a. $\frac{ML^2}{EI}$
b. $\frac{ML^2}{EI}$
c. $\frac{ML^2}{EI}$
d. $\frac{ML^2}{EI}$

23. For a long slender column of uniform cross section, the ratio of critical buckling load for the case with both ends clamped to the case with both the ends hinged is
(A) 1
(B) 2
(C) 4
(D) 8

24. If $E = 2.0 \times 10^5$ MPa an axial pull of 60 kN suddenly applied to a steel rod $\emptyset = 50$ mm in diameter and 4 m long, causes an instantaneous elongation of the order of
a. 1.22 mm
b. 2.19 mm
c. 3.19 mm
d. 11.9 mm

25. A steel wire of 10 mm diameter and length 150 m is used to lift a weight of 2.5 kN at its lowest end. Calculate the total elongation of wire if the unit mass of wire is 7.95 kg/m^3 and $E = 2.04 \times 10^5$ N/mm^2
a. 30 mm
b. 28.9 mm

c. 26.5 mm

d. 27.71mm

26. Customer arrive at a ticket counter at a rate of 50 per hr and tickets are issued in the order of their arrival. The average time taken for issuing a ticket is 1 min. Assuming that customer arrivals from a Poisson process and service times and exponentially distributed, the average waiting time is queue in min is

a. 3

b. 4

c. 5

d. 6

27. In simple exponential smoothing forecasting, to give higher weightage to recent demand information, the smoothing constant must be close to

(A) 1

(C) 0

(B) 0.5

(D) 1.0

28. Vehicle manufacturing assembly line is an example of

(A) **product layout**

(B) process layout

(C) manual layout

(D) fixed layout

28. Annual demand for window frames is 10000. Each frame cost Rs. 200 and ordering cost is Rs. 300 per order. Inventory holding cost is Rs. 4 per frame per year. The supplier is willing of offer 2% discount if the order quantity is 1000 or more, and 4% if order quantity is 2000 or more. If the total cost is to be minimized, the retailer should

(A) order 200 frames every time

(B) accept 2% discount

(C) accept 4% discount

(D) order Economic Order Quantity

29. Consider the following Linear Programming Problem (LPP):

Maximize $Z=3x_1 + 2x_2$

Subject to

$x_1 \leq 4$

$x_2 \leq 6$

$3x_1 + 2x_2 \leq 18$

$x_1 \geq 0_1, x_2 \geq 0$

(A) The LPP has a unique optimal solution

(B) The LPP is infeasible.

(C) The LPP is unbounded.

(D) The LPP has multiple optimal solutions

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31. The standard time of an operation while conducting a time study is
    a. Mean observed time + allowances
    b. Normal time + allowances
    c. Mean observed time X rating factor + allowances
    d. Normal time X rating factor + allowances

32. If α is the rake angle of the cutting tool. $\emptyset$ is the shear angle and V is the cutting velocity, velocity of chip sliding along the shear plane is given by
    a. $\frac{V\cos\emptyset}{\cos(\emptyset-\alpha)}$
    b. $\mathbf{\frac{V\sin\emptyset}{\cos(\emptyset-\alpha)}}$
    c. $\frac{V\cos\emptyset}{\sin(\emptyset-\alpha)}$
    d. $\frac{V\sin\emptyset}{\sin(\emptyset-\alpha)}$

33. In a rolling process, the state of stress of the material undergoing deformation is
    A. pure compression
    B. pure shear
    C. compression and shear
    D. tension and shear

34. For a ductile material, toughness is a measure of
    A. resistance to scratching
    B. ability to absorb energy up to fracture
    C. ability to absorb energy till elastic limit
    D. resistance to indentation.

35. A cube shaped solidifies in 5 min. The solidification time in min for a cube of the same material, which is 8 times heavier than the original casting, will be
    A. 10
    B. 20
    C. 24
    D. 40

36. A steel bar 200 mm in diameter is turned at a feed of 0.25 mm/rev with a depth of cut of 4 mm. The rotational speed of the workpiece is 160 rpm. The material removal rate in mm^3/s is
    A. 160
    B. 167.6
    C. 1600

D. 1675.5

37. A gas engine has a swept volume of 300 cc and clearance volume of 25 cc. Its volumetric efficiency is 0.88 and mechanical efficiency is 0.90. What is the volume of the mixture taken in per stroke
    (a) 248 cc
    (b) 252 cc
    (c) 264 cc
    (d) 286 cc

38. An engine produces 10 kW brake power while working with a brake thermal efficiency of 30%. If the calorific value of the fuel used is 40,000 kj/kg then what is the fuel consumption?
    (a)1.5kg/hour
    (b)3.0kg/hour
    (c) 0.3kg/hour
    (d)1.0kg/hour

39. An automobile engine operates at a fuel air ratio of 0.05, volumetric efficiency of 90% and indicated thermal efficiency of 30%. Given that the calorific value of the fuel is 45 MJ/kg and the density of air at intake is 1 kg/m^3, the indicated mean effective pressure for the engine is
    (a)6.075 bar
    (b)6.75 bar
    (c) 67.5 bar
    (d)243 bar

40. In a SI engine very high compression ratio cannot be used because
    (a) the engine efficiency would be unmanageable high
    (b)the power required for compression would be high
    (c)cylinders will required very thick walls
    (d)self-ignition may takes place before the spark occurs

41. Which one of the following action(s) increase(s) the knocking tendency in the SI engine?
    (a)Increasing mixture strength beyond equivalence ratio (<J>) = 1.4
    (b)Retarding the spark and increasing the compression ratio
    (c)Increasing the compression ratio and reducing engine speed
    (d)Increasing both mixture strength beyond equivalence (<]>) = 1.4 and the compression ratio

42. A homogeneous solid of any arbitrary shape floats upright in a homogeneous liquid with immersed volume V and is in stable equilibrium. If the solid is overturned and made to float upside down in a different homogeneous liquid with exactly same volume V above the liquid surface, then the equilibrium
    (a) Would be stable
    (b) Would be neutral
    (c) Would be unstable
    (d) **May or may not be stable**

43. A 25 cm long prismatic homogeneous solid floats in water with its axis vertical and 10 cm projecting above water surface. If the same solid floats in some oil with vertical and 5 cm projecting above the liquid surface, what is the specific gravity of the oil?
    (a) 0.60
    (b) 0.70
    (c) 0.75
    (d) 0.80

44. A semicircular plane area of diameter 1 m, is subjected to a uniform gas pressure of 420 kn/m^2. What is the moment of thrust (approximately) on the are about its straight edge?
    (a) **35 knm**
    (b) 41 knm
    (c) 55 knm
    (d) 82 knm

45. Which one of the following statement is correct? While using boundary layer equations, Bernoulli's equation.
    (a) can be used anywhere
    (b) **can be used only outside the boundary layer**
    (c) can be used only inside the boundary layer
    (d) cannot be used either inside or outside the boundary layer

46. The pressure drop in a pipe flow is directly proportional to the mean velocity. It can be deduced that be
    (a) **Flow is laminar**
    (b) Flow is turbulent
    (c) Pipe is smooth
    (d) Pipe is rough

47. It is recommended that the diffuser angle should be kept less than 18° because
    (a) pressure decreases in the flow direction and flow separation may occurs
    (b) pressure decreases in flow direction and flow may become turbulent
    (c) **pressure increases in flow direction and flow separation may occurs**
    (d) pressure increases in flow direction and flow may become turbulent

48. A wall of thickness 0.6 m has width has a normal area 1.5 m2 and is made up of material of thermal conductivity 0.4 W/mK. The temperatures on the two sides are 8000 C. What is the thermal resistance of the wall?
    (a) 1 W/K (b) 1.8 W/K **(c) 1 K/W** (d) 1.8 K/W

49. Two long parallel plates of same emissivity 0.5 are maintained at different temperatures and have radiation heat exchange between them. The radiation shield of emissivity 0.25 placed in the middle will reduce radiation heat exchange to
(a) 1/2 (b) 1/4 **(c) 3/10** (d) 3/5

50. Solar radiation of 1200 W/m2 falls perpendicularly on a grey opaque surface of emissivity 0.5. If the surface temperature is 50°C and surface emissive power 600 W/m^2, the radiosity of that surface will be
(a) 600 W/m^2 (b) 1000 W/m^2 **(c) 1200 W/m^2** (d) 1800 W/m^2