Mechanical Engineering

Q1 to 25 carry 1 mark each.

1. **Thermal expansion of material arises from**

   (a) Strong bonds (b) Weak bonds

   (c) Thermal vibration

   (d) Asymmetry of potential energy curve

2. **Ablation heat transfer method is used on surface of**

   (a) Submarines (b) Satellites

   (c) Nuclear warheads

   (d) High speed aircraft

3. **If one solid phase splits into two solid**

phases on heating the reaction is

(a) Eutectic (b) Peritectic
(c) Hypereutectic (d) Peritectoid

4. **The configuration in which viscous fluid flows between the concentric rotating cylinders is called as**

(a) Taylor-coutte flow
(b) Secondary flow
(c) Falkner-skan equation
(d) Tollmein-schlichting flow

5. **For two dimensional irrotational flow which of the following condition is indispensable (if ϕ is velocity potential and ψ is stream function)**

1. $\nabla^2\psi = 0$ 2. $\nabla^2\phi = 0$

3. $\phi_{xy} = \phi_{yx}$

(a) 2 and 3 (b) 1 and 3
(c) 1 and 2 (d) 1, 2 and 3

6. **Which of the following is not a maxwell's equation**

(a) $\left(\frac{\partial V}{\partial S}\right)_P = \left(\frac{\partial T}{\partial P}\right)_S$ (b) $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

(c) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$ (d) $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$

7. **Anti-dieseling system is part of**

(a) Modern carburetor
(b) Multiport fuel injection system
(c) Fuel pump in C.I. engine
(d) Fuel pump in S.I. engines

8. **Air is flowing in a pipeline having specific heat at constant pressure 1005 J/ kg°c at a velocity of 350 m/s and having pressure and temperature of 10Kpa and 25°C. then isentropic stagnation pressure is**

(a) 150.5 KPa (b) 192 KPa
(c) 171.7 KPa (d) 188.8 Kpa

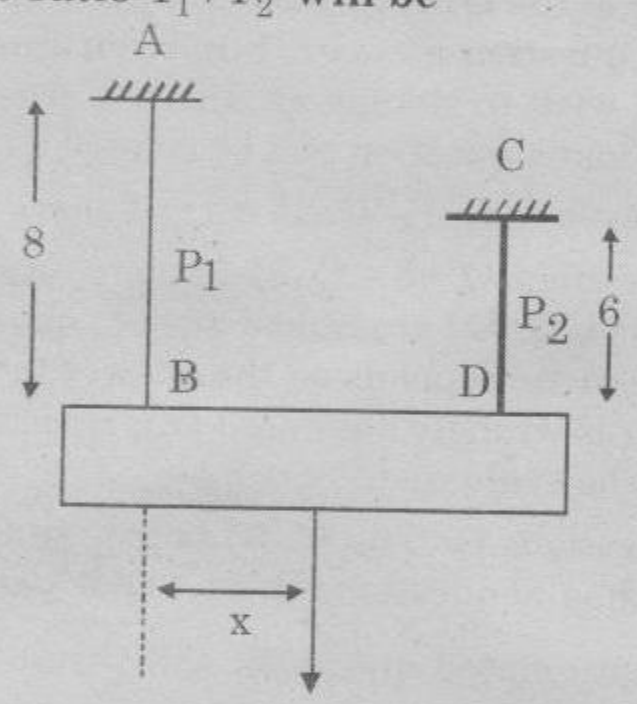
9. **Which of the following refrigerants have zero ozone depletion potential and negligible global warming potential?**

(a) R-11 (b) R-12
(c) R-22 (d) R-134$_a$

10. **Which of the following is incorrect with reference to work study**

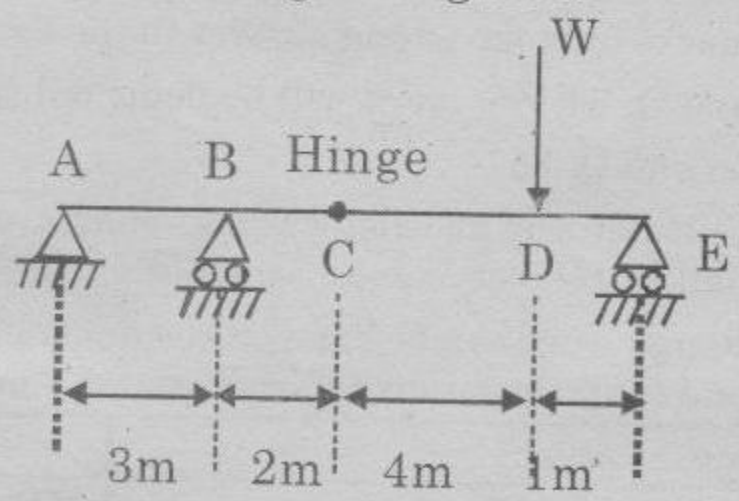
(a) Normal time = representative time × rating factor
(b) Normal time = representative time + rating time
(c) Standard time = work content + unavoidable delay
(d) Standard time = normal time

11. **A gradually applied load W is suspended by wire ropes AB and CD as shown in the figure. The wire AB and CD made of the same material and of the same cross-section are connected to a rigid block from which the load W is suspen-ded in such a way that both the ropes stretch by the same amount. If the stress in AB and CD are P_1 and P_2 respectively, then the ratio P_1 / P_2 will be**



(a) 3/2 (b) 2/3 (c) 3/4 (d) 4/3

12. **The reaction at B due to the load as shown in the given figure is**

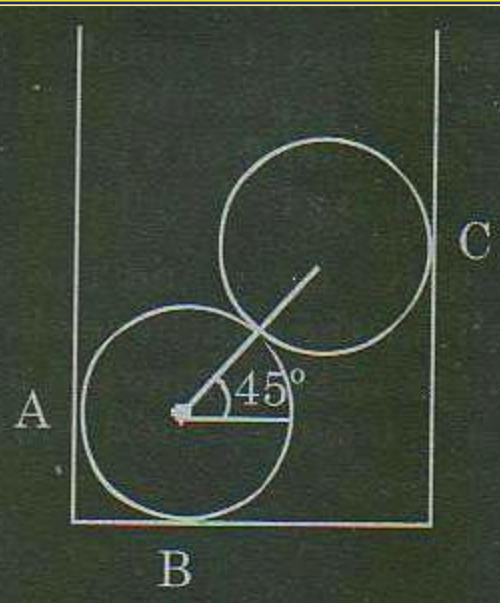


(a) $\omega/2$ (b) $\omega/3$ (c) 2ω (d) 3ω

13. **The rate of flow through v-notch is proportional to which one of the following?**

(a) H (b) $H^{1/2}$ (c) $H^{3/2}$ (d) $H^{5/2}$

14. **Two cylinder each weighing 900 N are placed in a box as shown then reactions at A, B and C are**



(a) $900, \frac{1900}{\sqrt{2}}, 900$ (b) $900, \frac{1800}{\sqrt{2}}, \frac{900}{\sqrt{2}}$

(c) 900,1800,900 (d) $\frac{900}{\sqrt{2}}, \frac{1800}{\sqrt{2}}, \frac{900}{\sqrt{2}}$

15. In a multiple disc clutch, if there are 8 discs on the driving shaft and 5 disc on the driven shaft, then the number of pairs of contact surface will be equal to
(a) 10 (b) 11 (c) 12 (d) 13

16. If the temperature of a solid surface changes from 27°C to 627°C, then its emissive power will increase in the ratio of
(a) 3 (b) 9 (c) 27 (d) 81

17. The interference can be avoided in involute gears by
(a) Changing the pressure angle, the centre distance can be varied
(b) Using modified involute
(c) Increasing the addendum on the smaller wheel and reducing it on the larger wheel
(d) All of the above methods

18. An ideal gas throttled through an insulated value. The exit pressure is lower than inlet pressure. The exit temperature
(a) Increases
(b) Decreases
(c) Remains constant
(d) Cannot be determined

19. It is required to drill a hole through 20mm thick plate a feed rate of 0.2 mm/rev. the time to accomplish this task will be
(a) 10 sec (b) 20 sec (c) 30 sec (d) 40 sec

20. Fixed investments for manufacturing a product in a particular year is Rs 80,000. the estimate sales for this period is Rs 210000. the variable cost per unit for this product is Rs. 10/-. If each unit is sold at Rs. 30/- then the break even point would be
(a) 4000 (b) 5000 (c) 1000 (d) 20000

21. The degree of the differential equation $\frac{d^2x}{dt^2} + 2x^3 = 0$ **is**
(a) 0 (b) 1 (c) 2 (d) 3

22. The point of maxima of the function 3.46 sin x + 2 cos x over the interval $[0, \pi]$ **is**
(a) $\pi/3$ (b) $\pi/6$ (c) $\pi/2$ (d) $5\pi/6$

23. If matrix A is symmetrical and matrix B is skew symmetric then
(a) C^TAC is skew-symmetric and C^TAB is symmetrical
(b) C^TAC is symmetrical at C^TBC is symmetrical
(c) both C^TAC and C^TBC are skew symmetrical
(d) C^TAC is symmetrical and C^TBC is skew symmetrical

24. For what value of Z the function w defined by $Z = e^{-v}(\cos u + i \sin u)$ **where** $\omega = u + iv$ **cease to be analytic?**
(a) i (b) –i (c) 0 (d) 1

25. The differential equation for all ellipses centroid at origin is
Where $y_1 = \frac{dy}{dx}, y_2 = \frac{d^2y}{dx^2}$
(a) $yy_1^2 + 2xy_1 - y = 0$
(b) $xyy_2 + xy_1^2 = xy_1$
(c) $xyy_2 + x(y_1)^2 - yy_1 = 0$
(d) $2xyy_2 + x(y_1)^2 - 2y = 0$

Q.26-55 carry two marks each

26. For Given matrix $A = \begin{bmatrix} 2 & -2 & 3 \\ -2 & -1 & 6 \\ 1 & 2 & 0 \end{bmatrix}$ **one**

of the eigen value is 3. the other two eigen values are

(a) 2,-5 (b) 3,-5
(c) 2,5 (d) 3,5

27. The solution of the differential equation $x\frac{dy}{dx} = y\left[\log(y) - \log(x) + 1\right]$ is y =

(a) e^{cx} (b) xe^{xc} (b) x^2e^{xc} (d) $xe^{x^{2c}}$

28. Identify the correct statements regarding roots of $x^2 + 15x^2 + 7x - 11 = 0$.it has

(a) One positive root (b) One negative root
(c) Has two real root (d) Has four real root

29. A cutting tool has a radius of 1.8 mm. the feed rate for the theoretical surface roughness of $R_a = 3\ \mu m$ is

(a) 0.168 mm/rev (b) 0.036 mm/rev
(c) 0.410 mm/rev (d) 0.529 mm/rev

30. Compute the strain hardening exponent n for a alloy in which a true stress of 515 MPa produces a true strain of 0.10. Assume a value of 2015 MPa for K.

(a) 0.30 (b) 0.40 (c) 0.50 (d) 0.60

31. Using Cauchy's integral theorem, the value of the integration (integration being taken in counter clockwise direction) $\int_c \frac{z^3 - 6}{3z - i} dz$ is

(a) $\frac{2\pi}{81} - 4\pi i$ (b) $\frac{\pi}{8} - 6\pi i$

(c) $\frac{4\pi}{81} - 6\pi i$ (d) 1

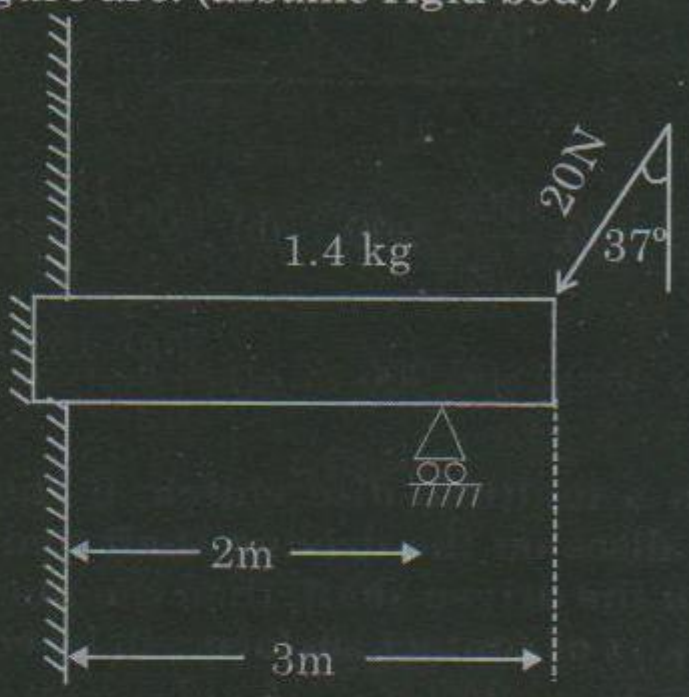
32. A riveting machine is driven by a constant torque 7 kw motor. The moving parts including the flywheel are equivalent to 175 kg at 0.7 m radius and riveting takes 1 second and absorb 10000 N-m of energy. The speed of flywheel is 500 rpm, before riveting then the number of rivets closed per minute is

(a) 20 (b) 22 (c) 40 (d) 42

33. A unbiased coin is tossed. If the result is head, a pair of unbiased dice is rolled and the number obtained by adding the numbers on the two faces is noted. If the result is tail, a card from a well shuffed pack of eleven cards numbered 2, 3,4—— 12 is picked and the number of the card is noted. The probability that the noted number is either 7 or 8 is

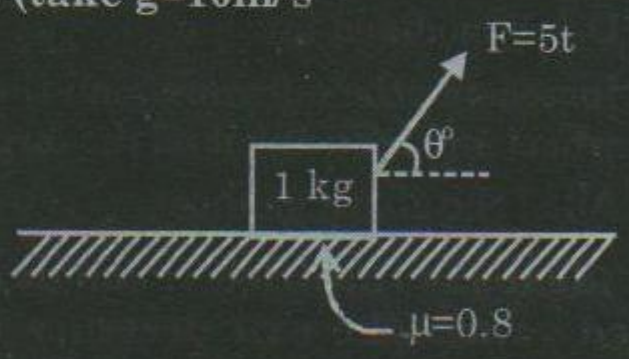
(a) 0.240 (b) 0.244 (c) 0.184 (d) 0.024

34. The reactive force and the moment at the wall for the cantilever beam of uniform mass 1.4kg supported as shown in figure are: (assume rigid body)



(a) 19.2N, 34.5N.m
(b) 30N, 34.5N.m
(c) 12N, 34.5N.m
(d) Can not be determined

35. In the given figure 1kg mass is lying on the rough surface. A force f=5t N is applied on it an angle θ from horizontal such that the mass leaves the surface without sliding. The minimum value of θ is (take g=10m/s^2



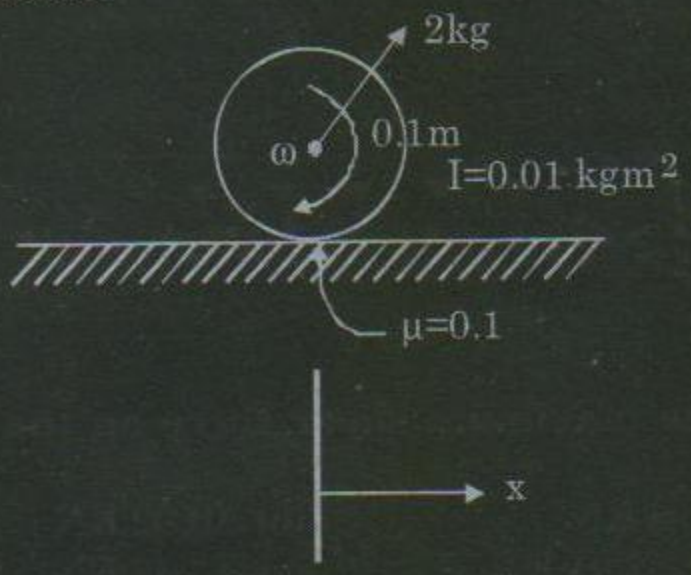
(a) 0° (b) 73° (b) 81° (d) 90°

36. A rotating machine 560kg operating at 1500rpm has an unbalance 0.12kgm. If the damping in isolation is given ξ= 0.08, Determine the stiffness of isolators so that the transmissibility at operating speed is less than 0.15

(a) 0.86MN/m (b) 2.02MN/m
(c) 3.8MN/m (d) 4.6MN/m

37. In the given figure a disc of mass 2kg having radius 0.1m and moment of inertia about its axis 0.01kgm^2 is given

initial angular velocity 10rad/sec and placed on the rough surface as shown in figure. There is no linear velocity of disc initially then identify the correct statements.



1. The frictional force at t=0 acts in positive x direction.
2. The frictional force at t=0 acts in negative x direction.
3. Frictional force at in positive x direction initially and after some time it acts in negative x direction (after t=0.5sec)
4. Frictional force acts in positive x direction till t=0.5sec and becomes negligible after that.
5. Frictional force acts in positive x direction till t=0.25sec and becomes negligible after that.

(a) 1 and 3 (b) 2 only
(c) 1 and 4 (d) 1, 3 and 5

38. Which of the following is/are higher pair?
1. Thomson indicator mechanism
2. Double McInnes indicator mechanism.
3. Hart's straight line mechanism.
4. Cross by indicator mechanism.
5. Tooth gearing mechanism.

(a) 1 only (b) 5 only
(b) 3 and 5 (d) 2, 3, 4 and 5

39. For a single degree viscously damped system, viscous damping coefficient =100N.s/m, spring constant=100N.m and mass involved is 5kg, then nature and equation of motion is

(a) Critically damped, $x = (A + Bt)\, e^{-10t}$

(b) Underdamped, $x = (A + Bt)\, e^{-10t}$

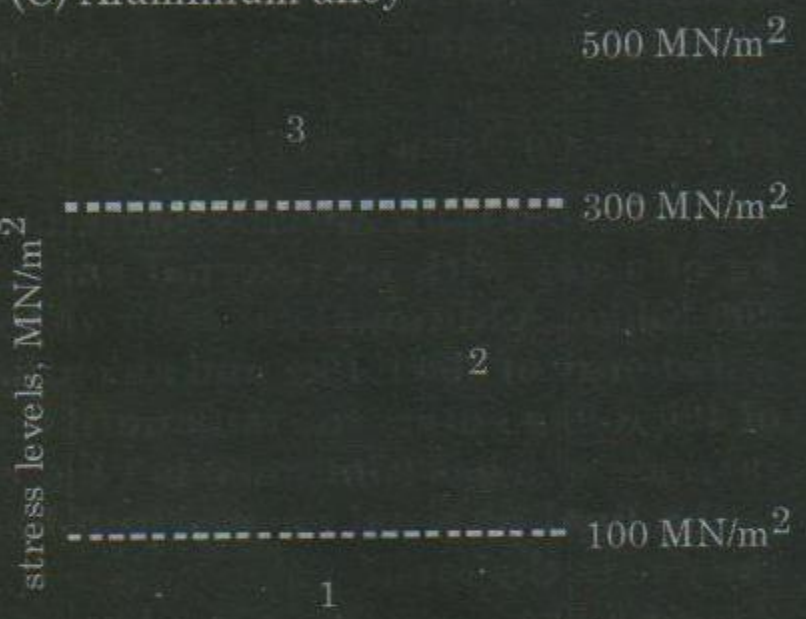
(c) Overdamped, $x = A e^{-18.94t} + B e^{-1.06t}$

(d) Under damped, $x = A e^{-18.94t} + B e^{-1.06t}$

40. The factors that promote non-crystallinity in polymers are
1. Large random side groups.
2. Addition of plasticizers.
3. Copolymerisation
4. Branching.

(a) 1, 2, 3 and 4 (b) 1, 2 and 3
(c) 1, 2 and 4 (d) 2 and 4

41. The S-N curves for three different materials are shown in the given figure then match the curve's with the materials involved.
(A) Nylon
(B) 0.5%c Steel
(C) Aluminium alloy



	A	B	C
(a)	1	2	3
(b)	1	3	2
(c)	2	1	3
(d)	3	1	2

42. Air (ideal gas with $\gamma = 1.4$) at 4 bar and 350 K meters a reversible and adiabatic nozzle with negligible velocity and leaves at 1 bar. If the molar mass of air is 29×10^{-3} kg / mol then exit velocity of nozzle is

(a) 479.35 m/s (b) 338.95 m/s
(c) 478.54 m/s (d) 337.54 m/s

43. Match List-I (Type of ends) with List-II (no. of active turns, N) and select the correct answer using the codes given below the lists:
List-I
A. Square ends
B. Square ends (ground)

C. Plain ends
D. Plain ends (ground)
List-II

1. $N_t - 2$ 2. $N_t - ½$ 3. N_t

Where N_t = Total no. of turns
Codes

	A	B	C	D
(a)	1	2	3	3
(b)	1	3	3	2
(c)	1	1	2	3
(d)	1	1	3	2

44. Given $\psi = \frac{3}{4}\left(y^2 - x^2\right)$ and $\phi = 7xy$ The discharge passing between the stream lines through the points (1, 3) and (5, 5) is
(a) 6 unit (b) 7 unit (c) 8 unit (d) 9 unit

45. An insulated tank initially contains 0.25 kg of a gas with an internal energy of 200 KJ/kg. Additional gas with an internal energy of 300 KJ/kg and an enthalpy of 400 KJ/kg enters the tank until the total mass of a gas contained is 1 kg. what is the final internal energy in KJ/kg of the gas in the tank?
(a) 265 KJ/kg (b) 275 KJ/kg
(c) 225 KJ/kg (d) 250 KJ/kg

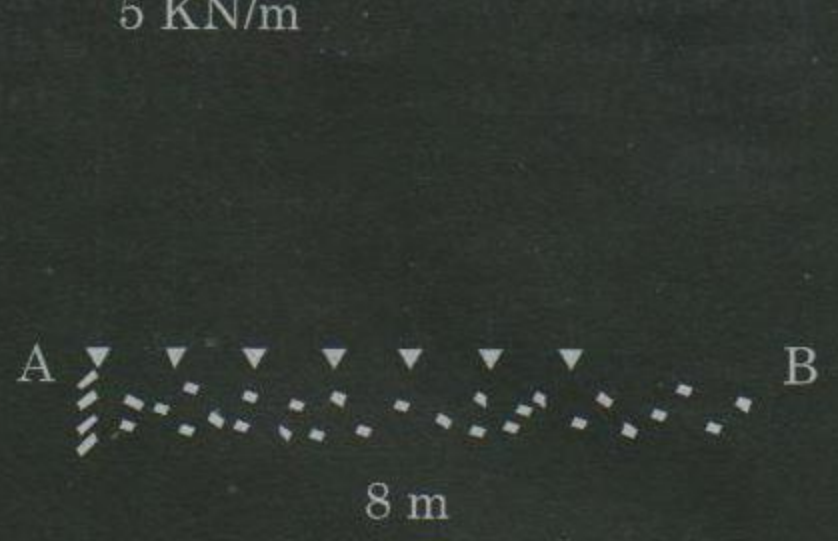
46. In a cotter joint, the width of the cotter at the centre of 40 mm and its thickness is 15 mm. The load acting on the cotter is 60 KN. What is the sharing stress developed in the cotter?
(a) $20\ N/mm^2$ (b) $30\ N/mm^2$
(c) $40\ N/mm^2$ (d) $50\ N/mm^2$

47. In an axial flow gas turbine, the hot gases approach the rotor inlet with an absolute velocity of 700 m/s in direction 60° from the wheel tangent. The gases leave the rotor axially. If the blade speed is 300 m/s, then the theoretical power output per kg/sec of gas flow will be
(a) 120 kw (b) 130 kw
(c) 140 kw (d) 150 kw

Common Data Questions:

Common Data question 48 and 49

A cantilever beam of HTS is loaded by a parabolic load as shown in figure. The length of beam is 8m and load intensity at the support is 5 KN/m. The beam is mode of square cross-section of size 40 mm.

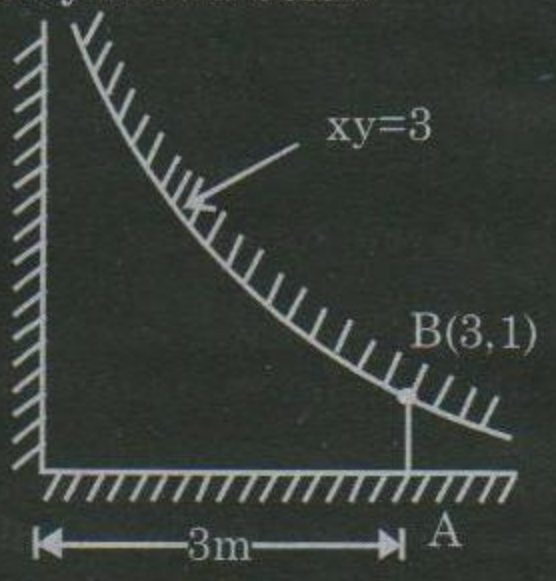


48. The maximum shear force on the beam is
(a) 8 KN (b) 10.02 KN
(c) 12.91 KN (c) 13.33 KN

49. The maximum shear stress on the fiberss of beam will be
(a) $12.5\ N/mm^2$ (b) $10.5\ N/mm^2$
(c) $8.5\ N/mm^2$ (d) $7.5\ N/mm^2$

Common data for question 50 to 51

The stream function $\psi = 4xy$ in which ψ is in cm^2/sec and x and y are in meters. Describe the incompressible flow between the boundary shown below



50. The velocity at B is
(a) $0.12\ cm/sec^2$
(b) $0.04\ cm/sec^2$
(c) $0.126\ cm/sec^2$
(d) $50.6\times10^{-6}\ cm/sec^2$

51. Convective acceleration at B is
(a) $48\times10^{-4}\ cm/s^2$
(b) $48\times10^{-6}\ cm/s^2$
(c) $50.6\times10^{-4}\ cm/s^2$
(d) $50.6\times10^{-6}\ cm/s^2$

Linked answer questions

Statement for linked question 52 and 53

A liquid vapour simple Freon-12 refrigerator operates at temperature 35°C and -15°C. The required properties of Freon 12 is given as

52. Then energy performance ratio (EPR) of the system is

Temp				Super heated			
				20 K		40 K	
T(°C)	$h_f\left(\frac{KJ}{kg}\right)$	$h_g\left(\frac{KJ}{kg}\right)$	$S_g\left(\frac{KJ}{kg.k}\right)$	$h\left(\frac{KJ}{kg}\right)$	$S\left(\frac{KJ}{kg.k}\right)$	$h\left(\frac{KJ}{kg}\right)$	$S\left(\frac{KJ}{kg.k}\right)$
35	69.5	201.5	0.6839	216.4	0.731	231.0	0.7741
-15	———	181.0	0.7052	193.2	0.751	205.7	0.7942

(a) 2.56 (b) 3.00 (c) 3.11 (d) 4.09

53. If the liquid-vapour heat exchanger is installed in the above system with the vapour leaving the heat exchanger at 15°C. then what is the new COP?

(a) 3.01 (b) 4.20 (c) 4.52 (c) 4.73

Statement linked question 54 and 55

54. A straight tube having a diameter of 40 mm carries water with a velocity of 10m/s. The temperature of he tube surface is 50°C and the flowing water is heated from in the inlet temperature $T_i = 15^\circ C$ to an outlet temperature $T_0 = 25^\circ C$. Take the physical properties of the water at its mean bulk temperature and the following correlation for heat transfer coefficient

$$Nu = 0.023(Re)^{0.8}(Pr)^{0.33}$$

$\upsilon = 1.006 \times 10^{-6} m^2/s, K = 59.86 \times 10^{-2} \omega/mk$

and $C_P = 4183\ J/kg.k$

(a) 5986 W/m^2k (b) 6174.4 W/m^2k

(c) 9239.6 W/m^2k (d) 2058 W/m^2k

55. For the above problem the amount of heat transferred to water per unit time is

(a) 125.3 kw (b) 209.6 kw

(c) 418.2 kw (d) 524.13 kw

General Aptitude (GA) Questions

Q.56 to Q.60 carry one marks each.

56. The question below consists of a pair of related words followed by four pair of words. Select the pair that best expresses the relation in original pair: PHILATELIST: STAMPS

(a) Numismatist: coins

(b) Astrologer: predictions

(c) Cartographer: maps.

(d) Pawn broken: jewelry

57. A screwdriver and a hammer currently have the same price. If the price of a screw driver rises by 3% by what percent will the cost of 3 screw drivers and 3 hammers rise?

(a) 3% (b) 4%

(c) 5% (d) 8%

58. Choose the most appropriate word from the options given below to complete the following sentence.

We last confidence in him because he never_____the grandiose promises he had made.

(a) Forgot about (b) Reneged on

(b) Tired of (d) Delivered on

59. Choose the most appropriate word from the options given below to complete the following sentence.

To the dismay of the student body, the class president was _____ berated by the principal at a school assembly

(a) Ignominiously (b) Privately

(c) Magnanimously (d) Fortuitously

60. Choose the word that is exactly similar in meaning to the given word:

VIGILANCE

(a) Bivouac (b) Guide
(c) Watchfulness (c) Passe

Q.61 to Q.65 carry two marks each.

61. When 6 gallons of gasoline are put into a car, the indicator goes from $\frac{1}{4}$ to $\frac{5}{8}$. The total capacity of tank is

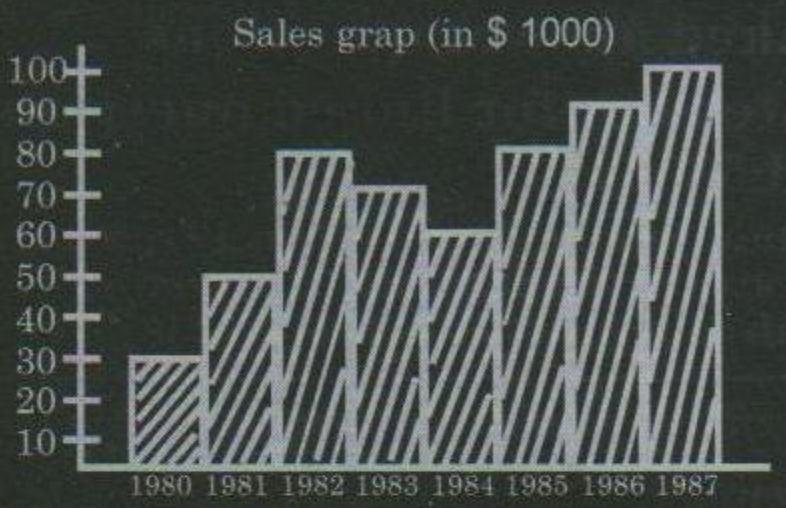
(a) 12 (b) 14 (c) 15 (c) 16

62. It is important to teach students to use Computers effectively Therefore, students should be taught computer programming in school.

Which of the following if true, most weaken the argument above,

(a) Only people who use computers effectively are skilled at computers programming.
(b) Only people skilled at computer programming use computers effectively.
(c) Some people who use computers effectively cannot write computer programs.
(d) None of these.

63. What is the average (arithmetic mean) in thousands of dollars of the sales for the period 1982–1985?



(a) $60 (b) $70 (c) $72.5 (d) $80

64. One wheel rotates once every 7 minutes and another rotates once every 5 minutes. How after will both begin to rotate at the same time?

The passage best supports the statement that:

(a) Every 6 minutes
(b) Every 12 minutes
(c) Every 17.5 minutes
(d) Every 35 minutes.

65. Which of the following has the greatest value?

(a) 0.3 (b) $\sqrt{0.3}$
(c) $\frac{2}{5}$ (d) 0.01π