2013 XE

EE25BTECH11021 - Dhanush sagar

1) If $3 \leq x \leq 5$ and $8 \leq y \leq 11$ then which of the following options is TRUE? [GATE 2013 XE]

a) $\frac{3}{11} \leq \frac{x}{y} \leq \frac{5}{8}$
b) $\frac{3}{(11)^2} \leq \frac{x}{y} \leq \frac{5}{8}$
c) $\frac{3}{(11)^2} \leq \frac{x}{y} \leq \frac{5}{(8)^2}$
d) $\frac{3}{8} \leq \frac{x}{y} \leq \frac{5}{(8)^2}$

2) The Headmaster _____ to speak to you. Which of the following options is **incorrect** to complete the above sentence? [GATE 2013 XE]

a) is wanting
b) wants
c) want
d) was wanting

3) Mahatma Gandhi was known for his humility as [GATE 2013 XE]

a) he played an important role in humiliating exit of British from India.
b) he worked for humanitarian causes.
c) he displayed modesty in his interactions.
d) he was a fine human being.

4) All engineering students should learn mechanics, mathematics and how to do computation. [GATE 2013 XE]

a) mechanics
b) mathematics
c) how to do computation
d) —

Which of the above underlined parts of the sentence is not appropriate?

a) I
b) II
c) III
d) IV

5) Select the pair that best expresses a relationship similar to that expressed in the pair: water : pipe :: [GATE 2013 XE]

a) cart : road
b) electricity : wire
c) sea : beach
d) music : instrument

6) Velocity of an object fired directly in upward direction is given by $v = 80 - 32t$, where t (time) is in seconds. When will the velocity be between 32 m/sec and 64 m/sec? [GATE 2013 XE]

a) $(1, \frac{3}{2})$
b) $(\frac{1}{2}, 1)$
c) $(\frac{1}{2}, \frac{3}{2})$
d) $(1, 3)$

7) In a factory, two machines M1 and M2 manufacture 60% and 40% of the autocomponents respectively. Out of the total production, 2% of M1 and 3% of M2 are found to be defective. If a randomly drawn autocomponent from the combined lot is found defective, what is the probability that it was manufactured by M2? [GATE 2013 XE]

a) 0.35
b) 0.45
c) 0.5
d) 0.4

8) Following table gives data on tourists from different countries visiting India in the year 2011.

Country	Number of Tourists
USA	2000
England	3500
Germany	1200
Italy	1100
Japan	2400
Australia	2300
France	1000

Which two countries contributed to the one third of the total number of tourists who visited India in 2011? [GATE 2013 XE]

a) USA and Japan
b) USA and Australia
c) England and France
d) Japan and Australia

9) If $|-2x+9| = 3$ then the possible value of $|-x| - x^2$ would be: [GATE 2013 XE]

a) 30
b) -30
c) -42
d) 42

10) All professors are researchers
Some scientists are professors
Which of the given conclusions is logically valid and is inferred from the above arguments: [GATE 2013 XE]

a) All scientists are researchers
b) All professors are scientists
c) Some researchers are scientists
d) No conclusion follows

11) The value of the integral

$$\int_0^\infty e^{-x^2} dx$$

is
[GATE 2013 XE]

a) $\frac{\sqrt{\pi}}{2}$ b) $\sqrt{\pi}$ c) $-\sqrt{\pi}$ d) $-\frac{\sqrt{\pi}}{2}$

12) Which one of the following partial differential equations **CANNOT** be reduced to two ordinary differential equations by the method of separation of variables?
[GATE 2013 XE]

a) $\frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial y^2} = 0$ b) $\frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial t^2} = 0$ c) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial u}{\partial t} = 0$ d) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial t^2} = 0$

13) The Fourier series of the periodic function

$$f(x) = |x|, \quad -1 < x < 1, \quad f(x+2) = f(x), \quad x \in \mathbb{R} \tag{1}$$

is given by

$$\frac{1}{2} - \sum_{n=1}^{\infty} \frac{4\cos((2n-1)\pi x)}{(2n-1)^2\pi^2}. \tag{2}$$

Using the above, the sum of the infinite series

$$1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \tag{3}$$

is [GATE 2013 XE]

a) $\frac{\pi^2}{4}$ b) $\frac{\pi^2}{8}$ c) $\frac{\pi^2}{6}$ d) $\frac{\pi^2}{2}$

14) Consider the function $f(z) = |z|, \quad z \in \mathbb{C}$. At $z = 0$, the function f [GATE 2013 XE]

a) does not satisfy the Cauchy-Riemann equations
b) satisfies the Cauchy-Riemann equations but is not differentiable
c) is differentiable but not analytic
d) is analytic

15) The integral $\oint_C \frac{(z+4)}{(z-1)(z-2)^3} dz$ alng the contour $C : |z - (1 + i)| = 2$, oriented anti-clockwise, is equal to [GATE 2013 XE]

a) 0 b) $\frac{\pi}{e}$ c) $-\frac{\pi}{e}$ d) $\frac{\pi}{i}$

16) The integral

$$\int \int_D y e^{xy} dx dy \tag{4}$$

over the domain $D : 0 \leq x \leq 1, 0 \leq y \leq 1$ equals [GATE 2013 XE]

a) $\frac{e-2}{e}$ b) $\frac{e+2}{e}$ c) $\frac{e-1}{e}$ d) $\frac{1-e}{e}$

17) If the mean and variance of a binomial distribution are 6 and 2 respectively, then the probability of two failures is [GATE 2013 XE]

a) $4\left(\frac{2}{3}\right)^7$ b) $4\left(\frac{2^2}{3^7}\right)$ c) $17\left(\frac{2}{3}\right)^7$ d) $17\left(\frac{2^2}{3^7}\right)$

18) For the matrix $M = \begin{pmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ 1 & 1 & -2 \end{pmatrix}$, consider the following statements: [GATE 2013 XE]

(P) The characteristic equation of M is $\lambda^3 - \lambda = 0$.
(Q) M^{-1} does not exist.
(R) The matrix M is diagonalizable.

Which of the above statements are true?

a) P, Q and R
b) P and R but not Q
c) P and Q but not R
d) Q and R but not P

19) The work done by the force $\mathbf{F} = (x+y)\hat{i} + (xy+x)\hat{j}$ in moving a particle once along the triangle with vertices $(0, 0), (1, 0)$ and $(0, 1)$ in the anti-clockwise direction is [GATE 2013 XE]

a) 0 b) $\frac{1}{6}$ c) $\frac{1}{3}$ d) $\frac{5}{3}$

20) The general solution of the differential equation

$$x^2 \frac{d^3y}{dx^3} + x\frac{d^2y}{dx^2} + (x-1)y = 0, \tag{5}$$

is [GATE 2013 XE]

a) $C_1e^x + e^{x/2}\left\{C_2\cos\left(\frac{\sqrt{3}}{2}x\right) + C_3\sin\left(\frac{\sqrt{3}}{2}x\right)\right\}$
b) $C_1x + x^{-1/2}\left\{C_2\cos\left(\frac{\sqrt{3}}{2}\log_e x\right) + C_3\sin\left(\frac{\sqrt{3}}{2}\log_e x\right)\right\}$
c) $C_1e^x + e^{-x/2}\left\{C_2\cos\left(\frac{\sqrt{3}}{2}x\right) + C_3\sin\left(\frac{\sqrt{3}}{2}x\right)\right\}$
d) $C_1x + x^{1/2}\left\{C_2\cos\left(\frac{\sqrt{3}}{2}\log_e x\right) + C_3\sin\left(\frac{\sqrt{3}}{2}\log_e x\right)\right\}$

21) Using Euler's method to solve the differential equation $\frac{dy}{dx} = 2\cos x$, $y(0) = 1$, with step-size $h = 0.25$, the value of $y(0.5)$ is [GATE 2013 XE]

a) 1.3125 b) 1.1875 c) 1.125 d) 1.0625

22) The gauge pressure inside a soap bubble of radius R, with σ denoting the surface tension between the soap solution and air, is: [GATE 2013 XE]

a) $\frac{4\sigma}{R}$
b) $\frac{2\sigma}{R}$
c) $\frac{\sigma}{R}$
d) $\frac{8\sigma}{R}$

23) Let M, B and G represent respectively the metacentre, centre of buoyancy and the centre of mass of a floating buoy. Which of the following statements is correct? [GATE 2013 XE]

a) M is above G; Buoy unstable
b) B is above G; Buoy stable
c) M is above G; Buoy stable
d) B is above G; Buoy unstable

24) A reservoir connected to a pipeline is being filled with water, as shown in the figure. At any time t, the free surface level in the reservoir is h. Find the time in seconds for the reservoir to get filled up to a height of 1 m, if the initial level is 0.2 m _____. [GATE 2013 XE]

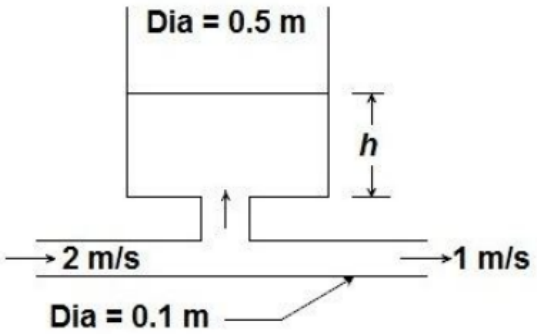


Fig. 24.

25) Bernoulli's equation is valid for the following type of flow:

a) Compressible, steady, inviscid
b) Incompressible, steady, viscous
c) Compressible, unsteady, viscous
d) Incompressible, steady, inviscid

26) If A is the area of a circle of radius r enclosing a plane forced vortex flow, with origin at the centre of the vortex and if ω is the angular velocity, ζ is the vorticity, $\mathbf{V}$ is the velocity vector, then the circulation around the contour of the circle is given by: [GATE 2013 XE]

a) $2\omega A$
b) $2\zeta A$
c) $2VA$
d) 0

27) Flow past a circular cylinder can be produced by superposition of the following elementary potential flows: [GATE 2013 XE]

a) Uniform flow, doublet
b) Uniform flow, vortex
c) Source, vortex
d) Sink, vortex

28) Let δ, δ_1 and δ_2 denote respectively the boundary-layer thickness, displacement thickness and the momentum thickness for laminar boundary layer flow of an incompressible fluid over a flat plate. The correct relation among these quantities is: [GATE 2013 XE]

a) $\delta < \delta_1 < \delta_2$
b) $\delta > \delta_1 > \delta_2$
c) $\delta > \delta_1 < \delta_2$
d) $\delta < \delta_1 > \delta_2$

29) In the hydrodynamic entry region of a circular duct, the pressure forces balance the sum of: [GATE 2013 XE]

a) viscous and buoyancy forces
b) inertia and buoyancy forces
c) inertia and surface tension forces
d) inertia and viscous forces

30) Bodies with various cross-sectional shapes subjected to cross-flow of air are shown in the figures. The characteristic dimension of all the shapes is the same. The cross-sectional shape with the largest coefficient of drag (i.e., sum of the pressure and skin-friction drags), at any moderately large Reynolds number, is: [GATE 2013 XE]

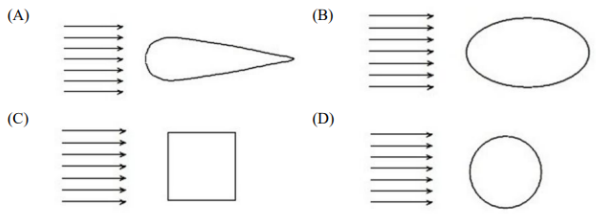


Fig. 30.

31) A U-tube of very small bore, with its limbs in a vertical plane and filled with a liquid of density ρ, up to height h, is rotated about a vertical axis, with angular velocity ω, as shown in the figure. The radius of each limb from the axis of rotation is R. Let p_a be the atmospheric pressure and g the acceleration due to gravity. The angular velocity at which the pressure at the point O becomes half of the atmospheric pressure is given by: [GATE 2013 XE]

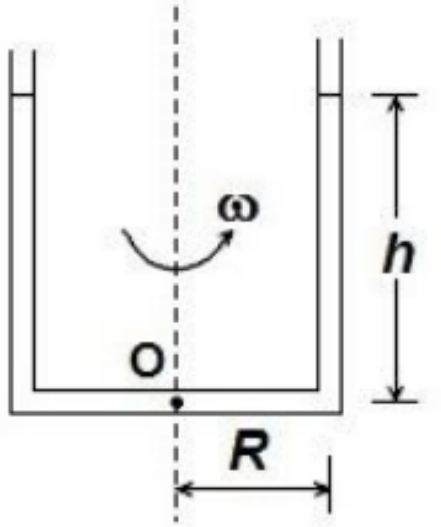


Fig. 31.

a) $\sqrt{\frac{p_a+2\rho gh}{\rho R^2}}$ b) $\sqrt{\frac{2(p_a+\rho gh)}{\rho R^2}}$ c) $\sqrt{\frac{p_a+2\rho gh}{2\rho R^2}}$ d) $\sqrt{\frac{p_a+\rho gh}{2\rho R^2}}$

32) An incompressible fluid at a pressure of 150 kPa (absolute) flows steadily through a two-dimensional channel with a velocity of 5 m/s as shown in the figure. The channel has a 90° bend. The fluid leaves the channel with a pressure of 100 kPa (absolute) and linearly varying velocity profile; $v_{\max}$ is four times $v_{\min}$. The density of the fluid is 914.3 kg/m^3. The velocity $v_{\min}$, in m/s, is: [GATE 2013 XE]

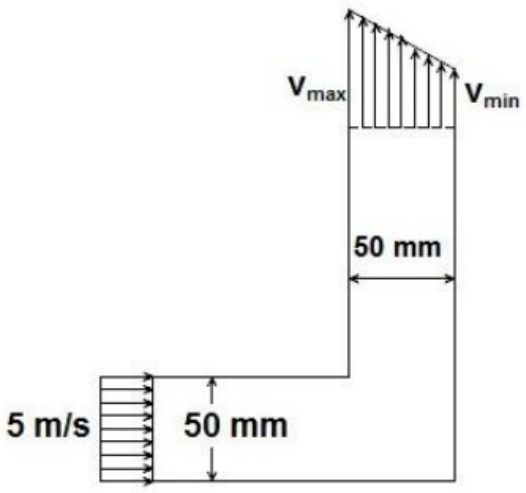


Fig. 32.

a) 25 b) 2.5 c) 2.0 d) 0.2

33) The velocity vector corresponding to a flow field is given by $\mathbf{V} = 3x\hat{i}+4y\hat{j}$. The magnitude of rotation at the point (2,2) in rad/s is: [GATE 2013 XE]

a) 0.75 b) 1.33 c) 2 d) 4

34) The stream function for a potential flow field is given by $\psi = x^2 - y^2$. The corresponding potential function, assuming zero potential at the origin, is: [GATE 2013 XE]

a) $x^2 + y^2$ b) $2xy$ c) $x^2 - y^2$ d) $x - y$

35) Fully developed flow of an oil takes place in a pipe of inner diameter 50 mm. The pressure drop per metre length of the pipe is 2 kPa. Determine the shear stress, in Pa, at the pipe wall _____. [GATE 2013 XE]

36) The Darcy friction factor f for a smooth pipe is given by $f = 64/\text{Re}$ for laminar flow and by $f = 0.3/\text{Re}^{0.25}$ for turbulent flow, where Re is the Reynolds number based on the diameter. For fully developed flow of a fluid of density 1000 kg/m^3 and dynamic viscosity 0.001 Pa.s through a smooth pipe of diameter 10 mm with a velocity of 1 m/s, determine the Darcy friction factor _____. [GATE 2013 XE]

37) Air flows steadily through a channel. The stagnation and static pressures at a point in the flow are measured by a Pitot tube and a wall pressure tap, respectively. The pressure difference is found to be 20 mm Hg. The densities of air, water and mercury, in kg/m^3, are 1.18, 1000 and 13600, respectively. The gravitational acceleration is 9.81 m/s^2. Determine the air speed in m/s _____. [GATE 2013 XE]

A. common data 38 and 39

The velocity field within a laminar boundary layer is given by the expression:

$$\mathbf{V} = \frac{Bu_\infty y}{x^{3/2}}\hat{i} + \frac{Bu_\infty y^2}{4x^{5/2}}\hat{j} \tag{6}$$

where $u = 100y^{1/2}$ m/s and $v = 0.01x/y$ m/s. The free stream velocity $U_\infty = 0.1$ m/s.

38) Calculate the x-direction component of the acceleration in m/s^2 at the point $x = 0.5$ m and $y = 50$mm_____. [GATE 2013 XE]

39) Find the slope of the streamline passing through the point $x = 0.5$ m and $y = 50$ mm_____. [GATE 2013 XE]

B. common data for 40 and 41

The wave and eddy resistance of a sea-going vessel, 96 m in length, driven at a velocity of 12 m/s, is to be determined. For this purpose, a 1/16$^{\text{th}}$ scale model is employed in fresh water and the coefficient of resistance C_{we} of the model is found to be 1.47×10^{-4}. The quantity C_{we} is defined as $C_{we} = R_{we}/brak\frac{1}{2}\rho V^2 L$, where R_{we} is the wave and eddy resistance, ρ is the fluid density, V is the velocity and L is the characteristic length. The density of sea water is 1026 kg/m^3.

40) The velocity in m/s, at which the model is towed, is: [GATE 2013 XE]

a) 0.75 b) 1.33 c) 3 d) 192

41) The resistance of the prototype, in kN, is: [GATE 2013 XE]

a) 6 b) 25 c) 26.9 d) 100.1

C. common data for 42 and 43

Water enters a symmetric forked pipe and discharges into atmosphere through the two branches as shown in the figure. The cross-sectional area of section-1 is 0.2 m^2 and the velocity across section-1 is 3 m/s. The density of water may be taken as 1000 kg/m^3. The viscous effects and elevation changes may be neglected.

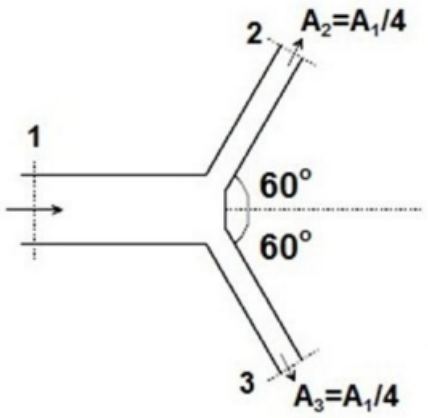


Fig. 41.

42) The gauge pressure at section-1, in kPa, is: [GATE 2013 XE]

a) 0.6 b) 13.5 c) 135 d) 600

43) The magnitude of the force, in kN, required to hold the pipe in place, is: [GATE 2013 XE]

a) 2.7 b) 5.4 c) 19 d) 27

USEFUL DATA:

Avogadro's Number	6.023×10^{23} mol^{-1}
Boltzmann's constant, k	1.38×10^{-23} J.K^{-1}
Electron Charge, e	1.6×10^{-19} C
Electron rest mass, m_0	9.1×10^{-31} kg
Gas Constant, R	8.314 J.mol^{-1}K^{-1}
Free Space Permittivity, ε_0	8.854×10^{-12} F.m^{-1}
Free Space magnetic permeability, μ_0	$4\pi \times 10^{-7}$ H.m^{-1}
Speed of light, c	3×10^{8} m.s^{-1}
Planck's constant, h	6.63×10^{-34} J.s^{-1}
Bohr Magneton, μ_b	9.27×10^{-24} A m^2

1 eV = 1.6×10^{-19} J
1 calorie = 4.2 J

44) As temperature increases, diffusivity of an atom in a solid material, [GATE 2013 XE]

a) increases
b) decreases
c) remains constant
d) depends on the specific material

45) Which of the following is NOT correct? [GATE 2013 XE]

a) Dislocations are thermodynamically unstable defects.
b) Dislocations can move inside a crystal under the action of an applied stress.
c) Screw dislocations can change the slip plane without climb.
d) Burger's vector of an edge dislocation is parallel to the dislocation line.

46) At a constant atmospheric pressure, the number of phases, P, which coexist in a system at equilibrium, is related to the number of components, C, and degree of freedom, F by [GATE 2013 XE]

a) $P + F = C - 2$
b) $P + F = C + 2$
c) $P + F = C + 1$
d) $P + F = C - 1$

47) Which one of the following metals is commonly alloyed with iron to improve its corrosion resistance? [GATE 2013 XE]

a) Co
b) Cr
c) Ti
d) Nb

48) The number of slip systems in a metal with FCC crystal structure is [GATE 2013 XE]

a) 4
b) 6
c) 8
d) 12

49) Upon recrystallization of a cold worked metal, [GATE 2013 XE]

a) strength increases and ductility decreases
b) strength decreases but ductility increases
c) both strength and ductility increase
d) both strength and ductility decrease

50) In carbon fiber reinforced resin composites, for a given fiber volume content, Young's modulus depends on fiber orientation with respect to load. Maximum value occurs when [GATE 2013 XE]

a) transverse
b) longitudinal
c) random
d) both transverse and longitudinal

51) Vulcanization is related to [GATE 2013 XE]

a) strengthening of rubber
b) extrusion
c) injection moulding
d) addition polymerisation

52) Which one of the following oxides crystallizes into fluorite structure? [GATE 2013 XE]

a) UO_2
b) MgO
c) $BaTiO_3$
d) $MgAl_2O_4$

53) Match the conventional ceramic materials listed in Column I with their respective common applications in Column II [GATE 2013 XE]

Column I	**Column II**
P. Lead Zirconate Titanate (PZT)	1. cutting tool
Q. Zinc Oxide (ZnO)	2. thermal barrier coating
R. Silicon Carbide (SiC)	3. actuator
S. Zirconia (ZrO_2)	4. varistor
	5. super conductor

a) P-1, Q-2, R-3, S-5
b) P-3, Q-2, R-1, S-5
c) P-2, Q-1, R-5, S-3
d) P-3, Q-4, R-1, S-2

54) Match the terminologies given in Column I with their relations listed in Column II[GATE 2013 XE]

Column I	Column II
P. domain wall	1. superconductors
Q. Fick's law	2. mechanical properties
R. Matthiessen's rule	3. ferromagnetic materials
S. Hall-Petch relation	4. resistivity of impure metals
T. Meissner effect	5. diffusion

a) P-1, Q-3, R-5, S-2, T-4
b) P-3, Q-5, R-2, S-4, T-1
c) P-3, Q-5, R-4, S-2, T-1
d) P-3, Q-4, R-3, S-2, T-4

55) Match the microscopes listed in Column I with their principle of operation listed in Column II[GATE 2013 XE]

Column I	Column II
P. Scanning Electron Microscope (SEM)	1. van der Waals forces between atoms
Q. Transmission Electron Microscope (TEM)	2. electrons to jump across a potential barrier
R. Scanning Tunnelling Microscope (STM)	3. diffraction of electrons
S. Atomic Force Microscope (AFM)	4. detection of secondary electrons
	5. photo emission of electrons

a) P-2, Q-5, R-3, S-1
b) P-3, Q-4, R-5, S-2
c) P-4, Q-3, R-2, S-1
d) P-4, Q-3, R-5, S-2

56) X-rays of unknown wavelength are diffracted by an FCC metal with a lattice parameter of 0.352 nm. The measured 2θ angle for the {200} peak is 61.08°. Calculate the wavelength of the X-ray used, in nm. _____ [GATE 2013 XE]

57) A metal with HCP crystal structure has lattice constants a = 0.30 nm and c = 0.56 nm. Determine the volume of the unit cell of this metal, in nm^3. _____ [GATE 2013 XE]

58) The band gap of a semiconducting material used to make an LED is 1.43 eV. What will be the minimum wavelength of the radiation emitted by this LED, in μm? _____ [GATE 2013 XE]

59) For automatic control of household electric water heater, a relay switch is activated by thermal expansion of a brass rod of length 50 cm as shown in the schematic below. The distance between the rod and the lever, x, is adjusted by moving the base of the rod. As the water gets heated, the rod expands and as soon as the rod touches the lever, the circuit is broken disconnecting the heater from the power supply. Find the distance, x, in mm, to be set at water temperature of 20°C such that the circuit is broken at 70°C. The coefficient of linear thermal expansion of brass is $20 \times 10^{-6}\ ^{\circ}C^{-1}$. _____.

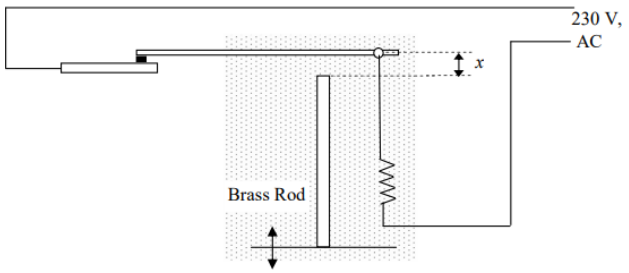


Fig. 59.

Common Data for Questions 60 and 61:
From tensile test of a particular alloy, the following values were obtained. The material exhibits linear work hardening as shown in the figure below.

	At Yield	At Fracture
Stress (GPa)	0.7	0.8
Strain (%)	1	4

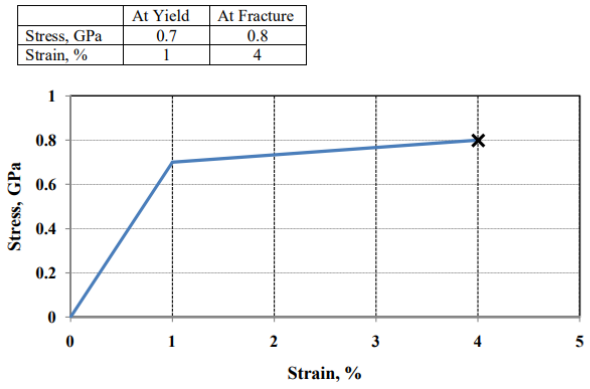


Fig. 59.

60) If the cylindrical specimen had a diameter of 10 mm and a length of 50 mm, find the length of the specimen at the yield point, in mm. _____ [GATE 2013 XE]

61) Find the toughness of the material, in MJ m^{-3}. _____ [GATE 2013 XE]

Common Data for Questions 63 and 62:

An isomorphous alloy system contains 47 wt% of A and 53 wt% of B and is at 1300°C. Referring to the phase diagram shown below, answer the following:

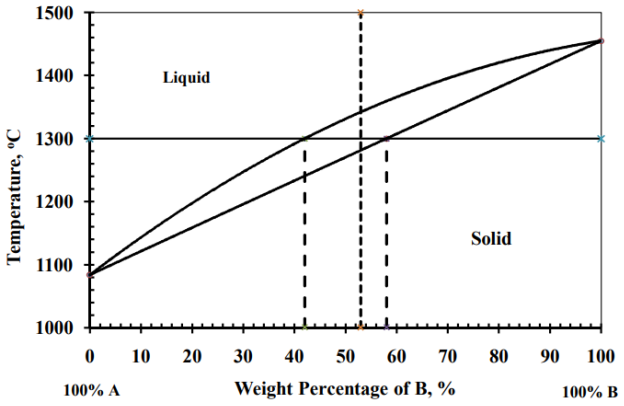


Fig. 61.

62) What is the weight percentage of A in solid phase at this temperature? _____ [GATE 2013 XE]

63) What weight percentage of this alloy is liquid? _____ [GATE 2013 XE]

Linked Answer Questions — Statement for Q.64 and Q.65:

A stress of 10 MPa is applied to an elastomer to generate a strain of 50%. The strain is held constant at this value. After 40 days at 20°C, the stress decreases to 5 MPa.

64) What is the **relaxation time constant** for this material? _____ [GATE 2013 XE]

65) What will be the **stress after 60 days** at 20°C? _____ [GATE 2013 XE]

66) At a point in a body subjected to plane stress, the state of stress is as shown in the Figure. One of the principal stresses is 180 MPa. Find the unknown shear stress τ (in MPa). _____ [GATE 2013 XE]

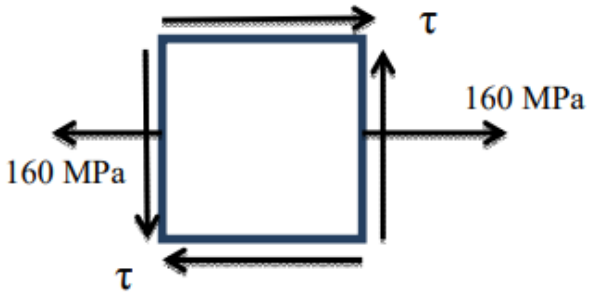


Fig. 66.

67) A point in a body is subjected to a hydrostatic pressure of 100 MPa. Find the maximum shear stress at this point in MPa. _____ [GATE 2013 XE]

68) A circular shaft of diameter 10 mm and length 3 m is subjected to a torque of $T = \pi$ N · m at a location 2 m away from the fixed end as shown in the Figure. Find the angle of twist (in radians) at the free end. Shear modulus of the material of the shaft is 10 GPa. _____ [GATE 2013 XE]

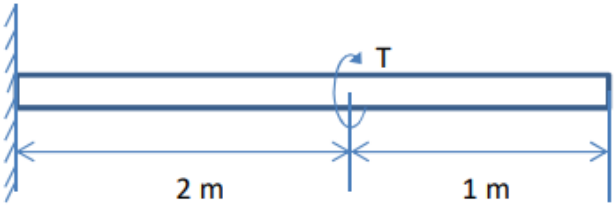


Fig. 68.

69) A rigid massless rod ABC is hinged at A and carries a point mass M (in kg) at C. Point B is connected to a linear spring with spring constant k (in N/m) as shown in the figure. The length AB and AC are a and L, respectively. Neglecting the effect of gravity, the natural frequency of this spring–mass system in rad/s is: [GATE 2013 XE]

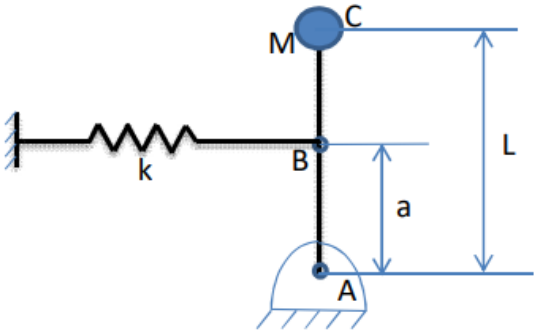


Fig. 69.

a) $\sqrt{\frac{kL^2}{Ma^2}}$ b) $\sqrt{\frac{ka}{Ml}}$ c) $\sqrt{\frac{ka^2}{ML^2}}$ d) $\sqrt{\frac{kL}{Ma}}$

70) A two–bar truss is shown in the Figure. The cross–sectional area and Young's modulus of bar 1 are 0.02 m^2 and 200 GPa, respectively. The cross–sectional area and Young's modulus of bar 2 are

0.01 m^2 and 80 GPa, respectively. The force F applied on the truss is 2 N. Find the stress developed in bar 2 in Pa. _____

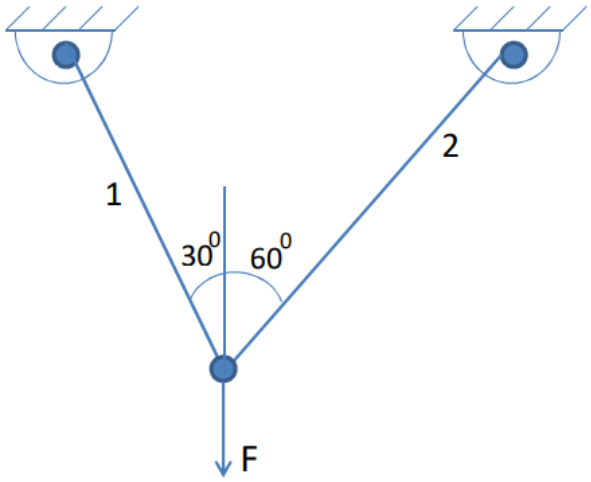


Fig. 70.

71) A spring balance reads 10 kg in a lift when the lift is stationary. When the lift starts moving with a constant acceleration, the new reading is 12.3 kg. If the upward acceleration is considered positive, what is the acceleration of the lift? Acceleration due to gravity may be taken as 10 m/s^2 downwards. _____

72) A force F = 2 N is applied on a block of mass M = 0.5 kg as shown in the figure. The block is constrained to move along the horizontal direction in a guideway. Find the distance (in meters) travelled by the block in 2 s starting from rest. Neglect any friction between the block and the guideway. _____

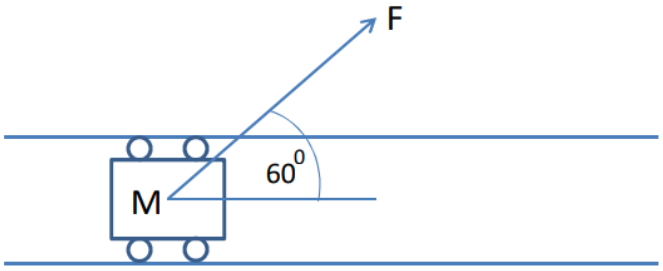


Fig. 72.

73) A man of mass 50 kg is walking on a long wooden board of mass 200 kg (as shown in the Figure). The wooden board is initially at rest on a frictionless ice surface. If the man walks with a velocity V = 1 m/s in the positive x direction relative to the wooden board, find the velocity of the board in m/s. Velocity is positive in the positive x direction. _____

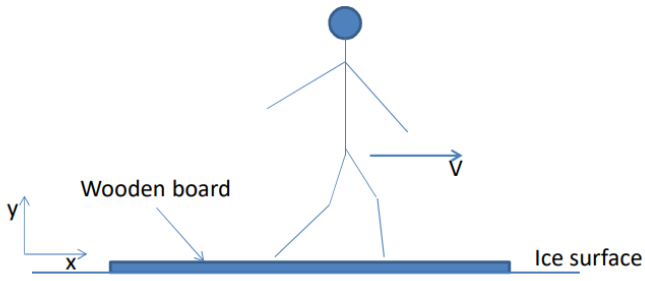


Fig. 73.

74) A rigid bar AB is hinged at B through a torsional spring with spring constant k_t. For small rotations of the bar AB about B, the critical load P_{cr} is given by:

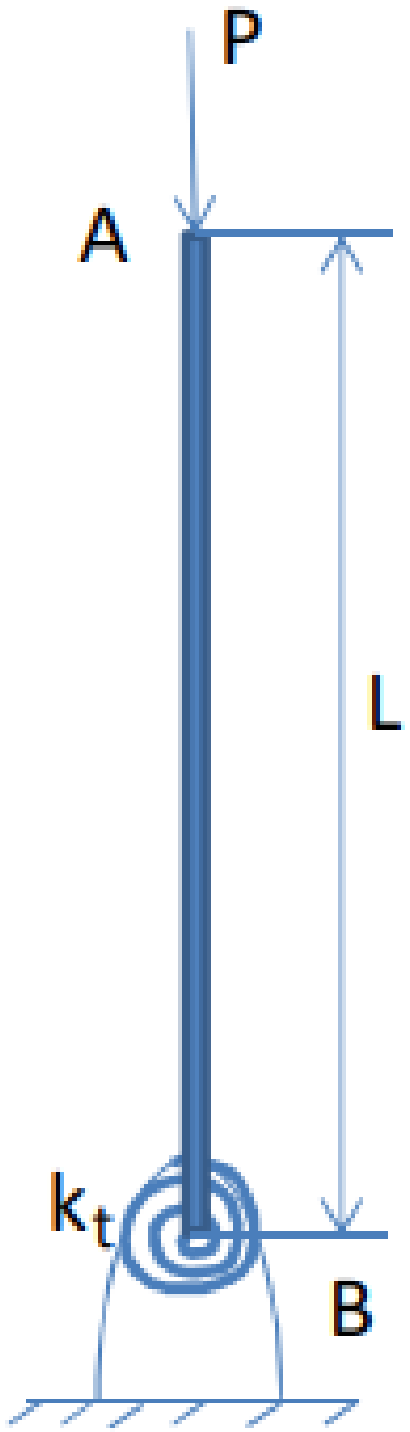


Fig. 74.

a) $\frac{\pi^2 EI}{L^2}$
b) $\frac{\pi^2 EI}{L}$
c) $\frac{EI}{L^3}$
d) $\frac{k_t}{L}$

75) A disk of mass M = 14 kg and radius 1 m is attached to a spring which has a stiffness k = 75 N/m and an unstretched length of 1 m. If the disk is released from rest in the position shown in the Figure and the disk rolls without slipping, find its angular velocity (in rad/s) at the instant the center of mass is displaced by 3 m. _____

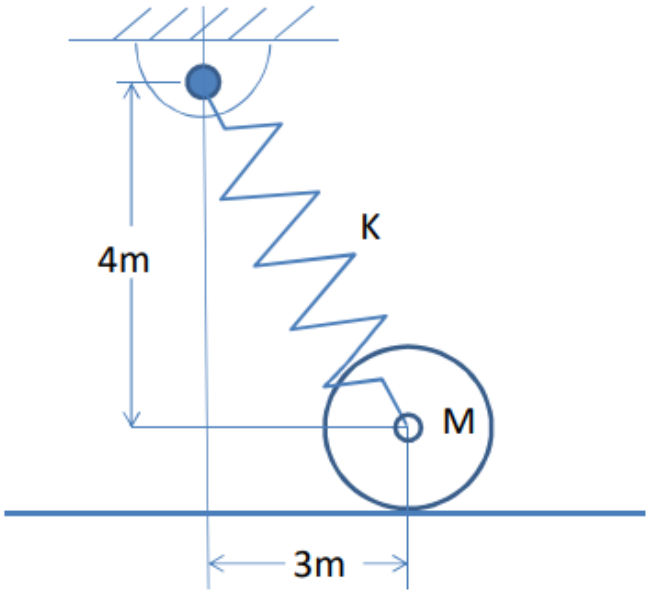


Fig. 75.

76) A strain gauge is mounted on the outer surface of a thin cylindrical pressure vessel in the circumferential direction. The mean diameter and thickness of the cylinder are 4.0 m and 20 mm, respectively. Young's modulus and Poisson's ratio of the material of the cylinder are 200 GPa and 0.25, respectively. Find the pressure in MPa inside the cylindrical vessel when the strain gauge indicates a strain of 7.0×10^{-4}. _____

77) A solid shaft of diameter 100 mm is rotating at a constant angular speed of $(10/\pi)$ rad/s. The shaft carries three rigid pulleys A, B and C as shown in the Figure. Pulley B is connected to a motor supplying 10 kW power. Pulley B and C are connected to two pumps consuming 5 kW each. Find the maximum shear stress (in MPa) in the shaft due to torsion alone. _____

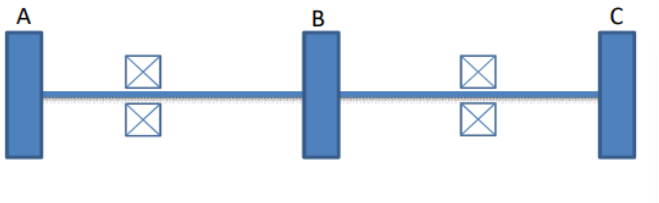


Fig. 77.

78) A beam is fixed at the left end and supported by a spring at the other end. The length of the beam is L and its flexural rigidity is EI. The spring constant of the spring is $k = \frac{3EI}{L^3}$. A vertical downward load P is applied at the right end. The deflection of the point under the load P is:

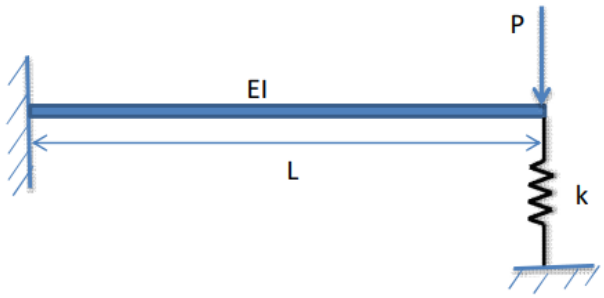


Fig. 78.

a) $\frac{PL^3}{9EI}$
b) $\frac{PL^3}{6EI}$
c) $\frac{2PL^3}{9EI}$
d) $\frac{5PL^3}{9EI}$

79) Find the maximum bending moment (magnitude wise) in kN–m for the beam shown in the Figure. _____

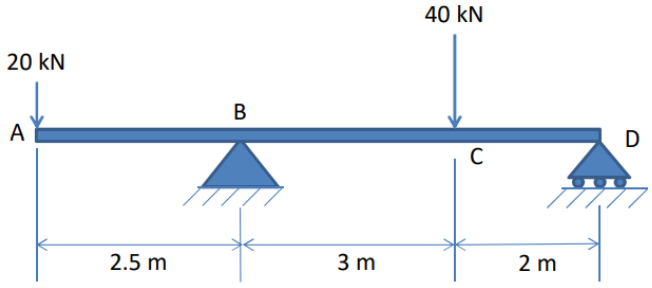


Fig. 79.

80) A projectile is fired with velocity $V = 3\sqrt{2}$ m/s from a point at height $H = 0.8$ m at an angle of 45° with respect to the horizontal directionn as shown in the Figure. Find the horizontal distance S in meters travelled by the projectile when it hits the ground. Take $g = 10$ m/s^2. Find the horizontal distance S in meters travelled when it hits the ground. _____

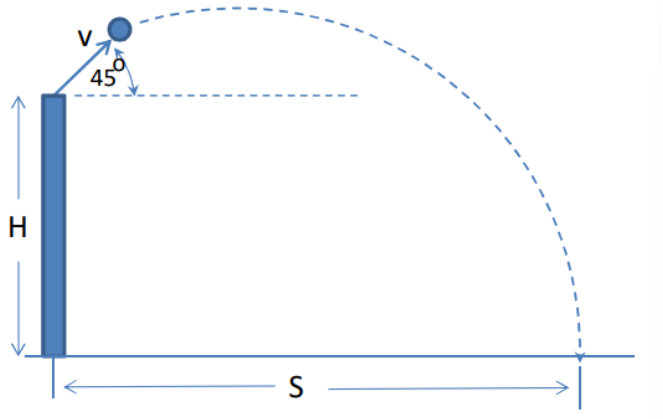


Fig. 80.

81) A particle P is moving on a circular path of radius $r = 1$ m . The angular location of the particle is measured as shown in the Figure. The motion of the particle is described by $\theta(t) = 2\sin t$. Find the magnitude of the total acceleration (in m/s2) of the particle at time $t = \pi/3$ s (m/s^2): _____

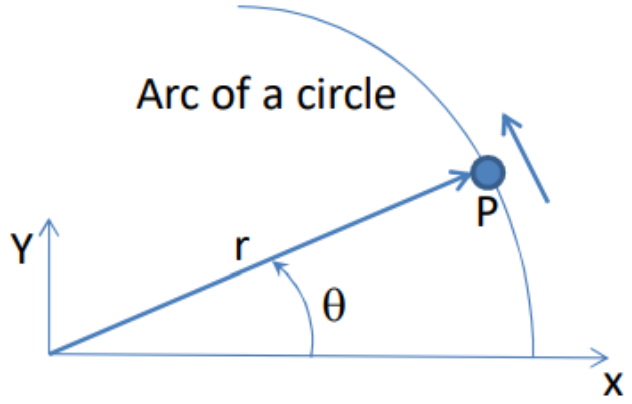


Fig. 81.

Common Data for Q.17–Q.18: A frame ABC is shown in the Figure. Members AB and BC both have length L and Young's modulus E. Members AB and BC both have a square cross-section of side a. A load P is applied at point C as shown in the figure.

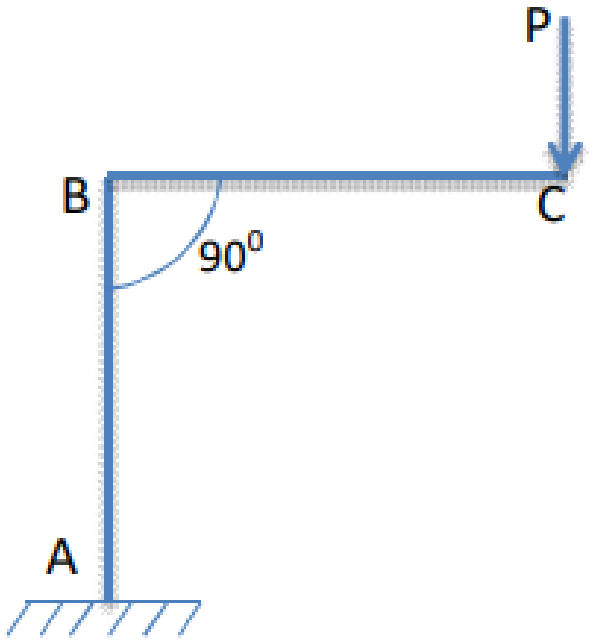


Fig. 81.

82) Neglecting axial compression of AB, the deflection of C in the direction of the load is:

a) $\frac{PL^3}{3EI}$
b) $\frac{PL^3}{6EI}$
c) $\frac{PL^3}{8EI}$
d) $\frac{PL^3}{12EI}$

83) The maximum bending stress in the frame is:

a) $\frac{PL}{a^3}$
b) $\frac{2PL}{a^3}$
c) $\frac{3PL}{a^3}$
d) $\frac{4PL}{a^3}$

Common Data for Q.19–Q.20: Plane stress state shown.

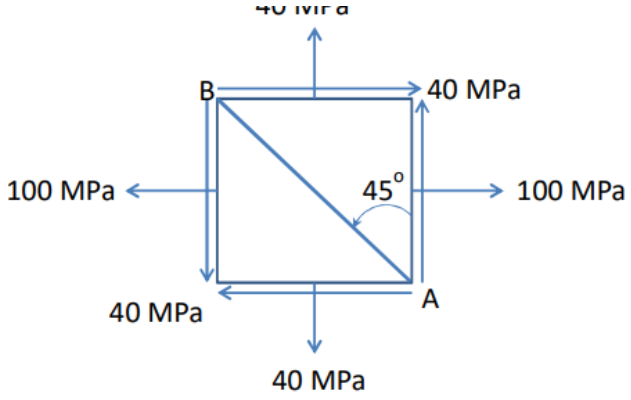


Fig. 83.

84) One principal stress (MPa): [GATE 2013 XE]

a) 40 b) 80 c) 120 d) 140

85) Normal stress on plane AB (MPa): [GATE 2013 XE]

a) 30 b) 70 c) 100 d) 110

Linked Answer Q.21–Q.22: Two rods are joined together and the entire assembly is supported between two rigid walls, as shown in the Figure. The cross-sectional area and Young's modulus for both the rods are $A = 0.01$ m^2 and 10 GPa, respectively. The coefficients of thermal expansion for the two rods are $\alpha_1 = 4 \times 10^{-6}/^{\circ}$C, $\alpha_2 = 10^{-6}/^{\circ}$C, respectively. The entire assembly is heated by 100°C. Neglect the effect of Poisson's ratio.

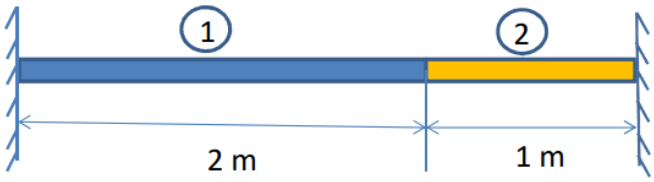


Fig. 85.

86) Stress in rod 1 (MPa): [GATE 2013 XE]

a) −4.0 b) −3.0 c) −2.5 d) −1.0

87) Considering the displacement to the right as positive, the displacement (in mm) of the interface between the two rods is: [GATE 2013 XE]

a) −0.4 b) −0.1 c) 0.1 d) 0.4

88) The measured temperature of a system is 30°C. Its exact absolute temperature in K is [GATE 2013 XE]

a) 303.00 b) 303.10 c) 303.15 d) 303.16

89) The fuel air mixture in a petrol engine is ignited with a spark plug at the end of compression stroke. This process [GATE 2013 XE]

a) increases the entropy of the fuel air mixture but decreases the entropy of the spark plug
b) decreases the entropy of the fuel air mixture but increases the entropy of the spark plug
c) decreases the entropy of the fuel air mixture and of the spark plug
d) increases the entropy of the fuel air mixture and of the spark plug

90) In the van der Waals equation of state given below: [GATE 2013 XE]

$$\left(p + \frac{a}{v^2}\right)(v - b) = RT \tag{7}$$

The constant a represents the effect of

a) attractive forces between molecules
b) repulsive forces between molecules
c) deviation from molecules being spherical
d) finite size of the molecule

91) For a reversible isothermal expansion of an ideal gas from a state 1 to a state 2, [GATE 2013 XE]

a) $s_1 = s_2$ b) $s_1 > s_2$ c) $s_1 < s_2$ d) $h_1 > h_2$

92) For a pure substance the critical isotherm on the $p - v$ plane exhibits [GATE 2013 XE]

a) a maximum b) a minimum c) a point of inflection d) a discontinuity

93) For an ideal gas as a working fluid for a given heat input Q, the process that gives the maximum work among the following four processes is [GATE 2013 XE]

a) isothermal b) constant volume c) constant pressure d) isentropic

94) An air standard Otto cycle has the following shape on a thermodynamic property plane. [GATE 2013 XE]

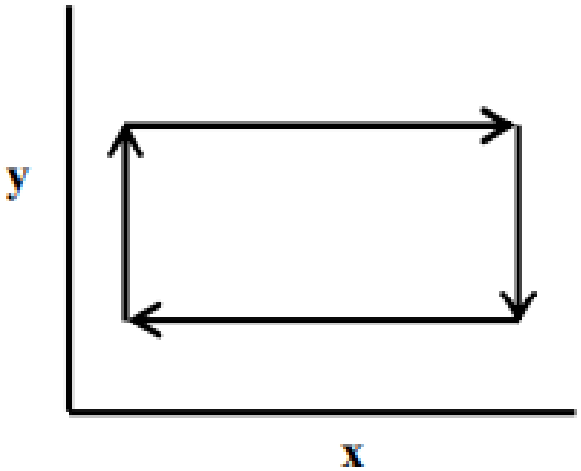


Fig. 94.

The x and y coordinates, respectively, are

a) v and p b) s and v c) v and T d) s and p

95) The specific volume of steam after expansion in a turbine is 12 m^3/kg. At this pressure the saturated liquid and saturated vapour specific volumes are 0.001 and 15.25 m^3/kg respectively. What is the dryness fraction to second decimal place accuracy? _____ [GATE 2013 XE]

96) Which of the following processes, shown in the figure below, represents the throttling of an ideal gas? [GATE 2013 XE]

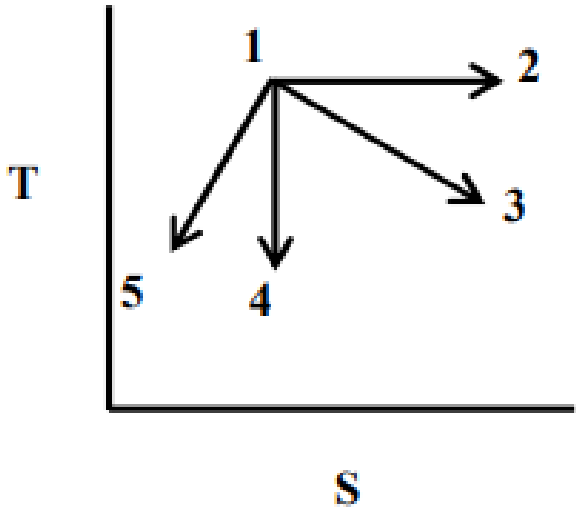


Fig. 96.

a) 1 to 2 b) 1 to 3 c) 1 to 4 d) 1 to 5

97) On a $\ln p$ vs h coordinate system, where $\ln p$ is the y-coordinate and h is the x coordinate, the slope of a constant entropy line is [GATE 2013 XE]

a) $1/v$ b) v c) p/v d) $1/(pv)$

98) Starting from the definition of Gibbs free energy function $g = h - Ts$, the Maxwell relation that can be derived is [GATE 2013 XE]

a) $\left(\frac{\partial T}{\partial p}\right)_s = \left(\frac{\partial v}{\partial s}\right)_p$ b) $\left(\frac{\partial T}{\partial p}\right)_s = v$ c) $\left(\frac{\partial s}{\partial p}\right)_T = -\left(\frac{\partial v}{\partial T}\right)_p$ d) $\left(\frac{\partial s}{\partial p}\right)_T = -\left(\frac{\partial p}{\partial T}\right)_v$

99) A thermodynamic cycle operates between one source at a temperature of 600 K, another source at a temperature of 300 K and a sink at a temperature T as shown in the figure below. If the First and Second laws of thermodynamics are not violated, what should be the value of T in K? _____ [GATE 2013 XE]

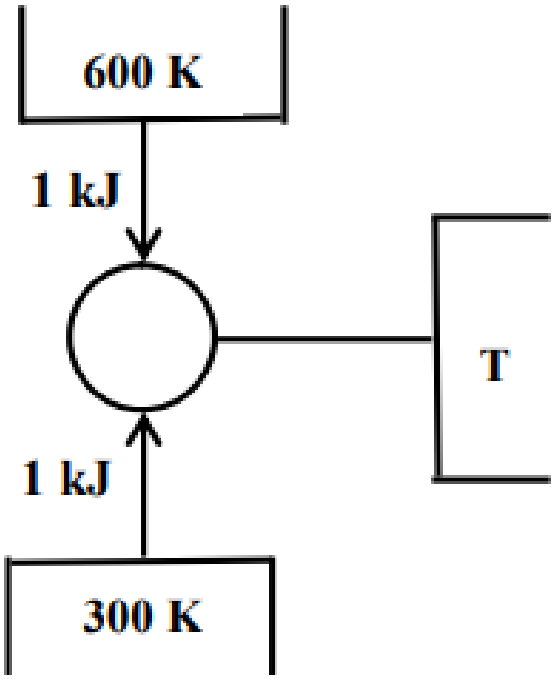


Fig. 99.

100) A closed system containing an ideal gas undergoes a cycle as shown in the figure below. For the process 1–2, which one of the following statements is true?

[GATE 2013 XE]

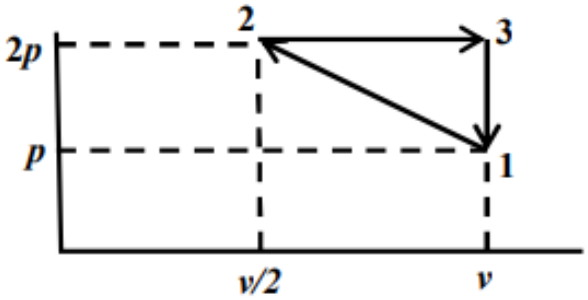
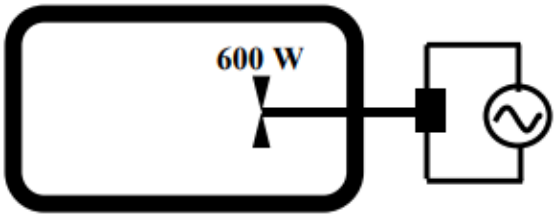


Fig. 100.

a) Heat added = $pv \ln 2$
b) Heat rejected = $pv \ln 2$
c) Heat added = pv
d) Heat rejected = pv

101) A well-insulated rigid hot water tank receives steady flow of water from two sources as shown in the figure below. There is no accumulation of water in the tank. A back-up heater is provided to ensure a constant outflow temperature of water at 60°C from the tank under steady state. What is the required capacity of the back-up heater to the nearest kW? _____

[GATE 2013 XE]



H

Fig. 102.

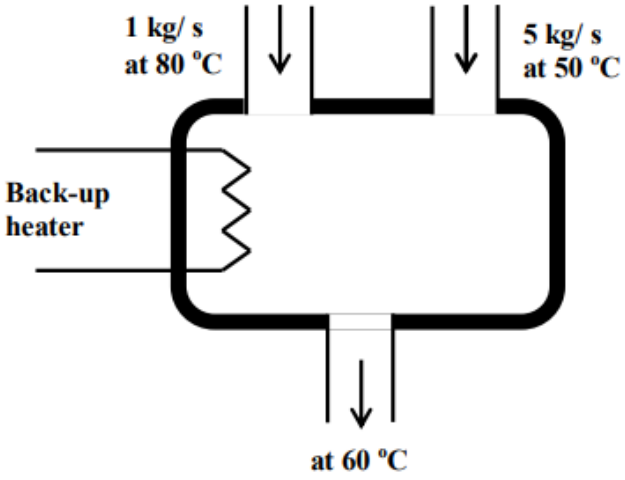


Fig. 101.

102) 1 kg of air in an insulated rigid tank of volume 1 m^3 is churned with a frictionless fan of 600 W capacity for 10 minutes. The fan efficiency is 100%. Treating air as an ideal gas and neglecting kinetic and potential energy changes, what is the increase of pressure, to the nearest kPa? _____

[GATE 2013 XE]

103) The isothermal compressibility of a liquid is 5×10^{-6} /kPa. If it is compressed at constant temperature from 5000 to 10000 kPa, what is the ratio of final volume to initial volume, to second decimal place accuracy? _____

[GATE 2013 XE]

common data for 104 and 105

At a location where the atmospheric pressure is 98 kPa and the ambient temperature is 30°C, the humidity ratio is 0.01 kg/kg of dry air. A high pressure front moves over the location which changes only the atmospheric pressure to 102 kPa, while the humidity ratio remains the same.

104) What is the partial pressure of water vapour in kPa to the first decimal place accuracy before the high pressure front moves in? _____

[GATE 2013 XE]

105) , what is the relative humidity of air under the influence of high pressure front to integer precision in %? _____

[GATE 2013 XE]

common data for 106 and 107

A rigid insulated cylinder is divided into two chambers A and B by a thin rigid insulating barrier as shown in the figure below. Initially, chamber A contains a mixture of 0.5 kg nitrogen and 0.5 kg helium at 300 K while chamber B contains 1 kg of pure nitrogen at 400 K. The pressure in chamber B is twice that in chamber A. The gases and gas mixtures are assumed to be ideal.

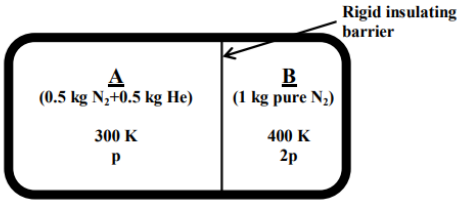


Fig. 105.

106) What is the ratio of the volumes of chambers A and B, i.e., V_A/V_B, to first decimal place accuracy? _____

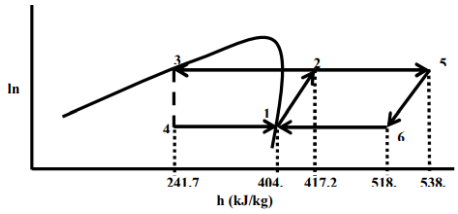
[GATE 2013 XE]

107) For the same data as in Q.19, if the barrier is removed and the gases are allowed to mix and reach thermodynamic equilibrium, what is the final temperature of the mixture, to the nearest K? _____

[GATE 2013 XE]

common data for 108 109

A combined vapour compression-cum-Brayton cycle is shown below.



1-2: Isentropic compression, 5-6: isentropic expansion.

Fig. 107.

The refrigeration system has a cooling capacity of 30 kW and the turbine generates a power of 30 kW.

108) What is the mass flow rate of the working fluid through the turbine, in kg/s, to first decimal place accuracy? _____

[GATE 2013 XE]

109) what is the power required to drive the compressor, to the nearest kW? _____

[GATE 2013 XE]

110) In free radical polymerization, one of the following techniques permits simultaneous increase in rate of polymerization and polymer molecular weight. [GATE 2025 XE]

a) Solution polymerization
b) Suspension polymerization
c) Bulk polymerization
d) Emulsion polymerization

111) The shear modulus, G, of plastic is related to the elastic modulus, E, and the Poisson ratio, ν, as [GATE 2025 XE]

a) $E = 2(1 - \nu)G$
b) $G = 2(1 + \nu)E$
c) $E = 2(1 + \nu)G$
d) $E = (1 + \nu)G$

112) LLDPE is obtained by [GATE 2025 XE]

a) Ziegler-Natta polymerization of ethylene
b) free-radical polymerization of ethylene
c) free-radical polymerization of ethylene and alpha-olefins
d) Ziegler-Natta copolymerization of ethylene and alpha-olefins

113) A hindered phenol is added to a polyolefin [GATE 2025 XE]

a) to increase ozone resistance
b) to increase foamability
c) to increase oxidation resistance
d) to increase crosslinkability

114) Stretching of rubber leads to [GATE 2025 XE]

a) decrease in alignment of polymer chains
b) increase in alignment of polymer chains
c) no change in alignment of polymer chains
d) decrease in strength of rubber

115) In a cone and plate viscometer, the rate of strain is related to the speed of rotation of the cone, ω (radian/second), and the angle between the cone and the plate, α (radian), by the following relation [GATE 2025 XE]

a) $\omega\alpha$
b) $\omega \cos \alpha$
c) $\frac{\omega}{\alpha}$
d) $\frac{\alpha}{\omega}$

116) The tensile breaking strength of polycarbonate (I), low density polyethylene (II), polystyrene (III) and polypropylene (IV) can be arranged as [GATE 2025 XE]

a) IV > II > I > III
b) I > II > IV > III
c) I > III > IV > II
d) III > I > II > IV

117) High molecular weight polymers could be obtained even at low monomer conversion in case of [GATE 2025 XE]

a) Step growth polymerization
b) Living polymerization
c) Chain growth polymerization
d) Solid state polymerization

118) A reinforced polymer composite is made by the incorporation of [GATE 2025 XE]

a) elastomers into the polymer
b) fibers into the polymer
c) plasticizers into the polymer
d) gaseous additives into the polymer

119) Match the following for free-radical copolymerization of two monomers with reactivity ratios, r_1 and r_2.

Reactivity Ratios:

a) $r_1 = r_2 = 0$
b) $r_1 = r_2 = 1$
c) $r_1 > 1, r_2 > 1$
d) $0 < r_1 r_2 < 1$

Copolymer Nature:

a) Random copolymer
b) Alternate copolymer
c) Block copolymer
d) Random-Block copolymer

(A) P-2; Q-1; R-3; S-4
(B) P-3; Q-1; R-2; S-4
(C) P-2; Q-4; R-3; S-1
(D) P-2; Q-3; R-1; S-4

120) The relative viscosity of a 1% solution (weight/volume) of a given polymer was found to be 1.1. The inherent viscosity of this polymer will be

(A) 0.065 dl/g (B) 0.075 dl/g (C) 0.085 dl/g (D) 0.095 dl/g

121) Match the following in case of step-growth polymerization, where A reacts only with B, and B reacts only with A (Note: A–A is expressed as A_2, and A–B is expressed as AB_2).

Monomers:	**Polymer:**
a) $A_2 + AB_3$	a) Hyperbranched Polymer
b) AB_2	b) Crosslinked Polymer
c) $AB + B_3$	c) Star Polymer
d) $A_2 + B_2$	d) Linear Polymer

(A) P-2; Q-3; R-1; S-4 (C) P-1; Q-2; R-3; S-4
(B) P-2; Q-1; R-3; S-4 (D) P-2; Q-4; R-1; S-3

122) Match each of the following additives for plastics with its function.

Additive:	**Function:**
a) α-Cellulose	a) Flame retarder
b) Zinc chromate	b) Plasticizer extender
c) Alumina trihydrate	c) Organic fibrous filler
d) Chlorinated paraffin wax	d) Colorant

(A) P-1; Q-2; R-3; S-4 (C) P-3; Q-4; R-1; S-2
(B) P-2; Q-3; R-4; S-1 (D) P-4; Q-1; R-2; S-3

123) The length of a glass fiber reinforced polymer increased by 0.03mm, from its initial length of 100mm, when the temperature was changed from -30°C to $+30^{\circ}$C. The coefficient of linear thermal expansion is

(A) 1.03×10^{-5} °C^{-1} (B) 9.82×10^{-6} °C^{-1} (C) 5.00×10^{-6} °C^{-1} (D) 14.4×10^{-5} °C^{-1}

124) A 40mm x 40mm square polymer composite sample with 5mm thickness (heat transfer distance) exhibited a heat flow rate of 60W, when the temperatures of the warm and cold surfaces were 90°C and 25°C respectively. The thermal conductivity of the sample in W.m^{-1}.K^{-1} is

(A) 5.67 (B) 15.3 (C) 2.88 (D) 0.667

125) An extruder is supplied with 40 kW of power. The mass flow rate of a polymer through the extruder is 240 kg h^{-1} and the specific heat capacity of the polymer is 4 kJ kg^{-1} K^{-1}. The maximum possible temperature rise in the polymer is

(A) 150 K (B) 100 K (C) 600 K (D) Zero

Common Data for Questions 126 and 127:
For a given free-radical polymerization, the only mode of termination is the bimolecular termination and there is no chain transfer. The final polymer produced was analyzed to contain an average of 1.60 initiator fragments per polymer chain.

126) Percentage of final polymer chains containing one initiator fragment per chain is [GATE 2013 XE]

a) 40% b) 50% c) 60% d) 70%

127) Percentage of polymer radicals terminated by coupling is [GATE 2013 XE]

a) 65% b) 75% c) 85% d) 95%

Common Data for Questions 128 and 129:
For the synthesis of polyester, 1.5 mole of pentaerythritol (tetra-ol) was reacted with 1.0 mole of a tricarboxylic acid.

128) The extent of reaction when the number average degree of polymerization of the reaction mixture approaches infinity is [GATE 2013 XE]

a) 80.33% b) 83.33% c) 84.33% d) 86.33%

129) The number average degree of polymerization of the reaction mixture when the polymerization was stopped at 80% conversion, is [GATE 2013 XE]

a) 1000 b) 100 c) 50 d) 25

Linked Answer Questions 130 and 131:
A viscoelastic fluid is modeled as a spring and two dashpots, all connected in series. The spring has elastic modulus G and the fluids in two dashpots have viscosities η_1 and η_2.

130) The constitutive equation (relation between stress σ and strain γ in which overdot represents the time derivative) for the fluid is: [GATE 2013 XE]

a) $\sigma = G\gamma + (\eta_1 + \eta_2)\dot{\gamma}$
b) $\sigma = G\gamma + (\eta_1 - \eta_2)\dot{\gamma}$
c) $\dot{\gamma} = \frac{\sigma}{G} + \left(\frac{1}{\eta_1} + \frac{1}{\eta_2}\right)\sigma$
d) $\dot{\gamma} = \frac{\sigma}{G} + \frac{\eta_1 - \eta_2}{\eta_1 + \eta_2}\sigma$

131) For a periodic stress $\sigma = \sigma_0 e^{i\omega t}$, the strain is given by [GATE 2013 XE]

a) $\gamma = \sigma_0 \left[\frac{1}{G} + \frac{1}{\eta_1}\left(\frac{1}{\eta_1} + \frac{1}{\eta_2}\right)\right] e^{i\omega t}$
b) $\gamma = \sigma_0 \left[\frac{1}{G} - \frac{1}{\eta_1}\left(\frac{1}{\eta_1} + \frac{1}{\eta_2}\right)\right] e^{i\omega t}$
c) $\gamma = \left[\sigma_0 + (\eta_1 + \eta_2)\omega i\right] \frac{e^{i\omega t}}{G}$
d) $\gamma = \left[\sigma_0 - (\eta_1 + \eta_2)\omega i\right] \frac{e^{i\omega t}}{G}$

132) Kawashiorikor disease is caused due to the deficiency of

a) lysine
b) unsaturated fatty acids
c) vitamin K
d) protein

133) Which of the following statements is TRUE in case of oxidative rancidity of vegetable oils and fats?

a) It is caused by the reaction of saturated fatty acids and oxygen
b) It involves polymerization of fatty acids
c) It is caused by the reaction of unsaturated fatty acids with oxygen
d) It is caused by oxidative enzymes

134) The food borne disease, Q fever is caused by the organism,

a) Clostridium perfringens
b) Coxiella burnetti
c) Bacillus cereus
d) Staphylococcus aureus

135) The primary bacterial spoilage of poultry meat at low temperature, with characteristic sliminess at outer surface, is caused by

a) Pseudomonas spp. b) Aspergillus spp. c) Bacillus spp. d) Candida spp.

136) The weight gain (in gram) per gram protein consumed is called

a) Net Protein Ratio (NPR)
b) Biological Value (BV)
c) Protein Efficiency Ratio (PER)
d) Chemical Score (CS)

137) Which of the following carbohydrates is NOT classified as dietary fibre?

a) Agar b) Pectin c) Sodium alginate d) Tapioca starch

138) In the extruder barrel, the compression is achieved by back pressure created by the die and by

a) increasing pitch and decreasing diameter of the screw
b) using the tapered barrel with constant pitch
c) increase in the clearance between barrel surface and screw
d) opening of the die

139) The brown colour of bread crust during baking is due to Maillard reaction between

a) aldehyde groups of sugars and amino groups of proteins
b) aldehyde groups of sugars and vitamins
c) aldehyde groups of sugars and salt
d) starch and yeast

140) Blanching influences vegetable tissues in terms of

a) enzymes production
b) alteration of cytoplasmic membrane
c) stabilization of cytoplasmic proteins
d) stabilization of nuclear proteins

141) Match the toxicants of plant foods in Group I with their main plant source given in Group II.

Group I	Group II
A. Gossypol	1. Khesari Dal (*Lathyrus sativus*)
B. Vicine	2. Cotton seeds
C. Glucosinolates	3. Beans
D. BOAA (Beta-N-Oxalyl Amino L-Alanine)	4. Mustard

a) P-2, Q-3, R-4, S-1
b) P-2, Q-4, R-3, S-1
c) P-3, Q-1, R-2, S-4
d) P-4, Q-3, R-1, S-2

142) Match the products in Group I with the enzymes used for their preparation given in Group II.

Group I	Group II
A. Aspartame	1. Lipase
B. Cocoa butter substitute	2. Glucose isomerase
C. High fructose corn syrup	3. Thermolysin
D. Lactose free milk	4. Trypsin
	5. Beta galactosidase

a) P-2, Q-1, R-4, S-3
b) P-3, Q-1, R-2, S-5
c) P-1, Q-3, R-2, S-4
d) P-2, Q-5, R-4, S-5

143) Match the food items in Group I with the type of colloidal dispersion given in Group II.

Group I	Group II
A. Mayonnaise	1. Sol
B. Tomato ketchup	2. Emulsion
C. Cake	3. Gel
D. Jelly	4. Solid foam

a) P-2, Q-1, R-2, S-3
b) P-3, Q-2, R-4, S-1
c) P-2, Q-3, R-4, S-1
d) P-2, Q-1, R-4, S-3

144) **Assertion:** In the presence of sucrose, the temperature and time for gelatinization of starch increases. **Reason:** Sucrose, due to its hygroscopic nature, competes with starch for water needed for gelatinization.

a) Both [a] and [r] are true and [r] is the correct reason for [a]
b) Both [a] and [r] are true but [r] is not the correct reason for [a]
c) Both [a] and [r] are false
a is true but [r] is false

145) Thermal death of viable spores of *Bacillus subtilis* in a food sample follows a first order kinetics with a specific death rate constant of 0.23 min^{-1} at 100°C. The time (in minutes) required to kill 99% of spores in the food sample at 100 $^{\circ}$C will be

a) 10
b) 20
c) 23
d) 60

146) How much skim milk (in kg) containing 0.1% fat should be added to 500 kg of cream containing 50% fat to produce standardized cream containing 36% fat?

a) 140
b) 165
c) 195
d) 210

147) Which of the following statements is NOT CORRECT in relation to muscle proteins?

a) Actin and myosin interact to form actomyosin which is responsible for muscle contraction
b) Collagen contributes to the toughness of muscles due to its abundant presence
c) Elastin, a constituent of ligaments, is tougher than collagen
d) Actomyosin is not the main state of actin and myosin in post-mortem muscles

common data for question 148 149

A cold storage plant is used for storing 50 tonnes of apples in boxes. Before storage, apples are cooled down from 28°C to storage temperature of 2°C (Specific heat = 0.874 Kcal kg^{-1} $^{\circ}C^{-1}$).

148) If this is attained in 16 hours, the refrigeration plant capacity (in Tons) is

a) 24
b) 26
c) 29
d) 32

149) If completed in 8 hours, the power required (in Horse Power) to operate the plant at a coefficient of performance (COP) of 2.5 will be

a) 65
b) 89
c) 96
d) 105

Common Data for Questions 19 and 20:

An actively growing culture of *Acetobacter aceti* is added to the vigorously aerated fermented fruit juice medium containing 10 g l^{-1} ethanol to produce vinegar. After some time, the ethanol concentration in the medium is 0.8 g l^{-1} and acetic acid produced is 8.4 g l^{-1}.

150) What is the conversion efficiency of the process with respect to theoretical yield?

a) 30
b) 50
c) 70
d) 90

151) The concentration of fermentable sugars (g l^{-1}) required in the fruit juice to produce 10 g l^{-1} ethanol, based on 90% fermentation efficiency is

a) 20.0
b) 21.7
c) 22.8
d) 25.1

Linked Answer Questions

Statement for Linked Answer Questions 21 and 22: An enzyme catalyzed reaction (following Michaelis-Menten kinetics) exhibits maximum reaction velocity (V_m) of 75 nmol l^{-1} min^{-1}. The enzyme at a substrate concentration of 1.0×10^{-4} M shows the initial reaction velocity of 60 nmol l^{-1} min^{-1}.

152) The K_m value of the enzyme in molar concentration (M) is

a) 2.5×10^{-5}
b) 5.0×10^{-5}
c) 2.5×10^{-4}
d) 5.0×10^{-4}

153) If the enzyme concentration for the reaction is doubled at a substrate concentration of 5.0×10^{-5} M, the initial reaction velocity in nmol l^{-1} min^{-1} will be

a) 37.5
b) 50
c) 60
d) 100