

# GATE 2023 Mechanical Question Paper PDF (Memory Based)

## General Aptitude

Question. Consider the following inequalities  $p^2 - 4q < 4$ ;  $3p + 2q < 6$  where  $p$  and  $q$  are positive integers. The value of  $(p + q)$ .

- A. 1                      B. 2  
C. 3                      D. 4

Answer. B

Question. How many pairs of sets  $(S,T)$  are possible among the subsets of  $\{1,2,3,4,5,6\}$  that satisfy the condition that  $S$  is the subset of  $T$ ?

- A. 665                    B. 664  
C. 729                    D. 728

Answer. A

Question. The minute hand and second hand of a clock cross each other.....times between 09:15:00 AM and 09:45:00 AM on a day

- A. 29                    B. 30  
C. 15                    D. 31

Answer. B

Question. The symbol O, \*,  $\Delta$  and  $\square$  are to be filled, one in each box as shown below. The rule for filling in the four symbols are as follow. 1. Every row and every column must contain each of the four symbol 2. Every  $2 \times 2$  square delineated by bold lines must contain each of the four symbols. Which symbol will occupy the box marked with '?' in particle filled figure.

	?		$\Delta$
	$\square$	*	
		$\square$	*
*		$\Delta$	O

- A. □
- B. \*
- C. Δ
- D. Δ

**Answer. B**

**Question.** In a recently held parent teacher meeting, the teacher had very few complaints about Ravi. After all Ravi was a hardworking and kind student. Incidentally, almost all Ravi's friend at school were hard working and kind too. But the teacher drew attention to Ravi's complete lack of interest in sports. The teacher believed that along with some of his friends who showed similar disinterest in sports. Ravi needed to engage in some sports for his overall development, which statement is logically correct.

- A. Some of Ravi's friends are hardworking and kind
- B. None of the Ravi's friends are interested in sports.
- C. All of Ravi's friends are hardworking and kind
- D. No one who is not a friend of Ravi is hard working and kind

**Answer. C**

**Question.** Which of the following sentence sequence in the given options creates a coherent narrative?

1. I could not bring myself to knock
2. There was a murmur of an unfamiliar voice coming from the big drawing room and the door was firmly shut.
3. The passage was dark for a bit but then it suddenly opened into a bright kitchen.
4. I decided I would rather wonder down the passage

**Answer. 1-2-4-3**

**Question.** Planting : Seed :: Raising : \_\_\_\_ (By word meaning)

- A. Height
- B. Lift
- C. Temperature
- D. Child

**Answer. D**

**Question. He did not manage to fix the car himself, so he ..... in the garage.**

- A. got it fixed**
- B. got fixed**
- C. gets fixed**
- D. Getting it fixed**

**Answer. A**

# GATE 2023 Mechanical Question Paper PDF (Memory Based) Mathematics

Question. A linear transformation maps a point  $(x, y)$  in the plane to point  $(x, y)$  according to rule  $x \rightarrow 3x, y \rightarrow 2y$ , then the disc  $x^2 + y^2 \leq 1$  gets transformed to a region with an area\_\_\_\_\_.

Answer. 17.5 to 19.5

Question. Consider the 2nd order LDE  $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} - y = 0, x \geq 1$  with initial condition  $y(x = 1) = 6$  &  $\frac{dy}{dx}|_{x=1} = 2$   $y(2) =$ \_\_\_\_. (integer)

Answer. 9 to 9

Question. The value of  $k$  that makes the complex valued function.  $f(z) = e^{-kx} [\cos 2y - i \sin 2y]$  analytic:

Answer. 2 to 2

Question.  $L^{-1} (1/s^3 - s)$

Answer.  $(e^t + e^{-t})/2 - 1$

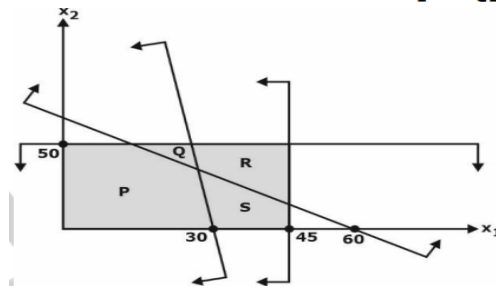
Question. The initial value problem  $dy/dt + 2y = 0, y(0) = 1$  is solve numerically using the forward Euler's method with a constant and positive time step of  $\Delta t$ . Let  $y_n$  represent the numerical solution obtained after  $n$  steps. The condition  $|y_{n+1}| \leq |y_n|$  is satisfied if and only if  $\Delta t$  does not exceed \_\_\_\_\_ integer).

Answer. 1 to 1

Question. Which one of the option given represent the feasible region of the linear program model:

$$Z_{\text{Max}} = 45x_1 + 60x_2, \quad x_1 \leq 45, \quad x_2 \leq 50, \quad 10x_1 + 10x_2 \geq 600, \quad 25x_1 + 5x_2 \leq 750$$

- A. P                      B. Q  
C. R                      D. S



Answer. B

Question. A cylinder of diameter  $d$  and height  $h$  is placed inside the cube of side  $L$ . What is view factor  $F_{SS}$ ? If  $S$  denote the inner surface of cube.

- A. 0  
B. 1  
C.  $(\pi/2d^2 + \pi dh) / 6L^2$   
D.  $1 - (\pi/2d^2 + \pi dh) / 6L^2$

Answer. D

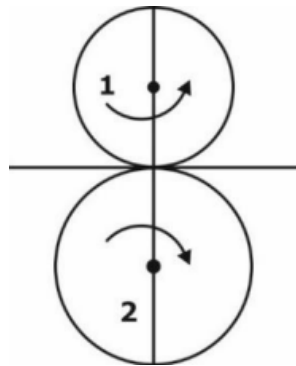
# GATE 2023 Mechanical Question Paper PDF (Memory Based)

## Mechanical Engineering

**Question.** A machine produces a defective component with  $P = 0.015$ . The number of defective components in packed box = 200 follow a Poisson's distribution. The mean and variance are?

**Answer.** Mean = 3 and Variance = 3

**Questions.** Two machine spur gear 1, and 2 with diametral pitch of 8 teeth per mm and an angular velocity  $\omega_1/\omega_2 = 1/4$  have their centres 30 mm apart. The number of teeth on driver (gear 1) is?



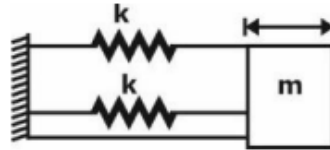
**Answer.** 96

**Question.** Consider incompressible laminar fluid flow of constant property Newtonian fluid in an isothermal circular tube. The flow is steady with fully developed temperature and velocity profiles. The Nusselt number for this flow depends on?

- A. the Prandtl number but not the Reynold number
- B. the Reynold number but not the Prandtl number
- C. neither the Reynold number not the Prandtl number
- D. both the Reynold number and Prandtl number

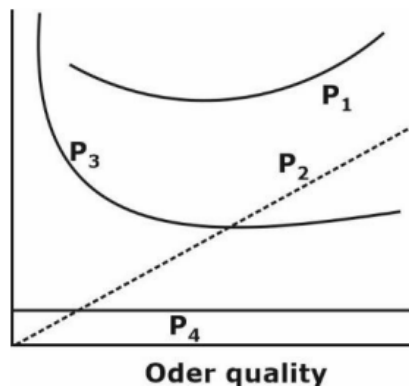
**Answer.** C

**Question.** The figure shows a block of  $m = 20$  kg attached to a pair of identical linear spring, each having spring constant  $k = 1000\text{N/m}$ . The clock oscillates on a frictionless horizontal surface assuming free vibration, the time taken by the block to complete 10 oscillation is  $\pi = 3.14$  \_\_\_\_\_ sec.



Answer. 6.0 to 6.4

Question. With reference to the EOQ model, which are of the options given is correct?



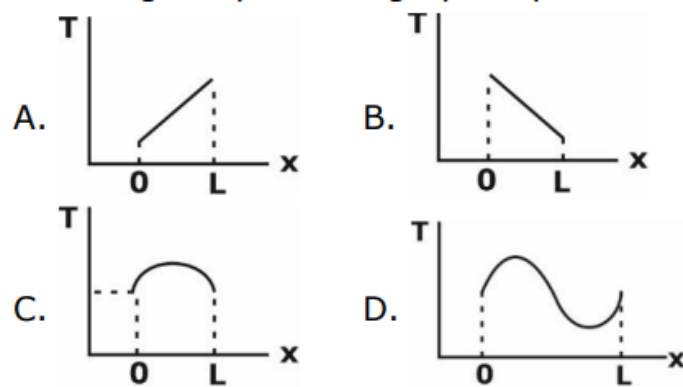
- A. Curve  $P_1$  total cost,  $P_2$  Holding cost,  $P_3$ : setup cost,  $P_4$ : production cost
- B.  $P_1$ : Production cost,  $P_2$  Holding cost,  $P_3$ : Total cost,  $P_4$  setup cost
- C.  $P_1$  Holding cost,  $P_2$  setup cost,  $P_3$  production cost,  $P_4$  total cost
- D.  $P_1$  total cost,  $P_2$  production cost,  $P_3$  Holding cost,  $P_4$  setup cost.

Answer. A

Question. Consider a counter flow heat exchanger with inlet temperatures of two fluids as 300 K and 350 K. The heat capacity rates are 1000 W/K and 400 W/K and effectiveness as 0.5. What is actual heat transfer rate is \_\_\_\_\_ kW.

Answer. 9.99 – 10.01

Question. The lateral surface of a rod is insulated. The thermal conductivity of material is constant. For steady heat flow and without heat generation, which of the following temperature graph is possible.



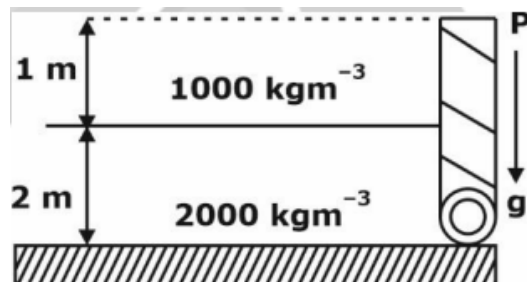
Answer. A, B

Question. A very large metal plate of thickness ( $d$ ) and thermal conductivity ( $K$ ) is cooled by stream of air ( $T = 300$  K).  $T_p$  (center line temperature). In which case lumped parameter model is used to study the heat transfer in metal plate.

- A.  $h = 100$  W/m<sup>2</sup>K,  $k = 1000$  W/mK,  $d = 1$  mm,  $T_p = 325$  K
- B.  $h = 100$  W/m<sup>2</sup>K,  $k = 100$  W/mK,  $d = 1$  m,  $T_p = 325$  K
- C.  $h = 1000$  W/m<sup>2</sup>K,  $k = 1$  W/mK,  $d = 1$  m,  $T_p = 350$  K
- D.  $h = 10$  W/m<sup>2</sup>K,  $k = 100$  W/mK,  $d = 1$  mm,  $T_p = 350$  K

Answer. A, D

Question. The figure shows two fluids held by a hinged gate. The atmospheric pressure is 100 kPa. Moment per unit width about the base of hinge is \_\_\_\_\_ kN-m/m. (Round off to decimal places). Assume acceleration due to gravity,  $g = 9.8$  m/s<sup>2</sup>.



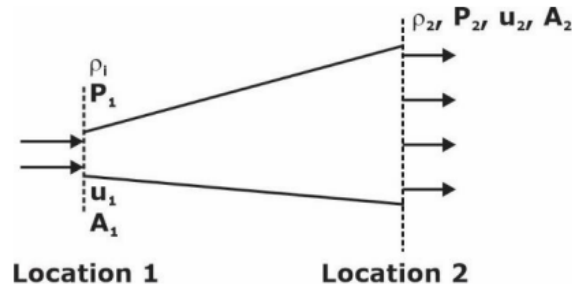
Answer. 83 – 84

Question. Consider a unidirectional flow with velocity field is given by  $V(x, y, z, t) = u(x, t)\mathbf{i}$  where,  $u(0, t) = 1$ . If spatially homogeneous density varies with time as  $\rho(t) = 1 + 0.2e^{-t}$ . The value of  $u(2, 1) =$  \_\_\_\_\_ (Round off to two decimal places). Assuming all dimensionless quantities.



Answer. 1.08 – 1.15

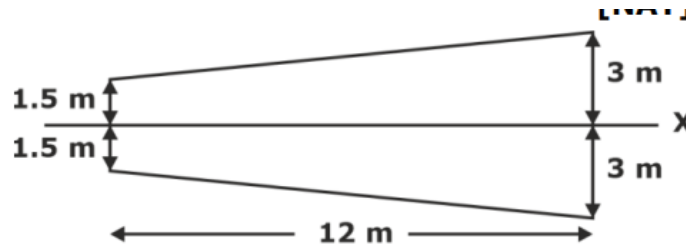
Question. Consider an isentropic flow of air (ratio of specific heats = 1.4) through a duct as shown in the figure. The variations in the flow across the cross-section are negligible. The flow condition at location 1 are given as follows:  $P_1 = 100 \text{ kPa}$ ,  $\rho = 1.2 \text{ kg/m}^3$ ,  $u_1 = 400 \text{ m/s}$ . The duct cross-sectional area at location 2 is given by  $A_2 = 2A_1$ , where  $A_1$  denotes the duct cross-sectional area at location 1. Which one of the given statements about the velocity  $u_2$  and pressure  $P_2$  at location 2 is TRUE?



- A.  $u_2 < u_1$ ,  $P_2 < P_1$
- B.  $u_2 < u_1$ ,  $P_2 > P_1$
- C.  $u_2 > u_1$ ,  $P_2 > P_1$
- D.  $u_2 > u_1$ ,  $P_2 < P_1$

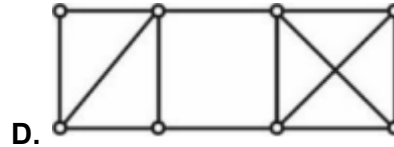
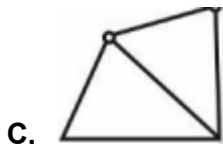
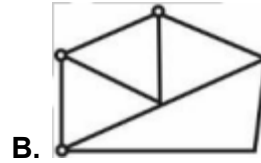
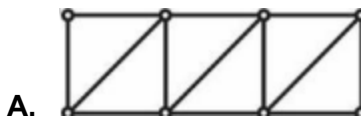
Answer. A

Question. The area moment of inertia about the Y axis of a linearly tapered section shown in fig. is \_\_\_\_  $\text{m}^4$ .



Answer. 3020 to 3030

Question. The options show frames consistory of rigid bar connected by pin joints. Which one of the frames is non rigid?



Answer. D

Question. Which of the following not correct?

- A. Any real gas behaves as an ideal gas at low pressure high temperature.
- B. For real gas going through adiabatic reversible process ( $PV^\gamma = C$  is the process equation)
- C. For ideal gas  $h \neq f(p)$
- D. Ideal gas polytropic process ( $PV^{1.5} = C$ )  $P/R = mT/V$  is the equation connecting  $P1V$  and  $T$  at any point along to the process.

Answer. B

Question. A HE extracts ( $Q_H$ ) from a TR at  $T = 1000K$  and rejects to ( $Q_L$ ) to TR at  $T = 100K$ . While producing ( $W$ ) work. While combination of [ $Q_H$ ,  $Q_L$  and  $W$ ] is allowed.

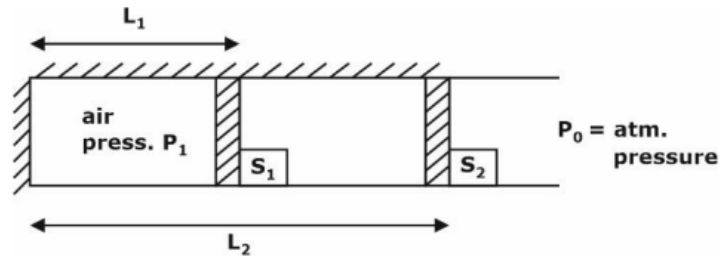
- A.  $Q_H = 2000 \text{ J}$ ,  $Q_L = 750 \text{ J}$ ,  $W = 1250 \text{ J}$
- B.  $Q_H = 6000 \text{ J}$ ,  $Q_L = 600 \text{ J}$ ,  $W = 5500 \text{ J}$
- C.  $Q_H = 2000 \text{ J}$ ,  $Q_L = 500 \text{ J}$ ,  $W = 1000 \text{ J}$
- D.  $Q_H = 6000 \text{ J}$ ,  $Q_L = 500 \text{ J}$ ,  $W = 5500 \text{ J}$

Answer. A

Questions. Two ideal gases (x, y) its weight  $M_x = 10 \text{ kg/k - mol}$ ,  $M_y = 20 \text{ kg/k - mol}$ . Total pressure in the chamber  $P_T = 10 \text{ kPa}$ ,  $V_T = 10 \text{ m}^3$ , Temperature of contents of the container  $300K$ , Mass of X is  $2 \text{ kg}$ , find the mass of y in kg Take  $R = 8314 \text{ J / k - mol.K}$

Answer. 3.95 to 4.1

Question.  $P1 \gg P0$ ,  $P2 \gg P0$ ,  $P2$  is pressure at location 2.



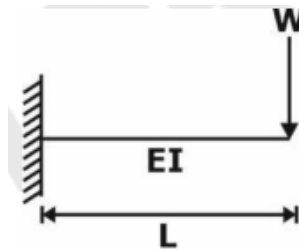
Area of distance =  $A$

Find the W.D. by piston on the atm. \_\_\_\_\_.

- A.  $P_1 A L_1 \ln(L_1/L_2)$       B.  $A(P_2 L_2 - P_1 L_1) / (1 - y)$   
 C.  $P_0 A(L_2 - L_1)$       D. 0

Answer. C

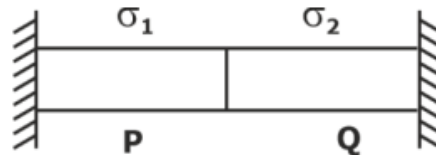
Question. Find stiffness



- A.  $EI / 3L^3$       B.  $3EI / L^3$   
 C.  $L^3 / 3EI$       D.  $3L^3 / EI$

Answer. B

Question.  $L_P = L_Q$ ,  $R_P = R_Q$ ,  $\alpha_Q = 2 \alpha_P$ ,  $E_Q = 2E_P$



- A.  $\sigma_1 = \sigma_2$   
 B.  $\sigma_1 < \sigma_2$   
 C. Interface between  $P$  &  $Q$  moves right.  
 D. Interface between  $P$  &  $Q$  moves left.

Answer. A, D

Question. The principal stress at a point  $P$  in a solid are  $70 \text{ MPa}$ ,  $-70 \text{ MPa}$ ,  $0$ . The  $s_y$  of material is  $100 \text{ MPa}$ . Which prediction about material failure at  $P$  is/are correct

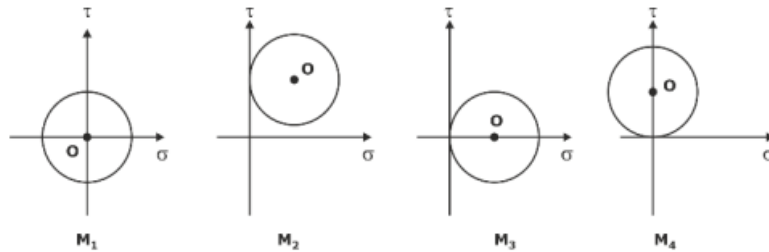
- A. Maximum normal stress theory predicts that material does not fail.
- B. MSST predicts material does not fail.
- C. Maximum normal stress theory predicts material fail.
- D. MSST predicts material fail.

Answer. A, D

Question. Consider the stress & shear relationship is  $\sigma = 400 \epsilon^{0.3}$  MPa  
 $\sigma$  = True stress,  $\epsilon$  = True strain. Find Engineering Ultimate tensile strength value of this material in MPa.

Answer. 277.8 to 278.5

Question. Representation of a plane stress state in a material



- A.  $M_1$
- B.  $M_2$
- C.  $M_3$
- D.  $M_4$

Answer. A, C

Questions. In a metal casting process to manufacture parts, both patterns & mould provide shape by dictating where the material should or should not go. Which of the option given correctly describe mould and pattern?

- A. Pattern walls indicates boundaries within which the molten part material is allowed, while mould walls indicate boundaries of region where mould material is not allowed.
- B. Mould wall indicates boundaries within which the molten part material is allowed while pattern wall indicate boundaries where mould material is not allowed.
- C. Mould can be used to make pattern.
- D. Pattern can be used to make mould.

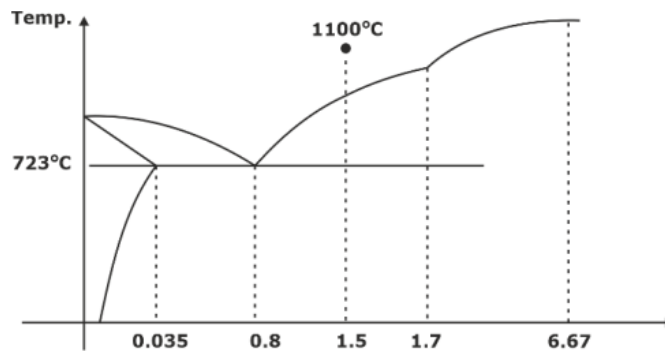
Answer. B, D

Question. To surfaces P & Q are to be joined together. Which of the given operations, there is no melting of two surfaces P & Q for creating a joint?

- A. Brazing
- B. Adhesive bonding
- C. Spot welding
- D. Arc welding

Answer. A, B

Question. Find the ratio of Proeutectoid Cementite / Total Cementite = ?



Answer. 0.48 to 0.57