

**GATE-2015**

**Question Paper**

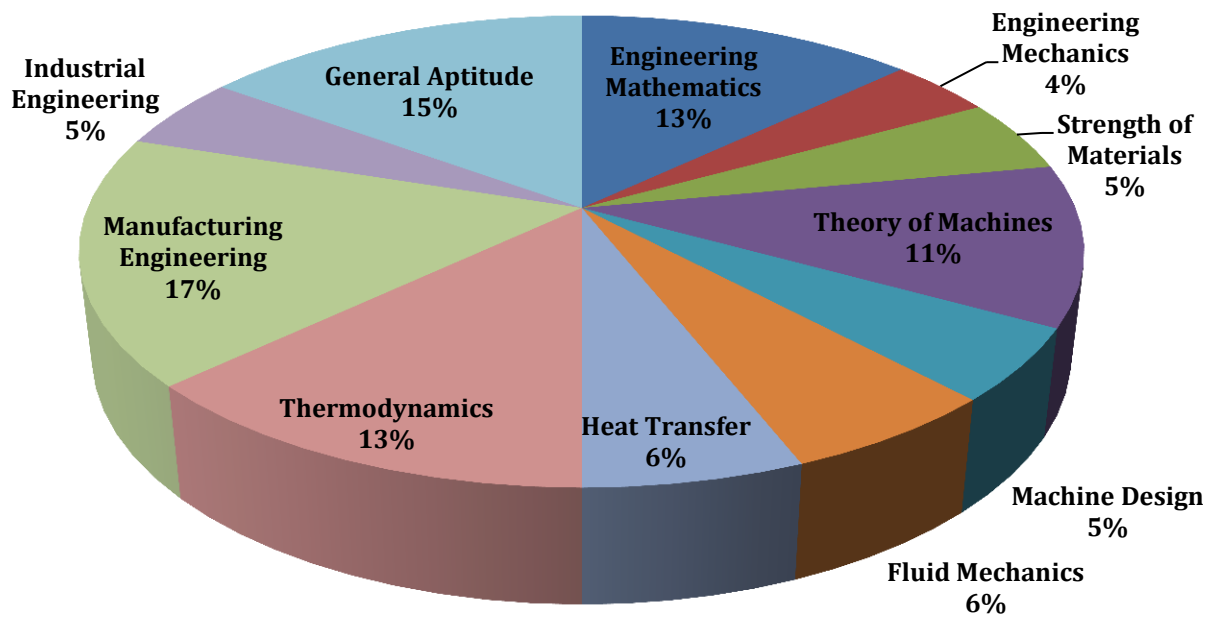
**&**

**Answer Keys**

# Index

1. Question Paper Analysis
2. Question Paper & Answer keys

# ANALYSIS OF GATE 2015 Mechanical Engineering



**GATE-2015- ME**

SUBJECT	NO OF QUESTION	Topics Asked in Paper	Total Marks
Engineering Mathematics	1M:5 2M:4	Calculus Probability and Distribution Numerical Method Linear Algebra Differential Equation Laplace Transform	13
Engineering Mechanics	1M:2 2M:1	Statics Dynamics	4
Strength of Materials	1M:1 2M:2	Mohr's Circle Area moment of inertia Shear Force & Bending Moment	5
Theory of Machines	1M:3 2M:4	Mechanism Vibration Gear Trains	11
Machine Design	1M:1 2M:2	Design for dynamic Loading Design of joints Design of Bearings	5
Fluid Mechanics	1M:2 2M:2	Fluid Dynamic Flow Through pipes Hydraulic Machine Fluid Kinematics	6
Heat Transfer	1M:2 2M:2	Heat Exchanger Convection Radiation; Conduction	6
Thermodynamics	1M:3 2M:5	Basic thermodynamics Thermodynamic Cycle and property Relations Psychrometrics Properties of gases and pure substances Basic thermodynamics Refrigeration	13
Manufacturing Engineering	1M:5 2M:6	Metrology and inspection Engg Materials Metal cutting Casting; Forming Process Computer integrated Manufacturing Joining Process Machining and Machine operation	17
Industrial Engineering	1M:1 2M:2	Production planning & Control Operational Research Inventory Control	5
General Aptitude	1M:5 2M:5	Verbal Ability Numerical Ability	15
<b>Total</b>	<b>65</b>		<b>100</b>

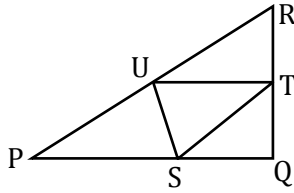
**GATE 2015 Examination**  
**MECHANICAL ENGINEERING**

**Test Date:** 1/02/2015  
**Test Time:** 2:00 PM 5:00 PM  
**Subject Name:** ME MECHANICAL ENGINEERING

**Section: General Aptitude**

1. Fill in the blank with the correct idiom/phrase.  
That boy from the town was a \_\_\_\_\_ in the sleepy village.  
(A) Dog out of herd (C) Fish out of water  
(B) Sheep from the heap (D) Bird from the flock  
**[Ans. C]**
2. Choose the statement where underlined word is used correctly.  
(A) When the teacher eludes to different authors, he is being elusive.  
(B) When the thief keeps eluding the police, he is being elusive.  
(C) Matters that are difficult to understand, identify or remember are allusive.  
(D) Mirages can be allusive, but a better way to express them is illusory.  
**[Ans. B]**
3. Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence:  
Apparent lifelessness \_\_\_\_\_ dormant life.  
(A) Harbours (C) Supports  
(B) Leads to (D) Affects  
**[Ans. A]**
4. Tanya is older than Eric.  
Cliff is older than Tanya.  
Eric is older than Cliff  
If the first two statements are true, then the third statement is:  
(A) True (C) Uncertain  
(B) False (D) Data insufficient  
**[Ans. B]**
5. Five teams have to compete in a league, with every team playing every other team exactly once, before going to the next round. How many matches will have to be held to complete the league round of matches?  
(A) 20 (C) 8  
(B) 10 (D) 5  
**[Ans. B]**

6. In the given figure angle Q is a right angle.  $PS : QS = 3:1$ ,  $RT:QT = 5:2$  and  $PU:UR = 1:1$ . If area of triangle QTS is  $20 \text{ cm}^2$ , then the area of triangle PQR (in  $\text{cm}^2$ ) is \_\_\_\_\_



[Ans. \*] Range: 280 to 280

7. Right triangle PQR is to be constructed in the  $xy$  - plane so that the right angle is at P and line PR is parallel to the  $x$ -axis. The  $x$  and  $y$  coordinates of P, Q and R are to be integers that satisfy the inequalities:  $-4 \leq x \leq 5$  and  $6 \leq y \leq 16$ . How many different triangles could be constructed with these properties?

- (A) 110 (C) 9,900  
(B) 1,100 (D) 10,000

[Ans. B]

8. A coin is tossed thrice. Let X be the event that head occurs in each of the first two tosses. Let Y be the event that a tail occurs on the third toss. Let Z be the event that two tails occur in three tosses. Based on the above information, which one of the following statements is TRUE?

- (A) X and Y are not independent (C) Y and Z are independent  
(B) Y and Z are dependent (D) X and Z are independent

[Ans. D]

9. Select the appropriate option in place of underlined part of the sentence.

Increased productivity necessary reflects greater efforts made by the employees.

- (A) Increase in productivity necessary (C) Increase in productivity necessarily  
(B) Increase productivity is necessary (D) No improvement required

[Ans. C]

10. Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.

Statements:

- (I) No manager is a leader.  
(II) All leaders are executives.

Conclusions:

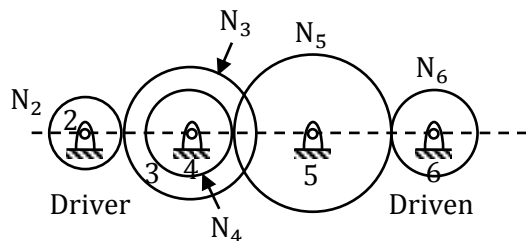
- (I) No manager is an executive.  
(II) No executive is a manager.  
(A) Only conclusion I follows  
(B) Only conclusion II follows.  
(C) Neither conclusion I nor II follows.  
(D) Both conclusions I and II follow.

[Ans. D]

**Section: Mechanical Engineering**

**Q.1 to Q. 25 carry one marks each.**

1. A gear train is made up of five spur gears as shown in the figure. Gear 2 is driver and gear 6 is driven member.  $N_2, N_3, N_4, N_5$  and  $N_6$  represent number of teeth on gears 2, 3, 4, 5, and 6 respectively. The gear(s) "which act(s) as idler(s) is/are



- (A) Only 3  
(B) Only 4  
(C) Only 5  
(D) Both 3 and 5

**[Ans. C]**

2. In the notation (a/b/c) : (d/e/f) for summarizing the characteristics of queueing situation, the letters 'b' and 'd' stand respectively for

- (A) Service time distribution and queue discipline  
(B) Number of servers and size of calling source  
(C) Number of senders and queue discipline  
(D) Service time distribution and maximum number allowed in system

**[Ans. A]**

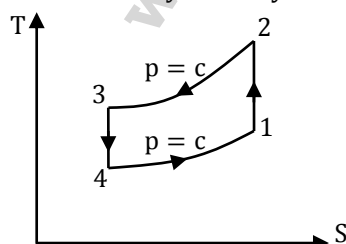
3. Which of the following statements are TRUE for damped vibrations?

- P. For a system having critical damping, the value of damping ratio is unity and system does not undergo a vibratory motion.  
Q. Logarithmic decrement method is used to determine the amount of damping in a physical system.  
R. In case of damping due to dry friction between moving surfaces resisting force of constant magnitude acts opposite to the relative motion.  
S. For the case of viscous damping, drag force is directly proportional to the square of relative velocity.

- (A) P and Q only  
(B) P and S only  
(C) P, Q and R only  
(D) Q and S only

**[Ans. C]**

4. The thermodynamic cycle shown in figure (T-S diagram) indicates



- (A) reversed Carnot cycle  
(B) reversed Brayton cycle  
(C) vapor compression cycle  
(D) vapor absorption cycle

**[Ans. B]**

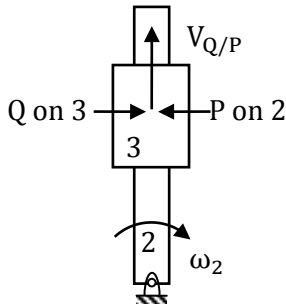
5. If  $P(X) = 1/4$ ,  $P(Y) = 1/3$ , and  $P(X \cap Y) = 1/12$ , the value of  $P(Y/X)$  is  
 (A)  $1/4$  (B)  $4/25$  (C)  $1/3$  (D)  $29/50$   
**[Ans. C]**
6. In a machining operation, if the generatrix and directrix both are straight lines, the surface obtained is  
 (A) Cylindrical (C) Plane  
 (B) Helical (D) Surface of revolution  
**[Ans. C]**
7. Saturated vapor is condensed to saturated liquid in a condenser. The heat capacity ratio is  $C_r = \frac{C_{\min}}{C_{\max}}$ . The effectiveness ( $\epsilon$ ) of the condenser is  
 (A)  $\frac{1 - \exp[-NTU(1+C_r)]}{1 + C_r}$  (C)  $\frac{NTU}{1 + NTU}$   
 (B)  $\frac{1 - \exp[-NTU(1-C_r)]}{1 - C_r \exp[-NTU(1 - C_r)]}$  (D)  $1 - \exp(-NTU)$   
**[Ans. D]**
8. The value of  $\lim_{x \rightarrow 0} \left( \frac{-\sin x}{2 \sin x + x \cos x} \right)$  is \_\_\_\_\_  
**[Ans. \*] Range: -0.333 to -0.333**
9. The strain hardening exponent  $n$  of stainless steel SS 304 with distinct yield and UTS value undergoing plastic deformation is  
 (A)  $n < 0$  (C)  $0 < n < 1$   
 (B)  $n = 0$  (D)  $n = 1$   
**[Ans. C]**
10. Couette flow is characterized by  
 (A) Steady, incompressible, laminar flow through a straight circular pipe  
 (B) Fully developed turbulent flow through a straight circular pipe  
 (C) Steady, incompressible, laminar flow between two fixed parallel plates  
 (D) Steady, incompressible, laminar flow between one fixed plate and the other moving with a constant velocity  
**[Ans. D]**
11. An air-standard Diesel cycle consists of the following processes:  
 1-2: Air is compressed isentropically.  
 2-3: Heat is added at constant pressure.  
 3-1: Air expands isentropically to the original volume.  
 4-1: Heat is rejected at constant volume  
 If  $\gamma$  and  $T$  denote the specific heat ratio and temperature, respectively, the efficiency of the cycle is  
 (A)  $1 - \frac{T_4 - T_1}{T_3 - T_2}$  (C)  $1 - \frac{\gamma(T_4 - T_1)}{T_3 - T_2}$   
 (B)  $1 - \frac{T_4 - T_1}{\gamma(T_3 - T_2)}$  (D)  $1 - \frac{T_4 - T_1}{(\gamma - 1)T_3 - T_2}$   
**[Ans. B]**



12. Which two of the following joining processes are autogeneous?
- |                          |                                  |
|--------------------------|----------------------------------|
| (i) Diffusion welding    | (iii) Tungsten inert gas welding |
| (ii) Electroslag welding | (iv) Friction welding            |
- (A) (i) and (iv)                      (C) (ii) and (iv)  
(B) (ii) and (iii)                    (D) (i) and (iii)

[Ans. A]

13. In the figure, link 2 rotates with constant angular velocity  $\omega_2$ . A slider link 3 moves outwards with a constant relative velocity  $V_{Q/P}$ , where Q is a point on slider 3 and P is a point on link 2. The magnitude and direction of Coriolis component of acceleration is given by



- (A)  $2 \omega_2 V_{Q/P}$ ; direction of  $V_{Q/P}$  rotated by  $90^\circ$  in the direction of  $\omega_2$   
(B)  $\omega_2 V_{Q/P}$ ; direction of  $V_{Q/P}$  rotated by  $90^\circ$  in the direction of  $\omega_2$   
(C)  $2 \omega_2 V_{Q/P}$ ; direction of  $V_{Q/P}$  rotated by  $90^\circ$  opposite to the direction of  $\omega_2$   
(D)  $\omega_2 V_{Q/P}$ ; direction of  $V_{Q/P}$  rotated by  $90^\circ$  opposite to the direction of  $\omega_2$

[Ans. A]

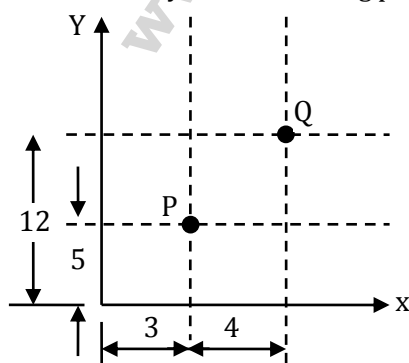
14. The ratio of momentum diffusivity ( $\nu$ ) to thermal diffusivity ( $\alpha$ ), is called
- |                    |                  |
|--------------------|------------------|
| (A) Prandtl number | (C) Biot number  |
| (B) Nusselt number | (D) Lewis number |

[Ans. A]

15. In full mould (cavity-less) casting process, the pattern is made of
- |                          |                      |
|--------------------------|----------------------|
| (A) expanded polystyrene | (C) epoxy            |
| (B) wax                  | (D) plaster of Paris |

[Ans. A]

16. A drill is positioned at point P and it has to proceed to point Q. The coordinates of point Q in the incremental system of defining position of a point in CNC part program will be



- (A) (3, 12)                      (B) (5, 7)                      (C) (7, 12)                      (D) (4, 7)  
[Ans. D]

17. Three parallel pipes connected at the two ends have flow-rates  $Q_1, Q_2$  and  $Q_3$  respectively. and the corresponding functional head losses are  $h_{L1}, h_{L2}$  and  $h_{L3}$  respectively. The correct expressions for total flow rate ( $Q$ ) and functional head loss across the two ends ( $h_L$ ) are

- (A)  $Q = Q_1 + Q_2 + Q_3; h_L = h_{L1} + h_{L2} + h_{L3}$   
 (B)  $Q = Q_1 + Q_2 + Q_3; h_L = h_{L1} = h_{L2} = h_{L3}$   
 (C)  $Q = Q_1 = Q_2 = Q_3; h_L = h_{L1} + h_{L2} + h_{L3}$   
 (D)  $Q = Q_1 = Q_2 = Q_3; h_L = h_{L1} = h_{L2} = h_{L3}$

[Ans. B]

18. A rigid container of volume  $0.5 \text{ m}^3$  contains  $1.0 \text{ kg}$  of water at  $120^\circ\text{C}$  ( $v_f = 0.00106 \text{ m}^3/\text{kg}$ ,  $v_g = 0.8908 \text{ m}^3/\text{kg}$ ) The state of water is

- (A) compressed liquid                      (C) a mixture of saturated liquid and saturated vapor  
 (B) saturated liquid                      (D) superheated vapor

[Ans. C]

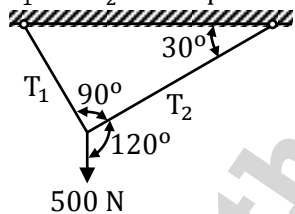
19. The lowest eigenvalue of the  $2 \times 2$  matrix  $\begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$  is \_\_\_\_\_

[Ans. \*] Range: 2 to 2

20. Using a unit step size, the value of integral  $\int_1^2 x \ln x \, dx$  by trapezoidal rule is \_\_\_\_\_

[Ans. \*] Range: 0.69 to 0.69

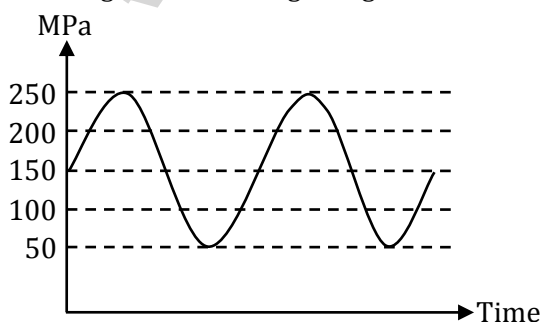
21. A weight of  $500 \text{ N}$  is supported by two metallic rope as shown in the figure. The value of tension  $T_1$  and  $T_2$  are respectively



- (A) 433 N and 250 N                      (C) 353.5 N and 250 N  
 (B) 250 N and 433 N                      (D) 250 N and 353.5 N

[Ans. A]

22. For the given fluctuating fating load, the value of stress amplitude and stress ratio are respectively



- (A) 100 MPa and 5 (C) 100 MPa and 0.20  
(B) 250 MPa and 5 (D) 250 MPa and 0.20

[Ans. C]

23. A cylindrical tank with closed ends is filled with compressed air at a pressure of 500 kPa. The inner radius of the tank is 2 m, and it has wall thickness of 10 mm. The magnitude of maximum in-plane shear stress (in MPa) is \_\_\_\_\_

[Ans. \*] Range: 25 to 25

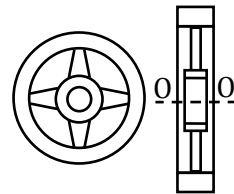
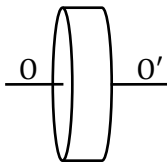
24. Let  $\phi$  be an arbitrary smooth real valued scalar function and  $\vec{V}$  be an arbitrary smooth vector valued function in a three-dimensional space Which one of the following is an identity?

- (A)  $\text{Curl}(\phi\vec{V}) = \nabla(\phi \text{Div}\vec{V})$  (C)  $\text{Div Curl}\vec{V} = 0$   
(B)  $\text{Div}\vec{V} = 0$  (D)  $\text{Div}(\phi\vec{V}) = \phi \text{Div}\vec{V}$

[Ans. C]

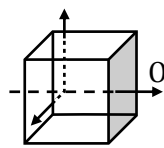
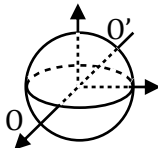
25. For the same material and the mass, which of the following configurations of flywheel will have maximum mass moment of inertia about the axis of rotation  $OO'$  passing through the center of gravity.

- (A) Solid Cylinder (B) Rimmed wheel



- (C) Solid sphere

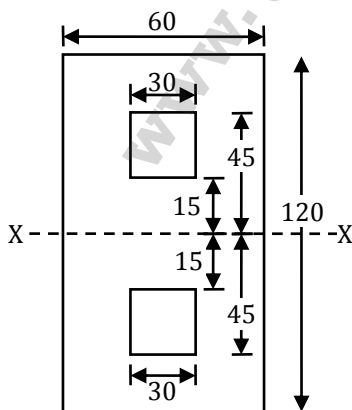
- (D) Solid Cube



[Ans. B]

Q. 26 - Q. 55 carry two marks each.

26. The value of moment of inertia of the section shown in the figure about the axis - XX is



All dimension are in mm

- (A)  $8.5050 \times 10^6 \text{ mm}^4$  (C)  $7.7625 \times 10^6 \text{ mm}^4$   
 (B)  $6.8850 \times 10^6 \text{ mm}^4$  (D)  $8.5725 \times 10^6 \text{ mm}^4$

[Ans. B]

27. Newton-Raphson method is used to find the roots of the equation,  $x^3 + 2x^2 + 3x - 1 = 0$ . If the initial guess is  $x_0 = 1$ , then the value of x after 2<sup>nd</sup> iteration is \_\_\_\_\_.

[Ans. \*] Range: 0.3 to 0.3

28. One side of a wall is maintained at 400 K and the other at 300 K. The rate of heat transfer through the wall is 1000 W and the surrounding temperature is 25°C. Assuming no generation of heat within the wall, the irreversibility (in W) due to heat transfer through the wall is \_\_\_\_\_

[Ans. \*] Range: 0.833 to 0.833

29. Orthogonal turning of a mild steel tube with a tool of rake angle 10° is earned out at a feed of 0.14 mm/rev. If the thickness of the chip produced is 0.28 mm. the values of shear angle and shear strain will be respectively

- (A) 28°20' and 2.19 (C) 24°30' and 4.19  
 (B) 22°20' and 3.53 (D) 37°20' and 5.19

[Ans. A]

30. For a given matrix  $P = \begin{bmatrix} 4 + 3i & -i \\ i & 4 - 3i \end{bmatrix}$ , where  $i = \sqrt{-1}$ , the invers of matrix P is

- (A)  $\frac{1}{24} \begin{bmatrix} 4 - 3i & i \\ -i & 4 + 3i \end{bmatrix}$  (C)  $\frac{1}{24} \begin{bmatrix} 4 + 3i & -i \\ i & 4 - 3i \end{bmatrix}$   
 (B)  $\frac{1}{25} \begin{bmatrix} i & 4 - 3i \\ 4 + 3i & -i \end{bmatrix}$  (D)  $\frac{1}{25} \begin{bmatrix} 4 + 3i & -i \\ i & 4 - 3i \end{bmatrix}$

[Ans. C]

31. Refrigerant vapor enters into the compressor of a standard vapor compression cycle at -10°C ( $h = 402 \text{ kJ/kg}$ ) and leaves the compressor at 50°C ( $h = 432 \text{ kJ/kg}$ ) It leaves the condenser at 30°C ( $h = 237 \text{ kJ/kg}$ ). The COP of the cycle is \_\_\_\_\_

[Ans. \*] Range: 5.5 to 5.5

32. In a rolling operation using rolls of diameter 500 mm, if a 25 mm thick plate cannot be reduced to less than 20 mm in one pass, the coefficient of friction between the roll and the plate is \_\_\_\_\_

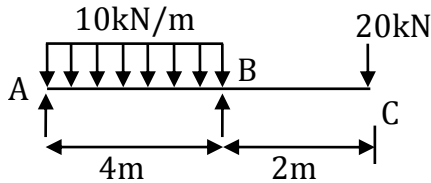
[Ans. \*] Range: 0.1414 to 0.1414

33. The dimensions of a cylindrical side riser (height = diameter) for a 25 cm × 15 cm × 5 cm steel casting are to be determined. For the tabulated shape factor values given below, the diameter of the riser (in cm) is \_\_\_\_\_

Shape factor	2	4	6	8	10	12
Riser volume/Casting volume	1.0	0.70	0.55	0.50	0.40	0.35

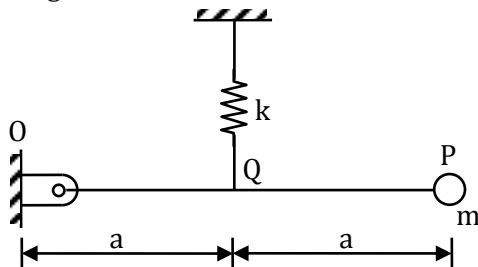
[Ans. \*] Range: 13.36 to 13.36

34. For the overhanging beam shown in figure, the magnitude of maximum bending moment (in kN-m) is \_\_\_\_\_



[Ans. \*] Range: 40 to 40

35. Figure shows a single degree of freedom system. The system consists of a massless rigid bar OP hinged at O and a mass  $m$  at end P. The natural frequency of vibration of the system is \_\_\_\_\_



(A)  $f_n = \frac{1}{2\pi} \sqrt{\frac{k}{4m}}$

(C)  $f_n = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$

(B)  $f_n = \frac{1}{2\pi} \sqrt{\frac{k}{2m}}$

(D)  $f_n = \frac{1}{2\pi} \sqrt{\frac{2k}{m}}$

[Ans. A]

36. For ball bearings, the fatigue life  $L$  measured in number of revolutions and the radial load  $F$  are related by  $FL^{1/3} = K$ . where  $K$  is a constant. It withstands a radial load of 2 kN for a life of 540 million revolutions. The load (in kN) for a life of one million revolutions is \_\_\_\_\_

[Ans. \*] Range: 16.286 to 16.286

37. The torque (in N-m) exerted on the crank shaft of a two stroke engine can be described as  $T = 10000 + 1000 \sin 2\theta - 1200 \cos 2\theta$ , where  $\theta$  is the crank angle as measured from inner dead center position. Assuming the resisting torque to be constant, the power (in kW) developed by the engine at 100 rpm is \_\_\_\_\_

[Ans. \*] Range: 16.67 to 16.67

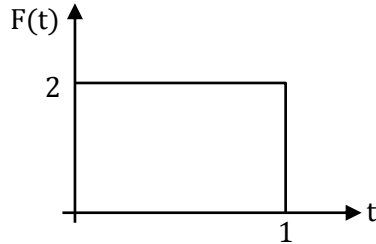
38. Air in a room is at 35°C and 60% relative humidity (RH). The pressure in the room is 0.1 MPa. The saturation pressure of water at 35°C is 5.63 kPa. The humidity ratio of the air (in gram/kg of dry air) is \_\_\_\_\_

[Ans. \*] Range: 21.7457 to 21.7457

39. Steam enters a turbine at 30 bar, 300°C ( $u = 2750$  kJ/kg,  $h = 2993$  kJ/kg) and exits the turbine as saturated liquid at 15 kPa ( $u = 225$  kJ/kg,  $h = 226$  kJ/kg). Heat loss to the surrounding is 50 kJ/kg of steam flowing through the turbine. Neglecting changes in kinetic energy and potential energy, the work output of the turbine (in kJ/kg of steam) is \_\_\_\_\_

[Ans. \*] Range: 2717 to 2717

40. Laplace transform of the function  $f(t)$  is given by  $F(s) = L \{f(t)\} = \int_0^{\infty} f(t)e^{-st} dt$ . Laplace transform of the function shown below is given by



(A)  $\frac{1 - e^{-2s}}{s}$

(B)  $\frac{1 - e^{-s}}{2s}$

(C)  $\frac{2 - 2e^{-2s}}{s}$

(D)  $\frac{1 - 2e^{-s}}{s}$

[Ans. C]

41. Which of the following statements are TRUE. When the cavitation parameter  $\sigma = 0$ ?

- (i) The local pressure is reduced to vapor pressure
- (ii) Cavitation starts
- (iii) Boiling of liquid starts
- (iv) Cavitation stops

(A) (i), (ii) and (iv)

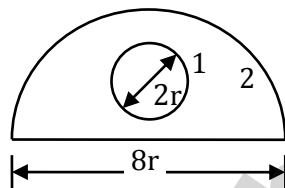
(B) only (ii) and (iii)

(C) only (i) and (iii)

(D) (i), (ii) and (iii)

[Ans. D]

42. A solid sphere 1 of radius 'r' is placed inside a hollow, closed hemispherical surface 2 of radius '4r'. the shape factor  $F_{2-1}$  is



(A) 1/12

(B) 1/2

(C) 2

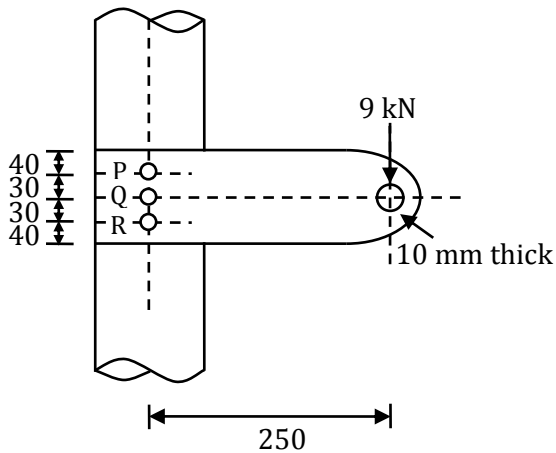
(D) 12

[Ans. A]

43. A Prandtl tube (Pitot-static tube with  $C = 1$ ) is used to measure the velocity of water. The differential manometer reading is 10 mm of liquid column with a relative density of 10. Assuming  $g = 9.8 \text{ m/s}^2$ , the velocity of water (in m/s) is \_\_\_\_\_

[Ans. \*] Range: 1.32 to 1.32

44. A cantilever bracket is bolted to a column using three M12 × 1.75 bolts P, Q and R. the value of maximum shear stress developed in the bolt P (in MPa) is \_\_\_\_\_

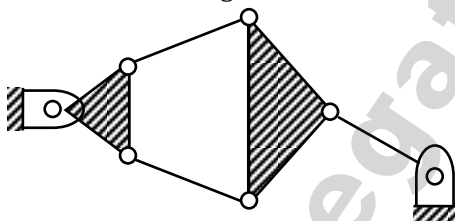


[Ans. \*] Range: 341 to 341

45. In a CNC milling operation, the tool has to machine the circular arc from point (20, 20) to (10, 10) at sequence number 5 of the CNC part program. If the center of the arc is at (20, 10) and the machine has incremental mode of defining position coordinates, the correct tool path command is
- (A) N 05 G90 G01 X-10 Y-10 R10 (C) N 05 G90 G03 X20 Y20 R10  
(B) N05 G91 G03 X-10 Y-10 R10 (D) N 05 G91 G02 X20 Y20 R10

[Ans. B]

46. The number of degree of freedom of the linkage shown in the figure is



- (A) -3 (C) 1  
(B) 0 (D) 2

[Ans. C]

47. A shaft of length 90 mm has a tapered portion of length 55 mm. the diameter of the taper is 80 mm at one end and 65 mm at the other. If the taper is made by tailstock set over method, the taper angle and the set over respectively are

- (A) 15°32' and 12.16 mm (C) 11°22' and 10.26 mm  
(B) 18°32' and 15.66 mm (D) 10°32' and 14.46 mm

[Ans. A]

48. The value of  $\int_C [(3x - 8y^2)dx + (4y - 6xy)dy]$ , (where C is the boundary of the region boundary by  $x = 0, y = 0$  and  $x + y = 1$ ) is \_\_\_\_\_

[Ans. \*] Range: 3.66 to 3.66

49. A brick wall ( $k = 0.9 \frac{W}{m.K}$ ) of thickness 0.18 m separates the warm air in a room from the cold ambient air. On a particular winter day, the outside air temperature is  $-5^{\circ}C$  and the room needs to be maintained at  $27^{\circ}C$ . The heat transfer coefficient associated with outside air is  $20 W/m^2 K$ . Neglecting the convective resistance of the air inside the room, the heat loss, in ( $W/m^2$ ), is
- (A) 88 (C) 128  
(B) 110 (D) 160
- [Ans. C]**

50. A mixture of ideal gasses has the following composition by mass

N <sub>2</sub>	O <sub>2</sub>	CO <sub>2</sub>
60%	30%	10%

If the universal gas constant is  $8314 J/kmol.K$ , the characteristic gas constant if the mixture (in  $J/kg.K$ ) is \_\_\_\_\_

**[Ans. \*] Range: 274.99 to 274.99**

51. For the linear programming problem:

$$\text{Maximize } Z = 3X_1 + 2X_2$$

Subject to

$$-2X_1 + 3X_2 \leq 9$$

$$X_1 - 5X_2 \geq -20$$

$$X_1, X_2 \geq 0$$

The above problem

(A) Unbounded solution

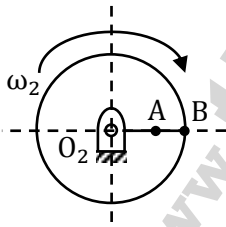
(C) Alternative optimum solution

(B) Infeasible solution

(D) Degenerate solution

**[Ans. A]**

52. Figure shows a wheel rotating about  $O_2$ . Two points A and B location along the radius of wheel have speeds of 80 m/s and 140 m/s respectively. The distance between the point A and B is 300 mm. The diameter of the wheel (in mm) is \_\_\_\_\_



**[Ans. \*] Range: 1400 to 1400**

53. Ratio of solidification time of a cylindrical casting (height = radius) to that of a cubic casting of side two times the height of cylindrical casting is \_\_\_\_\_

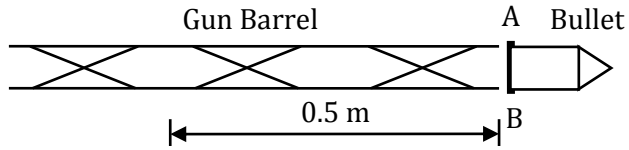
**[Ans. \*] Range: 0.25 to 0.25**

54. The annual requirement of rivets at a ship manufacturing company is 2000 kg. The rivets are supplied in units of 1 kg costing Rs. 25 each. If it costs Rs. 100 to place an order and the annual cost of earning one unit is 9% of its purchase cost, the cycle length of the order (in days) will be \_\_\_\_\_

**[Ans. \*] Range: 76.948 to 76.948**



55. A bullet spins as the shot is fired from a gun. For this purpose, two helical slots as shown in the figure are cut in the barrel. Projections A and B on the bullet engage in each of the slots.



Helical slots are such that one turn of helix is completed over a distance of 0.5 m. If velocity of bullet when it exits the barrel is 20 m/s, its spinning speed in rad/s is \_\_\_\_\_

[Ans. \*] Range: 251.3 to 251.3

www.thegateacademy.com