



GATE-2018
All India Mock GATE Test Series
Mechanical Engineering
Test Series 4

Name:

Test ID: **ME-TS-04-18**

Duration: 3 hours

Maximum marks : 100

Please read the following instructions carefully

General Instructions

1. Total duration of examination is 180 minutes (3 hours).
2. The clock will be set at the server. The countdown timer in the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You will not be required to end or submit your examination.
3. The Question Palette displayed on the right side of screen will show the status of each question using one of the following:
 - a. You have not visited the question yet.
 - b. You have not answered the question.
 - c. You have answered the question.
 - d. You have NOT answered the question, but have marked the question for review.
 - e. You have answered the question, but marked it for review.

The **Marked for Review** status for a question simply indicates that you would like to look at that question again. If a question is answered and **Marked for Review**, your answer for that question will be considered in the evaluation.

Navigating to a Question

4. To answer a question, do the following:
 - a. Click on the question number in the Question Palette to go to that question directly.
 - b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices namely A, B, C, D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
 - c. Click on **Save and Next** to save your answer for the current question and then go to the next question.
 - d. Click on **Mark for Review and Next** to save your answer for the current question, and also mark it for review, and then go to the next question.
 - e. **Caution:** Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on its question number without saving the answer to the previous questions.
 - f. You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question

5. Procedure for answering a multiple choice (MCQ) type question:
 - a. To select your answer, click on the bubble button of one of the options
 - b. To deselect your chosen answer, click on the bubble button of the chosen option again or click on the clear response button
 - c. To change your chosen answer, click on the bubble button of another option
 - d. To save your answer, you **MUST** click on the **Save and Next button**.
 - e. To mark the question for review, click on the **Mark for Review and Next** button. If an answer is selected for a question that is Marked for Review, that answer will be considered in the evaluation.

6. Procedure for answering a numerical answer type question:

- a. To enter a number as your answer, use the virtual numerical keypad
 - b. A fraction (eg. -0.3 or $-.3$) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
 - c. To clear your answer, click on the Clear Response button
 - d. To save your answer, you **MUST** click on the **Save and Next** button
 - e. To mark a question for review, click on the **Mark for Review and Next** button. If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is Marked for Review, that answer will be considered in the evaluation.
7. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
8. Note that **ONLY** Questions for which answers are saved or marked for review after answering will be considered for evaluation.

Paper Specific Instructions:

9. There are a total of 65 questions carrying 100 marks. Questions are of multiple choice type or numerical answer type. A multiple choice type question will have four choices for the answer with only one correct choice. For numerical answer type questions, the answer is a number and no choices will be given. A number as the answer should be entered using the virtual keyboard on the monitor.
10. Questions Q.1 – Q.10 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.1 – Q.5 carry 1mark each, and questions Q.6 – Q.10 carry 2marks each.
11. Questions Q.1 – Q.25 carry 1mark each. Questions Q.26 – Q.55 carry 2marks each.
12. Questions not attempted will result in zero mark. Wrong answers for multiple choice type questions will result in **NEGATIVE** marks. For all 1 mark questions, $\frac{1}{3}$ mark will be deducted for each wrong answer. For all 2 marks questions, $\frac{2}{3}$ mark will be deducted for each wrong answer. There is no negative marking for questions of numerical answer type.
13. Physical calculator is **NOT** allowed. All candidates will be provided with an online scientific calculator which has to be used to answer the questions.

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Test Series 4

Mechanical Engineering

General Aptitude:

Q.1 - Q.5 Carry One Mark each.

1. In the following question choose the word which is the exact OPPOSITE of the given words.

“QUIESCENT”

- (A) Active (B) Dormant
(C) Weak (D) Unconcerned

2. Which term of the series 5, 10, 20, 40, is 1280?

3. A train normally covers a certain distance at a speed of 60 km/hr. However, if it were to halt for a fixed time interval in each hour, its average reduced to 50 km/hr. what is the time interval for which the train halts in each hour?

- (A) 10 minutes (B) 20 minutes
(C) 6 minutes (D) 12 minutes

4. Radha moves towards South-East a distance of 7 km, then she moves towards West and travels a distance of 14 km. From here she moves towards North-West a distance of 7 km and finally she moves a distance of 4 km towards east. How far is she now from the starting point?

5. In the following question two statements are given and these statements are followed by two conclusions numbered (1) and (2). You have to take the given two statements to be true even if they seem to be at variance from commonly known facts. Read the conclusions and then decide which of the given conclusions logically follows from the two given statements, disregarding commonly known facts.

Statements: Some actors are singers. All the singers are dancers.

Conclusions:

1. Some actors are dancers.
2. No singer is actor.
(A) Only (1) conclusion follows (B) Only (2) conclusion follows
(C) Either (1) or (2) follows (D) Neither (1) nor (2) follows

Q.6 - Q.10 Carry Two Mark each.

6. If Rupert has 4 more coins than Laxmi, Laxmi has 1 more coin than bill and bill has 1 more coin than Hawkins. Finally Hawkins has 4 more coins than Ajim. Then minimum number of coins that must be transferred, if all of them wish to have an equal number of coins:

7. The last digit of the expression $4 \times 9^2 \times 4^3 \times 9^4 \times 4^5 \times 9^6 \times \dots \times 4^{99} \times 9^{100}$ is:
(A) 4 (B) 6
(C) 9 (D) 1
8. The average age of boys in class is 16.66, while the average age of girls is 18.75. Thus average age of all the 40 students of the class is 17.5. If the difference between the number of boys and girls is 8, then the number of girls in the class is:
(A) 12 (B) 16
(C) 18 (D) Data insufficient
9. In an election only two candidates contested 20% of the voters did not vote and 120 votes were declared as invalid. The winner got 200 votes more than his opponents thus he secured 41% votes of the total voters on the voter list. Percentage votes of the defeated candidate out of the total votes casted is :
(A) 47.5% (B) 51.25%
(C) 36% (D) 45%
10. The amount of work in a leather factory is increased by 50%. By what percent is it necessary to increase the number of workers to complete the new amount of work in previously planned time, if the productivity of the new labour is 25% more.

Technical:

Q.1 - Q.25 Carry One Mark each.

- If one of the eigenvalue of $[A]_{n \times n}$ is zero it implies
 - The solution to $[A][x] = [c]$ system of equation is unique
 - The determinant of $[A]$ is zero
 - The solution to $[A][x] = [0]$ system of linear equation is trivial
 - The determinant of $[A]$ is non-zero.
- The solution of $y'e^{\pi x} = y^2 + 1$ is

(A) $y = \tan(\pi e^{-\pi x} + c)$	(B) $y = \tan(-\pi e^{-\pi x} + c)$
(C) $y = \tan\left(\frac{e^{-\pi x}}{\pi} + c\right)$	(D) $y = \tan\left(\frac{-e^{-\pi x}}{\pi} + c\right)$
- Suppose that the probability that an item produced by a certain machine will be defective is 0.1. By Poisson approximation find the probability that a sample of 10 items will contain at most 1 defective item _____.
- The value of the contour integral $\oint_C \frac{\cos h3z}{z^5}$ around the circle $|z| = 2$ in the counter clockwise direction is

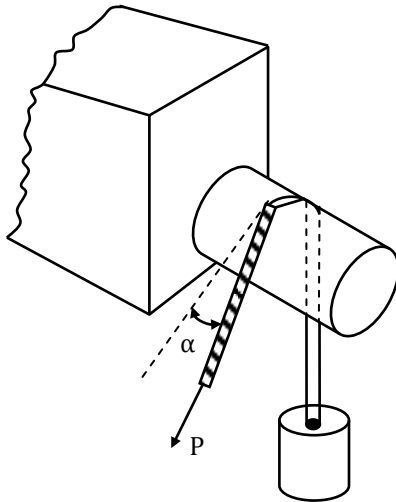
(A) $\frac{27}{4}\pi i$	(B) $\frac{81}{4}\pi i$
(C) 0	(D) $\frac{9\pi i}{4}$
- Which of the following function is not analytic

(A) z^4	(B) $e^{2x}(\cos 2y + i \sin 2y)$
(C) $e^{-x}(\cos y - i \sin y)$	(D) Imaginary (z^2)
- A 12kg fish swimming at a velocity of 2 m/s swallows an absent minded 2kg fish swimming towards it at 5m/s. What is the velocity of larger fish after eating small fish?

(A) 17/7 m/s	(B) 17/17 m/s
(C) 7/17 m/s	(D) None of the above
- A Shaft made up of a brittle material is subjected to combined bending and torsion of 20 MN mm and 4.8 MN mm respectively. Find out minimum diameter(mm) required if tensile strength is 100 MPa
- A boiler of 2 m diameter is made of 20 mm thick mild steel plates. Taking the efficiency of the longitudinal riveted joint as 75%. Calculate the permissible steam pressure in the boiler if the maximum tensile stress in the plate section through the rivets is not to exceed 100 MPa

(A) 1.5 MPa	(B) 3 MPa
(C) 6 MPa	(D) None of the above

9. For a certain co-efficient of friction ' μ' ' and a certain angle ' α' ', the 'P' force required to raise 'm' is 4 kN and that required to lower 'm' is 1.6 kN. The mass 'm' (in kg) is _____ kg.



10. Which one of the following is correct for a harmonically excited single degree of freedom viscous damped system
- (A) Spring force and inertia force are in phase and damping force leads them 90°
 (B) Spring force and damping are in phase and inertia force leads them by 90°
 (C) Spring force leads damping force by 90° while damping force leads inertia force by 180°
 (D) Inertia force leads damping force by 90° while damping force leads spring force by 90°
11. A propeller shaft of 200 mm external diameter and 100 mm internal diameter has to transmit 1350 kW power at 80 rpm. In addition it is subjected to a BM of 10 kNm and an end thrust of 100 kN. Find the magnitude of maximum tensile stress (MPa)
12. Which of the following is a material property
- (A) Theoretical stress concentration factor
 (B) Fatigue stress concentration factor
 (C) Notch sensitivity
 (D) Factor of safety
13. The velocity potential function for a two dimensional flow field is given as $\phi = x(2y - 1)$. The value of stream function at point P (4,5) is
- (A) 2 units
 (B) 3 units
 (C) 4 units
 (D) 5 units

14. For a fluid at rest
 (A) The shear stress depends upon the coefficient of viscosity
 (B) The shear stress on any plane is zero
 (C) The shear stress is zero only on horizontal planes
 (D) The shear stress is maximum on a plane inclined at 45° to the horizontal
15. Water at 50°C is filled in a closed cylindrical vessel of height 10 cm and cross-sectional area 10 cm^2 . The walls of the vessel are adiabatic but the flat parts are made of 1 mm thick aluminum ($k=200\text{ J/s-mk}$). Assume that the outside temperature is 20°C , density of water is 1000 kg/m^3 and the specific heat capacity of water = 4200 J/kg K . The time in second taken for the temperature to fall by 1.0°C is _____
16. A hot black body emits radiant energy at a rate of $16\text{ J/m}^2\text{ s}$ and its most intense radiation corresponds to $20,000\text{ \AA}$. When the temperature of this body is further increased and its most intense radiation corresponds to $10,000\text{ \AA}$, then the value of energy radiated is
 (A) $256\text{ J/m}^2\text{ s}$ (B) $258\text{ J/m}^2\text{ s}$
 (C) $260\text{ J/m}^2\text{ s}$ (D) $262\text{ J/m}^2\text{ s}$
17. Match List-I (Terms) with List-II (Relations) and select the correct answer using the codes given below in the lists.

List-I	List-II
a. Specific heat at Constant Volume (C_v)	1. $\frac{1}{V} \left(\frac{dV}{dT} \right)_P$
b. Isothermal Compressibility (k_T)	2. $-T \left(\frac{dP}{dV} \right)_T \left(\frac{dV}{dT} \right)_P^2$
c. Isobaric Volume expansivity (β)	3. $T \left(\frac{dS}{dT} \right)_V$
d. Difference between specific heat at constant pressure and at constant volume ($C_p - C_v$)	4. $\frac{-1}{V} \left(\frac{dV}{dP} \right)_T$

Codes:

	a	b	c	d
(A)	3	4	2	1
(B)	4	1	3	2
(C)	3	4	1	2
(D)	4	1	2	3

18. Operating temperature of a cold storage is -2°C from the surrounding at ambient temperature of 40°C heat leaked into the cold storage is 30 kW. If the actual COP of the plant is $\frac{1}{10}$ of the maximum possible COP, then what will be the power required to pump out the heat to maintain the cold storage temperature at -2°C ? (in Watt)

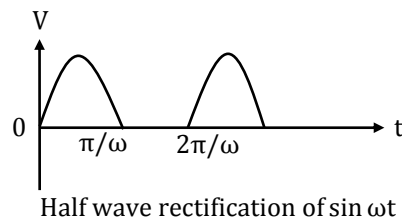
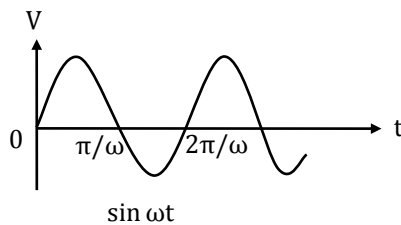
19. The thermal efficiency of a gas turbine cycle with ideal regeneration in terms of T_3 (maximum temperature), T_1 (minimum temperature), r_p (pressure ratio) and $k = \left(\frac{c_p}{c_v}\right)$ is given by:
- (A) $1 - \frac{T_1}{T_3} r_p^{\left(\frac{k}{k-1}\right)}$ (B) $1 - \frac{T_3}{T_1} r_p^{\left(\frac{k}{k-1}\right)}$
 (C) $1 - \frac{T_3}{T_1} r_p^{\left(\frac{k-1}{k}\right)}$ (D) $1 - \frac{T_1}{T_3} r_p^{\left(\frac{k-1}{k}\right)}$
20. Variance for critical path is
 a \rightarrow b = 4
 b \rightarrow c = 16
 c \rightarrow d = 4
 d \rightarrow e = 1
 Then standard deviation of critical path a \rightarrow e is
 (A) 6 (B) 5
 (C) 4 (D) 17
21. A die bar has a length of 200 mm. Each roller has a diameter of 20 mm. During taper angle measurement of a component, the height from the surface plate to the centre of a roller is 110 mm. The calculated taper angle (in degree) is
22. Which of the following arc welding techniques uses consumable electrode in wire form,
 (A) Shielded metal arc welding (SMAW)
 (B) Tungsten inert gas welding (TIG)
 (C) Submerged arc welding (SAW)
 (D) Plasma arc welding (PAW)
23. A wire of 10 mm initial diameter, Young's modulus of 200 GPa experience a load of 10 N. It has Poisson's ratio value as 0.3. Evaluate true stress (MPa).
24. Estimate the machining time to turn MS rod from 4 cm to 3 cm diameter for a length of 15 cm in a single cut. Assume cutting speed of 30 m/min and feed to be 0.4 mm/rev _____ mins. Neglect approach and over travel
25. During ultrasonic machining the metal removal is achieved by
 (A) High frequency eddy currents
 (B) High frequency sound waves
 (C) Hammering action of abrasive particles
 (D) Rubbing action between tool and work piece

Q.26 - Q.55 Carry Two Mark each.

26. The curve defined by the equation is $x^y = y^x$ the slope of the tangent to the curve at $(x^y = y^x)$. The slope of the tangent to the curve at $(x, y) = (2, 4)$

- (A) $\frac{\ln 2 - 2}{\ln 2 - \frac{1}{2}}$ (B) $\frac{2 \ln 2 - 2}{\ln 2 - \frac{1}{2}}$
(C) 0 (D) None

27. The Laplace transform of the half wave rectification of $\sin \omega t$ is



- (A) $\frac{\omega}{s^2 + \omega^2} \cdot \frac{1}{1 + e^{-\pi s/\omega}}$ (B) $\frac{\omega}{s^2 + \omega^2} \cdot \frac{1}{1 - e^{-\pi s/\omega}}$
(C) $\frac{\omega}{s^2 + \omega^2} \cdot \frac{1}{e^{-\pi s/\omega} - 1}$ (D) $\frac{-\omega}{s^2 + \omega^2} \cdot \frac{1}{1 + e^{-\pi s/\omega}}$

28. There are three coins of which two are unbiased and one is biased with head on both sides. A coin is drawn at random and tossed two times; it appears head on both the times. Find the probability that selected coins are biased coin.

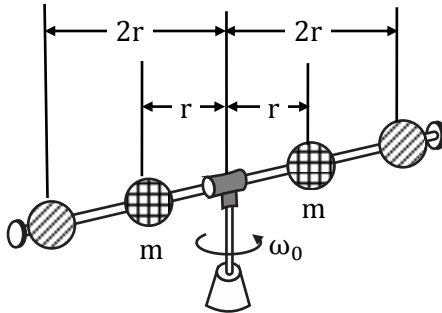
29. The density function of x is given by $f(x) = \begin{cases} 1 & \text{if } 0 \leq x \leq 1 \\ 0 & \text{otherwise} \end{cases}$

Determine the expectation of e^x

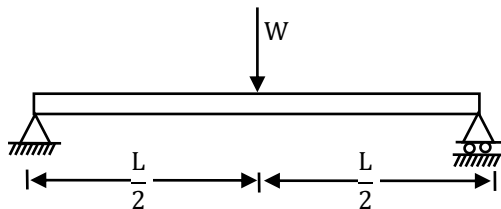
- (A) $e + 1$ (B) $e - 1$
(C) $1 - e$ (D) None of these

30. A braking torque of 80 Nm is applied for 5 sec to bring the shaft rotating at 100 rpm to rest, the heat generated is _____(kJ)

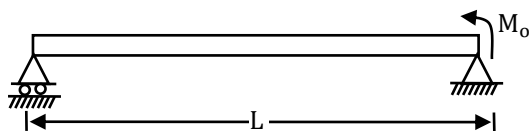
31. Two spheres of equal mass 'm' are able to slide along the horizontal rotating rod. If they are initially latched in position at a distance 'r' from the rotating axis with the assembly rotating freely with an angular velocity ' ω_0 '. The percentage loss in kinetic energy of the system after the spheres are released and finally assume positions at the ends of the rod at a radial distance of $2r$ ____% (Neglect small mass of rod and shaft)



32. For the below loading case to find out maximum deflection which of the following methods can be used

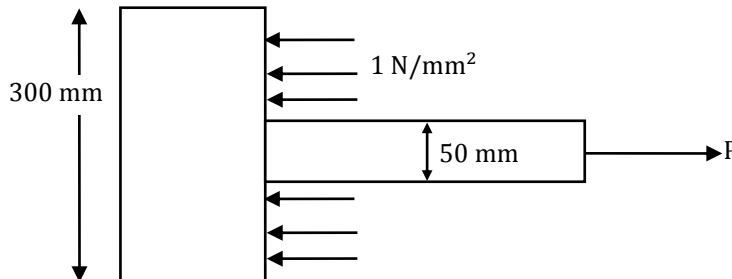


- (1) Double integration method
 (2) Macaulay's method
 (3) Area moment method
 (4) Strain energy method
- (A) 1, 2 and 3
 (B) 2, 3 and 4
 (C) 3, 4 and 1
 (D) All of the above
33. For a simply supported beam shown below. Find the length at which maximum, deflection occurs



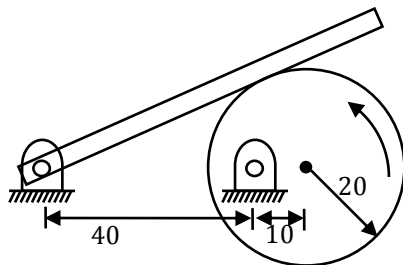
- (A) $\frac{2L}{\sqrt{3}}$
 (B) $\frac{L}{3}$
 (C) $\frac{2L}{3}$
 (D) $\frac{L}{\sqrt{3}}$

34. A piston of steam engine is 300 mm in diameter and the piston rod is 50 mm diameter. The steam pressure is 1 N/mm^2 . Find the elongation (mm) of the piston rod if it has a length of 800 mm. Take $E = 205 \text{ kN/mm}^2$



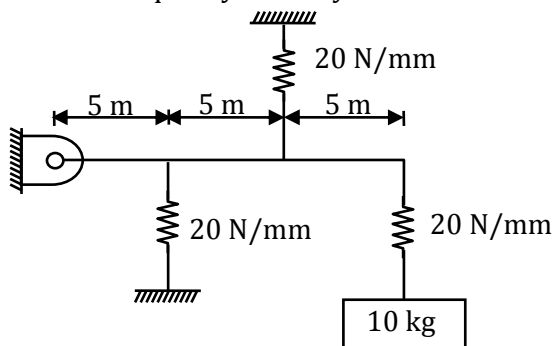
Note: Find the answer up to 4 decimal places

35. A steel beam of square cross section 25 mm^2 and length 1m is simply supported at its ends. If density of steel is 7600 kg/m^3 and young's modulus $E = 200 \text{ GPa}$. Deflection (mm) due to self-weight at the center of the beam is _____
36. In the mechanism given below, if the angular velocity of the eccentric circular disc is 2 rad/s , the sliding velocity (in m/s) of the follower link with respect to cam

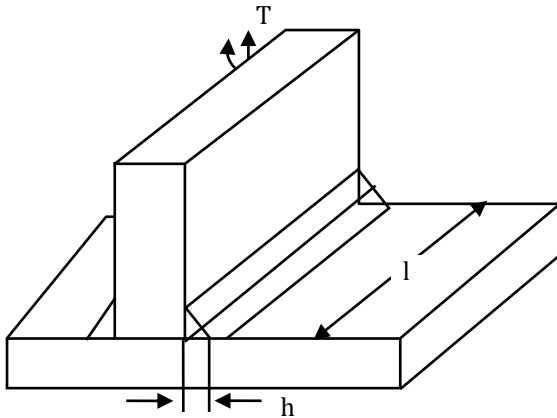


All dimensions are in mm

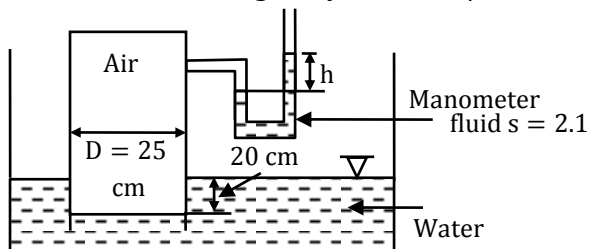
37. Natural frequency of the system shown in figure is (in rad/s) _____



38. A plate 1 m long 60mm thick welded to another plate at right angles to each other by 60 mm fillet weld as shown in figure. Find the maximum torque(Nm) that the welded joint can sustain if the permissible shear stress entering in the weld material is not to exceed 80 MPa

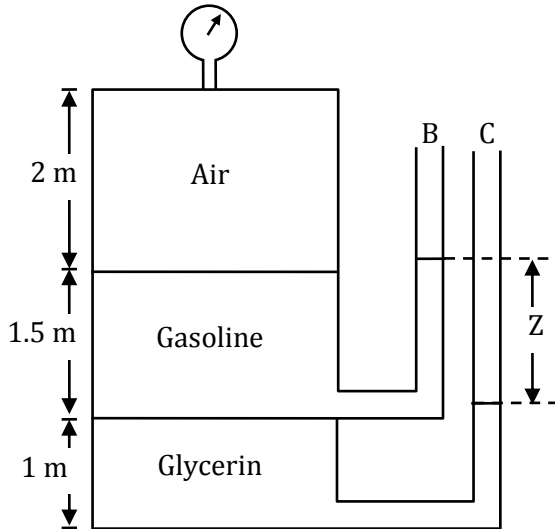


39. A cylindrical container whose weight is 65N is inverted and pressed into the water, as shown in the figure below. The differential height h of the manometer is _____cm. (Take acceleration due to gravity as 9.81 m/s^2 and density of water as 1000 kg/m^3)



40. Oil of viscosity 2.0 pa-sec is flowing between two fixed parallel plates with maximum velocity of 1.5 m/s . The pressure difference between two points 25 m apart is _____kPa.

41. In the figure, pressure gauge A reads 1.5 kPa. The elevation z in meters between the liquid levels in piezometer tubes B and C is _____ m
(Take $g = 10 \text{ m/s}^2$)



Density of air = 1.2 kg/m^3

Density of gasoline = 7 kg/m^3 and

Density of glycerin = 1236 kg/m^3

42. In a heat exchanger, the inner diameter of a tube is 25mm and its outer diameter is 30 mm. The overall heat transfer coefficient based on the inner area is $360 \text{ W/m}^2 \text{ } ^\circ\text{C}$. Then , the overall heat transfer coefficient based on the outer area is _____ $\text{W/m}^2 \text{ } ^\circ\text{C}$
43. The internal energy of air is given by $u = u_0 + 0.718t$, where u is in kJ/kg , u_0 is any arbitrary value of u at 0°C kJ/kg and t is the temperature in $^\circ\text{C}$.
Also for air, $P_v = 0.287(t + 273)$, where p is in kPa and v is in m^3/kg .
A mass of air is stirred by a paddle wheel in an insulated constant volume tank. The velocities due to stirring make a negligible contribution to the internal energy of the air. Air flows out through a small valve in the tank at a rate controlled to keep the temperature in the tank constant. At a certain instant the conditions are as follows:
Tank volume = 0.12 m^3 , Pressure = 1 MPa , Temperature = 150°C and power to Paddle Wheel = 0.1 kW . Find the rate of flow of air out of the tank at this instant _____ (in kg/hr) by treating air to behave as ideal gas?
44. A piston-cylinder device with air at an initial temperature of 30°C undergoes an expansion process for which pressure and volume are related as given below:
- | | | | |
|-----------------|-----|------|------|
| $P(\text{kPa})$ | 100 | 37.9 | 14.4 |
| $V(\text{m}^3)$ | 0.1 | 0.2 | 0.4 |
- Calculate work done by the system (kJ)

48. As the standoff distance measures beyond a certain value (say 5 mm) the depth of penetration in AJM
- (A) Increases
(B) Does not change
(C) Decreases
(D) Initially increases and then remains steady
49. Consider the following statement regarding solidification
1. Solidification of pure metal occurs at constant temperature rather than over a temperature range.
 2. Solidification of an alloy of any composition will occur over a temperature range
- Which of the above statements are true?
- (A) Both 1 and 2
(B) Only 1
(C) Only 2
(D) Neither 1 nor 2
50. If drilling is done on a CNC machine with contouring control system.
- (A) The "Cutter diameter compensation left" should be used
(B) The "Cutter diameter right" should be used
(C) Drilling cannot be done on CNC machines such contouring control systems
(D) Cutter diameter compensation is not required
51. An HSS tool is used for turning operation the tool life is 1 hr when turning is carried at 30 m/min, the tool life is reduced to 2 min if cutting speed is doubled. For 30 min tool life suitable speed will be _____ m/min
52. In an electro chemical machining operation the current used is 5000A, atomic weight of copper is 63 and valency of dissolution is 1, faradays constant is 96500 coulomb, the material removal rate (g/s) is _____. The density of copper is 8.96 g/cc
53. Determine the size of general type NO – h0 plug gauge for the checking hole of 30 H7/f8
Given: 1T7 tolerance = 16i
 $i = 0.45\sqrt[3]{D} + 0.001 D$ microns (D in mm)
Take gauge tolerance as 10% of work tolerance
Diameter step for 30 mm = 18 – 30 mm
- (A) $30_{-0.0231}^{-0.0231}$ mm
(B) $30_{-0.00}^{+0.0189}$ mm
(C) $30_{+0.0210}^{+0.0231}$ mm
(D) $30_{-0.0189}^{+0.0210}$ mm

54. A wire manufacturing company sells wire to TATA MOTOR CORPORATION as per following price lists:

Order Quantity	Price per unit(P)
1 – 299	₹ 2.50
300 – 619	₹ 2.30
620 +	₹ 2.00

The annual demand is 15000 wires per year. The carrying cost is 25% of unit price and cost of ordering is ₹ 6.50 per order. Assume instantaneous delivery. The optimal quantity is _____

- (A) 624.50 (B) 582.35
(C) 652.3 (D) 578.47
55. Critical path of project is _____
- | Activity | precedence | Duration (in days) |
|----------|------------|--------------------|
| a | - | 3 |
| b | - | 4 |
| c | a | 5 |
| d | b | 5 |
| e | c, d | 7 |
| f | c, d | 5 |
| g | e | 2 |
| h | f | 10 |
- (A) b → d → f → h (B) a → c → e → g
(C) b → d → e → g (D) a → c → f → h