SESSION - 3

GATE 2014: General Instructions during Examination

1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at 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 need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

1	You have not visited the question yet.
3	You have not answered the question.
5	You have answered the question.
7	You have NOT answered the question, but have marked the question for review.
9	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, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

7. 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 and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
   c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
   d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

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 :

8. Procedure for answering a multiple choice (MCQ) type question:
    a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
    b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
    c. To change your chosen answer, click on the bubble of another option.
    d. To save your answer, you MUST click on the **Save & Next** button.

9. Procedure for answering a numerical answer type question:
    a. To enter a number as your answer, use the virtual numerical keypad.
    b. A fraction (e.g. -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 & Next** button
10. To mark a question for review, click on the **Mark for Review & 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 unless the status is modified by the candidate.*

11. 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.
12. Note that ONLY Questions for which answers are *saved* or *marked for review after answering* will be considered for evaluation.

Choosing a Section :

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.
14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.
15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. After clicking the **Save & Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.

17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.

19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.

20. You can shuffle between different Sections or change the optional Sections any number of times.

GATE 2014 Examination

ME: Mechanical Engineering

Duration: **180 minutes**   *Maximum Marks*: **100**

Read the following instructions carefully.

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.
3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory.
   The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
   The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.
4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.

5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.
9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (◯) placed before the choice.
10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**. For these questions, the answer should be entered**by using the virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of⅓ marks for a 1-mark question and ⅔ marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.

13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

Declaration by the candidate:

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition".

Q. 1 – Q. 5 carry one mark each.

Q.1   "India is a country of rich heritage and cultural diversity."

Which one of the following facts best supports the claim made in the above sentence?

(A) India is a union of 28 states and 7 union territories.
(B) India has a population of over 1.1 billion.
(C) India is home to 22 official languages and thousands of dialects.
(D) The Indian cricket team draws players from over ten states.

Q.2   The value of one U.S. dollar is 65 Indian Rupees today, compared to 60 last year. The Indian Rupee has _____.

(A) depressed   (B) depreciated   (C) appreciated   (D) stabilized

Q.3   'Advice' is _____.

(A) a verb   (B) a noun   (C) an adjective   (D) both a verb and a noun

Q.4   The next term in the series 81, 54, 36, 24, … is _____

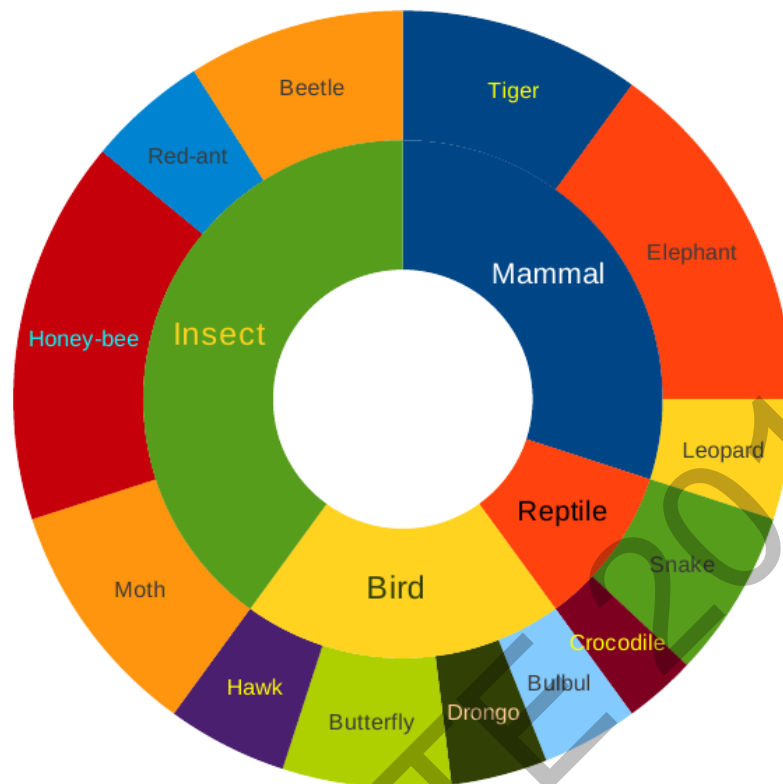Q.5   In which of the following options will the expression P < M be definitely true?

(A) M < R > P > S   (B) M > S < P < F   (C) Q < M < F = P   (D) P = A < R < M

Q. 6 – Q. 10 carry two marks each.

Q.6   Find the next term in the sequence: 7G, 11K, 13M, __

(A) 15Q   (B) 17Q   (C) 15P   (D) 17P

Q.7   The multi-level <u>hierarchical</u> pie chart shows the population of animals in a reserve forest. The correct conclusions from <u>this</u> information are:


(i) Butterflies are birds
(ii) There are more tigers in this forest than red ants
(iii) All reptiles in this forest are either snakes or crocodiles
(iv) Elephants are the largest mammals in this forest

(A) (i) and (ii) only   (B) (i), (ii), (iii) and (iv)
(C) (i), (iii) and (iv) only   (D) (i), (ii) and (iii) only

Q.8   A man can row at 8 km per hour in still water. If it takes him thrice as long to row upstream, as to row downstream, then find the stream velocity in km per hour.

Q.9   A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. If the company registered a profit of Rs. 10 lakhs in 2012, at what price (in Rs.) was each air purifier sold?
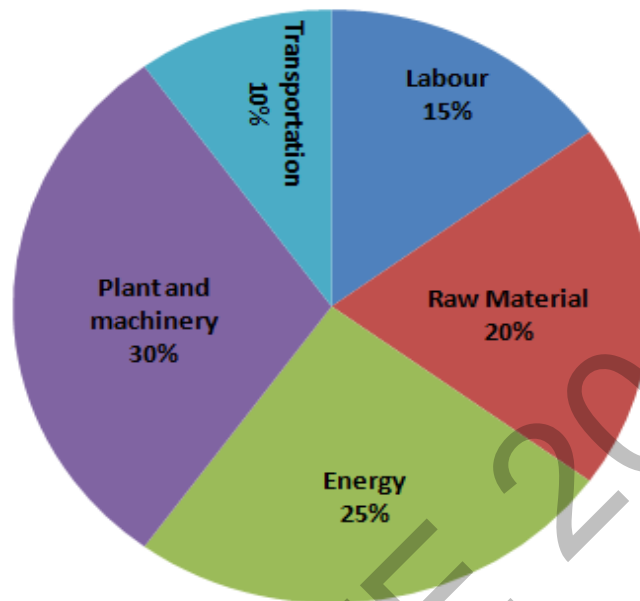

Q.10   A batch of one hundred bulbs is inspected by testing four randomly chosen bulbs. The batch is rejected if even one of the bulbs is defective. A batch typically has five defective bulbs. The probability that the current batch is accepted is _____

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1   Consider a 3×3 real symmetric matrix S such that two of its eigenvalues are $a \neq 0, b \neq 0$ with respective eigenvectors $\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$. If $a \neq b$ then $x_1 y_1 + x_2 y_2 + x_3 y_3$ equals

(A) a (B) b (C) ab (D) 0

Q.2   If a function is continuous at a point,

(A) the limit of the function may not exist at the point
(B) the function must be derivable at the point
(C) the limit of the function at the point tends to infinity
(D) the limit must exist at the point and the value of limit should be same as the value of the function at that point

Q.3   Divergence of the vector field $x^2 z\, \hat{i} + x\, y\, \hat{j} - y\, z^2\, \hat{k}$ at $(1, -1, 1)$ is

(A) 0   (B) 3   (C) 5   (D) 6

Q.4   A group consists of equal number of men and women. Of this group 20% of the men and 50% of the women are unemployed. If a person is selected at random from this group, the probability of the selected person being employed is _____

Q.5   The definite integral $\int_1^3 \frac{1}{x}\, dx$ is evaluated using Trapezoidal rule with a step size of 1. The correct answer is _____

Q.6   A rotating steel shaft is supported at the ends. It is subjected to a point load at the center. The maximum bending stress developed is 100 MPa. If the yield, ultimate and corrected endurance strength of the shaft material are 300 MPa, 500 MPa and 200 MPa, respectively, then the factor of safety for the shaft is _____

Q.7   Two solid circular shafts of radii R_1 and R_2 are subjected to same torque. The maximum shear stresses developed in the two shafts are τ_1 and τ_2. If $R_1/R_2 = 2$, then τ_2/τ_1 is _____

Q.8   Consider a single degree-of-freedom system with viscous damping excited by a harmonic force. At resonance, the phase angle (in degree) of the displacement with respect to the exciting force is

(A) 0   (B) 45   (C) 90   (D) 135

Q.9   A mass m_1 of 100 kg travelling with a uniform velocity of 5 m/s along a line collides with a stationary mass m_2 of 1000 kg. After the collision, both the masses travel together with the same velocity. The coefficient of restitution is

(A) 0.6   (B) 0.1   (C) 0.01   (D) 0

Q.10   Which one of following is **NOT** correct?

(A) Intermediate principal stress is ignored when applying the maximum principal stress theory
(B) The maximum shear stress theory gives the most accurate results amongst all the failure theories
(C) As per the maximum strain energy theory, failure occurs when the strain energy per unit volume exceeds a critical value
(D) As per the maximum distortion energy theory, failure occurs when the distortion energy per unit volume exceeds a critical value

Q.11   Gear 2 rotates at 1200 rpm in counter clockwise direction and engages with Gear 3. Gear 3 and Gear 4 are mounted on the same shaft. Gear 5 engages with Gear 4. The numbers of teeth on Gears 2, 3, 4 and 5 are 20, 40, 15 and 30, respectively. The angular speed of Gear 5 is
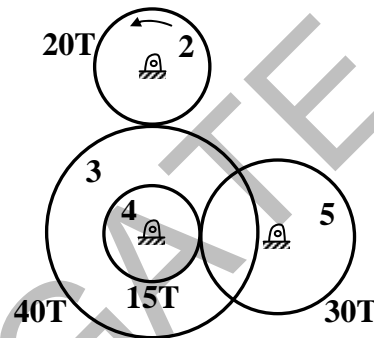
(A) 300 rpm counterclockwise   (B) 300 rpm clockwise

(C) 4800 rpm counterclockwise   (D) 4800 rpm clockwise

Q.12   Consider a long cylindrical tube of inner and outer radii, r_i and r_o, respectively, length, L and thermal conductivity, k. Its inner and outer surfaces are maintained at T_i and T_o, respectively $(T_i > T_o)$. Assuming one-dimensional steady state heat conduction in the radial direction, the thermal resistance in the wall of the tube is

(A) $\dfrac{1}{2\pi kL}\ln\left(\dfrac{r_i}{r_o}\right)$ (B) $\dfrac{L}{2\pi r_i k}$

(C) $\dfrac{1}{2\pi kL}\ln\left(\dfrac{r_o}{r_i}\right)$ (D) $\dfrac{1}{4\pi kL}\ln\left(\dfrac{r_o}{r_i}\right)$

Q.13   Which one of the following pairs of equations describes an irreversible heat engine?

(A) $\oint \delta Q > 0$ and $\oint \frac{\delta Q}{T} < 0$ (B) $\oint \delta Q < 0$ and $\oint \frac{\delta Q}{T} < 0$

(C) $\oint \delta Q > 0$ and $\oint \frac{\delta Q}{T} > 0$ (D) $\oint \delta Q < 0$ and $\oint \frac{\delta Q}{T} > 0$

Q.14   Consider the turbulent flow of a fluid through a circular pipe of diameter, D. Identify the correct pair of statements.

I. The fluid is well-mixed
II. The fluid is unmixed
III. $Re_D < 2300$
IV. $Re_D > 2300$

(A) I, III   (B) II, IV   (C) II, III   (D) I, IV

Q.15   For a gas turbine power plant, identify the correct pair of statements.

P. Smaller in size compared to steam power plant for same power output
Q. Starts quickly compared to steam power plant
R. Works on the principle of Rankine cycle
S. Good compatibility with solid fuel

(A) P, Q   (B) R, S   (C) Q, R   (D) P, S

Q.16   A source at a temperature of 500 K provides 1000 kJ of heat. The temperature of environment is 27°C. The maximum useful work (in kJ) that can be obtained from the heat source is _____

Q.17   A sample of moist air at a total pressure of 85 kPa has a dry bulb temperature of 30°C (saturation vapour pressure of water = 4.24 kPa). If the air sample has a relative humidity of 65%, the absolute humidity (in gram) of water vapour per kg of dry air is _____

Q.18   The process utilizing mainly thermal energy for removing material is

(A) Ultrasonic Machining   (B) Electrochemical Machining
(C) Abrasive Jet Machining   (D) Laser Beam Machining

Q.19   The actual sales of a product in different months of a particular year are given below:

September	October	November	December	January	February
180	280	250	190	240	?

The forecast of the sales, using the 4-month moving average method, for the month of February is _____

Q.20 A straight turning operation is carried out using a single point cutting tool on an AISI 1020 steel rod. The feed is 0.2 mm/rev and the depth of cut is 0.5 mm. The tool has a side cutting edge angle of 60°. The uncut chip thickness (in mm) is _____

Q.21 A minimal spanning tree in network flow models involves

(A) all the nodes with cycle/loop allowed   (B) all the nodes with cycle/loop not allowed
(C) shortest path between start and end nodes   (D) all the nodes with directed arcs

Q.22 Match the casting defects (Group A) with the probable causes (Group B):

Group A		Group B
P: Hot tears	1:	Improper fusion of two streams of liquid metal
Q: Shrinkage	2:	Low permeability of the sand mould
R: Blow holes	3:	Volumetric contraction both in liquid and solid stage
S: Cold Shut	4:	Differential cooling rate

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

Q.23 Cutting tool is much harder than the workpiece. Yet the tool wears out during the tool-work interaction, because

(A) extra hardness is imparted to the workpiece due to coolant used

(B) oxide layers on the workpiece surface impart extra hardness to it

(C) extra hardness is imparted to the workpiece due to severe rate of strain

(D) vibration is induced in the machine tool

Q.24　The stress-strain curve for mild steel is shown in the figure given below. Choose the correct option referring to both figure and table.
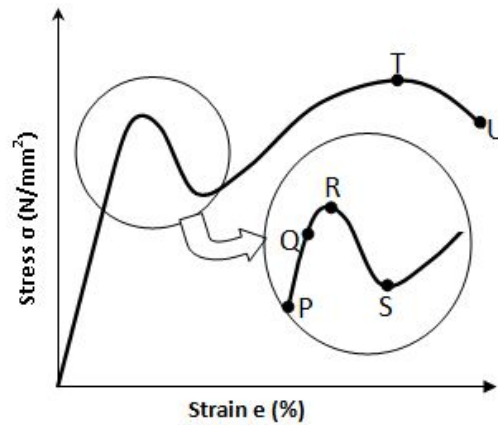
Point on the graph	Description of the point
P	1. Upper Yield Point
Q	2. Ultimate Tensile Strength
R	3. Proportionality Limit
S	4. Elastic Limit
T	5. Lower Yield Point
U	6. Failure

(A) P-1, Q-2, R-3, S-4, T-5, U-6
(B) P-3, Q-1, R-4, S-2, T-6, U-5
(C) P-3, Q-4, R-1, S-5, T-2, U-6
(D) P-4, Q-1, R-5, S-2, T-3, U-6

Q.25　The hot tearing in a metal casting is due to

(A) high fluidity　　　　　　　　　　　　(B) high melt temperature
(C) wide range of solidification temperature　(D) low coefficient of thermal expansion

Q. 26 – Q. 55 carry two marks each.

Q.26 An analytic function of a complex variable $z = x + i\,y$ is expressed as $f(z) = u(x, y) + i\,v(x, y)$, where $i = \sqrt{-1}$. If $u(x, y) = x^2 - y^2$, then expression for $v(x, y)$ in terms of x, y and a general constant c would be

(A) $xy + c$ (B) $\dfrac{x^2 + y^2}{2} + c$ (C) $2xy + c$ (D) $\dfrac{(x - y)^2}{2} + c$

Q.27 Consider two solutions $x(t) = x_1(t)$ and $x(t) = x_2(t)$ of the differential equation

$\dfrac{d^2 x(t)}{dt^2} + x(t) = 0, t > 0$, such that $x_1(0) = 1, \left.\dfrac{dx_1(t)}{dt}\right|_{t=0} = 0,\ x_2(0) = 0, \left.\dfrac{dx_2(t)}{dt}\right|_{t=0} = 1.$

The Wronskian $W(t) = \begin{vmatrix} x_1(t) & x_2(t) \\ \dfrac{dx_1(t)}{dt} & \dfrac{dx_2(t)}{dt} \end{vmatrix}$ at $t = \pi/2$ is

(A) 1   (B) –1   (C) 0   (D) $\pi/2$

Q.28 A machine produces 0, 1 or 2 defective pieces in a day with associated probability of 1/6, 2/3 and 1/6, respectively. The mean value and the variance of the number of defective pieces produced by the machine in a day, respectively, are

(A) 1 and 1/3   (B) 1/3 and 1
(C) 1 and 4/3   (D) 1/3 and 4/3

Q.29 The real root of the equation $5x - 2\cos x - 1 = 0$ (up to two decimal accuracy) is _____

Q.30 A drum brake is shown in the figure. The drum is rotating in anticlockwise direction. The coefficient of friction between drum and shoe is 0.2. The dimensions shown in the figure are in mm. The braking torque (in N.m) for the brake shoe is _____
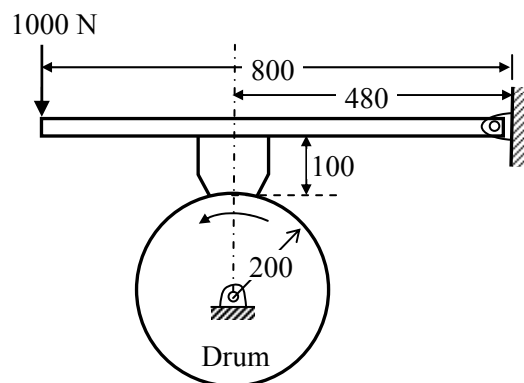
Q.31   A body of mass (*M*) 10 kg is initially stationary on a 45° inclined plane as shown in figure. The coefficient of dynamic friction between the body and the plane is 0.5. The body slides down the plane and attains a velocity of 20 m/s. The distance travelled (in meter) by the body along the plane is _____
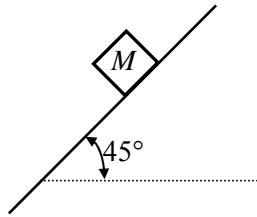
Q.32   Consider a simply supported beam of length, 50*h*, with a rectangular cross-section of depth, *h*, and width, 2*h*. The beam carries a vertical point load, *P*, at its mid-point. The ratio of the maximum shear stress to the maximum bending stress in the beam is

(A) 0.02   (B) 0.10   (C) 0.05   (D) 0.01

Q.33   The damping ratio of a single degree of freedom spring-mass-damper system with mass of 1 kg, stiffness 100 N/m and viscous damping coefficient of 25 N.s/m is _____

Q.34   An annular disc has a mass *m*, inner radius *R* and outer radius 2*R*. The disc rolls on a flat surface without slipping. If the velocity of the center of mass is *v*, the kinetic energy of the disc is

(A) $\dfrac{9}{16}mv^2$ (B) $\dfrac{11}{16}mv^2$ (C) $\dfrac{13}{16}mv^2$ (D) $\dfrac{15}{16}mv^2$

Q.35   A force P is applied at a distance x from the end of the beam as shown in the figure. What would be the value of x so that the displacement at 'A' is equal to zero?
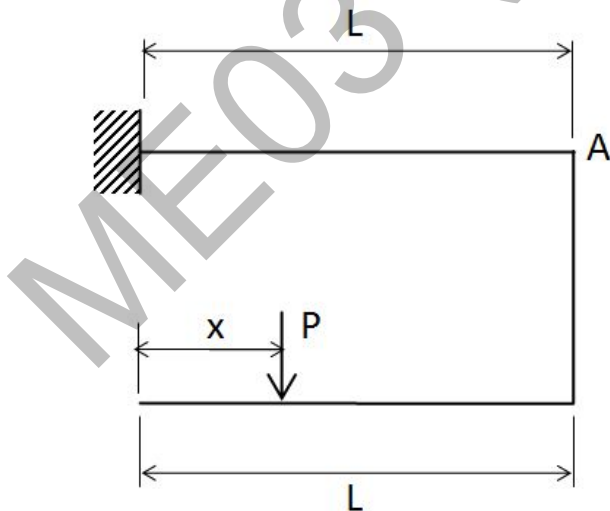
(A) 0.5L   (B) 0.25L   (C) 0.33L   (D) 0.66L

Q.36   Consider a rotating disk cam and a translating roller follower with zero offset. Which one of the following pitch curves, parameterized by t, lying in the interval 0 to 2π, is associated with the maximum translation of the follower during one full rotation of the cam rotating about the center at $(x, y) = (0, 0)$?

(A) $x(t) = \cos t,\ y(t) = \sin t$

(B) $x(t) = \cos t,\ y(t) = 2\sin t$

(C) $x(t) = \dfrac{1}{2} + \cos t,\ y(t) = 2\sin t$

(D) $x(t) = \dfrac{1}{2} + \cos t,\ y(t) = \sin t$

Q.37   A four-wheel vehicle of mass 1000 kg moves uniformly in a straight line with the wheels revolving at 10 rad/s. The wheels are identical, each with a radius of 0.2 m. Then a constant braking torque is applied to all the wheels and the vehicle experiences a uniform deceleration. For the vehicle to stop in 10 s, the braking torque (in N.m) on each wheel is _____

Q.38   A slider-crank mechanism with crank radius 60 mm and connecting rod length 240 mm is shown in figure. The crank is rotating with a uniform angular speed of 10 rad/s, counter clockwise. For the given configuration, the speed (in m/s) of the slider is _____
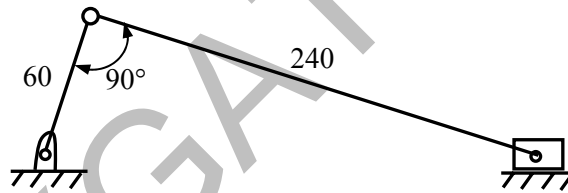
Q.39   Consider an objective function $Z(x_1, x_2) = 3x_1 + 9x_2$ and the constraints

$x_1 + x_2 \le 8,$
$x_1 + 2x_2 \le 4,$
$x_1 \ge 0, x_2 \ge 0.$

The maximum value of the objective function is _____

Q.40　A mass-spring-dashpot system with mass $m = 10$ kg, spring constant $k = 6250$ N/m is excited by a harmonic excitation of $10 \cos(25t)$ N. At the steady state, the vibration amplitude of the mass is 40 mm. The damping coefficient (c, in N.s/m) of the dashpot is _____


$F=10 \cos(25t)$
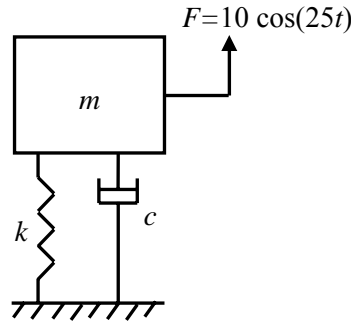
Q.41　A certain amount of an ideal gas is initially at a pressure p_1 and temperature T_1. First, it undergoes a constant pressure process 1-2 such that $T_2 = 3T_1/4$. Then, it undergoes a constant volume process 2-3 such that $T_3 = T_1/2$. The ratio of the final volume to the initial volume of the ideal gas is

(A) 0.25　　　　　(B) 0.75　　　　　(C) 1.0　　　　　(D) 1.5

Q.42　An amount of 100 kW of heat is transferred through a wall in steady state. One side of the wall is maintained at 127°C and the other side at 27°C. The entropy generated (in W/K) due to the heat transfer through the wall is _____

Q.43　A siphon is used to drain water from a large tank as shown in the figure below. Assume that the level of water is maintained constant. Ignore frictional effect due to viscosity and losses at entry and exit. At the exit of the siphon, the velocity of water is
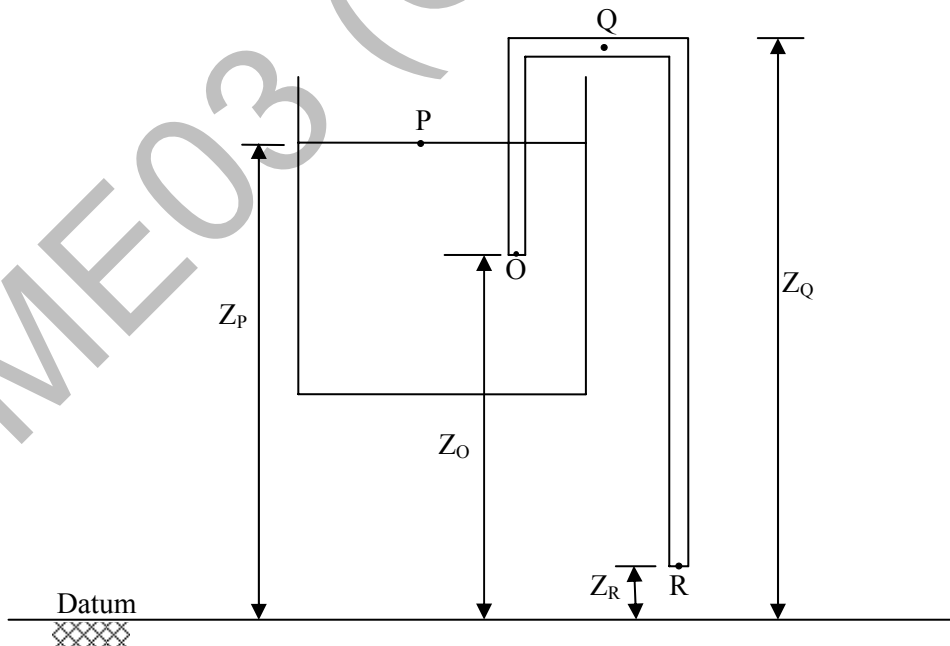
(A) $\sqrt{2g(Z_Q - Z_R)}$　　(B) $\sqrt{2g(Z_P - Z_R)}$　　(C) $\sqrt{2g(Z_O - Z_R)}$　　(D) $\sqrt{2gZ_Q}$

Q.44 Heat transfer through a composite wall is shown in figure. Both the sections of the wall have equal thickness (*l*). The conductivity of one section is *k* and that of the other is 2*k*. The left face of the wall is at 600 K and the right face is at 300 K.
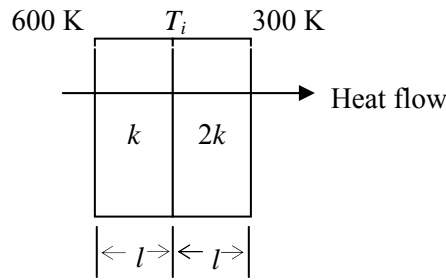

The interface temperature T_i (in K) of the composite wall is _____

Q.45 A fluid of dynamic viscosity 2×10^{-5} kg/m.s and density 1 kg/m^3 flows with an average velocity of 1 m/s through a long duct of rectangular (25 mm × 15 mm) cross-section. Assuming laminar flow, the pressure drop (in Pa) in the fully developed region per meter length of the duct is _____

Q.46 At the inlet of an axial impulse turbine rotor, the blade linear speed is 25 m/s, the magnitude of absolute velocity is 100 m/s and the angle between them is 25°. The relative velocity and the axial component of velocity remain the same between the inlet and outlet of the blades. The blade inlet and outlet velocity triangles are shown in the figure. Assuming no losses, the specific work (in J/kg) is _____
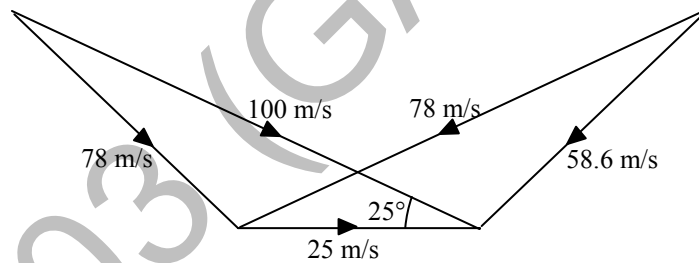
Q.47 A solid sphere of radius r_1 = 20 mm is placed concentrically inside a hollow sphere of radius r_2 = 30 mm as shown in the figure.
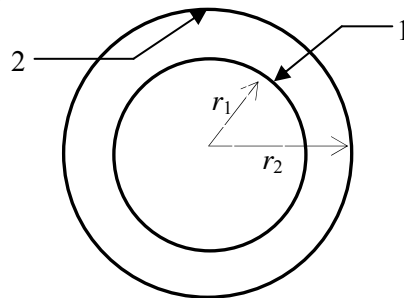

The view factor F_{21} for radiation heat transfer is

(A) $\dfrac{2}{3}$ (B) $\dfrac{4}{9}$ (C) $\dfrac{8}{27}$ (D) $\dfrac{9}{4}$

Q.48   A double-pipe counter-flow heat exchanger transfers heat between two water streams. Tube side water at 19 liter/s is heated from 10°C to 38°C. Shell side water at 25 liter/s is entering at 46°C. Assume constant properties of water; density is 1000 kg/m^3 and specific heat is 4186 J/kg.K. The LMTD (in °C) is _____

Q.49   A diesel engine has a compression ratio of 17 and cut-off takes place at 10% of the stroke. Assuming ratio of specific heats (γ) as 1.4, the air-standard efficiency (in percent) is _____

Q.50   Consider the given project network, where numbers along various activities represent the normal time. The free float on activity 4-6 and the project duration, respectively, are
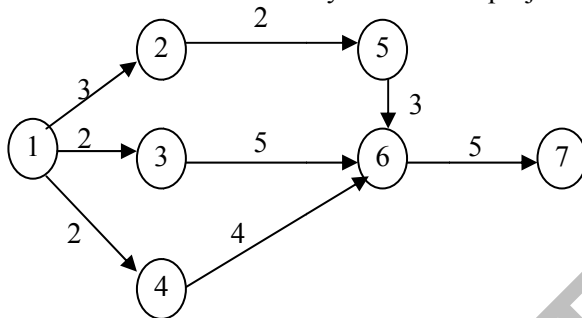

(A) 2, 13   (B) 0, 13   (C) –2, 13   (D) 2, 12

Q.51   A manufacturer can produce 12000 bearings per day. The manufacturer received an order of 8000 bearings per day from a customer. The cost of holding a bearing in stock is Rs. 0.20 per month. Setup cost per production run is Rs. 500. Assuming 300 working days in a year, the frequency of production run should be

(A) 4.5 days   (B) 4.5 months   (C) 6.8 days   (D) 6.8 months

Q.52   A cylindrical blind riser with diameter d and height h, is placed on the top of the mold cavity of a closed type sand mold as shown in the figure. If the riser is of constant volume, then the rate of solidification in the riser is the least when the ratio h:d is
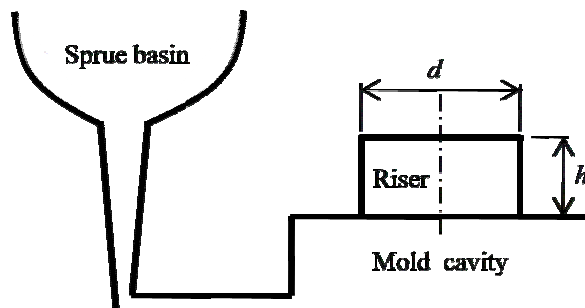
(A) 1:2   (B) 2:1   (C) 1:4   (D) 4:1

Q.53 The diameter of a recessed ring was measured by using two spherical balls of diameter d_2=60 mm and d_1=40 mm as shown in the figure.
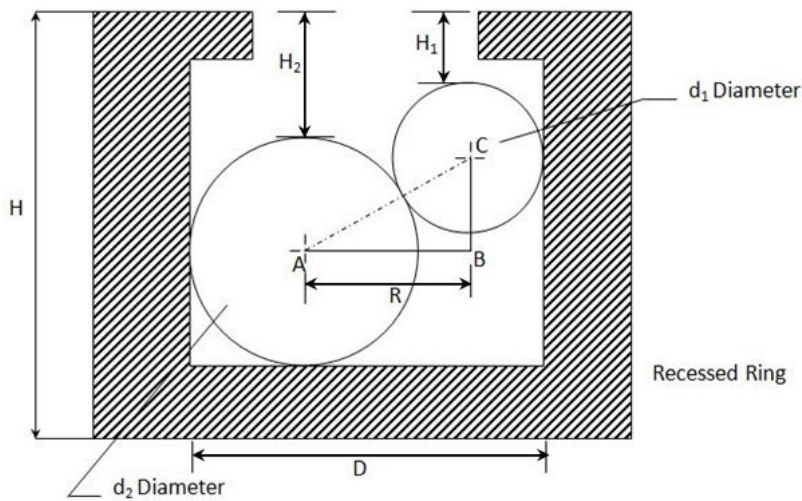
The distance H_2=35.55 mm and H_1=20.55 mm. The diameter (D, in mm) of the ring gauge is _____

Q.54 Which pair of following statements is correct for orthogonal cutting using a single-point cutting tool?

P. Reduction in friction angle increases cutting force
Q. Reduction in friction angle decreases cutting force
R. Reduction in friction angle increases chip thickness
S. Reduction in friction angle decreases chip thickness

(A) P and R   (B) P and S   (C) Q and R   (D) Q and S

Q.55 For spot welding of two steel sheets (base metal) each of 3 mm thickness, welding current of 10000 A is applied for 0.2 s. The heat dissipated to the base metal is 1000 J. Assuming that the heat required for melting 1 mm^3 volume of steel is 20 J and interfacial contact resistance between sheets is 0.0002 Ω, the volume (in mm^3) of weld nugget is _____

END OF THE QUESTION PAPER

GATE 2014
Answer Keys for ME - Mechanical Engineering

Section	Q. No.	SESSION - Key / Range	Marks	Section	Q. No.	SESSION - Key / Range	Marks
GA	1	C	1	ME	24	C	1
GA	2	B	1	ME	25	C	1
GA	3	B	1	ME	26	C	2
GA	4	16 to 16	1	ME	27	A	2
GA	5	D	1	ME	28	A	2
GA	6	B	2	ME	29	0.53 to 0.56	2
GA	7	D	2	ME	30	63 to 65	2
GA	8	4 to 4	2	ME	31	56 to 59	2
GA	9	20000 to 20000	2	ME	32	D	2
GA	10	0.80 to 0.82	2	ME	33	1.24 to 1.26	2
ME	1	D	1	ME	34	C	2
ME	2	D	1	ME	35	C	2
ME	3	C	1	ME	36	C	2
ME	4	0.64 to 0.66	1	ME	37	9 to 11	2
ME	5	1.1 to 1.2	1	ME	38	0.54 to 0.68	2
ME	6	1.9 to 2.1	1	ME	39	17 to 19	2
ME	7	7.9 to 8.1	1	ME	40	9 to 11	2
ME	8	C	1	ME	41	B	2
ME	9	D	1	ME	42	80 to 85	2
ME	10	B	1	ME	43	B	2
ME	11	A	1	ME	44	399 to 401	2
ME	12	C	1	ME	45	1.7 to 2.0	2
ME	13	A	1	ME	46	3250 to 3300	2
ME	14	D	1	ME	47	B	2
ME	15	A	1	ME	48	10.8 to 11.2	2
ME	16	399 to 401	1	ME	49	58 to 62	2
ME	17	19 to 22	1	ME	50	A	2
ME	18	D	1	ME	51	C	2
ME	19	239 to 241	1	ME	52	A	2
ME	20	0.08 to 0.12	1	ME	53	92 to 94	2
ME	21	B	1	ME	54	D	2
ME	22	B	1	ME	55	140 to 160	2
ME	23	C	1				