GATE 2020

Graduate Aptitude Test in Engineering 2020

IIT Delhi
Organising Institute

Home   Information Brochure   GATE International   Pre Examination   Important Dates   FAQs   Contact Us

ME2: Mechanical Engineering

GA - General Aptitude

Q1 - Q5 carry one mark each.

Q.No. 1   While I agree_____his proposal this time, I do not often agree_____him.

(A)   to, with

(B)   with, to

(C)   with, with

(D)   to, to

Q.No. 2   The recent measures to improve the output would_____the level of production to our satisfaction.

(A)   increase

(B)   decrease

(C)   speed

(D)   equalise

Q.No. 3   Select the word that fits the analogy:

White: Whitening : : Light: _____

(A)   Lightning

(B)   Lightening

(C)   Lighting

(D)   Enlightening

Q.No. 4   In one of the greatest innings ever seen in 142 years of Test history, Ben Stokes upped the tempo in a five-and-a-half hour long stay of 219 balls including 11 fours and 8 sixes that saw him finish on a 135 not out as England squared the five-match series.

Based on their connotations in the given passage, which one of the following meanings DOES NOT match?

(A)   upped = increased

(B)   squared = lost

(C)   tempo = enthusiasm

(D)   saw = resulted in

Q.No. 5

There are five levels $\{P, Q, R, S, T\}$ in a linear supply chain before a product reaches customers, as shown in the figure.

| P | → | Q | → | R | → | S | → | T | → | Customers |
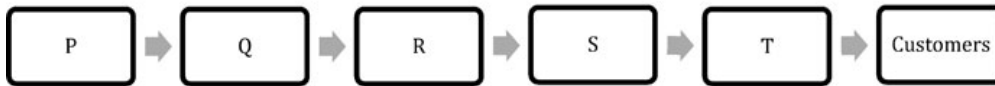
At each of the five levels, the price of the product is increased by 25%. If the product is produced at level P at the cost of Rs. 120 per unit, what is the price paid (in rupees) by the customers?

(A)   187.50
(B)   234.38
(C)   292.96
(D)   366.21

Q6 - Q10 carry two marks each.

Q.No. 6   Climate change and resilience deal with two aspects – reduction of sources of non-renewable energy resources and reducing vulnerability of climate change aspects. The terms 'mitigation' and 'adaptation' are used to refer to these aspects, respectively.

Which of the following assertions is best supported by the above information?

(A)   Mitigation deals with consequences of climate change.
(B)   Adaptation deals with causes of climate change.
(C)   Mitigation deals with actions taken to reduce the use of fossil fuels.
(D)   Adaptation deals with actions taken to combat green-house gas emissions.

Q.No. 7   Find the missing element in the following figure.
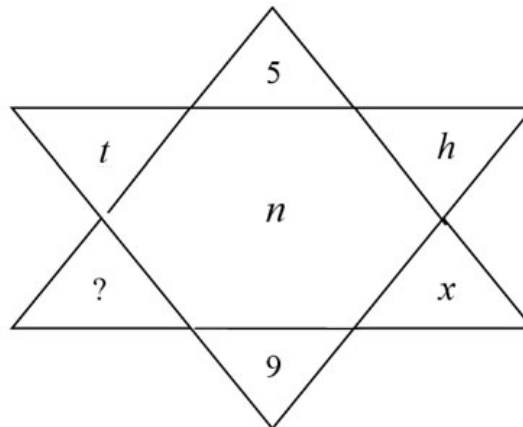

(A) d
(B) e
(C) w
(D) y

Q.No. 8   It was estimated that 52 men can complete a strip in a newly constructed highway connecting cities P and Q in 10 days. Due to an emergency, 12 men were sent to another project. How many number of days, more than the original estimate, will be required to complete the strip?

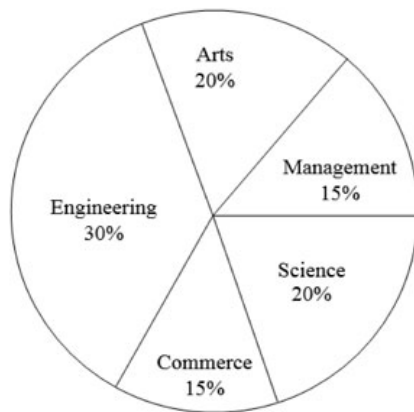(A)   3 days
(B)   5 days
(C)   10 days
(D)   13 days

Q.No. 9   An engineer measures THREE quantities X, Y and Z in an experiment. She finds that they follow a relationship that is represented in the figure below: (the product of X and Y linearly varies with Z)
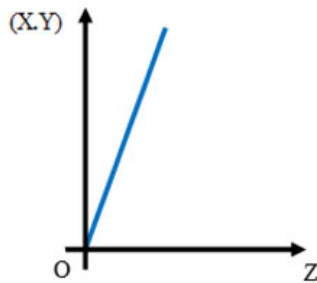

Then, which of the following statements is FALSE?

(A)   For fixed Z; X is proportional to Y

(B)   For fixed Y; X is proportional to Z

(C)   For fixed X; Z is proportional to Y

(D)   XY/Z is constant

Q.No. 10   The two pie-charts given below show the data of total students and only girls registered in different streams in a university. If the total number of students registered in the university is 5000, and the total number of the registered girls is 1500; then, the ratio of boys enrolled in Arts to the girls enrolled in Management is _____.
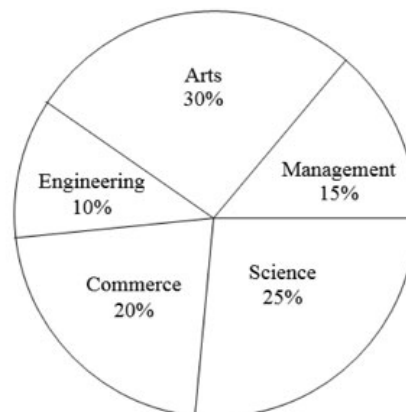
(A)   2 : 1
(B)   9 : 22
(C)   11 : 9
(D)   22 : 9

ME2: Mechanical Engineering
Q1 - Q25 carry one mark each.

Q.No. 1   The sum of two normally distributed random variables X and Y is

(A)   always normally distributed

(B)   normally distributed, only if X and Y are independent

(C)   normally distributed, only if X and Y have the same standard deviation

(D)   normally distributed, only if X and Y have the same mean

Q.No. 2   A matrix P is decomposed into its symmetric part S and skew symmetric part V.

If

$$S = \begin{pmatrix} -4 & 4 & 2 \\ 4 & 3 & 7/2 \\ 2 & 7/2 & 2 \end{pmatrix}, \quad V = \begin{pmatrix} 0 & -2 & 3 \\ 2 & 0 & 7/2 \\ -3 & -7/2 & 0 \end{pmatrix},$$

then matrix P is

(A) $\begin{pmatrix} -4 & 6 & -1 \\ 2 & 3 & 0 \\ 5 & 7 & 2 \end{pmatrix}$

(B) $\begin{pmatrix} -4 & 2 & 5 \\ 6 & 3 & 7 \\ -1 & 0 & 2 \end{pmatrix}$

(C) $\begin{pmatrix} 4 & -6 & 1 \\ -2 & -3 & 0 \\ -5 & -7 & -2 \end{pmatrix}$

(D) $\begin{pmatrix} -2 & 9/2 & -1 \\ -1 & 81/4 & 11 \\ -2 & 45/2 & 73/4 \end{pmatrix}$

Q.No. 3   Let $I = \int_{x=0}^{1} \int_{y=0}^{x^2} xy^2 \, dy \, dx$. Then, I may also be expressed as

(A) $\displaystyle\int_{y=0}^{1} \int_{x=0}^{\sqrt{y}} xy^2 \, dx \, dy$

(B) $\displaystyle\int_{y=0}^{1} \int_{x=\sqrt{y}}^{1} yx^2 \, dx \, dy$

(C) $\displaystyle\int_{y=0}^{1} \int_{x=\sqrt{y}}^{1} xy^2 \, dx \, dy$

(D) $\displaystyle\int_{y=0}^{1} \int_{x=0}^{\sqrt{y}} yx^2 \, dx \, dy$
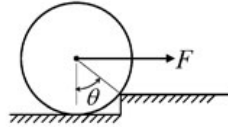
Q.No. 4   The solution of

$$\frac{d^2 y}{dt^2} - y = 1,$$

which additionally satisfies $y|_{t=0} = \left.\frac{dy}{dt}\right|_{t=0} = 0$ in the Laplace s-domain is

(A) $\dfrac{1}{s(s+1)(s-1)}$

(B) $\dfrac{1}{s(s+1)}$

(C) $\dfrac{1}{s(s-1)}$

(D) $\dfrac{1}{s-1}$

Q.No. 5

An attempt is made to pull a roller of weight W over a curb (step) by applying a horizontal force F as shown in the figure.

The coefficient of static friction between the roller and the ground (including the edge of the step) is μ. Identify the correct free body diagram (FBD) of the roller when the roller is just about to climb over the step.

(A)

(B)

(C)

(D)

Q.No. 6   A circular disk of radius r is confined to roll without slipping at P and Q as shown in the figure.
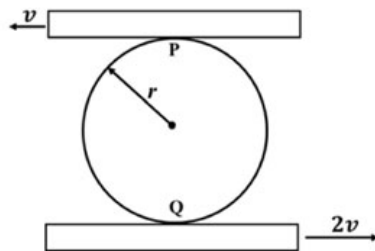
If the plates have velocities as shown, the magnitude of the angular velocity of the disk is

(A) $\dfrac{v}{r}$

(B) $\dfrac{v}{2r}$

(C) $\dfrac{2v}{3r}$

(D) $$\frac{3v}{2r}$$

Q.No. 7 The equation of motion of a spring-mass-damper system is given by

$$\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 9x = 10\sin(5t)$$

The damping factor for the system is

(A)   0.25

(B)   0.5

(C)   2

(D)   3

Q.No. 8 The number of qualitatively distinct kinematic inversions possible for a Grashof chain with four revolute pairs is

(A)   1

(B)   2

(C)   3

(D)   4

Q.No. 9 The process, that uses a tapered horn to amplify and focus the mechanical energy for machining of glass, is

(A)   electrochemical machining

(B)   electrical discharge machining

(C)   ultrasonic machining

(D)   abrasive jet machining

Q.No. 10 Two plates, each of 6 mm thickness, are to be butt-welded. Consider the following processes and select the correct sequence in increasing order of size of the heat affected zone.

1. Arc welding

2. MIG welding

3. Laser beam welding

4. Submerged arc welding

(A)   1-4-2-3

(B)   3-4-2-1

(C)   4-3-2-1

(D)   3-2-4-1

**Q.No. 11** Which one of the following statements about a phase diagram is **INCORRECT?**

(A)   It indicates the temperature at which different phases start to melt

(B)   Relative amount of different phases can be found under given equillibrium conditions

(C)   It gives information on transformation rates

(D)   Solid solubility limits are depicted by it

Q.No. 12 The figure below shows a symbolic representation of the surface texture in a perpendicular lay orientation with indicative values (I through VI) marking the various specifications whose definitions are listed below.

P: Maximum Waviness Height (mm); Q: Maximum Roughness Height (mm);

R: Minimum Roughness Height (mm); S: Maximum Waviness Width (mm);

T: Maximum Roughness Width (mm); U: Roughness Width Cutoff (mm).
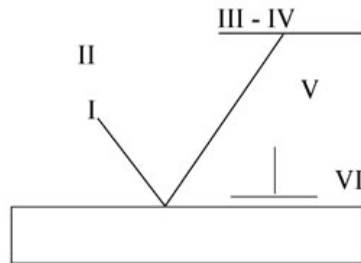
The correct match between the specifications and the symbols (I to VI) is

(A)   I-R, II-Q, III-P, IV-S, V-U, VI-T
(B)   I-R, II-P, III-U, IV-S, V-T, VI-Q
(C)   I-U, II-S, III-Q, IV-T, V-R, VI-P
(D)   I-Q, II-U, III-R, IV-T, V-S, VI-P

Q.No. 13 In Materials Requirement Planning, if the inventory holding cost is very high and the setup cost is zero, which one of the following lot sizing approaches should be used?

(A)   Economic Order Quantity
(B)   Lot-for-Lot
(C)   Base Stock Level
(D)   Fixed Period Quantity, for 2 periods

Q.No. 14 Which of the following conditions is used to determine the stable equilibrium of all partially submerged floating bodies?

(A)   Centre of buoyancy must be above the centre of gravity
(B)   Centre of buoyancy must be below the centre of gravity
(C)   Metacentre must be at a higher level than the centre of gravity
(D)   Metacentre must be at a lower level than the centre of gravity

Q.No. 15 In the space above the mercury column in a barometer tube, the gauge pressure of the vapour is

(A)   positive, but more than one atmosphere
(B)   negative
(C)   zero
(D)   positive, but less than one atmosphere

Q.No. 16

A closed vessel contains pure water, in thermal equilibrium with its vapour at 25°C (Stage #1), as shown.

Not to scale   Isothermal oven at 80°C

Stage #1   Stage #2
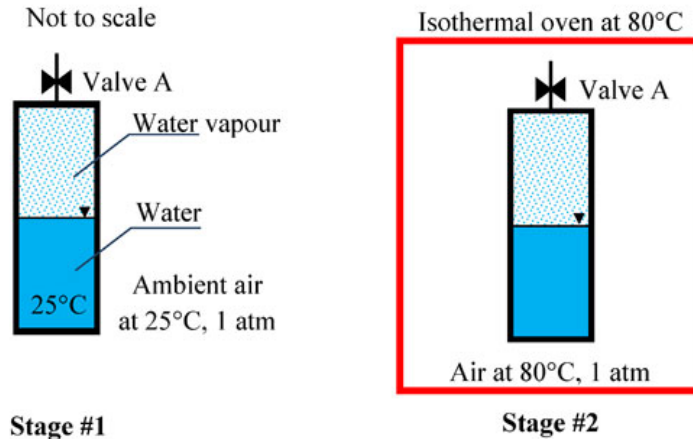
The vessel in this stage is then kept inside an isothermal oven which is having an atmosphere of hot air maintained at 80°C. The vessel exchanges heat with the oven atmosphere and attains a new thermal equilibrium (Stage #2). If the Valve A is now opened inside the oven, what will happen immediately after opening the valve?

(A)   Water vapor inside the vessel will come out of the Valve A
(B)   Hot air will go inside the vessel through Valve A
(C)   Nothing will happen – the vessel will continue to remain in equilibrium
(D)   All the vapor inside the vessel will immediately condense

Q.No. 17   For an air-standard Diesel cycle,
(A)   heat addition is at constant volume and heat rejection is at constant pressure
(B)   heat addition is at constant pressure and heat rejection is at constant pressure
(C)   heat addition is at constant pressure and heat rejection is at constant volume
(D)   heat addition is at constant volume and heat rejection is at constant volume

Q.No. 18   The values of enthalpies at the stator inlet and rotor outlet of a hydraulic turbomachine stage are h_1 and h_3 respectively. The enthalpy at the stator outlet (or, rotor inlet) is h_2. The condition $(h_2 - h_1) = (h_3 - h_2)$ indicates that the degree of reaction of this stage is
(A)   zero
(B)   50%
(C)   75%
(D)   100%

Q.No. 19   Let $\mathbf{I}$ be a 100 dimensional identity matrix and $\mathbf{E}$ be the set of its distinct (no value appears more than once in $\mathbf{E}$) real eigenvalues. The number of elements in $\mathbf{E}$ is _____.

Q.No. 20

A beam of negligible mass is hinged at support P and has a roller support Q as shown in the figure.
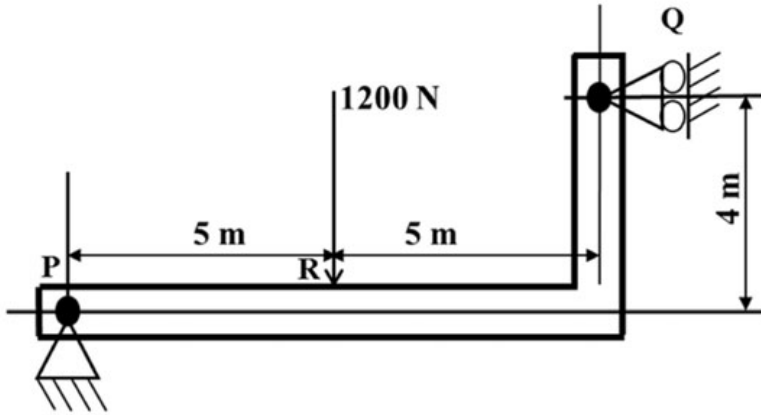

A point load of 1200 N is applied at point R. The magnitude of the reaction force at support Q is _____ N.

Q.No. 21 A machine member is subjected to fluctuating stress $\sigma = \sigma_0 \cos(8\pi t)$. The endurance limit of the material is 350 MPa. If the factor of safety used in the design is 3.5 then the maximum allowable value of σ_0 is _____ MPa (*round off to 2 decimal places*).

Q.No. 22 A bolt head has to be made at the end of a rod of diameter $d = 12$ mm by localized forging (upsetting) operation. The length of the unsupported portion of the rod is 40 mm. To avoid buckling of the rod, a closed forging operation has to be performed with a maximum die diameter of _____ mm.

Q.No. 23 Consider the following network of activities, with each activity named A–L, illustrated in the nodes of the network.
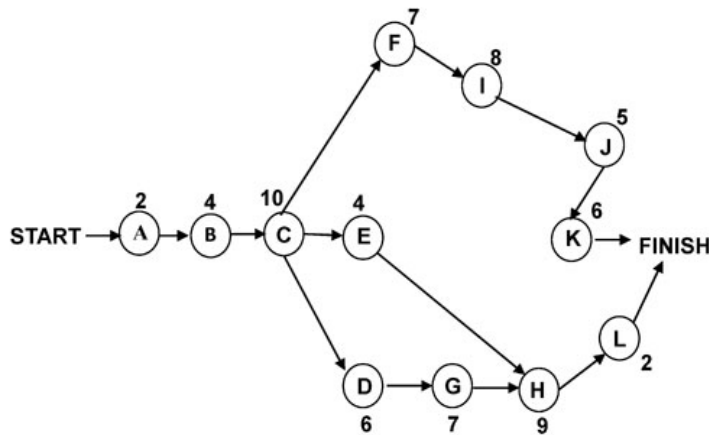
The number of hours required for each activity is shown alongside the nodes. The slack on the activity **L**, is _____ hours.

Q.No. 24

In a furnace, the inner and outer sides of the brick wall (k_1 = 2.5 W/m.K) are maintained at 1100°C and 700°C, respectively as shown in figure.
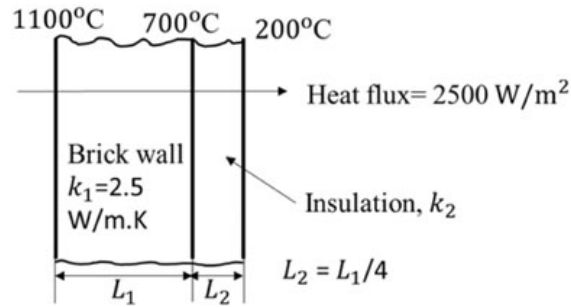
The brick wall is covered by an insulating material of thermal conductivity k_2. The thickness of the insulation is $1/4^{th}$ of the thickness of the brick wall. The outer surface of the insulation is at 200°C. The heat flux through the composite walls is 2500 W/m².

The value of k_2 is _____ W/m.K (*round off to one decimal place*).

Q.No. 25   If a reversed Carnot cycle operates between the temperature limits of 27°C and –3°C, then the ratio of the COP of a refrigerator to that of a heat pump (COP of refrigerator / COP of heat pump) based on the cycle is _____ (*round off to 2 decimal places*).

Q26 - Q55 carry two marks each.

Q.No. 26   The directional derivative of $f(x, y, z) = xyz$ at point $(-1,1,3)$ in the direction of vector $\hat{\imath} - 2\hat{\jmath} + 2\hat{k}$ is

(A) $3\hat{\imath} - 3\hat{\jmath} - \hat{k}$

(B) $-\dfrac{7}{3}$

(C) $\dfrac{7}{3}$

(D) 7

Q.No. 27   The function $f(z)$ of complex variable $z = x + i\,y$, where $i = \sqrt{-1}$, is given as $f(z) = (x^3 - 3xy^2) + i\,v(x,y)$. For this function to be analytic, $v(x,y)$ should be

(A) $(3xy^2 - y^3)$ + constant

(B) $(3x^2y^2 - y^3)$ + constant

(C) $(x^3 - 3x^2y)$ + constant

(D) $(3x^2y - y^3)$ + constant

Q.No. 28

A cantilever of length l, and flexural rigidity EI, stiffened by a spring of stiffness k, is loaded by a transverse force P, as shown.
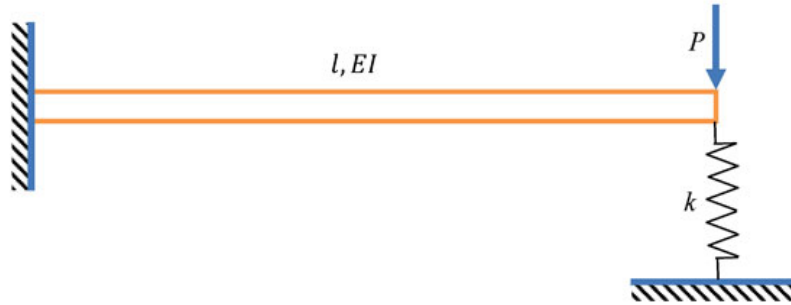
The transverse deflection under the load is

(A) $\dfrac{Pl^3}{3EI}\left[\dfrac{3EI}{3EI+2kl^3}\right]$

(B) $\dfrac{Pl^3}{3EI}\left[\dfrac{6EI-kl^3}{6EI}\right]$

(C) $\dfrac{Pl^3}{3EI}\left[\dfrac{3EI-kl^3}{3EI}\right]$

(D) $\dfrac{Pl^3}{3EI}\left[\dfrac{3EI}{3EI+kl^3}\right]$

Q.No. 29   The sun (S) and the planet (P) of an epicyclic gear train shown in the figure have identical number of teeth.
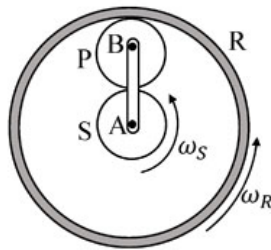
If the sun (S) and the outer ring (R) gears are rotated in the same direction with angular speed ω_S and ω_R, respectively, then the angular speed of the arm AB is

(A) $\dfrac{3}{4}\omega_R+\dfrac{1}{4}\omega_S$

(B)

(C)

(D)

Q.No. 30

(A)

(B)

(C)

(D)

Q.No. 31

(A)

(B)

(C)

(D)

Q.No. 32

(A)

(B)

(C)

(D)

Q.No. 33

(A)

(B)

(C)

(D)

Q.No. 34

(A)

(B)

(C)

(D)

Q.No. 35

Q.No. 36

Q.No. 37

Q.No. 38

Q.No. 39

Q.No. 40

Q.No. 41

Q.No. 42

Q.No. 43

Q.No. 44

Q.No. 45

Q.No. 46

Q.No. 47

Q.No. 48

Q.No. 49

Q.No. 50

Q.No. 51

Q.No. 52

Q.No. 53

Q.No. 54

Q.No. 55