

# GATE SAMPLE PAPER FOR MECHANICAL ENGINEERING

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Sample paper for Gate (Mechanical Engineering)

## **Question no.1 to 25 carries 1 mark each**

**The all eigen values of symmetric matrix are**

- a) Complex with non-zero positive imaginary part
- b) Complex with non-zero negative imaginary part
- c) Real
- d) Pure imaginary

answer: c

**2) The threaded bolts A and B of same material and length are subjected to identical tensile load. If the elastic strain energy stored in bolt A is four times that of the bolt B and the mean diameter of bolt A is 12mm, the mean diameter of bolt B in mm is**

- a) 16
- b) 24
- c) 36
- d) 48

answer: b

**3) The pressure, relative humidity and dry bulb temperature of air in a room are 1bar, 70% and 30°C respectively. If the saturated steam pressure at 30°C is 4.25kPa, the specific humidity of the room air in kg water vapour / kg dry air is**

- a) 0.0083
- b) 0.0101
- c) 0.0191
- d) 0.0232

3.answer: c

**4) The state of stress of the material undergoing deformation in a rolling process is**

- a) Pure compression
- b) Pure shear

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c) Compression and shear

d) Tension and shear

answer: c

**5) A metric thread of pitch 2mm and thread angle  $60^\circ$  is inspected for its pitch diameter using three-wire method. The best size wire diameter in mm is**

a) 0.866

b) 1.000

c) 1.154

d) 2.000

Answer:c

**6) The arrival rate of customers at the ticket counter is 50 per hour and**

**in the order of their arrival tickets are issued. The average time taken for issuing a ticket is 1min. Let's assume that customer arrivals form a Poisson process and service times are exponentially distributed, the average waiting time in queue in minutes is:**

a) 3

b) 4

c) 5

c) 6

Answer:c

**7) A steel bar 200 mm in diameter is turned at a feed of 0.25 mm/rev with a depth of cut of 4 mm. The rotational speed of the workpiece is 160 rpm. The removal rate of the material**

**in 3 mm / s is**

a)160

b) 167.6

c) 1600

d) 1675.5

Answer:d

**8) A cube shaped casting solidifies in 5 minutes. The solidification time in minutes**

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for a cube of the same material, which is 8 times heavier than the original casting

will be

- a) 10
- b) 20
- c) 24
- d) 40

answer: b

9) To have maximum power from a Pelton turbine, the speed of the bucket must

be

- a) Equal to the jet speed
- b) Equal to half the jet speed
- c) Equal to twice the jet speed
- d) Independent of the jet speed

answer: b

10) A cylinder contains  $5\text{ m}^3$  of ideal gas at a pressure of 1 bar. This gas is compressed in a reversible isothermal process till its pressure increases to 5 bar.

The work in kJ required for this process is

- a) 804.7
- b) 953.2
- c) 981.7
- d) 1012.2

answer: a

11) A long thin walled cylindrical shell, closed at both ends, is subjected to an internal pressure. The ratio of the hoop stress (circumferential stress) to longitudinal stress developed in the shell is

- a) 0.5
- b) 1.0

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c) 2.0

d) 4.0

answer: c

**12) During whirling of a simply supported long slender rotating shaft, If two nodes are observed at a frequency of 1800 rpm the first critical speed of the shaft in rpm is**

a) 200

b) 450

c) 600

d) 900

answer: d

**13) With rigid links A planar closed kinematic chain is made PQ = 2.0m, QR = 3.0m,**

**RS = 2.5m and SP = 2.7m with all revolute joints. The link which are to be fixed to obtain a double rocker (rocker-rocker) mechanism is**

a) PQ

b) QR

c) RS

d) SP

answer: c

**14) An equipotential and streamline line in a flow field**

a) Are parallel to each other

b) Are perpendicular to each other

c) Intersect at an acute angle

d) Are identical

answer: b

**15) The maximum possible draft in cold rolling of sheet will increase if the**

a) Coefficient of friction increase

b) Coefficient of friction decrease

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c) Roll radius decrease

d) Roll velocity Increase

answer: a

**16) In which operation oil is permeated into the pores of a powder metallurgy product ?**

a) Mixing

b) Sintering

c) Impregnation

d) Infiltration

answer: c

**17) Work and heat are**

a) Intensive properties

b) Extensive properties

c) Point functions

d) Path functions

answer: d

**18) A column has a length of 1m and a rectangular cross-section of 10mm x 20mm .The slenderness ratio of the column is close to**

a) 200

b) 346

c) 477

d) 1000

answer: b

**19) Mould of green sand indicates that**

a) Polymeric mould has been cured

b) Mould has been totally dried

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c) Mould is green in colour

d) Mould contains moisture

Answer: d

**20) The values of Eigen of a real symmetric matrix are always**

a) Positive

b) Negative

c) Real

d) Complex

answer: c

**21. The result of product of two complex numbers  $1 + i$  and  $2 - 5i$  is**

a)  $7 - 3i$

b)  $3 - 4i$

c)  $-3 - 4i$

d)  $7 + 3i$

answer: a

**22. Cars arrive at a service station according to Poisson's distribution with a mean rate of 5 per hour. The service time per car is exponential with a mean of**

**10minutes. At steady state, the average waiting time in the queue is**

a) 10 minutes

b) 20 minutes

c) 25 minutes

d) 50 minutes

answer: d

**23. The coefficient of restitution of a perfectly plastic impact is**

(A) 0

(B) 1

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(C) 2

(D)

answer:a

**24) Among the following which one welding processes uses non-consumable electrode?**

- a) Gas metal arc welding
- b) Submerged arc welding
- c) Gas tungsten arc welding
- d) Flux coated arc welding

answer: c

**25) The crystal structure of austenite is**

- a) Body centered cubic
- b) Face centered cubic
- c) Hexagonal closed packed
- d) Body centered tetragonal

answer: b

**Question no 26 to 51 carries 2 marks each**

**26) The values of enthalpy of steam at the inlet and outlet of a steam turbine in a Rankine cycle are 2800kJ/kg and 1800kJ/kg respectively. Neglecting pump work, the specific steam consumption in kg/kW-hour is**

- (A) 3.60 (B) 0.36 (C) 0.06 (D) 0.01

answer: a

**27) Two identical ball bearings P and Q are operating at loads 30kN and 45kN respectively. The ratio of the life of bearing P to the life of bearing Q is**

- (A) 81/16 (B) 27/8 (C) 9/4 (D) 3/2

Answer: - (B)

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28) An unbiased coin is tossed five times. The outcome of each toss is either a head or a tail. The probability of getting at least one head is

(A)  $1/32$

(B)  $13/32$

(C)  $16/32$

(D)  $31/32$

Answer: - (D)

29) The shear strength of a sheet metal is 300MPa. The blanking force required to produce a blank of 100mm diameter from a 1.5 mm thick sheet is close to

(A) 45kN (B) 70kN (C) 141kN (D) 3500kN

Answer: - (C)

30) The crank radius of a single-cylinder I. C. engine is 60mm and the diameter of the cylinder is 80mm. The swept volume of the cylinder in 3 cm is

(A) 48 (B) 96 (C) 302 (D) 603

Answer: - (D)

31) A pump handling a liquid raises its pressure from 1 bar to 30 bar. Take the density of the liquid as  $990 \text{ kg/m}^3$ . The isentropic specific work done by the pump in kJ/kg is

(A) 0.10 (B) 0.30 (C) 2.50 (D) 2.93

Answer: - (D)

32) A spherical steel ball of 12mm diameter is initially at 1000K. It is slowly cooled in a surrounding of 300K. The heat transfer coefficient between the steel ball and the surrounding is  $25 \text{ W/m}^2 \text{ K}$ . The thermal conductivity of steel is  $20 \text{ W/mK}$ . The temperature difference between the centre and the surface of the steel ball is

(A) Large because conduction resistance is far higher than the convective resistance

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(B) Large because conduction resistance is far less than the convective resistance

(C) Small because conduction resistance is far higher than the convective

resistance

(D) Small because conduction resistance is far less than the convective resistance

Answer: - (D)

**33) An ideal Brayton cycle, operating between the pressure limits of 1 bar and 6 bar, has minimum and maximum temperatures of 300K and 1500K. The ratio of**

**specific heats of the working fluid is 1.4. The approximate final temperatures in**

**Kelvin at the end of the compression and expansion processes are respectively**

(A) 500 and 900

(B) 900 and 500

(C) 500 and 500

(D) 900 and 900

Answer: - (A)

**34) A single-point cutting tool with 0° rake angle is used to machine a steel work-**

**piece. The depth of cut, i.e. uncut thickness is 0.81mm. The chip thickness under orthogonal machining condition is 1.8mm. The shear angle is approximately**

(A) 0.22 (B) 0.26 (C) 0.56 (D) 0.76

Answer: - (B)

**35) A cubic casting of 50mm side undergoes volumetric solidification shrinkage and volumetric solid contraction of 4% and 6% respectively. No riser is used. For assumption uniform cooling in all directions. The side of the cube after contraction and solidification is**

(A) 48.32mm

(B) 49.90mm

(C) 49.94mm

(D) 49.96mm

Answer: - (A)

**36) Water is coming out from a tap and falls vertically downwards. At the tap**

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opening, the stream diameter is 20mm with uniform velocity of 2 m/s.

Acceleration due to gravity is  $9.81 \text{ m/s}^2$ . Assuming steady, inviscid flow, constant atmospheric pressure everywhere and neglecting curvature and surface tension effects, the diameter is mm of the stream 0.5m below the tap is approximately

- (A) 10
- (B) 15
- (C) 20
- (D) 25

Answer: (B)

37) In a CAD package, mirror image of a 2D point P(5, 10) is to be obtained about a line which passes through the origin and makes an angle of  $45^\circ$  counterclockwise with the X-axis. The coordinates of the transformed point will be

- (A) (7.5, 5) (B) (10, 5) (C) (7.5, -5) (D) (10, -5)

Answer: (B)

38) During the electrochemical machining (ECM) of iron (atomic weight=56, valency=2) at current of 1000 A with 90% current efficiency, the material removal rate was observed to be 0.26 gm/s. If Titanium (atomic weight = 48, valency=3) is machined by the ECM process at the current of 2000 A with 90% current efficiency, the expected material removal rate in gm/s will be

- (A) 0.11 (B) 0.23 (C) 0.30 (D) 0.52

Answer: (C)

39) A single degree of freedom system having mass 1 kg and stiffness 10kN/m initially at rest is subjected to an impulse force of magnitude 5 kN for  $10^{-4}$  seconds. The amplitude in mm of the resulting free vibration is

- (A) 0.5 (B) 1.0 (C) 5.0 (D) 10.0

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Answer: (C)

**40) A bar is subjected to fluctuating tensile load from 20 kN to 100 kN. The material has yield strength of 240 MPa and endurance limit in reversed bending is 160 MPa. According to the Soderberg principle, the area of cross-section in 2 mm of the bar for a factor of safety of 2 is**

- (A) 400
- (B) 600
- (C) 750
- (D) 1000

Answer: (d)

**41) Two large diffuse gray parallel plates, separated by a small distance, have surface temperatures of 400 K and 300 K. If the emissivities of the surfaces are 0.8 and the Stefan-Boltzmann constant is  $5.67 \times 10^{-8} \text{ W/m}^2 \text{K}^{-4}$ , the net radiation heat exchange rate in kW/m between the two plates is**

- (A) 0.66
- (B) 0.79
- (C) 0.99
- (D) 3.96

Answer: (A)

**42) The pressure, temperature and velocity of air flowing in a pipe are 5 bar, 500K and 50 m/s, respectively. The specific heats of air at constant pressure and at constant volume are 1.005 kJ/kgK and 0.718 kJ/kgK, respectively. Neglect potential energy. If the pressure and temperature of the surroundings are 1 bar and 300 K, respectively, the available energy in kJ/kg of the air stream is**

- (A) 170
- (B) 187

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(C) 191

(D) 213

Answer: (B)

**43) During normalizing process of steel, the specimen is heated**

a) Between the upper and lower critical temperature and cooled in still air

b) Above the upper critical temperature and cooled in furnace

c) Above the upper critical temperature and cooled in still air

d) Between the upper and lower critical temperature and cooled in furnace

answer: (c)

**44) A solid disc of radius  $r$  rolls without slipping on the horizontal floor with angular velocity and angular acceleration. The magnitude of acceleration of the point of contact on the disc is**

a) zero

b)

c)  $r^2$

answer: (a)

**45) In a spring mass system, the mass is 0.1 kg and the stiffness of the spring is 1 kN/m. By introducing a damper, the frequency of oscillation is found to be 90% of the original value. What is the damping coefficient of the damper?**

a) 1.2 N.s/m

b) 3.4 N.s/m

c) 8.7 N.s/m

d) 12.0 N.s/m

45. answer: (c)

**In an experimental set-up, air flows between two stations P and Q adiabatically.**

**The direction of flow depends on the pressure and temperature conditions**

**maintained at P and Q. The conditions at station P are 150 kPa and 350 K. The**

**temperature at station Q is 300 K.**

**The following are the properties and relations pertaining to air:**

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Specific heat at constant pressure,  $p C = 1.005 \text{ kJ / kgK}$ ;

Specific heat at constant volume,  $v C = 0.718 \text{ kJ / kgK}$ ;

Characteristic gas constant,  $R = 0.287 \text{ kJ / kgK}$

Enthalpy,  $p h = c T$

Internal energy,  $v u = c T$

46) If the air has to flow from station P to station Q, the maximum possible value of pressure in kPa at station Q is close to

(A) 50 (B) 87 (C) 128 (D) 150

Answer: - (B)

47. If the pressure at station Q is 50kPa, the change in entropy ( $s_q - s_p$ ) in kJ/kgK is

(A) -0.155 (B) 0 (C) 0.160 (D) 0.355

Answer: - (C)

48. Out of all the 2-digit integers between 1 and 100, a 2-digit number has to be selected at random. What is the probability that the selected number is not divisible by 7?

(A) 13/90 (B) 12/90 (C) 78/90 (D) 77/90

Answer: (D)

49. A tourist covers half of his journey by train at 60 km/h, half of the remainder by bus at 30 km/h and the rest by cycle at 10 km/h. The average of the tourist in km/h during his entire journey is

(A) 36 (B) 30 (C) 24 (D) 18

Answer: (C)

50. The current erection cost of a structure is Rs. 13,200. If the labour wages per day increase by  $1/5$  of the current wages and the working hours decrease by  $1/24$  of the current period, then the new cost of erection in Rs. is

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(A) 16,500 (B) 15,180 (C) 11,000 (D) 10,120

Answer: (B)

## **Question no 51 to 60 each carries 2 marks**

**51. After several defeats in wars, Robert Bruce went in exile and wanted to commit suicide. Just before committing suicide, he came across a spider attempting tirelessly to have its net. Time and again the spider failed but that did not deter it to refrain from making attempts. Such attempts by the spider made Bruce curious. Thus, Bruce started observing the near-impossible goal of the spider to have the net. Ultimately, the spider succeeded in having its net despite several failures. Such act of the spider encouraged Bruce not to commit suicide. And then, Bruce went back again and won many a battle, and the rest is history.**

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

- (A) Failure is the pillar of success
- (B) Honesty is the best policy
- (C) Life begins and ends with adventures
- (D) No adversity justifies giving up hope

Answer: (D)

**52. The current erection cost of a structure is Rs. 13,200. If the labour wages per day increase by  $\frac{1}{5}$  of the current wages and the working hours decrease by  $\frac{1}{24}$  of the current period, then the new cost of erection in Rs. is**

(A) 16,500 (B) 15,180 (C) 11,000 (D) 10,120

Answer: (B)

**53. Few school curricula include a unit on how to deal with bereavement and grief, and yet all students at some point in their lives suffer from losses through death and parting.**

**Based on the above passage which topic would not be included in a unit on**

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bereavement?

- (A) how to write a letter of condolence
- (B) what emotional stages are passed through in the healing process
- (C) what the leading causes of death are
- (D) how to give support to a grieving friend

Answer: - (C)

**54. A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time.**

**How much spirit is now left in the container?**

- (A) 7.58 litres (B) 7.84 litres (C) 7 litres (D) 7.29 litres

Answer: - (D)

**55. Choose the most appropriate word from the options given below to complete the following sentence.**

**I contemplated \_\_\_\_\_ Singapore for my vacation but decided against it.**

- (A) To visit (B) having to visit (C) visiting (D) for a visit

Answer: - (C)

**56. The variable cost (V) of manufacturing a product varies according to the equation**

**$V = 4q$ , where  $q$  is the quantity produced. The fixed cost (F) of production of same**

**product reduces with  $q$  according to the equation  $F = 100/q$ . How many units**

**should be produced to minimize the total cost (V+F)?**

- (A) 5 (B) 4 (C) 7 (D) 6

Answer: (A)

**57. A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the**

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end of the 4th day he can clear all the orders. Alternatively, if he uses only 3

trucks, then all the orders are cleared at the end of the 10th day. What is the

minimum number of trucks required so that there will be no pending order at the

end of the 5th day?

(A) 4 (B) 5 (C) 6 (D) 7

Answer: - (C)

58. In a condenser of a power plant, the steam condenses at a temperature of  $60\text{ }^{\circ}\text{C}$ .

The cooling water enters at  $30\text{ }^{\circ}\text{C}$  and leaves at  $45\text{ }^{\circ}\text{C}$ . The logarithmic mean

temperature difference (LMTD) of the condenser is

(A)  $16.2\text{ }^{\circ}\text{C}$  (B)  $21.6\text{ }^{\circ}\text{C}$  (C)  $30\text{ }^{\circ}\text{C}$  (D)  $37.5\text{ }^{\circ}\text{C}$

Answer: - (B)

59. A column has a rectangular cross-section of  $10\text{ mm} \times 20\text{ mm}$  and a length of  $1\text{ m}$ . The slenderness ratio of the column is close to

(A) 200 (B) 346 (C) 477 (D) 1000

Answer: - (B)

60. 34. Two cutting tools are being compared for a machining operation. The tool life equations are:

Carbide tool:  $VT^{1.6} = 3000$

HSS tool:  $0.6 VT^{0.6} = 200$

Where  $V$  is the cutting speed in  $\text{m/min}$  and  $T$  is the tool life in  $\text{min}$ . The carbide

toll will provide higher tool life if the cutting speed in  $\text{m/min}$  exceeds

(A) 15.0 (B) 39.4 (C) 49.3 (D) 60.0

Answer: (B)

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