



*GATE PREVIOUS YEAR SOLVED PAPERS*

## **Mechanical Engineering Previous Year Solved Papers**

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**GENERAL APTITUDE**

**Q. No. 1 - 5 Carry One Mark Each**

1. Find the missing sequence in the letter series below:

A, CD, GHI, ?, UVWXY

- (A) LMN                      (B) MNO                      (C) MNOP                      (D) NOPQ

**Answer: (C)**

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2. Choose the correct verb to fill in the blank below:

Let us \_\_\_\_\_.

- (A) Introvert                      (B) alternate                      (C) atheist                      (D) altruist

**Answer: (B)**

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3. Choose the most appropriate word from the options given below to complete the following sentence?

If the athlete had wanted to come first in the race, he \_\_\_\_\_ several hours every day.

- (A) Should practice                      (B) Should have practiced  
(C) Practised                      (D) Should be practicing

**Answer: (B)**

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4. Choose the most suitable one word substitute for the following expression

Connotation of a road or way

- (A) Pertinacious                      (B) Viaticum  
(C) Clandestine                      (D) Ravenous

**Answer: (B)**

5. If  $x > y > 1$ , which of the following must be true?

- (i)  $\ln x > \ln y$                       (ii)  $e^x > e^y$                       (iii)  $y^x > x^y$                       (iv)  $\cos x > \cos y$
- (A) (i) and (ii)                                      (B) (i) and (iii)
- (C) (iii) and (iv)                                      (D) (ii) and (iv)

**Answer: (A)**

Q. No. 6 – 10 Carry Two Marks Each

6. From a circular sheet of paper of radius 30cm, a sector of 10% area is removed. If the remaining part is used to make a conical surface, then the ratio of the radius and height of the cone is \_\_\_\_\_.

**Answer: (2.06)**

7. In the following question, the first and the last sentence of the passage are in order and numbered 1 and 6. The rest of the passage is split into 4 parts and numbered as 2,3,4, and 5. These 4 parts are not arranged in proper order. Read the sentences and arrange them in a logical sequence to make a passage and choose the correct sequence from the given options.

1. One Diwali, the family rises early in the morning.
2. The whole family, including the young and the old enjoy doing this,
3. Children let off fireworks later in the night with their friends.
4. At sunset, the lamps are lit and the family performs various rituals
5. Father, mother, and children visit relatives and exchange gifts and sweets.
6. Houses look so pretty with lighted lamps all around.

- (A) 2, 5, 3, 4                      (B) 5, 2, 4, 3                      (C) 3, 5, 4, 2                      (D) 4, 5, 2, 3

**Answer: (B)**

8. Ms X will be in Bagdogra from 01/05/2014 to 20/05/2014 and from 22/05/2014 to 31/05/2014. On the morning of 21/05/2014, she will reach Kochi via Mumbai

Which one of the statements below is logically valid and can be inferred from the above sentences?

- (A) Ms. X will be in Kochi for one day, only in May
- (B) Ms. X will be in Kochi for only one day in May
- (C) Ms. X will be only in Kochi for one day in May
- (D) Only Ms. X will be in Kochi for one day in May.

**Answer: (B)**

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9.  $\log \tan 1^\circ + \log \tan 2^\circ + \dots + \log \tan 89^\circ$  is .....

- (A) 1
- (B)  $1/\sqrt{2}$
- (C) 0
- (D) -1

**Answer: (C)**

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10. Ram and Shyam shared a secret and promised to each other that it would remain between them. Ram expressed himself in one of the following ways as given in the choices below. Identify the correct way as per standard English.

- (A) It would remain between you and me.
- (B) It would remain between I and you
- (C) It would remain between you and I
- (D) It would remain with me.

**Answer: (A)**

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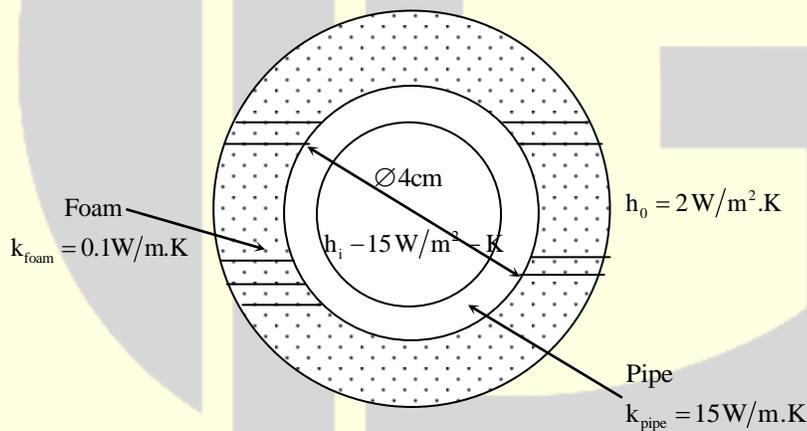
6. Within a boundary layer for a steady incompressible flow, the Bernoulli equation
- (A) holds because the flow is steady
  - (B) holds because the flow is incompressible
  - (C) holds because the flow is transitional
  - (D) does not hold because the flow is frictional

**Answer: (D)**

7. The atomic packing factor for a material with body centered cubic structure is \_\_\_\_\_.

**Answer: (0.68)**

8. If a foam insulation is added to a 4cm outer diameter pipe as shown in the figure, the critical radius of insulation (in cm) is \_\_\_\_\_



**Answer: (5)**

9. During the development of a product an entirely new process plan is made based on design logic, examination of geometry and tolerance information. This type of process planning is known as
- (A) Retrieval
  - (B) Generative
  - (C) Variant
  - (D) Group technology based

**Answer: (B)**

10. Annual demand of a product is 50000 units and the ordering cost is Rs. 7000 per order considering the basic economic order quantity model, the economic order quantity is 10000 units. When the annual inventory cost is minimized, the annual inventory holding cost (in Rs.) is \_\_\_\_\_.

**Answer: (35000)**

11. Sales data of a product is given in the following table:

Month	January	February	March	April	May
Number of unit sold	10	11	16	19	25

Regarding forecast for the month of June, which one of the following statements is **TRUE**?

- (A) Moving average will forecast a higher value compared to regression
- (B) Higher the value of order N, the greater will be the forecast value by moving average.
- (C) Exponential smoothing will forecast a higher value compared to regression.
- (D) Regression will forecast a higher value compared to moving average

**Answer: (D)**

12. The Vander Waals equation of state is  $\left(p + \frac{a}{v^2}\right)(v - b) = RT$ , where p is pressure, v is specific volume, T is temperature and R is characteristic gas constant. The SI unit of a is

- (A) J/kg.K
- (B) m<sup>3</sup>/kg
- (C) m<sup>5</sup>/kg-s<sup>2</sup>
- (D) Pa/kg

**Answer: (C)**

13. Which of the following statements regarding a Rankine cycle with reheating are **TRUE**?

- (i) increase in average temperature of heat addition
- (ii) reduction in thermal efficiency
- (iii) drier steam at the turbine exit

- (A) only (i) and (ii) are correct                      (B) only (ii) and (iii) are correct  
(C) only (i) and (iii) are correct                      (D) (i), (ii) and (iii) are correct

**Answer: (C)**

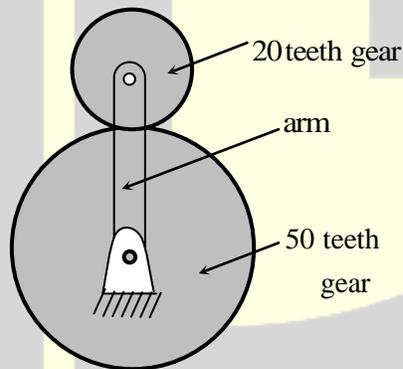
- 14.** In a spring-mass system, the mass is  $m$  and the spring constant is  $k$ . The critical damping coefficient of the system is  $0.1\text{kg/s}$ . In another spring-mass system, the mass is  $2m$  and the spring constant is  $8K$ . The critical damping coefficient (in  $\text{kg/s}$ ) of this system is \_\_\_\_\_.

**Answer: (0.4)**

- 15.** The COP of a Carnot heat pump operating between  $6^\circ\text{C}$  and  $37^\circ\text{C}$  is \_\_\_\_\_.

**Answer: (10)**

- 16.** The number of degrees of freedom of the planetary gear train shown in the figure is



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

**Answer: (C)**

- 17.** A rope-brake dynamometer attached to the crank shaft of an I.C. engine measures a brake power of  $10\text{kW}$  when the speed of rotation of the shaft is  $400\text{ rad/s}$ . The shaft torque (in  $\text{N-m}$ ) sensed by the dynamometer is \_\_\_\_\_

**Answer: (25)**

18. At least one eigen value of a singular matrix is  
(A) Positive                      (B) Zero                      (C) Negative                      (D) Imaginary

**Answer: (B)**

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19. If the fluid velocity for a potential flow is given by  $V(x,y) = u(x,y)i + v(x,y)j$  with usual notations, then the slope of the potential line at  $(x,y)$  is

(A)  $\frac{v}{u}$                       (B)  $-\frac{u}{v}$                       (C)  $\frac{v^2}{u^2}$                       (D)  $\frac{u}{v}$

**Answer: (B)**

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20. Which one of the following statements is TRUE?  
(A) The 'GO' gage controls the upper limit of a hole  
(B) The 'NO' gage controls the lower limit of a shaft  
(C) The 'GO' gage controls the lower limit of a hole  
(D) The 'NO GO' gage controls the lower limit of a hole

**Answer: (C)**

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21. Three vendors were asked to supply a very high precision component. The respective probabilities of their meeting the strict design specifications are 0.8, 0.7 and 0.5. Each vendor supplies one component. The probability that out of total three components supplied by the vendors, at least one will meet the design specification is \_\_\_\_\_.

**Answer: (0.97)**

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22. The Laplace transform of  $e^{i5t}$  where  $i = \sqrt{-1}$ , is

(A)  $\frac{s-5i}{s^2-25}$                       (B)  $\frac{s+5i}{s^2+25}$                       (C)  $\frac{s+5i}{s^2-25}$                       (D)  $\frac{s-5i}{s^2+25}$

**Answer: (B)**



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23. A gas is stored in a cylindrical tank of inner radius 7 m and wall thickness 50 mm. The gage pressure of the gas is 2MPa. The maximum shear stress (in MPa) in the wall is
- (A) 35                      (B) 70                      (C) 140                      (D) 280

**Answer: (C)**

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24. In the laminar flow of air ( $Pr=0.7$ ) over a heated plate if  $\delta$  and  $\delta_T$  denote, respectively, the hydrodynamic and thermal boundary layer thicknesses, then
- (A)  $\delta = \delta_T$                       (B)  $\delta > \delta_T$                       (C)  $\delta < \delta_T$                       (D)  $\delta = 0$  but  $\delta_T \neq 0$

**Answer: (C)**

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25. At  $x = 0$ , the function  $f(x) = |x|$  has
- (A) A minimum  
(B) A maximum  
(C) A point of inflexion  
(D) Neither a maximum nor minimum

**Answer: (A)**

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**Q. No. 26 - 55 Carry Two Marks Each**

26. The total emissive power of a surface is  $500 \text{ W/m}^2$  at a temperature  $T_1$  and  $1200 \text{ W/m}^2$  at a temperature  $T_2$ . Where the temperatures are in Kelvin. Assuming the emissivity of the surface to be constant, the ratio of the temperatures  $\frac{T_1}{T_2}$  is
- (A) 0.308                      (B) 0.416                      (C) 0.803                      (D) 0.874

**Answer: (C)**

27. A hollow shaft of 1m length is designed to transmit a power of 30 kW at 700 rpm. The maximum permissible angle of twist in the shaft is  $1^\circ$ . The inner diameter of the shaft is 0.7 times the outer diameter. The modulus of rigidity is 80 GPa. The outside diameter (in mm) of the shaft is \_\_\_\_\_.

**Answer: (44.52)**

28. In a Rankine cycle, the enthalpies at turbine entry and outlet are 3159kJ/kg. and 2187 kJ/kg, respectively. If the specific pump work is 2kJ/kg the specific steam consumption (in kg/kW-h) of the cycle based on net output is \_\_\_\_\_.

**Answer: (3.71)**

29. A single point cutting tool with  $0^\circ$  rake angle is used in an orthogonal machining process. At a cutting speed of 180 m/min, the thrust force is 490N. If the coefficient of friction between the tool and the chip is 0.7, then the power consumption (in kW) for the machining operation is \_\_\_\_\_.

**Answer: (2.1)**

30. The chance of a student passing an exam is 20%. The chance of a student passing the exam and getting above 90% marks in it is 5% Given that a student passes the examination, the probability that the student gets above 90% marks is

(A)  $\frac{1}{18}$                       (B)  $\frac{1}{4}$                       (C)  $\frac{2}{9}$                       (D)  $\frac{5}{18}$

**Answer: (B)**

31. A manufacturer has the following data regarding a product:

Fixed cost per month = Rs. 50000

Variable cost per unit = Rs.200

Selling price per unit = Rs.300

Production capacity = 1500 units per month

If the production is carried out at 80% of the rated capacity, that the monthly profit (in Rs.) is \_\_\_\_\_.

**Answer: (70000)**

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**32.** The head loss for a laminar incompressible flow through a horizontal circular pipe is  $h_1$ . Pipe length and fluid remaining the same, if the average flow velocity doubles and the pipe diameter reduces to half its previous value, the head loss is  $h_2$ . The ratio  $h_2/h_1$  is

- (A) 1                      (B) 4                      (C) 8                      (D) 16

**Answer: (C)**

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**33.** A cube and a sphere made of cast iron (each of volume  $1000 \text{ cm}^3$ ) were cast under identical conditions. The time taken for solidifying the cube was 4s. The solidification time (in s) for the sphere is \_\_\_\_\_.

**Answer: (6.15)**

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**34.** One kg of air ( $R = 287 \text{ J/kg.K}$ ) undergoes an irreversible process between equilibrium state 1 ( $20^\circ\text{C}, 0.9\text{m}^3$ ) and equilibrium state 2 ( $20^\circ\text{C}, 0.6\text{m}^3$ ). The change in entropy  $S_2 - S_1$  (in  $\text{J/kg.K}$ ) is \_\_\_\_\_.

**Answer: (116.36)**

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**35.** In a plane stress condition, the components of stress at point are  $\sigma_x = 20 \text{ MPa}$ ,  $\sigma_y = 80 \text{ MPa}$  and  $\tau_{xy} = 40 \text{ MPa}$ . The maximum shear stress (in MPa) at the point is

- (A) 20                      (B) 25                      (C) 50                      (D) 100

**Answer: (C)**

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**36.** Work is done on an adiabatic system due to which its velocity changes from 10 m/s to 20 m/s, elevation increases by 20 m and temperature increases by 1 K. The mass of the system is 10 kg.  $C_v = 100 \text{ J/(kg.K)}$

and gravitational acceleration is  $10 \text{ m/s}^2$ . If there is no change in any other component of the energy of the system, the magnitude of total work done (in kJ) on the system is \_\_\_\_\_.

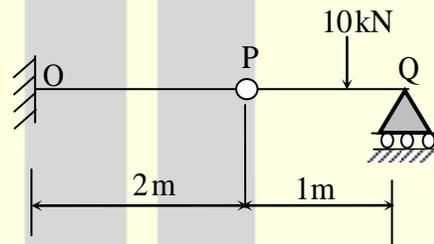
**Answer: (4.5)**

37. A hollow shaft  $d_o = 2d_i$  (where  $d_o$  and  $d_i$  are the outer and inner diameters respectively) needs to transmit 20kW power at 3000 RPM. If the maximum permissible shear stress is 30 MPa,  $d_o$  is

- (A) 11.29 mm                      (B) 22.58mm                      (C) 33.87 mm                      (D) 45.16mm

**Answer: (B)**

38. A cantilever beam OP is connected to another beam PQ with a pin joint as shown in the figure. A load of 10kN is applied at the mid-point of PQ. The magnitude of bending moment (in kN-m) at fixed end O is



- (A) 2.5                      (B) 5                      (C) 10                      (D) 25

**Answer: (C)**

39. The flow stress (in MPa) of a material is given by

$$\sigma = 500\varepsilon^{0.1}$$

Where  $\varepsilon$  is true strain. The Young's modulus of elasticity of the material is 200 GPa. A block of thickness 100 mm made of this material is compressed to 95 mm thickness and then the load is removed.

The final dimension of the block (in mm) is \_\_\_\_\_.

**Answer: (95.18)**

40. The initial velocity of an object is 40m/s. The acceleration  $a$  of the object is given by the following expression:  $a = -0.1V$

Where  $V$  is the instantaneous velocity of the object. The velocity of the object after 3 seconds will be \_\_\_\_\_.

**Answer: (29.632)**

41. A balanced counter flow heat exchanger has a surface area of  $20\text{m}^2$  and overall heat transfer coefficient of  $20\text{ W/m}^2\text{-K}$ . Air ( $C_p = 1000\text{J/kg-K}$ ) entering at  $0.4\text{ kg/s}$  and  $280\text{ K}$  is to be preheated by the air leaving the system at  $0.4\text{ kg/s}$  and  $300\text{ K}$ . The outlet temperature (in K) of the preheated air is

(A) 290                      (B) 300                      (C) 320                      (D) 350

**Answer: (A)**

42. The values of function  $f(x)$  at 5 discrete point are given below:

$x$	0	0.1	0.2	0.3	0.4
$f(x)$	0	10	40	90	160

Using Trapezoidal rule with step size of 0.1, the value of  $\int_0^{0.4} f(x)dx$  is \_\_\_\_\_.

**Answer: (22)**

43. In a two-stage wire drawing operation, the fractional reduction (ratio of change in cross-sectional area to initial cross-sectional area) in the first stage is 0.4. The fractional reduction in the second stage is 0.3. The overall fractional reduction is

(A) 0.24                      (B) 0.58                      (C) 0.60                      (D) 1.00

**Answer: (B)**

44. A single-degree-freedom spring-mass system is subjected to a sinusoidal force of 10 N amplitude and frequency  $\omega$  along the axis of the spring. The stiffness of the spring is 150 N/m, damping factor is 0.2 and the undamped natural frequency is  $10\omega$ . At steady state, the amplitude of vibration (in m) is approximately
- (A) 0.05                      (B) 0.07                      (C) 0.70                      (D) 0.90

**Answer: (B)**

45. For a fully developed laminar flow of water (dynamic viscosity 0.001 Pa-s) through a pipe of radius 5cm. the axial pressure gradient is  $-10\text{Pa/m}$ . The magnitude of axial velocity (in m/s) at a radial location of 0.2 cm is \_\_\_\_\_.

**Answer: (6.24)**

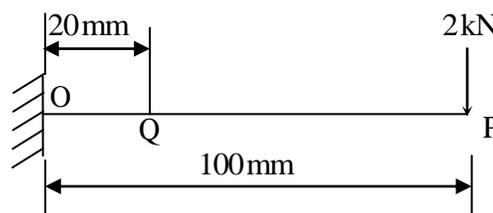
46. In a certain slider-crank mechanism, lengths of crank and connecting rod are equal. If the crank rotates with a uniform angular speed of 14 rad/s and the crank length is 300 mm, the maximum acceleration of the slider (in  $\text{m/s}^2$ ) is \_\_\_\_\_.

**Answer: (117.6)**

47. The surface integral  $\iint_s \frac{1}{\pi} (9xi - 3yj) \cdot n dS$  over the sphere given by  $x^2 + y^2 + z^2 = 9$  is \_\_\_\_\_.

**Answer: (216)**

48. A cantilever beam with square cross-section of 6mm side is subjected to a load of 2kN normal to the top surface as shown in the figure.



The young's modulus of elasticity of the material of the beam is 210 GPa. The magnitude of slope. (in radian) at Q (20 mm from the fixed end) is \_\_\_\_\_.

**Answer: (0.1587)**

- 49.** A cylindrical uranium fuel rod of radius 5 mm in a nuclear reactor is generating heat at the rate of  $4 \times 10^7 \text{ W/m}^3$ . The rod is cooled by a liquid (convective heat transfer coefficient  $1000 \text{ W/m}^2 \cdot \text{K}$ ) at  $25^\circ\text{C}$ . At steady state, the surface temperature (in K) of the rod is
- (A) 308                      (B) 398                      (C) 418                      (D) 448

**Answer: (B)**

- 50.** For the same values of peak pressure, peak temperature and heat rejection, the correct order of efficiencies for Otto, Dual and Diesel cycles is
- (A)  $\eta_{\text{otto}} > \eta_{\text{Dual}} > \eta_{\text{Diesel}}$                       (B)  $\eta_{\text{Diesel}} > \eta_{\text{Dual}} > \eta_{\text{otto}}$   
 (C)  $\eta_{\text{Dual}} > \eta_{\text{Diesel}} > \eta_{\text{otto}}$                       (D)  $\eta_{\text{Diesel}} > \eta_{\text{Otto}} > \eta_{\text{Dual}}$

**Answer: (B)**

- 51.** During a TIG welding process, the arc current and arc voltage were 50 A and 60 V, respectively, when in the welding speed was 150 mm/min. In another process, the TIG welding is carried out at a welding speed of 120 mm/min at the same arc voltage and heat input to the material so that weld quality remains the same. The welding current (in A) for this process is
- (A) 40.00                      (B) 44.72                      (C) 55.90                      (D) 62.25

**Answer: (A)**

- 52.** Consider the following differential equation:

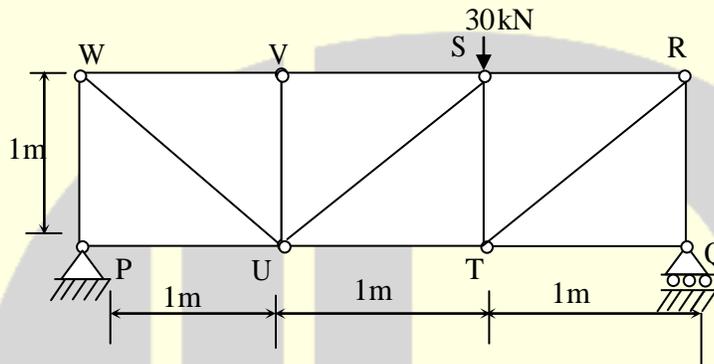
$$\frac{dy}{dt} = -5y; \text{ initial condition : } y = 2 \text{ at } t = 0.$$

The value of  $y$  at  $t = 3$  is

- (A)  $-5e^{-10}$                       (B)  $2e^{-10}$                       (C)  $2e^{-15}$                       (D)  $-15e^2$

**Answer: (C)**

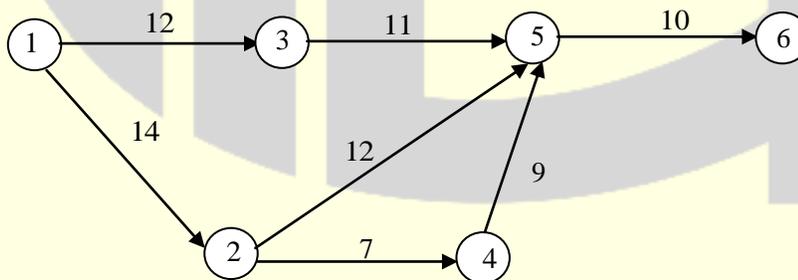
**53.** For the truss shown in the figure, the magnitude of the force (in kN) in the member SR is



- (A) 10                      (B) 14.14                      (C) 20                      (D) 28.28

**Answer: (C)**

**54.** A project consists of 7 activities. The network along with the time durations (in days) for various activities is shown in the figure.



The minimum time (in days) for completion of the project is \_\_\_\_\_.

**Answer: (40)**

55. A resistance-capacitance relaxation circuit is used in an electrical discharge machining process. The discharge voltage is 100 V. At a spark cycle time of  $\mu\text{s}$ , the average power input required is 1 kW. The capacitance (in  $\mu\text{F}$ ) in the circuit is
- (A) 2.5                      (B) 5.0                      (C) 7.5                      (D) 10.0

**Answer: (B)**

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