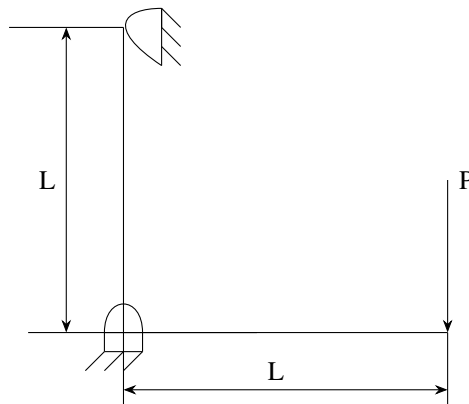


- 1) A forged steel link with a uniform diameter of 30 mm at the centre is subjected to an axial force that varies from 40 kN in compression to 160 kN in tension. The tensile strength ( $S_u$ ), yield strength ( $S_y$ ), and corrected endurance strength ( $S_e$ ) of the steel material are 600 MPa, 420 MPa, and 240 MPa, respectively. The factor of safety against fatigue endurance as per Soderberg's criterion is
  - a) 1.26
  - b) 1.37
  - c) 1.45
  - d) 2.00
- 2) An automatic engine weighing 240kg is supported on four springs with linear characteristics. Each of the two front springs have a stiffness of 16 MN/m while the stiffness of each rear spring is 32 MN/m. The engine speed (in rpm), at which resonance is likely to occur, is
  - a) 6040
  - b) 3020
  - c) 1424
  - d) 955
- 3) A vehicle suspension system consists of a spring and a damper. The stiffness of the spring is 3.6 kN/m and the damping constant of the damper is 400 Ns/m. If the mass is 50kg, then the damping factor ( $d$ ) and damping natural frequency ( $f_n$ ), respectively, are
  - a) 0.471 and 1.19 Hz
  - b) 0.471 and 7.48 Hz
  - c) 0.666 and 1.35 Hz
  - d) 0.666 and 8.50 Hz
- 4) A frame of two arms of equal length  $L$  is shown in adjacent figure. The flexural rigidity of each arm of the frame is  $EI$ . The vertical deflection at the point of application of load  $P$  is



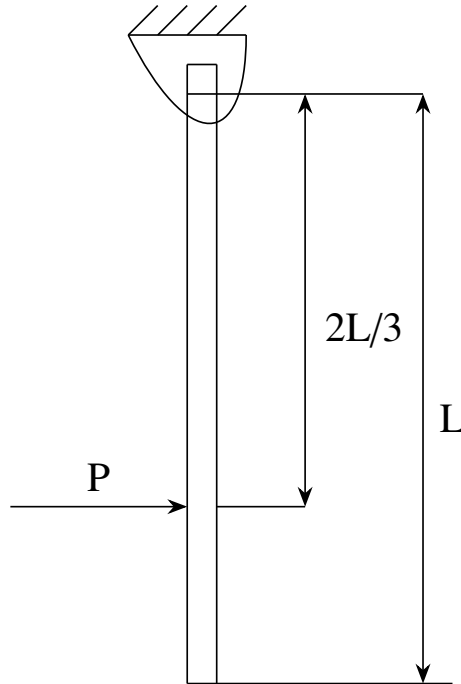
a)  $\frac{PL^3}{3EI}$

b)  $\frac{2PL^3}{3EI}$

c)  $\frac{PL^3}{EI}$

d)  $\frac{4PL^3}{3EI}$

- 5) A uniform rigid rod of mass  $M$  and length  $L$  is hinged at one end as shown in the adjacent figure. A force  $P$  is applied at a distance of  $\frac{2L}{3}$  from the hinge so that the rod swings to the right. The reaction at the hinge is



a)  $-P$

b)  $0$

c)  $\frac{P}{3}$

d)  $\frac{2P}{3}$

- 6) Match the approaches given below to perform stated kinematics / dynamics analysis of machine.

Analysis	Approach
P. Continuous relative rotation	1. D'Alembert's principle
Q. Velocity and acceleration	2. Grubler's criterion
R. Mobility	3. Grashoff's law
S. Dynamic-static analysis	4. Kennedy's theorem

a) P-1,Q-2,R-3,S-4

c) P-2,Q-3,R-4,S-1

b) P-3,Q-4,R-2,S-1

d) P-4,Q-2,R-1,S-3

- 7) A company uses 2555 units of an item annually. Delivery lead time is 8 days. The reorder point (in number of units) to achieve optimum inventory is

- a) 7                      b) 8                      c) 56                      d) 60

8) Consider the following Linear Programming Problem (LPP) :

$$\text{Maximize } z = 3x_1 + 2x_2$$

$$\text{Subject to } x_1 \leq 4$$

$$x_2 \leq 6$$

$$3x_1 + 2x_2 \leq 18$$

$$x_1 \geq 0, x_2 \geq 0$$

- a) The LLP has a unique optimal solution  
 b) The LLP is infeasible.  
 c) The LLP is unbounded.  
 d) The LLP has multiple optimal solutions.
- 9) Six jobs arrived in a sequence as given below. Average flow time (in days) for the

Jobs	Processing Time (days)
I	4
II	9
III	5
IV	10
V	6
VI	8

above jobs using Shortest Processing Time rule is

- a) 20.83                      b) 23.16                      c) 125.00                      d) 139.00

10) Minimum shear strain in orthogonal turning with a cutting tool of zero rake angle is

- a) 0.0                      b) 0.5                      c) 1.0                      d) 2.0

11) Electrochemical machining is performed to remove material from an iron surface of 20 mm × 20 mm under the following conditions:

Inter electrode gap = 0.2 mm

Supply voltage (DC) = 12V

Specific resistance of electrolyte = 2 Ω

Atomic weight of Iron = 55.85

Valency of Iron = 2

Faraday's constant = 96540 Coulombs

The material removal rate (in g/s) is

a) 0.3471

b) 3.471

c) 34.71

d) 347.1

12) Match the following:

NC Code	Definition
P. M05	1. Absolute coordinate system
Q. G01	2. Dwell
R. G04	3. Spindle stop
S. G90	4. Linear interpolation

a) P-2,Q-3,R-4,S-1

c) P-3,Q-4,R-2,S-1

b) P-3,Q-4,R-1,S-2

d) P-4,Q-3,R-2,S-1