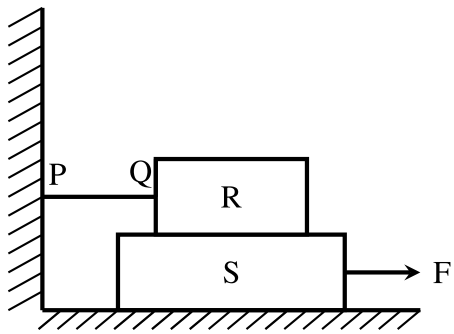
2014-ME

EE24BTECH11020 - Ellanti Rohith

1) The state of stress at a point is given by $\sigma_x = -6$ MPa, $\sigma_y = 4$ MPa, and $\tau_{xy} = -8$ MPa. The maximum tensile stress (in MPa) at the point is __________ [GATE 2014]

2) A block R of mass 100 kg is placed on a block S of mass 150 kg as shown in the figure. Block R is tied to the wall by a massless and inextensible string PQ. If the coefficient of static friction for all surfaces is 0.4, the minimum force F (in kN) needed to move the block S is [GATE 2014]



a) 0.69 b) 0.88 c) 0.98 d) 1.37

3) A pair of spur gears with module 5 mm and a center distance of 450 mm is used for a speed reduction of 5:1. The number of teeth on pinion is __________ [GATE 2014]

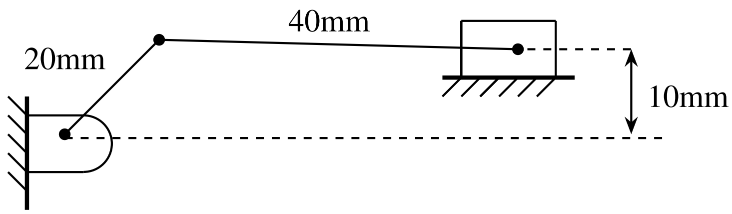
4) Consider a cantilever beam, having negligible mass and uniform flexural rigidity, with length 0.01 m. The frequency of vibration of the beam, with a 0.5 kg mass attached at the free tip, is 100 Hz. The flexural rigidity (in N·m^2) of the beam is __________ [GATE 2014]

5) An ideal water jet with volume flow rate of 0.05 m^3/s strikes a flat plate placed normal to its path and exerts a force of 1000 N. Considering the density of water as 1000 kg/m^3, the diameter (in mm) of the water jet is __________ [GATE 2014]

6) A block weighing 200 N is in contact with a level plane whose coefficients of static and kinetic friction are 0.4 and 0.2, respectively. The block is acted upon by a horizontal force (in newton) $P = 10t$, where t denotes the time in seconds. The velocity (in m/s) of the block attained after 10 seconds is __________ [GATE 2014]

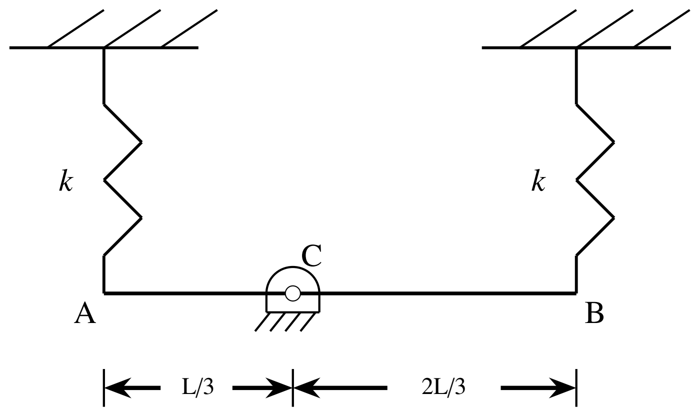
7) A slider crank mechanism has slider mass of 10 kg, stroke of 0.2 m and rotates with a uniform angular velocity of 10 rad/s. The primary inertia forces of the slider are partially balanced by a revolving mass of 6 kg at the crank, placed at a distance equal to crank radius. Neglect the mass of connecting rod and crank. When the crank angle (with respect to slider axis) is 30Â°, the unbalanced force (in newton) normal to the slider axis is__________ [GATE 2014]

8) An offset slider-crank mechanism is shown in the figure at an instant. Conventionally, the Quick Return Ratio (QRR) is considered to be greater than one. The value of QRR is



[GATE 2014]

9) A rigid uniform rod AB of length L and mass m is hinged at C such that $AC = L/3$, $CB = 2L/3$. Ends A and B are supported by springs of spring constant k. The natural frequency of the system is given by



[GATE 2014]

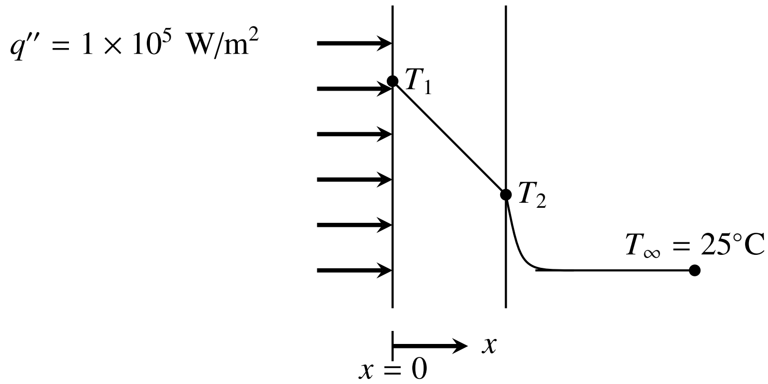
a) $\sqrt{\frac{k}{2m}}$ b) $\sqrt{\frac{k}{m}}$ c) $\sqrt{\frac{2k}{m}}$ d) $\sqrt{\frac{5k}{m}}$

10) A hydrodynamic journal bearing is subject to 2000 N load at a rotational speed of 2000 rpm. Both bearing bore diameter and length are 40 mm. If radial clearance is 20 μm and bearing is lubricated with an oil having viscosity 0.03 Pa.s, the Sommerfeld number of the bearing is __________[GATE 2014]

11) A 200 mm long, stress-free rod at room temperature is held between two immovable rigid walls. The temperature of the rod is uniformly raised by 250°C. If the Young's modulus and coefficient of thermal expansion are 200 GPa and $1 \times 10^{-5}/°C$, respectively, the magnitude of the longitudinal stress (in MPa) developed in the rod is __________ [GATE 2014]

12) 1.5 kg of water is in saturated liquid state at 2 bar (v_f = 0.001061 m^3/kg, u_f = 504.0 kJ/kg, h_f = 505 kJ/kg). Heat is added in a constant pressure process till the temperature of water reaches 400°C (v = 1.5493 m^3/kg, u = 2967.0 kJ/kg, h = 3277.0 kJ/kg). The heat added (in kJ) in the process is __________ [GATE 2014]

13) Consider one dimensional steady state heat conduction across a wall (as shown in figure below) of thickness 30 mm and thermal conductivity 15 W/m.K. At $x = 0$, a constant heat flux, $q'' = 1 \times 10^5$ W/m^2 is applied. On the other side of the wall, heat is removed from the wall by convection with a fluid at 25°C and heat transfer coefficient of 250 W/m$^2 \cdot$ K. The temperature (in °C), at $x = 0$ is __________ [GATE 2014]


$q'' = 1 \times 10^5$ W/m^2
T_1
T_2
$T_\infty = 25°C$
x
$x = 0$