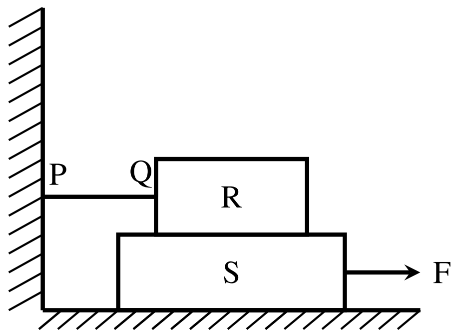
2014-ME

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]

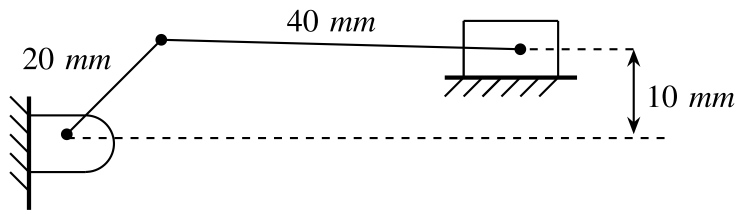
4) Consider a cantilever beam, having negligible mass and uniform flexural rigidity, with length 0.01 m. The frequency of vibration of the beam, with a 0.5 kg mass attached at the free tip, is 100 Hz. The flexural rigidity (in $\mathrm{N{\cdot}m^2}$) of the beam is __________ [GATE 2014]

5) An ideal water jet with volume flow rate of 0.05 $\mathrm{m^3/s}$ 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]

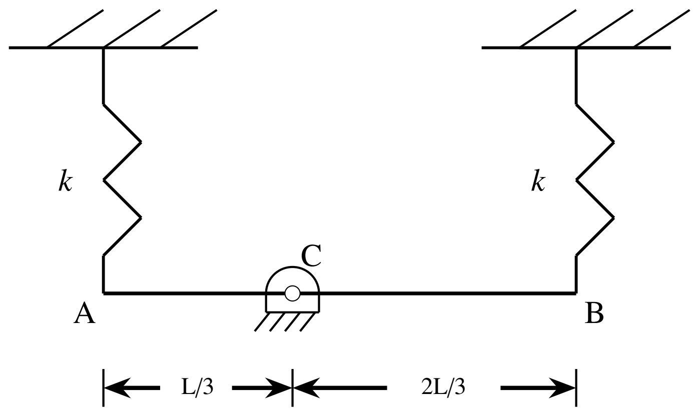
7) A slider crank mechanism has slider mass of 10 kg, stroke of 0.2 m and rotates with a uniform angular velocity of 10 rad/s. The primary inertia forces of the slider are partially balanced by a revolving mass of 6 kg at the crank, placed at a distance equal to crank radius. Neglect the mass of connecting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

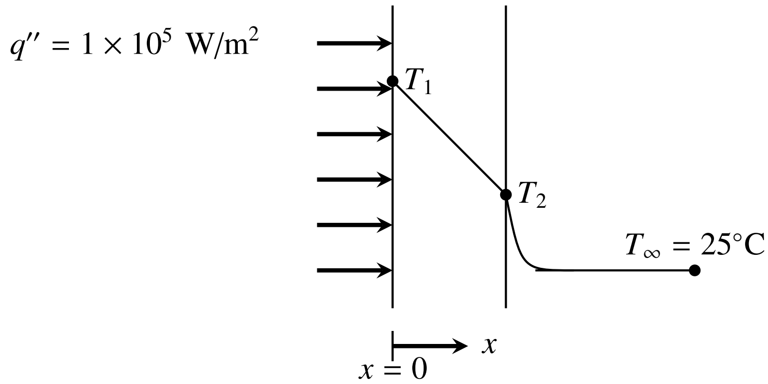
a) $\sqrt{\frac{k}{2m}}$ b) $\sqrt{\frac{k}{m}}$ c) $\sqrt{\frac{2k}{m}}$ d) $\sqrt{\frac{5k}{m}}$

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
$x = 0$