COEP Satellite Team Induction Questionnaire

February 2022

Structure Subsystem

Important Instructions:

1. Logical justification to answers is expected.

2. Answers should be submitted through online submission using the link https://forms.gle/JyaQ56uSaDHKsC14A .Submit your soft copy only in PDF form. Create PDFs of different images of your answers but mailing of separate images is not allowed. You may use adobe scanner to create a soft copy of your answers.

3. Deadline for submission is **Monday 14/02/2022 11:59 pm**.

4. Attempt as many questions as you can.

5. The open ended (no accurate answer) questions will be judged on the efforts put in answering them and creativity and practicality of the solution.

6. Assume suitable data wherever necessary and state your assumptions in the beginning.

7. Write down your thought process for the answer. You will be judged on the basis of your thinking and approach.

8. You may use any source of information, but provide reference at the end of the solution. Please make sure that this source is not "the answer sheet of another candidate". No copy pastes please. It is very easy to catch and leads to both the people being eliminated.

9. Preferred branches are Mechanical, Production, Metallurgy and Material Science, and Civil.

10. For any kind of queries, feel free to contact Vaishnavi Butte (7757856178), Aditya Kelkar (9503149400).

Q1) Consider that suddenly the mass of earth increases by 100% and radius by 300%. Find the height of the geostationary satellite about the earth? (Assume that the time period of the earth's rotation about its axis is 24 hours).

Q2) The end of the rod (length 1.0m, density 1.5 g/cc) is attached to a wire whose other end is attached to the bottom of a tank. The tank is filled with two fluids of densities 3g/cc and 4.5g/cc as shown. Find the angle made by the rod with the string at equilibrium.
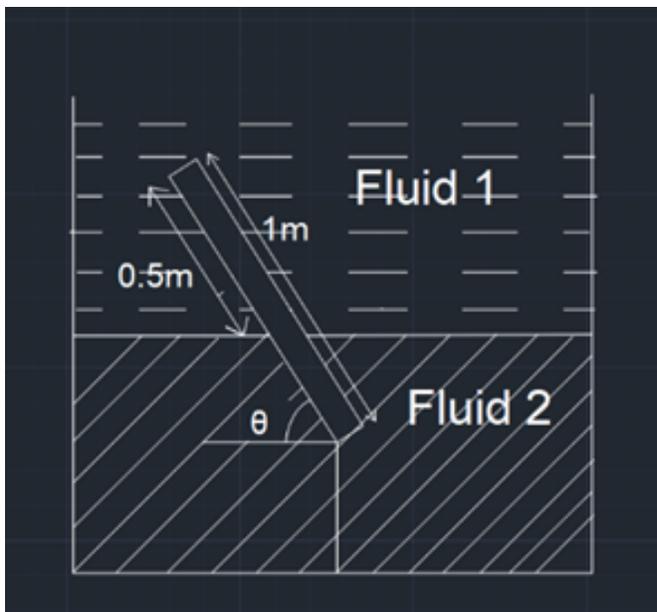
Q3) Consider a plate coated with white paint and black paint on either side. Dimensions of the plate are 100x100x1mm, with a conductivity of 205 W/mK. Thickness of both the coatings is 0.2mm, with a conductivity of 0.001W/mK. The plate is in vacuum at an ambient temperature of 273K. The white coating side is maintained at 10°C. The emissivity of the white side is 0.84 and that of the black side is 0.94. The rate of heat transfer through the coated plate is 5W. Find the total heat radiated from the coated sides of the plate.

Q4) Draw labeled VT, PT and TS diagrams for the following cycle.
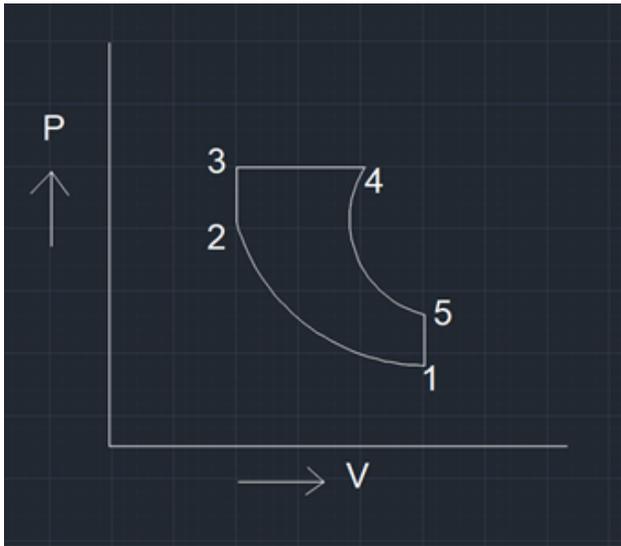
Q5) Initially the cylinder of mass M and radius R is at rest and is kept on a rough surface. It is given a small displacement x as shown in figure. What type of motion will the cylinder undergo? Find the time period of oscillation. If the displacement x is not small, what type of motion will the cylinder undergo?


Q6) If f(x) = $\int_{h(x)}^{g(x)} 2tx^3 \, dt$ and g'(x) = h(x). If h(x) = $\frac{lnx}{x}$ and f(2) = -ln4, find g(x).

Q7) A ball of mass 1kg is attached to a string and pulled up to point B and released. Given that the length of the string is 1m and the coefficient of restitution between wall and ball is 0.3. Find the maximum angle made by the string after its 2nd collision with the inclined wall. (g=10m/s^2).
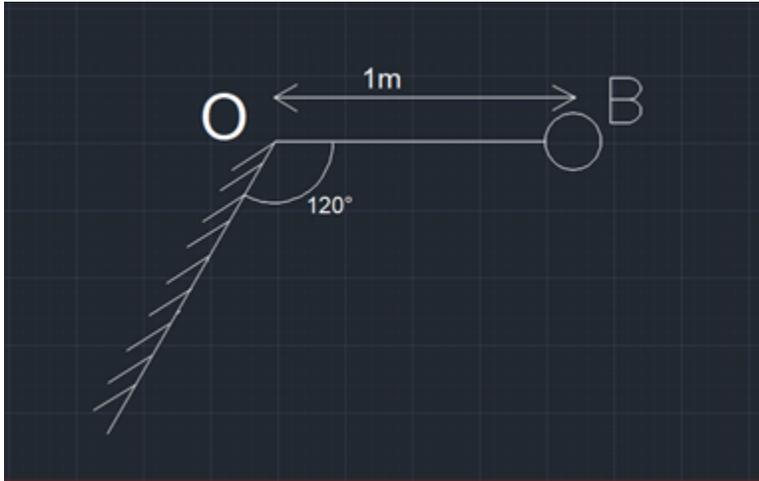
Q8) A box of mass 1kg initially at rest is pushed from bottom on an inclined plane at 60 degrees by a force of 50N from point A to B, at B the force stops acting on it. From B-C the surface of the plane has a coefficient of static friction 0.2 and from A-B & C-D the surface is smooth. Find the height upto which the block will rise from the ground. (Assume g=10m/s^2)
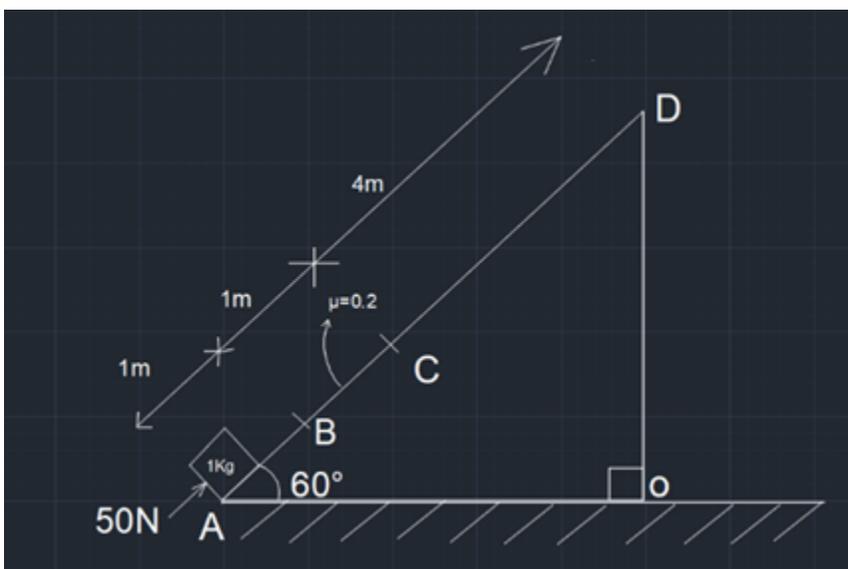
Q9) This is a very unique cup with an interesting principle of working. Initially, the cup fills normally as any other cup. However, as the person desiring the drink pours more than a threshold amount, the cup empties all its contents on the drinker's lap. That's why it is called the Greedy Cup. Suggest a manufacturing procedure to make such a cup, mention possible materials to be used and explain each process briefly.

Q10) Suggest suitable mechanisms to be incorporated in a tennis ball launcher. The mechanism should be able to launch standard size tennis balls (6.54–6.86 cm) to a sufficient distance.The tennis balls should follow a parabolic trajectory. The mechanism should be unique and innovative.

Q11) In the squid games tug of war round, dimensions of rope are as follows: Before the match, Diameter of rope = 0.052 m, Length = 10 m After the match, Diameter of rope = 0.05 m, Length = 11 m Value of shear modulus of the rope is 70 GPa. If the match is drawn, calculate force applied by one side.

Q12) Draw all possible isometric views for the following orthographic views.

F.V.

T.V.