KSCP Examination
2020/2021 Academic Session

September 2021

EAS151 – Statics and Dynamics

Duration: 2 hours

Please ensure that this examination paper contains **NINE (9)** printed pages before you begin the examination.

Instructions: This paper contains **FIVE (5)** questions. Answer **THREE (3)** questions in Part A. **Question 5** in Part B is **COMPULSORY**.

All questions **MUST BE** answered on a new page.

...2/-

PART A

1. (a). In **Figure 1**, the tension in cable BC is 145 N, determine the resultant of the three forces exerted at point B of beam AB.

[12 marks]

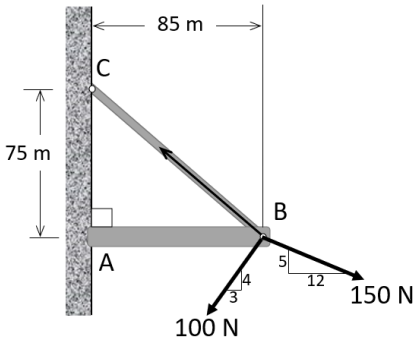


Figure 1

(b). A collar that can slide on a vertical rod is subjected to the three forces as shown in **Figure 2**. For equilibrium condition, determine:

i) the value of the angle α so that the resultant of the three forces is horizontal.

[10 marks]

ii) the corresponding magnitude of the resultant force.

[3 marks]

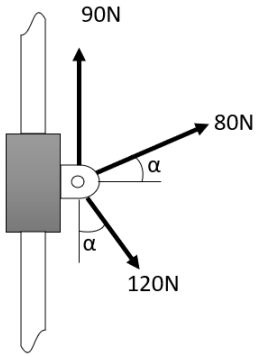


Figure 2

...3/-

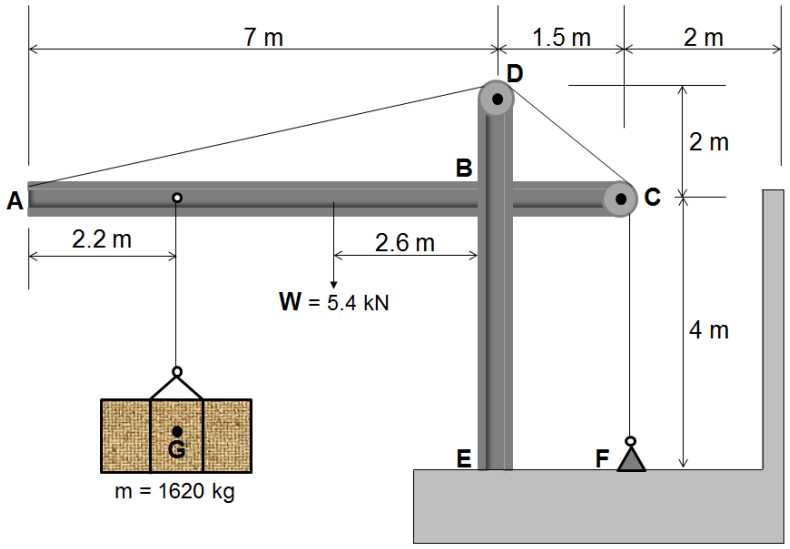
2. (a). The rig shown in **Figure 3** consists of a horizontal member ABC and a vertical member DBE welded together at B. The rig is used to raise a 1620 kg box with its center of mass at G. Assume the 5.4 kN self-weight of the horizontal member ABC is acting at 2.6 m from B. The rig is supported by a cable ADCF with a tension of 18 kN.

i) Replace the force system acting on the rig with an equivalent system of a resultant force and a couple moment at point B.

[6 marks]

ii) If a single equivalent resultant force system is to be developed, specify the new location of the resultant force along AB, measured from point A.

[4 marks]



The drawing is not to scale

Figure 3

(b). By referring to **Figure 4**, determine the resultant moment produced by forces F_B and F_C about point O. Express the resultant moment in a Cartesian vector form. What will be the direction angle of the resultant moment from x, y and z axes?

[15 marks]

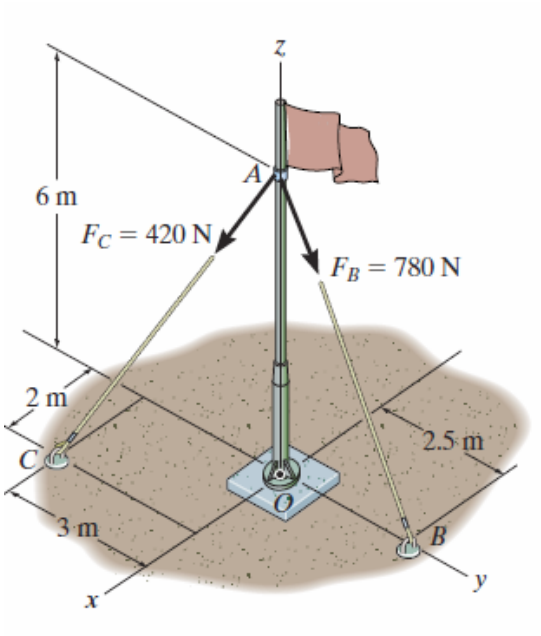


Figure 4

3. (a). A uniform concrete slab has a mass of 2400kg supported by three cables at A, B, and C, as shown in **Figure 5**. In addition, a concentrated load of 15 kN acts at D. Determine the tension in each of the three parallel supporting cables when the slab is held in the horizontal plane. Consider the mass of the concrete slab in the analysis.

[7 marks]

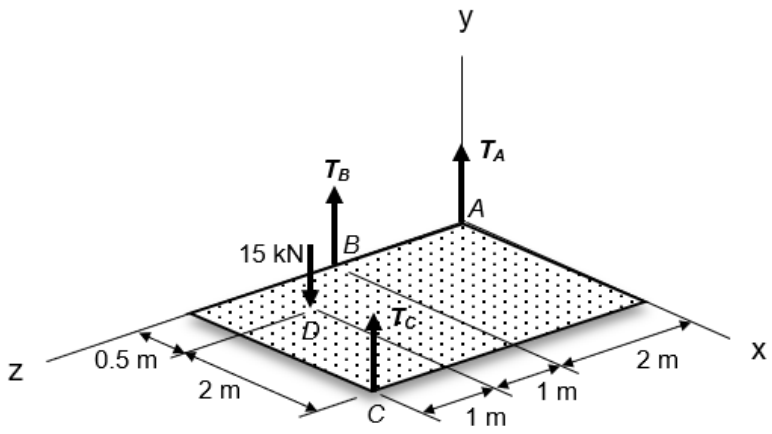


Figure 5

(b). A boom supports the two vertical loads, F_1 and F_2, at D and B, respectively, as shown in **Figure 6**. The boom is pinned at A. Ignore the self-weight of the boom.

i) Draw a free-body diagram of the system.

[2 marks]

ii) Determine the horizontal and vertical force components at pin A and the force in cable CB. Set F_1 = 800 N and F_2 = 350 N.

[7 marks]

iii) The cable CB can sustain a maximum load of 1500 N before it fails, determine the critical loads if $F_1 = 2F_2$. Also, determine the magnitude of the maximum reaction at pin A.

[9 marks]

…6/-

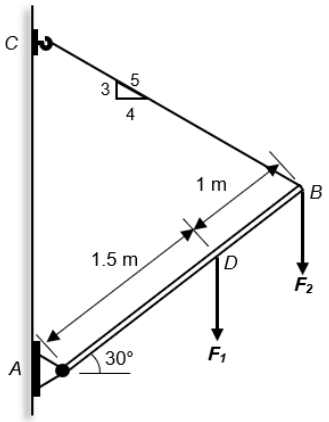


Figure 6

4. (a). By referring to **Figure 7**, formulate the moment of inertia for the shaded vertical strip with respect to x- and y- axes.

[8 marks]

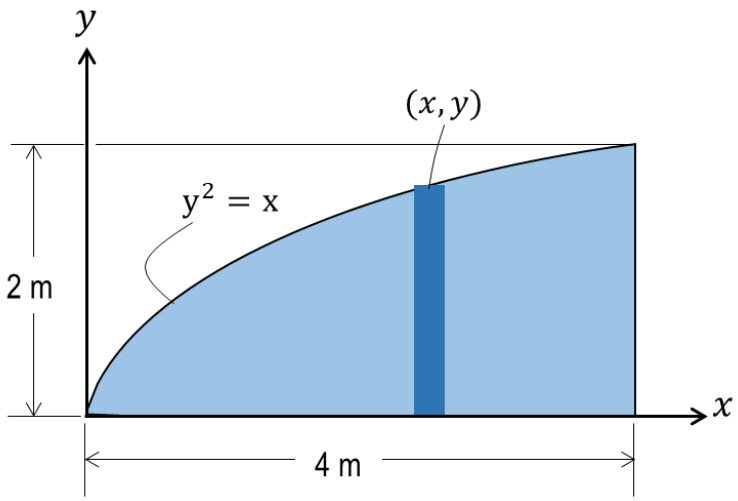


Figure 7

…7/-

(b). Determine the second moment of area of the shape shown in **Figure 8** about the axis S-S. All dimensions in meters. Given $I_{\bar{x},\,circle} = I_{\bar{y},\,circle} = \frac{\pi r^4}{4}$.

[17 marks]

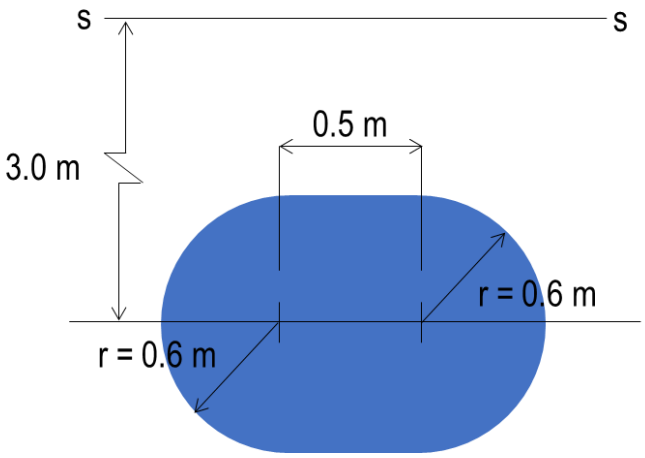


Figure 8

PART B

5. (a). A particle starts from rest with an acceleration of *A* m/s^2. The acceleration then decreases linearly with time to zero in 15 seconds. After that, the particle continues to move at a constant speed of 60 m/s. Determine *A* and the position of the particle at time t=15 s.

[8 marks]

(b). **Figure 9** shows an assembly of a slider system. The collar has a mass of 2.5 kg and is attached to the light spring. The spring has a stiffness of 30 N/m and an unstretched length of 1.5 m. The collar is released from rest at A and slides down the smooth rod. Another spring with stiffness k_B is located at point B, which will be compressed by the slider as it slides beyond point B.

i) Calculate the velocity *v* of the collar as it reaches point B.

[9 Marks]

ii) If it is desired that the slider does not move beyond point C, as shown in **Figure 10**, check if k_B= 45 kN/m is sufficient.

[8 Marks]

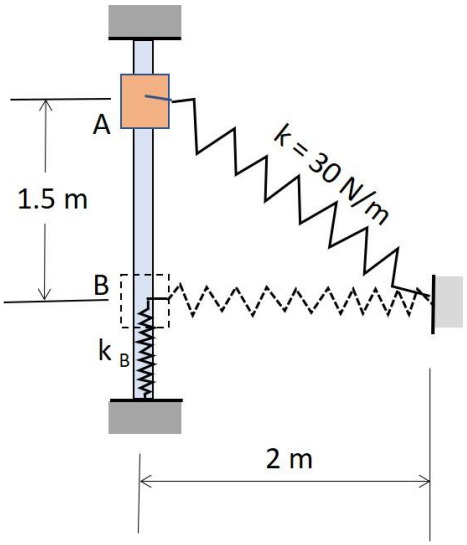


Figure 9

…9/-

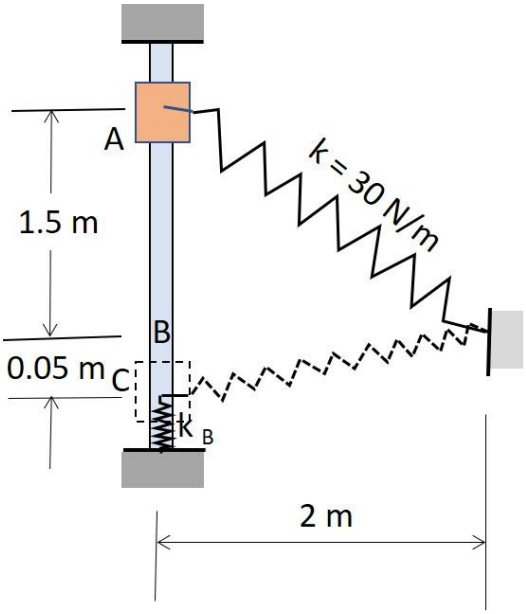


Figure 10

-oooOOOooo-