First Semester Examination
2021/2022 Academic Session

February/March 2022

EAS151 – Statics and Dynamics

Duration : 2 hours

Please check that this examination paper consists of **NINE (9)** pages of printed material including appendix before you begin the examination.

Instructions : This paper contains **FOUR (4)** questions. Answer **ALL** questions.

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

1. (a). The cabin of the cable car shown in Figure 1 is suspended from a set of wheels that can roll freely on the support cable ACB and is being pulled at a constant speed by cable DE. Knowing that $\alpha = 44^{o}$ and $\beta = 35^{o}$, the tension in cable DE is 2**x** kN (**x** is last digit of your matrix number. E.g., Your matrix number is 1234**5**, then P = 2**5** N), and assuming the tension in cable DF to be negligible, determine:

i) The tension in the support cable ACB

[6 marks]

ii) The combined weight of the cabin, its support system, and its passengers

[4 marks]

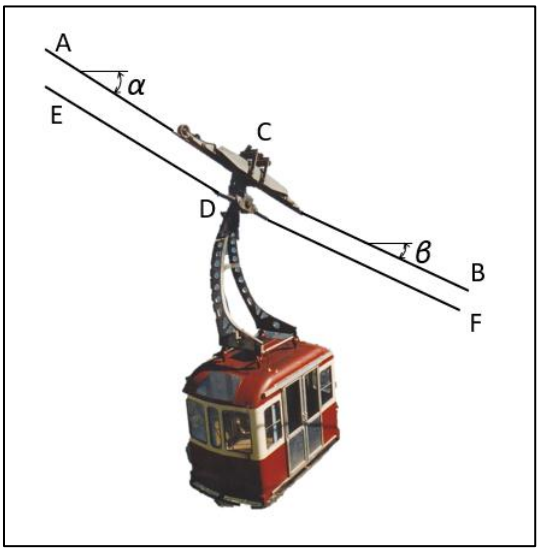

Figure 1

(b). Collars A and B in **Figure 2** is connected by a 1 m long wire and can slide freely and can slide freely on a frictionless rods. If a force P = 6**xx** N (**xx** is last two digits of your matrix number. E.g., Your matrix number is 123**45**, then P = 6**45** N) is applied at A, determine:

i) The tension in the wire when y = 250mm.

[10 marks]

ii) The magnitude of the force Q required to maintain equilibrium of the system.

[5 marks]

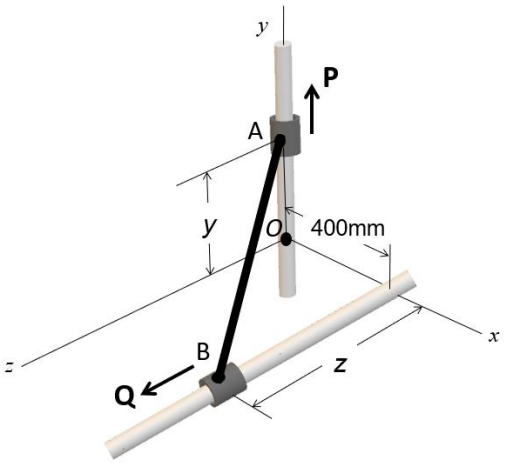

Figure 2

2. (a). The slab in **Figure 3** supports five parallel forces. The resultant force is required to act at the centre of the slab. Determine the magnitude of F2 and F4, and the magnitude of the resultant force so that the equivalent resultant force acts through the midpoint O of the slab.

[12 marks]

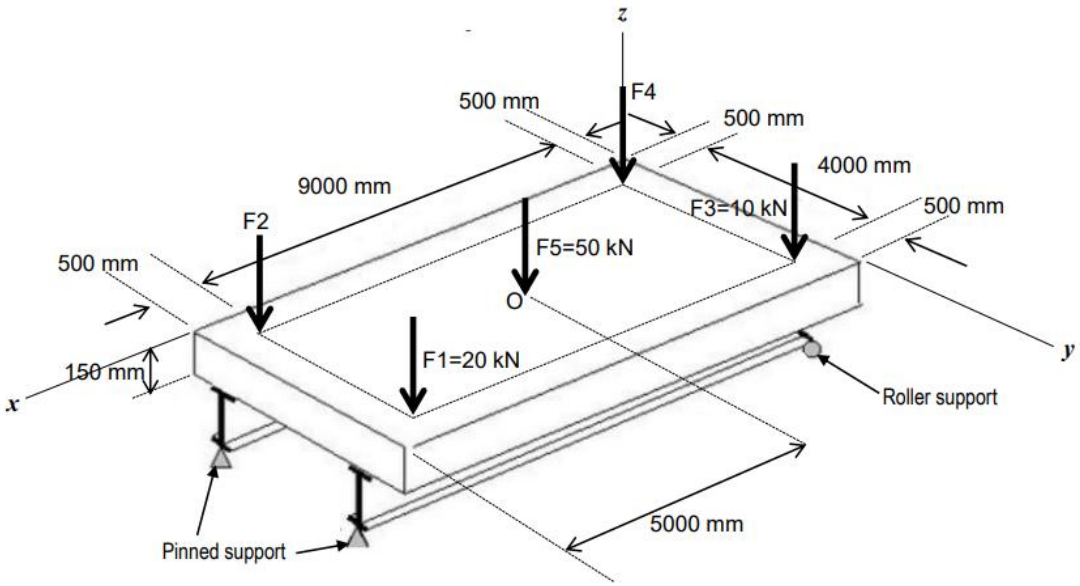

Figure 3

(b). Cable AB is used to hold panel ACDE in the position as shown in **Figure 4**. Determine the magnitude of the moment produced by force **F** about the hinged axis CD of the panel. Use the following values for **F**.

[13 marks]

The last digit of the matric number*	**0,2**	**1,3**	**4,6**	**5,7**	**8,9**
Force, **F**	600 N	635 N	555 N	590 N	595 N

Example: * Matric number = 5007**8**, The last digit of the matric number = 8, Force F = 595 N.

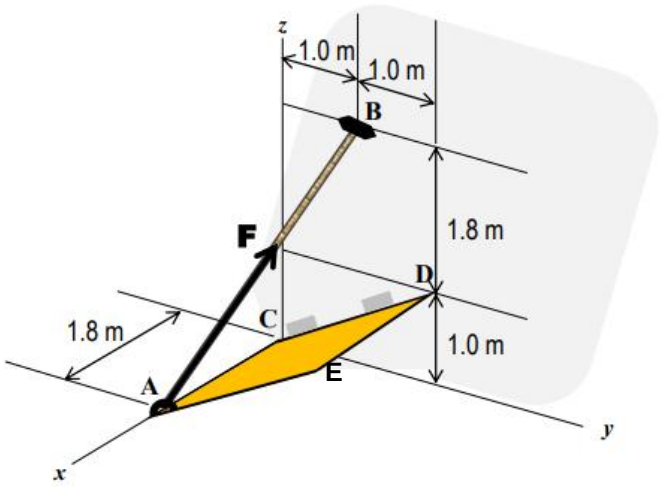

Figure 4

3. **Figure 5** shows a rod supported by two cables, AB and AC. The rod is pinned at support D. A concentrated load of P acts at A at 30° to plane-xz, and parallel to plane-yz. Determine the tension in each cable and the reaction components at D needed to support the load using the vector approach. Use the following values for P.

[25 marks]

The last digit of the matric number*	**0,2**	**1,3**	**4,6**	**5,7**	**8,9**
Force, P	400 N	500 N	600 N	500 N	400 N
a	6 m	6 m	6 m	5 m	5 m
b	2 m	1 m	2 m	2 m	2 m
c	3 m	3 m	2 m	3 m	3 m

Example: * Matric number = 5007**8**, The last digit of the matric number = 8, Force P = 400 N, a = 5 m, b = 2 m, and c = 3 m.

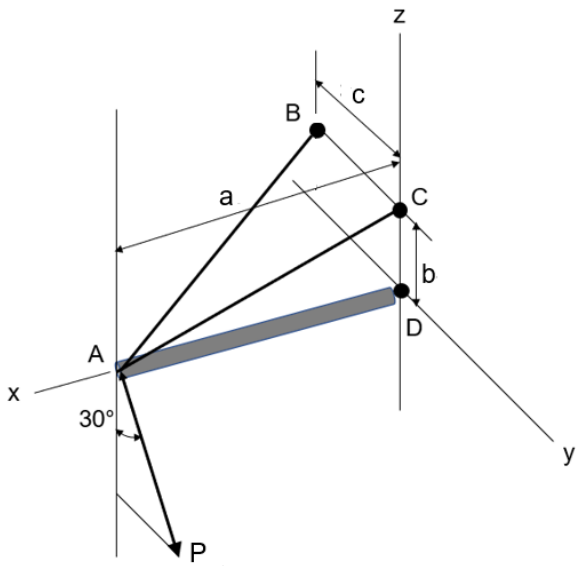

Figure 5

4. (a). Describe with an example, the kinematics and kinetics of a particle.

[6 marks]

(b). A van shown in **Figure 6** moves in a straight line such that for a short time its velocity is defined by $v = (3t^2 + 2t)$ m/s, where t is in seconds. Given t = 0, s = 0;

i) Determine its position and acceleration when t = X seconds. (Use the value of X from the table provided in **Table 1**)

[3 marks]

Table 1

The last digit of the matric number*	**0,2**	**1,3**	**4,6**	**5,7**	**8,9**
X	4 s	4.5 s	5 s	5.5 s	6 s
Y	30 m/s	40 m/s	50 m/s	70 m/s	90 m/s
Z	900 m	800 m	700 m	600 m	500 m
V	10 kg	40 kg	30 kg	25 kg	20 kg
W	100 kg	120 kg	110 kg	95 kg	130 kg

Example: * Matric number = 5007**8**, The last digit of the matric number = 8, X = 6 s, Y = 90 m/s, Z = 500 m, V = 20 kg and W = 130 kg

ii) A van then travels on curved from t = X seconds and applies brakes causing a constant deceleration rate. The speed has decreased to Y m/s, determine the acceleration of the van immediately after the brakes are applied. Given curvature radius ρ of the road is Z. (use the value of X, Y and Z from the **Table 1**).

[3 marks]

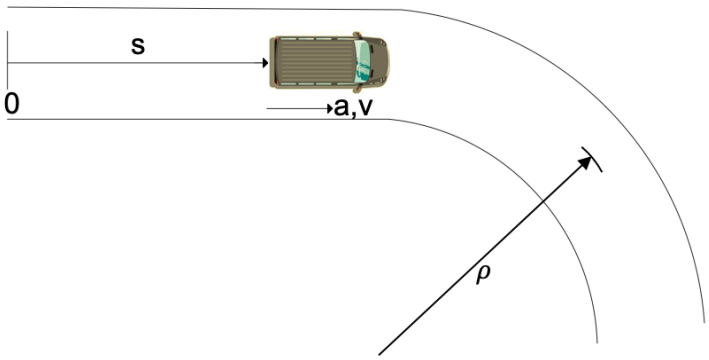

Figure 6

(c) Blocks *A* and *B* as shown in **Figure 7** have a mass of V kg and W kg, respectively. Determine the distance block *B* travels when it is released from rest to the point where its speed becomes 2 m/s. (use the value of V and W from the **Table 1**).

[13 marks]

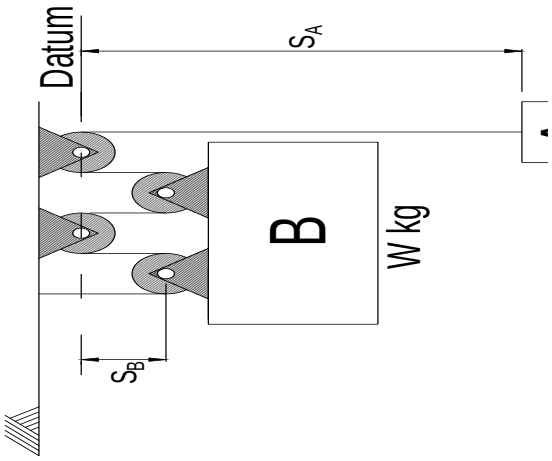

Figure 7

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